Waterfront Toronto

East Bayfront
Functional Servicing Report

Updated March 2009

The Municipal Infrastructure Group Ltd.
2300 Steeles Avenue West Suite 120
Vaughan ON CA L4K 5X6
Tel 905.738.5700 Fax 905.738.8075
www.tmig.ca

Prepared on behalf of:

Preface

This report is an update of the December 2007 *East Bayfront Functional Servicing Plan* Report prepared by The Municipal Infrastructure Group Ltd. (TMIG), and is provided to address comments and feedback received from approval agencies, and also to present the revised analyses, findings, and recommendations established through continued progress on the project.

Notable elements of this update include:

- A response to City of Toronto comments on the earlier document, encapsulated within this report.
- Revised functional design and corresponding figures to reflect the current road layout and phasing plan.
- Revisions to reflect the progress and refinements associated with the first phase (Dockside).
- Update of the stormwater management plan to identify and describe the preferred facility configuration.
- Additional information associated with the Sherbourne Park UV system and receiving water features, as these relate to the proposed stormwater management plan.
- Inclusion of a detailed water balance analysis for the overall East Bayfront redevelopment.

In summary, this report encapsulates all the investigations and discussions that have occurred to date, which together firmly establish the feasibility of the functional servicing elements needed to support the proposed East Bayfront redevelopment project.

Acknowledgements

This updated report incorporates and gratefully acknowledges the input and effort of a number of organizations, including:

- Waterfront Toronto
- City of Toronto
- Aquatic Habitat Toronto
- Dillon Consulting
- West 8 + DTAH
- Halsall Associates
- Schollen and Company
- Phillips Farevaag Smallenberg

Responses to Comments

Letter from City of Toronto (April 7, 2008)

1. *Stormwater Management Section Comments*

   a. *Overall: The generally imaginative concept of using a portion of the Inner Harbour for a Dunkers or equivalent facility has been retained; the Consultants are congratulated on this major innovation in their design, as well as commitment to water management on future private property. Such as commitment will improve the environmental sustainability of the development, as per Waterfront Toronto and Toronto Water mandates.*

Acknowledged and thank you. Please note that **Section 5** of this updated FSR has been revised to document our progress in identifying the preferred stormwater management system.

   b. *Literature Review – Stormwater Management: Provide data on where such innovative facilities are located both internationally and locally. This information, provided in a functional servicing report, will assist providing context and examples for other subsequent users of this report.*

Our research has not yielded an example of a facility that is identical to the proposed East Bayfront facility with respect to form and function. However, elements of the proposed facility can be seen elsewhere. There are examples of storage facilities constructed within water bodies, and numerous examples of UV treatment of runoff. Selected examples are included in **Appendix 5b** of this updated report.

   c. *Section 4.6 Stormwater Management Strategy: A functional servicing report must show how 'annual' Water balance will be attained, and what the targets are for specific land blocks (units mm/year). A qualitative description of potential on-site measures (section 4.3) and anticipated performance (Section 6.0) is insufficient for a functional servicing report.*

   The report must establish:

   - *What baseline water balance is currently, (units annual mm/year),*
   - *How proposed conditions (without source control measures) will alter water balance (which is one basis for establishing post development targets)*
   - *Post development targets, and*
   - *Calculate with illustrative measures, how site controls will achieve water balance targets.*

   The City recognizes that as specific blocks are developed, the example measures illustrated in the functional servicing report may change. But the number, type, and density of measures provided in the Functional Servicing Report will provide a guide to the Developer for the Block and City on level of expectation when specific applications are put forward.

   The calculations also will provide a realistic picture of what can and cannot be achieved; if the targets cannot be met, then off-site compensatory measures may be needed, which are established at time of submittal and acceptance by the City of the Functional Servicing Report. Especially for redevelopment applications directly adjoining the waterfront, unique opportunities exist.

   In addition, the report should specify applicable peak flow requirements, based on WWF guidelines, and comment on how storage for such peak flow storage and rain-water harvesting can/cannot be made mutually compatible. It should comment on whether such stored water could be used for summer air conditioned systems.

A water balance analysis has been prepared and submitted under separate cover (dated January 23, 2009). This analysis has been reproduced within this document in **Section 4.8**.

d. Conveyance controls: Potential use of OGS's are suggested for upstream of the EOP, potentially on an interim basis for the first few blocks. It is noted that the OGS locations, detailed analysis, maintenance provisions and back up design data will be required to be provided with the submission of each phase of development.

Acknowledged. Oil-grit separators are proposed for each quadrant of the proposed redevelopment area. **Section 7** illustrates the proposed OGS locations.

e. Review of Section 5.1 Stormwater Facility

i. Page 24

- *A quoted E Coli levels of 10,000 to 30,000 is inappropriately low. For waterfront and associated areas, monitoring data and the WWFMMP modeling analyses used about 400,000 as the representative range. Please revise your calculations accordingly and re-size the storage requirements estimated in Table 5-3*
- *Please provide references which indicate die-off rate cited in the first sentence. This die-off rate is optimistic.*
- *Please provide estimates of storage required if the half-time (50% reduction) is 48 hours.*
- *Summarize the above on page 24.*

With regards to expected E.coli levels and die-off rates, we acknowledge sources of information that describe values in the ranges noted above. As the sizing of the preferred facility configuration described in **Section 5** is not premised on E.coli levels and die-off rates, we suggest that performance monitoring of the facility will more effectively identify the rates and values that will be realized for East Bayfront. As such, we have not updated our calculations as requested, but instead have qualified the text in **Section 5.1.2** to recognize the validity and potential of the higher E.coli levels and lower die-off rates.

ii. In appendix Provide a summary of EOP facilities proposed in EA report, and how drainage redesign necessitated resizing and what the size would be commensurate with cost estimates for Option 4 outlined on Page 34

The underground tanks proposed in the EA were resized to account for the accumulation of sediment that would occur within the tanks over time, and as well provide sufficient space for 'sediment handling' by operations and maintenance equipment. In addition to the cost associated with the increased volume of 12,000 m^3, the evaluation also considered the further cost of excavating and disposing of the prevailing contaminated soils, along with the dewatering that would be required due to the existing high water table.

The cost evaluation of all considered options has been updated in **Section 5.5**, while a comprehensive comparison of the various options is included in **Table 5-3** (**Section 5.6**).

iii. Describe O and M aspects with options A to C in a separate section – perhaps page 26, as a separate section 5.4, before section 5.3.5

We have added preliminary information relating to operations and maintenance in **Section 5.7.1** of this updated report.

iv. Include shipping lane that Port Authority uses as a reserve in front of East Bayfront to get to Redpath Sugar, and comment on how Option B (Figure 5.4) would interfere with that reserve.

Figure 5-3 within this updated report illustrates the shipping lane requirement of Redpath Sugar. This requirement does present a constraint to Options B and C presented in the December 2007 FSR, and was a factor considered in identification of the preferred facility configuration described in **Section 5**.

v. *Subject to further internal discussion and future confirmation, Toronto Water will not accept a facility such as Option B to assume responsibility for operations and maintenance of such a facility after commissioning. Toronto Water is prepared to accept a facility such as Option C*

Acknowledged. We note that significant dialogue with the City, along with review of all other considerations, has yielded the preferred facility concept described in **Section 5**. This preferred configuration varies from the Options presented in the December 2007 FSR, but we trust that this concept is consistent with the City's expectations and requirements.

f. *Fish Habitat*

i. *Provide information on fish habitat compensation measures which are needed to address taking of habitat*

ii. *Provide design opportunities of say Option C to address habitat taking issues.*

iii. *Actually, it would be opportune to discuss what habitat enhance opportunities could devolve from say Option C*

iv. *Provide a new "Recommendations – Section 16.3 – Fish Habitat" section*

The evaluation of fish habitat compensation requirements and opportunities has progressed in parallel with the selection and preliminary design of the preferred end-of-pipe facility, as evidenced by presentations made to the Aquatic Habitat Toronto (AHT) group, of which the City is a member. Discussion of the preliminary approach to compensation is provided in **Section 5.7.7** of this updated report.

g. *Marine Uses: We need a section somewhere that addresses marine uses associated with any of the Options, and whether any of them or neutral or enhance such uses. That is, address them to the extent that such issues of impact/enhance can be addressed with present knowledge and lack of precision in providing an outlook for such uses.*

Table 5-3 in **Section 5.6** provides a matrix of considerations, including marine uses, used to evaluate and compare the facility alternatives.

h. *Summary of Options – Page 34*

i. *'water within the facility will be cleaner that the water already in the harbour" this is highly doubtful. With stormwater runoff TP levels of 200 ug/L and approximately 50% removal expected in the EOP facility, that amounts to about 100 ug/L expected in the effluent. This permits "green-pea soup" to develop in the EOP facility. Monitoring data from this past summer had detection limit data for the Harbour – less than 20 ug/L TP. Please revise statement.*

The above noted statement has been removed from the text as requested (**Section 5.3**).

ii. *Why is Option C so much less money than Option A?*

The estimate for Option C largely yielded a lower cost as the length of surrounding dockwall required would be significantly less than in Options A or B. This stems from the fact that a square pond is more efficient in its use of area than a long, thin facility (i.e. Option A). While the preferred option maintains a longer facility, the component that was not contemplated in the earlier version of the FSR was the required rehabilitation of the dockwall that will now be avoided with the current solution. The details of the preferred facility concept and the associated costs, including a comparison to previous estimates, have been summarized in **Section 5.5**.

i. *Section 5.4 UV Disinfection Methodology: The City accepts the commitment to install such as system as necessary to meet the SWM criteria and WWF objectives for this site. The City will accept and assume responsibility for operations and maintenance of such a facility, once built and commissioned; we may provide additional evaluation of pages 5.4 in the future, and on how such details should be further developed into a detailed design brief.*

A design brief for the complete stormwater management system will be submitted to Waterfront Toronto and the City and will include all design criteria, treatment objectives, and the methods used to achieve both. The report will demonstrate that MOE water quality criteria and the City's Wet Weather Flow Management Guidelines have been satisfied.

j. *Other benefits – Sustainability: A total summary of how the redevelopment of East Bayfront (perhaps as a new section) contributes to 'water infrastructure and habitat based sustainability' would be useful, rather than forcing the reader to glean the information from the current report. Pertinent aspects include:*

    i. *Energy for SWM – will power produced by site scale developments be fed to the grid amount to a sufficient amount to off-set future power requirements for pumping potable water East Bayfront and for lifting it in high-rise buildings, wastewater lift stations and treatment plant requirements, and any pumping and treatment associated with the stormwater collection / management system*

    ii. *Water Efficiency – reduction in sanitary sewage flow through use of efficient washers, showerheads, etc.*

    iii. *Reuse of rainwater as substitute for potable water*

    iv. *Fish habitat enhancement consistent with TWAHRS and RAP delisting targets and any new fishing piers*

    v. *Recreational uses of the waterfront and the associated aquatic resources.*

Section 16.3 endeavours to summarize the sustainability elements associated with servicing the proposed redevelopment, including the various aspects described above. With respect to aquatic habitat enhancement, **Section 5.7.7** describes the proposed approach to both habitat compensation and enhancement, to be refined through design.

2. *Sewer Asset Planning Comments*

    a. *It is not clear whether all future developments, other than the East Bayfront Development, have been included in the sanitary flow analysis? Does East Bayfront include all future developments in the area draining to Scott Street PS?*

In the analysis presented in the December 2007 FSR, the City's official planning projections for full build-out of the Waterfront East planning subzone were included in the 'Full Build-Out of East Bayfront' scenario. The interim scenarios were developed based on existing (2006 Census) residential and employment populations with the additional flows from the Corus building and also all of Phase I of East Bayfront.

The City (Development Engineering) has since provided details of developments that have become occupied since the 2006 Census, and also additional developments on the planning horizon.

The updated population projections were presented in a June 4, 2008 memo to the City, and are also referenced in this updated document.

b. *Same comment as [a], when the report says "Full Buildout" of East Bayfront (Section 8.3.1), does it include all future developments or just East Bayfront?*

Please see our response to part (a) of this comment.

c. *The report concluded that there are no overflows at Scott Street PS (Section 8.1.2). However, there are several weir overflows upstream. The reason no overflows have been observed at the pumping station could be due to overflows upstream thus relieving the pumping station. Therefore, it may not be totally accurate to say that the SSPS system does not have any overflow problems, especially during major storm events. The Sony Centre next to SSPS had flooding occurred before.*

During preparation of December 2007 FSR, City staff indicated that the sewers in the Scott Street SPS drainage basin were completely separated from the storm system; i.e. that no overflows were still in operation. On that basis, infiltration rates were determined as shown in detail in **Appendix 3a** of the FSR and the projected peak flows are considered to be appropriately calculated.

Additional review of record drawings indicates that there are three locations within the eastern portion of the Scott Street SPS catchment area where there could be overflows between the sanitary sewer and storm/combined sewers:

1. The Esplanade and Scott Street;
2. The Esplanade and Market Street; and,
3. Front Street and Frederick Street

It appears that the overflows were intended to provide relief to the sanitary sewer and Scott Street SPS. The elevations indicated on the drawings, however, show that the overflow invert elevations could be below high Lake Ontario water levels, thereby permitting flow from the storm/combined sewers into the sanitary sewer and the Scott Street SPS.

District Operations has since inspected all three locations, and have confirmed that there are no control devices preventing backflow from the storm/combined sewers into the sanitary sewer. It has not been confirmed whether these overflows are active nor in which direction overflows generally occur. The basement of the Sony Centre has reportedly flooded in the past, but it is suspected that this was the result of failure of the ejector pumps within that building.

d. *Using flow data collected for the June 19, 2007 rain event, the report determined that the extraneous infiltration rate during rain events was 1.19 L/ha/s. The report asserted that this was a "typical" event, therefore this infiltration rate was used as the representative rate for design. What was the basis of saying that this was a "typical" event? Was it based on statistical analysis of all the rain events? I assume that a bigger event could result in greater than 1.19 L/ha/s, which would make the extraneous flow calculations higher for design. Could a more severe event causing higher extraneous infiltration rates be used?*

As per Appendix A of the December 2007 FSR, ten separate events between Nov 15th 2006 and June 20th 2007 were analysed, and peak Rainfall-Derived Inflow and Infiltration (RDI/I) rates of 1.10 to 1.19 L/ha/s were calculated for four of those events.

We have since received additional flow data from the pumping station, and extended the RDI/I analysis through 2008. Another eight rainfall events were analysed, and the peak calculated RDI/I has increased to 1.35 L/ha/s.

e. Could they add a column to show the "Project Year" of the development in Table 8-10 page 86 so that it is more clear on timing:

  i. Existing – 2007

  ii. Corus – 2010

  iii. Phase 1 – 2015

  iv. Full Buildout – 2031

  (see development engineering comments in support of these questions)

Table 8-10 has been amended as requested.

3. Water Asset Planning

The FSP anticipates that the City will take information provided by the consultant, run a model and provide results to be used to finalize recommendations for watermain infrastructure. However, staff expects the consultant to combine their data (actual field tests and preliminary recommendations for proposed infrastructure) with that provided by the City, to run their own modeling exercise and use the results to finalize recommendations for watermain infrastructure. The City can provide a cut-out of the area's existing data to the Consultant and they would need to complete their own minor modeling exercise in conjunction with field testing to see whether their works are suitable.

We have developed a WaterCAD model of the local system based on field pressure and flow testing. Preliminary results are consistent with our original analysis, confirming that there is sufficient water supply and pressure available to the East Bayfront area.

4. Operations and Maintenance

Operations staff have asked for an optimization of the number of OGS structures, consolidated to fewer larger structures improve the effectiveness of both the performance of the units and the maintenance effort required.

It is our understanding that the extensive discussions between the consultant team and City staff, particularly with regard to Phase 1, have yielded general principles that will guide the inclusion of OGS structures into the overall stormwater management plan (**Sections 4.5** and **7**). Detailed specifications will be established as part of detailed design.

Maintenance manuals are to be provided detailing the expected oil/grit separator cleaning frequency and the expected yearly volume / weight of sediment, as well as the volume / weight of floatables. Detail as well the maintenance area around each unit and the type of equipment required to maintain them. If specialized equipment is required, a maintenance fund will also be required.

These will be prepared and submitted in conjunction with detailed design.

With respect to the end of pipe facility provide:

a. Expected dredging frequency and expected volume of accumulated silt before material must be removed.

b. Address how access to each cell of the proposed end-of-pipe stormwater management facility is to be provided

c. Address whether specialized equipment is needed to carry out the cleaning of the stormwater management facility. Who will pay for this equipment?

d. Provide access to the proposed stormwater management facility's pumping equipment and UV treatment facility with equipment

e. *Provision of operating manuals for all operations*

f. *Detail the method to carry out dredging operations – is the dredging to be carried out from land, or must it be done from the lake side?*

g. *Can material from the stormwater management facility be disposed of further out within the lake or must it be disposed of at a landfill site (on land)*

h. *Will heavy equipment be able to enter the pond, or must it be supported on a barge.*

Section 5.7.1 provides a description of Operations and Maintenance investigations that will form part of the detailed design of the facility, which will include consideration for all the items noted below.

5. *Policy and Asset Management*

   a. *Figure 7.2 and 7.3, Section 15: Flooding is anticipated under major rainfall events along Lakeshore. Confirm that proposed grading within EBF will not make flooding worse. A proposed full topographic survey should include Lakeshore to confirm its profile and overland flood routing. Reconfirm any opportunities to alleviate flooding on Lakeshore by taking major flows through EBF or otherwise, without adversely affecting existing CSOs or the proposed lake pond, under interim and ultimate conditions.*

As discussed in **Section 15**, the overall major system flow route has been defined based on a topographic survey conducted during the summer of 2008. It is noted that construction of the East Bayfront will not alleviate flooding issues on Lakeshore, but it will provide an improvement and without impact to the existing CSOs.

   b. *Appendix 15-A: Grades on Drawing G1 are missing. Drawing G1 should be expanded to include all of EBF.*

Agreed; based on the updated topographic survey, the overall grading concept is now defined, along with the overland flow routes.

6. *Development Engineering*

   a. *The proposed phasing of the development is generally acceptable. It is noted however that Waterfront Toronto assumes the risk of developing in advance of the completion of numerous EA studies and any OMB appeals for the zoning. It is also acknowledged that this risk must be mitigated wherever possible.*

Acknowledged.

   b. *Development Engineering has been assisting Sewer Asset Management in providing data for the known developments that will be tributary to the Scott Street Pumping Station. This has helped to provide a measure of expected flows to support the determination of capacity of the plant to accommodate Corus, Phase 1 development, and the ultimate East Bayfront Development. The attached chart [see Appendix XX] has been provided to Toronto Water recently and is still being reviewed. It is provided to you in order for you to refine the downstream sewer improvements, to ensure that all known development has been accommodated and not just the East Bayfront Development.*

Please see our response to Sewer Asset Planning comment 2a.

   c. *At this time the City is considering proposing physical improvements to the Scott Pumping Station in the near future to coincide with an adjacent development. These would prepare the station for an ultimate expansion without increasing its current* *capacity. Toronto Water will also initiate the process to prepare the EA Study for the expansion of capacity of the plant.*

TMIG are arranging a meeting with Associated Engineering to discuss the scope of the station improvements.

d. The City is in the process of preparing standard design guidelines for development. This proposed document is unavailable at this time however the proposal is to establish a set flow per capita determination for new sanitary sewer design. This has been set at the present time as 300 l/cap/day which is notably higher than the 190 l/cap/day and 170 l/cap/day contained in the FSP for residential and non-residential flows.

TMIG have obtained a copy of the draft design criteria, and have updated the flow projections accordingly. This was initially addressed in the June 4th 2007 memo, and is reflected in this updated FSR.

e. In performing the recommendations for downstream improvements, a sensitivity analysis is to be performed to address comparative sizing for both scenarios. Downstream improvements design will also be required to address proposed location of new sewers, existing connections, utilities and crossings. This will greatly affect sizing as well.

TMIG released a memo June 4th, 2008 presenting two alternative sets of design criteria, both of which considered per-capita design flows of 300 Lpcd for new development as per the Draft Design Criteria. The more conservative design criteria generally resulted in pipe diameter increases of one pipe size.

At a meeting with Development Engineering and Sewer Asset Planning on October 31st, 2008, it was agreed that the design would consider the larger pipe sizes.

f. At this point there is no mention as to how the downstream improvements will be funded or whether Waterfront Toronto will facilitate the improvements. It is anticipated that Development Charge funds would be used where the legislation permits it to assist in funding of these improvements.

An initial meeting was held with Waterfront Toronto and the City to discuss generalities with respect to funding. A subsequent meeting is being arranged by the City to discuss the issue further with Waterfront Toronto.

g. Parks, Forestry and Recreation cite that City policy prohibits the encumbrance of new parks with infrastructure. While it is thought that the current proposal of Sherbourne Park design may feature the UV treatment, the servicing in the park must be minimized. Any proposed servicing through park property must be approved by Parks Forestry and Recreation. However, Toronto Water must also have access and ability to maintain the infrastructure on a regular basis and this may affect the design of the promenade and the park.

All mechanical infrastructure will be located within the Raw Water Pumping Station at the foot of Parliament Street slip or in the Sherbourne Park Pavilion. The connecting raw water pipeline, the make-up water intake, and the recirculation line will be installed within the Sherbourne Park boundaries

h. Toronto Fire requires fire protection of the dockside and marine activities. Whereas Building Code dictates a certain procedure for building sites, Toronto Fire requires dockside access for fire protection for marine needs as well as secondary support for fires within East Bayfront and for the Redpath refinery across the Jarvis Slip from East Bayfront. Toronto Fire has indicated that hydrants can be provided at approximate

100m intervals in proximity of the promenade. In phase one this would coincide with the public access corridors on private lands. If used for fire needs only, i.e. no domestic use, fire lines will required check valves to maintain domestic water quality and to minimize maintenance requirements. This will also require the use of service easements on the private access lands in Phase 1 as well as coordination with and approval from Parks Forestry and Recreation.

Fire Hydrants are proposed with access to the water's edge for fire protection. The hydrants are provided on lines with backflow prevention.

i. Pavement widths for all new City roads and private driveways must conform to the spirit of the DIPS policy especially where access for fire vehicles is being provided.

Though the functional traffic design for this project was completed by others, the proposed cross sections in the Phase 1 (Dockside) draft plan are 18.5m wide, with an 8.5m wide asphalt section which is generally in compliance with the DIPS policy. Future cross sections will also be compliant with DIPS on proposed and re-constructed existing roadways.

j. Detailed comments for issues under Transportation Services purview are not provided in the FSP but are under separate reporting directly to Transportation Services and Transportation Planning. Coordination and timing of the construction of Queens Quay East, the realignment of Lower Sherbourne Street, the treatment of the existing rail spur are all still topics that need to be addressed and are not covered in this document.

Transportation issues have been addressed in the report issued by BA Group in December 2007. Subsequent to the release of the BA report and the East Bayfront FSR, the Toronto Terminal Rail spur on Queens Quay was abandoned and removed.

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1 Introduction

The Municipal Infrastructure Group Ltd. was retained by Waterfront Toronto to review the existing municipal infrastructure and prepare preliminary and detailed design for services to support the East Bayfront Precinct (EBF), a 22-hectare redevelopment project in the City of Toronto. The project encompasses both publicly and privately held lands within the East Bayfront Precinct. These lands are bordered by Lakeshore Boulevard to the north, Lake Ontario to the south, Parliament Slip to the East and Jarvis Street to the West. **Figure 1-1** depicts the study area location.

Figure 1-1: Site Location Plan

The vision for the East Bayfront is as a mixed-use water's edge community with goals of high levels of sustainability and design excellence. The East Bayfront is part of the collective Toronto Central Waterfront Revitalization project, an extensive revitalization effort intended to propel the City of Toronto to world class city status. The four principles of the Central Waterfront Revitalization are as indicated in the East Bayfront Precinct Plan:

- Removing barriers/making connections
- Building a network of spectacular waterfront parks
- Promoting a clean and green environment
- Creating dynamic and diverse new communities

As also indicated in the East Bayfront Precinct Plan, the East Bayfront will ultimately house 10,000 residents and provide 8,000 employment spaces in approximately 2 million square feet of commercial floor space. It is intended that 25% of the gross floor area within the East Bayfront will be used for employment use. Full buildout of the East Bayfront will occur over the next 15 to 25 years.

1.1 Objective

The objectives of this Functional Servicing Report (FSR) are to:

- Analyze the capability of existing municipal services to provide: storm drainage, sanitary drainage, water supply for domestic use and for firefighting, hydro, gas and telecom as well as district energy services.
- Recommend improvements to the existing system, where required, to support the re-development of the East Bayfront.
- Describe additional infrastructure required to accommodate the development.

This Functional Servicing Report, after approval by the City, is intended to form the framework for the detailed design of services for the EBF. The report will also be used as a background document in the draft plan approval of the first and subsequent phases of development. The draft plan for the first phase of the East Bayfront (Dockside) was approved by the City on July 15, 2008. Within the first phase, construction of the Corus building is underway, while the detailed design stage for the public realm features and services for the remaining Dockside lands is nearing completion.

1.2 Background Document Review

1.2.1 East Bayfront Precinct Plan

Waterfront Toronto retained a consultant team led by Koetter, Kim and Associates to complete a Precinct Plan for the East Bayfront Development Area in February 2005. The purpose of the Precinct Plan was to provide a detailed look at the principles and guidelines for development of the lands that would not otherwise be possible during a secondary planning exercise. The Precinct Plan addressed the concepts and guidelines for the construction of infrastructure within the precinct. The plan was reviewed by the City and input was received on the plan from Public forums and stakeholder meetings.

In terms of infrastructure, the Precinct Plan laid out guidelines for infrastructure planning for the East Bayfront. Specifically, the plan stated that opportunities should be taken to utilize the existing infrastructure and consideration given for rehabilitation of the existing infrastructure, if feasible. The Precinct Plan did not provide details as to how these objectives were to be achieved.

The overriding concept of the plan with respect to municipal infrastructure was that all infrastructure should be constructed with sustainability as a key component. Consideration should be given to the following concepts:

- Municipal water conservation and water efficiency.
- Separation of stormwater from “clean” areas such as rooftops and landscaped areas from drainage from roads and parking areas.
- The use of stormwater as a resource, as discussed in the City of Toronto Wet Weather Flow Master Plan.

1.2.2 East Bayfront Municipal Services Engineering Report

The East Bayfront Municipal Services Engineering Report was completed in February of 2005 by Lea and Associates on behalf of Waterfront Toronto in support of the East Bayfront Precinct Plan. This report identified the objectives of the infrastructure planning portion of the Precinct Plan and looked at opportunities and constraints regarding the servicing of the East Bayfront. The report did go into specific detail on pipe replacements for sanitary and storm sewers on the basis of flow analysis. Specifically, the report identified:

- Stormwater management was to be accomplished by splitting flows in to clean and dirty sources and conveyance. Treatment was proposed by using settling of “dirty” stormwater from hard surfaced areas and treatment of both streams with UV disinfection.
- Sanitary sewers were analyzed for capacity and upgrades were recommended on Sherbourne and Jarvis Street, south of Lakeshore. The report noted that further analysis was required on the Scott Street Sewage pumping station and that it was near capacity.

- The report identified that existing local watermains should be sufficient for water distribution within the East Bayfront based on size. It recommended that the existing watermain on Lower Sherbourne be replaced due to frequent breaks.
- The report did not consider additional utilities or District Energy.

1.2.3 East Bayfront Class Environmental Assessment Master Plan

The East Bayfront Class Environmental Assessment Master Plan was completed in January of 2006 by Lea and Associates on behalf of Waterfront Toronto. The plan was intended to address specific upgrades required of the roads, water, wastewater and stormwater infrastructure. The plan outlined potential upgrades and the Class environmental assessment impacts. Specifically, the report identified:

- As noted in the Municipal Services Engineering Report, stormwater management was to be accomplished by splitting flows in to clean and dirty sources and conveyance. Treatment was proposed by using settling of “dirty” stormwater from hard surfaced areas and treatment of both streams with UV disinfection.
- The plan recommended upsizing sanitary sewers On Lower Sherbourne, Lower Jarvis and on Lakeshore Boulevard. The plan recommended that the remaining sewers should be analyzed by the City and replaced if required.
- The plan identified that existing local watermains should be sufficient for water distribution within the East Bayfront based on size. It recommended a combination of rehabilitation by cleaning, cement mortar lining, and replacement in identified problem areas.
- The plan reviewed a variety of transportation alternatives within the East Bayfront, considering various elements, such as cross section and inclusion of transit.

1.2.4 East Bayfront Phase 1 Functional Servicing Report

The Phase 1 Functional Servicing Report completed by Marshall Macklin Monaghan Limited in May 2007 reviewed in detail, the sanitary, water, and stormwater services required to service lands from Jarvis Slip to Sherbourne Park, south of Queens Quay. The report concluded that there was sufficient capacity within the existing services to service Phase 1, but that an analysis of Scott Street Sewage pumping station was required. The report did not review the capacity of the sewers between the East Bayfront lands and the Scott Street pump station. The report roughly followed the recommendations of the East Bayfront Class Environmental Assessment Master Plan.

1.2.5 Other Related Documents

Other documents referenced in this report can be found in **Section 17**.

2 Existing Site Conditions

2.1 Existing Land Use

The East Bayfront lands were created by lake filling that occurred from the late 1800's to the mid 1950's. Existing land use is predominantly commercial, light industrial, and parking lot uses. The lands north of Queens Quay have been used for light industrial and warehouse facilities, while south of Queens Quay historical marine terminal uses have recently been converted to a movie studio and private recreational facilities. Inactive rail spurs and remnants traverse the study area. A single active rail spur was located on the south side of Queens Quay East, but was removed in the fall of 2008. The figure below illustrates the existing land use in the area.

Figure 2-1: East Bayfront Existing Land Use

source: google earth

2.2 Subsurface Conditions

As noted previously, the East Bayfront lands were created through the placement of fill within the lake. Previous soils investigations have indicated that the fill materials varied considerably, ranging from dredged material, excavation spoil, garbage, and rubble.

A Phase I and II Environmental Site assessment was completed on behalf of the Toronto Economic Development Corporation (TEDCO) by Dillon Consulting Limited on the south western portion of East Bayfront. This report found the potential for poor quality fill materials and groundwater potentially containing contaminants, as well as methane generated from buried lake bottom sediments.

Geotechnically, the report found mixed sand, silt, gravel and clay fill with concrete, brick and organic debris to a depth of approximate 6 to 7 metres, silty clay and clayey silt till lake bottom sediments 4 to 6 metres below the fill, and shale bedrock at approximately 12 metres below grade. Groundwater was encountered at depths ranging from 0.44 to 2.45 metres below grade (Dillon Consulting Limited, 2007).

Dockwall Assessment reports carried out by Baird and Associates for Waterfront Toronto in 2007 indicate that there are tiebacks from the dockwall extending approximately 20 metres into East Bayfront.

A Geotechnical report in support of the East Bayfront Dockside (Phase1) development was completed by Alston Associates in June of 2008. The report found very poor quality soils consisting of uncompacted fill or potential fill to a depth of up to 11 metres below surface. Bedrock was found at depths of 10.5 to 14 metres below existing ground, overlain by native lake-bottom sediments. The report recommended special provisions for pipe and buried chamber design including extra depth reinforced foundations, and provisions to resist uplift on the chambers.

3 Proposed Development

East Bayfront is envisioned as a mixed-use community that is intended to house 10,000 residents, supply employment for 8,000, and provide public realm amenities such as Sherbourne Park, Sugar Beach, and the water's edge boardwalk and promenade. **Figure 3-1** illustrates the overall East Bayfront development concept.

Figure 3-1: East Bayfront Development Concept

Figure 3-2 highlights the different East Bayfront phases that are presently contemplated. *Dockside* represents the first phase of development, which includes the new Corus and George Brown College facilities, as well as Sugar Beach and Sherbourne Park.

Figure 3-2: East Bayfront Phasing Plan

The Dockside phase has advanced considerably since the December 2007 FSR, with construction presently underway on the Corus building. To some degree, commencement of construction in Dockside has been premised on the municipal infrastructure concepts and commitments established in the December 2007 FSR. Accordingly, detailed design drawings and reports in support of this first phase have been prepared and submitted to the City and other agencies for review and approval. Approval from the City was received on November 27, 2008; Certificates of Approval were received from the Ministry of Environment on September 30, 2008 for the oil-grit separator and on November 28, 2008 for sewer and watermains; a Permit was received from the Toronto and Region Conservation Authority on November 12, 2008. This updated FSR incorporates some of the feedback and design refinements that have resulted from the review and approval process.

In terms of development staging, buildout of East Bayfront will also be influenced by ongoing studies that include:

- A transit Environmental Assessment being undertaken by the Toronto Transit Commission (TTC). The transit EA is examining alternatives for the possible extension of a streetcar line along Queens Quay for the entire length of the East Bayfront.
- Queens Quay Environmental Assessment currently being undertaken by Waterfront Toronto to determine the preferred cross-section for the Queens Quay as well as to make recommendations on surfacing and building materials to be used.
- The Don and Waterfront Trunk Sewers and Combined Sewer Overflow Control Strategy Municipal Class Environmental Assessment being undertaken by Toronto Water to assess and consider options for upgrades to the existing combined sewer outfalls within the Don River Watershed.
- Waterfront Toronto has commissioned an individual Class Environmental Assessment to consider the removal of the Gardiner Expressway from Jarvis Street to the Don Valley Parkway. This EA had not been started as of the writing of this report.

It is anticipated that the reconstruction of Queens Quay will take place prior to full build-out of Dockside and that coordination of infrastructure works will be required to ensure that construction conflicts are minimized. The re-alignment of Lower Sherbourne Street north of Queens Quay is also expected to take place during the build-out of Dockside. Reconstruction of Lower Sherbourne is not required for the Dockside works. The development of Sherbourne Park and Sugar Beach are anticipated to be undertaken concurrently with Dockside.

Works along the Public Promenade will also be undertaken in a phased program during the development of the East Bayfront. Given the nature of the integrated water’s edge promenade and stormwater management facility (**Section 5**), due regard must be given to establishing a staging and phasing plan that ensures coordination with adjacent works, and as well satisfies the target dates desired by Waterfront Toronto and the City. This plan is being formulated in conjunction with the Public Realm consultants as part of the detailed design efforts.

Areas not associated with a particular phase on **Figure 3-2** are a mix of public and private ownership, and development is similarly anticipated to occur in a phased manner subject to market forces.

4 Stormwater Management Strategy

This section of the report describes the overall stormwater management strategy proposed to service the development of the East Bayfront community. Typical stormwater management objectives include water quality treatment, erosion attenuation, and water quantity (peak storm) control.

Due to the proximity of the community to Lake Ontario, and the applicability of the Wet Weather Flow Management Guidelines issued by the City of Toronto (November 2006), reduction and treatment of *Escherichia coli* bacteria (E.coli) is also desired, while erosion attenuation and water quantity objectives are less relevant with respect to discharges to the lake. Waterfront Toronto's Sustainability Framework was also considered as a guiding principle in the evaluation of suitable stormwater management alternatives.

In summary, the fundamental objectives of the stormwater management strategy for East Bayfront are:

- Water quality treatment to remove a minimum of 80% of the total suspended solids (and associated contaminants), in accordance with the Ministry of Environment's Stormwater Management Planning and Design Manual (March 2003).
- Reduction in the concentration of E.coli prior to discharging to Lake Ontario to a maximum of 100 counts per 100ml, which is the Provincial Water Quality Objective (PWQO) for E.coli, and also the threshold for water contact recreational activity.
- Utilization of runoff as a resource to reduce potable water consumption and minimize treatment requirements, per Waterfront Toronto's Sustainability Framework.

Significant deliberation on available and innovative alternatives, and corresponding liaison with approval agency representatives, has yielded the stormwater management strategy described herein. Agency consultation was conducted with both the City of Toronto and the Aquatic Habitat Toronto (AHT) group, whose membership includes representatives of the City of Toronto, the Toronto and Region Conservation Authority (TRCA), the Ministry of Natural Resources (MNR), the Department of Fisheries and Oceans (DFO), and Waterfront Toronto.

4.1 Background

A Class Environmental Assessment (EA) was undertaken for the East Bayfront lands, encapsulated within the "*East Bayfront Class Environmental Assessment Master Plan*" report, dated January 2006. With respect to stormwater collection and conveyance, the preferred solution, Alternative 'E', as established through the EA process was described as follows:

- *Ultimately combined sewer overflows will be collected in the new CSO [combined sewer overflow] interceptor, and treated (as part of the City's implementation of the WWFMMP [Wet Weather Flow Management Master Plan]);*
- *Clean and dirty stormwater will generally be collected separately;*
- *Dirty water will be conveyed to two collection points for end-of-pipe treatment;*
- *Clean water will be collected on development sites and in parks, and contained at source as much as possible (e.g. green roofs etc.). All or some of this water may be re-used, if feasible;*
- *Remaining clean stormwater will be conveyed on the surface in landscaped architectural features as much as possible. Some sections of piped system may be required. This clean stormwater will be conveyed to the same collection points as for dirty stormwater;*
- *After end-of-pipe treatment, the stormwater will be discharged into Lake Ontario. If the option of treating East Bayfront stormwater in the proposed CSO tunnel is not used, then the CSO outfalls – once they are no longer needed for combined sewer flows – will be used as stormwater outfalls following quality control treatment.*

A similar evaluation was undertaken to identify a preferred end-of-pipe treatment mechanism. The preferred end-of-pipe solution, Alternative 'D', was described as follows:

- *Sedimentation Tanks, Filters and Disinfection. The dirty stormwater would be settled-out as described for Alternative C, then the settled-out dirty stormwater, and the clean stormwater would both be passed through sand filters and the UV disinfection units. This would remove additional suspended solids and destroy bacteria and viruses.*
- For reference, as cited above, Alternative C entailed the provision of: *Sedimentation Tanks. Collect the first flush of dirty stormwater in underground sedimentation tanks. A 2 inch storm can be captured. After settlement the tank can be pumped out and then flushed to clear the sediments. The sediments can be discharged into the sanitary sewer system.*

In summary, this earlier version of the stormwater management strategy for East Bayfront proposed a two-pipe system to separate relatively clean rooftop runoff from other (less clean) surface runoff. The end-of-pipe component consisted of two subsurface tanks, which would facilitate settlement of suspended particles, ultimately yielding water of sufficient clarity for effective ultraviolet (UV) treatment of E.coli. The approach entails the detention of a 2” (50mm) event from the overall study area, filtration, and UV disinfection prior to discharge to Lake Ontario. Given practical and spatial limitations with respect to tank size, this method requires filtration and UV treatment of a maximum peak flow, which implies a relatively high cost and maintenance burden to both install and operate the equipment. While this approach likely satisfies water quality and E.coli treatment objectives, an alternative strategy has been explored that also satisfies these objectives, potentially offers additional benefits to the proposed community, and better achieves the principles of Waterfront Toronto’s Sustainability Framework.

As documented in the Ministry of Environment’s Stormwater Management Planning and Design Manual (March 2003), there are typically three components to be considered in each SWM strategy: on-site measures, conveyance measures, and end-of-pipe measures. Each of these has been explored to arrive at the current stormwater strategy for East Bayfront.

4.2 Study Area Characterization

The sizing of stormwater management measures is dependent on the hydrologic characteristics of the contributing drainage area. Typical stormwater management investigations also include a review of the existing hydrologic conditions of a subject site. However, given that the East Bayfront lands are presently comprised of a combination of warehouse-style buildings and paved parking areas, yielding an imperviousness of about 100%, this analysis was deemed unnecessary. Furthermore, both the City’s Wet Weather Flow Management Guidelines and Waterfront Toronto’s Sustainability Framework advocate stormwater management approaches with an emphasis on best efforts as opposed to maintenance of existing conditions. Nevertheless, and in response to comments from the City (**Appendix 1b**), a detailed water balance analysis was undertaken for the entire East Bayfront area and submitted under separate cover. This analysis is provided in **Section 4.8** in its entirety.

An evaluation of the base hydrologic characteristics of the East Bayfront lands was also undertaken, utilizing the current precinct plan (**Figure 3-1**), to establish runoff coefficients using those stipulated by the Wet Weather Flow Management Guidelines (November 2006, page 30). These are summarized for reference in **Table 4-1**.

Table 4-1: Runoff Coefficients per the WWFM Guidelines

Single Family Residential	0.50	Commercial	0.90
Semi-Detached Residential	0.60	Industrial	0.85
Townhouses	0.65	Institutional	0.75
Apartments	0.75	Asphalt, Concrete, Roof Areas	0.95
Parkland	0.25		

The detailed site characterization is provided in **Appendix 1a**. **Table 4-2**, below, provides a summary of the base runoff coefficients anticipated for East Bayfront. An external 2.70-

hectare area to the north of Queens Quay and west of Jarvis Street is also to be conveyed through East Bayfront for treatment via the proposed stormwater management measures.

Table 4-2: Base Hydrologic Characteristics

Site Component	Total Area (ha)	Base Runoff Coefficient
Building (north of Queens Quay)	6.17	0.95
Building (south of Queens Quay)	4.94	0.95
Right-of-ways	6.72	0.95
Park (including Sherbourne Park)	1.36	0.50
Sugar Beach	0.42	0.95
Promenade	2.68	0.95
External Area – paved	1.09	0.95
External Area – mixed	1.61	0.75
Total / Average	24.99	0.90

It should be noted that the provision of on-site stormwater management measures, described in **Section 4.3**, will yield reductions in the runoff coefficient for the purpose of sizing infrastructure. To that end, the base runoff coefficient, C, for each individual lot and as derived from the above table, is 0.95. It should also be noted that the runoff coefficient for rights-of-way is conservatively based on the assumption that these are comprised entirely of hard surfaces; further refinement of this value is possible upon finalization of right-of-way configurations. For example, the proposed installation of *Silva Cells* for tree planting may yield runoff reductions through the collection, attenuation, and potential infiltration of drainage from the boulevards. However, as the extent of application of such measures is subject to detailed design, these have not been considered in the evaluation of runoff coefficients for the subject lands.

4.3 On-Site Measures

On-site measures refer to those mechanisms that can be employed at the individual lot level to control both the quality and quantity of runoff. Traditional on-site measures include rooftop storage, parking lot storage, lot grading, and oversized storm sewers. These types of measures are effective in reducing peak flow, but do not typically reduce the volume of runoff generated by a developed site. Measures that are capable of reducing runoff volume normally involve runoff reuse, increased evapotranspiration, or infiltration.

In accordance with the progressive form of development envisioned and planned for in East Bayfront, many of the proposed buildings are anticipated to strive for recognition under the LEED® Canada certification program; LEED is an acronym for Leadership in Energy and Environmental Design, administered in Canada by the Canada Green Building Council (CaGBC). A number of LEED credits are intended to encourage sustainable stormwater management practices, often in relation to reduced runoff volume. Some of the recommended measures which are presently anticipated for application within East Bayfront include green roofs and rainwater harvesting, proposed for both landscape irrigation and flushing water closets.

Infiltration practices are also recommended as a method by which LEED credits related to stormwater management may be achieved. In general, while these measures may be selectively applied within East Bayfront to encourage infiltration, the predominantly high water table will limit their effectiveness. Hence infiltration practices have not been included in the suite of proposed on-site measures, although their discretionary implementation may be deemed appropriate on a site-by-site basis.

Given the expectation for LEED Gold certification for all the lands south of Queens Quay, and similar development objectives for lands north of Queens Quay, there is an opportunity to significantly decrease the volume of runoff generated by each of the individual lots. Furthermore, City of Toronto requirements, via the Wet Weather Flow Management Master Plan and the Green Development Standard, also encourage considerably more regard for on-site measures as opposed to total reliance on end-of-pipe systems. Reference to the anticipated performance of proposed measures with respect to these criteria is provided in **Section 4**.

The on-site component of the stormwater management strategy recommends and relies upon the implementation of these measures to achieve the benefit of reduced runoff. It is important to note that this reduction in runoff at the source decreases the extent of quality and E.coli treatment (and hence infrastructure) required at the end-of-pipe.

To quantify the contribution of such measures to the overall stormwater management strategy, reduced runoff coefficients have been established that reflect the anticipated extent and form of on-site measures to be implemented. The following assumptions were fundamental to the evaluation of appropriate runoff coefficients:

- For development parcels south of Queens Quay, with anticipated LEED Gold certification, the combination of extensive green roofs and rainwater harvesting measures will capture and utilize the first **15mm** of every storm event.
- For development parcels north of Queens Quay, presently under private ownership, adherence to the Wet Weather Flow Management Guidelines will require that a minimum of **5mm** of every storm event will be captured and utilized on-site.

The reduction in runoff coefficient varies with each storm event. The depth of each return-period storm event was established through simulation of the events using Visual OTTHYMO v2.0, with the characteristics of each event defined by the intensity-duration-frequency (IDF) relationships stipulated by the Wet Weather Flow Management Guideline. The details of the simulation are provided in **Appendix 1a**, while **Table 4-3** summarizes the depth of rainfall attributed to each storm event.

The following excerpt from the Guideline (page 32) explains the genesis of the current IDF curves:

> *The updated IDF curves were derived based on the rainfall statistic analysis from three Toronto Gauges: Toronto Bloor Street (Gauge #6158350 – 24 years record), Ellesmere (Gauge #6158520 – 21 years record) and Pearson Airport (Gauge #6158733), as part of the WWFMP Study. The Parameter C is of negative value because the equation is written in a "multiplication" instead of a "reciprocal" format. It can also be written in the familiar format as:* $I = a/(t + b)^c$*, where, for a 2-year storm, a=21.8, b=0, and c=0.78.*

Table 4-3: Rainfall Depths

Event	IDF Parameters (WWFM Guideline)		Rainfall Depth (mm)
	A	C	
25mm	--	--	25.00
2-Year	21.8	-0.78	29.57
5-Year	32.0	-0.79	42.80
10-Year	38.7	-0.80	51.05
25-Year	45.2	-0.80	59.62
50-Year	53.5	-0.80	70.57
100-Year	59.7	-0.80	78.75

The runoff coefficient adjustment is proportionate to the reduction in expected runoff by either 5mm or 15mm, for each of the 25mm and 2 through 100-year return-period storm events described above. **Table 4-4** and **Table 4-5** illustrate the method and results of this evaluation for 5mm and 15mm reductions, respectively.

Table 4-4: Individual Site Runoff Coefficient Adjustments (5mm Runoff Reduction)

Event	Rainfall Depth (mm)	Base Runoff Coefficient (C_{BASE})	Base Runoff (mm)	Runoff Reduced by 5mm (mm)	Adjusted C (C_5)
25mm	25.00	0.95	23.75	18.75	0.75
2 Yr	29.57	0.95	28.09	23.09	0.78
5 Yr	42.80	0.95	40.66	35.66	0.83
10 Yr	51.05	0.95	48.50	43.50	0.85
25 Yr	59.62	0.95	56.64	51.64	0.87
50 Yr	70.57	0.95	67.04	62.04	0.88
100 Yr	78.75	0.95	74.81	69.81	0.89

Table 4-5: Individual Site Runoff Coefficient Adjustments (15mm Runoff Reduction)

Event	Rainfall Depth (mm)	Base Runoff Coefficient (C_{BASE})	Base Runoff (mm)	Runoff Reduced by 15mm (mm)	Adjusted C (C_{15})
25mm	25.00	0.95	23.75	8.75	0.35
2 Yr	29.57	0.95	28.09	13.09	0.44
5 Yr	42.80	0.95	40.66	25.66	0.60
10 Yr	51.05	0.95	48.50	33.50	0.66
25 Yr	59.62	0.95	56.64	41.64	0.70
50 Yr	70.57	0.95	67.04	52.04	0.74
100 Yr	78.75	0.95	74.81	59.81	0.76

Detailed calculations yielding the above results are provided in **Appendix 1a**. The above runoff coefficient adjustments are applicable to individual lots having the base runoff coefficient of 0.95. This value corresponds to a lot comprised of approximately 90% rooftop area and 10% predominantly hard landscaping (i.e. pavement), although both of these have been assigned runoff coefficients of 0.95.

The overall East Bayfront composite runoff coefficient (and corresponding imperviousness) has been similarly adjusted using the above values as part of computations associated with the end-of-pipe facility sizing in **Section 5.1.2**.

Subsequent to completion of the December 2007 FSR, a stormwater management evaluation and report was prepared for the proposed Corus Entertainment building (*Corus Entertainment Building - Stormwater Management Report, TMIG October 2008*). Part of this evaluation included review of the proposed green roof and rainwater harvesting systems to confirm the 15mm rainfall reduction objective described above. The analysis concluded with verification that the design of the building would achieve the 15mm target. More generally, the analysis demonstrated that the 15mm target is feasible and implementable.

4.4 Runoff Coefficient Evaluation

The runoff coefficients for the proposed buildings within East Bayfront have been adjusted to account for the presence of on-site measures (such as green roofs and rainwater harvesting), which result in reductions in the volume of runoff generated by these areas (**Section 4.3**). In order to assess the size and performance of proposed end-of-pipe infrastructure, the overall East Bayfront runoff coefficient has been established which incorporates these refined components. **Table 4-6** summarizes the results of the analysis, while the detailed calculations are provided in **Appendix 1a**.

It should be noted that the total drainage area of 22.31 hectares includes the 2.70-hectare external area to the north and west of Queens Quay and Jarvis Street, but does not include the 2.68-hectare lake-front promenade, as it is anticipated that this narrow area will drain directly to Lake Ontario. While treatment of this area is technically feasible, the challenges and associated cost will likely be prohibitive with respect to the benefit to be realized. Furthermore, the introduction of storm sewers below the surface of the boardwalk could interfere with and/or impact the existing dock wall tie-backs, inherently affecting stability.

Table 4-6: East Bayfront Runoff Coefficient and Imperviousness

Event	Runoff Coefficient	Imperviousness
25mm	0.72	74%
2 Year	0.75	78%
5 Year	0.80	85%
10 Year	0.82	88%
25 Year	0.83	90%
50 Year	0.84	92%
100 Year	0.85	93%

During a 2-year return period event, the breakdown of land use and runoff coefficients may be summarized as shown in **Table 4-7**.

Table 4-7: Landuse and Runoff Coefficient Breakdown (2-Year Event)

Site Component	Area (ha)	Adjusted C
Building (north of Queens Quay)	6.17	**0.78**
Building (south of Queens Quay)	4.94	**0.44**
Right-of-ways	6.72	0.95
Park (including Sherbourne Park)	1.36	0.50
Sugar Beach	0.42	0.95
External area – paved	1.09	0.95
External area -mixed	1.61	0.75
Total / Average	22.31	**0.75**

4.5 Conveyance Measures

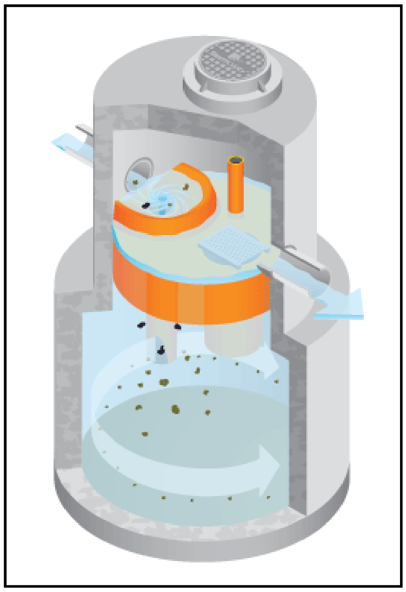
The second component of the stormwater management strategy, following the model advocated by the Ministry of Environment's Stormwater Management Planning and Design Manual, explores opportunities to treat runoff en route between the source (i.e. individual sites) and the discharge point. Such measures typically include grassed swales, pervious pipe systems, and vegetated filter strips.

However, public realm objectives and the proposed urban form of the East Bayfront development somewhat limit opportunities for the full spectrum of traditional conveyance stormwater management measures. Furthermore, many conveyance mechanisms rely to a large extent on infiltration, which as described previously is anticipated to be largely ineffective within East Bayfront. While conveyance measures will offer limited benefit from a quantity control perspective, on-line water quality treatment devices (also referred to as oil/grit separators), as well as goss traps, could be implemented to effectively reduce the transport of suspended particles and related contaminants. The capture and storage of surface runoff within the right-of-ways for the watering of trees (i.e. Silva Cells) in the boulevard is another option that may be explored, and in keeping with the principle of stormwater reuse; however, the volume of runoff utilized for this application is difficult to quantify, and as such has not been accounted for in this exercise.

Oil/grit separators use a series of chambers to capture sediment and oil as they enter the sewer system. These have traditionally been used to capture parking lot runoff, but have been implemented in some cases for use in municipal storm sewer systems. While flows resulting from major storm events must bypass the device, they can still achieve worthwhile reductions of road-related contaminants, since stormwater pollutants are usually most concentrated in the first stages of runoff.

The Wet Weather Flow Management Guidelines outline the City of Toronto's requirements with respect to oil/grit separators. In essence, the City considers that these devices should not be solely relied upon to achieve water quality objectives, but should rather form part of a series of stormwater management measures, and that these devices, in the absence of additional field performance data, will only be credited with achieving a maximum of 50% removal of total suspended solids. As per the Guideline, the list of products currently accepted by the City includes (but is not necessarily limited to) *VortSentry*, *Vortechs*, *High Efficiency CDS*, *Baysaver Separator System*, *Downstream Defender*, and *StormCeptor*. The figure below depicts one of these systems for illustrative purposes.

Figure 4-1: Sample Oil/Grit Separator



source: www.stormceptor.ca

Refinement of the specifications defining the type, size, number, and location of products to be implemented for East Bayfront will be conducted through the detailed design process. However, preliminary siting of these devices has been incorporated in the definition of the storm sewer network proposed to service the community (**Section 7**). Four oil/grit separation devices are presently proposed to service the four East Bayfront quadrants and the external area. These devices will reduce overall runoff turbidity (and improve clarity and quality) prior to discharge to the end-of-pipe receiving system. This will decrease the extent of quality treatment required at a centralized facility, while also improving the efficiency of UV disinfection systems. A further benefit of both water quality devices and goss traps is the control of hydrocarbons and other floatables that may have adverse community impacts.

Sizing criteria for these devices will be based on the contributing catchment area and a runoff coefficient that considers the presence of the on-site measures identified in **Section 4.3**, along with the City's stipulations described above. The benefit of the proposed conveyance controls to the overall stormwater management strategy will be quantified by assessing the system as a distributed and weighted network, with the combined objective of achieving "enhanced" water quality treatment, or better, prior to discharge to Lake Ontario.

The City of Toronto and the AHT group, through initial consultation, have confirmed a preference to include on-line water quality treatment devices as part of the overall stormwater management strategy. More specifically, the concern has been raised that the accumulation of debris and contaminants within an end-of-pipe surface facility may adversely affect the aesthetic value of the facility, both visually and in terms of odour, and thus the implementation of water quality treatment devices upstream of the facility could effectively reduce the severity of this concern.

Representatives of the City also indicated, as part of the initial consultations, that provision for maintenance must be incorporated in the siting of the oil/grit separators, in the form of pads adjacent to device locations to station maintenance vehicles.

Subsequent to submission of the December 2007 FSR, progression on the design of the Dockside (Phase 1) lands has yielded additional feedback from City staff, and corresponding refinements to the preferred oil/grit separator specifications. **Section 4.7** provides additional information on the Dockside phase of the East Bayfront development.

4.6 End-of-Pipe Measures

The end-of-pipe system for East Bayfront is contemplated as an in-lake facility that provides a minimum of 80% suspended solid removal and connectivity to a UV treatment facility for E.coli disinfection. The analyses, alternatives, and findings of investigations related to the end-of-pipe system are detailed in **Section 5** of this report.

4.7 Dockside Stormwater Management Strategy

The Dockside (Phase 1) portion of East Bayfront represents approximately 5.46 hectares of the overall redevelopment area, with an anticipated first occupancy date of 2010 to facilitate the requirements of the future Corus building, an important feature and future tenant of the East Bayfront community.

The Draft Plan for Dockside (*Phase 1, Holding Jones Vanderveen Inc., Revision B, February 14, 2008*), encompasses the lands west of and including Sherbourne Park, south of Queens Quay, and east of Jarvis Slip. The *Phase 1 (Dockside) Stormwater Management Implementation Report* (TMIG, Updated June 2008) established that the Dockside lands have a total area of 5.46 hectares, along with approximately 9.17 hectares of external drainage that will be conveyed via infrastructure within Dockside (the external area is comprised of both areas external to Phase 1, but within East Bayfront, and areas external to East Bayfront).

Given that the overall East Bayfront stormwater strategy will not be in place within the Dockside timeframe, an interim stormwater management approach has been defined to accommodate this first phase of development in the short term. The Dockside strategy entails the implementation of all the on-site and conveyance measures described in the preceding sections, with interim discharge of runoff to the existing Sherbourne CSO outlet that discharges to the Lake in the vicinity of the future Sherbourne Park. **Figure 7-2** illustrates the Dockside drainage patterns and proposed stormwater management strategy. Water quality treatment during the interim condition will be achieved via an oil/grit separator device.

Once the ultimate East Bayfront stormwater strategy is in place, particularly in regards to completion of the end-of-pipe facility, runoff conveyed to the Sherbourne CSO during the interim condition will be redirected to a new storm sewer that discharges to the end-of-pipe facility. The end-of-pipe component of the stormwater strategy is described in further detail in **Section 5**. In the ultimate condition, the oil/grit separator proposed for water quality treatment in the interim will continue to be utilized for pre-treatment of runoff to the end-of-pipe facility.

Drainage from the 9.17-hectare area external to Dockside is presently conveyed via the storm sewer along Queens Quay. These lands will continue to drain via Dockside in the future, and hence the proposed storm network and related infrastructure must be designed to accommodate these external flows.

This approach provides for the storm-related services associated with the ultimate strategy, and prepares the site for eventual discharge to the proposed stormwater management facility, described in **Section 5**. Feedback and liaison with City staff as part of the detailed design of Dockside has yielded acceptance of the approach and design.

4.8 Water Balance Analysis

The WWF guidelines require that water balance analyses be undertaken in support of development applications. For East Bayfront, this requirement was reaffirmed through feedback from the City on the December 2007 FSR. The analysis presented in this section was submitted under separate cover to the City on January 23, 2009, and is provided here in its entirety for reference purposes. It should be noted the analysis has been refined from the January submission to reflect minor revision to drainage areas established through more detailed review as part of this FSR update. In general, the analysis was undertaken in a manner consistent with the recommendations of both the WWF guidelines and the MOE SWMPD manual.

4.8.1 Objective and Background

The primary objective of a water balance analysis is to define the various parameters of the hydrologic cycle that exist for a given area, to identify the potential change in these parameters following a change in land use, and to identify suitable measures to mitigate these changes as part of the new land use condition. A typical simplified water balance consists of four parameters governed by the relationship P = ET + I + R, where P is precipitation, ET is evapotranspiration, I is infiltration, and R is surface runoff. Essentially, this relationship indicates that all the water that falls as precipitation is consumed or utilized through one of the processes of evapotranspiration, infiltration, or runoff. There are other parameters and losses that influence the water balance relationship, but these have less significance within the context of a simplified analysis. Within the Greater Toronto Area, average values associated with these processes for an undeveloped setting (i.e. greenfield) are listed in **Table 4-8**, as documented in the MOE SWMPD manual.

Table 4-8: Typical Annual Average Water Balance Relationship

Precipitation (mm)	940
Evapotranspiration (mm)	538
Runoff (mm)	179
Infiltration (mm)	223

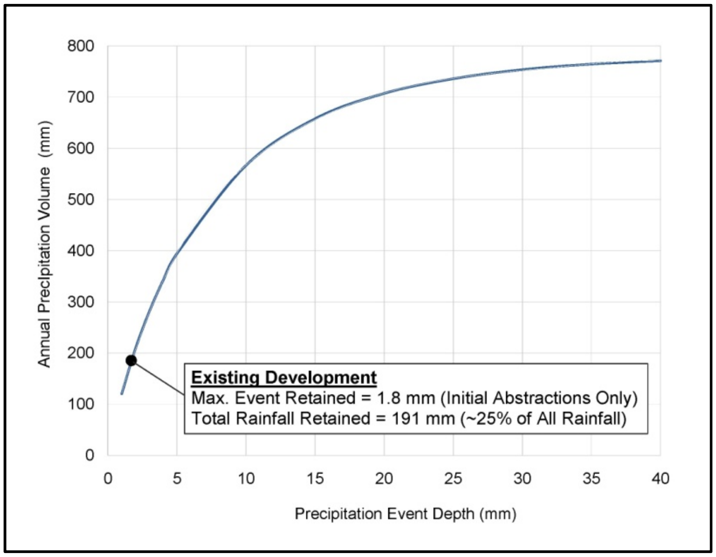
4.8.2 Existing Conditions

As described in **Section 2**, the East Bayfront lands are presently comprised of a combination of warehouse-style buildings and paved parking areas, yielding a weighted imperviousness of about 100% (C=0.90). The overall area of 22.31 hectares established previously has been used in this analysis; this area excludes the promenade at the water's edge as it is anticipated that no change will occur hydrologically between the pre and post development scenarios. The imperviousness of 100% for the remaining East Bayfront area suggests that no infiltration is presently occurring.

Due to the lack of vegetation present within the study area, the evapotranspiration component of the water balance relationship has been estimated on the basis of the initial abstractions that occur on its surface. The initial abstractions are those minor depressions and surface imperfections that provide some degree of storage during rainfall events; with exposure to wind and solar energy, this stored rainfall has the potential to dissipate via evaporation.

For the purposes of this analysis, existing initial abstractions within East Bayfront have been estimated to be a typical value of 1.5 mm plus 20%, or 1.8 mm. To establish the annual average contribution of the 1.8 mm initial abstraction to the water balance relationship, a review of regional precipitation data (Pearson recording station, 1965 to 2002) has been undertaken, represented graphically in **Figure 4-2**.

Figure 4-2: Precipitation Analysis – Initial Abstractions (Pearson data, 1965-2002)



The curve is a variation on Figures 1a and 1b of the WWF guideline, with annual precipitation volume as the y-axis as opposed to the percentage of total average annual rainfall depth. This allows for an estimation of the annual precipitation that is captured by the initial abstraction of 1.8 mm, determined to be 191 mm or approximately 25% of the average annual precipitation. As the Pearson dataset yields an average annual precipitation depth of 784 mm, the annual initial abstraction capture has been proportionally adjusted to correspond to an average annual precipitation depth of 940 mm (MOE, **Table 4-8**). This adjustment results in an annual value for the capture through initial abstractions of 229 mm, which represents the evapotranspiration component of the current water balance relationship for the East Bayfront study area.

On this basis, the existing condition water balance relationship for the East Bayfront lands may be characterized as shown in **Table 4-9**, which establishes the unknown runoff value, R, as being 711 mm annually.

Table 4-9: Existing East Bayfront Water Balance Relationship

Precipitation (mm)	940
Evapotranspiration (mm)	229
Runoff (mm)	711
Infiltration (mm)	0

4.8.3 Proposed Conditions

As noted previously, the density of development anticipated for East Bayfront would typically yield a weighted imperviousness of 100%, which corresponds to a runoff coefficient of about 0.90. Hydrologic analyses often place emphasis on the definition of runoff coefficients for the different land uses, to provide guidance to the sizing and design of stormwater management infrastructure. This conservative approach is appropriate for the simulation of return period storm events, but less appropriate when considering water balance on the basis of average annual rainfall events.

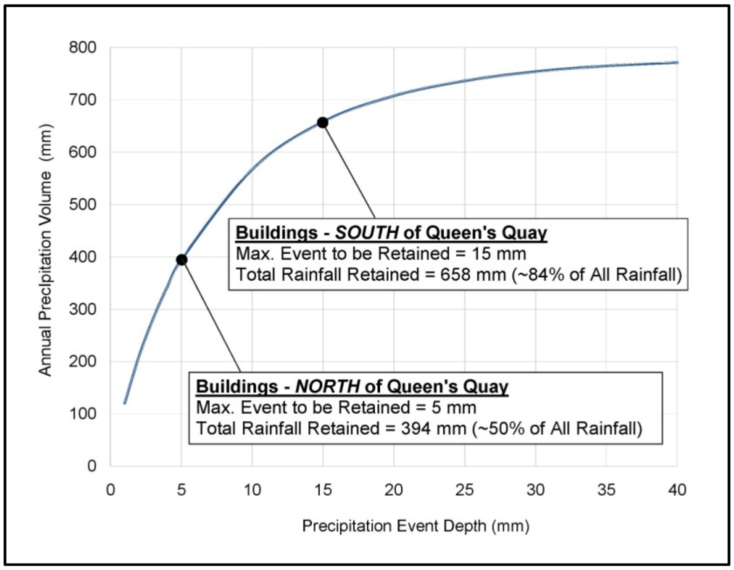
As noted in **Sections 4.3** and **4.4**, the runoff coefficients for the building areas have been adjusted to account for the extent of low impact development measures proposed within East

Bayfront. Namely, building rooftops north of Queens Quay will be required to capture and reuse a minimum of 5 mm from every rainfall event, while rooftops south of Queens Quay will capture and reuse a minimum of 15 mm from every event. These targets are expected to be achieved through a combination of green roof installations and rainwater harvesting practices.

A review of the water balance relationship for each of the land use areas listed in **Table 4-7** (**Section 4.4**) has been undertaken to establish the water balance for the overall East Bayfront in the post-development condition.

For building areas, the noted 5 mm and 15 mm rainfall reuse requirements have bearing on the post-development water balance relationship. In particular, the removal of a portion of every rainfall event can be quantified in annual average terms in a manner similar to that shown for the initial abstraction capture. **Figure 4-3** illustrates the annual equivalence of the required 5 mm and 15 mm event capture, yielding volumes of 394 mm (~50%) and 658 mm (~84%) annually. Proportional adjustment to correspond to an annual precipitation volume of 940 mm yields annual capture volumes of 472 mm and 789 mm, respectively, for each of the 5 mm and 15 mm targets.

Figure 4-3: Rooftop Capture and Reuse Targets (Pearson Data, 1965-2002)



For the Corus building, within the first phase of East Bayfront and south of Queens Quay, the 15 mm requirement has been achieved through the application of a green roof over 25% of the roof area, along with rainwater harvesting for use in building systems from the remaining 75% of the roof area. By using the Corus building as an example, it is possible to identify the water balance parameter(s) to which the 15 mm capture may be assigned on an annual basis. The capture that occurs over the green roof area may be recognized as evapotranspiration, and by applying the 25% rooftop area to the capture of 789 mm that has been determined to occur annually over the entire rooftop, the volume of precipitation that evapotranspires annually becomes 197 mm.

A new water balance parameter is needed to identify the volume of annual precipitation that is reused for the building systems (i.e. flushing toilets); the value of this parameter is determined by applying the remaining roof area of 75% to the 789 mm total annual capture volume, yielding an annual reuse volume, U, of 592 mm. In addition, a portion of the rainfall that would otherwise run off from the rainwater harvesting system will be retained through initial abstractions (i.e. adherence to roof gravel/ballast etc.). While typical values plus 20% (i.e. 1.5 mm + 0.3 mm = 1.8 mm) were considered for the existing site due to historical grading imperfections and long term weathering, it is anticipated that the proposed site grading will possess fewer imperfections, and thus only typical values would be realized for the initial abstractions (i.e. 1.5 mm). Hence the water balance relationship for the building rooftops that mimic the Corus example (i.e. buildings south of Queens Quay) may be characterized by **Table 4-10**.

Table 4-10: Rooftop Annual Water Balance Relationship – South Buildings / Corus

Precipitation (mm)	940
Evapotranspiration (mm)	340
Reuse	592
Runoff (mm)	8
Infiltration (mm)	0

As noted previously, a similar analysis was undertaken for the lands north of Queens Quay, considering the reduced capture of 5 mm in evaluating the effects of the green roof and rainwater harvesting systems. Once again, typical initial abstractions were accounted for over the rainwater harvesting area. **Table 4-11** illustrates the resultant water balance distribution that is anticipated for the buildings north of Queens Quay.

Table 4-11: Rooftop Annual Water Balance Relationship – North Buildings

Precipitation (mm)	940
Evapotranspiration (mm)	261
Reuse	354
Runoff (mm)	325
Infiltration (mm)	0

For the areas that are expected to be relatively impervious and smaller contributors to the overall water balance relationship across the site, a distribution similar to that considered for the existing conditions was accounted for. However, as with the buildings, only typical initial abstractions values were incorporated resulting in the distribution shown in **Table 4-12**.

Table 4-12: Impervious Areas Annual Water Balance Relationship

Precipitation (mm)	940
Evapotranspiration (mm)	191
Reuse	0
Runoff (mm)	749
Infiltration (mm)	0

Finally, for the areas that are designated as park, a blended water balance distribution has been calculated. This takes into account both the pervious nature of the proposed grassed areas within Sherbourne Park and the impervious treatment that will be established within the Sugar Beach area, both of which represent approximately 50% of the land uses noted as park. Although Sugar Beach is anticipated to be partially covered in sand (i.e. beach), a hard surface has been assumed for the purpose of these analyses. For the pervious surfaces, as defined within the MOE SWMP Manual, an “Urban Lawn” distribution with underlying clay soils has been used to estimate the water balance conditions, while the distribution shown in **Table 4-12** has been employed for the impervious areas. **Table 4-13** summarizes the water balance relationship for the park areas.

Table 4-13: Park Areas Annual Water Balance Relationship

	Impervious Portion	Pervious Portion	Weighted Average
Precipitation (mm)	940	940	940
Evapotranspiration (mm)	191	525	358
Reuse	0	0	0
Runoff (mm)	749	270	510
Infiltration (mm)	0	145	73

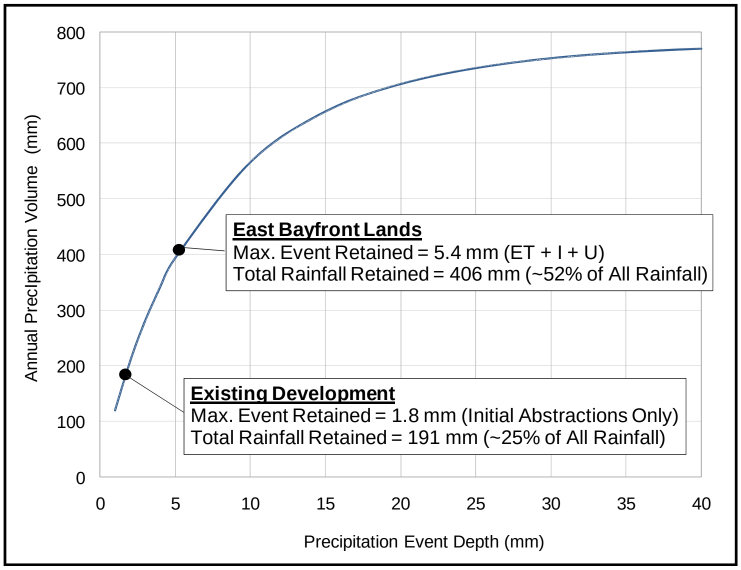
To evaluate the effect of the above noted distributions on the water balance of the entire area, and establish the post-development water balance relationship for the East Bayfront lands, a weighted average was undertaken using the areas defined in **Table 4-7** (**Section 4.4**). This weighted average is shown in **Table 4-14** with more detailed calculations included in **Appendix 1b**.

Table 4-14: Proposed East Bayfront Annual Water Balance Relationship

Precipitation (mm)	940
Evapotranspiration (mm)	254
Reuse	229
Runoff (mm)	453
Infiltration (mm)	4

As noted previously, the goal of the WWF guideline is to provide retention of the first 5 mm of every storm event onsite through the use of evapotranspiration, reuse and infiltration techniques. For the East Bayfront lands, and from the values listed in **Table 4-14**, these three components add up to a total of 487 mm or roughly 52% of the total annual rainfall column of 940 mm, as defined within the MOE SWMP Manual. Conversion of this value to rainfall conditions more indicative of the East Bayfront lands (i.e. using Toronto data with 784 mm total rainfall), this is equivalent to approximately 406 mm. Plotting of this retention value on the precipitation depth versus volume curve demonstrates that the proposed East Bayfront development is anticipated to retain approximately 5.4 mm from every rainfall event, as illustrated in **Figure 4-4**.

Figure 4-4: Proposed East Bayfront Water Balance Equivalence



4.8.4 Wet Weather Flow Criteria

To demonstrate that the proposed water balance measures are sufficient, the appropriate criteria (for sites greater than 5 hectares) listed in Table 7 of the City's Wet Weather Flow guidelines have been provided below in italics, followed by an explanation as to how each has been satisfied.

1. *Retain stormwater on-site to the extent practicable, to achieve the same level of annual volume of overland runoff allowable from the development site under pre-development conditions;*

   As the pre-development land use consisted primarily of warehouse buildings and asphalt parking areas, runoff retention was very limited and comprised only initial abstractions as noted earlier. With the implementation of the green roof and rainwater harvesting systems along with the creation of Sherbourne Park, the amount of runoff retained on the site is significantly more than in the pre-development condition. Therefore, this objective of the guideline has been achieved.

2. *If the allowable annual runoff volume from the development site under post-development conditions is less than the pre-development conditions, then the more stringent runoff control requirement becomes the governing target for the development site. The maximum allowable annual runoff volume from any development site is 50% of the total average annual rainfall depth;*

   Within **Table 4-14**, above, the total average runoff from the proposed tributary area has been calculated to be 453 mm annually, which represents approximately 48% of the total rainfall column of 940 mm. It should be noted that, if the external areas are removed from the calculations to just account for the East Bayfront Lands, this runoff volume is reduced to just 412 mm which is only 44% of the total column. As a result, it can be concluded that the proposed range of stormwater management measures sufficiently provide the level of attenuation required to satisfy the guideline.

   This water balance analysis has included the external lands to maintain consistency with the overall stormwater management plan; however, as the Wet Weather Flow document states that the guidelines should apply to the site in question, exclusion of the external lands is appropriate.

3. *In all cases, the minimum on-site runoff retention requires the proponent to retain all runoff from a small design rainfall event – typically 5 mm (In Toronto, storms with 24 hour volumes of 5 mm or less contribute about 50% of the total average annual rainfall volume) through infiltration, evapotranspiration & rainwater reuse.*

   Figure 4-4 demonstrates an increase in the amount of retained runoff from the pre-development condition of 229 mm to approximately 487 mm, which is equivalent to all storms up to and including the 5.4 mm event. Additionally, as noted above, exclusion of the external areas increases the volume of stormwater that is retained over the East Bayfront area to 528 mm, which is equivalent to the retention of all storms up to and including the 6.3 mm event. As a result, this objective of the guideline has been satisfied.

4.9 Strategy Summary

The stormwater management strategy for East Bayfront proposes a range of mechanisms that span the on-site, conveyance, and end-of-pipe categories. In summary, the strategy proposes the following:

- Implementation of on-site measures to the extent feasible, consistent with both the City of Toronto's Wet Weather Flow Management Guidelines and LEED credit requirements. Recommended measures include green roofs and rainwater harvesting for landscape irrigation and water closets. Infiltration measures are not specifically recommended due to the prevailing soil and groundwater conditions.
- The implementation of the range of sustainable on site measures yields a net reduction in runoff generated by the subject lands.
- Runoff coefficients to be refined to reflect implementation of on-site measures; based on the removal of 15mm of runoff (per rainfall event) for lands south of Queens Quay, and, in accordance with Wet Weather Flow criteria, 5mm for lands north of Queens Quay.
- Conveyance measures in the form of oil/grit separation devices to be distributed along the storm sewer network.
- End-of-pipe facility to achieve minimum 80% removal of total suspended solids (in combination with on-site and conveyance measures), and improve water clarity for effective UV treatment of E.coli. The end-of-pipe facility is described further in **Section 5**.
- A strategy for the first phase (Dockside) has also been defined to ensure suitable treatment of runoff on an interim basis, in anticipation of the ultimate stormwater management strategy.

5 Stormwater Management Facility

This section of the report has been updated since the December 2007 FSR to describe the various investigations undertaken to establish the preferred end-of-pipe facility configuration. The information and materials presented in the previous report have also been retained to comprehensively record the process leading to the preferred configuration. The concept put forward in this document is intended to guide subsequent stages of design, through which evaluation of facility details and agency feedback will yield further refinements.

The end-of-pipe component of the stormwater management strategy represents the final phase of passive runoff treatment prior to discharge to Lake Ontario, and in concert with the on-site and conveyance controls described above, must reduce the suspended solids by a minimum of 80% to satisfy “enhanced” water quality criteria as defined by the Ministry of Environment. A suitable reduction in suspended solid content is also needed to ensure sufficient runoff clarity to allow for the effective UV treatment of E.coli.

The proximity of the East Bayfront lands to Lake Ontario presents a unique opportunity to utilize stormwater as a resource and an amenity to the new community; enclosure of a portion of the lake nearby or adjacent to the development area effectively yields a stormwater management “pond”, with the lake elevation providing an average dredged depth of between 7 and 8 metres to act as the permanent pool. The required size of the facility is based on the tributary drainage area, the corresponding runoff coefficient, the depth of fluctuation available above the normal operating water level, and protection for maximum levels expected within the lake.

The stormwater management strategy has thus included an investigation of the feasibility of a facility within Lake Ontario. The technical requirements and functional objectives of the facility were first determined, in an effort to guide the formulation and comparison of alternatives, as detailed in the following subsections.

Three alternative configurations were originally identified and reviewed as part of the December 2007 FSR, as described in **Section 5.4**. Subsequently, feedback from the City, Waterfront Toronto, and the public realm consulting team, along with continued design efforts, have yielded the preferred facility configuration described in **Section 5.4.5**.

5.1 Technical Requirements

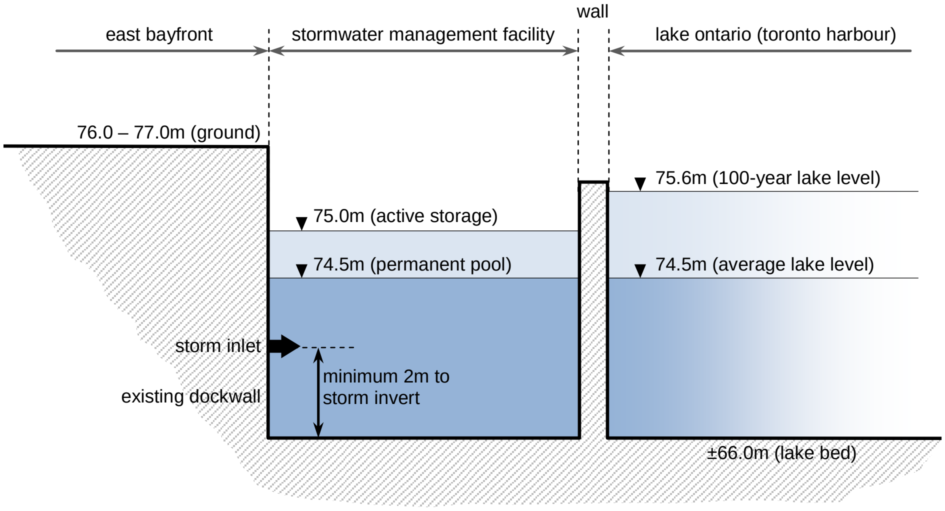
As part of the initial consultations, a facility footprint of approximately one hectare, along with other facility characteristics, was presented based on preliminary investigative efforts. Further study of the anticipated imperviousness of the tributary drainage area was conducted, corresponding to the runoff coefficient reductions associated with on-site measures (**Section 4.3**), resulting in a refinement of the facility requirements.

Several approaches are available to establish the operational characteristics of the facility, which vary depending on a choice of fundamental assumptions. As presented in the following subsections, a review of each approach has been conducted to identify the most appropriate sizing methodology. **Table 5-2** provides a summary of this assessment.

5.1.1 General Operational Specifications

Figure 5-1 provides a cross-sectional illustration of the envisioned facility concept, generally applicable to all of the facility configurations that were considered. The illustration identifies the existing normal and 100-year high water levels in Lake Ontario relative to the average lake bed elevation. **Table 5-1** summarizes this information, which was documented in the February 2005 *Municipal Services Planning Objectives and Evaluation of Infrastructure Plans*, prepared by Lea Consulting. The normal water level for Lake Ontario, listed as 74.5 metres in **Table 5-1**, corresponds closely to the all-time average of 74.75 metres, as cited by the Canadian Hydrographic Service (*http://www.waterlevels.gc.ca/C&A/network_means.html*), based on data spanning the period from 1918 to 2006.

Figure 5-1: Schematic Pond Cross Section



Note: dimensions/elevations are conceptual, preliminary, and not to scale

Table 5-1: Ground and Lake Levels

Approximate Existing East Bayfront Ground Levels	76.00 – 77.00m
Lake Ontario Historical High Flood Level	75.81m
100-Year Flood Level Assumed for Design	75.60m
25-Year Flood Level	75.40m
2-Year Flood Level	75.00m
Average Lake Level	74.50m

The elevation and state of the existing East Bayfront dock wall was investigated through the *East Bayfront Dock Wall Condition Assessment*, dated October 5, 2007, by Baird and Associates, yielding an elevation range of 76.27 to 76.97 metres. A dock wall elevation of 77.00 metres has been assumed for conceptual design purposes. Actual datum information will be used in the final design.

The average dredged depth to the lake bed throughout the Toronto Harbour is 8.2 metres as specified on the Toronto Harbour Nautical Chart published by the Canadian Hydrographic Service. During the construction of an in-lake facility, dredging in the proposed facility area will be required to account for the accumulation of sediment on the lake bed, and to maximize the available depth (and permanent pool) within the facility.

Based on these relative values, the proposed facility will have a normal water level of 74.5 metres, consistent with the average level within the lake, and yielding a permanent pool with a depth of 7 to 8 metres, depending on the thickness of foundation required. The perimeter of the facility should respect the 100-year lake level of 75.6 metres, and consider uniformity with the existing dock wall elevation of 76.0-77.0 metres. As the purpose of the facility is to accept and attenuate runoff from the community, a maximum fluctuation within the pond of 0.5 metres has also been specified, corresponding to the 2-year level in the lake, which allows for a reasonable ‘active’ volume and ensures sufficient freeboard to prevent undue overtopping. The elevation of the storm sewer inlet to the facility should be set at least 1.5 to 2.0 metres above the lake bed to account for sediment accumulation over time. As the inlet invert also impacts the upstream storm sewer network, further discussion regarding the established invert is provided in **Section 7**.

All of the above-stated elevations will be verified through the detailed design process.

5.1.2 Volume Sizing

The following subsections describe the various approaches to establishing the facility volumes that would be required to satisfy the prescribed targets.

First Flush Approach

The first flush theorem suggests that the majority of surface contaminants and debris are carried by an initial volume of rain, historically characterized as a 13mm event, and more recently established as a 25mm event.

As such, the initial evaluation of facility size was defined on the basis of the total volume of water generated by a 25mm storm event, previously considered in conjunction with an imperviousness of 90%. A refinement of this approach, that considers the adjusted runoff coefficient of 0.75 (**Section 4.4**), yields a total volume requirement of approximately 4200 m^3 for the 22.31-hectare drainage area. Based on a maximum 0.5-metre fluctuation in the depth above the normal pond water level (i.e. lake level), a facility surface area requirement of about 8500 m^2, or 0.85 hectares, has been established. While this approach does not account for the presence of the permanent pool or the routing of flows that pass through the facility, it does ensure that all contaminants and particulate matter not managed by the on-site and conveyance measures will be captured within the centralized facility.

Permanent Pool Approach

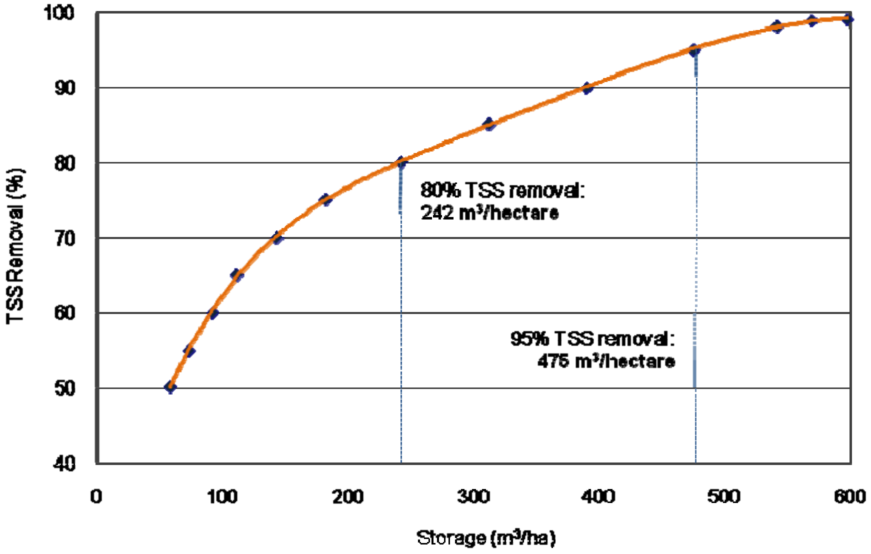
As documented within the MOE Stormwater Management Planning and Design Manual, a permanent body of water (or “permanent pool”) within a facility effectively reduces the suspended solid content of runoff that is routed through the facility. Sizing guidelines for the permanent pool are provided in the MOE manual (Table 3.2), which predominantly account for the upstream drainage area and imperviousness.

In accordance with the manual, and based on empirical evidence, an 80% reduction in total suspended solid content is the highest level of performance that is, typically, economically feasible. On this basis, and considering that the average lake depth in the vicinity of East Bayfront is 8.2 metres, it is possible to define a suitable permanent pool volume and corresponding footprint. As described in the preceding section, the majority of surface contaminants are conveyed downstream during a “first flush” event, historically characterized as either a 13mm or 25mm event. As a result, for the purpose of sizing the permanent pool, the imperviousness corresponding to the 2-year event, or 78% (±80%), has been used.

With a drainage area of 22.31 hectares, and a rounded imperviousness of 80%, Table 3.2 of the MOE manual suggests a water quality treatment volume based on 242m^3/hectare. Of this value, 40m^3/hectare is defined as “active storage”, meaning the storage component that fluctuates above the permanent pool water level following rainfall events. As such, the required permanent pool volume is about 4500m^3, with an additional active storage component of about 900m^3.

In addition to water quality treatment, the facility is also intended to generate water of sufficient clarity for effective UV disinfection. As such, extrapolation of the permanent pool requirements listed in the MOE manual provides a range of unit volumes corresponding to higher degrees of total suspended solids removal, in an effort to establish a minimum conservative volume based on the permanent pool methodology. The following graph depicts the relationship between percentage suspended solids removal and water quality treatment volume. The asymptotic nature of the curve suggests that achieving 100% total suspended solids removal would be very challenging.

Figure 5-2: Water Quality Treatment Volume (80% Imperviousness)



On a conservative basis, achieving 95% total suspended solids removal would require a unit water quality treatment volume of 475m^3/hectare. This yields a total permanent pool requirement of 9700m^3, with a corresponding active storage component of 900m^3.

Hydraulic Routing Approach

While recognizing the empirical value of the “first-flush” and “permanent pool” approaches, a third approach was explored that considered hydraulic routing through the facility within the context of the frequency and intensity of typical rainfall events. To this end, precipitation data was acquired to create a model that could simulate the operation of the facility over a historical period of record. An overview of the model is provided in **Section 5.2**, within the context of defining a suitable facility outflow rate. The approach utilized the active volume established by the “first flush” approach to define the required capacity of the receiving UV disinfection mechanism. In summary, the simulation yielded an optimum facility outflow rate of 67 L/s, which forms the basis for the design of UV equipment, and satisfies the maximum 1 overflow per 2-year performance target. Further discussion of the UV system is provided in **Section 5.8**.

E.coli Die-Off and Natural Ultraviolet Disinfection

The December 2007 FSR explored the potential for natural die-off of E.coli as an alternative to mechanical UV disinfection. However, and as noted in comments from the City on the earlier report, the anticipated E.coli levels within stormwater runoff, and the expected die-off rates that could be realized through attenuation, require further study. As such, while this report retains the earlier discussion and analyses with regards to natural E.coli die-off, it is acknowledged that significantly higher incoming E.coli levels and lower die-off rates should be explored in any future exercises of a similar nature. Furthermore, monitoring of the constructed end-of-pipe facility is recommended to supplement existing data with regards to the E.coli content of input stormwater and die-off rates.

The December 2007 FSR had performed calculations premised on the assumption that E.coli has a die-off rate of 80-90% over a period of 24-48 hours. Similarly, the earlier report assumed E.coli concentrations within the runoff from East Bayfront in the order of 10,000 to 20,000 counts per 100ml. On this basis, it was expected that the deliberate exposure of detained runoff to sunlight over a 3 day period could naturally reduce the E.coli concentration to less than 100 counts per 100ml, thus satisfying the treatment target described in **Section 1**.

This theory implies that natural die-off of E.coli could eliminate the need for mechanical UV disinfection. However, uncertainty associated with the underlying assumptions necessitates a facility design that includes the mechanical UV disinfection component. Should monitoring of the facility reveal, in time, that the E.coli concentrations are being adequately reduced prior to

UV treatment, utilization of the UV equipment solely for the treatment of lake water could be considered.

On the basis of the above-noted assumptions, and within the context of the die-off premise, a variation on the approach described in the preceding section was undertaken to identify the facility size required to achieve the treatment targets. A spreadsheet model was prepared to simulate the flow of runoff into the facility over the period of historic record, along with the subsequent detention of captured runoff for a minimum of 3 days before release into Lake Ontario. As with the hydraulic routing approach, the performance objective was set to a maximum of one facility overflow per year. Several different simulations were conducted to explore variations on the assumptions associated with the dispersion of E.coli-laden runoff as it entered the facility. Further detail of this evaluation is provided in **Appendix 1c**.

The simulations concluded that a permanent pool volume of about 39,000 m^3 would allow for the natural reduction of E.coli concentrations to the desired 100 counts per 100ml, while also limiting overflows to one per year. Should natural UV disinfection be explored in future projects, in the absence of data confirming the assumptions described above, the analyses should consider more conservative assumptions with respect to expected E.coli concentrations and die-off rates. Nevertheless, efforts to maximize the effectiveness of passive treatment mechanisms, such as exposure of detained stormwater to sunlight, should be considered for consistency with the tenets of sustainability, and to minimize operations and maintenance requirements.

Volume Requirement Summary

The following table compares the volume requirements and key features of the approaches described in the preceding sections.

Table 5-2: Summary of Approaches to Establish Facility Requirements

Approach	Required Permanent Pool Volume (m^3)	Required Active Volume (m^3)	Comments
First Flush	--	4200	Along with upstream measures, ensures capture of all contaminants within facility.
Permanent Pool 80% TSS Reduction	4500	900	Outflows potentially would not achieve clarity required for UV treatment.
Permanent Pool 95% TSS Reduction	9700	900	Outflows expected to achieve required clarity for effective UV treatment.
Hydraulic Routing	--	4200	Simulated approach established outflow rate of 67 L/s for a maximum of one facility overflow every two years.
E.coli Die-Off and Natural UV Disinfection	39000	--	Natural E.coli die-off premise needs to be verified through local monitoring.

The evaluation has revealed that the recommended facility configuration should include a minimum permanent pool volume of 9700 m^3, consistent with that required to achieve the 95% suspended solid reduction, along with an active storage component of 4200 m^3 that satisfies the treatment objectives for all of the above approaches.

These volumetric requirements, with the maximum active storage fluctuation of 0.5 metres, confirms the applicability of a facility footprint of 8500 m^2 (0.85 hectares), driven by the active storage requirement. Considering the depth of the permanent pool of 8.2 metres, and the facility footprint of 8500 m^2, the available permanent pool within the proposed East Bayfront facility is approximately 70,000 m^3; this is more than seven times the volume required to achieve 95% suspended solids removal. This suggests that the facility will provide treatment for quality, sediment, and E.coli to the maximum extent possible, both with and, potentially, without mechanical UV disinfection.

From a sustainability perspective, the possible reduction in the level of mechanical UV disinfection required, along with the optional treatment of lake water for amenity uses, as described in the last approach, represents a significant and desirable benefit to the community.

5.2 Facility Outflow

As established in the previous section, an active (fluctuating) volume of 4200 m^3, along with a permanent pool largely governed by lake depth, provide an opportunity for settling of suspended solids. The effectiveness of this volume in providing the required level of water quality and clarity is also dependent on the rate at which flow is discharged from the facility and conveyed to the UV disinfection system. Identification of the outflow rate must consider two primary factors: (i) the frequency of facility overflows, and (ii) the time over which captured runoff is retained prior to discharge.

First, a suitable frequency at which the facility volume will be exceeded, resulting in direct discharge of runoff to the lake, needs to be identified. Facility overflows will impact the quality of water in the harbour. In the future, once the prevailing water quality in the lake is suitable for contact (i.e. swimming), these overflows will result in short term beach closures. In order to minimize beach closures during the swimming season, an overflow frequency equivalent to once every two years, or 0.5 overflows per year, has been deemed an appropriate target.

The objective of improving water clarity is necessary to ensure effective UV treatment. Suspended particles absorb and scatter light, yielding murky water. As a result, removal of particles allows for better UV penetration, and hence disinfection. Furthermore, reducing particle size eliminates ‘bacterial shielding’, whereby large particles suspended in the water prevent the UV light from irradiating the bacteria that lie in their shadow. The effectiveness of the facility in removing particles is related to the length of time over which runoff is stored prior to discharge. In accordance with the MOE SWMPD manual, and preliminary review of particle size distributions and the length of time required for settlement, a minimum detention time of 24 hours would yield the clarity of water necessary for effective UV treatment.

To establish an outflow rate that achieves the overflow frequency of once every two years and the minimum detention time of 24 hours, a continuous simulation of the facility’s operation was undertaken using daily rainfall data from Toronto Island Airport, for the period of 1940 to 2003. Given the extensive period of record, and the resulting 23,000 lines of data, details of the spreadsheet model have not been included in this report, but can be provided upon request.

The model simulated input to the facility based on the runoff generated by the daily rainfall data; the outflow rate from the facility was determined iteratively to achieve the overflow frequency and detention time targets. The simulation yielded an optimum facility outflow rate of 67 L/s, corresponding to about 0.47 overflows per year (on average).

The established outflow rate of 67 L/s provides the basis for the sizing of UV equipment and related pump and pipe infrastructure, described in **Section 5.8**.

5.3 Functional Objectives

The preferred facility configuration should have consideration for the following objectives:

a. *Regulatory Framework*: Preliminary liaison with some approval agency representatives has yielded general acceptance and enthusiasm with regards to the “pond in lake” concept. However, formal acceptance and approval is required for the stormwater management facility to be realized, with the extent of liaison and the specific types of approvals to be established as the development process progresses. The proposed facility must satisfy the requirements of the applicable agencies, which include the Toronto Port Authority, Transport Canada (Navigable Waters Act), the Department of Fisheries and Oceans (Fisheries Act), the Ministry of Environment, the Ministry of Natural Resources, the City of Toronto, and the Toronto and Region Conservation Authority.

b. *Community Amenity and Public Realm*: Within the context of Waterfront Toronto’s Sustainability Framework, opportunities to utilize the facility as an amenity to the community should be explored and implemented. Similarly, maintaining the visibility of the facility is desirable for public education purposes and to demonstrate the degree of innovation advocated and inherent in the development of the East Bayfront lands. In addition, as public realm principles are intrinsic to the design of the overall community, these principles should be reflected in the design of a facility that also serves as a community feature and amenity.

c. *Natural UV Treatment*: Maintaining the visibility of the facility also allows for the exposure of collected stormwater runoff to sunlight, a natural source of UV disinfection, which will potentially yield a system that can satisfy all the treatment objectives without mechanical means.

d. *Combined Sewer Overflows*: Several CSO (combined-sewer-overflow) outlets presently traverse the East Bayfront lands to discharge into Lake Ontario. Should the preferred facility configuration interfere with these outlets, additional design and approval effort will be required.

e. *Aquatic Habitat Compensation*: The enclosure of a portion of lake-bed within the proposed facility footprint represents a reduction in aquatic habitat. As such, and per Department of Fisheries and Oceans' (DFO) requirements, compensation is required for this reduction. The optimum facility configuration should include compensatory elements where possible, and/or recognize that off-site compensation will also be required. Opportunities exist to introduce relatively innocuous measures along the outer face of the proposed facility that will improve aquatic habitat. In addition, the provision of clean water to the lake arguably represents a significant gain with respect to aquatic habitat quality.

f. *Harbour Navigability*: The Toronto Harbour is presently utilized for marine traffic, and as such the proposed facility should not interfere with known navigation routes. **Figure 5-3** illustrates the navigation routes associated with vehicles servicing the Redpath Sugar facility immediately west of the Jarvis Slip.

Figure 5-3: Redpath Shipping Routes

Source: WEST 8 + DTAH

g. *Stormwater Aesthetics*: Initial discussions with agency representatives yielded a potential concern that the accumulation of debris and contaminants within a surface facility may adversely affect the aesthetic quality of the facility, both visually and in terms of odour. Algal growth is similarly undesirable. The conveyance measures proposed as part of the overall stormwater management plan for East Bayfront include water quality treatment devices to reduce the transport of debris and contaminants into the facility. As an added measure, water withdrawn from the facility for UV disinfection should be collected near the surface; bacteria and algae are largely photo-reactive, and hence collection close to the surface will reduce the quantity of these malodorous entities.

In addition, concern has also been expressed with respect to the influence of salt accumulation and stratification within the facility on anaerobic processes and resulting odour. The facility must endeavour to minimize the potential for salt accumulation and stratification, through either source control measures which are largely influenced by current City practices or via other mechanisms to be incorporated into the facility design.

While the concerns may be addressed technically as described above, apparent public perception regarding the aesthetic appeal of stormwater management facilities may require that the facility include additional mitigative measures. Some of these measures could include the concealment of a portion of the facility, as well as agitative mechanisms to prevent stagnancy.

h. *Technical Feasibility*: The facility must be technically feasible with respect to the following:

  - As described in **Section 5.1**, a surface area of 0.85 hectares, with an available fluctuation in depth of approximately 0.5 metres, is needed to achieve the treatment targets.
  - In accordance with MOE provisions, the shape of the facility is also integral to its performance; a 3:1 length-to-width ratio is recommended as a minimum in order to maximize the flow path and optimize the opportunity for particle settlement.
  - The provision of a facility inlet location and elevation that is achievable with respect to the proposed grading and servicing configurations for East Bayfront, and consistent with the interim stormwater servicing anticipated for the Phase 1 lands, as described in **Section 7**.
  - Suitable connectivity with UV disinfection equipment and housing, currently proposed for placement in Sherbourne Park for ease of maintenance and access to treated stormwater for amenity uses. All of the options will require pumping and piping of facility outflows to the UV disinfection equipment.
  - The facility must include provisions to accommodate periodic maintenance activities, most notably associated with the removal of accumulated sediment.

i. *Cost*: The facility must be economically feasible and sustainable. An evaluation of the costs associated with each alternative considered in this report is provided in **Section 5.5**. It is important to note that the estimates presented within this report are for comparative purposes only, and are not intended to provide an indication of the actual costs of facility construction. More detailed and accurate cost evaluations will be undertaken in conjunction with detailed design of the facility.

5.4 Technical Evaluation of Options

Three facility configurations were identified and evaluated in the December 2007 FSR, as described in the following sections and illustrated in **Figure 5-4**, **Figure 5-5**, and **Figure 5-6**. The original tank concept, selected as the preferred alternative through the January 2006 Environmental Assessment, was also assessed for comparison purposes (Option D). As noted previously, significant liaison and preliminary design effort has occurred since submission of the December 2007 FSR, yielding a preferred facility configuration that varies from the three options initially considered. The evaluation of the original three options revealed challenges and opportunities instrumental in the formulation of the preferred configuration, which is presented as Option E in the following subsections, and illustrated in **Figure 5-7**. This section summarizes the deliberations and evaluations leading to selection of the preferred alternative.

The cost component of the evaluations has also been updated, as presented in **Section 5.5**. A detailed summary of the evaluation of all options has been provided in **Table 5-3** (**Section 5.6**).

5.4.1 Option A

Figure 5-4 illustrates the Option A configuration. This concept considers integration of the facility with the proposed boardwalk component of the lakefront promenade that will extend over the water. Specifically, the facility would be positioned underneath the boardwalk along the length of the East Bayfront dock wall. In order to satisfy the volumetric requirement, the boardwalk would need to be widened from the currently envisioned 8 metres, which was established as part of the public realm design for the central waterfront, to 13 metres.

Coordination with the storm servicing plan requires that the pond inlet be located centrally rather than at the end of the facility, to be achieved through the installation of a baffle wall that splits the forebay of the facility lengthwise and extends the flow path. A pipe and pump are required for connectivity with the UV disinfection facility.

The containment structure along the boardwalk would consist of caissons and sheet piling around the outside, with a rehabilitated dockwall forming the inner face. The existing dockwall has been noted to require substantial repair and rehabilitation; however, where the proposed containment structure abuts the dockwall, such extensive rehabilitation would not be required. From a structural perspective, the outer wall of the containment structure could also double as the support for the proposed boardwalk adjacent to the promenade.

The option effectively conceals the facility from the community, thus potentially satisfying the concerns associated with the aesthetic qualities of stormwater. However, this also negates the possibility of utilizing the natural UV disinfection expected to occur through exposure to sunlight. While the long linear shape crosses two CSO discharge locations, intrusion into the harbour is minimized.

Technically, the minimum recommended length-to-width ratio is greatly exceeded, which suggests that this configuration would be very effective in the settling of suspended particles.

5.4.2 Option B

This concept separates the end-of-pipe treatment into two distinct components: a “forebay” consisting of a single cell integrated with the proposed boardwalk (similar to Option A), and an off-shore cell that provides the secondary treatment and forms part of an in-lake aesthetic feature, such as a maple leaf or other geometric shape. Semi-treated stormwater from the first cell will be conveyed to the second cell by a pipe within the lake. A second pipe and pump is needed to convey treated stormwater from the off-shore cell to the on-shore UV disinfection facility.

The distance between the first and second cells has not been established; however, for the purposes of this exercise, a distance of 100 metres has been assumed. Further investigation would be required to establish the location and configuration of the off-shore cell to avoid impact to existing navigational routes within the harbour. **Figure 5-5** illustrates the Option B concept.

The structure of the forebay section would be similar to that of Option A, i.e. a containment structure along the boardwalk consisting of caissons and sheet piling around the outside, with a rehabilitated dockwall forming the inner face. As with Option A, where the proposed containment structure abuts the dockwall, such extensive rehabilitation of the dockwall would not be required. Similarly, the outer wall of the containment structure can also double as the support for the proposed boardwalk adjacent to the promenade. Where no containment structure is present, dockwall rehabilitation and boardwalk support would be required.

Although the first cell is concealed by the boardwalk, the second cell would be very visible and, if implemented, will likely become a significant feature of the waterfront. Through its exposure, the benefit of natural UV disinfection would also be realized. The siting of the second cell also yields a potential opportunity to treat lake water between storm events, which could be considered as a significant contribution to aquatic habitat quality.

With respect to technical feasibility, the conveyance of flow to and from the off-shore cell presents potential challenges. In addition, the distance from the community limits the available maintenance techniques.

5.4.3 Option C

The Option C concept, shown in **Figure 5-6**, provides for a tri-celled rectangular facility approximately 300 metres long and 28.5 metres wide, positioned along the eastern half of the East Bayfront dock wall. Flows enter the facility at the westernmost cell, with subsequent cells further clarifying runoff prior to discharge via an outlet pipe at the facility’s east limit to the UV treatment system.

The construction of the containment structure is expected to be similar to that described for Options A and B, and hence the section of the facility abutting the dockwall may negate the need for extensive dockwall repairs and boardwalk structural support.

This configuration avoids the existing CSO outlets, and may integrate in part with the proposed boardwalk. Given its connectivity and visibility to the East Bayfront community, further coordination with community designers would be required to ensure the consistency of the feature with the vision for East Bayfront. As the facility is largely exposed, the potential for natural UV disinfection is maintained. The first cell of the facility could be covered with decking to address aesthetic concerns. A pipe and pump are required for connectivity with the UV disinfection facility.

5.4.4 Option D

Option D represents the tank option described and recommended through the Class Environmental Assessment Master Plan (**Section 4.1**), with the sizing re-evaluated to reflect the findings and objectives stated throughout this report. **Appendix 1c** outlines the sizing methodology. In summary, the tank option requires a storage volume of approximately 12,000 m^3, to be provided by a containment structure or series of structures having total dimensions of 40m wide by 150m long, and 3.5m deep. Structural support for the tanks would be provided by either piles or a concrete slab.

Runoff from the community would be conveyed to the tank(s) for storage in an effort to settle out sediments. The tanks would then discharge to the UV facility once the attenuated volume was of sufficient clarity.

In this scenario, and primarily as input to the cost evaluation in **Section 5.5**, it is important to note that a full rehabilitation of the dockwall and provision of a support structure for the boardwalk would be necessary along the entire length of the East Bayfront lands.

5.4.5 Option E

Option E, illustrated in **Figure 5-7**, is a variation of Option A that proposes a narrower (9.5m) concrete containment structure along the length of, and integrated with, the boardwalk, extending into a wetland feature at the head of Parliament Slip. The wetland incorporates an open element to make the stormwater treatment system publically visible, and to maintain the potential for natural UV disinfection through exposure to sunlight. From the wetland, clarified stormwater will be conveyed to the UV disinfection facility proposed within Sherbourne Park.

Along the water’s edge, and varying from Option A, the containment structure is to be comprised of a series of concrete cells, which together form a long linear settling tank. These cells also provide the structural support for the proposed boardwalk, and negate the need for the previously noted dockwall repairs. The overall facility provides the required footprint of 0.85 ha, and accommodates the active fluctuation depth of 0.5 metres. To avoid the existing CSOs, these will be by-passed through incorporation of piped segments that connect the facility’s upstream and downstream concrete cells.

Runoff from the community will enter the facility in two locations, roughly east and west of Sherbourne Park. As in Option A, a mid-span baffle wall will be introduced to direct flows first west and then east to maximize the flow length over which sediments and suspended solids will have an opportunity to settle.

Figure 5-4: Stormwater Management Facility Concept - Option A

Figure 5-5: Stormwater Management Facility Concept - Option B

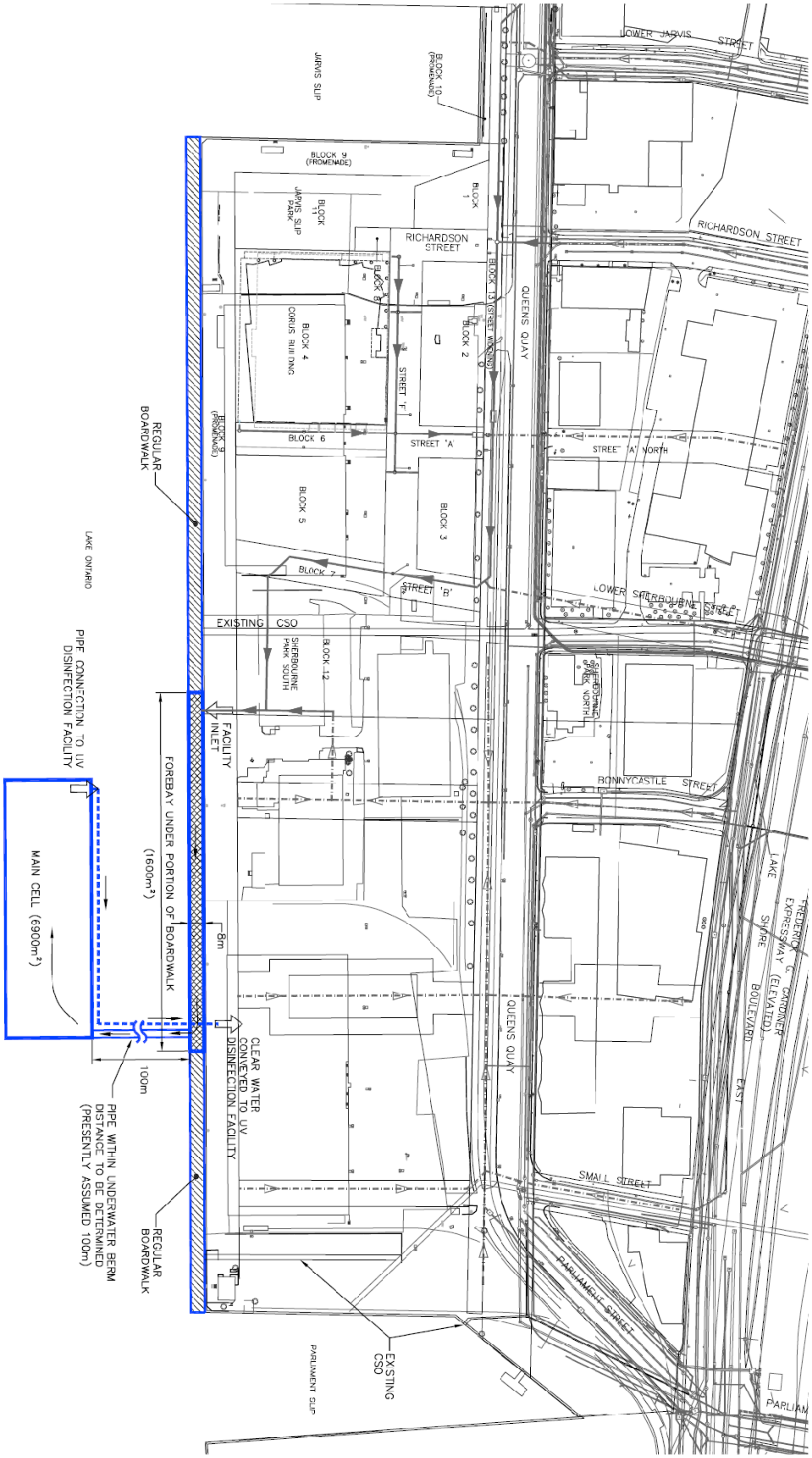


Figure 5-6: Stormwater Management Facility Concept - Option C

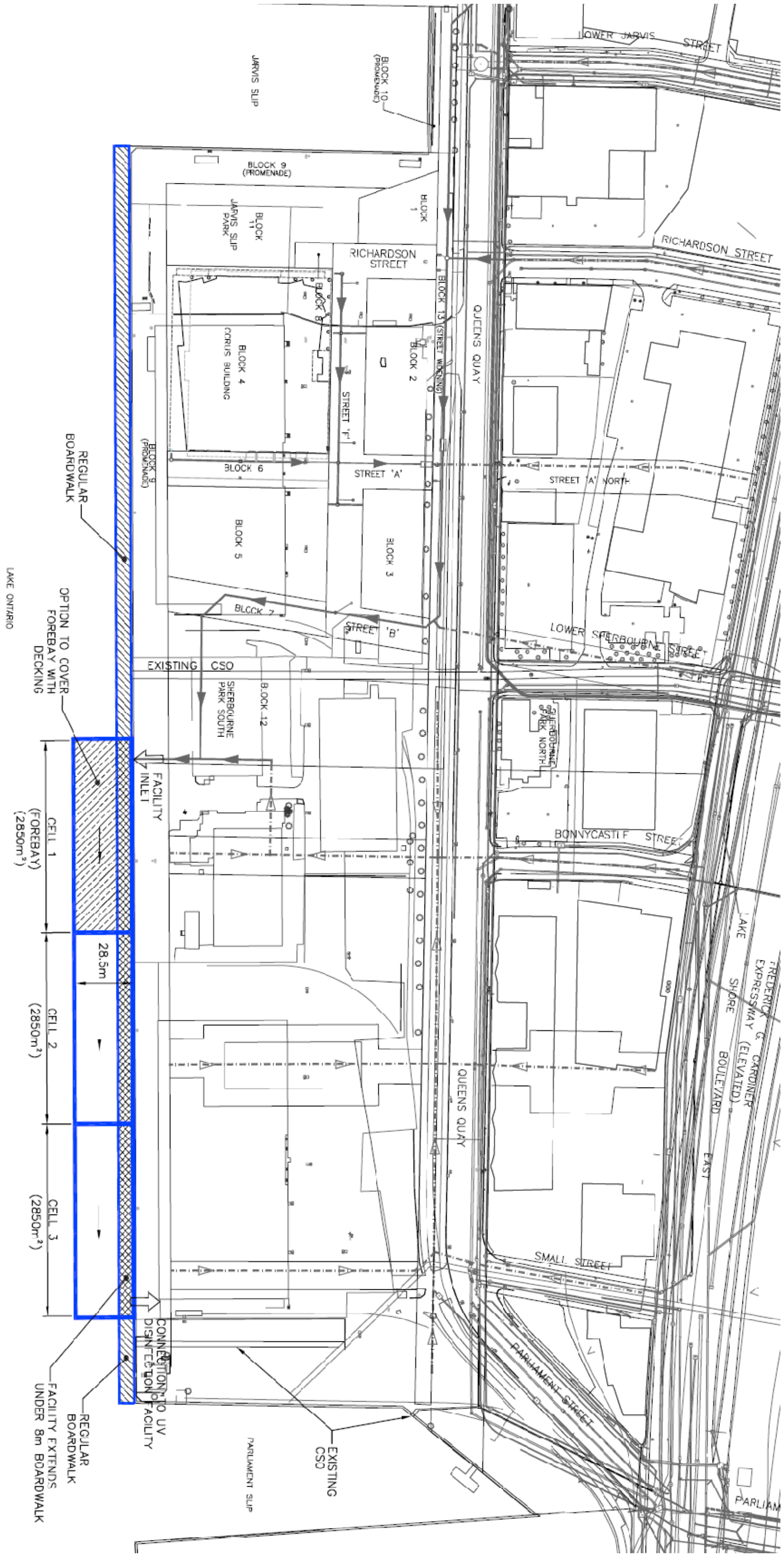
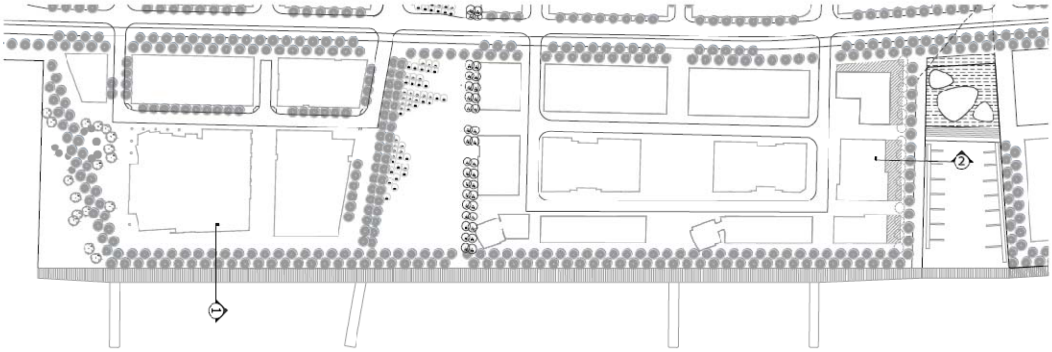
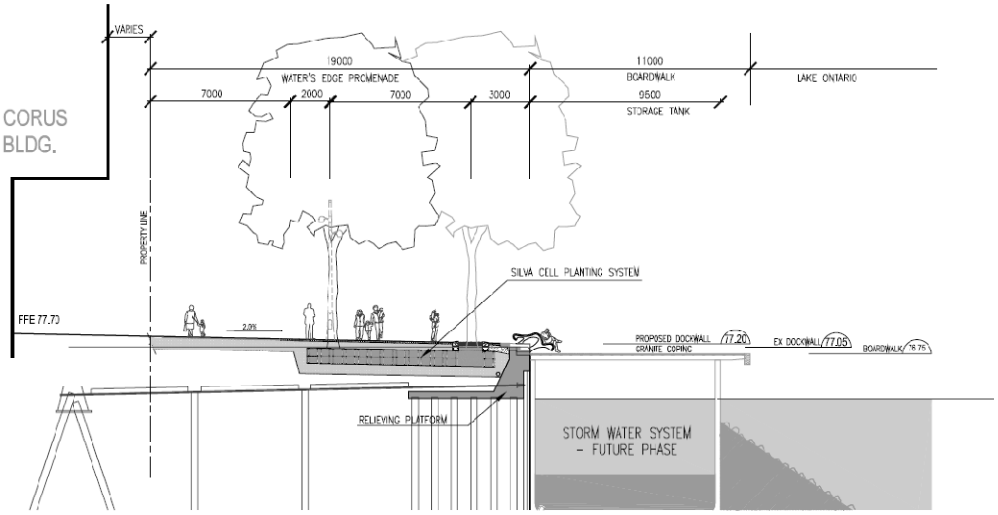


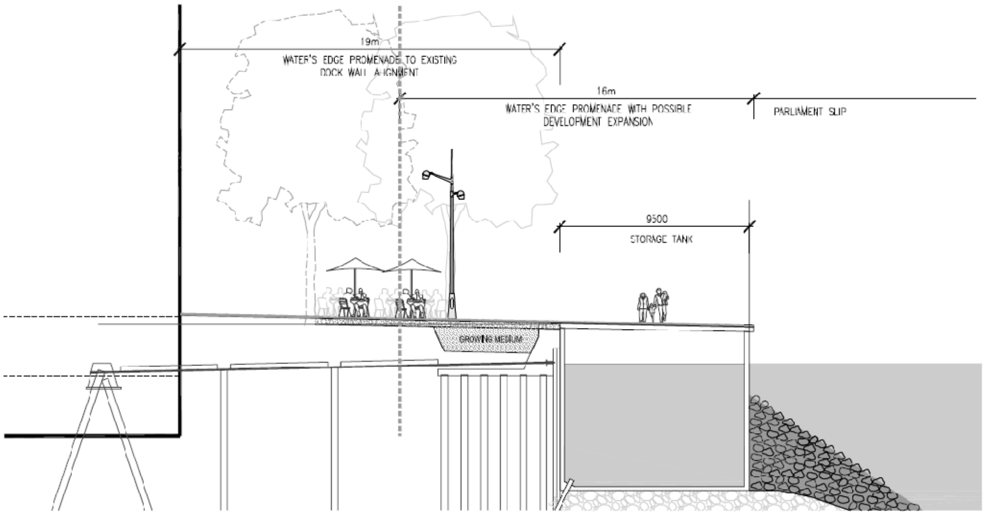
Figure 5-7: Stormwater Management Facility Concept - Option E



WATER'S EDGE PROMENADE - EAST BAYFRONT. PLAN
scale 1:3000



SECTION 1. WATER'S EDGE PROMENADE TYPICAL SECTION
scale 1:150



SECTION 2. WATER'S EDGE PROMENADE AT PARLIAMENT SLIP
scale 1:150

prepared by West 8 + DTAH

5.5 Cost Evaluation of Options

As already noted, and as further detailed in **Section 5.5**, ongoing effort following the initial submission of the FSR in December 2007 has established a preferred option (Option E) for the proposed stormwater management end-of-pipe facility for East Bayfront. The previous version of the report identified four different SWM alternatives and compiled corresponding cost estimates to aid in assessing the best option. That investigation identified Option C as being the most cost effective. With the scenario that is now preferred, a new costing assessment has been undertaken along with a revisiting of the previous estimates to ensure that similar items are comparable.

The configuration of the preferred option, Option E, yields a major advantage in that the concrete box sections will replace the function of a rehabilitated dockwall, thereby eliminating a significant cost. Similarly, the concrete box sections will also double as the supporting structure for the proposed boardwalk. However, the December 2007 FSR estimates did not consider the costs associated with dockwall rehabilitation or boardwalk structural support.

As a result, the cost estimates for the original options have been adjusted to account for these items such that a more accurate comparison can be made and to demonstrate the savings realized by implementing the concrete sections that perform more than just a stormwater containment role. It should be noted that landscaping and fisheries compensation costs have been removed from the options as these are considered to be outside of the scope of the SWM facility estimating exercise, and would generally be equivalent expenditures for each of the scenarios. It is important to note that the estimates presented within this report are for comparative purposes only, and are not intended to provide an indication of the actual costs of facility construction. More detailed and accurate cost evaluations will be undertaken in conjunction with detailed design of the facility.

The adjusted cost estimates for Options A through D are shown below, with a more detailed breakdown provided in **Appendix 1d**. As can be seen, while not new items, the costs of rehabilitating the dockwall and providing support to the boardwalk are significant, and are required to be identified.

- Adjusted Option A - $42,000,000
- Adjusted Option B - $52,000,000
- Adjusted Option C - $49,000,000
- Adjusted Option D - $60,000,000

The costs associated with Option E have been estimated in the same manner as the originally anticipated scenarios with the full extents of the proposed SWM facility taken into account. This includes the extension of the system into Parliament Slip, which represents a considerable increase in infrastructure over that previously contemplated and an additional cost to be included. As shown in more detail in **Appendix 1d**, the estimated cost of the preferred option is as follows:

- Option E - $42,000,000

Therefore, even with an increase in infrastructure, the offsetting of dockwall replacement and boardwalk support costs is substantial enough to produce a lower or equal expense when the whole system is considered. It should be noted that the costs of the concrete box sections have been assumed based upon earlier estimates from Rider Levett Bucknall and are subject to refinement as part of the preliminary and detailed design processes. Additionally, the Option E configuration yields an opportunity to better utilize development parcels along the west side of Parliament Slip, due to the extension of the boardwalk and promenade that overlay the concrete box sections in this area. The positive financial implications of this improved land utility have also not been incorporated into this estimating effort.

5.6 Option Evaluation Summary and Preferred Alternative

The process leading to selection of the preferred facility alternative occurred through discussions, deliberations, and analyses over the course of a year since submission of the December 2007 FSR. These efforts represent extensive collaboration among members of the project team and Waterfront Toronto, along with feedback received over this period from the City and other review agencies. The exercise has been summarized in tabular format, following a matrix approach similar to that typically undertaken as part of environmental assessments, as shown in **Table 5-3**. Points qualitatively awarded for every item (in brackets) are summed to gauge the relative merits of the options for each category; fewer points represent a better relative ranking.

Table 5-3: Option Evaluation Matrix

Category of Consideration / Evaluation Criteria	**Option A** (13m integrated boardwalk facility)	**Option B** (integrated boardwalk facility forebay + offshore facility)	**Option C** (tri-celled rectangular tank adjacent portion of dockwall)	**Option D** (underground storage tanks)	**Option E** (9.5m integrated boardwalk facility + parliament wetland)
TECHNICAL					
Constructability of proposed infrastructure	Require mid-span baffle wall Structural integrity of boardwalk facility In-water works Extension or bypass of CSO outlet pipes -------- **moderately difficult (2)**	Structural integrity of boardwalk and off-shore elements Extension or bypass of CSO outlet pipes Challenge to connect boardwalk and off-shore elements Challenging in-water works, especially off-shore component -------- **very difficult (5)**	Structural integrity of boardwalk facility In-water works -------- **difficult (1)**	Extensive excavation work and potentially challenging material disposal Structural support for tanks Structural implications to all surrounding infrastructure Dewatering next to lake required and very difficult -------- **very difficult (4)**	Require mid-span baffle wall Structural integrity of boardwalk facility In-water works Extension or bypass of CSO outlet pipes Challenges with wetland construction -------- **moderately difficult (3)**
Overall effectiveness of solids removal	Satisfies established criteria Utilizes full lake depth -------- **effective (1)**	Satisfies established criteria Utilizes full lake depth -------- **effective (1)**	Satisfies established criteria Utilizes full lake depth -------- **effective (1)**	Satisfies established criteria -------- **less effective (5)**	Satisfies established criteria Utilizes full lake depth -------- **effective (1)**
Overall effectiveness of pathogen reduction	Yes, with UV facility No 'natural' UV disinfection (covered system) -------- **effective (3)**	Combination of UV facility and exposure to sunlight -------- **more effective (2)**	Combination of UV facility and exposure to sunlight If open-water area includes wetland elements, more effective for treatment (phyto-remediation) -------- **more effective (2)**	Yes, with UV facility No 'natural' UV disinfection (closed system) Pathogen reduction dependent on effective solids removal -------- **least effective (5)**	Combination of UV facility and exposure to sunlight Wetland component typically more effective for treatment (phyto-remediation) -------- **most effective (1)**

Table 5-3: Option Evaluation Matrix

Category of Consideration / Evaluation Criteria	**Option A** (13m integrated boardwalk facility)	**Option B** (integrated boardwalk facility forebay + offshore facility)	**Option C** (tri-celled rectangular tank adjacent portion of dockwall)	**Option D** (underground storage tanks)	**Option E** (9.5m integrated boardwalk facility + parliament wetland)
Potential requirements for future maintenance	Known UV and associated pump maintenance Clearing of accumulated sediment in boardwalk tank – accessible from land -------- **low frequency** **moderately complex (2)**	Known UV and associated pump maintenance Clearing of accumulated sediment in boardwalk tank – accessible from land Additional maintenance for pump between cells Dredging / clearing of accumulated sediment in off shore facility – requires training / education / equipment -------- **low frequency** **most complex (5)**	Known UV and associated pump maintenance Clearing of accumulated sediment in facility – accessible from land -------- **low frequency** **complex (1)**	Known UV and associated pump maintenance Clearing of accumulated sediment in tanks – accessible from land Increased frequency and park disturbance -------- **high frequency** **moderately complex (4)**	Known UV and associated pump maintenance Dredging / clearing of accumulated sediment in boardwalk tank and wetland – accessible from land -------- **low frequency** **moderately complex (3)**
Potential conflicts with existing municipal and utility services	Conflict with existing CSO outlet pipes -------- **moderate conflict potential (3)**	Potential conflict with existing CSO outlet pipes -------- **low conflict potential (2)**	Potential conflict with existing CSO outlet pipes -------- **low conflict potential (1)**	Requires coordination with other municipal and utility services -------- **high conflict potential (5)**	Conflict with existing CSO outlet pipes -------- **moderate conflict potential (3)**
Potential effects on infrastructure security	Exposure to shipping traffic -------- **moderate potential (3)**	Exposure of boardwalk and offshore component to shipping traffic -------- **very high potential (5)**	Exposure to shipping traffic and public -------- **high potential (4)**	Exposure to public -------- **low potential (1)**	Exposure of boardwalk component to shipping traffic Public access to wetland -------- **moderate potential (2)**

Table 5-3: Option Evaluation Matrix

Category of Consideration / Evaluation Criteria	**Option A** (13m integrated boardwalk facility)	**Option B** (integrated boardwalk facility forebay + offshore facility)	**Option C** (tri-celled rectangular tank adjacent portion of dockwall)	**Option D** (underground storage tanks)	**Option E** (9.5m integrated boardwalk facility + parliament wetland)
Potential effects on overall efficiency of the stormwater management system	Relatively simplistic Lake depth permanent pool improves water quality treatment Long linear flow path increases solids removal efficiency No open-water component -------- **more efficient (2)**	Increased length of pipe conveyance and pumping between boardwalk and off shore element Lake depth permanent pool improves water quality treatment Open-water component potentially increases long term efficiency -------- **moderately efficient (3)**	Relatively simplistic Open-water component potentially increases long term efficiency Lake depth permanent pool improves water quality treatment -------- **more efficient (2)**	No open-water component Minimum required permanent pool -------- **least efficient (5)**	Relatively simplistic Lake depth permanent pool improves water quality treatment Open-water component potentially yields increased long term efficiency Long linear flow path increases solids removal efficiency -------- **most efficient (1)**
Flexibility for future expansion of system	Potential expansion of boardwalk possible but would require reconstruction and alteration of design concept Potential connectivity to similar systems -------- **Flexible (4)**	Potential expansion of boardwalk possible but would require reconstruction and alteration of design concept Potential expansion of off-shore element given modular design and continued compliance with design parameters (e.g. shipping constraints) -------- **more flexible (3)**	Potential expansion possible but would require reconstruction and alteration of design concept -------- **more flexible (2)**	No opportunity to expand tanks without extensive reconstruction -------- **least flexible (5)**	Potential expansion of boardwalk possible but would require reconstruction and alteration of design concept Potential expansion or extension of wetland Potential connectivity to similar systems, especially to wetland from the east -------- **most flexible (1)**

Table 5-3: Option Evaluation Matrix

Category of Consideration / Evaluation Criteria	**Option A** (13m integrated boardwalk facility)	**Option B** (integrated boardwalk facility forebay + offshore facility)	**Option C** (tri-celled rectangular tank adjacent portion of dockwall)	**Option D** (underground storage tanks)	**Option E** (9.5m integrated boardwalk facility + parliament wetland)
Acceptability of design and treatment methodology by review agencies	Conforms to City preference for covered elements Does not satisfy City and AHT preference for open-water elements -------- **Acceptable (2)**	Conforms to City preference for covered elements Conforms to City and AHT preference for open-water elements Potential navigable waters concerns Maintenance access concerns -------- **less acceptable (4)**	Can conform to City preference for covered elements Conforms with City and AHT preference for open-water elements Potential navigable waters concerns Maintenance access concerns -------- **less acceptable (3)**	Conforms to City preference for covered elements Does not satisfy City and AHT preference for open-water elements City has indicated reluctance to accept in-land tanks – strong opposition anticipated for infrastructure within parks -------- **least acceptable (5)**	Conforms to City preference for covered elements Conforms with City and AHT preference for open-water elements -------- **most acceptable (1)**
Construction risks	Challenges associated with in-water works Phasing challenges for boardwalk -------- **moderate risk (1)**	Challenges associated with in-water and off-shore works -------- **very high risk (5)**	Challenges associated with in-water works -------- **moderate risk (1)**	Challenges associated with in-ground works and ongoing coordination with construction of adjacent infrastructure -------- **high risk (4)**	Challenges associated with in-water works Phasing challenges for boardwalk -------- **moderate risk (1)**
Timelines of approvals and construction	-------- **moderate timeline (1)**	Potentially lengthy approval and construction processes for off shore elements -------- **long timeline (3)**	-------- **moderate timeline (1)**	Challenges associated with coordination of tank placement with other infrastructure could lengthen process -------- **long timeline (5)**	-------- **moderate timeline (1)**

Table 5-3: Option Evaluation Matrix

Category of Consideration / Evaluation Criteria	**Option A** (13m integrated boardwalk facility)	**Option B** (integrated boardwalk facility forebay + offshore facility)	**Option C** (tri-celled rectangular tank adjacent portion of dockwall)	**Option D** (underground storage tanks)	**Option E** (9.5m integrated boardwalk facility + parliament wetland)
SUMMARY: TECHNICAL	**3rd (24 pts)** -------- Although similar to Option E, the lack of an open water element and the extension of the facility further into the lake challenge both desired performance and approvability.	**4th (38 pts)** -------- The most significant challenges associated with this option, from a technical perspective, are the constructability and approvability of the in-lake component. While the combination of open-water and closed cell elements suggests a highly effective treatment process, the distance to the open-water component yields inefficiencies and complex maintenance requirements.	**2nd (19 pts)** -------- In relative terms, this option may be the simplest to construct, operate, and maintain. Technically, the utilization of lake depth and exposure to sunlight yield optimum levels of expected effectiveness. However, the placement of the facility into the harbour presents potential challenges with existing shipping routes. .	**5th (48 pts)** -------- This option is least desirable from a technical perspective. The tank has significantly reduced effectiveness due to its limited volume as compared to the options that utilize the full depth of the lake, and will thus require more frequent and disruptive maintenance. Furthermore, the prevailing soil and groundwater conditions yield a challenging construction process.	**1st (18 pts)** -------- This is the best alternative with respect to technical considerations. It incorporates both covered and vegetated open-water elements, and utilizes lake depth to yield more effective runoff treatment and satisfy agency expectations. It also maintains proximity and accessibility for construction, maintenance, and potential future expansion, thus further easing the approval process and timelines. In relative terms, construction effort is anticipated to be average.
NATURAL ENVIRONMENT					
Potential effects on fish habitat	Compensation for facility footprint required -------- **impact on fish habitat** **opportunity to mitigate impacts (5)**	Compensation for facility footprint required opportunity to augment indirect fish habitat via vegetated open water elements -------- **impact on fish habitat** **opportunity to mitigate impacts** **(3)**	Compensation for facility footprint required opportunity to augment indirect fish habitat via vegetated open water elements -------- **impact on fish habitat** **opportunity to mitigate impacts** **(3)**	No impact on fish habitat -------- **no impact (1)**	Compensation for facility footprint required opportunity to augment indirect fish habitat via vegetated open water elements -------- **impact on fish habitat** **opportunity to mitigate impacts** **(3)**
Potential effects on terrestrial habitat	n/a	n/a	n/a	n/a	n/a
Potential effects on known habitat for Species of Concern	n/a	n/a	n/a	n/a	n/a

Table 5-3: Option Evaluation Matrix

Category of Consideration / Evaluation Criteria	**Option A** (13m integrated boardwalk facility)	**Option B** (integrated boardwalk facility forebay + offshore facility)	**Option C** (tri-celled rectangular tank adjacent portion of dockwall)	**Option D** (underground storage tanks)	**Option E** (9.5m integrated boardwalk facility + parliament wetland)
Potential groundwater effects	Groundwater movement anticipated to be no different from existing dock wall -------- **least groundwater effect (1)**	Groundwater movement anticipated to be no different from existing dock wall -------- **least groundwater effect (1)**	Groundwater movement anticipated to be no different from existing dock wall -------- **least groundwater effect (1)**	Extensive dewatering required for tank installation -------- **potential groundwater impacts associated with tank installation** **most groundwater effect (5)**	Groundwater movement anticipated to be no different from existing dock wall -------- **least groundwater effect (1)**
Overall improvement to Effluent Quality	Achieves over 80%TSS removal and pathogen treatment Effectiveness augmented by utilization of full lake depth throughout facility -------- **moderate improvement (3)**	Achieves over 80% TSS removal and pathogen treatment Effectiveness augmented by utilization of full lake depth throughout facility Vegetated open water element provides potential to reduce contaminants via phyto-remediation -------- **most improvement (1)**	Achieves over 80% TSS removal and pathogen treatment Effectiveness augmented by utilization of full lake depth throughout facility Vegetated open water element provides potential to reduce contaminants via phyto-remediation -------- **most improvement (1)**	Limited volume available within tanks for treatment -------- **least improvement (5)**	Achieves over 80% TSS removal and pathogen treatment Effectiveness augmented by utilization of full lake depth throughout facility Vegetated open water element provides potential to reduce contaminants via phyto-remediation -------- **most improvement (1)**
Potential effects from soil contamination	No interaction between facility and existing on-shore soils Some in-lake dredging required -------- **least effect (1)**	No interaction between facility and existing on-shore soils Some in-lake dredging required -------- **least effect (1)**	No interaction between facility and existing on-shore soils Some in-lake dredging required -------- **least effect (1)**	Removal and disposal of potentially contaminated soils for park component Some in-lake dredging required -------- **most effect (5)**	No interaction between facility and existing on-shore soils Some in-lake dredging required -------- **least effect (1)**

Table 5-3: Option Evaluation Matrix

Category of Consideration / Evaluation Criteria	**Option A** (13m integrated boardwalk facility)	**Option B** (integrated boardwalk facility forebay + offshore facility)	**Option C** (tri-celled rectangular tank adjacent portion of dockwall)	**Option D** (underground storage tanks)	**Option E** (9.5m integrated boardwalk facility + parliament wetland)
SUMMARY: NATURAL ENVIRONMENT	**4th (10 pts)** -------- Option A is similar to Options B, C, and E with respect to anticipated impacts to the natural environment. The enclosed configuration limits the potential for indirect contribution to fish habitat. Compensation opportunities are available along the perimeter of the facility.	**1st (6 pts)** -------- Options B, C, and E are all deemed equivalent with respect to the anticipated impacts to the natural environment, and the opportunities to mitigate these impacts. Most notable are the potential for planted open water areas to indirectly contribute to fish habitat. Additional compensation opportunities exist along the outer perimeter of the facility.	**1st (6 pts)** -------- See description under Option B	**5th (16 pts)** -------- This option is least desirable from a natural environment perspective. While the configuration does not impact fish habitat, placement of a tank within the community necessitates dewatering as well as the removal and disposal of a substantial volume of contaminated material.	**1st (6 pts)** -------- See description under Option B
SOCIO-ECONOMIC ENVIRONMENT					
Potential for disturbing existing residences, businesses, and/or community, institutional, and/or recreational facilities (through construction noise, dust and odours, traffic disruption, property access disruption, etc)	Interruption of marine uses during construction -------- **least potential (1)**	Interruption of marine uses during construction Long term potential interruption of harbour uses -------- **more potential (4)**	Interruption of marine uses during construction Long term potential interruption of harbour uses -------- **some potential (3)**	Tank installation will require disruption within park, and long term periodic disturbance for operations and maintenance activity -------- **most potential (5)**	Interruption of marine uses during construction Long term impact on marine uses within Parliament Slip -------- **some potential (2)**
Potential for conflict with existing harbour activities; e.g., shipping, recreation	Potential implications of 13m boardwalk Not anticipated to be a significant conflict -------- **low potential conflict (2)**	Off-shore component potentially significant conflict with harbour uses -------- **highest potential conflict (5)**	Potential implications of 30m intrusion into harbour -------- **moderate potential conflict (4)**	No anticipated conflicts -------- **least potential conflict (1)**	Reduction in available area of Parliament Slip for harbour activities -------- **moderate potential conflict (3)**

Table 5-3: Option Evaluation Matrix

Category of Consideration / Evaluation Criteria	**Option A** (13m integrated boardwalk facility)	**Option B** (integrated boardwalk facility forebay + offshore facility)	**Option C** (tri-celled rectangular tank adjacent portion of dockwall)	**Option D** (underground storage tanks)	**Option E** (9.5m integrated boardwalk facility + parliament wetland)
Potential for requiring private property	n/a	n/a	n/a	n/a	n/a
Potential impact on parks	Minimal impact during infrequent maintenance Increased recreational space with wider boardwalk -------- **no impact (1)**	Minimal impact during infrequent maintenance Potential increased recreational space with off-shore element -------- **no impact (1)**	Minimal impact during infrequent maintenance Potential increased recreational space with rectangular facility element -------- **no impact (1)**	Potential challenge to balance park uses with presence of tank Interruption to park facilities during routine maintenance -------- **negative impact (5)**	Minimal impact during infrequent maintenance Increased recreational space with parliament slip wavedeck -------- **no impact (1)**
SUMMARY: SOCIO-ECONOMIC ENVIRONMENT	**1st (4 pts)** -------- This is the best alternative from a socio-economic perspective, as impacts and conflicts are minimized through full integration of the facility within the boardwalk, although the wider boardwalk may have some impact on harbour uses.	**4th (10 pts)** -------- The off shore component of the facility represents a long-term interruption of harbour uses.	**3rd (8 pts)** -------- The intrusion into the harbour represents a potential long-term intrusion into the harbour.	**5th (11 pts)** -------- While this alternative offers the least imposition on existing marine and harbour uses, the presence of the tank within the community requires frequent and disruptive maintenance.	**2nd (6 pts)** -------- The usage of a portion of Parliament Slip represents a permanent reduction in available recreational marine space within the slip. The width of the boardwalk is not anticipated to have any impact on harbour uses.
CULTURAL ENVIRONMENT					
Potential effects on existing and proposed cultural landscape and heritage resources	Integrates entirely with proposed boardwalk, but requires widening of boardwalk to 13m -------- **moderate effect (3)**	Partially integrates with proposed boardwalk – significant impact on inner harbour aesthetic -------- **more effect (4)**	No integration – facility is exposed and not contiguous with other community features -------- **greatest effect (5)**	Effects anticipated to be minimal -------- **least effect (1)**	Boardwalk and parliament wavedeck / wetland elements consistent with public realm vision for community -------- **low effect (2)**

Table 5-3: Option Evaluation Matrix

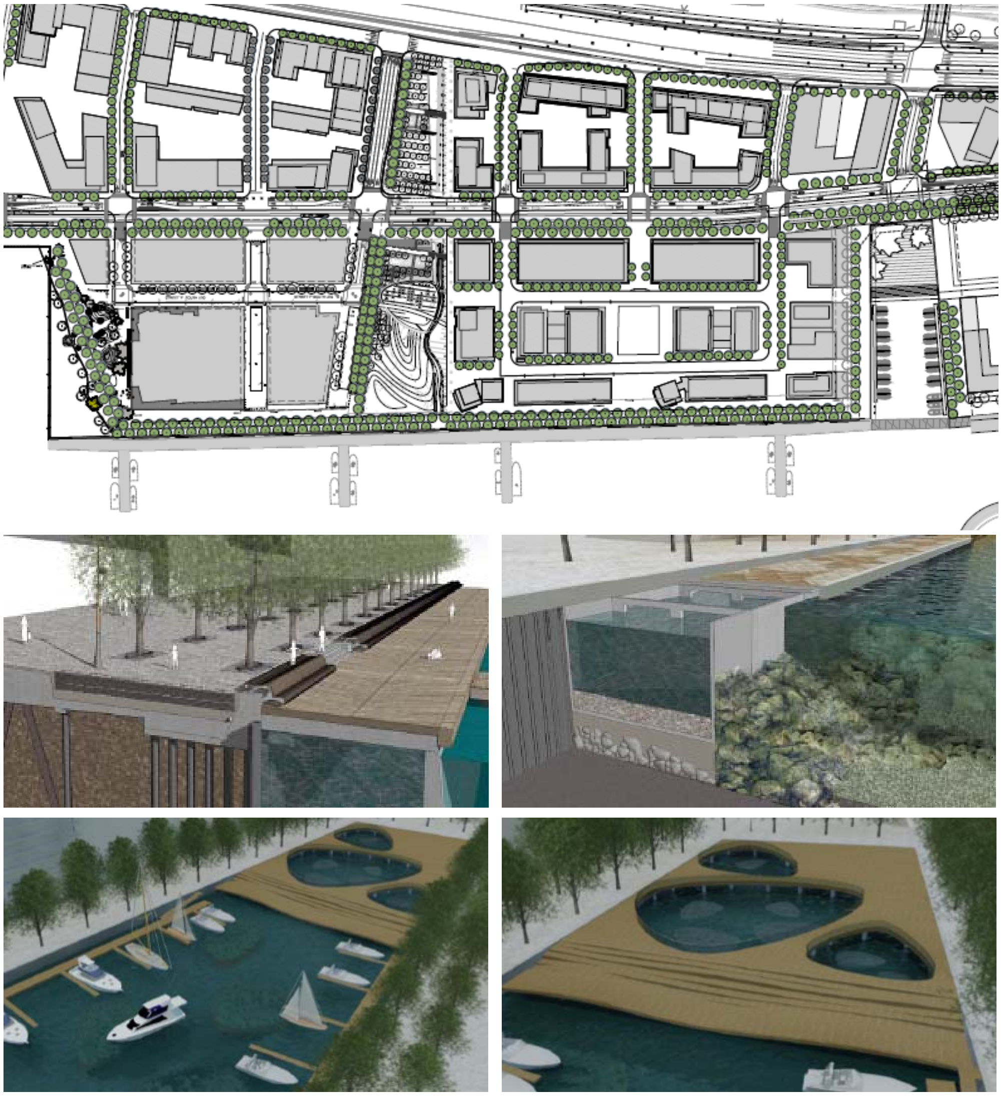
Category of Consideration / Evaluation Criteria	**Option A** (13m integrated boardwalk facility)	**Option B** (integrated boardwalk facility forebay + offshore facility)	**Option C** (tri-celled rectangular tank adjacent portion of dockwall)	**Option D** (underground storage tanks)	**Option E** (9.5m integrated boardwalk facility + parliament wetland)
Enhancement to cultural amenity	Integrates fully with boardwalk -------- **no impact (2)**	Arguable enhancement with off-shore component -------- **potential enhancement (3)**	Arguable enhancement with extruding cell into lake -------- **potential enhancement (4)**	Frequent disturbance to community for maintenance -------- **least (5)**	Integrates and complements boardwalk and wavedeck elements -------- **greatest enhancement (1)**
SUMMARY: CULTURAL ENVIRONMENT	**2nd (5)** -------- While fully integrated, facility does not enhance community.	**4th (7)** -------- The off shore component is an arguable enhancement to the community.	**5th (9)** -------- The facility configuration is inconsistent with the public realm vision for both East Bayfront and the overall central waterfront.	**3rd (6)** -------- The tanks will not impact the cultural environment of the community, other than the frequent maintenance activity.	**1st (3)** -------- Option E illustrates coordination of public realm and public infrastructure.
DESIGN EXCELLENCE					
Sustainability	Use of harbour rather than tableland Covered system requires perpetual mechanical UV disinfection -------- **moderately sustainable (3)**	Use of harbour and slip rather than tableland Open-water component – potential for natural UV disinfection Lost efficiencies due to length of pipe and conveyance required -------- **more sustainable (4)**	Use of harbour and slip rather than tableland Open-water component – potential for natural UV disinfection -------- **more sustainable (2)**	Closed system requires perpetual mechanical UV disinfection Tank component requires more maintenance -------- **least sustainable (5)**	Use of harbour and slip rather than tableland Open-water component – potential for natural UV disinfection Use of facility for boardwalk support and dockwall rehabilitation -------- **most sustainable (1)**
Aesthetic Impact	Facility is consistent with public realm vision for community – requires widening of boardwalk to 13m -------- **low impact (2)**	Offshore element will have a significant aesthetic impact on the overall central waterfront and inner harbour -------- **high impact (4)**	Facility represents departure from current public realm vision for community -------- **moderately sustainable (5)**	Tanks will have little if any impact on aesthetics of the community -------- **no impact (1)**	Integration with public realm elements Variation on existing slip usage -------- **low impact (3)**

Table 5-3: Option Evaluation Matrix

Category of Consideration / Evaluation Criteria	**Option A** (13m integrated boardwalk facility)	**Option B** (integrated boardwalk facility forebay + offshore facility)	**Option C** (tri-celled rectangular tank adjacent portion of dockwall)	**Option D** (underground storage tanks)	**Option E** (9.5m integrated boardwalk facility + parliament wetland)
Harmony with surrounding structures and open space and integration with other design elements	Integrates fully with boardwalk Treated water supplies Sherbourne Park water features -------- **Fully integrated and partially complementary (2)**	Partially integrates with boardwalk Offshore element represents new feature in inner harbour Treated water supplies Sherbourne Park water features -------- **partially integrated (4)**	Facility stands out with respect to surrounding landscape Treated water supplies Sherbourne Park water features -------- **not integrated (5)**	Facility entirely hidden underground Treated water supplies Sherbourne Park water features -------- **fully integrated but hidden (3)**	Integrates and complements boardwalk and wavedeck elements Treated water supplies Sherbourne Park water features -------- **fully integrated and complementary (1)**
Originality / Uniqueness / Landmark potential	Innovation in design, and multiple benefit of partial dockwall rehabilitation and boardwalk structural support -------- **(3)**	Very original and innovative design, offshore element has significant landmark potential -------- **(2)**	Innovation in design, has some degree of landmark potential -------- **(3)**	Facility hidden and representative of traditional approaches -------- **(5)**	Innovation in design, and multiple benefit of dockwall rehabilitation and boardwalk structural support Parliament wavedeck / wetland has landmark potential similar to Spadina wavedeck -------- **(1)**
SUMMARY: DESIGN EXCELLENCE	**2nd (10)**	**3rd (14)**	**5th (15)**	**4th (14)**	**1st (6)**
FINANCIAL					
Capital cost (including land value)	42,000,000 -------- **(1)**	52,000,000 -------- **(3)**	49,000,000 -------- **(2)**	60,000,000 -------- **(4)**	42,000,000 -------- **(1)**
SUMMARY: FINANCIAL	**1st (1)**	**4th (3)**	**3rd (2)**	**5th (4)**	**1st (1)**
SUMMARY					
OVERALL RANKING	(54 pts) -------- **2nd overall**	(78 pts) -------- **4th overall**	(59 pts) -------- **3rd overall**	(99 pts) -------- **5th overall**	(40 pts) -------- **1st overall**

Table 5-3 documents the effort and deliberations undertaken by the project team over the period both before and since issue of the December 2007 FSR; these established Option E as the preferred alternative for configuration of the end-of-pipe facility for East Bayfront as shown in **Figure 5-7**. **Figure 5-8** depicts some of the public realm renderings of the facility as part of the community.

Figure 5-8: Stormwater Management Facility and Public Realm Integration



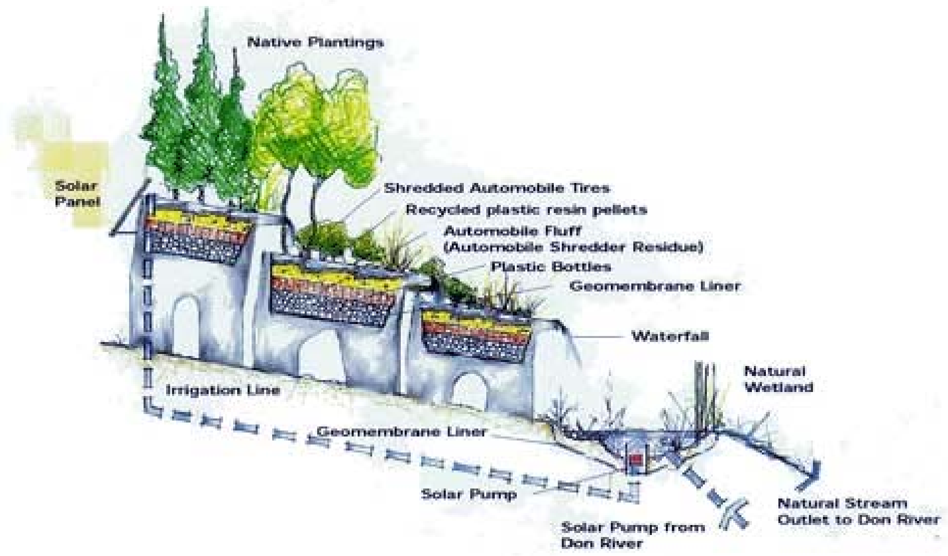
prepared by West 8 + DTAH

In general, all of the contemplated alternatives could satisfy the criteria for water quality and clarity prior to UV treatment. However, while all the options are technically feasible, adherence to the sustainability framework would suggest that simplicity, which implies long-term viability, should also be an objective in the planning and design of infrastructure. Within this context, some of the options possess characteristics which are fundamentally complex, and selection of the preferred configuration considered the precept of sustainability as paramount. Additionally, key elements that include utilization of lake depth for the permanent pool, consideration for long term operations and maintenance by maximizing passive versus active treatment, provision of a vegetated open-water element, avoidance of existing harbour navigation routes, and perhaps most notably, integration with the public realm vision for the community, have culminated in the formulation of Option E.

Section 5.7 elaborates on the various analyses and additional considerations that must form part of the process leading to the final design of the stormwater management facility. A number of variations, refinements, and features were considered in the course of identifying the preferred alternative, before and after submission of the December 2007 FSR. Two of these that did not form part of the preferred alternative are described below, both for reference and to possibly inform future studies of a similar nature.

While all of the in-lake options could include features to improve aquatic habitat, such as the treatment of the outer walls, other mechanisms could be explored to provide off-shore water quality treatment of lake water as opposed to stormwater runoff. While physically disconnected, these could be associated with the East Bayfront facility through their fulfillment of the habitat compensation requirements, by improving water quality within the lake. A contemplated approach involved the installation of a series of either “floating” or “elevated” wetlands (similar to the elevated wetlands seen along the Don Valley Parkway, near the Don Mills Road exit, **Figure 5-9**), which would receive pumped lake water for filtration and phytoremediation through wetland vegetation. The treated water would then be either conveyed to the next elevated wetland in the series, or released back into the lake.

Figure 5-9: Elevated Wetlands



source: elevatedwetlands.com

The EA document also made brief reference to an alternative that considered discharge of all East Bayfront runoff to the proposed CSO interceptor planned along the Queens Quay right-of-way. The alternative relies on the acceptability of discharging untreated runoff to Lake Ontario in the interim, until the CSO interceptor is in place. This approach acknowledges that water quality in the immediate vicinity of the development will not substantially improve until the existing CSO outfalls are decommissioned, notwithstanding the implementation of local stormwater management on-site/conveyance measures within East Bayfront. Furthermore, utilization of the proposed interceptor provides an opportunity to centralize the end-of-pipe treatment (and pool funds) for an area that extends beyond East Bayfront.

However, in the interim, the approach contravenes the principles of both the "Sustainability Framework" and the stipulations of the Wet Weather Flow guideline. In addition, the anticipated approval challenges associated with pursuit of an alternative that relies on the unknown timing of the CSO interceptor, and that contravenes the findings of the approved EA, suggested that other approaches would yield a greater likelihood of success.

5.7 Guidance to Detailed Design of Facility

As noted previously, progression of the East Bayfront development subsequent to the December 2007 FSR has included extensive deliberations with the project team and Waterfront Toronto, as well as input and feedback from City of Toronto staff. Relevant correspondence is provided in **Appendix 5a**. Elements of these discussions, including both input and concerns raised, have supplemented the list of items to be addressed as part of the detailed design process; prominent items are described in the following subsections.

5.7.1 Operations and Maintenance

Design of the facility must include considerable attention to the short and long-term / life-cycle operational and maintenance (O+M) characteristics, yielding incorporation of O+M features in the design, within the context of the City's requirements. As part of this effort, preparation of an Operations and Maintenance report for the facility will be undertaken in parallel with the design process. This document will also describe the O+M requirements associated with the proposed oil-grit separators and UV disinfection system.

In brief, analyses and effort associated with O+M considerations will include:

- Assessment of the rate of anticipated sediment accumulation, with consideration for the Wet Weather Flow particle size distribution, accumulation rates provided by MOE, and evaluation of settling velocities and distances.
- Provision and evaluation of 'deliberate' sediment accumulation areas, which include all flow or velocity transitions such as inlets, corners, and piped segments (where CSOs are to be traversed, etc).
- Provision and evaluation of mechanisms needed for access to sediment accumulation areas, to facilitate cleanout. Elements of this evaluation include the need for vehicular access, maintenance hatches, and potentially pipe leads connected to junction box headers for vacuum cleanout.
- Identification of maintenance schedules and milestones guiding both periodic visual inspections and facility cleanouts.

Prior to the updating of this report, variations on the preferred configuration of the stormwater management facility were presented to the City, at which time concern was expressed over the long, narrow configuration and the potential challenges associated with maintenance and cleanout. With respect to maintenance frequency, utilization of lake depth as a permanent pool yields a significant space in which sediment may accumulate before performance of the facility is compromised. As such, it is reasonable to expect that cleanout of the facility will be relatively infrequent. Preliminary estimates, to be refined through the design process, identify a maintenance interval greater than 20 years.

Input from City staff is critical to ensure that the maintenance requirements of the facility are reasonable, realistic, and in keeping with existing City maintenance protocols as much as possible. Efforts to engage the City in this exercise have commenced as part of the preliminary design of the facility. O+M investigations will establish the frequency, effort, and equipment that will be required to maintain the facilities, all of which will be documented in O+M manuals specific to each aspect of the stormwater management system.

With respect to the long, narrow configuration, the previous section elaborates on the benefits of this design. The multiple objectives to be realized through the integration of the SWM facility with the boardwalk, treatment of storm runoff, structural support of the proposed boardwalk, and reduction in the extent of required dockwall repairs, yield a community feature that is consistent with both Waterfront Toronto's Sustainability Framework and the Central Waterfront Master Plan, and therefore worth pursuing.

All equipment associated with the UV disinfection facility will be located at a proposed pavillion building within Sherbourne Park, which will be accessible to City staff. Similarly, should the design reveal the need for a pumping station in close proximity to the Parliament Slip wetland, access would be provided in the same manner as a typical sewage pumping station (e.g. manway access and pump hatches for rail-mounted submersible pumps).

5.7.2 Salt

Given the use of salt within the community to ensure road safety in winter conditions, the potential exists for dissolved salt to accumulate and stratify within the facility. This stratification, yielding a brackish water layer near the bottom, can encourage anaerobic biological processes that generate foul odour as a by-product. Preliminary research efforts to address this concern have yielded the following general observations:

- The application of road salt for winter accident prevention serves as the primary anthropogenic source of chloride to the environment. Road salt is considered to be a toxic substance in Canada under the Canadian Environmental Protection Act (CEPA). However, while Environment Canada has acknowledged the environmental implications of road salt usage, emphasis has been placed on the management of salt usage to minimize quantities while maintaining the safety of the public.
- Discussion with Mr. Peter Noehammer, Director of Transportation for the City of Toronto, revealed that the City is presently managing salt applications, and is making efforts to improve salt management processes through on-going studies at both the University of Guelph and the Canadian Centre for Inland Waters (CCIW). Notwithstanding these efforts, the application of salt is still required to maintain road safety during the winter.
- CCIW is also participating with the Town of Richmond Hill on a 2-year monitoring study of a pilot salt management system. The system consists of a large flat parking area to which snow clearing vehicles deposit collected snow. The area has ditch inlets that convey runoff to a water quality manhole, which then discharges to a stormwater wetland. Due to slow melt conditions and subsequently low velocities, it has been observed that much of the debris and salt remain on the parking lot, and the receiving water quality manhole traps much of the finer materials with inherent salt content. The visible health of the receiving wetland suggests that the system is thus far effective; the salt concentration within the wetland is below the threshold that results in adverse impacts to vegetation.
- Dr. Bahram Gharabaghi of the University of Guelph is working with the City of Toronto to investigate the effectiveness of a ‘treatment tank’ for salt-laden runoff. In brief, it is expected that the salt-laden runoff will stratify within the tank, allowing for removal of the majority of salt content prior to discharge downstream.
- Other research indicates that chloride-rich water can adversely impact aquatic organisms, roadside vegetation, and wetland plants. In addition, increased salt concentrations in lakes can lead to stratification that retards or prevents the seasonal mixing of water, thereby affecting the distribution of oxygen and nutrients. An increase in the level of the Cl- ion has also been noted to have a dramatic effect on the heavy metal bio-availability of sediment within a detention pond. In other words, high salt content may affect sediment transport and the capacity of settled sediments to adhere to pollutants.
- A study of three wet ponds in Canada, namely the Heritage Estates Wet Pond, the Harding Park Wet Extended Detention Pond with Wetland, and the Rouge River Wet Extended Detention Pond, indicated that these stormwater management facilities have little effect on the control of chloride levels. Winter chloride inputs continued to have a strong influence on the ponds during the summer months. There was evidence of gradual accumulation of chlorides in the bottom of the permanent pool over time, and a strong chemical stratification was caused by a dense layer of chloride-rich water that entered the pond in the winter and persisted at the bottom of the pond throughout the summer months. During summer, the salt concentration also increased with reduced precipitation and increasing air temperature.
- The primary concern with road salt is the discharge of chloride-rich water into the natural stream system; stratification of the salt layer, leading to odour issues, does not appear to be the prevalent concern. Furthermore, there is no economical way to remove applied roadway salt from the resulting runoff.

Notwithstanding the issues and challenges described above, the facility design effort will include consideration for measures and mechanisms to address the concern. One approach is to attempt to mitigate the potential for stratification due to salt accumulation. While measures that encourage mixing of stratified layers would also undermine the intended function of the facility to settle out particulate matter, such methods could be reviewed to establish a balance of mixing and settling, if feasible.

Alternative approaches could include a periodic draw from the bottom of the facility to remove some of the salt-laden water, or the incorporation of venting mechanisms to ensure that the community is shielded from the potentially foul odour generated within the salt layer. Ongoing consultation with the City is required, as is typical through any detailed design process, to ensure that any measures to be implemented in the facility will adequately address the concern.

5.7.3 Geotechnical

With a facility to be situated on the bed of the lake adjacent the existing dockwall, significant consideration and emphasis must be given to the geotechnical conditions to ensure the stability and longevity of the design.

5.7.4 Structural

The structural integrity of the facility is critical to both its function and life span, and hence the design of the concrete cellular network that is the basis of the facility will be largely led by a structural engineer.

5.7.5 Winter Operation

The Wet Weather Flow guidelines do not specify a requirement to provide UV disinfection during the winter months. As such, the design of the facility must consider varying seasonal operating characteristics that ensure runoff from the community continues to pass through the facility without affecting upstream hydraulic gradeline conditions, while continuing to achieve the MOE water quality criteria prior to discharge to the lake.

One method that may be considered as part of detailed design could include the addition of an ‘off-season’ pipe connecting to the facility wet well, rendered inoperable during warm-weather months via a valve mechanism. This pipe could be configured to draw water from the bottom of the facility for discharge directly to the lake during the winter. This approach would continue to satisfy the 80% suspended solid removal requirement, and could also reduce the salt load within the facility during winter months as salt-laden water would stratify near the bottom. Further evaluation of this and similar mechanisms will be undertaken during the detailed design of the facility.

5.7.6 Overflow

The facility has been configured to capture and attenuate runoff generated by a 25mm storm event. For events that exceed the volume available within the facility, the detailed design must include provision for an emergency overflow mechanism to discharge excess flow to the lake and minimize potential risks to persons, property, and infrastructure. One method that may be considered involves the addition of a series of weir openings along the length of the facility to allow excess volume to discharge directly to the lake. The invert of these overflow weirs should be set at or above the 100-year lake level, to prevent the potential inflow of lake water into the facility, and to minimize potential impacts to the upstream hydraulic gradeline. Further evaluation of this and similar overflow mechanisms will be undertaken during the detailed design of the facility.

5.7.7 Aquatic Habitat Compensation, Enhancement, and Rehabilitation

Consultation with the Aquatic Habitat Toronto group (AHT, formerly TWAHRS) has yielded input with respect to the nature and extent of aquatic habitat compensation that will be required in conjunction with construction of the proposed stormwater management facility. Preliminary compensation drawings have been prepared by Schollen and Company and presented to AHT for input. While this effort is still underway, some contemplated elements of the proposed aquatic habitat compensation plan include:

- The placement of rock rubble and plantings along the outer wall of the facility/boardwalk to increase habitat diversity.
- The provision of submerged planting pods within Parliament Slip.
- Plantings within the wetland component of the facility to promote phytoremediation and encourage ‘contributing’ fish habitat.

Both the type of features and the degree of compensation required are subject to the review and approval of the AHT group, whose membership includes representatives from DFO, MNR, the City, and TRCA.

5.7.8 Expansion Potential of Facility Service Area

Redevelopment of Toronto’s central waterfront in the relative near term has been segmented into three large redevelopment areas: East Bayfront, the West Don Lands, and the Lower Don Lands. The Lower Don Lands may be further considered as two parcels divided by the existing Keating Channel, referred to as the North Keating and South Keating lands. **Figure 5-10** depicts the location of these areas.

Figure 5-10: Central Waterfront Redevelopment Areas

At the request of the City, efforts have been initiated to explore holistically the stormwater management opportunities for the combined redevelopment areas, particularly with regard to centralization of the end-of-pipe and UV treatment infrastructure. One aspect of this investigation considers the potential for expansion of the proposed East Bayfront end-of-pipe and/or UV treatment facilities to service some or all of the adjacent redevelopment areas.

A memo detailing a preliminary review of expansion opportunities is included in **Appendix 5a**. This review generally concluded that, from a functional perspective, the UV component of the East Bayfront stormwater management strategy could be augmented to service a larger area, but that expansion of the end-of-pipe facility to service the larger area poses several challenges, including:

- Challenges in providing gravity drainage from the areas external to East Bayfront, particularly with respect to the crossing of existing infrastructure. Pumping of runoff would require some form of attenuation (and hence storage) local to the external area.
- Implications to the hydraulic gradeline in the storm sewer system servicing East Bayfront, potentially increasing the frequency and/or severity of nuisance flooding within the community.

- Potential further compromise of the public realm vision for East Bayfront and the overall central waterfront area.

Once completed and accepted by both Waterfront Toronto and the City, the findings of the stormwater management centralization investigations will need to be incorporated into the detailed design of infrastructure for East Bayfront, where applicable.

Given the observations of the preliminary review described above, it is expected that modification to the design of East Bayfront infrastructure will be limited to the UV system and its associated pumps and pipes. On this basis, and for the purposes of this functional document, it has been assumed that UV treatment of clarified flow from a portion of the North Keating lands (west of Cherry Street and south of Lakeshore Boulevard) will occur within East Bayfront. The UV disinfection system is described in **Section 5.8**.

5.8 Ultraviolet Disinfection

5.8.1 System Objective

As noted in **Section 4**, one of the stormwater management objectives applicable to East Bayfront, and stipulated by the City's Wet Weather Flow guideline, is the reduction of E.coli concentrations to 100 counts per 100ml prior to discharge to Lake Ontario. This requirement necessitates the incorporation of ultraviolet (UV) disinfection into the overall stormwater management system. UV radiation is commonly applied to municipal water and wastewater treatment processes, and is effective by causing damage to the genetic structure of bacteria, viruses, and other pathogens, making them incapable of reproduction.

Successful UV disinfection requires relatively clear water. Suspended particles absorb and scatter light, yielding murky water. As a result, removal of particles allows for better UV penetration, and hence disinfection. Furthermore, reducing particle size eliminates 'bacterial shielding', whereby large particles suspended in the water prevent the UV light from irradiating the bacteria that lie in their shadow. In addition to satisfying traditional water quality criteria, the storage component of the stormwater management system for East Bayfront is intended to settle out the larger particles and provide sufficient water clarity for effective UV disinfection.

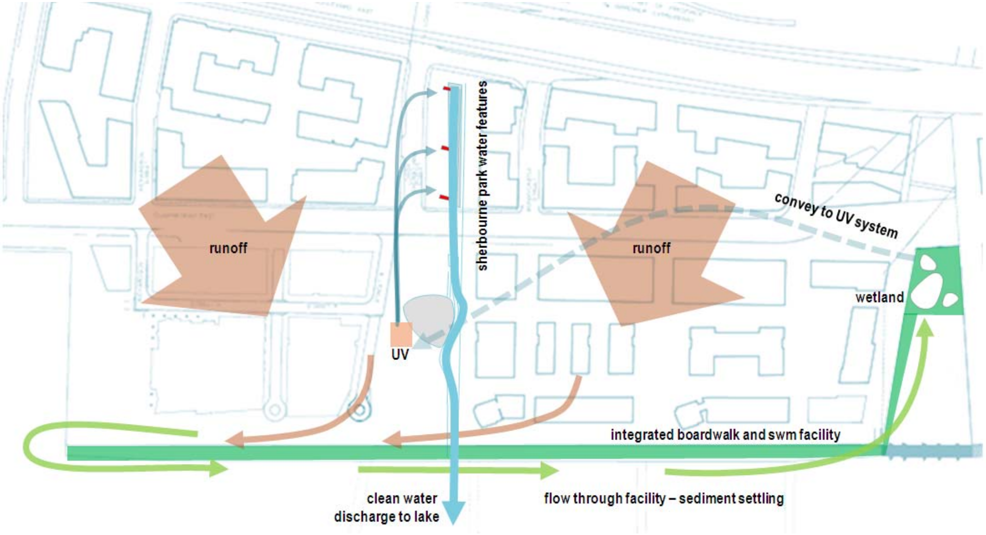
5.8.2 System Flow Rate

Section 5.2 established that the optimum facility outflow rate of 67 L/s will yield water of suitable clarity for delivery to the UV system. A 'rounded' and conservative flow rate of 70 L/s thus forms the basis for the sizing UV and related equipment within the context of the East Bayfront stormwater management requirements. However, as described in **Section 5.7.8**, design of the system must also consider potential expansion to provide UV treatment of clarified runoff from external areas. At present the external area under consideration is limited to the North Keating lands west of Cherry Street (**Figure 5-10**), although further direction is required through liaison with the City, Waterfront Toronto, and other stakeholders. Design of the UV facility must allow adequate space to support the conclusions of this effort, through expansion of the UV system and the associated pumps and pipes.

5.8.3 Clarified Flow Conveyance

Figure 5-11 provides an overall system schematic for the East Bayfront stormwater management and UV disinfection system. As described previously, the stormwater management strategy for East Bayfront has been designed to satisfy water quality requirements and provide water clarity suitable for effective UV treatment. The proposed wetland feature within Parliament Slip forms the final stage in the stormwater clarification process. From a wet well within the wetland, clarified stormwater will be conveyed to the UV disinfection facility, housed within a proposed pavillion building in Sherbourne Park. The intake will be multi-levelled, avoiding silt from the bottom and micro-organisms living in the light-sensitive upper levels.

Figure 5-11: Stormwater Management System Schematic



The alignment and configuration of the flow path between the Parliament wetland and Sherbourne Park is subject to more detailed design, but is presently contemplated as a forcemain or gravity feed along either Queens Quay or the boardwalk tank system, with the associated pumping station in close proximity to the Parliament wetland, if required. The detailed design process will consider the viability of gravity conveyance and the merits of alternate alignments.

5.8.4 UV System Specifications

The selection of UV equipment requires determination of the necessary 'contact time' and UV dosage, which, in combination with the flow rate, anticipated water quality, initial bacteriological counts, and target bacteriological counts, yields specifications related to the spacing and brightness of the UV lamps. It should be noted that, while the objective of the facility with respect to E.coli is to yield concentrations of less than 100 counts per 100 ml, sizing of equipment assumes a more stringent requirement of 50 counts per 100 ml to ensure that the actual target is always satisfied.

Preliminary and conservative evaluation of the various parameters suggests that water exiting the stormwater management facility will have a UV transmissivity of 52% (a measure of water clarity) and an incoming E.coli concentration of 400,000 counts per 100 ml.

To achieve the E.coli target of 50 counts per 100 ml, with a design flow rate of 70 L/s, a UV unit measuring 1m x 1m x 5m long will be required. Traditionally such tanks are installed horizontally as shown in **Figure 5-12**. Water enters one end, is passed by a series of closely spaced lamps to ensure adequate UV dosage to any bacteria, and exits the far end. The tank is kept full to ensure that the hydraulic retention time is kept at the design level, and to prevent the lamps from burning out prematurely. Automatic sensors in the system measure water clarity and flow rate, and adjust the wattage of the lamps automatically to provide the required dosage. As described in **Section 5.8.2**, above, the potential for system expansion to accommodate higher flow rates must be considered as part its detailed design.

Figure 5-12: Ultraviolet Disinfection System

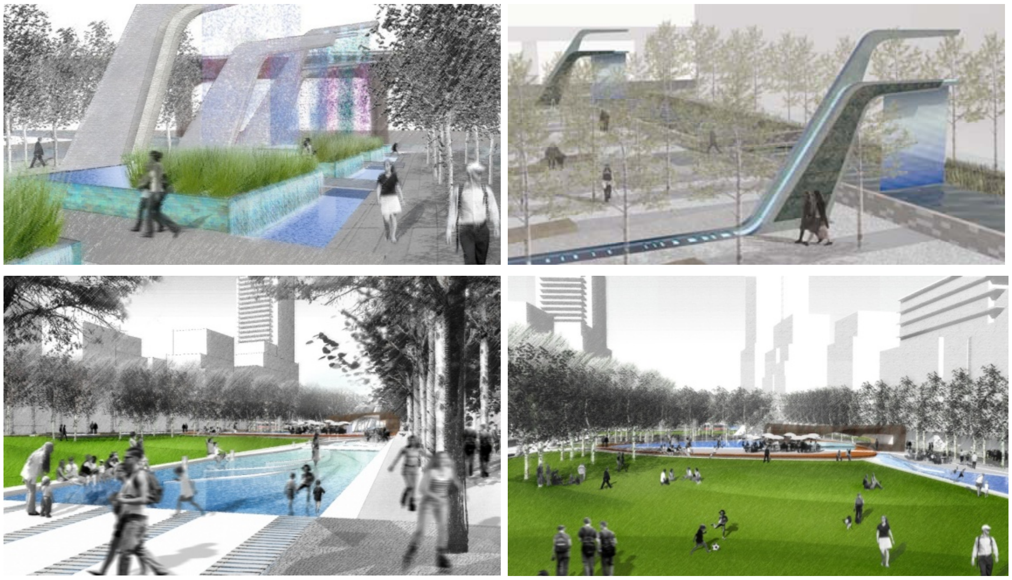
5.8.5 Sherbourne Park Water Features

Runoff treated by the UV disinfection facility is then available for use in a series of water features proposed within Sherbourne Park (**Figure 5-13**). The water features include three public art scrim walls (miniature waterfalls) north of Queens Quay, and a channel that runs from north to south along the length of the park before discharging into Lake Ontario. The UV treated water is also proposed for use in the irrigation of the parks grassed areas, and potentially for non-potable use in park restrooms. Additional pumping is required to provide water to these various features.

It is anticipated that the Sherbourne Park water features will be operational throughout the warm-weather season (i.e. May through September), and that flow will be continuous over this period. Furthermore, the flow rates upon which the park water features will be designed to exceed the 70 L/s flow rate needed for stormwater management. From a stormwater management perspective, pumping and treatment of clarified stormwater from the Parliament wetland will only occur after a rainfall event, and only up to the maximum flow rate of 70 L/s. As such, alternative sources of water are needed to supply the park water features during dry-weather periods, and to augment the flow to these features during wet weather. Sources could include the potential recirculation of water already running through the park features, or a direct intake from Lake Ontario (subject to confirmation of water quality and clarity), which would be UV disinfected prior to use in the park features.

A splash pad “water-play” feature is also proposed within Sherbourne Park, to be supplied by potable water. The splash pad can be used as a skating rink in the winter months. Although disconnected from the stormwater management system, the outlet of the splash pad could be integrated with the above-noted recirculation system to supplement the flow rate within the other park water features when required.

Figure 5-13: Sherbourne Park Water Features



Renderings prepared by Phillips Farevaag Smallenberg

6 Stormwater Management Performance Standards and Approval Requirements

This section is intended to briefly summarize adherence to the various applicable standards that guide the stormwater management strategy.

6.1 Wet Weather Flow Management Guideline

Table 7 of the Wet Weather Flow Management Guideline summarizes the applicable criteria for various types of developments. For East Bayfront, which falls under the category of large new developments (i.e. greater than 5.0 hectares), the following stipulations apply with respect to stormwater management:

- *Water Balance*: The guideline requires the minimum on-site retention of all runoff from a small design rainfall event – typically 5mm. Accordingly, the stormwater management strategy for East Bayfront recommends the 5mm target for all lands north of Queens Quay, while lands south of Queens Quay, with LEED Gold objectives, are expected to retain 15mm of runoff. This combination of measures has been evaluated holistically for the entire East Bayfront (**Section 4.8**). This evaluation has demonstrated that the specific water quality objectives of the WWF guideline can be achieved for the overall redevelopment area.
- *Water Quality*: The long-term average removal of 80% of TSS is to be achieved through the combination of proposed on-site, conveyance, and end-of-pipe measures. It is worth noting that the proposed end-of-pipe configuration on its own will achieve more than the 80% target. End-of-pipe discharges will be conveyed to a UV treatment facility for disinfection, with the objective of achieving the dry-weather E.coli concentration of 100 counts per 100ml.

6.2 Toronto Green Development Standard

The Toronto Green Development Standard provides a series of recommendations to guide and encourage sustainable development practices. For East Bayfront, applicable categories relating to stormwater management include:

- *Urban Heat Island Reduction – Roof*: The proposed implementation of green roofs for buildings south of Queens Quay is anticipated to satisfy this recommendation, subject to design of the individual buildings.
- *Stormwater Run-Off*: Recommendations under this category include the removal of at least 80% of TSS, as well as runoff disinfection. As described in the preceding section, both of these measures are integral to the proposed stormwater management strategy for East Bayfront.
- *Stormwater Retention – Water Balance*: The minimum Wet Weather Flow requirement of 5mm runoff retention forms part of the East Bayfront stormwater management strategy, which also satisfies this recommendation.
- *Rainwater Harvesting*: Rainwater harvesting measures are proposed for lands south of Queens Quay to utilize runoff for both landscape irrigation and flushing water closets. Lands north of Queens Quay may also incorporate rainwater harvesting measures, to be established through the design of the individual buildings.

6.3 Stormwater Management LEED Credits

The following LEED credits affect or are affected by the quality and quantity of runoff from the East Bayfront lands.

- *Credit 6.1: Stormwater Management - Rate and Quantity*: This credit is dependent on the 'existing' condition - for existing imperviousness less than 50%, stormwater management targets based on pre-development 1.5 year, 24 hour peak flow and volume; for existing imperviousness greater than 50%, target based on 25% decrease in existing flow and volume. For the East Bayfront, individual buildings will be required to demonstrate that these targets will be achieved in order to qualify for this credit. However, it is generally anticipated that the retention of 15mm of runoff proposed for lands south of Queens Quay will inherently satisfy this target.

- *Credit 6.2: Stormwater Management – Treatment*: This credit requires the removal of 80% of TSS and 40% of total phosphorus based on average 2-year 24-hour storm. As documented in the MOE Stormwater Management Planning and Design Manual, the sizing of infiltration measures to achieve 80% TSS removal is based on a unit volume of approximately 40m^3 per hectare. For a sample 1-hectare building, this equates to the required infiltration of 40m^3 to achieve the 80% target. In similar terms, the retention of 15mm of runoff, as is anticipated for lands south of Queens Quay, equates to a storage volume of 150m^3 for the 1-hectare sample area. As such, the 15mm of runoff retention is expected to yield a greater reduction in TSS than the target 80%. With respect to phosphorus, monitoring of retention facilities (i.e. wet ponds and wetlands) documented within the June 1991, June 1994, and March 2003 versions of the Ministry of Environment's stormwater management guidelines indicates that a typical wet facility will reduce phosphorus content by a range of 40 to 60%. These guidelines also suggest that a facility's performance with respect to phosphorus reduction is proportionate to its effectiveness in terms of TSS removal. Thus it is anticipated that the stormwater management strategy for East Bayfront will reduce phosphorus content by the requisite 40%.
- *Credit 7.2: Heat Island Effect - Roof*: This credit requires a high emissivity roof with 75% coverage OR green roof with 50% coverage. While green roofs are anticipated, individual building designs will need to verify adherence to this requirement.
- *Credit 1.2: Water Efficient Landscaping - No Potable Water Use or No Irrigation*: This credit requires rainwater harvesting to eliminate potable water irrigation needs or that permanent landscape irrigation systems not be installed. While rainwater harvesting measures are anticipated, the extent of the replacement of traditional potable sources will need to be verified through the design process for individual buildings.

6.4 Ministry of Environment Stormwater Management Planning and Design Manual

The pertinent criterion with respect to stormwater management targets, as documented in the MOE manual, is a minimum reduction in TSS concentrations by 80% to achieve "enhanced" protection. The overall stormwater management strategy for East Bayfront, which includes the on-site, conveyance, and end-of-pipe measures, has been devised to achieve this target.

7 Storm Sewer Servicing

7.1 Existing Storm Drainage

The East Bayfront is currently serviced by a combination of municipal and private storm sewer networks as shown on **Figure 7-1**. North of Queens Quay, storm service is provided by municipal storm sewers which, though separated from the sanitary sewer network, ultimately connect to the combined sewer outfalls noted in **Section 7.2**. South of Queens Quay, storm service is provided by private sewers which also connect to the Sherbourne and Parliament CSOs.

The pipes north of Queens Quay were typically built in the 1920s to 1930s, making them approximately 75 years old. South of Queens Quay, the sewers were likely built in the 1950s co-incidentally with the lake-filling of these lands and the construction of the Queen Elizabeth Docks.

Both north and south of Queens Quay, storm sewers flow directly to the lake without any stormwater management quantity or quality controls. The majority of the existing pipes within East Bayfront are located below lake level, and as such operate under surcharged conditions at all times.

The City of Toronto provided TMIG with HVM modeling for the storm sewer network (see **Appendix 2a**). Based on this modeling, the existing pipes do not have sufficient capacity to adequately drain the East Bayfront lands under existing conditions during a two-year return period event. Visual evidence seen onsite indicates that the Queens Quay storm sewer heading west to Jarvis from Lower Sherbourne may be partially blocked or plugged. Therefore replacement of this section of sewer on an expedited basis is required.

Given the age of the existing storm sewer network, the fact that it connects directly to the CSOs and the network's lack of capacity, there will be little opportunity to utilize the existing storm sewer network within the East Bayfront after re-development as proposed in the Precinct Plan and East Bayfront Class Environmental Assessment Master Plan.

There are currently no designated major overland flow routes on the East Bayfront. Overland flow from the lands south of Queens Quay do drain towards Queens Quay, but lands north of Queens Quay do not indicate a specific drainage direction. Queens Quay and Lakeshore Boulevard are both very flat, with an average grade on Queens Quay from lower Sherbourne Street to the Jarvis and Parliament slips of less than 0.1%. Based on the survey data that is currently available and on-site observations, it is anticipated that, with existing conditions under major rainfall events, flooding on Queens Quay and Lakeshore will occur without a positive outlet. There are large grates on Queens Quay at Lower Jarvis, Lower Sherbourne and Small Streets and it is thought that these grates may be major system inlets to the existing CSOs at these locations.

7.2 Combined Sewer Outfalls (CSO)

Three combined sewer outfalls cross the EBF from north to south. The outfalls are located under Jarvis Street, Sherbourne Street and Small Street (as an extension of a sewer under Parliament Street) all as shown on **Figure 7-1**. The Jarvis Street CSO is deep (greater than 10m below grade), and outlets to the Jarvis Street slip and thus is at the periphery of the East Bayfront project.

The Sherbourne CSO is relatively shallow, with a cover of approximately two metres at Queens Quay. This CSO provides somewhat of a barrier to underground services through the East Bayfront, as it is a large 3.0 x 3.0m box section. The Sherbourne CSO was constructed in approximately 1929-1931 north of Queens Quay, and in the 1950s south of Queens Quay.

The Small Street (or Parliament) CSO is again shallow with approximately 2.5m of cover at Queens Quay. This pipe bends south of Queens Quay to avoid the existing warehouse at 261 Queens Quay, and outlets directly into the harbour at the end of the Parliament slip (Baird, 2007). Detailed underground locating of this sewer is required at the detailed planning stage for this area of the EBF. Waterfront Toronto is investigating the possibility of relocating this CSO to a proposed right-of-way as the current alignment presents challenges with respect to the utility of the surrounding area for development. The Baird report identified a third potential CSO within Parliament slip. A review of existing plans indicates that the opening in the dockwall is actually a water intake for the former Gooderham and Worts Distillery (the basis of the Distillery district). This is assumed to be non-functioning and will be blocked with the installation of the proposed stormwater management facility (**Section 5**).

Discussions with City of Toronto Staff have revealed that a Class Environmental Assessment to eliminate the CSO discharges to the lake is underway by MMM Group. However, it is not anticipated that disconnection of the CSOs to the lake will occur within the initial phases of the East Bayfront. As such, TMIG and Waterfront Toronto have been instructed by the City of Toronto to work around the CSOs, which will be brought offline in due time.

As described further in **Section 7.3.1**, the CSOs will form an integral part of the major system drainage for the East Bayfront and will have to be left in place after the flows north of Queens Quay are intercepted.

7.3 Proposed Storm Drainage

The East Bayfront Class Environmental Assessment Master Plan considered a dual pipe, “clean and dirty,” storm sewer system for the East Bayfront, along with major overland flow routes. As proposed, this system would require two sets of storm sewers across the East Bayfront: one to convey “clean” runoff from rooftops and landscaped areas, and another to convey runoff from parking areas and roads. Runoff was to be collected for the “dirty” system and treatment provided by sedimentation in tanks. Both systems would be discharged through a UV disinfection system, prior to discharge to the lake. In consultation with Waterfront Toronto and the City of Toronto, this dual storm sewer system concept has been amended to utilize a single storm sewer pipe with enhanced on-site and conveyance controls as more fully detailed in **Section 4**.

The intention of the proposed storm drainage system is to provide an outlet for minor system flows, as well as safe conveyance for flows up to and including the 100-year return period event. In compliance with the City of Toronto Wet Weather Flow Master Plan, the minor drainage system will be designed to convey rainfall originating from a two-year return-period event. The East Bayfront Class Environmental Assessment Master Plan suggested that the design of the minor drainage system should be to a five-year return-period level for the combined “clean” and “dirty” flows but provided no basis for that decision. A two year level is recommended to comply with the WWFMP and to follow the sustainability guidelines to realize the benefit of minimizing infrastructure. In addition, smaller pipes transmit flow with a higher velocity allowing for more frequent attainment of self-cleansing velocity within the pipe.

Since the system will be submerged below lake levels, it will be designed on a hydraulic grade line basis. All minor system pipes will be designed as pressure pipes, since they will be submerged most, if not all of the time. The pipes will be designed to achieve a minimum self-cleansing velocity of 0.7 m/s under the runoff generated by a 2-year return period event. In addition, the hydraulic grade line during both 100-year and 2-year return period events must not be allowed to exceed an elevation of 76.21m. This elevation was specifically chosen based on the lowest elevation of land within the East Bayfront Area, located at Jarvis Street and Queens Quay. The starting elevation for the calculation of the hydraulic grade line will be 75.6m. This elevation corresponds to the 100-year high water level in Lake Ontario. Although the stormwater management facility described in **Section 5** is proposed to operate at lower levels, the 100-year level accounts for a potential inundation of the pond during the occurrence of an extreme high level in the lake. Further refinement of the maximum HGL elevation may be possible following the detailed design of Queens Quay.

Detailed review of the anticipated runoff coefficients corresponding to the proposed form of development proposed for East Bayfront is described in **Section 4.4**. The derivation of runoff coefficients includes consideration for the commitment to implement sustainable development technologies such as green roofs and rainwater harvesting. The following table summarizes the runoff coefficients for the 2-year and 100-year return period events, respectively. As the sizing of infrastructure is premised on the established runoff coefficients, implementation of the appropriate runoff reduction measures for each development parcel is critical to the function of the community as a whole.

Table 7-1: East Bayfront Runoff Coefficients

Land Use	2-Year Runoff Coefficient	100-Year Runoff Coefficient
Roads and Walkways, Hard Landscaped Areas	0.95	0.95
“Green” Parks	0.50	0.50
Buildings South of Queens Quay	0.44	0.76
Buildings North of Queens Quay, Pre-development	0.95	0.95
Buildings North of Queens Quay, Post-development	0.78	0.89

As outlined in **Section 4** stormwater quality control will be accomplished as part of a treatment train. The proposed stormwater drainage system will utilize catchbasins with Goss traps to capture floatable debris entering the catchbasin. In addition, oil-grit separators (OGS’s) will be used for pre-treatment of East Bayfront drainage. The OGS’s will settle out larger particles and capture additional floatables. Finally, the proposed sewers will discharge to the stormwater management facility described in **Section 5**, and ultimately to the UV disinfection system described in **Section 5.8.**

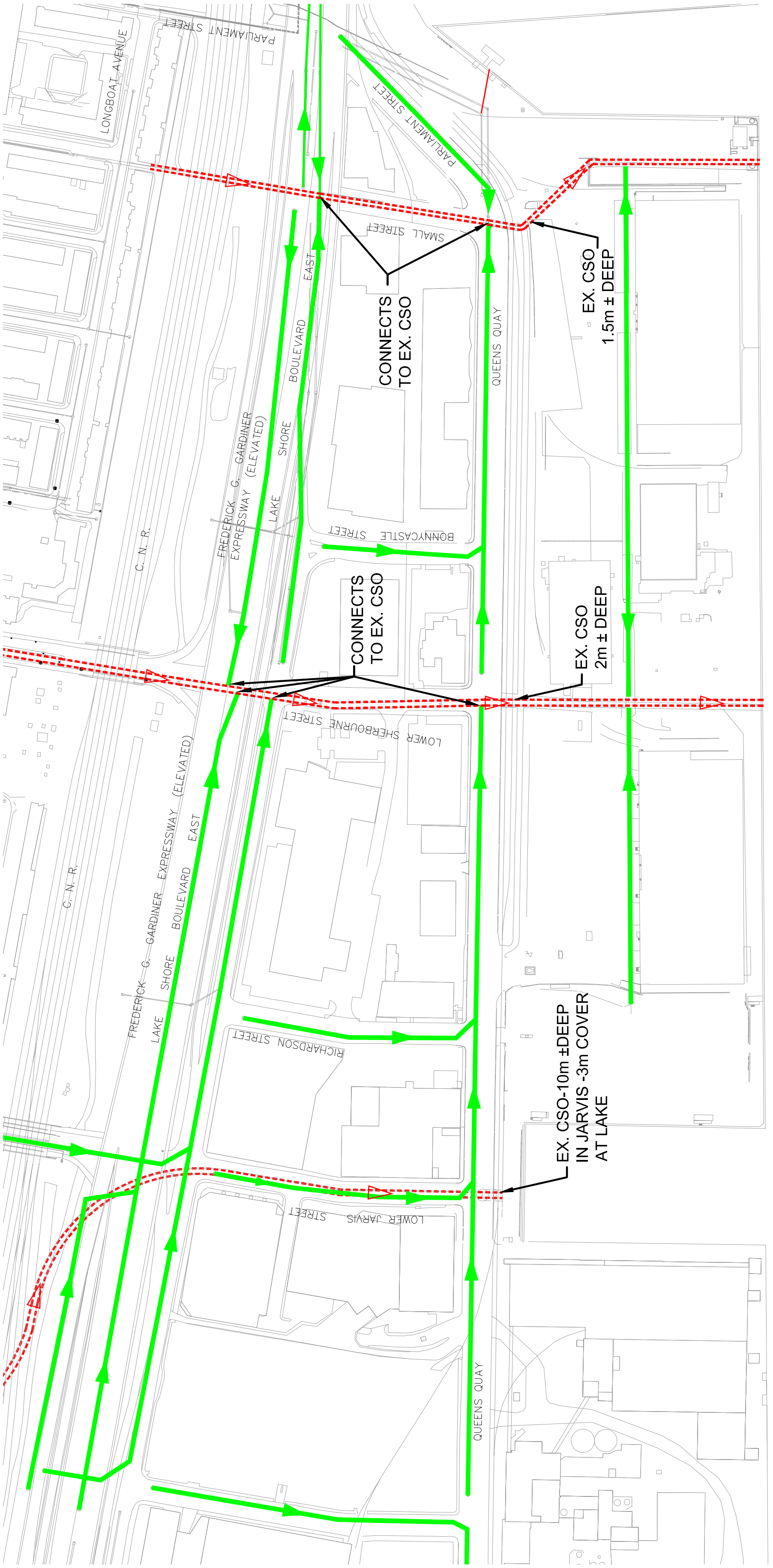
7.3.1 Phase 1 Storm Drainage

Storm servicing for Dockside will follow conventional minor/major storm system drainage planning. The minor system, designed on a 2-year return period will be collected in storm sewers. The major system will be drained to the roadways and directed to a suitable outlet.

The minor system will collect drainage from the internal development blocks, roads, Jarvis Slip Park, and Sherbourne Park. Due to the difficulty in constructing storm sewers along the length of the promenade through an area identified as containing structural tie-backs for the dock wall (Baird 2007), runoff from the lakefront promenade will be drained directly to the lake or to the proposed tree planting beds to assist with irrigation. The proposed minor system drainage for Dockside is shown on **Figure 7-2**. Storm sewer design sheets are included in **Appendix 2b**.

In order to convey sanitary drainage from Dockside to the existing sanitary sewer on Richardson Street, a storm sewer on Queens Quay will need to be reconstructed from Richardson Street to the Sherbourne CSO. The existing 900mm diameter sewer will be replaced with a 1200mm diameter sewer, expanding to an 1800mm sewer further east on Queens Quay towards the extension of Sherbourne Street. The sewer alignment will be relocated to the south side of the Queens Quay right-of-way and accommodates two possible outcomes of the Road Class EA being done on Queens Quay. Construction of this sewer, prior to the completion of the Road EA is a task to be undertaken at the risk of Waterfront Toronto, as neither cross section is guaranteed to be accepted. If the final accepted cross section varies from those presented in this report, there may be a need to re-align this sewer.

The proposed trunk storm sewer will be directed south from Queens Quay onto the proposed east leg of Street F and across Sherbourne Park. In Sherbourne Park under Phase 1 conditions, the storm sewer will connect to the Sherbourne CSO but will be rerouted along the southerly extension of Street F and out to the proposed stormwater management facility only once the facility is complete. The connection to the SWM facility will be located at least 2m above the bottom of the facility. At this point, the connection to the CSO will be blocked off at a manhole within an easement along the extension of Street F. In order to make the connection through the dockwall, the reinforcement of the dockwall by the proposed SWM facility needs to be completed at the connection point for structural reasons.



LEGEND:

🟩 ➤	EXISTING STORM SEWERS
🟥 ▷	EXISTING CSOs

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EXISTING STORM SEWERS

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FIGURE 7-1

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All construction within Sherbourne Park will be completed if possible under the Dockside construction program, as Waterfront Toronto and the City have expressed concerns not to excavate in the park after it has been completed.

An external drainage area west of Jarvis street is to be connected to the East Bayfront storm drainage system. The existing sewers in this area already drain to the Sherbourne Street CSO. Therefore, considering the possible improvements to the area provided by development of East Bayfront, this drainage area will be accepted into the storm drainage system and drained toward the proposed oil-grit separator and, eventually, the stormwater management facility, allowing runoff to be “cleaned” in the process.

Minor system drainage from north of Dockside on Jarvis and Richardson Streets will be taken into the re-constructed sewer on Queens Quay. An analysis on the impact to the storm sewers on Richardson and Jarvis was conducted proposing construction of Dockside sewers and along Queens Quay, and leaving Jarvis and Richardson as existing. These sewers are currently indicated as over capacity on the City’s HVM modeling. The analysis shows that the existing sewers on Jarvis and Richardson will continue to be over capacity during a 2-year return period rainfall event after reconstruction of Dockside. However, these sewers will benefit by re-building the trunk storm sewer on Queens Quay.

The major system drainage from Dockside will be directed to Queens Quay as proposed in the East Bayfront Class Environmental Assessment Master Plan. Drainage will then be directed either to Jarvis Street Slip, or to a proposed low point near the intersection of Sherbourne and Queens Quay. It is proposed to reconstruct Queens Quay ultimately using a “sawtooth” profile to achieve positive overland drainage. A proposed profile for Queens Quay is shown in **Figure 15-2**. The proposed “sawtooth” profile defines three definite low points, with the overall direction of overland drainage maintained in one direction, at a slope considerably lower than typical minimum standards. In this case, the theoretical maximum depth of ponding at a “sawtooth” low point would be 0.1m. The profile was developed to limit filling on proposed Queens Quay to a maximum of 0.3m. There are numerous shallow utilities buried below the road surface of Queen Quay, including a Hydro One 115 kV transmission line so proposed cutting was limited to 0.1m.

At Sherbourne and Queens Quay, a total capture inlet is proposed to capture major system flows and direct them to the Sherbourne CSO. The Sherbourne Street CSO will have improved capacity for the major system drainage when the existing minor system drainage from the EBF is removed and taken to the proposed stormwater management facility. This analysis is demonstrated in **Appendix 2c**.

It is not proposed to reconstruct Queens Quay during the construction of Dockside. However, Queens Quay as noted above does not have a defined flow path for overland drainage. But under Phase 1 conditions, the major drainage to Queens Quay will be reduced from existing levels and thus considered an improvement. Queens Quay is anticipated to be reconstructed approximately one to two years after Dockside is serviced. It would be premature at this time to reconstruct Queens Quay, as Queens Quay is subject to two Municipal Class Environmental Assessment processes currently underway. Major system drainage for the entire East Bayfront is shown on **Figure 7-3**.

Major system drainage for the lands north of Queens Quay is generally from north to south. Under Dockside (Phase 1) development, reconstruction of the roads, along with the major and minor storm systems in these areas, will not be undertaken. Current drainage and grading patterns in these areas cannot be changed without changes to the construction of the existing buildings, causing inconvenience and disruption to the current tenants.

Quality treatment of storm runoff from the proposed Dockside lands will be ultimately accommodated in the proposed stormwater management facility presented in **Section 5**. It is not anticipated that that the ultimate stormwater management facility will be in place prior to development in Dockside. Accordingly, as more fully described in **Section 4.5**, an oil grit separator (OGS) is proposed in conjunction with the development of Dockside. It will be located at the intersection of the South and East legs of Street F and will provide treatment of flows from Dockside, Queens Quay, the external drainage area to the west, and lands west of Sherbourne, north of Queens Quay. The role of the OGS in the stormwater management plan is discussed in further detail in **Section 4.5**.

Some areas tributary to the proposed oil-grit separator are not to be developed as part of Phase 1. Hence any reduction of total suspended solid content from these areas may be viewed as a bonus – i.e. over and above the requirements. Within this context, the provision of treatment of the existing areas, when combined with the 50% total suspended solid reduction proposed for the Phase 1 area, may be viewed as a net reduction of 100% when considering the Phase 1 area alone. This statement demonstrates that, while recognizing that the oil-grit separation device provides a maximum suspended solid reduction of 50% per the Wet Weather Flow criteria, the provision of treatment of the existing area yields a net water quality benefit greater than that suggested by the 50% value.

7.3.1 Full East Bayfront Storm Drainage

Under full buildout, all minor system drainage from the East Bayfront will be directed to the proposed stormwater management facility described in **Section 5**. Minor system drainage from the EBF will be collected in a trunk storm sewer on Queens Quay, and drained through internal roads to the proposed storm water management facility. An additional trunk sewer to drain development on the east side of the East Bayfront to the proposed stormwater management facility will need to be constructed east of Sherbourne Park, likely in the extension of the Bonnycastle street alignment to connect drainage from Bayside, Queens Quay and areas to the north. The direction for minor drainage from this area will be better known once the final road and public spaces layouts are determined for the area. The anticipated minor storm sewer system is shown on **Figure 7-2**.

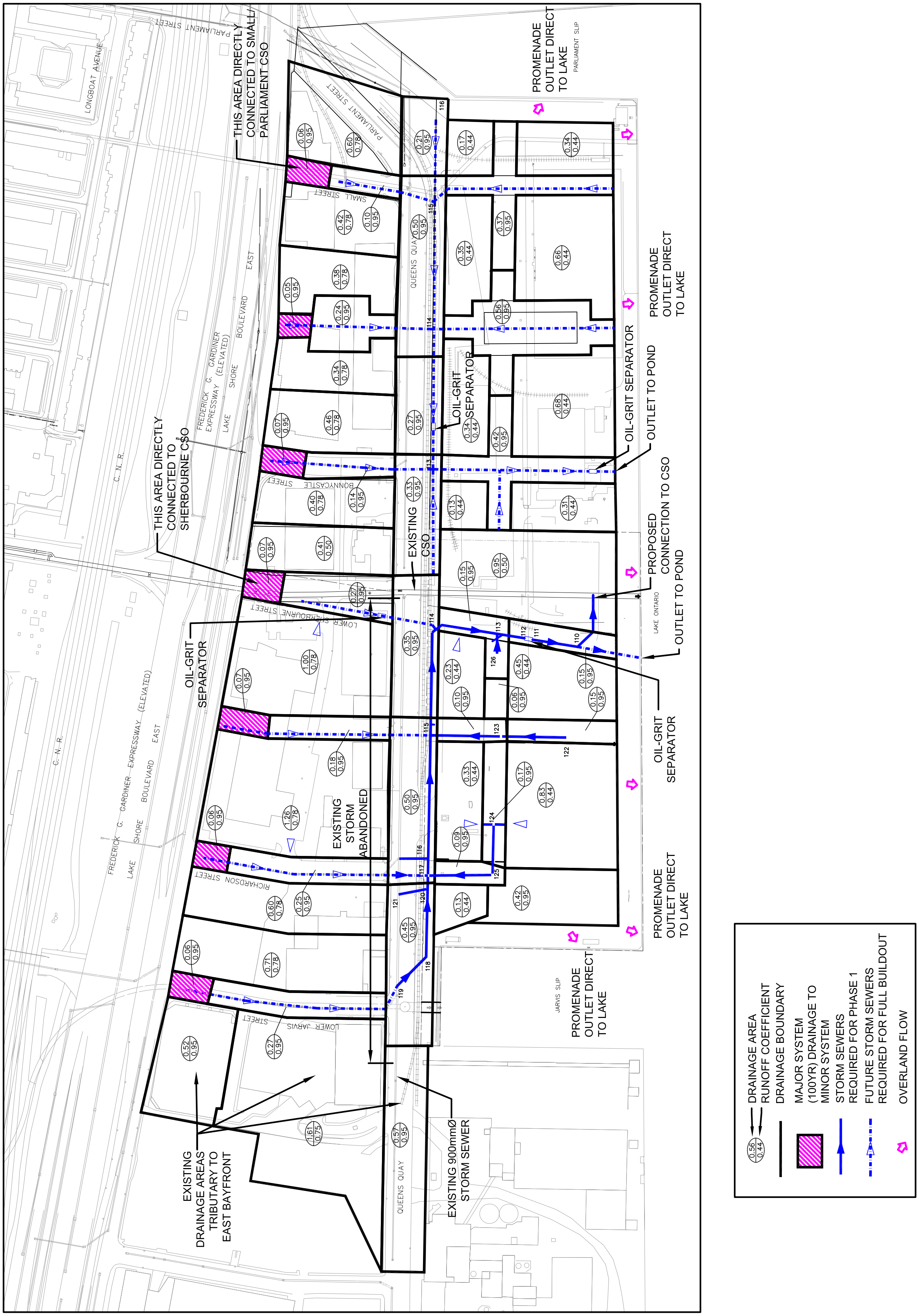
Major System drainage will be conveyed towards Queens Quay from all areas of the EBF, with the exception of the water's edge promenade which will drain directly to the lake. The current elevation of the dockwall through the East Bayfront is approximately one metre higher than Queens Quay, preventing the conveyance of overland flow from Queens Quay to the lake. It is proposed to reconstruct Queens Quay with a "sawtooth" profile to facilitate major system drainage overland to specific outlets. The proposed major system will be conveyed to three outlets: Jarvis Street Slip, Sherbourne Street CSO and Parliament Street Slip. As mentioned in **Section 7.3.1**, the Sherbourne Street CSO will have improved capacity for the major system drainage since the additional minor system drainage from the EBF will be removed and taken to the proposed stormwater management facility. This analysis is demonstrated in **Appendix 2c**.

The proposed major system outlets to Jarvis and Parliament Street slips will have to be designed with input from the TTC to confirm their requirements regarding ponding under major system events on the LRT lines.

Conceptual design of the major overland flow outlets have been considered as part of this report. At Lower Jarvis Street and Queens Quay, it is anticipated that a surface overland drainage route can be achieved. However, this will involve the conversion of the south curbline to a depressed "rollover" type curb to facilitate drainage without flooding existing properties on the north side of Queens Quay.

At Small Street and Parliament Street there are two different options available, the first of which is to drain overland flow directly into the north end of Parliament Street Slip. This portion of the slip will be operational as part of the proposed stormwater management facility, which is designed to accommodate minor system flows only. However, conveyance of the major flows will be provided from the facility to the Lake on an emergency overflow basis which is only anticipated to occur at intervals less frequently than every two years. The direct overflow of the facility to the Lake and, as such the bypass of UV treatment for infrequent events, is considered part of the operational characteristics of the facility.

A secondary option is to reconstruct the portion of the Small Street CSO south of Queens Quay with additional capacity to convey overland flow from the eastern portion of the EBF. The reconstruction of the CSO has several additional benefits: (i) Waterfront Toronto has expressed the desire to relocate the CSO into a right-of-way and thus improve the development utility of the surrounding parcels; and (ii) with the CSO lowered and the grade changed to a low point at Small Street, the proposed Queens Quay sanitary trunk could be brought across the CSO at a depth below finished grade to provide additional separation between the sanitary sewer and utilities and proposed surface treatments such as trees. Both of these options need to be considered prior to and as part of detailed design.



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PROPOSED MINOR SYSTEM DRAINAGE PLAN

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FIGURE 7-2

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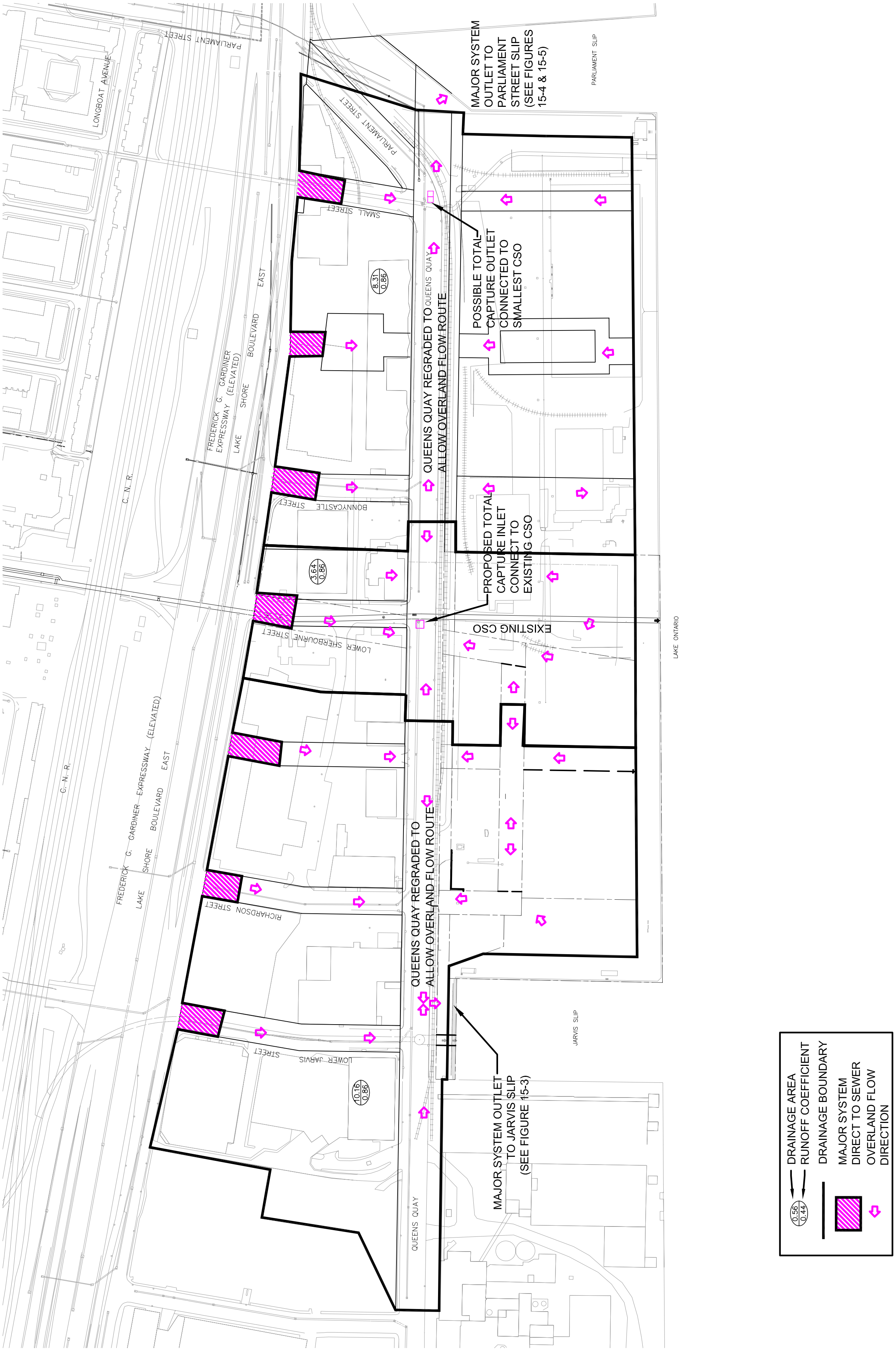
The specifications for the total capture outlets on Queens Quay at Lower Sherbourne, Lower Jarvis and Small Street/Parliament Slip will have to be determined when detailed design of Queens Quay, Lower Sherbourne and the proposed stormwater management facility are undertaken.

Major system drainage from the north of Queens Quay, including external areas north of Lakeshore will be conveyed south towards Queens Quay and eventually to the proposed stormwater management facility. The quantity of flow encountered over Lakeshore under major system events is difficult to determine, as it requires consideration of a complicated interconnection of drainage areas to CSOs, local sewers and spill conditions to and from dedicated storm/sanitary/combined systems. A topographic survey undertaken in 2008 indicated that the ground elevation of Lakeshore Boulevard at the north limit of the EBF is level to slightly higher in elevation than Queens Quay. Reconstruction of the proposed north-south roads will allow for conveyance of flows from Lakeshore to Queens Quay. The maximum differential from the Lakeshore Boulevard gutter line to the high point on each north south road is proposed to be limited to 0.15m. It is intended that this will either maintain or improve the poor existing overland drainage conditions encountered on Lakeshore Boulevard. Once flow from Lakeshore Boulevard is directed to Queens Quay, it will flow to the outlets noted above. Refer to **Figure 15-1** for the conceptual grading plan for the East Bayfront.

Small sections of the minor storm system within the roads north of Queens Quay will also need to be designed to convey the storm flows up to 100-year flow conditions. This is required as this runoff would otherwise drain to Lakeshore Boulevard under major flow events which, as a major arterial road, is not designed with sufficient slope to convey major system flows. Since CSOs exist along Lower Sherbourne and Small Streets, the minor portions of these streets, which would otherwise drain towards Lakeshore Boulevard, will discharge 100-year flows directly to the CSOs. Detailed design of the intersections on the north-south roads that meet Lakeshore will have to incorporate sufficient capture to limit the direction of 100-year flows onto Lakeshore. The proposed major system flow network is illustrated on **Figure 7-3**.

The East Bayfront Class Environmental Assessment Master Plan suggested using overland flow routes and culverts to convey portions of the major and minor drainage from the north of Queens Quay to the stormwater management facility south of Queens Quay. This approach has not been adopted as part of the functional design as it requires the conveyance of untreated runoff through high occupancy areas. Additionally, open ditches and culverts would not fit the urban design intention of the area, and the grade differential across most of this area is zero making implementation of this option impractical.



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PROPOSED MAJOR SYSTEM DRAINAGE PLAN

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FIGURE 7-3

8 Sanitary Servicing

This section describes the existing sanitary sewer system, the proposed design criteria, and the required sanitary sewer servicing for the East Bayfront. The main objectives are to determine sanitary infrastructure requirements for each development stage.

The majority of existing sanitary sewers within East Bayfront drain to the Scott Street Sewage Pumping Station (SSPS), however, the small portion of the East Bayfront lands east of Parliament Street drains directly to the Ashbridge's Bay Sewage Treatment Plant. Analyses have been undertaken to determine the required infrastructure within the EBF area and the required upgrades to the existing system to meet the needs of each of the development stages of the EBF.

Implementation of sanitary sewer upgrades must always be done with the long-term view (30 years or greater) in mind. As described in **Section 3,** development will take place in roughly three stages: Corus Building (occupancy 2010), the remainder of Phase 1 (estimated occupancy between 2010 and 2015), and Full Buildout by 2031. It is necessary to determine the required infrastructure for each stage; however, infrastructure installed at any stage must be suitable for the long-term requirements. For example, if Phase 1 development required a 300mm-diameter sewer at a certain location, but full buildout required a 450mm-diameter sewer in that same location, then the 450mm-diameter sewer would be installed as part of the Phase 1 servicing works. Additionally, any downstream impacts of a replacement sewer must be considered. For example, if a sewer requires lowering for Phase 1, all sewers downstream of that point will likely also require replacement during Phase 1 whether the additional capacity is required for Phase 1 or not.

The sections below describe the required sanitary sewer servicing for the East Bayfront, beginning with existing conditions and then working backwards from Full Buildout. In this manner, the ultimate (Buildout) requirements for servicing will be known, and the requirements for each earlier stage can be viewed within that context. Recommended infrastructure for each stage will then accurately acknowledge the long-term needs as well.

As discussed below, conveyance of sewage generated within the East Bayfront includes sewers that are outside of the East Bayfront Development Area. Replacement of some of these sewers and expansion of the Scott Street Sewage Pumping Station (SSPS) are required to support each stage of development. As such, the affected sewers are included in the general analysis and requirements for their replacement are carried, as appropriate, with each stage of development. A separate summary of their upgrade requirements is presented at the end of the section.

8.1 Existing Sanitary Services

8.1.1 Scott Street Sewage Pumping Station

The majority of the EBF area drains to the Scott Street Sewage Pumping Station (SSPS), with only a small portion draining east directly towards the Ashbridge's Bay Sewage Treatment Plant. The SSPS is located on Scott Street between Front Street and the Esplanade, as shown on **Figure 8-1**. The station lifts sewage to a gravity sewer which in turn outlets to the Low Level Interceptor (LLI). A section showing the station's key operating components is shown on **Figure 8-1**. The station was apparently constructed prior to the requirement for a Certificate of Approval from the Ontario Ministry of the Environment (MOE). Accordingly, it has no formal rated pumping capacity. The City commissioned a report (Gore and Storrie, 1995; see **Appendix 3b**) that stated the station could pump 396 L/s against a Total Dynamic Head (TDH) of 7.3m. It did not consider actual operating conditions when assessing the capacity. That report also stated that the capacity of the sewer leading to the LLI was approximately 990 L/s. (It will be seen later that Buildout flows are anticipated to be much less than 990 L/s).

A detailed review of the SSPS was undertaken by TMIG to determine its actual pumping capacity based on operational parameters, and this review is attached as **Appendix 3a**. The analysis is based on actual recent pumping station flow data provided by the City (see **Appendix 3e**) and coordinated with current (2006) Census data (see **Appendix 3f**) and rainfall data (see **Appendix 3g**). A summary of the approach and results is provided below.

The SSPS has three pumps: two rated at 198L/s (at 7.3m TDH), and one at a slightly higher capacity. Since firm capacity is based on the largest pump being out of service, these two smaller pumps – operating in parallel – were considered to represent the firm capacity of the station. The 1995 G&S report included pump curves and these matched with the rated point noted above. Flow data were reviewed and determined that the pumps were not operating up to their curves. This is not surprising, considering that the impellers are no longer commercially available and are now replaced based on casts made of the existing impellers. **Figure 8-3** shows the actual pump curve expected from the pumps.

The final sewer entering the station is a 1.07m x 1.37m brick sewer with a capacity of 4,600 L/s; i.e., far in excess of any planned flows. The second last sewer is a 450 mm-diameter sewer on a slope of 0.8% giving it a capacity of 277 L/s. As this is less than the anticipated flow rate entering the station, it has been assumed that this sewer is filled to its obvert; i.e. outlet control. The elevation of the obvert is then taken as the maximum allowable liquid level in the wet well (since there will be no losses in the 4,600L/s-capacity final sewer) and is 2.47m above the floor of the wet well sump.

Finally, the friction losses within the station were calculated and the system curve was developed. **Figure 8-3** shows the intersection of the firm pump capacity curve and the system curve, indicating that the station has a firm capacity of 405L/s, which is approximately equal to the estimated peak flow rate (see **Appendix 3m**).

The station's firm capacity is also approximately 40 L/s greater than the highest instantaneous flow rate of the past two years (365 L/s, recorded April 11, 2008). Operations staff have indicated that no overflows at the SSPS have occurred in the known history of the station (see **Appendix 3i**, Meeting Record). The basement of the Sony Centre has reportedly flooded in the past, but it is suspected that this was the result of failure of the ejector pumps within that building.

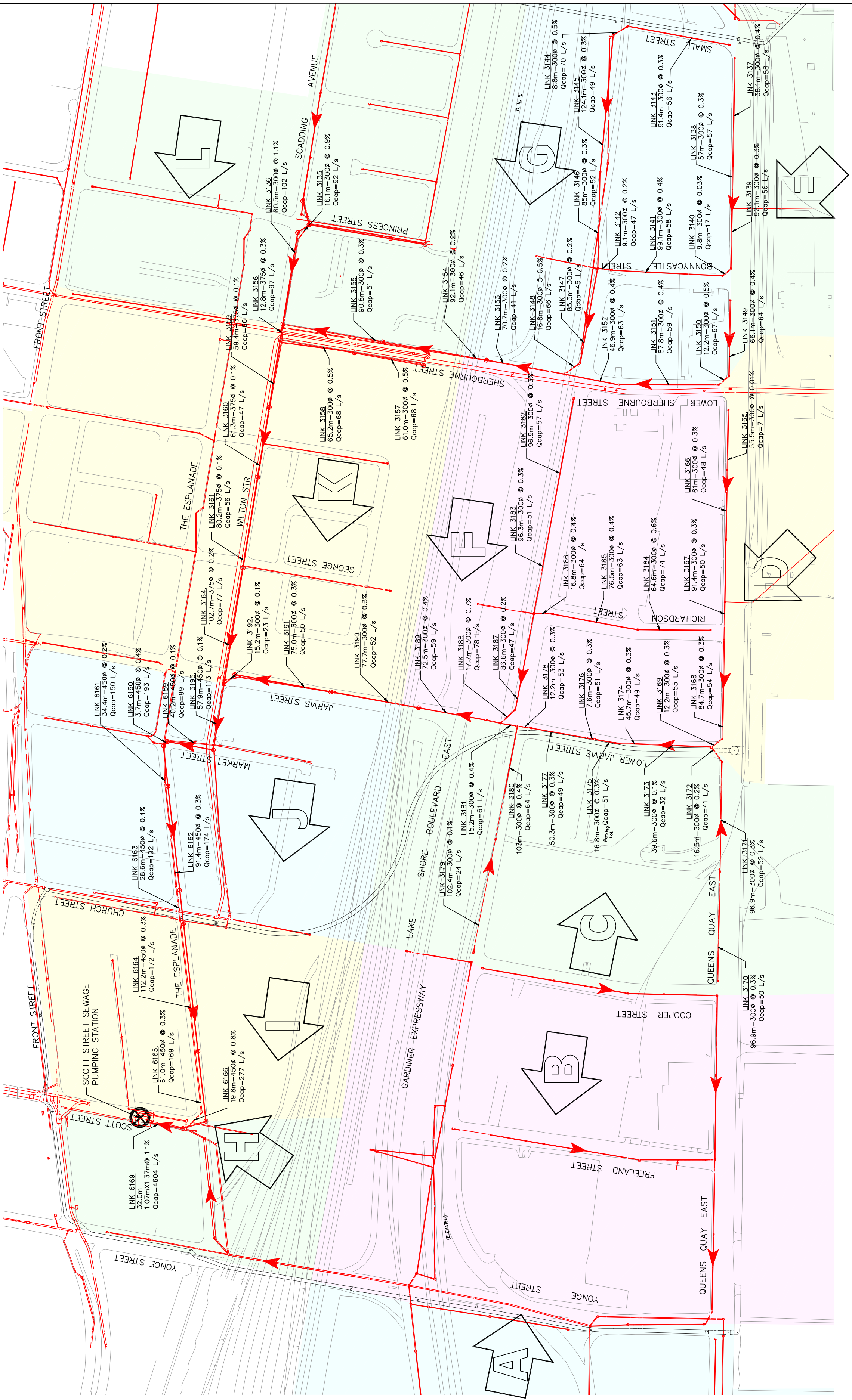
8.1.1 Collection System

EBF existing sanitary collection system is shown on **Figure 8-1**. Generally, sewage is collected via a sewer under Jarvis Street for the west side of the EBF and via a sewer under Sherbourne Street for the east side. As shown on **Figure 8-1**, the sewer under Jarvis Street connects to a sewer on Wilton Street flowing west, which connects to the Esplanade by the St. Lawrence Market and ultimately to the Scott Street SPS. The Sherbourne Street sewer also runs north to Wilton Street before proceeding west to meet up with drainage from the west side at Jarvis and Wilton. At Sherbourne and Wilton, the existing 450mm cast iron sanitary sewer is routed directly through the Sherbourne CSO.

The "Link" references on the sewer runs shown on **Figure 8-1** refer to the designation in the City's model which is provided in **Appendix 3h**.

Record drawings for existing sewers were provided by the City. The list of received drawings is included in **Appendix 3c**. A drawing review indicated that many of the existing sewers are vitrified clay pipe. These sewers were built with successive land reclamation to around 1930. Some of the sewers under The Esplanade appear to have been constructed well before 1930. All of the original sewers in the drainage area are now indicated to be dedicated sanitary sewers (with the exception of the large CSOs). The last combined sewer on the drainage route was on The Esplanade from Market Street to Scott Street, and this was, according to the City, separated in 1990.

It should be noted, though, that the sanitary sewer system does not function as a true separated sanitary sewer. Rather, it should be considered 'partially-separated', as only road drainage was initially directed to the new storm sewers. Any buildings built while the combined sewers were in place would generally only have a single service connection, conveying all of the domestic flows and storm flows (roof and foundation drains) to the original combined sewer. As there was no practical method of separating the building drainage, the roof and foundation drains are still connected to the sanitary sewers. Any buildings that have been constructed post-separation should have completely separate sewer systems, directing roof and foundation drains to the storm sewers.



File: G:\Projects\2007\07135 • Waterfront Toronto - East Bayfront\Drawings\FIGURES\FSR\FIG 08-1-8-6-11.dwg Layout: FIG 8-1 EX SAN Date: Mar 20, 2009 - 1:53pm Edit By: l.stone

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LEGEND:

🟦 🟨 🟩 🟪 SUB-DRAINAGE AREAS

⟵ EX. SANITARY SEWER

EXISTING SANITARY SEWERS

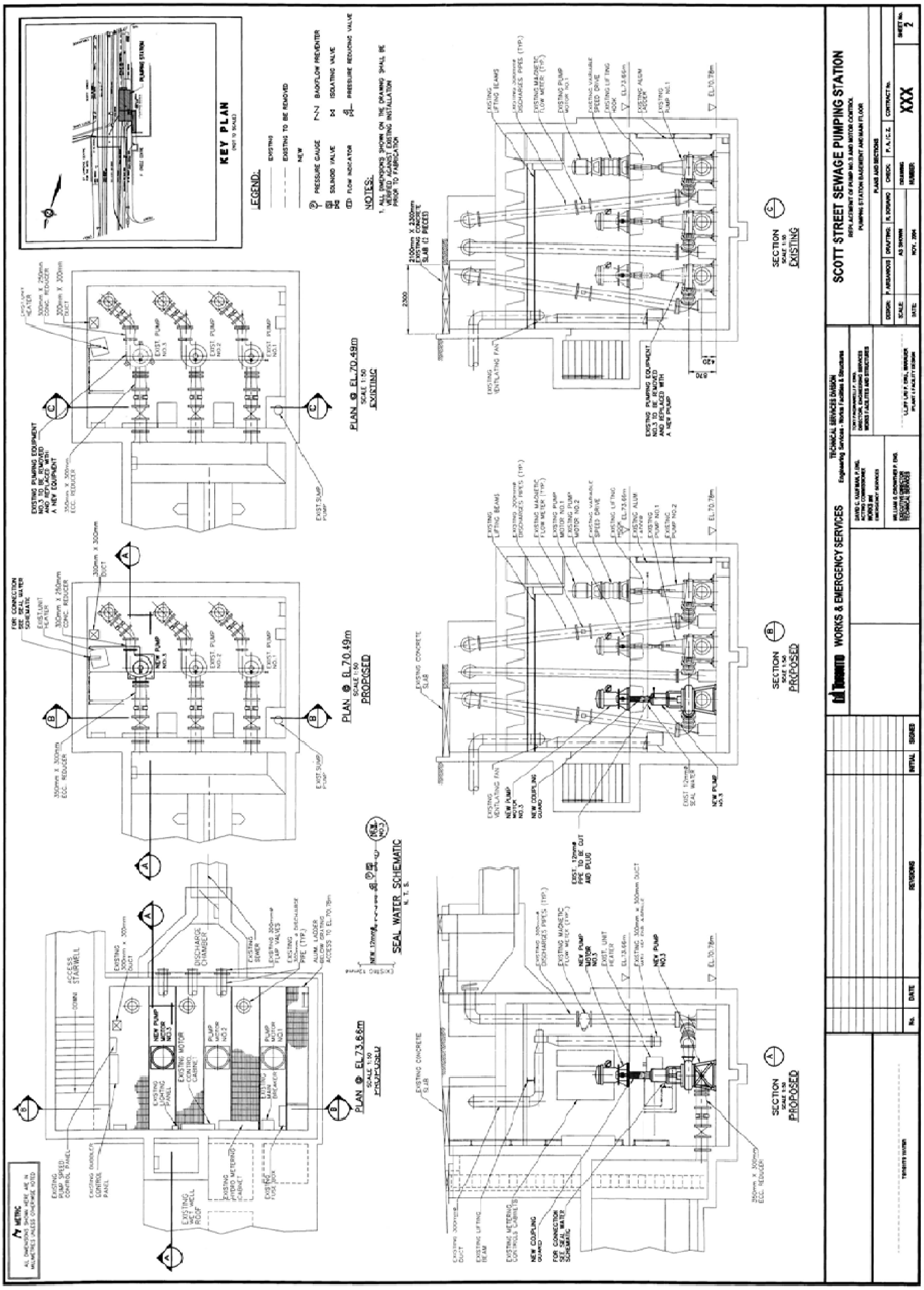
SCOTT STREET SEWAGE PUMPING STATION
SUB-DRAINAGE AREAS

DATE:
MAR 2009

SCALE:
50 25 0 50

PROJECT No.
07135

FIGURE 8-1



LEGEND:

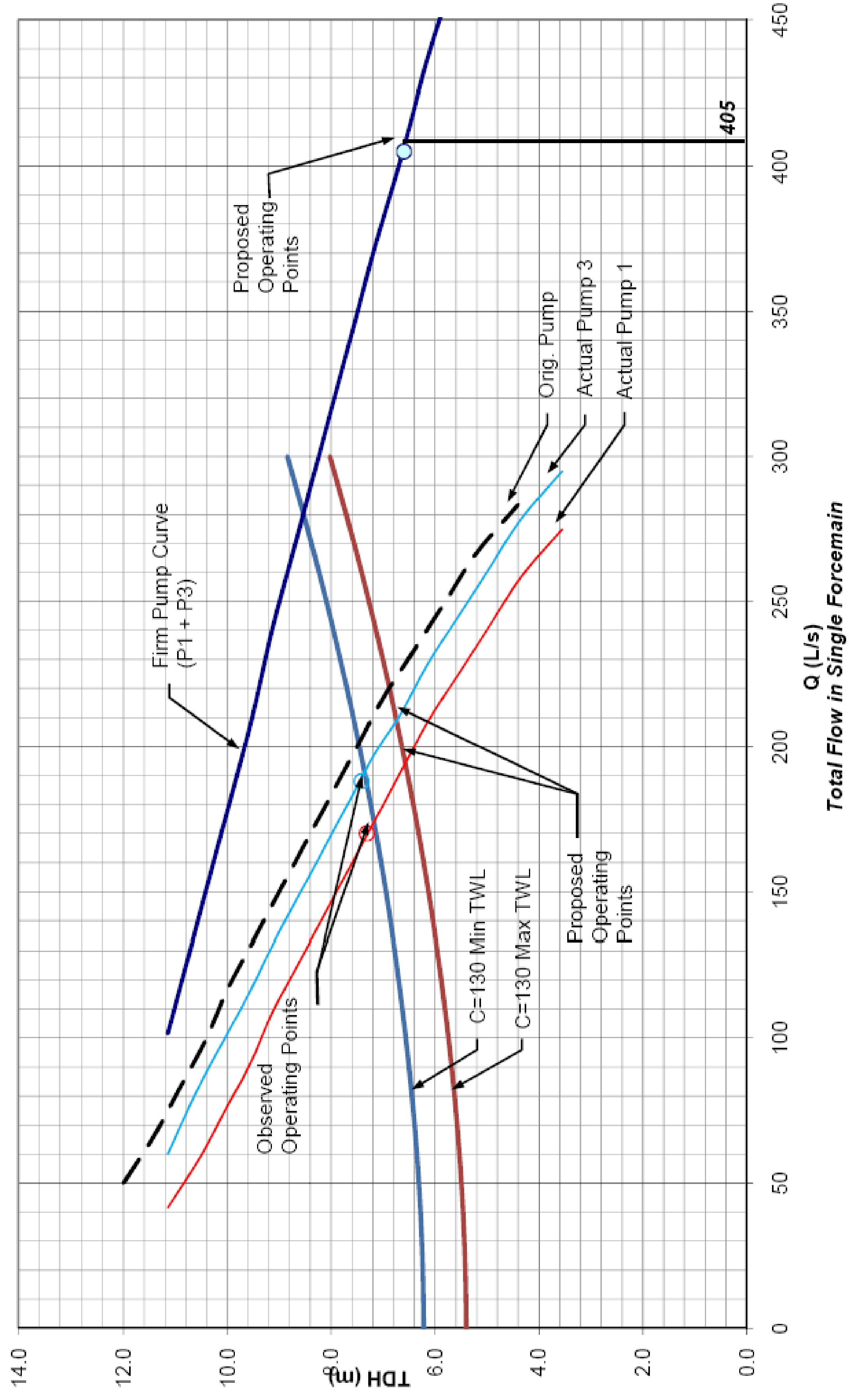
SCOTT STREET SEWAGE PUMPING STATION CONFIGURATION

DATE: MAR 2009

PROJECT No. 07135

SCALE: NTS

FIGURE 8-2



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SCOTT STREET SPS PUMP CURVES AND SYSTEM CURVES FOR THE EXISTING 300 MM DISCHARGE PIPES

DATE: MAR 2009	PROJECT No. 07135
SCALE: NTS	FIGURE 8-3

Furthermore, review of record drawings indicates that there are three locations within the eastern portion of the Scott Street SPS catchment area where there could be overflows between the sanitary sewer and storm/combined sewers:

1. The Esplanade and Scott Street;
2. The Esplanade and Market Street; and,
3. Front Street and Frederick Street.

It appears that the overflows were intended to provide relief to the sanitary sewer and Scott Street SPS. The elevations indicated on the drawings, however, show that the overflow invert elevations could be below high Lake Ontario water levels, thereby permitting flow from the storm/combined sewers into the sanitary sewer and the Scott Street SPS.

While vitrified clay pipe serving as a sanitary sewer can last for as long as 100 years, the typical lifespan is approximately 60 to 80 years (City of Vancouver). The sewers within the Scott Street sewer shed are approximately 75 years old. As such, the City of Toronto should conduct a detailed review of the existing sewer network and commence a replacement program. The sewers downstream of the East Bayfront should be replaced on the basis of age alone. The very high infiltration rate observed for existing sewers (1.65 L/ha/s as opposed to 0.26 L/ha/s expected for new development; see **Appendix 3a**) supports this statement.

Modeling was provided by City of Toronto staff for the sanitary sewer network to Scott Street SPS (see **Appendix 3h**). City staff have indicated that the modelling is approximately 20 years old and has not been updated to reflect upgrades such as the separation of the combined sewer under The Esplanade or more recent developments. As such, a revised hydraulic grade line (HGL) analysis was conducted (see **Appendix 3d**) which determined that the existing sewer, while surcharged in many areas, does convey flows for the existing development. City Operations staff comments that the pumping station has never overflowed (see **Appendix 3i**) lends some support to this statement.

Table 8-1 lists the capacity of the existing sewers and the flow rate and percent utilization under existing conditions. The existing sewers and their capacities are also shown on **Figure 8-1**.

Table 8-1: Capacity of Existing Sanitary Sewers

Street	*Pipe ID*	*Capacity (L/s)*	*Existing Flow (L/s)*	*Utilization (% full)*
Jarvis Street	3173	32	31	97%
Jarvis Street	3174	48	31	65%
Jarvis Street	3175	50	31	62%
Jarvis Street	3176	51	31	61%
Jarvis Street	3177	49	31	63%
Jarvis Street	3178	53	31	58%
Jarvis Street	3181	61	31	51%
Richardson Street	3184	74	40	54%
Richardson Street	3185	63	40	63%
Richardson Street	3186	63	40	63%
Lakeshore Boulevard	3187	47	40	85%
Lakeshore Boulevard	3188	79	40	51%
Jarvis Street	3189	59	66	112%
Jarvis Street	3190	52	66	127%
Jarvis Street	3191	50	66	132%
Jarvis Street	3192	24	66	275%
Queens Quay	3149	114	10	9%
Queens Quay	3150	67	10	15%
Sherbourne Street	3151	59	10	17%
Sherbourne Street	3152	63	10	16%
Sherbourne Street	3153	41	40	98%
Sherbourne Street	3154	45	40	89%
Sherbourne Street	3155	51	40	78%
Sherbourne Street	3156	98	78	80%
Wilton Street	3159	65	124	191%
Wilton Street	3160	48	124	258%
Wilton Street	3161	54	124	230%
Wilton Street	3164	77	124	161%
Wilton Street	3193	113	204	181%
Market Street	6159	100	204	204%
Market Street	6160	194	204	105%
Esplanade Street	6161	151	204	135%
Esplanade Street	6162	174	204	117%
Esplanade Street	6163	194	204	105%
Esplanade Street	6164	174	219	126%
Esplanade Street	6165	168	219	130%
Esplanade Street	6166	277	219	79%
Scott Street	6169	2984	397	13%
Note: Existing flows assume 240 Lpcd for existing residential lands, 240 L/empl/day for existing employment lands, and extraneous flows of 1.65 L/ha/s (base flow plus RDI/I).				

8.2 Sanitary Design Criteria

To date, the City of Toronto has not adopted formal design criteria for sanitary sewerage. Criteria for proposed developments have been forwarded for the City's consideration and are provided in **Table 8-2**. The proposed values are typical for dense urban environments utilizing the LEED standards. Existing and proposed development areas are recognized as having different flow generation rates, infiltration rates, and peaking factors due to the age of the system and current water efficiency standards.

Table 8-2: Sanitary Design Criteria

Criterion	*Observed*	*Proposed for Existing Development*	*Proposed for New Development*
Residential generation (per capita)	240 Lpcd	240 Lpcd	300 Lpcd
Employment Generation (per capita)	240 Lpcd	240 Lpcd	300 Lpcd
Dry-Weather Base Infiltration	40 L/s (0.29 L/s/ha)	0.29 L/ha/s	0 L/ha/s
Rainfall-Derived Infiltration/Inflow (RDI/I)	176 L/s (1.35 L/s/ha)	1.35 L/ha/s	0.26 L/ha/s
Peaking Factor	2.10 (80% of Harmon)	Observed	Harmon
Basis for Pipe Sizing			Peak Flow less than 100% of Pipe Capacity

The values for the existing areas were determined from the flow rate data provided by the City (**Appendix 3e**). Details on the derivation of each parameter are provided in **Appendix 3a** and summarized in the following sections.

The data used are "real" data for the existing system and represent all of the data available from the City over the past two years, and the quality of the data appears to be relatively consistent. That said, we have been advised that the flow meters being used consist of a "strap-on" installation (which are generally less accurate that magnetic flow meters). Meter calibration records have not been reviewed.

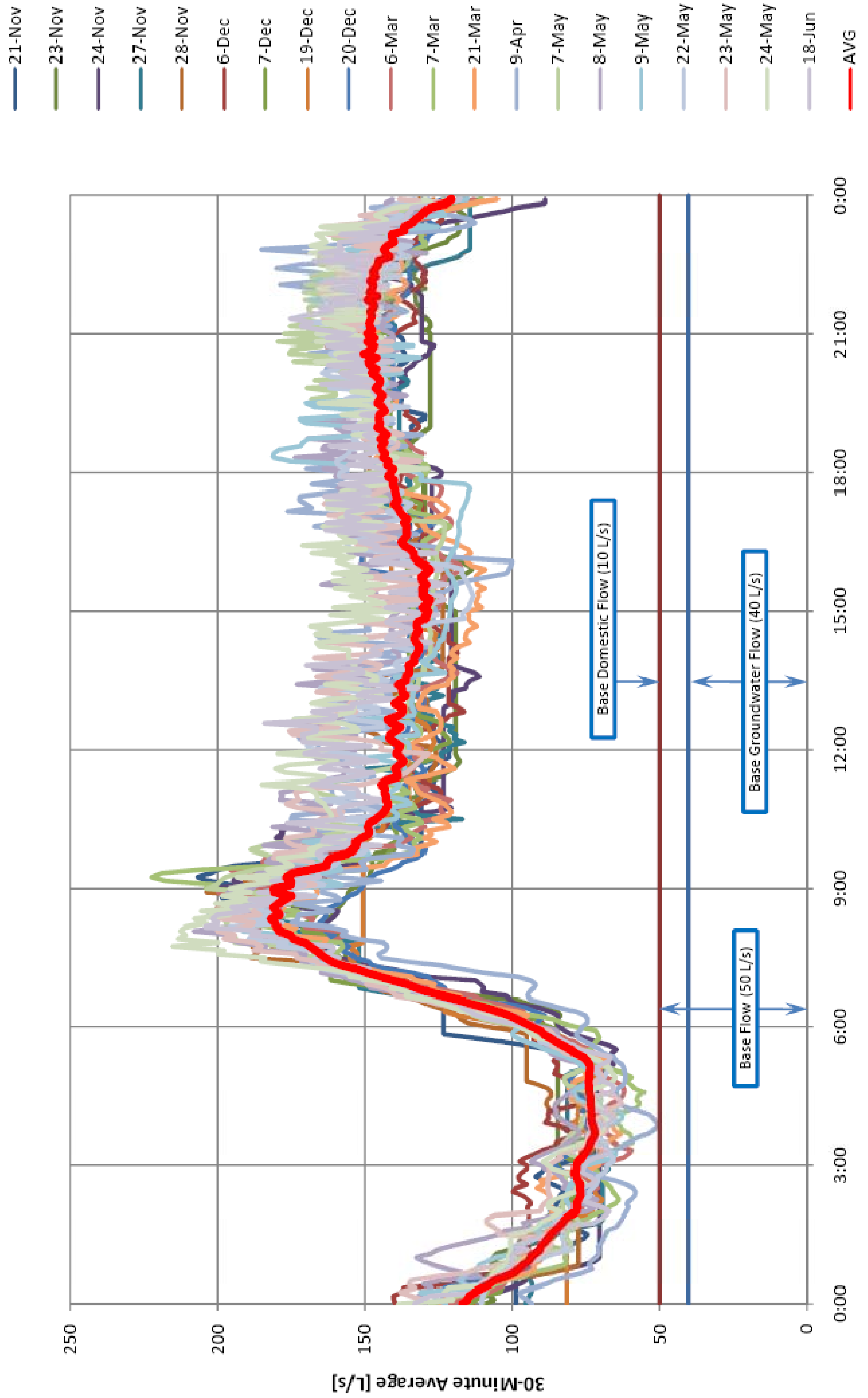
8.2.1 Dry Weather Base Infiltration

The flow data (**Appendix 3a**) indicate that a base flow rate of 50 L/s is always present in the SSPS drainage area (**Figure 8-4**). This flow consists of infiltration, building dewatering, and some domestic use. Short of a detailed investigation of every contributor, the actual split of the flows is unknown. For this report, it has been assumed that 40 L/s (80% of the base flow) is from infiltration and building dewatering and that the remainder is from actual domestic generation.

8.2.2 Per Capita Flow Generation

To determine the average-day contribution on a per-person basis, the effects of rain events must be factored out of the analysis. Flow records with several days of preceding dry weather were reviewed and the flows generated during those times were used in the analysis. The base flow of 40L/s was subtracted from the total flow and the average volume for weekdays and weekends was determined. The population and employment numbers for the existing area were established from 2006 Census data and City transportation data (**Appendices 3f** and **3n**, respectively) and determined the per capita sanitary sewage flow generation rate to be 240 Lpcd for weekdays (the days showing the highest flow rates).

The build-out population values were greater in the City transportation data than the Precinct plan. The more conservative transportation planning data were used.



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LEGEND:

CLASSIFICATION OF BASE DRY-WEATHER FLOW COMPONENTS

DATE: MAR 2009

PROJECT No. 07135

SCALE: NTS

FIGURE 8-4

8.2.3 Peaking Factor

The same flow data (less the base flow rate) were analyzed to determine the existing peaking factor. Dry-weather days were analyzed and the peak instantaneous flow rate was compared to the average daily flow rate. The ratio of those two numbers generated a peak factor at the SSPS of 2.1, as shown in **Figure 8-5**. It is noteworthy that this is approximately 85 percent of the value predicted from the Harmon Peak Factor formula for the same population (Harmon formula returns a peaking factor of 2.47 for a population of 30,643).

8.2.4 Extraneous Infiltration Rate

During rain events, additional flows can enter the sanitary sewer system through manhole lids, direct roof connections, perimeter drains, etc. To determine the infiltration rate for the SSPS drainage area, several rain events were investigated and the impact was measured. A typical rain event is shown on **Figure 8-6**. It can be seen that an increase of 154 L/s of flow was measured at the SSPS immediately during this event. Considering that the entire drainage area covers 137 ha, this equates to an extraneous infiltration rate of 1.35 L/ha/s.

Relevant criteria are listed in **Table 8-2** together with proposed values for existing and new development as described above.

The City's draft design criteria stipulate that the design criteria for wastewater flows be 300 Lpcd for all new development. Since this is 25% greater than the observed flows within the Scott Street SPS catchment area, it has been proposed and agreed to that no additional conservatism is required in the pipe design, and that the traditional practice of designing pipes to 125% of the design flow is not required. As such, the full pipe capacity is deemed to be available to convey the design flow.

The observed values (see **Appendix 3a**) were used for areas for which no major redevelopment of any kind is planned. Where regeneration of superstructures are expected, but infrastructure is unchanged, per capita generation rates for "New" development were used, but base flow and extraneous infiltration rates were taken as "observed." Where complete regeneration of superstructures and infrastructure are planned (e.g., the East Bayfront) all criteria were taken to be "new."

8.3 Proposed Sanitary Servicing

Because of the elevated water table and the anticipated poor soil conditions, it is proposed that the new sewers will be constructed out of fully-restrained pressure pipe. For pipe sizes of 600 mm and less, PVC pipe will be used. Concrete pressure pipe will be used for larger pipe sizes.

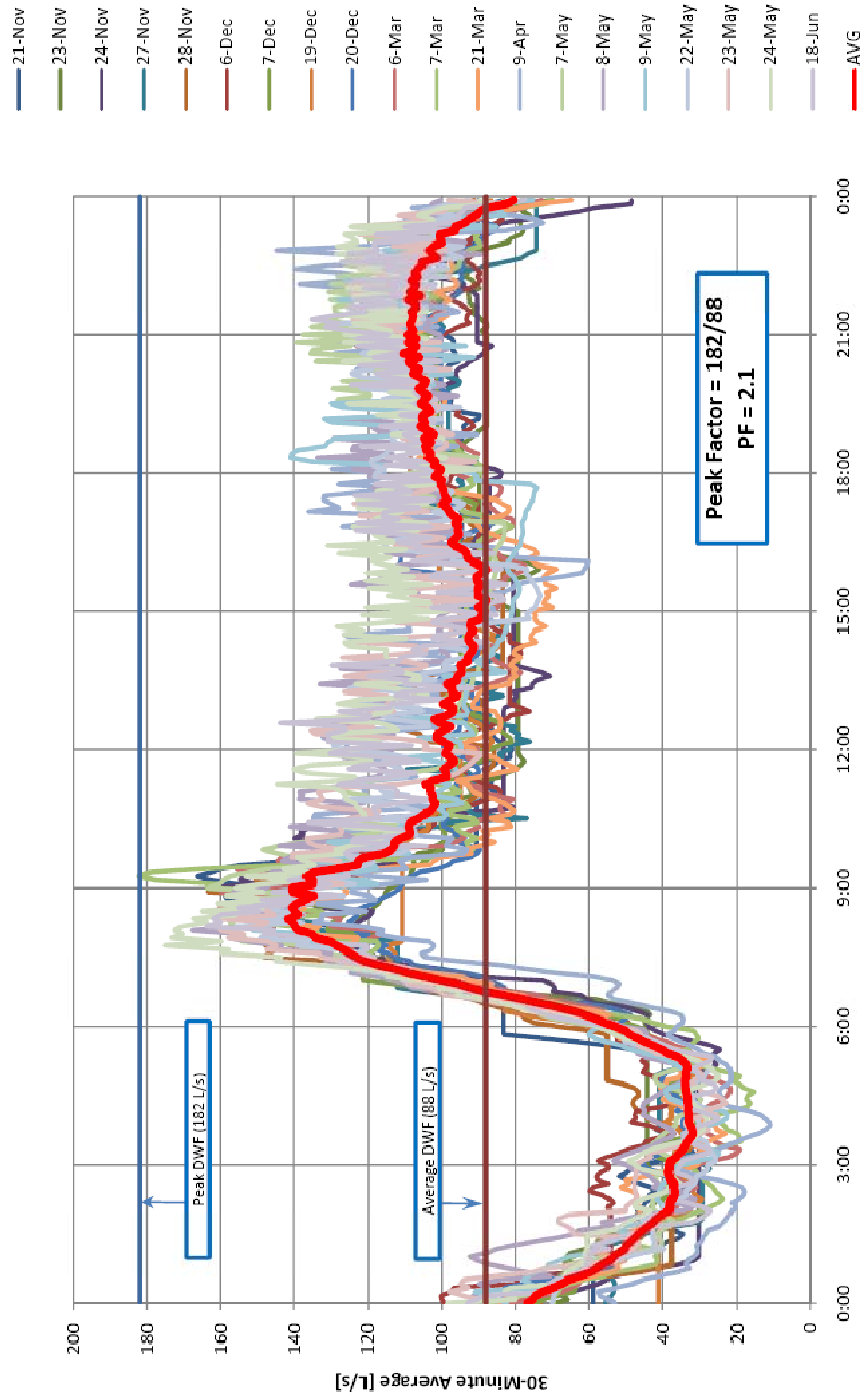
8.3.1 Full Buildout of East Bayfront

As noted in **Section 8.1**, an analysis was first performed for the buildout of the entire East Bayfront area. This analysis included calculation of buildout population and employment numbers and then used these numbers to calculate domestic sewage generation for all of the proposed areas contributing to the Scott Street Pumping Station (SSPS) drainage area.

Population and Employment

Census data for 2006 from Statistics Canada (see **Appendix 3f**) were provided by the City as were full-time and part-time employment data (see **Appendix 3n**) Together, these were used to determine the existing population and employment numbers for the area.

City-provided transportation-planning projections were used as the basis for future population and employment numbers. These projections are based on data from Places to Grown (MPIR, 2006).



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LEGEND:

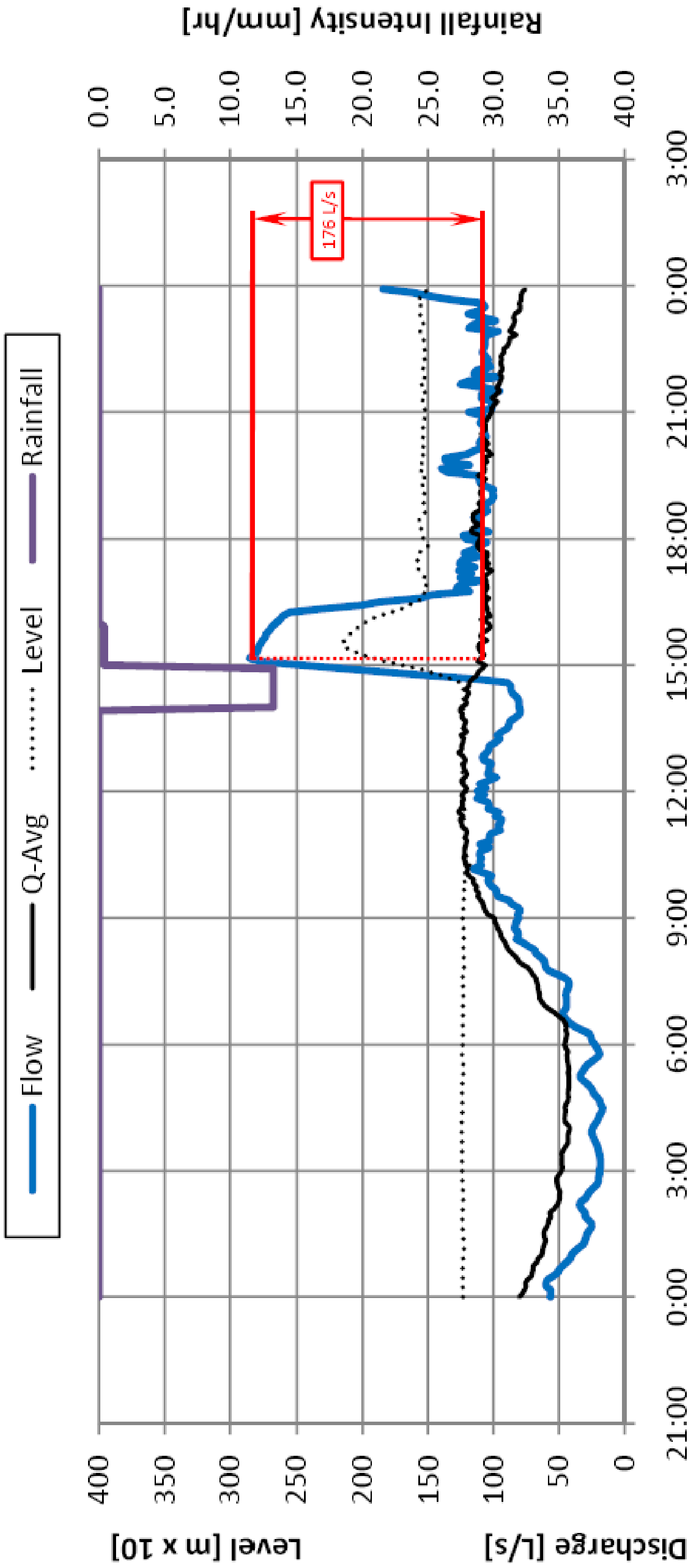
CALCULATION OF DOMESTIC PEAKING FACTOR

DATE: MAR 2009

PROJECT No. 07135

SCALE: NTS

FIGURE 8-5



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LEGEND:

DERIVATION OF EXTRANEOUS INFLOW RATE

DATE: MAR 2009	PROJECT No. 07135
SCALE: NTS	**FIGURE 8-6**

To allocate the populations to specific drainage sub-areas, rational drainage sub areas and the census and transportation data were overlain on a single map. Population and employment numbers were then distributed over the drainage sub-areas on an area-proportional basis (with some minor exceptions to account for areas of very low population - e.g., the Gardiner Expressway - as detailed in **Appendix 3j**).

In some cases, the transportation-planning projections were increased based on data provided by Development Engineering (see **Appendix 3n**). This had the overall effect of increasing the ultimate population projections slightly. The resulting population distribution is shown on **Figure 8-7**.

Flow Generation

As described above, sanitary sewage flows were calculated separately for existing areas and for proposed Buildout. **Appendix 3j** provides details and a summary is provided in **Table 8-3**.

Table 8-3: Flow Calculation Basis – Full Buildout

Flow Component	*Quantity*	*Unit Rate*	*Flow*	
Average Flow – Existing Population	16,326 residents	240 Lpcd	45 L/s	(A)
Average Flow – Population Growth	22,640 residents	300 Lpcd	79 L/s	(B)
Average Flow – Existing Employment	14,317 jobs	240 Lpcd	40 L/s	(C)
Average Flow – Employment Growth	21,770 jobs	300 Lpcd	76 L/s	(D)
Peak Flow (1)	**240 L/s average**	**2.10 (2)**	**504 L/s**	**(E)**
Infiltration Allowance – Existing Areas	109.5 ha	1.65 L/ha/s	181 L/s	(F)
Infiltration Allowance – Redeveloped Areas	27.1 ha	0.26 L/ha/s	7 L/s	(G)
TOTAL DESIGN FLOW (3)			**692 L/s**	**(H)**

Notes:
1. Peak Flow = Sum of (A) through (D), times the Peaking Factor.
2. Peaking Factor of 2.1 observed at Scott Street SPS.
3. Total Design Flow = Sum of (E) through (G).

The contributing areas together with the associated population and employment numbers are shown on **Figure 8-7**. Using the population, employment, drainage area, per capita generation, peaking factors, and infiltration values summarized in **Table 8-3**, a sanitary sewer design sheet was generated to determine the required sewer capacities. A single peaking factor was applied to the flows entering Scott Street Sewage Pumping Station. At the buildout population levels, the observed peaking factor and the Harmon Peaking factor coincided. This design sheet is shown in **Appendix 3o**. The necessary upgrades, taken from that design sheet, are reproduced below as **Table 8-4**.

Table 8-4: Required Sanitary Sewer Upgrades – Full Buildout

Street	*From*	*To*	*Length*	*Existing Diameter*	*Proposed Diameter*
The Esplanade	Scott Street SPS	Market Street	383 m	450 mm	750 mm
Market Street	The Esplanade	Wilton Street	40 m	450 mm	750 mm
Wilton Street	Market Street	Lower Jarvis Street	58 m	450 mm	750 mm
Lower Jarvis Street	Wilton Street	Queens Quay	440 m	300 mm	750 mm
Queens Quay	Lower Jarvis Street	Sherbourne Street	293 m	300 mm	600 mm
Queens Quay	Sherbourne Street	Bonnycastle Street	66 m	300 mm	450 mm
Queens Quay	Bonnycastle Street	Small Street	187 m	300 mm	400 mm
Richardson	Lakeshore	Queens Quay	150 m	300 mm	300 mm
Bonny Castle	Lakeshore	Queens Quay	105 m	300 mm	300 mm
Small Street	Lakeshore	Queens Quay	85 m	300 mm	300 mm

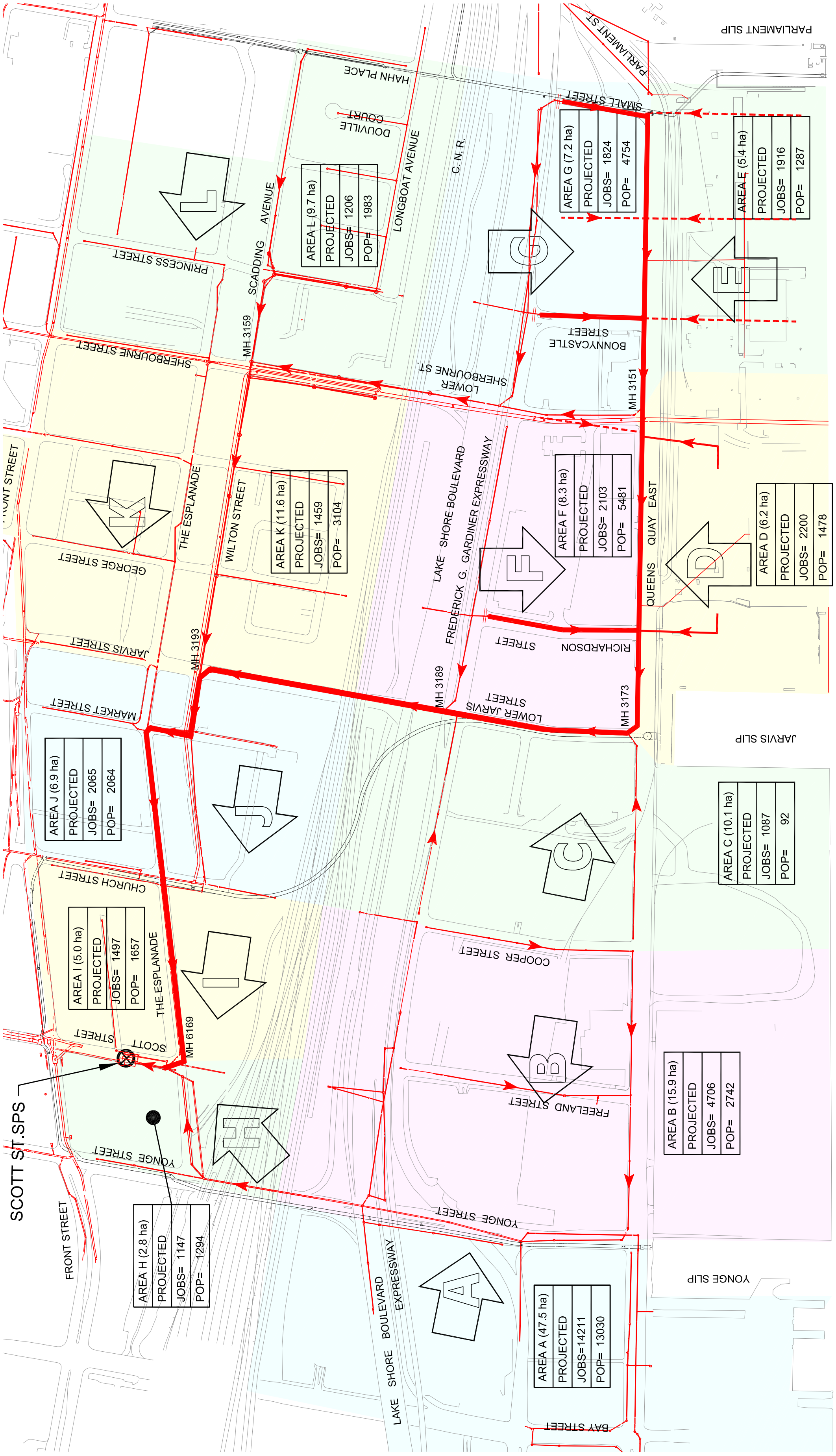
The resulting conceptual pipe layout is shown on **Figure 8-8**.

One concern is the crossing of the Sherbourne Street CSO. The proposed sanitary sewer draining along Queens Quay to the west would conflict with the CSO at Sherbourne Street. There is insufficient cover to allow the sanitary sewer to go above the CSO, and meet the City's design criteria for minimum depth of cover. Going under the CSO would push the sewer system so low that it would not reach the Scott Street Sewage Pumping Station at a workable elevation. Several alternatives have been identified for servicing the lands east of Sherbourne, and the preferred solution will be determined during detailed design in consultation with City Staff.

Cross through the Roof of the Sherbourne CSO: This option would have a section of the concrete slab roof removed and replaced with a 50 mm steel plate, upon which the upgraded sewer would rest. Following installation of the sewer, a new roof slab would be poured around the existing sewer. With this approach, the upstream section of the sewer system would have a depth of cover of 1.2 m at Small Street. This is less than the City's design criteria of 3.5 m for commercial areas, so the design would need to mitigate against any servicing issues associated with a shallow sewer (freezing, frost action, draining basements, etc)

Take the Sewer North to Wilton: Instead of crossing the CSO at Queens Quay / Sherbourne Street, the sanitary drainage for the east part of the EBF could be taken north on Sherbourne Street, passing through the CSO at Wilton Street. The west part of the EBF would drain as shown. Disadvantages include the cost associated with replacement of approximately 800m of sewer (plus right-of-way surface restoration), and the fact that the sewer still has to pass through the CSO. It would be necessary to go far north of Wilton Street to allow passage under the CSO.

Take the Sewer through the CSO at Sherbourne Street and Widen the CSO at Queens Quay: During construction of the sewer, the CSO could be widened at the location where the proposed sewer would cross through it. This would effectively increase the hydraulic capacity of the CSO and mitigate any negative hydraulic impact associated with the proposed crossing.



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LEGEND:

▭ ▭ ▭ ▭ SUB-DRAINAGE AREAS
← EX. SANITARY SEWER
⟵ PR. SAN. REPLACEMENT
- - ← - - PR. SAN. SEWER

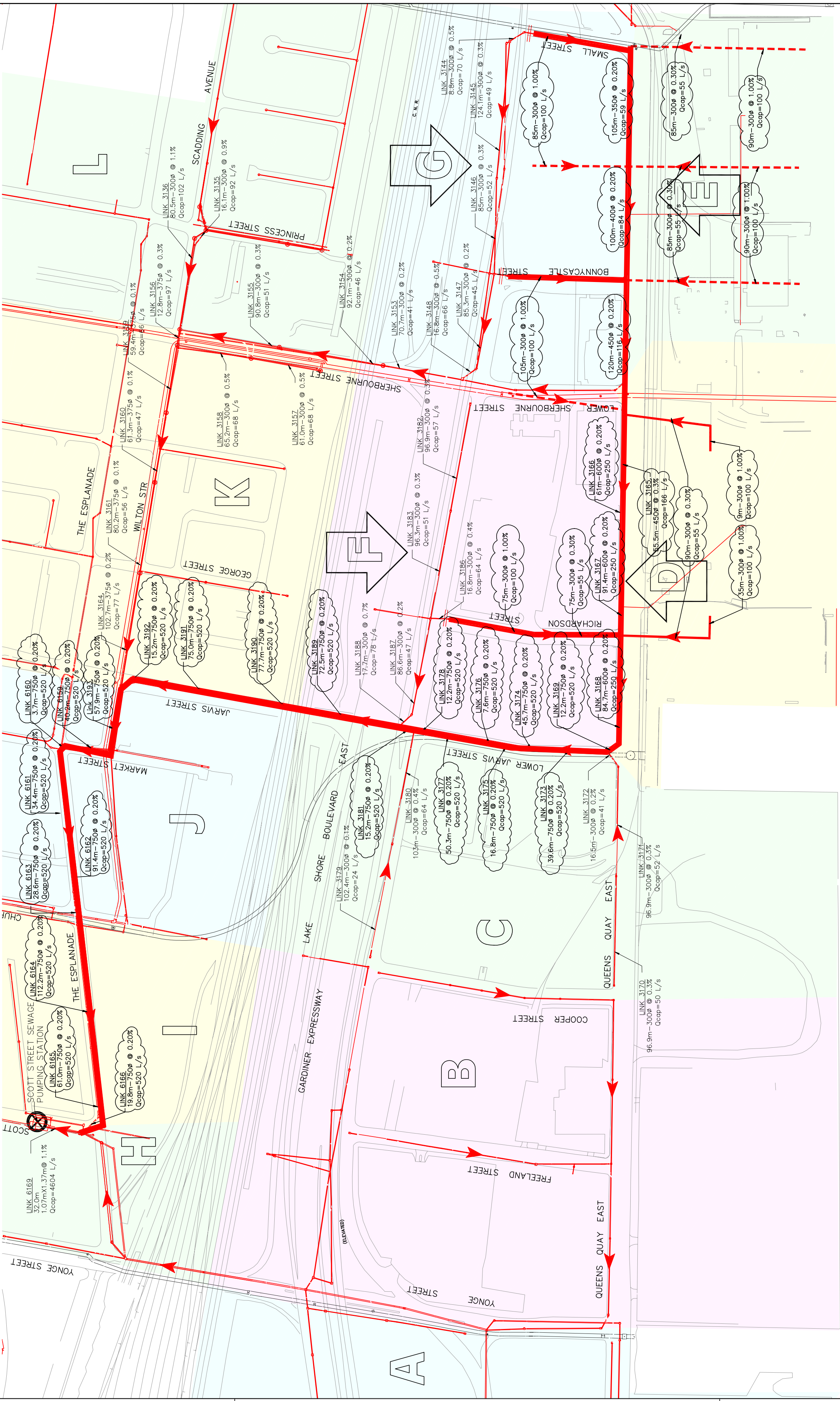
FULL BUILD OUT POPULATION AND EMPLOYMENT SUMMARIES
SCOTT STREET SEWAGE PUMPING STATION SUB-DRAINAGE AREAS

DATE:
MAR 2009

PROJECT No.
07135

SCALE:
25 0 50 100

FIGURE 8-7



LEGEND:

🟦 🟨 🟩 🟪 SUB-DRAINAGE AREAS
EX. SANITARY SEWER
PR. SAN. REPLACEMENT
PR. SAN. SEWER
PR. SAN. INFORMATION

SANITARY SEWERS REQUIRED FOR BUILD-OUT

SCOTT STREET SEWAGE PUMPING STATION
SUB-DRAINAGE AREAS

DATE:
MAR 2009

SCALE:
50 25 0 50

PROJECT No.
07135

FIGURE 8-8

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File : G:\Projects\2007\07135 - Waterfront Toronto - East Bayfront\Drawings\FIGURES\FSR\FIG 08-1-7-8-9-11.dwg, Layout : 8-8 Date :Mar 20, 2009 - 1:45pm, Edit By : rstone

Build the Sanitary Sewer as a Siphon: During construction of the sewer, it would be built as a siphon, going underneath the CSO, allowing the CSO to remain where it is. This would also be a very difficult undertaking, considering the size of the CSO and the fact that it is below lake level. Additionally, operation of siphons is problematic, especially one where the minimum flow rates are expected to be very small.

Construct a Sewage Pumping Station: A small lift station could pump the flows over the CSO into a manhole just west of the CSO. Heat tracing and insulation would allow the forcemain to be installed closer to the surface. Disadvantages include land requirements and the ongoing operation and maintenance efforts for the station.

Summary

The full Buildout of East Bayfront will require 1,800 m of replacement sewers ranging in diameter from 300 mm to 750 mm, the peak flow rate coming off the Full Buildout of the East Bayfront area is 229 L/s and the peak flow rate into the SSPS is 691 L/s. This increase in flow rate will require a significant expansion to the SSPS. As development continues, the expansion will be required before full buildout.

8.3.2 East Bayfront Phase 1

Population and Employment

Census data for 2006 from Statistics Canada (see **Appendix 3f**) were provided by the City as were full-time and part-time employment data (see **Appendix 3k**). Together, these were used to determine the existing population and employment numbers for the area.

City-provided transportation-planning projections were used as the basis for future population and employment numbers. These projections are based on data from Places to Grown (MPIR, 2006).

To allocate the populations to specific drainage sub-areas, rational drainage sub areas and the census and transportation data were overlain on a single map. Population and employment numbers were then distributed over the drainage sub-areas on an area-proportional basis (with some exceptions).

In some cases, the transportation-planning projections were increased based on data provided by Development Engineering (see **Appendix 3n**). This had the overall effect of increasing the ultimate population projections slightly. The resulting population distribution is shown on **Figure 8-9** and a summary is provided in **Table 8-5**. Details of the calculation are provided in **Appendix 3k**.

Flow Generation

As with the evaluation of the Buildout flows, sanitary sewage flows for Phase 1 were calculated separately for existing areas and for proposed Phase 1 development (as per design criteria noted above). This is necessary because the considerable age of the existing sewers (~75 years) and the LEED Gold standard to which new development will be subjected yield substantially different results on a per person basis. A summary of the calculations, including relevant design parameters, is shown in **Table 8-5**.

Table 8-5: Flow Calculation Basis – Phase 1

Flow Component	*Quantity*	*Unit Rate*	*Flow*	
Average Flow – Existing Population	16,326 residents	240 Lpcd	45 L/s	(A)
Average Flow – Population Growth	11,597 residents	300 Lpcd	40 L/s	(B)
Average Flow – Existing Employment	14,317 jobs	240 Lpcd	40 L/s	(C)
Average Flow – Employment Growth	2,840 jobs	300 Lpcd	10 L/s	(D)
Peak Flow (1)	**135 L/s average**	**2.10 (2)**	**284 L/s**	**(E)**
Infiltration Allowance – Existing Areas	130.4 ha	1.65 L/ha/s	215 L/s	(F)
Infiltration Allowance – Redeveloped Areas	6.2 ha	0.26 L/ha/s	2 L/s	(G)
TOTAL DESIGN FLOW (3)			**501 L/s**	**(H)**

Notes:

1. Peak Flow = Sum of (A) through (D), times the Peaking Factor.
2. Peaking Factor of 2.1 observed at Scott Street SPS.
3. Total Design Flow = Sum of (E) through (G).

Using the population, employment, drainage area, per capita generation, peaking factors, and infiltration values summarized in **Table 8-5**, a sanitary sewer design sheet was generated to determine the required sewer capacities. For Phase 1, the observed peaking factor was applied to the flows entering Scott Street Sewage Pumping Station. The design sheet is provided in **Appendix 3o** and the required upgrades are brought forward into **Table 8-6**, below.

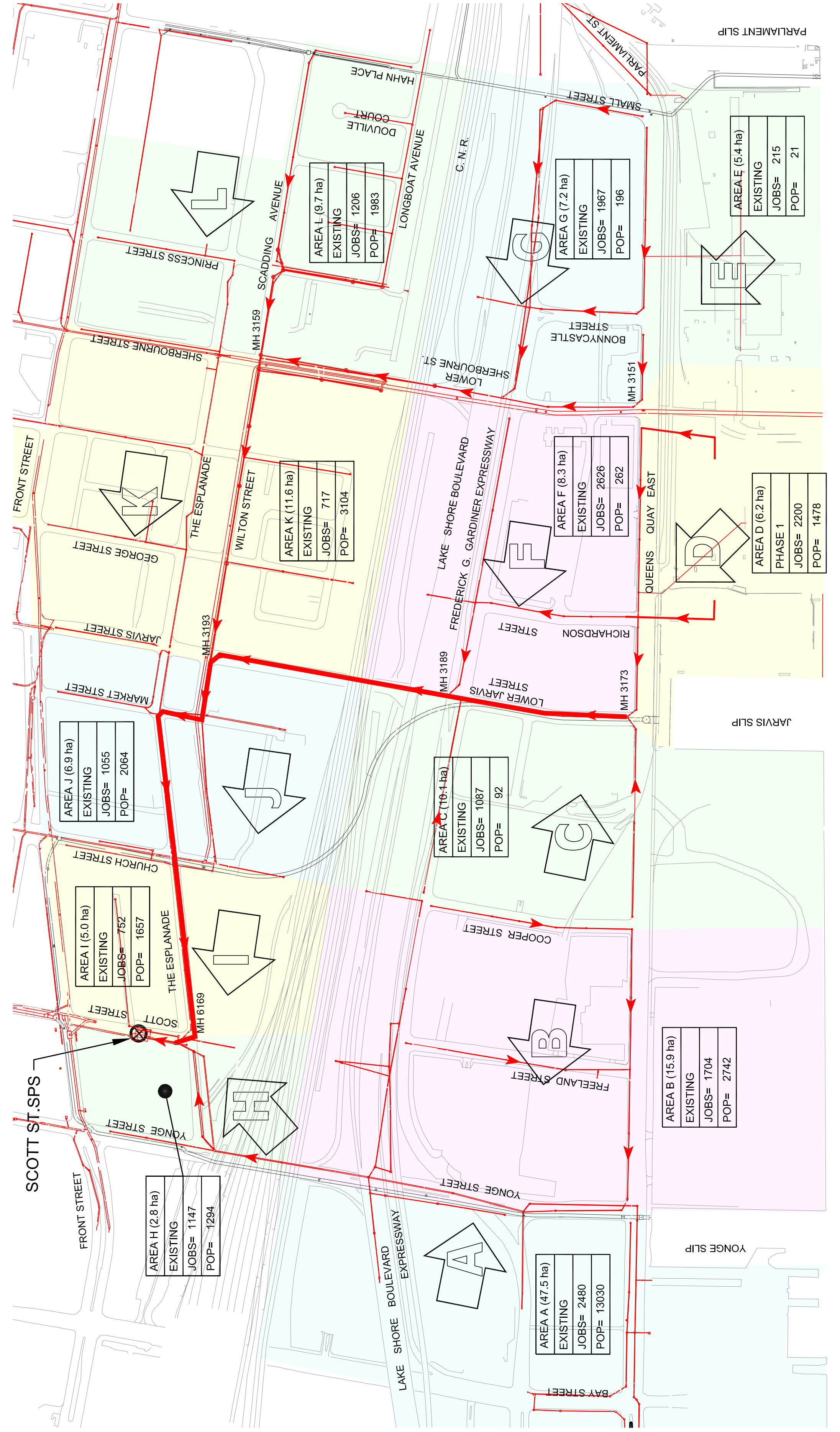
Table 8-6: Required Sanitary Sewer Upgrades – Phase 1

Street	*From*	*To*	*Length*	*Existing Diameter*	*Proposed Diameter*
The Esplanade	Scott Street SPS	Market Street	383 m	450 mm	750 mm
Market Street	The Esplanade	Wilton Street	40 m	450 mm	750 mm
Wilton Street	Market Street	Lower Jarvis Street	58 m	450 mm	750 mm
Lower Jarvis Street	Wilton Street	Queens Quay	440 m	300 mm	750 mm

The resulting conceptual pipe layout is shown on **Figure 8-10**.

Summary

920 m of 750 mm sewers will be required, the peak flow rate coming off Phase 1 of the East Bayfront area is 44 L/s and the peak flow rate into the SSPS (which includes all development within the SPS drainage area between now and 2010) will be 501 L/s. This increase in flow rate will require an expansion of the SSPS.



LEGEND:

🟦 🟨 🟩 🟪 SUB-DRAINAGE AREAS

EX. SANITARY SEWER

PR. SAN. REPLACEMENT

PR. SAN. SEWER

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2006 POPULATION & EMPLOYMENT + PHASE 1 SUMMARIES

SCOTT STREET SEWAGE PUMPING STATION
SUB-DRAINAGE AREAS

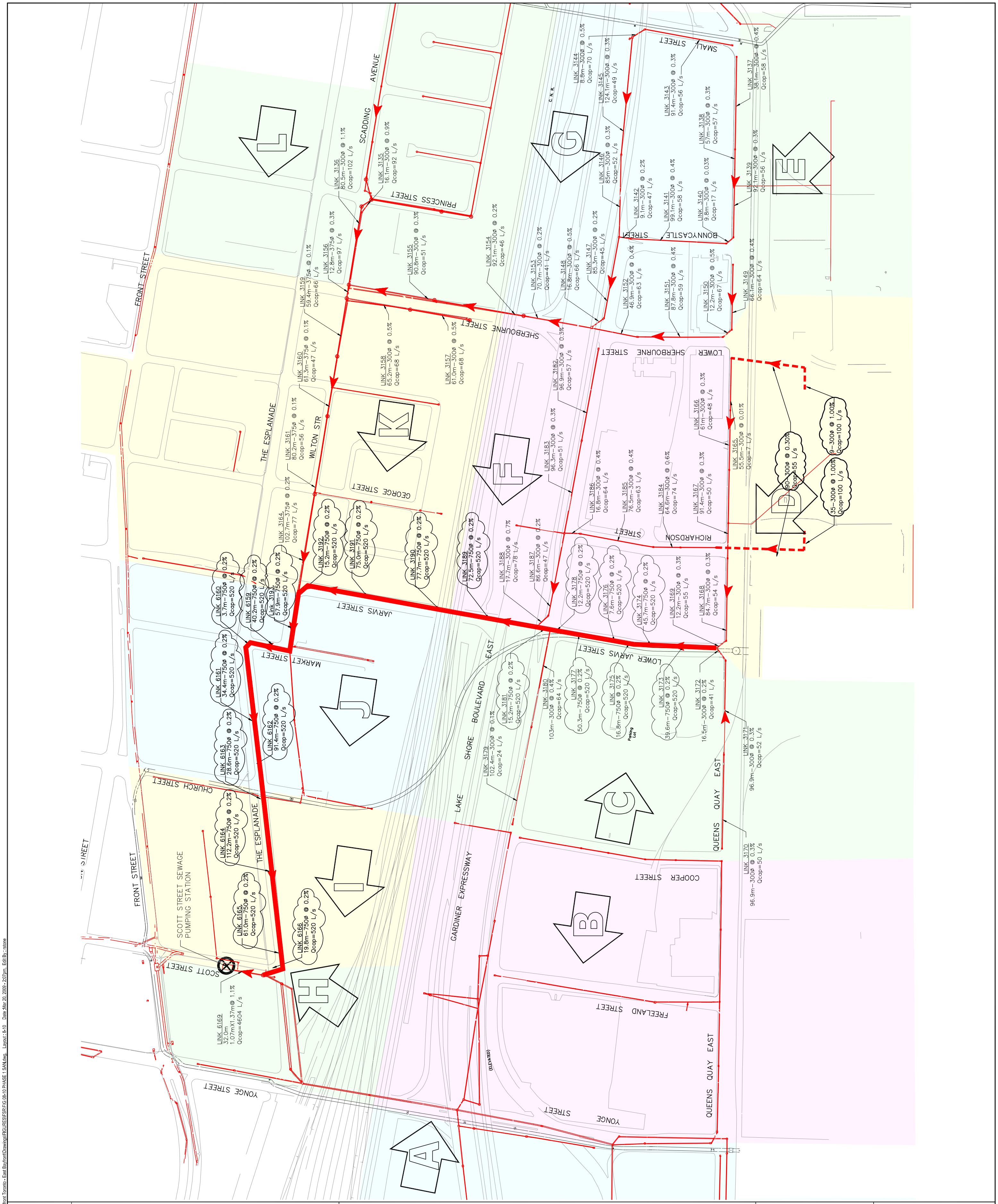
DATE: MAR 2009

PROJECT No. 07135

SCALE: 25 0 50 100

FIGURE 8-9

File : G:\Projects\2007\07135 - Waterfront Toronto - East Bayfront\Drawings\FIGURES\FSR\FIG 08-1-7-8-9-11.dwg, Layout : 8-9 Date :Mar 20, 2009 - 1:55pm, Edit By : rstone



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LEGEND:

🟦 🟨 🟩 🟪 SUB-DRAINAGE AREAS
EX. SANITARY SEWER
PR. SAN. REPLACEMENT
PR. SAN. SEWER
PR. SAN. INFORMATION

SANITARY SEWERS REQUIRED FOR PHASE 1

SCOTT STREET SEWAGE PUMPING STATION
SUB-DRAINAGE AREAS

DATE:
MAR 2009

PROJECT No.
07135

SCALE:
25 0 50

FIGURE 8-10

8.3.3 Corus Development

Population and Employment

Census data for 2006 from Statistics Canada (see **Appendix 3f**) were provided by the City as were full-time and part-time employment data (see **Appendix 3l**). Together, these were used to determine the existing population and employment numbers for the area. The population of the Corus Building was determined based on the current density estimates for that type of building.

City-provided transportation-planning projections were used as the basis for future population and employment numbers. These projections are based on data from Places to Grown (MPIR, 2006).

To allocate the populations to specific drainage sub-areas, rational drainage sub areas and the census data were overlain on a single map. Population and employment numbers were then distributed over the drainage sub-areas on an area-proportional basis (with some exceptions).

In some cases, the transportation-planning projections were increased based on data provided by Development Engineering (**see Appendix 3n**). This had the overall effect of increasing the ultimate population projections slightly. The resulting population distribution is shown on **Figure 8-11** and summary is provided in **Table 8-7**. The detailed analysis is provided in **Appendix 3l**.

Flow Generation

As with the evaluation of all flows, sanitary sewage flows for Corus were calculated separately for existing areas and for the proposed Corus development (as per design criteria noted above) (see **Appendix 3a**). This is necessary because the considerable age of the existing sewers (~75 years) and the LEED Gold standard to which new development will be subjected yield substantially different results on a per person basis. A summary of the calculations, including relevant design parameters, is shown in **Table 8-7** and complete details of the analysis are provided in **Appendix 3a**.

Table 8-7: Flow Calculation Basis – Corus

Flow Component	*Quantity*	*Unit Rate*	*Flow*	
Average Flow – Existing Population	16,326 residents	240 Lpcd	45 L/s	(A)
Average Flow – Population Growth	10,140 residents	300 Lpcd	35 L/s	(B)
Average Flow – Existing Employment	14,317 jobs	240 Lpcd	40 L/s	(C)
Average Flow – Employment Growth	2,840 jobs	300 Lpcd	10 L/s	(D)
Peak Flow (1)	**130 L/s average**	**2.10 (2)**	**273 L/s**	**(E)**
Infiltration Allowance – Existing Areas	130.4 ha	1.65 L/ha/s	215 L/s	(F)
Infiltration Allowance – Redeveloped Areas	6.2 ha	0.26 L/ha/s	2 L/s	(G)
TOTAL DESIGN FLOW (3)			**490 L/s**	**(H)**

Notes:
1. Peak Flow = Sum of (A) through (D), times the Peaking Factor.
2. Peaking Factor of 2.1 observed at Scott Street SPS.
3. Total Design Flow = Sum of (E) through (G).

Using the population, employment, drainage area, per capita generation, peaking factors, and infiltration values summarized in **Table 8-7** a sanitary sewer design sheet was generated to determine the required sewer capacities. Similar to Phase 1 analysis, the observed peaking factor was applied to the flows entering Scott Street Sewage Pumping Station. The design sheet is provided in **Appendix 3o**.

It can be seen that some flow rates exceed the capacity of the existing sewers. A hydraulic grade line (HGL) analysis was undertaken (see **Appendix 3d**) and it indicates that the maximum hydraulic grade level (under existing peak domestic generation and the highest infiltration rates) using the existing sanitary sewer system is approximately 2.0 m below grade at the Corus Building.

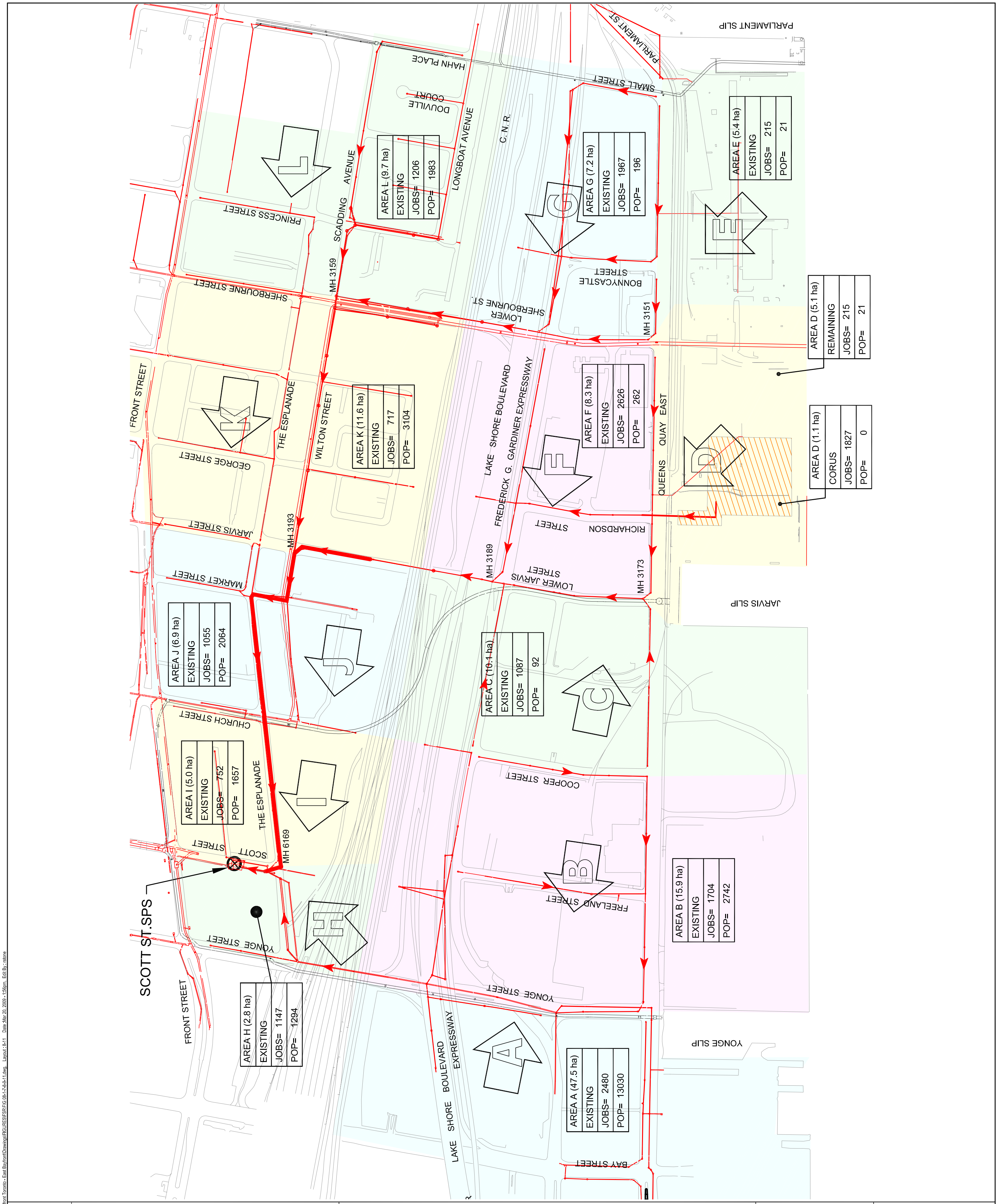
To ensure that adverse effects are not created, pre-development HGL levels (2.0 m below grade at Corus and greater over the remaining lengths, see **Figure 8-13**) must be maintained or lowered. The upgrades as shown in **Table 8-8** achieve this.

Table 8-8: Required Sanitary Sewer Upgrades – Corus

Street	*From*	*To*	*Length*	*Existing Diameter*	*Proposed Diameter*
The Esplanade	Scott Street SPS	Market Street	383 m	450 mm	750 mm
Market Street	The Esplanade	Wilton Street	40 m	450 mm	750 mm
Wilton Street	Market Street	Lower Jarvis Street	58 m	450 mm	750 mm
Lower Jarvis Street	Wilton Street	90 m South	90 m	300 mm	750 mm

Summary

The replacement of approximately 570 m of 300 mm and 450 mm-diameter sewer with 750 mm-diameter sewer will be required to service the Corus development. The peak flow rate coming from the Corus Building will be 26 L/s and the peak flow rate into the SSPS (which includes all development within the SPS drainage area between now and 2010) will be 489 L/s. This increase in flow rate will require an expansion to the SSPS.



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LEGEND:

▢ ▢ ▢ ▢	SUB-DRAINAGE AREAS
←	EX. SANITARY SEWER
⟵	PR. SAN. REPLACEMENT
- - ← - -	PR. SAN. SEWER

2006 POPULATION & EMPLOYMENT + CORUS SUMMARIES

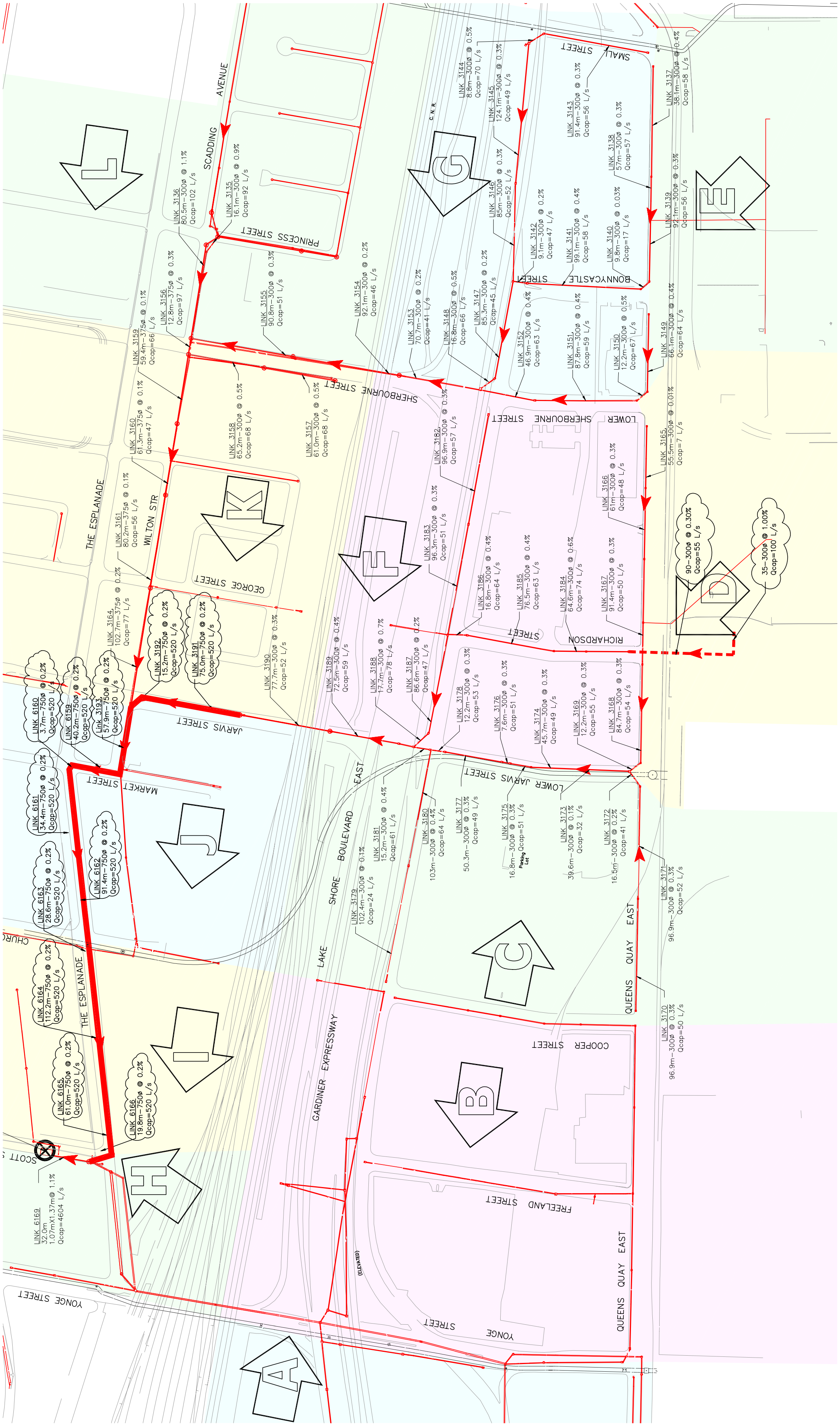
SCOTT STREET SEWAGE PUMPING STATION SUB-DRAINAGE AREAS

DATE: MAR 2009

PROJECT No. 07135

SCALE: 25 0 50 100

FIGURE 8-11



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LEGEND:

🟦 🟨 🟩 🟪 SUB-DRAINAGE AREAS
EX. SANITARY SEWER
PR. SAN. REPLACEMENT
PR. SAN. SEWER
PR. SAN. INFORMATION

SANITARY SEWERS REQUIRED FOR CORUS

SCOTT STREET SEWAGE PUMPING STATION
SUB-DRAINAGE AREAS

DATE: MAR 2009

PROJECT No. 07135

SCALE: 50 25 0 50

FIGURE 8-12

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Figure 8-13a:

HGL ANALYSIS OF SCOTT STREET SPS COLLECTION SYSTEM - EXISTING PIPES

Flows: Corus-Jarvis **HGL Start Point:** 3165 (Queen's Quay, west of Sherbourne)

Assumed Wet Well Level: 71.490 (Existing + 0.82m) **Outlet Control?** Yes

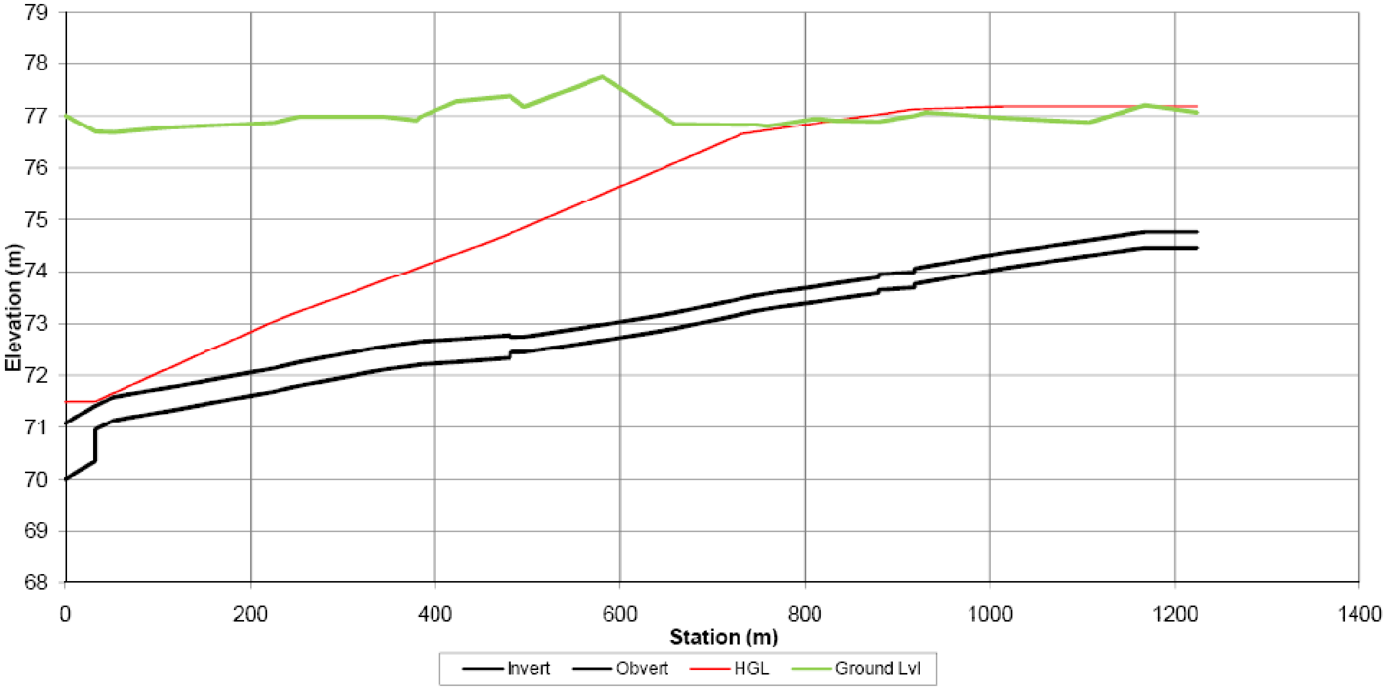
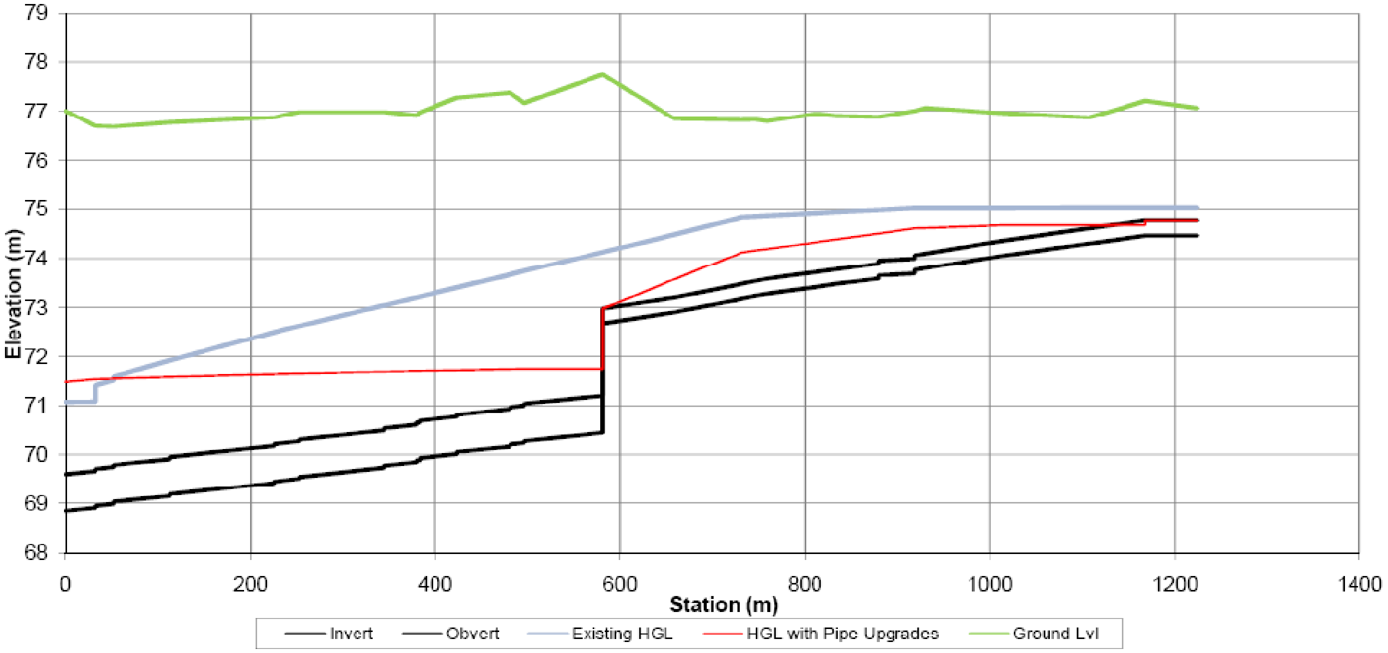


Figure 8-13b:

HGL ANALYSIS OF SCOTT STREET SPS COLLECTION SYSTEM - NEW PIPES

Flows: Existing plus Corus **HGL Start Point:** 3165 (Queen's Quay, west of Sherbourne)

Assumed Wet Well Level: 71.490 (Existing + 0.82m) **Outlet Control?** Yes



The Municipal Infrastructure Group Ltd

LEGEND:

HGL ANALYSIS OF SCOTT STREET SPS
COLLECTION SYSTEM

DATE: MAR 2009

PROJECT No. 07135

SCALE: NTS

FIGURE 8-13

8.4 Proposed Offsite Sanitary Upgrades

8.4.1 Offsite Sanitary Upgrades – Sewers

As noted in **Section 8.1**, determination of all required sewer upgrades was made for each stage of development, irrespective of whether they were within the East Bayfront Area or outside of it. To provide a summary of the works required outside of the East Bayfront Area, external upgrades from each stage, as noted in **Table 8-4, Table 8-6**, and **Table 8-8**, are presented below in **Table 8-9**.

Table 8-9: Required Sanitary Sewer Upgrades Not within the EBF

Street	*From*	*To*	*Length*	*Existing Diameter*	*Proposed Diameter*
The Esplanade	Scott Street SPS	Market Street	383 m	450 mm	750 mm
Market Street	The Esplanade	Wilton Street	40 m	450 mm	750 mm
Wilton Street	Market Street	Lower Jarvis Street	58 m	450 mm	750 mm
Lower Jarvis Street	Wilton Street	Lakeshore Blvd	240 m	300 mm	750 mm

8.4.2 Offsite Sanitary Upgrades – Scott Street Sewage Pumping Station

General

Figure 8-1 shows the drainage area for the Scott Street Sewage Pumping Station (SSPS). This area includes almost all of the East Bayfront (a 1-ha area at the east end of Queens Quay drains directly to the Ashbridge's Bay WPCP), and an additional 109.5ha as far west as Lower Spadina Avenue and as far north as King Street. While the station has no rated capacity or a C. of A., calculations provided in **Appendix 3d** concluded that the firm capacity of the station is 405L/s. A summary of the evaluation is provided in **Section 8.1.1**.

The Master Plan EA for East Bayfront considered that all proposed flows would go to the SSPS.

Flows into the SSPS are given for existing conditions (based on available flow records), and for each of the stages of development: Corus, Phase 1, and full Buildout. Flow calculations are given in **Appendices 3j, 3k, 3l** and **3m** and a summary is provided in **Table 8-10**, below. The conclusions are valid only for the hydraulic capacity of the system and do not address issues of standby power, access, maintenance, SCADA, OHSA, etc.

Table 8-10: Peak Flows to SSPS at each Stage of Development

Stage (approximate timing)	*Peak Flow In (L/s)*	*Additional Capacity Required; above existing*[(1)] *(L/s)*
Existing (2007)	404	0
Corus (2010)	490	85
Phase 1 (2015)	501	96
Full Buildout (2031)	691	286

Note:

1. As per **Section 8.1.1**, the existing firm capacity of the Scott Street SPS is approximately 405 L/s.

Existing

The existing capacity of 405L/s is just adequate to convey the expected and observed peak flow rate of 404 L/s with essentially no reserve capacity. No upgrades are required as per the population and employment data from the 2006 Census, but recent development within the catchment area will very likely have increased the existing flows into the station.

Corus

The addition of the Corus Building and other development outside of East Bayfront will add an estimated 86 L/s over the existing peak flow rate, bringing the peak flow rate for this stage to 490 L/s by 2010. Since the station capacity is currently 405 L/s, an additional pumping capacity of 85 L/s will be required.

Phase 1

The addition of the remainder of Phase 1, together with the additional population in other contributory areas will bring the peak flow rate to 501 L/s by 2015. Since the station capacity is currently 405L/s, an additional pumping capacity of 96 L/s will be required.

Full Buildout

The addition of the remainder of the East Bayfront will bring the peak flow rate for this stage to 691 L/s. Since the station capacity is 405 L/s, the station will require a pumping capacity upgrade of 286 L/s.

This expansion may require upgrades to the physical dimensions of the station as well as to the standby power system and other peripherals; however, they would be dealt with at the preliminary design stage.

9 Water Servicing

This section describes the existing water distribution system, the proposed design criteria, and the required water servicing for East Bayfront.

9.1 Existing Water Servicing

The East Bayfront area is located at the lower end (the higher-pressure end) of Pressure District 1 of Toronto's water distribution system and the East Bayfront Class Environmental Assessment Master Plan reports that local static pressures are approximately 70 - 85 psi. Pressure and flow testing undertaken in July of 2008 confirmed that static pressures in mains on Queens Quay are in the range of 84-88 psi (579-607 KPa). These static pressures are above the ideal operating range recommended by the City of Toronto's Design Guidelines and the Ministry of the Environment (MOE) which recommend pressures up to 80 psi (550 KPa). However, both MOE and the City allow for an upper limit of 100 psi (700KPa) before pressure reducing measures are required.

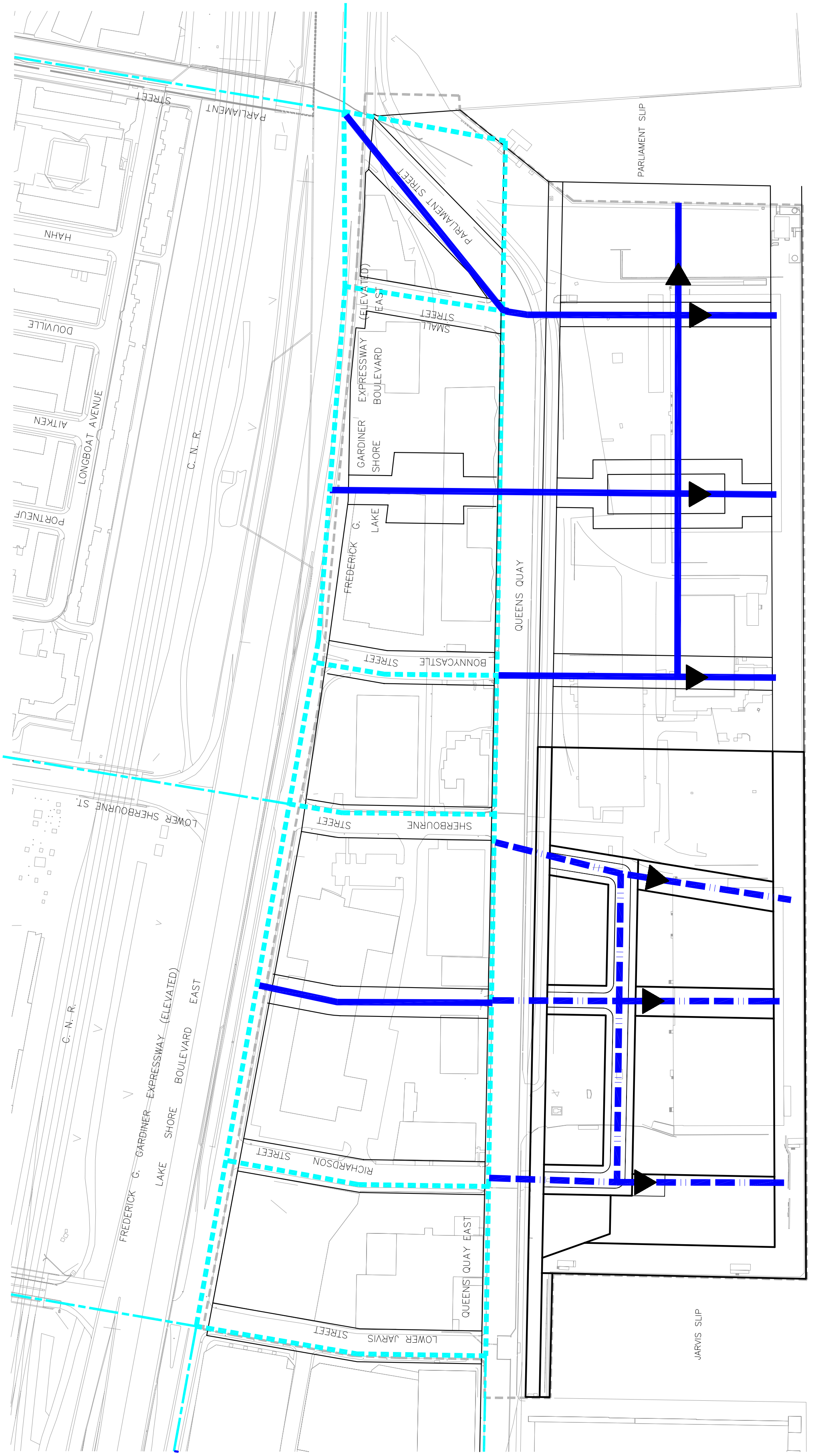
The EBF's service is provided via 300mm diameter watermains on Queens Quay, Lakeshore Blvd., Jarvis Street, Sherbourne Street and Parliament Street. **Figure 9-1** illustrates the existing and proposed water distribution system within the East Bayfront.

Though not noted on the City's Plan and Profile drawings, it is estimated that the water distribution system in this area is approximately 75 years old, based on the time that the lands north of Queens Quay were serviced. The drawings do note that the watermains are of cast-iron construction and the East Bayfront Class Environmental Assessment Master Plan noted two failures of the watermain: on Lower Sherbourne Street in August 1996 and December 1998.

The estimated service life of cast iron watermains produced in the 1920s and 1930s is approximately 100 years. The estimated service life of cast iron watermain produced after World War II, when the south side of Queens Quay was constructed, is estimated to be about 60 years (U.S. Congressional Testimony, Beverley Ingram, March 2001). In each case, the lifespan of the existing cast iron mains will be approaching its end, by the completion of the buildout of the East Bayfront. In addition, the existing watermains will be subject to higher flows as development proceeds and will be affected by vibration and lateral soil movement from work and dewatering activities occurring around the pipes. It is anticipated that these factors will lead to a significantly higher number of breaks of the older mains. The East Bayfront Class Environmental Assessment Master Plan recommended maintaining as much of the existing infrastructure as feasibly possible. However, with the considerable money and effort being expended on providing a world-class development, we recommend that the existing watermains be replaced as development proceeds. This will avoid subsequent repairs and future replacements in the newly developed areas.

Flow testing on existing mains on Queens Quay reflects a high rate of mineral build up, tuberculation, in the mains resulting in a calculated Hazen Williams C value in the range of 70-100. City of Toronto criteria recommends a value of 120 for new pipes. However manufacturers claim a C value in the range of 140 for new PVC pipes. It should be noted that Hazen Williams C values are increasingly resistive with a lower number.

The flow testing also indicated that the network has sufficient looping and interconnection to the high pressure zone to provide acceptable residual pressures under higher flow conditions. Residual pressures of 63-64psi (434-441 Kpa) were encountered at flows of 2040-2120 usgpm (128-133 l/s).



NOTE:

RECONSTRUCTED MAINS REQUIRED TO BE 300mmØ. NEW MAINS VARY IN SIZE AND WILL BE SIZED AT DETAIL DESIGN STAGE. ROAD LAYOUT AND INFRASTRUCTURE IS CONCEPTUAL FOR ALL FUTURE PHASES.

LEGEND

─ · ─	EXISTING OFFSITE WATERMAINS
┅	EXISTING MUNICIPAL WATER DISTRIBUTION MAINS TO BE REPLACED WITH ROAD RECONSTRUCTION
━	PROPOSED POSSIBLE ADDITIONAL WATER DISTRIBUTION MAINS
━ · ━	PROPOSED ADDITIONAL MAINS REQUIRED FOR PHASE 1 DEVELOPMENT
▶	BACKFLOW PREVENTER IN CHAMBER

File : G:\Projects\2007\07135 - Waterfront Toronto - East Bayfront\Drawings\FIGURES\FSR\FIG 09-1.dwg, Layout : WD1 Date :Mar 20, 2009 - 2:14pm, Edit By : rstone

The MUNICIPAL INFRASTRUCTURE Group Ltd

LEGEND:

PROPOSED WATER
DISTRIBUTION NETWORK
EAST BAYFRONT - TORONTO WATERFRONT

DATE: MAR 2009

PROJECT No. 07135

SCALE: 25 0 50

FIGURE 9-1

9.2 Proposed Water Servicing

As noted in **Section 8**, population and employment numbers for the build-out of East Bayfront and surrounding areas were developed and summarized in **Table 8-2**. Using these numbers, average day demands have been developed. Essentially, as obtained from the City of Toronto's Design Criteria for sewers and watermains, average day demands are based on a per capita water usage of 190 litres per capita per day (Lpcd) for residential apartment occupancy. No specific number is given in the criteria for employment per capita use, so the 190 Lpcd was carried for employment use as well. Typically, employment use is less than residential and has been suggested in other municipalities to be 170 Lpcd

Table 9-1 below illustrates the average day, maximum day and peak hour water demands from the four quadrants of the East Bayfront. A detailed table to determine domestic water demand is presented in **Appendix 4a**.

From the flow testing, it is demonstrated that flows in the range of the proposed domestic peak hour demand can be supplied by the existing six 300mm diameter watermains and still maintain a minimum 40 psi (275 KPa) residual pressure.

Table 9-1: Summary of Design Flow Rates at Buildout

Area	*Average Day Flow (L/s)*	*Maximum Day Flow Rate (L/s)*	*Peak Hour Flow Rate (L/s)*
Peaking Factor		1.65	2.5
South of Queens Quay, West of Sherbourne (Dockside)	8.1	13.4	20.3
North of Queens Quay, West of Sherbourne	16.8	27.7	41.9
South of Queens Quay, East of Sherbourne (Bayside)	7.1	11.7	17.7
North of Queens Quay, East of Sherbourne (Parkside)	14.5	24.0	36.4
Total East Bayfront	46.5	76.8	116.3

The proposed water servicing plan is illustrated in **Figure 9-1**.

9.3 Fire Protection

The East Bayfront is currently served by fire hydrants, both on private lands and on Municipal rights-of-way. Fire hydrants are proposed on the newly constructed and existing watermains in the East Bayfront. As a minimum, hydrants should be spaced the closest of either 75m, to provide proximity requirements to entrances and Fire Department Connections as per the Ontario building and fire codes or to provide sufficient coverage based on fire flows. Typically, the maximum attainable flow from a hydrant is assumed to be 75 l/s - 110 l/s or 1000-1500 GPM.

Fire flows have been calculated based on the Fire Underwriters Survey (FUS) "Water Supply for Public Fire protection". The FUS calculation is inherently conservative as it has been written by insurance underwriters to minimize potential claims. However, given the proposed land uses within the East Bayfront and the high level of occupancy, we believe that it should be considered for fire flow calculation. Two cases were modeled: the first assumes a fire at the Corus Building which represents a large floor plate, mid-rise building; and the second assumes a fire at a smaller footprint thirty-storey tower that the Precinct Plan shows at the northern corners of Jarvis, Sherbourne and Parliament Streets. The resultant fire flows are both approximately 400 l/s, which equates to four to six hydrants flowing full.

The City of Toronto also has guidelines for minimum fire flows for various developments. The maximum flow rate for the type of development proposed in East Bayfront is in the rage of

300-380 l/s. This serves to confirm that the FUS fire flow rate calculated at 400 l/s is a conservative, but reasonable estimation.

The East Bayfront Municipal Services Class EA Report considered fire flows in the range of 75 l/s to 180 l/s. Given the alternative calculations and proposed land use with high real estate value, we consider these latter fire flows are not appropriate to use for analysis.

It is proposed to place fire hydrants at the water's edge promenade to provide protection for the wooden boardwalk and boats moored onshore. The proposed hydrants will be connected to the internal streets on "dead-end" watermains complete with backflow preventers in chambers that will protect the domestic mains from a potential mixing of water. The dead-end mains are required as it is not desirable, from a security of supply perspective, to run mains along the existing dockwall as a failure in an open loop in this location would precipitate possible catastrophic failure of the dockwall. In addition, minimal seasonal service connections are the only connections proposed for the water's edge, so poor circulation in a looped water's edge main could result in stagnation and ultimately fouling of municipal water supply.

Additional fire protection may also be available from the lake. Toronto Fire operates a fireboat, the *William Lyon Mackenzie*. Through discussions with Toronto Fire note that this is only to be considered on a supplemental basis, as the boat would take approximately 20 minutes to arrive at the East Bayfront.

The effects of fighting fires on surge induced hydraulic transients are a key consideration. The surge pressures generated with these higher flow rates may prove too high for the some of the existing pipe, even though on paper the pipes may have a few years left in them. Failure of a major supply pipe in the middle of a fire event could be disastrous. Identifying potential weaknesses in the watermain system under these conditions is very difficult. Therefore, it is advisable to undertake a replacement program of the existing watermains within the East Bayfront as development occurs.

There may also be concerns with transient conditions as surge pressures reach out to the existing network. Evaluation of this effect is beyond the scope of the East Bayfront functional servicing plan and should be evaluated by Toronto Water. This may precipitate the replacement of existing aging mains around the periphery of the East Bayfront. The proposed refit of PVC pipes in the East Bayfront will help to mitigate the level of the transient conditions (PVC pipes act somewhat as a "shock absorber" absorbing more of a surge pressure by allowing larger deflections in the shape of the pipe than what occurs in an iron pipe), but the additional flows required to serve and protect the development area will increase the risk of transient induced breaks in the surrounding pipe network.

9.4 Flow Modeling

Detailed modelling of the area was requested from Toronto Water but was unavailable for use. A basic flow model for the East Bayfront was completed using WaterCAD, proprietary water distribution modelling software. The software was modelled on a system curve developed from the onsite flow testing. It was assumed that the surrounding network is sufficiently interconnected and capable of providing a stable level of residual pressure and water supply.

The flow modelling was setup to review three scenarios: The occupancy of the Corus building (2010), the full buildout of Dockside (2012), and full buildout. The full buildout scenario also evaluated two options for Queens Quay; one by replacing the existing main with a like 300mm, and an additional scenario considering a 400mm replacement. Each scenario was modelled on the impacts under Peak hour, as well as max day plus fire flow. Fire flow, as noted above, has been determined to be 400 l/s by the FUS calculations.

Under all three scenarios, sufficient water supply and pressure are available to provide fire flows for the proposed development within the East Bayfront. The modelling indicated that there is no need to upgrade the diameter of the existing pipes within the East Bayfront.

9.5 System Upgrades

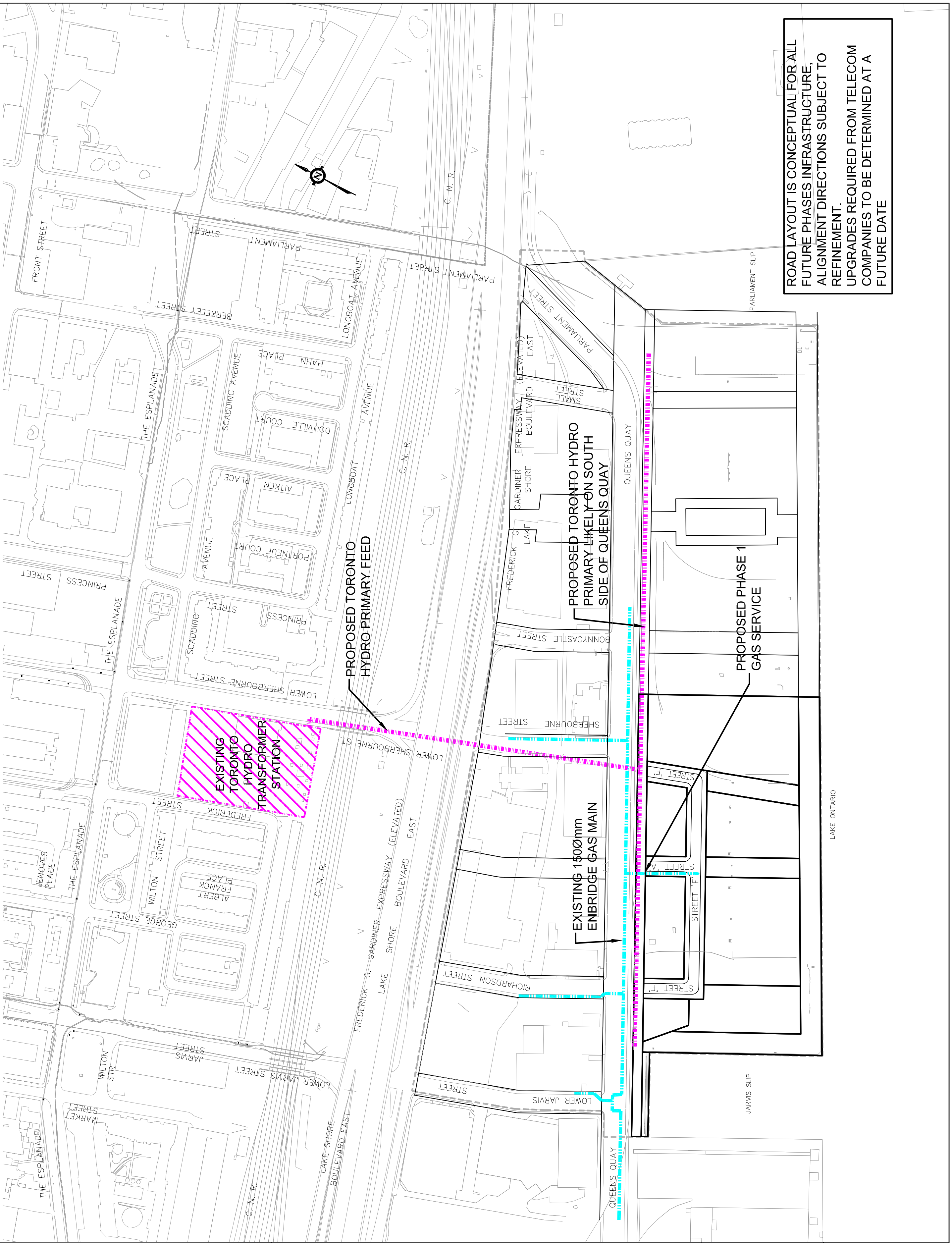
The modelling described above indicated that sizing upgrades of the existing system are not necessary for hydraulic reasons. Individual sizing upgrades may be completed at the detailed design stage as determined by the City or by Waterfront Toronto.

However, based on the age of the existing watermains approaching the end of their service lifetime and the importance of maintaining water supply (especially during fire events), it would be wise to undertake a program of watermain replacement with each street reconstruction. The East Bayfront Class Environmental Assessment Master Plan’s recommendation to rehabilitate and re-use the existing infrastructure may not, upon review, be the most appropriate approach, as most watermains within the East Bayfront will require replacement within the next 15-25 years and will most likely have higher incidences of failures during that time. In our opinion, the social cost of shutting down a street to replace the main once the East Bayfront is fully built out and active outweighs the additional carrying cost of moving watermain reconstruction forward to the time of road reconstruction. Additionally, the economic and human cost of having the fire-fighting system fail at a crucial time is immeasurable.

10 Hydro Servicing

The existing Hydro distribution network in the East Bayfront is operated by Toronto Hydro. They have determined that the current network is insufficient to supply primary power for either the proposed Corus building or for the full buildout development of the East Bayfront. Toronto Hydro will be extending a primary feed from the existing Esplanade Transformer Station at Sherbourne and the Gardiner Expressway to Queens Quay. The alignment of this feed will be addressed in the detail design stage, but it is anticipated that it will be brought down Sherbourne Street, partially through the proposed Sherbourne Park to Queens Quay. The Hydro feed has to be routed through the park to keep separation requirements and install the Hydro within the existing right-of-way. The right-of-way for Sherbourne Street will change with the development of the East Bayfront, thus leaving a portion of the new hydro under the Southwest corner of the park. Refer to **Figure 10-1** for the proposed Hydro servicing plan.

Hydro will be serviced in a joint trench with Telecom service providers. For Phase 1 of the development, it was decided to utilize a single-sided utility corridor. This provided additional space for tree planting on the opposite side of the right-of-way. Though not typical, preliminary discussions with utility companies indicated their acceptance. In this case, where services are provided on a block basis, crossings will be kept to a minimum, and single sided servicing can work. A proposed and conceptual internal road cross section is shown as **Figure 10-2**.



ROAD LAYOUT IS CONCEPTUAL FOR ALL FUTURE PHASES INFRASTRUCTURE, ALIGNMENT DIRECTIONS SUBJECT TO REFINEMENT.
UPGRADES REQUIRED FROM TELECOM COMPANIES TO BE DETERMINED AT A FUTURE DATE

LEGEND:

- ▬ GAS
- ▬ PROPOSED HYDRO

PROPOSED UTILITY TRUNK SYSTEM UPGRADES TO SERVICE

EAST BAYFRONT - TORONTO WATERFRONT

DATE:
MAR 2009

PROJECT No.
07135

SCALE:
50 25 0 50

FIGURE 10-1

The MUNICIPAL INFRASTRUCTURE Group Ltd

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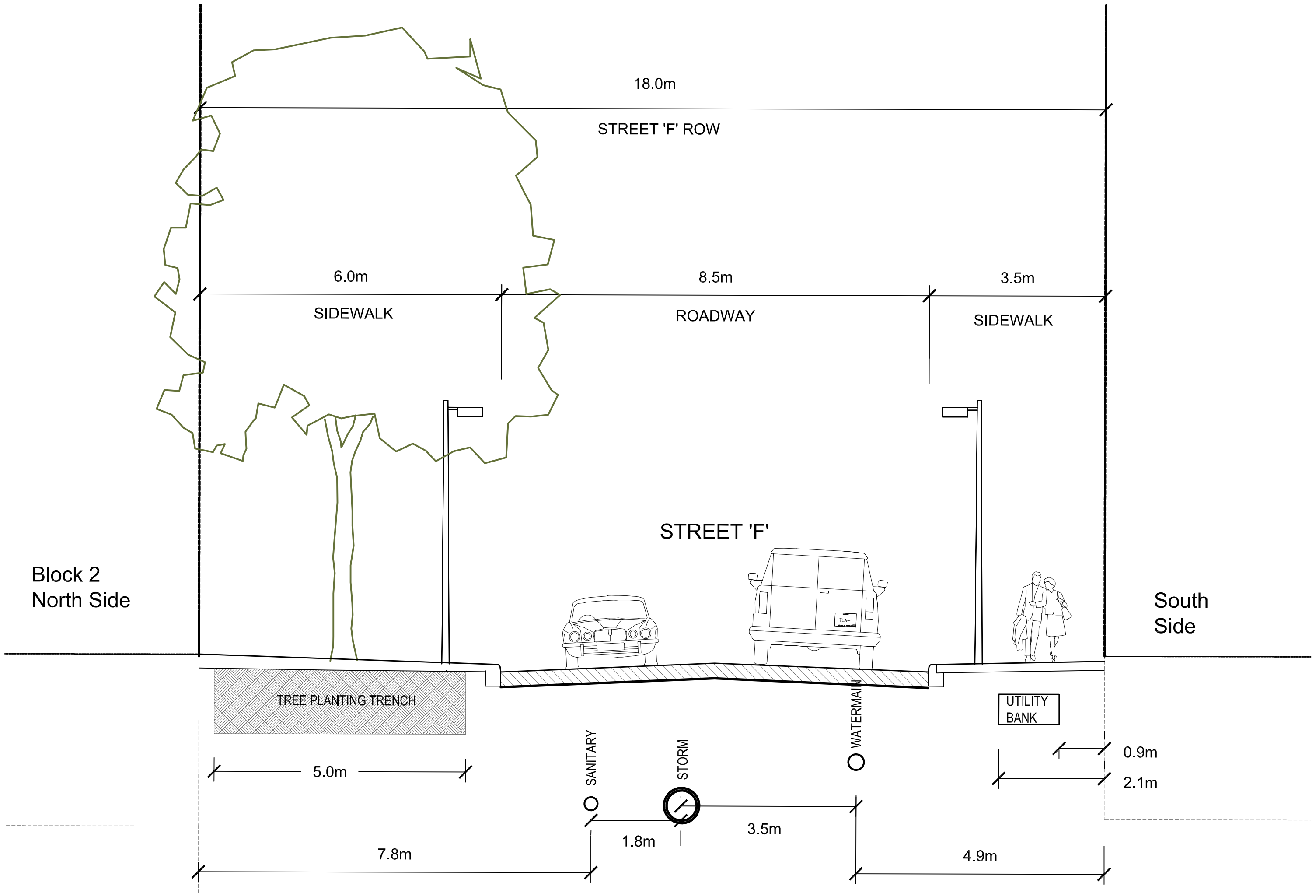


STREET 'F' - SECTION
SHOWING UTILITY BANK

The MUNICIPAL INFRASTRUCTURE Group Ltd

LEGEND:

PHASE 1 INTERNAL ROAD CROSS SECTION

EAST BAYFRONT - TORONTO WATERFRONT

DATE:
MAR 2009

PROJECT No.
07135

SCALE:
50 25 0 50

FIGURE 10-2

File : G:\Projects\2007\07135 - Waterfront Toronto - East Bayfront\Drawings\FIGURES\FSR\FIG 10-2.DWG, Layout : FIG 10-2 Date :Mar 20, 2009 - 2:51pm, Edit By : rstone

11 Gas Servicing

Enbridge will provide natural gas servicing for the East Bayfront. Currently, Enbridge operates a 150mm main on Queens Quay from Jarvis to approximately Bonnycastle Street. Enbridge have indicated that the proposed gas main has sufficient capacity to service the Corus building and possibly the temporary District Energy plant proposed on Block 2. Gas service to Phase 1 will be provided by a simple loop off of the existing Queens Quay main onto Street A to Street F.

It is Enbridge policy not to consider full servicing of the East Bayfront until customer loads can be determined. Therefore, they have not identified any upgrades to service the entire East Bayfront. Though not likely to be a concern in Phase 1, Enbridge may want to service areas where the final public realm construction may be completed. The proposed public realm construction will be costly to restore after gas installation, so it makes sense holistically to install gas prior to finishing the surface treatments of the rights-of-way.

The full requirement for Enbridge servicing is not clear at this time as heating for the East Bayfront will be provided through a district energy (heating and cooling) network.

12 Telecom Servicing

12.1 Bell Canada Servicing

Bell Canada will be providing Telecom Services to the East Bayfront. Currently Bell Canada has available service capacity along Queens Quay. Service to Phase 1 can be constructed as an extension of the existing service on Queens Quay. Bell Canada services will be provided to Phase 1 in the common telecom/hydro trench on Street F. Bell Canada's servicing plan for Phase 1 is shown on **Figure 10-1**.

12.2 Rogers Cable

Rogers Cable may provide Telecom services to the East Bayfront. Rogers has not proposed construction of any services to the East Bayfront at this time. However, Rogers are currently in discussions to bring empty ductwork down Lower Sherbourne Street from north of Lakeshore to Queens Quay. It is anticipated that Rogers Cable will utilize space within the common telecom/hydro trench on Queens Quay and feed internal roads from there.

12.3 Cogeco Cable

Cogeco Cable will provide Telecom services to the East Bayfront. Cogeco has proposed service to the Corus Building, originating at Queens Quay and Richardson and brought into Street F and looped through Street F back to Queens Quay. Cogeco will also occupy space in the common telecom/hydro trench proposed on Queens Quay to enable future expansion of their network.

12.4 Beanfield Technologies

Beanfield Technologies, a broadband provider, will provide telecom services for the East Bayfront. Beanfield has proposed service to the Corus Building, originating west on Queens Quay, past Lower Jarvis Street. Their service will be brought into Street F and looped through Street F back to Queens Quay. Beanfield will also occupy space in the common telecom/hydro trench proposed on Queens Quay to enable future expansion of their network.

12.5 Waterfront Intelligent Communities, iWaterfront

Waterfront Toronto has retained the services of Cygnal Technologies to set up and operate a dedicated ultra broadband data communication network within the Toronto Waterfront. Implementation of this network's design has yet to commence, but it anticipated that a trunk line will be constructed along Queens Quay to feed future internal development roads and blocks. The construction of substantial and possibly offsite infrastructure required for the project is beyond the scope of this study, and will be addressed by Cygnal at a later date.

13 District Energy

It is proposed to service East Bayfront with district heating and cooling services. At the time of writing this report, the plant to supply district heating and cooling services to the East Bayfront had not yet been constructed, but the location had been determined to be within the West Don Lands development area. As a result, a temporary plant has been proposed and is currently under construction on Block 2, between Queens Quay and Street F, within Phase 1.

Regardless of plant location, pipes for district energy will eventually need to be constructed with the reconstruction of Queens Quay. There is a risk in locating the district energy pipes within Queens Quay, prior to the completion of the Class EA, in that the proposed cross section may change and the pipes may need to be relocated. If Phase 1 is to be serviced from the proposed temporary plant located on Block 2, then construction of district energy pipes within Queens Quay is not an immediate necessity. Service can be provided internally within Phase 1 from the interim plant for Corus, although the plant has not been sized to accommodate other developments within Phase 1.

The two possible cross sections that may be established by the Queens Quay Class EA show two different locations for district energy transmission piping. These are reflected in **Figure 13-2**. In addition, the district energy piping must come from the proposed West Don Plant to Queens Quay. The currently anticipated best location for this connection is along Small Street. **Figure 13-3** indicates that the proposed district energy network will fit within the Small Street right-of-way, but trees cannot be planted along the east boulevard of the street. Small Street is congested with proposed buried storm, sanitary, and water services, as well as proposed utilities and an existing large CSO. Alternatively, trees could still be planted within the right-of-way if additional land is utilized and the right-of-way is widened to 23.0m. The extra width required for this right-of-way is yet to be tested by the precinct planning team and should also be reviewed by Waterfront Toronto’s EA specialist for compliance with the precinct plan class EA document. This needs further detailed review from the district energy, public realm and municipal servicing teams.

The remaining lands within the East Bayfront can be serviced from Queens Quay and on the local roads, as the roads develop. Discussions with FVB energy, the district energy provider, have revealed a preference to have the tee locations established during mainline trench construction, as opposed to future live tap connections. The layout of the district energy servicing plan is shown on **Figure 13-1**.

ROAD LAYOUT IS CONCEPTUAL. FOR ALL FUTURE PHASES INFRASTRUCTURE, ALIGNMENT DIRECTIONS SUBJECT TO REFINEMENT.

The MUNICIPAL INFRASTRUCTURE Group Ltd

LEGEND:

PROPOSED DISTRICT ENERGY NETWORK

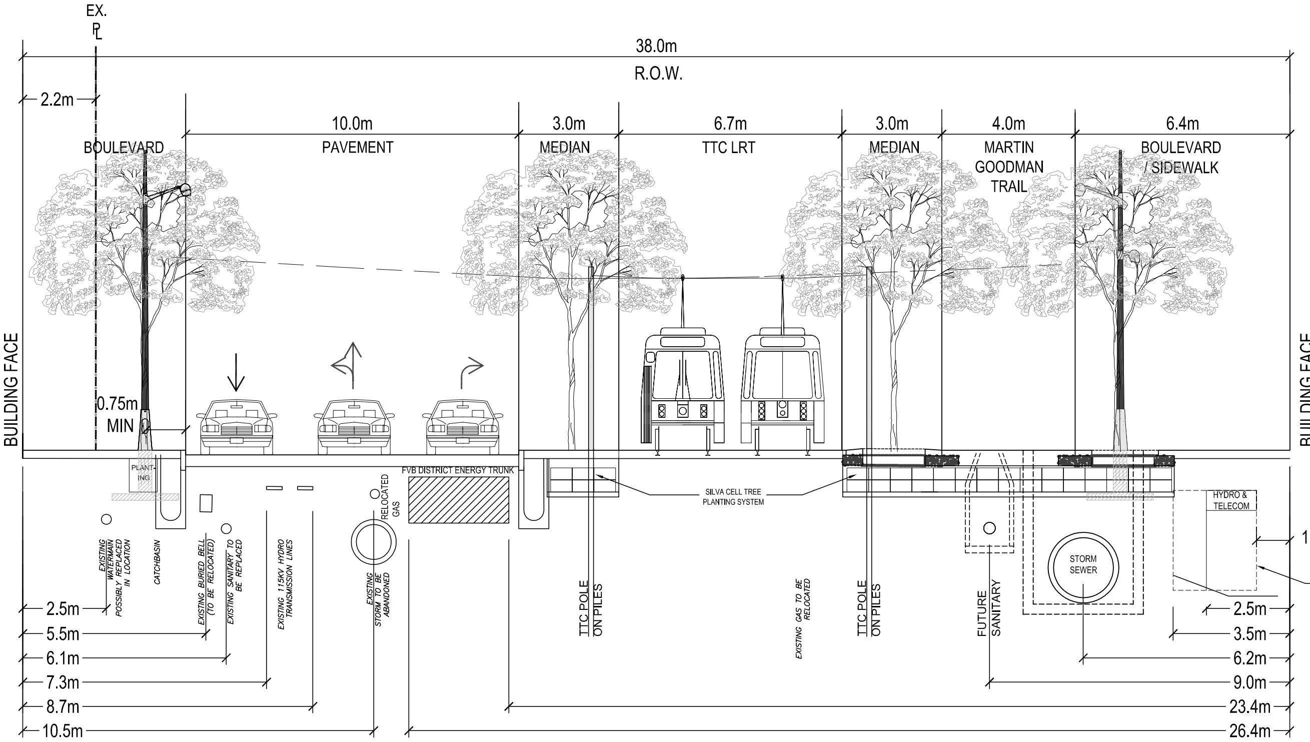
EAST BAYFRONT - TORONTO WATERFRONT

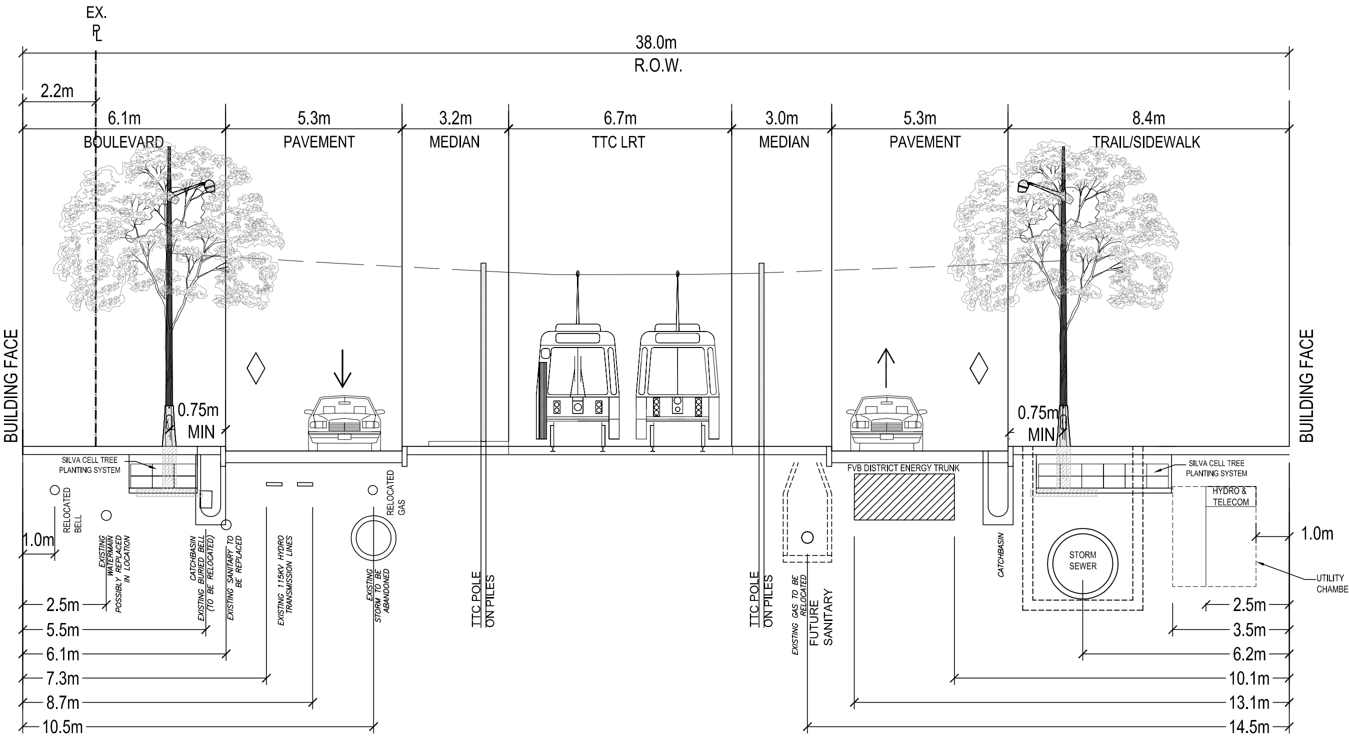
DATE: MAR 2009

SCALE: 50 25 0 50

PROJECT No. 07135

FIGURE 13-1





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LEGEND:

POSSIBLE QUEENS QUAY ROAD CROSS SECTIONS

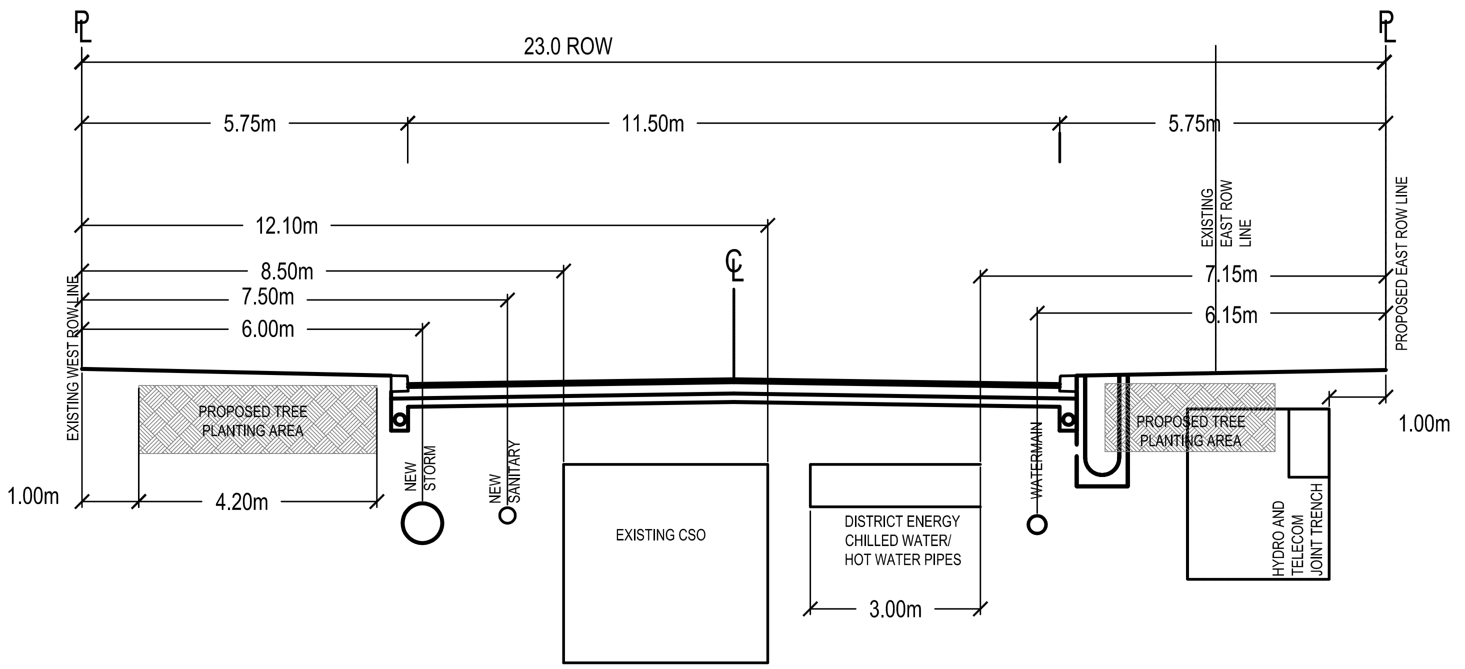
EAST BAYFRONT - TORONTO WATERFRONT

DATE: MAR 2009

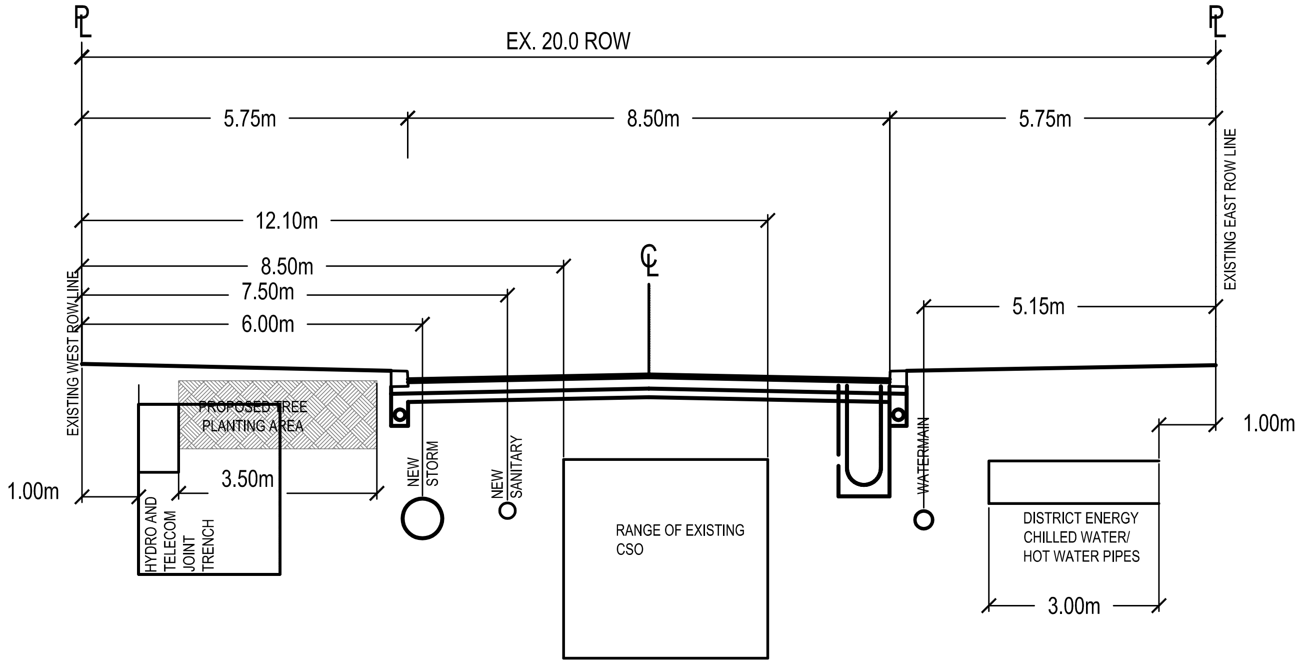
PROJECT No. 07135

SCALE: N.T.S.

FIGURE 13-2



EXPANDED RIGHT-OF-WAY - 23.0m TOTAL WIDTH - 3.0m WIDENING REQUIRED



EXISTING 20.0m RIGHT-OF-WAY

LEGEND:

POSSIBLE SMALL STREET
CROSS SECTIONS
EAST BAYFRONT - TORONTO WATERFRONT

DATE: MAR 2009

PROJECT No. 07135

SCALE: N.T.S.

FIGURE 13-3

14 Transportation Servicing

Queens Quay is subject to two Class Environmental Assessments currently underway for transit and road design. If the EA follows a typical course, Queens Quay may be reconstructed in 2009 or 2010. At that time, the grading revisions necessary to create a sawtooth profile on Queens Quay, and to create low points at Jarvis Slip, Sherbourne, and Queens Quay, as described in **Section 15**, should be implemented. It is likely that lower Sherbourne Street will also be reconstructed at that time.

BA Group has completed a functional design for the road networks within Phase 1, submitted under separate cover. This report considered the impact of connections with Queens Quay.

15 Site Grading Design

Currently, the East Bayfront lands are essentially flat. There is approximately 1.2m of elevation variance on the EBF from a high point in the Phase 1 area to a low point at Queens Quay and Jarvis. As a result, as mentioned in **Section 7**, there is minimal opportunity to properly drain the lands overland in a major storm event. With reconstruction of lands within East Bayfront, an opportunity can be realized to provide proper grading and drainage design that would result in a better level of service. It is proposed to design the internal grading to typical municipal standards that consist of:

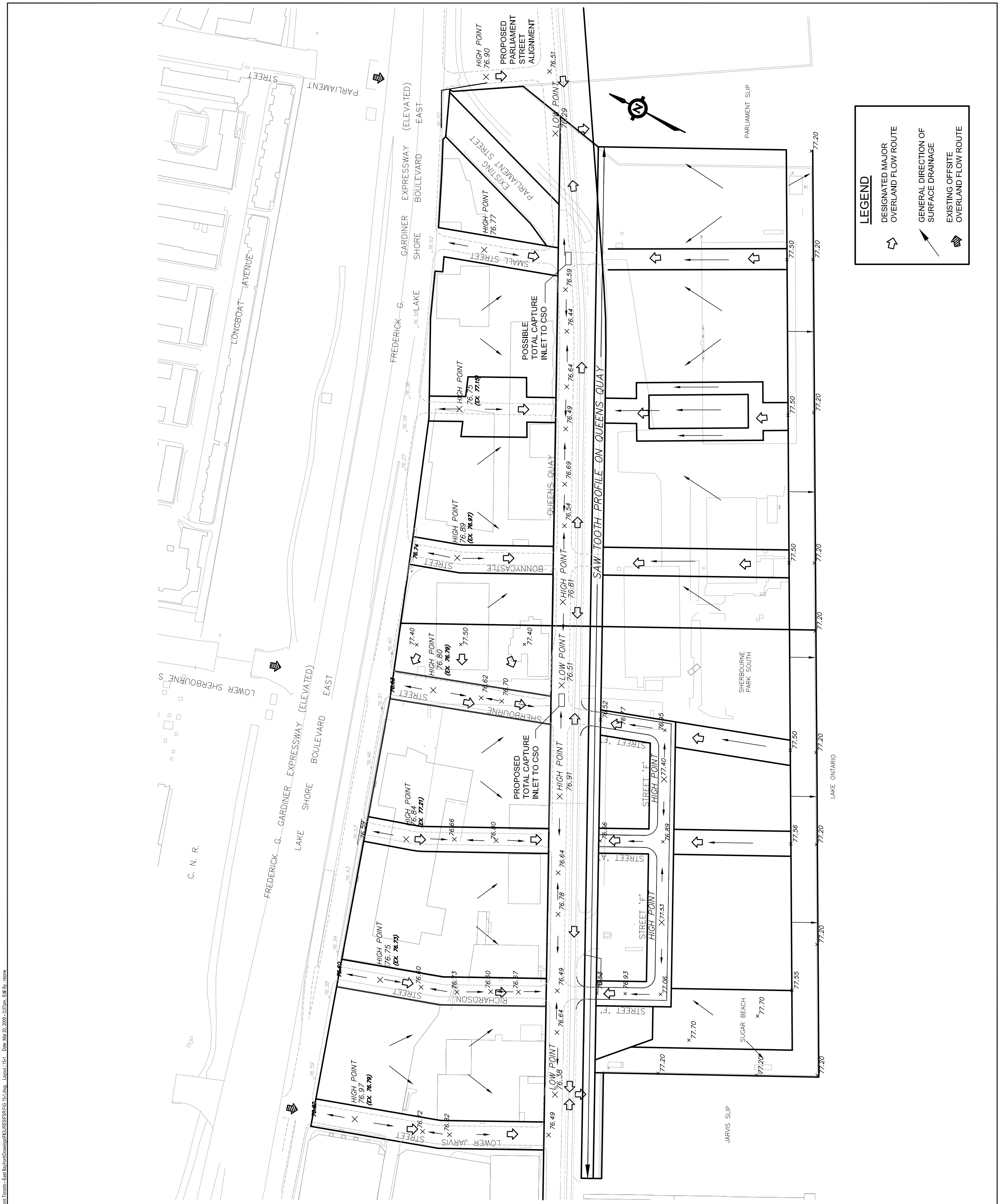
- 0.5% minimum gutter grades.
- 2% minimum, 4% maximum boulevards
- 2% cross fall on roadways.
- Positive major overland flow drainage (though as mentioned in **Section 7**, this may not be achievable on Queens Quay without using a “sawtooth” type road profile)
- 1% minimum slope on hard surface landscaped areas
- 2% minimum slope on soft landscaped areas.

It is proposed in **Section 7** of this document to reconstruct Queens Quay with a “sawtooth” profile to facilitate overland drainage. The Sawtooth profile allows for cascading of major overland flow from a specific high point to a low point at overall elevations much less than minimum, while still allowing minor flows to drain at minimum slopes. The proposed profile along Queens Quay is illustrated in **Figure 15-2**. It should be noted that although this profile would be beneficial to service Phase 1, reconstruction is not critical to allow the implementation of Phase 1, as Queens Quay is subject to two Class Environmental Assessments that are currently underway.

A detailed grading control plan has been prepared for Phase 1 as shown in **Figure 15-1**. This grading control plan should be referenced during preparation of the subdivision and site plan grading submissions and road designs. TMIG, as author of this document, should review the proposed site plans on behalf of Waterfront Toronto for compliance.

A full topographic survey of the existing roads within the East Bayfront has been undertaken to confirm the area grading plan.

Detailed grading will need to be reviewed at several key locations including the interface with the proposed TTC LRT on Queens Quay, and especially at the intersections with the north south roads and at proposed major system outlets. Conceptual illustrating how these areas may be designed are included as **Figure 15-3**, **Figure 15-4**, and **Figure 15-5**.



File : G:\Projects\2007\07135 - Waterfront Toronto - East Bayfront\Drawings\FIGURES\FSR\FIG 15-1.dwg, Layout : 15-1 Date :Mar 20, 2009 - 3:37pm, Edit By : rstone

The MUNICIPAL INFRASTRUCTURE Group Ltd

LEGEND:

OVERALL CONCEPTUAL PROPOSED GRADING PLAN

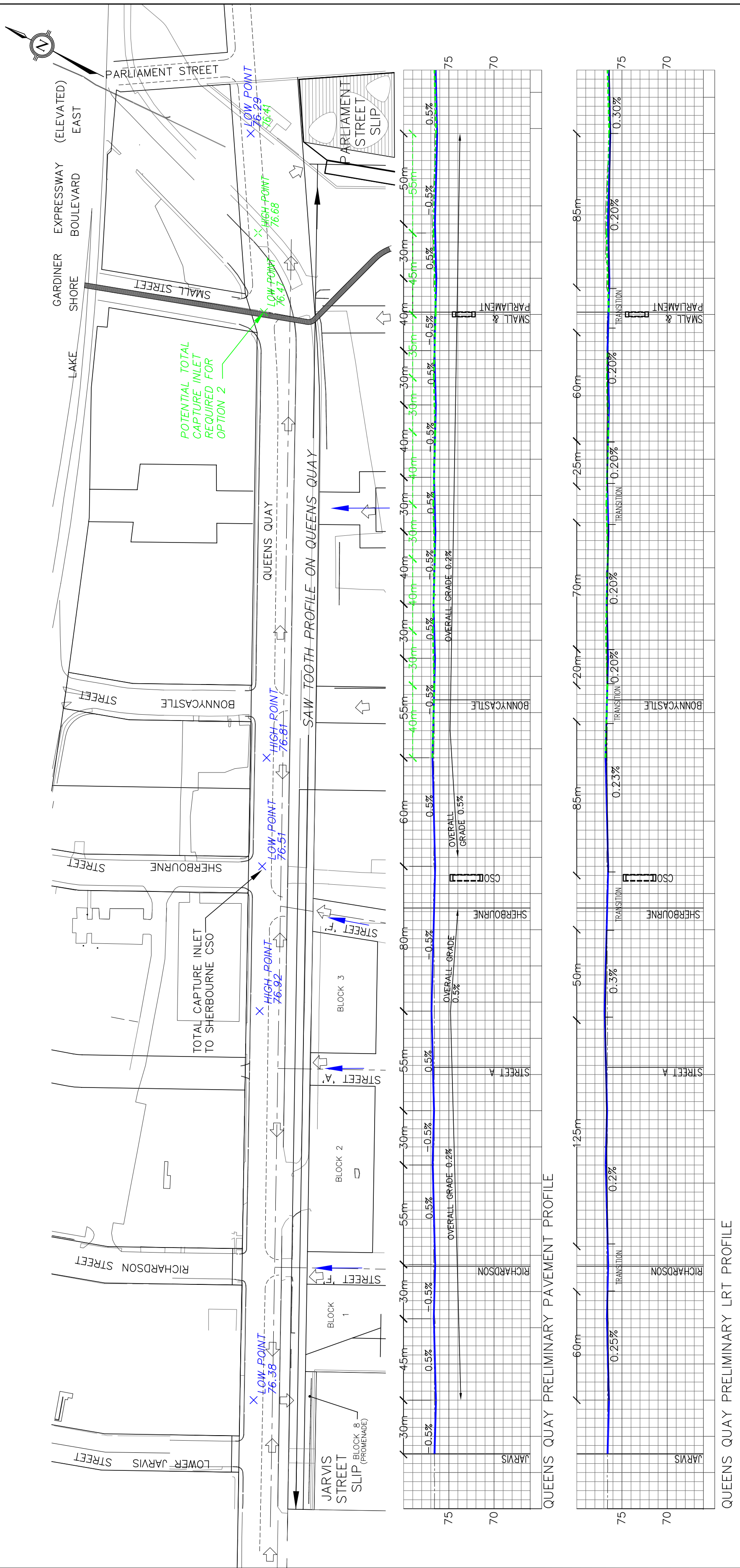
EAST BAYFRONT - TORONTO WATERFRONT

DATE: MAR 2009

PROJECT No. 07135

SCALE: 25 0 50

FIGURE 15-1



LEGEND:

— OPTION 1

- - - OPTION 2

⇦ DIRECTION OF FLOW

PRELIMINARY PLAN AND PROFILE
QUEENS QUAY
EAST BAYFRONT - TORONTO WATERFRONT

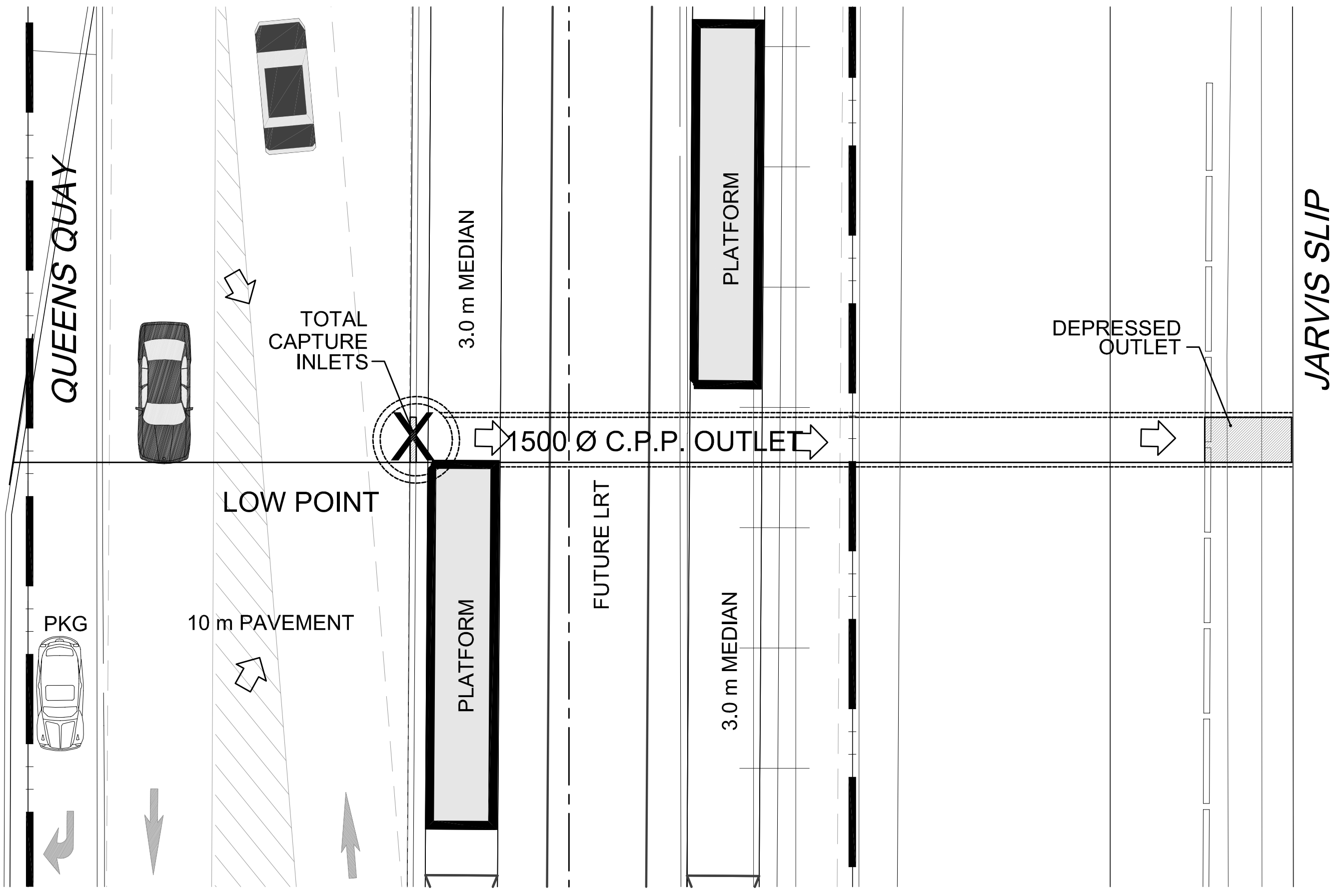
DATE:
MAR 2009

PROJECT No.
07135

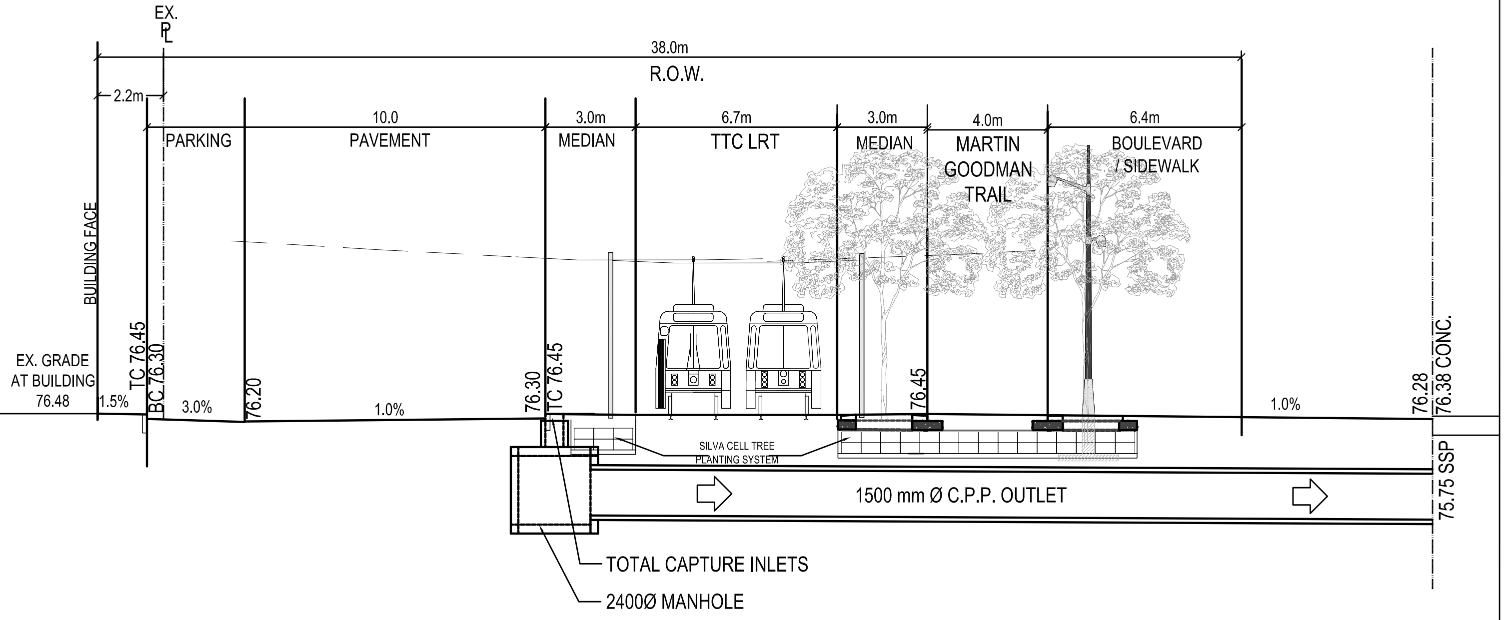
SCALE:
25 0 50

FIGURE 15-2

The MUNICIPAL INFRASTRUCTURE Group Ltd.

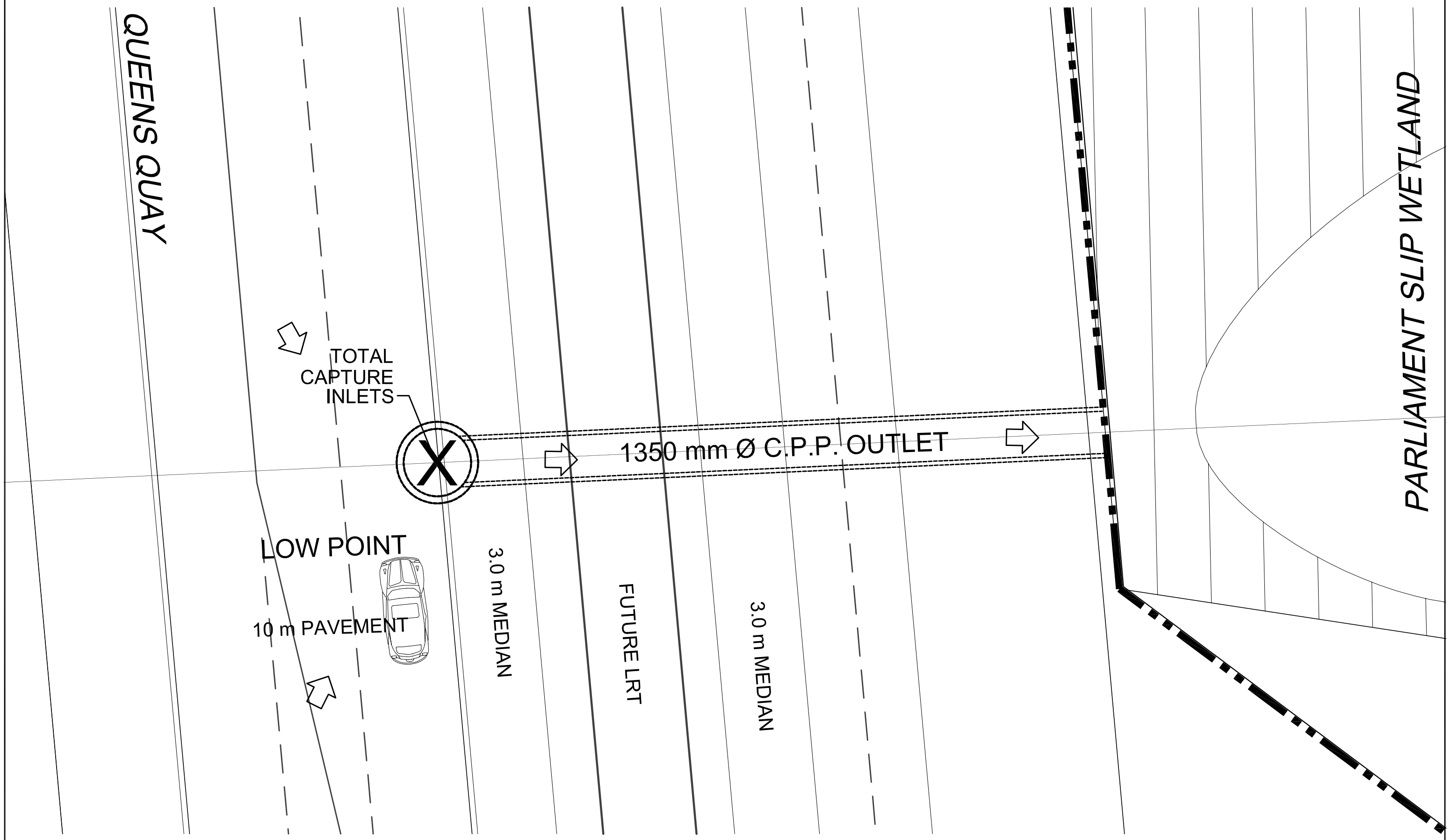


JARVIS STREET OUTLET

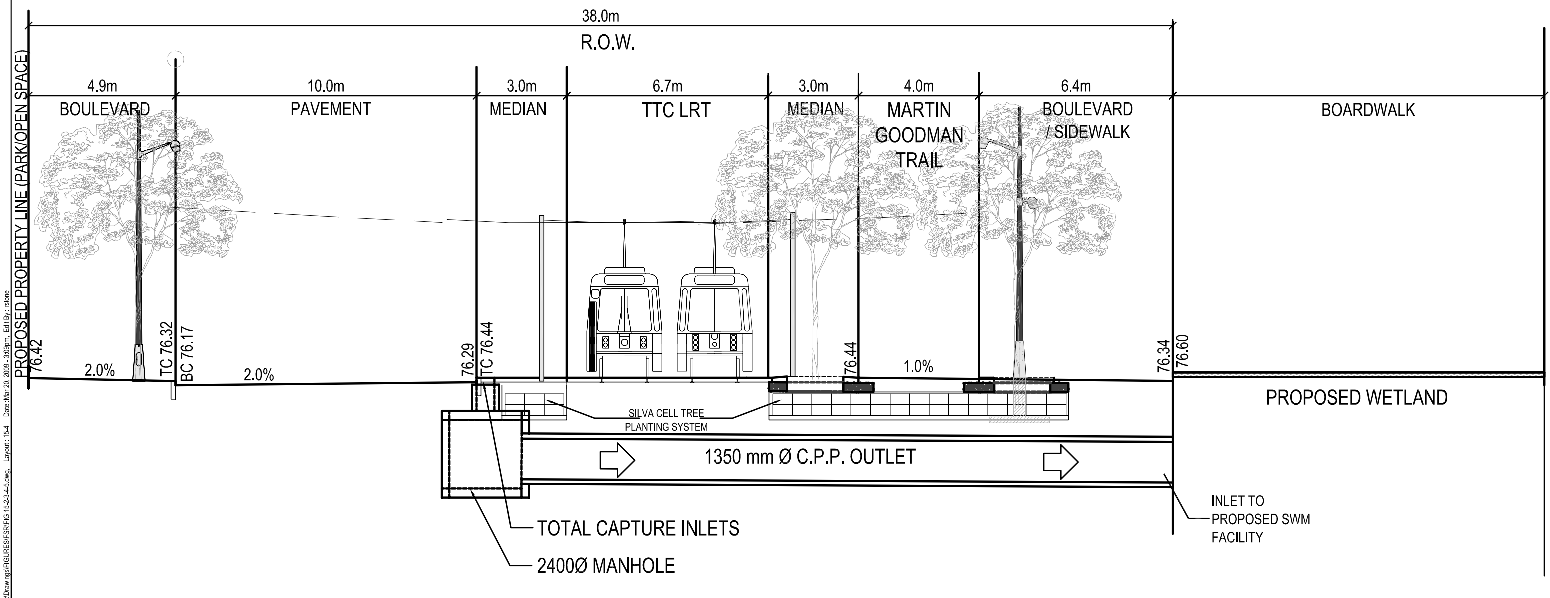


File : G:\Projects\2007\07135 - Waterfront Toronto - East Bayfront\Drawings\FIGURES\FSR\FIG 15-2-3-4-5.dwg, Layout : 15-3 Date :Mar 20, 2009 - 3:55pm, Edit By : rstone

LEGEND:		PRELIMINARY JARVIS SLIP MAJOR SYSTEM FLOW OUTLET EAST BAYFRONT - TORONTO WATERFRONT	DATE: MAR 2009	PROJECT No. 07135
⇦	DIRECTION OF FLOW		SCALE: N.T.S.	FIGURE 15-3



PARLIAMENT STREET SLIP - OPTION 1



File : G:\Projects\2007\07135 - Waterfront Toronto - East Bayfront\Drawings\FIGURES\FSR\FIG 15-2-3-4-5.dwg, Layout : 15-4 Date :Mar 20, 2009 - 3:09pm, Edit By : rstone

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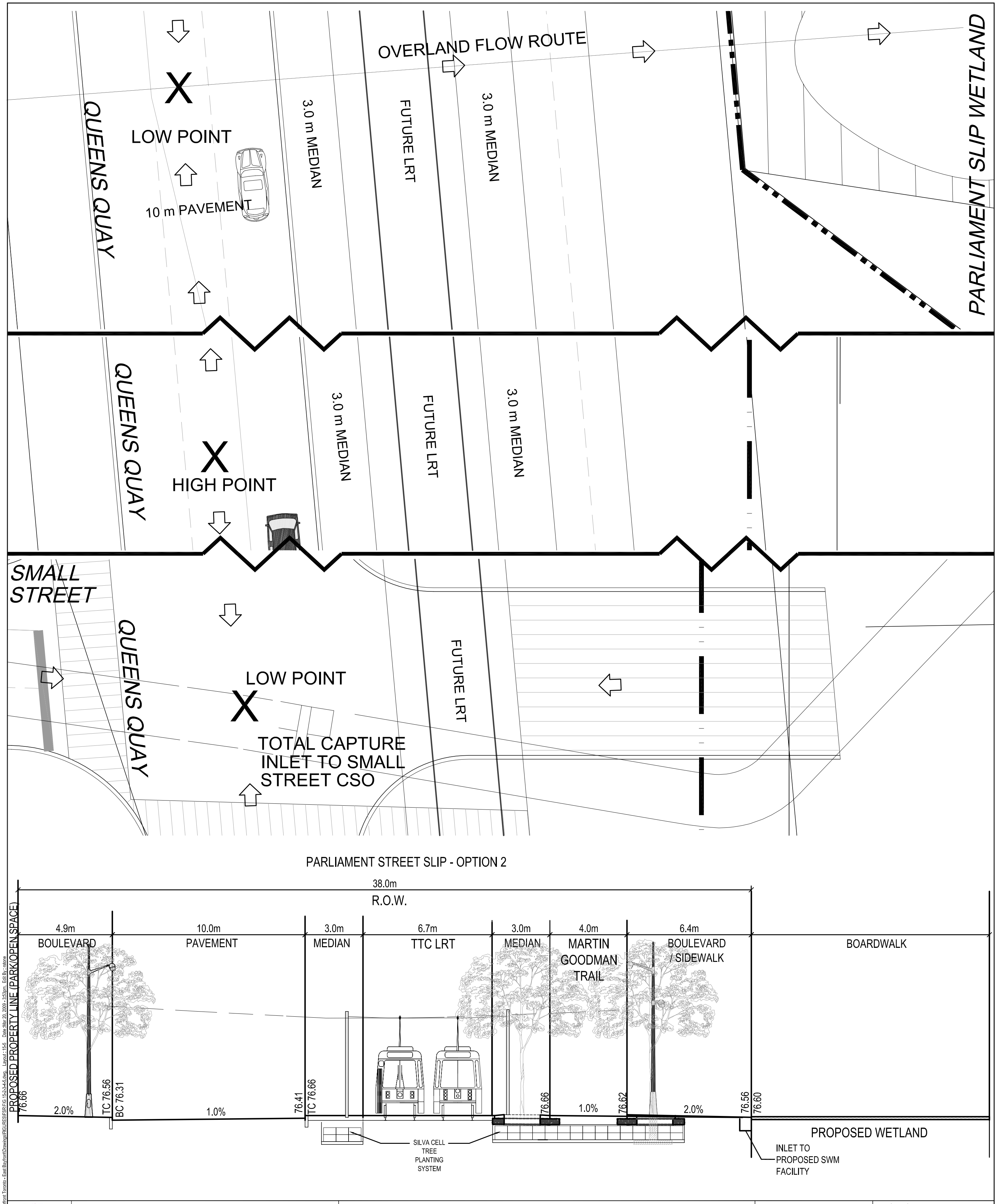
LEGEND:

⇦ DIRECTION OF FLOW

PRELIMINARY PARLIAMENT SLIP
MAJOR SYSTEM FLOW OUTLET - OPTION 1

EAST BAYFRONT - TORONTO WATERFRONT

DATE: MAR 2009
PROJECT No. 07135
SCALE: N.T.S.
FIGURE 15-4



File : G:\Projects\2007\07135 - Waterfront Toronto - East Bayfront\Drawings\FIGURES\FSR\FIG 15-2-3-4-5.dwg, Layout : 15-5 Date :Mar 20, 2009 - 3:53pm, Edit By : rstone

The MUNICIPAL INFRASTRUCTURE Group Ltd

LEGEND:

⇦ DIRECTION OF FLOW

PRELIMINARY PARLIAMENT SLIP OVERLAND FLOW OUTLET - OPTION 2

EAST BAYFRONT - TORONTO WATERFRONT

DATE: MAR 2009

PROJECT No. 07135

SCALE: N.T.S.

FIGURE 15-5

16 Recommendations

16.1 Stormwater Management

If implemented the stormwater management strategy identified herein will provide a sustainable, effective, and economic demonstration of stormwater runoff treatment that will illustrate the City of Toronto's and Waterfront Toronto's commitment to sustainability. Recommendations associated with the strategy include:

- A treatment train approach to stormwater management is required for East Bayfront.
- On-site measures (i.e. 15mm retention) as proposed south of Queens Quay form a significant part of the stormwater management strategy.
- On-site measures (i.e. 5mm retention) north of Queens Quay are consistent with the City of Toronto's Wet Weather Flow Management Guidelines.
- Four water quality treatment manholes (OGS') should be implemented to service the four quadrants of East Bayfront.
- Phase 1 will be implemented and consistent with the overall East Bayfront stormwater management strategy, and meet the intent of all applicable agency criteria.
- An end-of-pipe stormwater management facility needs to be implemented. A stormwater management pond of approximately 0.85 hectares, with a 0.5-metre fluctuation in depth, to be integrated with the boardwalk and Parliament Slip wavedeck, would achieve the treatment requirements.
- The footprint of the proposed stormwater management facility will require aquatic habitat compensation.
- Runoff treated by the stormwater management facility will be further treated by a UV disinfection system within Sherbourne Park. The resulting water will be supplied to proposed water features within the park, prior to eventual release to Lake Ontario.

16.2 Municipal Services and Utilities

The East Bayfront is serviceable by municipal infrastructure and utilities. A summary of recommended upgrades necessary for each stage is presented below:

Corus Building

To service the Corus Building, which is currently planned to achieve occupancy in 2010, the following upgrades are recommended:

Storm

- Construct the trunk storm sewer from Phase 1 to the proposed connection at the Pond (without connecting to the lake). At the crossing of the Sherbourne CSO, the sewer should be constructed under the CSO and a temporary connection provided to the CSO.
- Replace the existing storm sewer on Queens Quay with a trunk sewer from Richardson Street to the Phase 1 trunk sewer. Jarvis and Richardson Street storm sewers should be reconnected, but do not need to be reconstructed at this time.
- Install an Oil Grit Separator on the external trunk sewer line at Street F East Leg, south of the South Leg.
- Install the total capture inlet at Lower Sherbourne Street and Queens Quay, and connect the inlet to the Sherbourne CSO, at the time that Queens Quay is reconstructed.
- Install a total capture inlet and a culvert to allow major overland flow into Jarvis Slip at Jarvis Street and Queens Quay at the time that Queens

Quay is reconstructed.

- Install the proposed storm sewers internal to Phase 1.

Sanitary

- Reconstruct 570m of Sanitary Sewers on The Esplanade, Market, Wilton, and Lower Jarvis Streets
- Connect the proposed sanitary sewer from the west end of Phase 1 to the sanitary sewer on Lower Jarvis Street.
- Commence the Class Environmental Assessment to determine the necessary changes to the Scott Street Sewage Pumping Station.
- Upgrade flow monitoring at the Scott Street SPS and continue monitoring.
- Install the proposed sanitary sewers internal to Phase 1.

Water

- Construct the internal loop from Richardson and Queens Quay, along Street F and return to Queens Quay on Street A.

Utilities

- Extend Primary Hydro from Sherbourne and the Gardiner to Lower Sherbourne and Queens Quay, and along Queens Quay to Jarvis
- Construct the internal joint-use utility corridor.
- Extend the proposed Bell upgrades into the Phase 1 lands.
- Extend Rogers' network to Phase 1 from Parliament and Front Streets, along Queens Quay.
- Construct the District Energy system as required, depending on the plant location.
- Construct the internal gas service loop on Street A to Street F, and connect to the existing gas main on Queens Quay.

Full Phase 1 (Dockside) Construction

Full Phase 1 occupancy will occur sometime after Corus is completed. At this time, timing is not known. The required additional upgrades to service Phase 1 are:

Sanitary

- Extend the Sanitary Sewer Reconstruction south along Lower Jarvis Street to Queens Quay.
- Connect the proposed sanitary sewer from the east end of Phase 1 to the Queens Quay sanitary sewer.

Water

- Complete the internal loop from Street A and Street F to Queens Quay and Lower Sherbourne Street, along Street F.

All other services should be able to support Phase 1 at this point.

Reconstruction of Lower Sherbourne and Queens Quay

It is anticipated that the EAs for Queens Quay will wrap up by the end of 2009, with detail design finishing the year after. It is anticipated that construction of Queens Quay, and also Lower Sherbourne, which will likely be undertaken at the same time, will occur at the earliest in 2010. The upgrades required to reconstruct Queens Quay and Lower Sherbourne include:

Storm

- Construct the trunk storm sewer from its terminus by Sherbourne Park and Queens Quay, along Queens Quay to the Parliament Slip.
- Construct Oil Grit Separators (OGS) along the trunk sewer as needed.
- Construct the proposed stormwater management facility.

- Install three total capture inlets at the overland flow route at the Parliament Street Slip (or Small Street CSO), Jarvis Street Slip and the Sherbourne CSO.

Sanitary

- Extend the sanitary sewer reconstruction from Jarvis and Queens Quay along Queens Quay to the Parliament Street Slip.

Water

- Replace the existing watermains on Lower Jarvis, Lower Sherbourne and Queens Quay. Upgrades in size may be required based on the results of the City of Toronto water modeling and flow testing.

Utilities

- Extend services terminated at the frontage of Phase 1 the full length of Queens Quay.

Grading

- When Lower Jarvis and Lower Sherbourne sewers and watermains are reconstructed, the road profiles should also be adjusted to account for the required major overland flow routes.

Future Phases of the East Bayfront

Once Queens Quay, Lower Jarvis and Lower Sherbourne are reconstructed, full external services will be provided to the East Bayfront. Queens Quay will essentially be a service “spine” for the development area. Under Queens Quay, trunk storm, sanitary, water, district energy and utility services will be provided. Individual roads and portions of future phases can be constructed from Queens Quay as development pressures dictate, without the need for further external upgrades.

16.3 Sustainability

The selection of infrastructure and servicing systems necessary to support the East Bayfront redevelopment included consideration for numerous factors, including sustainability. The following subsections describe several elements of the proposed redevelopment for which sustainability is evident, or where sustainable practices are recommended.

Water Efficiency

- On-site measures will include green roofs and rainwater harvesting systems, thereby reducing both runoff and potable water consumption.
- Runoff generated by the community, and treated by the proposed stormwater management system, will supply irrigation systems and water features within Sherbourne Park. This adheres to the principles of the sustainability framework through utilization of stormwater as a resource and reduced potable water consumption.
- Although beyond the purview of this Functional Servicing Report, it is generally recommended that water efficient practices be investigated, and incorporated where reasonable, into other aspects of the redeveloping community. As described in the City of Toronto’s Water Efficiency Plan (December 2002), some of these practices may include the installation of water efficient appliances and fixtures, use of computer controlled or forecast-based irrigation systems, and promotion of public education programs. The planned LEED certification of many of the buildings within East Bayfront is expected to result in the adoption of many of these practices.

Energy Efficiency

- The planned LEED certification of proposed buildings and facilities within East Bayfront is expected to result in the incorporation of energy efficient practices on a broad scale.
- The district heating and cooling infrastructure is expected to yield reductions in energy consumption.

- The density of the proposed redevelopment, in conjunction with the existing and planned proximity to public transportation services, is in part intended to reduce energy consumption.
- The energy requirements associated with the stormwater management system, specifically in regard to the energy usage for the UV equipment and associated pumps, have been estimated and are provided in **Appendix 5c**. In accordance with discussions with the City, methods to offset the estimated energy consumption will be explored as the redevelopment process progresses, possibly through the addition of alternative or renewable energy mechanisms.

17 References

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Waterfront Toronto

East Bayfront
Functional Servicing Report

Updated March 2009

APPENDICES

The Municipal Infrastructure Group Ltd.
2300 Steeles Avenue West Suite 120
Vaughan ON CA L4K 5X6
Tel 905.738.5700 Fax 905.738.8075
www.tmig.ca

Prepared on behalf of:

Appendix 1a

Hydrologic Site Characterization

07135 - East Bayfront

Date: March-2009 **Area-Runoff Calculation**

25mm Storm

	Area (ha)	C	AC		
North of Queens Quay	2.60	0.75	1.95	East Outlet	
South of Queens Quay	2.97	0.35	1.04		
Roads	3.34	0.95	3.17		
North of Queens Quay	3.57	0.75	2.68	West Outlet	
South of Queens Quay	1.97	0.35	0.69		
Parks	1.36	0.50	0.68		
Jarvis Slip	0.42	0.95	0.40		
Roads	3.38	0.95	3.21		
External areas	0.52	0.95	0.49		
	0.57	0.95	0.54		
	1.61	0.75	1.21		
Total	22.31		16.06	<--- Weighted C =	0.72
				Weighted I =	0.74

2yr Storm

	Area (ha)	C	AC		
North of Queens Quay	2.60	0.78	2.03	East Outlet	
South of Queens Quay	2.97	0.44	1.31		
Roads	3.34	0.95	3.17		
North of Queens Quay	3.57	0.78	2.78	West Outlet	
South of Queens Quay	1.97	0.44	0.87		
Parks	1.36	0.5	0.68		
Jarvis Slip	0.42	0.95	0.40		
Roads	3.38	0.95	3.21		
External areas	0.52	0.95	0.49		
	0.57	0.95	0.54		
	1.61	0.75	1.21		
Total	22.31		16.69	<--- Weighted C =	0.75
				Weighted I =	0.78

5yr Storm

	Area (ha)	C	AC		
North of Queens Quay	2.60	0.83	2.16	East Outlet	
South of Queens Quay	2.97	0.6	1.78		
Roads	3.34	0.95	3.17		
North of Queens Quay	3.57	0.83	2.96	West Outlet	
South of Queens Quay	1.97	0.6	1.18		
Parks	1.36	0.5	0.68		
Jarvis Slip	0.42	0.95	0.40		
Roads	3.38	0.95	3.21		
External areas	0.52	0.95	0.49		
	0.57	0.95	0.54		
	1.61	0.75	1.21		
Total	22.31		17.79	<--- Weighted C =	0.80
				Weighted I =	0.85

07135 - East Bayfront

Date: March-2009 **Area-Runoff Calculation**

10yr Storm

	Area (ha)	C	AC	
North of Queens Quay	2.60	0.85	2.21	East Outlet
South of Queens Quay	2.97	0.66	1.96	
Roads	3.34	0.95	3.17	
North of Queens Quay	3.57	0.85	3.03	West Outlet
South of Queens Quay	1.97	0.66	1.30	
Parks	1.36	0.5	0.68	
Jarvis Slip	0.42	0.95	0.40	
Roads	3.38	0.95	3.21	
External areas	0.52	0.95	0.49	
	0.57	0.95	0.54	
	1.61	0.75	1.21	
Total	22.31		18.21	<--- Weighted C = 0.82

Weighted I = 0.88

25yr Storm

	Area (ha)	C	AC	
North of Queens Quay	2.60	0.87	2.26	East Outlet
South of Queens Quay	2.97	0.7	2.08	
Roads	3.34	0.95	3.17	
North of Queens Quay	3.57	0.87	3.11	West Outlet
South of Queens Quay	1.97	0.7	1.38	
Parks	1.36	0.5	0.68	
Jarvis Slip	0.42	0.95	0.40	
Roads	3.38	0.95	3.21	
External areas	0.52	0.95	0.49	
	0.57	0.95	0.54	
	1.61	0.75	1.21	
Total	22.31		18.53	<--- Weighted C = 0.83

Weighted I = 0.90

50yr Storm

	Area (ha)	C	AC	
North of Queens Quay	2.60	0.88	2.29	East Outlet
South of Queens Quay	2.97	0.74	2.20	
Roads	3.34	0.95	3.17	
North of Queens Quay	3.57	0.88	3.14	West Outlet
South of Queens Quay	1.97	0.74	1.46	
Parks	1.36	0.5	0.68	
Jarvis Slip	0.42	0.95	0.40	
Roads	3.38	0.95	3.21	
External areas	0.52	0.95	0.49	
	0.57	0.95	0.54	
	1.61	0.75	1.21	
Total	22.31		18.79	<--- Weighted C = 0.84

Weighted I = 0.92

07135 - East Bayfront

Date: March-2009 Area-Runoff Calculation

100yr Storm

	Area (ha)	C	AC		
North of Queens Quay	2.60	0.89	2.31	East Outlet	
South of Queens Quay	2.97	0.76	2.26		
Roads	3.34	0.95	3.17		
North of Queens Quay	3.57	0.89	3.18	West Outlet	
South of Queens Quay	1.97	0.76	1.50		
Parks	1.36	0.5	0.68		
Jarvis Slip	0.42	0.95	0.40		
Roads	3.38	0.95	3.21		
External areas	0.52	0.95	0.49		
	0.57	0.95	0.54		
	1.61	0.75	1.21		
Total	22.31		18.95	<--- Weighted C =	0.85
				Weighted I =	0.93

East Bayfront - Runoff Coefficient Evaluation (March 2009 Functional Servicing Report)

Storm Volumes (Wet Weather Flow IDF)

25mm	*25.00 mm*
2 Year	*29.57 mm*
5 Year	*42.80 mm*
10 Year	*51.05 mm*
25 Year	*59.62 mm*
50 Year	*70.57 mm*
100 Year	*78.75 mm*

Overall Area Breakdown (Base Conditions)

Site Component	A (ha)	CxA	C_{BASE}
Building (Rooftop - north of Queens Quay)	6.17	5.831	0.95
Building (Rooftop - south of Queens Quay)	4.94	4.668	0.95
Right-of-ways	6.72	6.350	0.95
Park (including Sherbourne Park)	1.36	0.673	0.50
Sugar Beach	0.42	0.397	0.95
Promenade	2.68	2.533	0.95
External Area - paved	1.09	1.030	0.95
External Area - mixed	1.61	1.199	0.75
Total / Average	24.99	22.682	0.91

Bldg Base Runoff Coefficient:	***0.95***
15mm Runoff Reduction:	***15***
5mm Runoff Reduction:	***5***

Adjustment to Building Runoff Coefficient to Account for On-Site Measures

event	depth (mm)	base runoff (mm)	runoff reduced by 15mm (south of Queens Quay)	C_{15}	runoff reduced by 5mm (north of Queens Quay)	C_{5}
25mm	*25.00*	23.75	8.75	***0.35***	18.75	***0.75***
2 Year	*29.57*	28.09	13.09	***0.44***	23.09	***0.78***
5 Year	*42.80*	40.66	25.66	***0.60***	35.66	***0.83***
10 Year	*51.05*	48.50	33.50	***0.66***	43.50	***0.85***
25 Year	*59.62*	56.64	41.64	***0.70***	51.64	***0.87***
50 Year	*70.57*	67.04	52.04	***0.74***	62.04	***0.88***
100 Year	*78.75*	74.81	59.81	***0.76***	69.81	***0.89***

```
 ****************************
 ** SIMULATION NUMBER:   1 ** (2 YEAR EVENT)
 ****************************


--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=  10.00
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  35.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       5.00         5.00
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     258.20        40.00
     Mannings n           =       .013         .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                               ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .083    1.84 | 1.083   10.48 | 2.083    3.94 |  3.08    2.16
                .167    1.84 | 1.167   10.48 | 2.167    3.94 |  3.17    2.16
                .250    2.08 | 1.250   88.19 | 2.250    3.43 |  3.25    2.02
                .333    2.08 | 1.333   88.19 | 2.333    3.43 |  3.33    2.02
                .417    2.41 | 1.417   13.13 | 2.417    3.05 |  3.42    1.89
                .500    2.41 | 1.500   13.13 | 2.500    3.05 |  3.50    1.89
                .583    2.90 | 1.583    7.84 | 2.583    2.75 |  3.58    1.79
                .667    2.90 | 1.667    7.84 | 2.667    2.75 |  3.67    1.79
                .750    3.68 | 1.750    5.79 | 2.750    2.51 |  3.75    1.70
                .833    3.68 | 1.833    5.79 | 2.833    2.51 |  3.83    1.70
                .917    5.22 | 1.917    4.66 | 2.917    2.32 |  3.92    1.61
               1.000    5.22 | 2.000    4.66 | 3.000    2.32 |  4.00    1.61
```

```
     Max.Eff.Inten.(mm/hr)=      88.19        70.78
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       4.75 (ii)   12.85 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .22          .08
                                                               *TOTALS*
     PEAK FLOW       (cms)=        .76          .41           .992 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.50           1.33
     RUNOFF VOLUME    (mm)=      28.57         9.07          15.90
     TOTAL RAINFALL   (mm)=      29.57        29.57          29.57
     RUNOFF COEFFICIENT   =        .97          .31            .54

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!


       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00           K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
  ****************************
  ** SIMULATION NUMBER:   2 ** (5 YEAR EVENT)
  ****************************


--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=  10.00
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  35.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       5.00         5.00
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
```

```
     Length            (m)=     258.20        40.00
     Mannings n           =       .013         .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                 ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .083    2.55 | 1.083   14.84 | 2.083    5.50 |  3.08    2.99
                 .167    2.55 | 1.167   14.84 | 2.167    5.50 |  3.17    2.99
                 .250    2.89 | 1.250  131.79 | 2.250    4.78 |  3.25    2.79
                 .333    2.89 | 1.333  131.79 | 2.333    4.78 |  3.33    2.79
                 .417    3.35 | 1.417   18.64 | 2.417    4.25 |  3.42    2.62
                 .500    3.35 | 1.500   18.64 | 2.500    4.25 |  3.50    2.62
                 .583    4.03 | 1.583   11.05 | 2.583    3.83 |  3.58    2.48
                 .667    4.03 | 1.667   11.05 | 2.667    3.83 |  3.67    2.48
                 .750    5.14 | 1.750    8.13 | 2.750    3.49 |  3.75    2.35
                 .833    5.14 | 1.833    8.13 | 2.833    3.49 |  3.83    2.35
                 .917    7.32 | 1.917    6.53 | 2.917    3.22 |  3.92    2.23
                1.000    7.32 | 2.000    6.53 | 3.000    3.22 |  4.00    2.23

     Max.Eff.Inten.(mm/hr)=     131.79       130.85
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       4.04 (ii)   10.38 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .24          .09
                                                             *TOTALS*
     PEAK FLOW       (cms)=       1.18          .83          1.674 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.50           1.33
     RUNOFF VOLUME    (mm)=      41.80        16.78          25.53
     TOTAL RAINFALL   (mm)=      42.80        42.80          42.80
     RUNOFF COEFFICIENT   =        .98          .39            .60

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
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```
     (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
          Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
          Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
    (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
         THAN THE STORAGE COEFFICIENT.
   (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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  ****************************
  ** SIMULATION NUMBER:   3 ** (10 YEAR EVENT)
  ****************************

--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=  10.00
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  35.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       5.00         5.00
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     258.20        40.00
     Mannings n           =       .013         .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                 ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .083    2.90 | 1.083   17.27 | 2.083    6.32 |  3.08    3.41
                 .167    2.90 | 1.167   17.27 | 2.167    6.32 |  3.17    3.41
                 .250    3.29 | 1.250  162.26 | 2.250    5.48 |  3.25    3.18
                 .333    3.29 | 1.333  162.26 | 2.333    5.48 |  3.33    3.18
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                .417    3.83 | 1.417   21.76 | 2.417    4.86 |  3.42    2.99
                .500    3.83 | 1.500   21.76 | 2.500    4.86 |  3.50    2.99
                .583    4.61 | 1.583   12.81 | 2.583    4.38 |  3.58    2.82
                .667    4.61 | 1.667   12.81 | 2.667    4.38 |  3.67    2.82
                .750    5.90 | 1.750    9.39 | 2.750    3.99 |  3.75    2.67
                .833    5.90 | 1.833    9.39 | 2.833    3.99 |  3.83    2.67
                .917    8.45 | 1.917    7.52 | 2.917    3.67 |  3.92    2.53
               1.000    8.45 | 2.000    7.52 | 3.000    3.67 |  4.00    2.53

     Max.Eff.Inten.(mm/hr)=     162.26       172.23
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.72 (ii)    9.40 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=        .25          .12
                                                               *TOTALS*
     PEAK FLOW       (cms)=       1.48         1.33          2.683 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.42           1.33
     RUNOFF VOLUME    (mm)=      50.05        22.71          32.28
     TOTAL RAINFALL   (mm)=      51.05        51.05          51.05
     RUNOFF COEFFICIENT   =        .98          .44            .63

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00           K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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  ***************************
  ** SIMULATION NUMBER:   4 ** (25 YEAR EVENT)
  ***************************
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--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=  10.00
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  35.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       5.00         5.00
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     258.20        40.00
     Mannings n           =       .013         .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
                  TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                  .083    3.38 | 1.083   20.18 | 2.083    7.39 |  3.08    3.98
                  .167    3.38 | 1.167   20.18 | 2.167    7.39 |  3.17    3.98
                  .250    3.84 | 1.250  189.52 | 2.250    6.41 |  3.25    3.72
                  .333    3.84 | 1.333  189.52 | 2.333    6.41 |  3.33    3.72
                  .417    4.47 | 1.417   25.42 | 2.417    5.68 |  3.42    3.49
                  .500    4.47 | 1.500   25.42 | 2.500    5.68 |  3.50    3.49
                  .583    5.39 | 1.583   14.96 | 2.583    5.11 |  3.58    3.29
                  .667    5.39 | 1.667   14.96 | 2.667    5.11 |  3.67    3.29
                  .750    6.89 | 1.750   10.97 | 2.750    4.66 |  3.75    3.11
                  .833    6.89 | 1.833   10.97 | 2.833    4.66 |  3.83    3.11
                  .917    9.87 | 1.917    8.78 | 2.917    4.29 |  3.92    2.96
                 1.000    9.87 | 2.000    8.78 | 3.000    4.29 |  4.00    2.96

     Max.Eff.Inten.(mm/hr)=     189.52       209.87
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.50 (ii)    8.74 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
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    Unit Hyd. peak  (cms)=        .26          .12
                                                       *TOTALS*
    PEAK FLOW       (cms)=       1.75         1.68          3.286 (iii)
    TIME TO PEAK    (hrs)=       1.33         1.42           1.33
    RUNOFF VOLUME    (mm)=      58.62        28.56          39.08
    TOTAL RAINFALL   (mm)=      59.62        59.62          59.62
    RUNOFF COEFFICIENT   =        .98          .48            .66

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

      (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
           Fo   (mm/hr)= 50.00           K  (1/hr)=  2.00
           Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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  ****************************
  ** SIMULATION NUMBER:   5 ** (50 YEAR EVENT)
  ****************************

--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=  10.00
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  35.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
    Surface Area     (ha)=       5.00         5.00
    Dep. Storage     (mm)=       1.00         1.50
    Average Slope     (%)=       1.00         2.00
    Length            (m)=     258.20        40.00
    Mannings n           =       .013         .250

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
```

```
                        ---- TRANSFORMED HYETOGRAPH ----
           TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
            hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
           .083    4.01 | 1.083   23.88 | 2.083    8.74 |  3.08    4.71
           .167    4.01 | 1.167   23.88 | 2.167    8.74 |  3.17    4.71
           .250    4.55 | 1.250  224.33 | 2.250    7.58 |  3.25    4.40
           .333    4.55 | 1.333  224.33 | 2.333    7.58 |  3.33    4.40
           .417    5.29 | 1.417   30.08 | 2.417    6.72 |  3.42    4.13
           .500    5.29 | 1.500   30.08 | 2.500    6.72 |  3.50    4.13
           .583    6.38 | 1.583   17.71 | 2.583    6.05 |  3.58    3.89
           .667    6.38 | 1.667   17.71 | 2.667    6.05 |  3.67    3.89
           .750    8.15 | 1.750   12.98 | 2.750    5.52 |  3.75    3.69
           .833    8.15 | 1.833   12.98 | 2.833    5.52 |  3.83    3.69
           .917   11.68 | 1.917   10.40 | 2.917    5.08 |  3.92    3.50
          1.000   11.68 | 2.000   10.40 | 3.000    5.08 |  4.00    3.50

    Max.Eff.Inten.(mm/hr)=     224.33       258.34
               over (min)        5.00        10.00
    Storage Coeff.  (min)=       3.27 (ii)    8.10 (ii)
    Unit Hyd. Tpeak (min)=       5.00        10.00
    Unit Hyd. peak  (cms)=        .27          .13
                                                       *TOTALS*
    PEAK FLOW       (cms)=       2.09         2.14          4.079 (iii)
    TIME TO PEAK    (hrs)=       1.33         1.42           1.33
    RUNOFF VOLUME    (mm)=      69.57        37.05          48.44
    TOTAL RAINFALL   (mm)=      70.57        70.57          70.57
    RUNOFF COEFFICIENT   =        .99          .53            .69

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

      (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
           Fo   (mm/hr)= 50.00           K  (1/hr)=  2.00
           Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
```

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     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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  ****************************
  ** SIMULATION NUMBER:   6 ** (100 YEAR EVENT)
  ****************************

 --------------------
 | CALIB            |
 | STANDHYD  (0001) |   Area    (ha)=  10.00
 |ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  35.00
 --------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       5.00         5.00
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     258.20        40.00
     Mannings n           =       .013         .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                               ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .083    4.47 | 1.083   26.65 | 2.083    9.75 |  3.08    5.26
                 .167    4.47 | 1.167   26.65 | 2.167    9.75 |  3.17    5.26
                 .250    5.08 | 1.250  250.32 | 2.250    8.46 |  3.25    4.91
                 .333    5.08 | 1.333  250.32 | 2.333    8.46 |  3.33    4.91
                 .417    5.91 | 1.417   33.57 | 2.417    7.50 |  3.42    4.61
                 .500    5.91 | 1.500   33.57 | 2.500    7.50 |  3.50    4.61
                 .583    7.12 | 1.583   19.76 | 2.583    6.75 |  3.58    4.34
                 .667    7.12 | 1.667   19.76 | 2.667    6.75 |  3.67    4.34
```

```
                 .750    9.10 | 1.750   14.49 | 2.750    6.16 |  3.75    4.11
                 .833    9.10 | 1.833   14.49 | 2.833    6.16 |  3.83    4.11
                 .917   13.03 | 1.917   11.60 | 2.917    5.67 |  3.92    3.91
                1.000   13.03 | 2.000   11.60 | 3.000    5.67 |  4.00    3.91

      Max.Eff.Inten.(mm/hr)=     250.32       297.18
                 over (min)       5.00        10.00
      Storage Coeff.  (min)=       3.13 (ii)    7.69 (ii)
      Unit Hyd. Tpeak (min)=       5.00        10.00
      Unit Hyd. peak  (cms)=        .27          .13
                                                             *TOTALS*
      PEAK FLOW       (cms)=       2.34         2.50          4.717 (iii)
      TIME TO PEAK    (hrs)=       1.33         1.42           1.33
      RUNOFF VOLUME    (mm)=      77.75        44.16          55.92
      TOTAL RAINFALL   (mm)=      78.75        78.75          78.75
      RUNOFF COEFFICIENT   =        .99          .56            .71

 ***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00           K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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Appendix 1b

Water Balance Analysis

March 2009
Our File: 07135

East Bayfront Water Balance Worksheet

Land Use Description	Area - A (ha)	Runoff Coefficient - C	Anticipated Distribution of Rainfall *(MOE)* Column by Land Use (mm)					Total Rainfall *(MOE)* over Tributary Area					Comments
			Evapotranspiration - ET	Infiltration - I	Runoff - R	Reuse - U	*Total*	ET x A	I x A	R x A	U x A	*Total*	
Building (north of Queen's Quay)	6.17	0.78	261	0	325	354	***940***	1611	0	2004	2184	***5800***	Assumes **5 mm** event reuse, initial abstractions on 75% of area
Building (south of Queen's Quay)	4.94	0.44	340	0	8	592	***940***	1681	0	39	2923	***4644***	Assumes **15 mm** event reuse, initial abstractions on 75% of area
Rights-of-way	6.72	0.95	191	0	749	0	***940***	1282	0	5034	0	***6317***	Assumes existing condition relationship (ie. no infiltration, initial abstractions over entire area)
Park (including Sherbourne Park)	1.36	0.50	358	73	510	0	***940***	487	99	693	0	***1278***	Assumes blended (ie. pervious + impervious) water balance relationship
Sugar Beach	0.42	0.95	191	0	749	0	***940***	80	0	315	0	***395***	Assumes existing condition relationship (ie. no infiltration, initial abstractions over entire area)
External area - paved	1.09	0.95	191	0	749	0	***940***	208	0	817	0	***1025***	Assumes existing condition relationship (ie. no infiltration, initial abstractions over entire area)
External area - mixed	1.61	0.75	191	0	749	0	***940***	307	0	1206	0	***1513***	Assumes existing condition relationship (ie. no infiltration, initial abstractions over entire area)
TOTAL	**22.31**	**---**	**---**	**---**	**---**	**---**	**---**	**5657**	**99**	**10108**	**5107**	***20971***	**---**

	ET	I	R	U	TOTAL
Resultant Average Rainfall *(MOE)* Column over Tributary Area	**254**	**4**	**453**	**229**	**940**
Average Rainfall *(TORONTO)* Column (Converted from *MOE*)	***211***	***4***	***378***	***191***	***784***

Appendix 1c

Stormwater Management Facility Calculations

Memo

The
MUNICIPAL
INFRASTRUCTURE
Group

Date: December 11, 2007

To: File

From: Nick Zeibots

Project: 07135

Subject: SIZING METHODOLOGY – POTENTIAL UNDERGROUND STORAGE TANK
STORMWATER MANAGEMENT – EAST BAYFRONT COMMUNITY
WATERFRONT TORONTO
CITY OF TORONTO

As a potential option for the treatment of post-development stormwater flows from the East Bayfront community, sizing for an underground storage tank was undertaken. The purpose of this tank was to provide sufficient volume to settle out suspended sediments such that appropriate Ultraviolet (UV) radiation treatment would be possible. The following provides the assumptions that were incorporated into the simulation model and the overall methodology used in determining the size of the required underground facility.

To begin, the key assumptions used in the sizing are as follows:

- East Bayfront Tributary Area = 21.90 ha
  Average Runoff Coefficient = 0.75 (Imperviousness = 78 %)
- Successive storm events more applicable than singular rainfall volumes due to required detention times
- Sediments require one full day of settling time without interruption from successive storm events prior to discharge
- No permanent pool volume available to dilute flows or reduce incoming velocities
- Capacity of tank can only be exceeded, on average, once per annual swimming season (ie. May 15th to September 30th) such that recreational activities along waterfront would not be significantly affected
- UV treatment and pumping station capacity sufficient to discharge tank in one day
- Cleanout frequency of tank sufficient such that sediment build up and reduction of available storage volumes are not affected

As noted earlier, rather than using singular storm events to size the facility, it was determined that, considering the detention times required to settle out suspended particles, successive storm events may be more critical to the operation of the tank. Within a relatively small and contained facility such as a storage tank, successive storm events can cause resuspension of particles therefore negating the effects of prior detention. As a result, to simulate the effects of actual runoff patterns, a spreadsheet model was compiled using daily precipitation data from 1940 onwards, as obtained from Environment Canada for Toronto Pearson Airport, such that stormwater volumes entering into the tank could be calculated on an ongoing basis. Further to this, daily temperature data was also incorporated to reflect the effects of melting snow on the storage volume requirements.

With inputs for the tributary area and overall runoff coefficient included, the following demonstrates the order of operations used by the model to determine the required size of the storage facility:

1) On any given day, runoff volumes enter into the storage facility from the upstream tributary area in the form of rainfall or snowmelt.
2) On the following day, volumes entering into the facility from the previous day settle out sediments. Should successive runoff volumes enter into the facility on this day, then the detention of volumes from the previous day is negated. This is repeated, with stored volumes being increased cumulatively, until there are no runoff volumes entering the facility for one day after the last runoff event.
3) Once a "no runoff" day is realized, the following day is used for UV treatment and discharge of detained flows such that "clean" water returns to Lake Ontario. Runoff volumes cannot enter into the facility on this day either therefore effectively extending the time period with no runoff volumes to two days.
4) The facility is sized such that this pattern can be followed without the capacity of the storage facility being frequently exceeded.
5) When an exceedence does occur, this is checked against the date and, if it takes place between May 15th and September 30th of that year (ie. swimming / body contact season), then an overflow is recorded.
6) On average, the tank was sized such that only one overflow occurs during the swimming season.

With the above considered, a storage tank measuring 80 metres by 75 metres by 2 metres deep would be required to provide sufficient volumes such that appropriate settling will result. This does not account for wet well sediment storage or freeboard which would also need to be incorporated into any design. The resulting required volume for the underground storage tank is 12,000 m^3.

The model demonstrating the above can be found on the attached CD.

Memo

The
MUNICIPAL
INFRASTRUCTURE
Group

Date: December 11, 2007

To: File

From: Nick Zeibots

Project: 07135

Subject: **SIZING METHODOLOGY – COMPLETE MIXING POND**
STORMWATER MANAGEMENT – EAST BAYFRONT COMMUNITY
WATERFRONT TORONTO
CITY OF TORONTO

As a potential option for the treatment of post-development stormwater flows from the East Bayfront community, sizing for a contained pond within Lake Ontario was undertaken. The purpose of this pond was to provide sufficient volume to allow for natural reduction in E.Coli. counts within post-development runoff prior to discharge to Lake Ontario. The following provides the assumptions that were incorporated into the simulation model and the overall methodology used in determining the size of the required pond facility.

To begin, the key assumptions used in the sizing are as follows:

- East Bayfront Tributary Area = 21.90 ha
  Average Runoff Coefficient = 0.75 (Imperviousness = 78 %)
- Successive storm events more applicable than singular rainfall volumes due to required detention times.
- 80% daily natural reduction in E.Coli. counts due to UV radiation within sunlight.
- Natural depth of Lake (approximately 6.5 m) available to dilute incoming runoff volumes.
- Runoff with higher E.Coli. counts assumed to theoretically mix immediately with existing volumes in pond such that uniform, lower E.Coli. counts result throughout pond.
- Capacity of pond can only be exceeded, on average, once per annual swimming season (ie. May 15th to September 30th) such that recreational activities along waterfront would not be significantly affected by increased E.Coli. counts.
- As runoff volumes enter pond, equal volume is immediately discharged to Lake via non-mechanical outlet structure therefore pond water level will not fluctuate.
- Sediment settling not considered as mechanical UV treatment facilities are not required due to natural E.Coli. die off rates and detention times.
- Cleanout frequency of pond sufficient such that sediment build up and reduction of available storage volumes are not affected.

As noted earlier, rather than using singular storm events to size the facility, it was determined that, considering the detention times required for natural E.Coli. die off; successive storm events may be more critical to the operation of the pond. The increased E.Coli. counts within post-development runoff, and assuming immediate and complete mixing with existing pond volumes, will cause the E.Coli. concentration to change with further runoff inputs therefore the impact of successive events will be notable. As a result, to simulate the effects of actual runoff patterns, a spreadsheet model was compiled using daily precipitation data from 1940 onwards, as obtained from Environment Canada for Toronto Pearson Airport, such that stormwater volumes entering into the pond could be calculated on an ongoing basis. Further to this, daily temperature data was also incorporated to reflect the effects of melting snow on the storage volume requirements.

With inputs for the tributary area and overall runoff coefficient included, the following demonstrates the order of operations used by the model to determine the required size of the storage facility:

1) On any given day, runoff volumes with higher E.Coli. concentrations (6,500 counts / 100 mL) enter into the storage facility from the upstream tributary area in the form of rainfall or snowmelt. "Clean" water in assumed to be present in the pond which discharges to the Lake in the same volume as the incoming "dirty" water.
2) This "dirty" water mixes immediately and completely with the remaining existing "clean" water in the pond to produce a new overall E.Coli. concentration for the whole pond volume.
3) The E.Coli. counts in this new concentration of pond water decrease by 80% over one day via natural die off such that a new concentration remains. If there are no successive events then there will not be any further discharges to the Lake and E.Coli. counts within the pond will continue to reduce at a rate of 80% per day.
4) If a successive event inputs further runoff volumes into the pond, then the new, reduced concentration will mix with the incoming "dirty" water and the same natural reduction pattern repeats itself.
5) The pond capacity is exceeded when the volumes are not sufficient to dilute incoming "dirty" runoff to a level lower than 100 counts / 100 mL. When an exceedence does occur, this is checked against the date and, if it takes place between May 15th and September 30th of that year (ie. swimming / body contact season), then an overflow is recorded.
6) On average, the pond was sized such that only one overflow occurs during the swimming season.

With the above considered, a pond measuring 300 metres by 20 metres by 6.5 metres deep would be required to provide sufficient volumes such that appropriate E.Coli. count reduction will result. This is a theoretical model only as the assumed immediate and complete mixing may not occur under actual conditions. Further to this, post-development runoff E.Coli. concentrations and natural die off rates are based upon literature reviews only which would require confirmation. The resulting required volume for the complete mixing pond is 39,000 m^3.

The model demonstrating the above can be found on the attached CD.

East Bayfront

Per the MOE SWM Design and Planning Manual

% Imperviousness = 70

Storage (m3/ha)	TSS Removal (%)	
58.3	51.43	
68.75	55	
85	**60**	**Basic**
101.85	65	
130	**70**	**Normal**
165	75	
225	**80**	**Enhanced**
278.7	85	
336.72	90	
400.78	95	
450	98	
475	98.9	
500	99	
550	99	

% Imperviousness = 85

Storage (m3/ha)	TSS Removal (%)	
58.3	49.4	
75	55	
95	**60**	**Basic**
115.89	65	
150	**70**	**Normal**
190	75	
250	**80**	**Enhanced**
328.97	85	
416.82	90	
512.15	95	
586.92	98	
616.82	98.9	
646.72	99	
700	99	

Interpolated Values

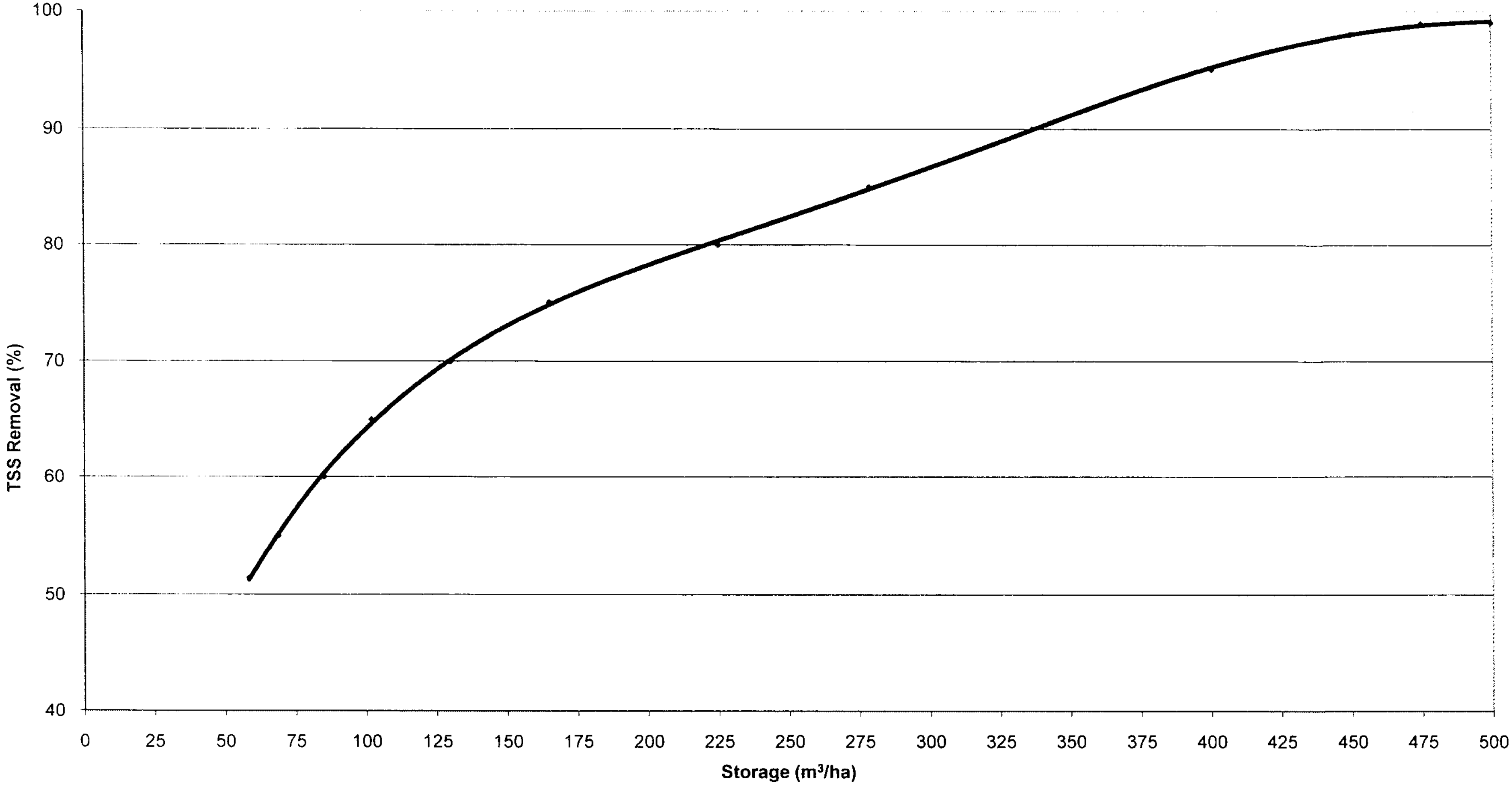
% Imperviousness = **80**

Storage (m3/ha)	TSS Removal (%)	
58.3	**50.08**	
73	**55**	
92	**60**	**Basic**
111	**65**	
143	**70**	**Normal**
182	**75**	
242	**80**	**Enhanced**
312	**85**	
390	**90**	
475	**95**	
541	**98**	
570	**98.9**	
598	**99**	
649	**99**	

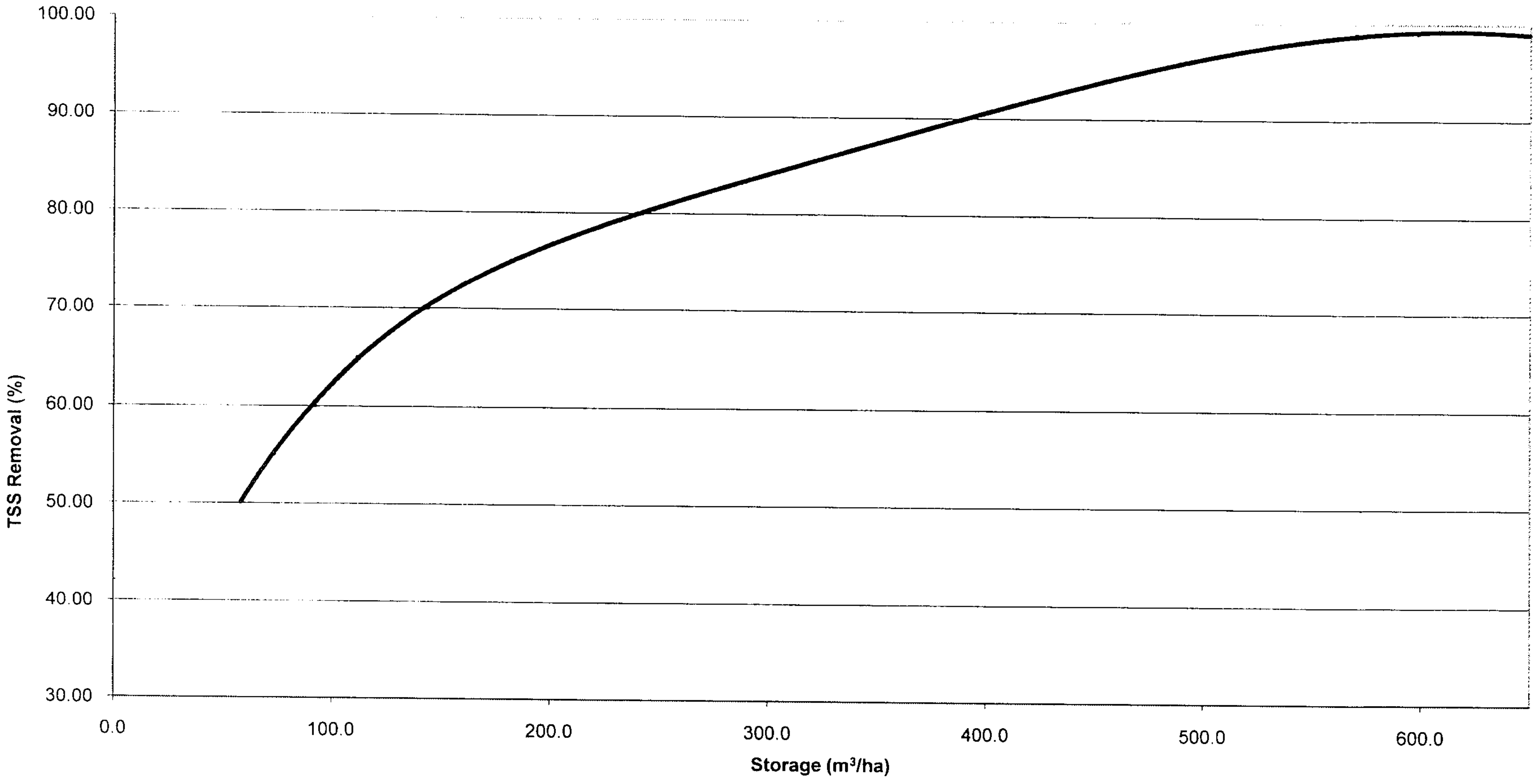
% Imperviousness = **90**

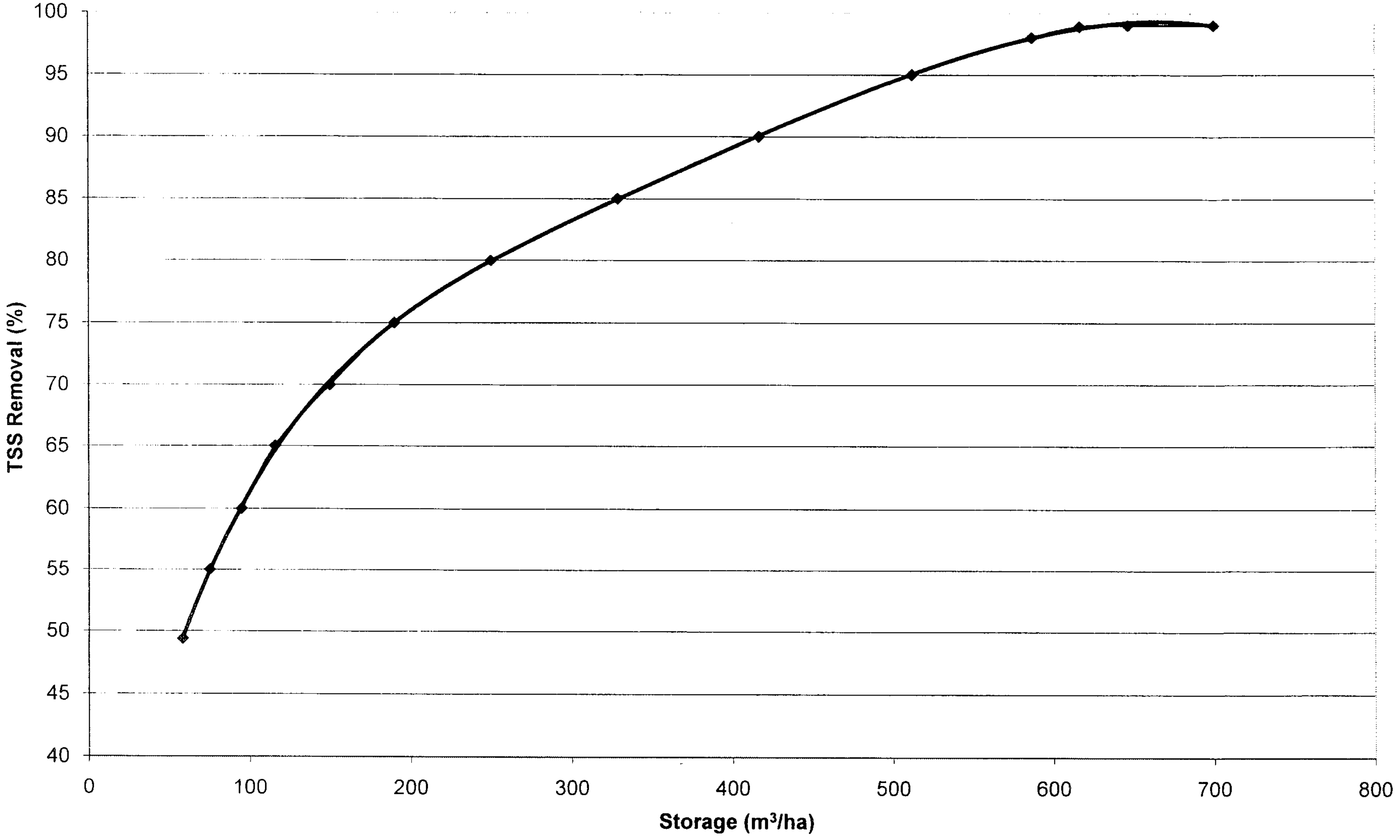
Storage (m3/ha)	TSS Removal (%)	
58.3	**48.72**	
77	**55**	
98	**60**	**Basic**
121	**65**	
157	**70**	**Normal**
198	**75**	
258	**80**	**Enhanced**
346	**85**	
444	**90**	
549	**95**	
633	**98**	
664	**98.9**	
696	**99**	
750	**99**	

Water Quality Storage Criteria (70% Imperviousness)



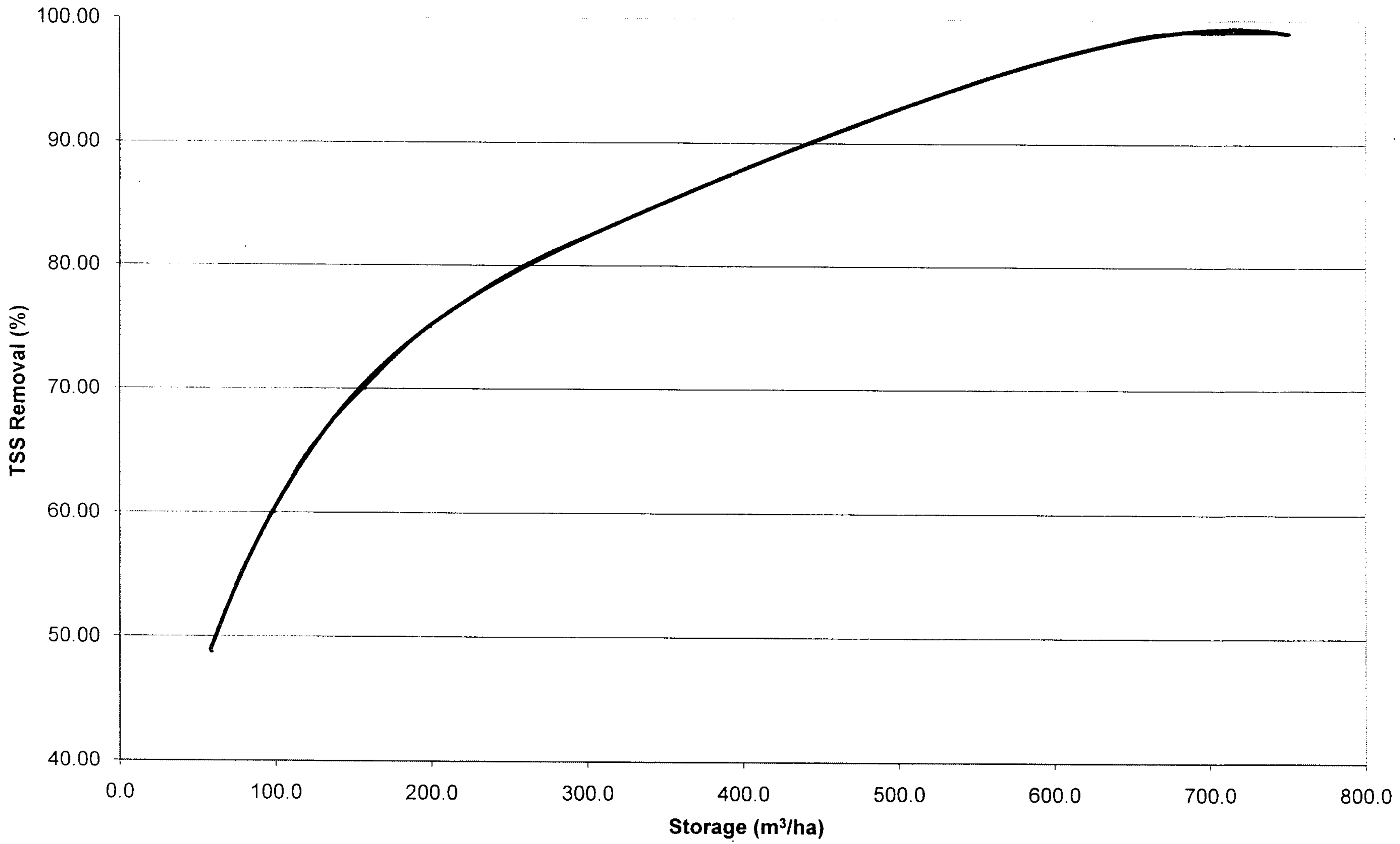
Water Quality Storage Criteria (80% Imperviousness)





Water Quality Storage Criteria (85% Imperviousness)

Water Quality Storage Criteria (90% Imperviousness)



Appendix 1d

Preliminary Cost Comparison of Facility Alternatives

The
MUNICIPAL
INFRASTRUCTURE
Group

Date:	January 29, 2009
To:	File
From:	Nick Zeibots
Project:	07135
Subject:	**REVISED COST ESTIMATES – SWM FACILITY OPTIONS** EAST BAYFRONT LANDS – WATERFRONT TORONTO CITY OF TORONTO

Since the initial submission of the Functional Servicing Report (FSR) in December 2007, a preferred option has been established for the proposed Stormwater Management (SWM) Facility in the East Bayfront (EBF) Lands. Previously, four different SWM alternatives were identified and cost estimates compiled to aid in assessing the best option to proceed with. With the scenario that is now preferred, a new costing assessment is required along with a revisiting of the previous estimates to ensure that similar items are comparable.

To begin, the preferred SWM facility option is shown in the attached figure and can be summarized by the follow points:

- 9.5 m wide connected, concrete box sections to be situated within the lake, along entire south edge of EBF lands and into Parliament Slip at east end.
- Concrete box sections will provide storage for attenuation of post-development flows to ensure appropriate settling of sediments to allow for subsequent UV treatment and discharge to the lake.
- Stormwater flows will enter from the storm sewer system into the connected box sections near the mid-point of the system and will be directed west initially via a baffle wall in the forebay area.
- Flows will then be directed back east for further settling.
- Clarified stormwater will then be pumped from the east end of the facility to a UV treatment system for discharge to a proposed channel within Sherbourne Park.
- The concrete box sections will be used to reinforce existing dockwall without any requirements to replace the wall.
- Box sections will also provide support to the proposed boardwalk that will be aligned adjacent to the promenade.
- A larger storage area will be available within Parliament Slip where clarified flows will be pumped from. Wetland and aesthetic decking features will be incorporated into this area.

- To avoid the existing CSO pipe located near the midpoint of the EBF lands, a piped bypass structure will be incorporated and the CSO pipe will also be extended.
- During drier periods of the Summer months, either recirculated water or raw water from the lake will be used to generate flow within the proposed outlet channel through Sherbourne Park.

Further to this, the following provides some key points from the options that were presented in the initial version of the FSR:

Option A (see attached Figure 5.3 – as taken from December 2007 FSR)

- Similar to preferred option however easterly extent is the end of the dockwall just prior to Parliament Slip
- Containment structure would consist of caissons and sheet piling around the outside, with a rehabilitated dockwall forming the inner face. It should be noted that, where the proposed containment structure fronts the dockwall, the existing structure would not require as much rehabilitation as without the new caisson and sheet piles in place.
- New outside wall would provide support for boardwalk adjacent to promenade

Option B (see attached Figure 5.4 – as taken from December 2007 FSR)

- Forebay would be situated adjacent to dockwall near midpoint of EBF lands with similar structure enclosing it as in Option A
- Main cell would be situated offshore in a enclosed structure that potentially could be arranged to resemble a maple leaf or other aesthetic feature
- A pipe would connect the forebay to the main cell in the lake with a subsequent pumped outlet system to discharge to the UV treatment facility.
- The existing dockwall would need to be rehabilitated along with an additional boardwalk support structure outside of the forebay area. It should be noted that, where the proposed containment structure fronts the dockwall, the existing structure would not require as much rehabilitation as without the new caisson and sheet piles in place.

Option C (see attached Figure 5.6 – as taken from December 2007 FSR)

- Tri-celled storage facility in lake located adjacent to the existing dockwall on the easterly portion of the EBF lands.
- Each cell would extend 28.5 m into the lake with flows entering into the facility at the west end into a covered forebay area.
- The subsequent cells would act to clarify the post-development flows of sediments with discharge through an outlet pipe at the east end to the UV treatment facility.
- As previous, the dockwall will require rehabilitation throughout and a boardwalk support structure will be required outside of the tri-cell area. It should be noted that, where the proposed containment structure fronts the dockwall, the existing structure would not require as much rehabilitation as without the new caisson and sheet piles in place.

Option D – Underground Tank Storage

- 40 m wide by 150 m long by 3.5 m deep storage tank (or multiple tanks with equivalent volume) that would be used to settle out sediments from the post-development flows.
- Would be required to be supported entirely on either piles or a concrete slab.
- Storm sewers would discharge directly into the tank(s) with discharge to the UV facility once the attenuated volume was of sufficient clarity.
- For comparison purposes, the dockwall rehabilitation is still considered to be required in its entirety along with a boardwalk support structure along the whole length of the EBF lands.

As noted previously, cost estimates were arranged for the initial four options with the following amounts realized, the breakdowns of which can be found in the December 2007 FSR:

Option A - $32,000,000
Option B - $31,000,000
Option C - $22,000,000
Option D - $44,000,000

With the progression of the preferred option described earlier, a major advantage was that the concrete box sections themselves would replace the function of a rehabilitated dockwall therefore eliminating a significant cost. However, in the estimates of the previous options, as this cost was consistent within all of the scenarios, it was not considered in the overall calculations. Further to this, the boardwalk support that is provided by the concrete box sections in the preferred option was also not accounted for previously. As a result, the cost estimates for the original options have been adjusted to account for these items such that a more accurate comparison can be made and to demonstrate the savings realized by implementing the concrete sections that perform more than just a storage containment role. It should be noted that landscaping and fisheries compensation costs have been removed from the options as it was thought that these items are outside of the scope of the SWM facility estimating exercise and would be equivalent expenditures within each of the scenarios that would not be required to be taken into account.

The adjusted cost estimates for each of the earlier options are shown below, with a more detailed breakdown included herein as Appendix A. As can be seen, while not new items, the costs of rehabilitating the dockwall and providing support to the boardwalk are significant, and are required to be identified.

Adjusted Option A - $42,000,000
Adjusted Option B - $52,000,000
Adjusted Option C - $49,000,000
Adjusted Option D - $60,000,000

The cost of the preferred option has been estimated in the same manner as the originally anticipated scenarios with the full extents of the proposed SWM facility taken into account. This includes the extension of the system into Parliament Slip which represents a considerable increase in infrastructure over that previously contemplated and an additional cost to be included. As shown in more detail in Appendix B, the estimated cost of the preferred option is as follows:

Preferred Option - $42,000,000

Therefore, even with an increase in infrastructure, the offsetting of dockwall replacement and boardwalk support costs is substantial enough to produce a lower expense when the whole system is considered. It should be noted that the costs of the concrete box sections has been assumed based upon earlier estimates from Rider Levett Bucknall and should be confirmed with Halsall & Associates, the consulting structural engineering firm. It is our understanding that Halsall is currently in the process of assembling their estimate and it should be available shortly. Additionally, the cost of the preferred option does not account for the savings in promenade land area that the new concrete box sections in Parliament Slip provide. This effectively extends the useable building area on the west side of the EBF lands such that the optimum layout can be achieved.

If any questions or comments arise from the information presented herein, please do not hesitate to contact the author.

APPENDIX A

Adjusted Cost Estimates – Original SWM Facility Options

Waterfront Toronto

East Bayfront 12-Dec-07
Revised *29-Jan-09*

Conceptual Stormwater Management Cost Comparison

OPTION A - *Pond along Dockwall from Jarvis to Parliament*

Assumptions
Pond Area = 8645
Runoff Coefficient 0.90
8m deep dockwall
UV Treatment included
Decking based on high-end wood structure
Dockwall repairs behind pond wall assumed to be half of full repair cost

Pond Dimensions			
Pond Length	m	665	
Depth	m	8	
Width	m	13	
Wall Length	m	795	10 intermediate
Deck Length	m	795	
Deck Width	m	8	
Deck Area	m^2	6360	

Item		**Unit**	**Qty.**	**Unit Price**	**Total**
ORIGINAL ESTIMATE					
1	Dockwall / Pond Wall (includes forebay baffle)	m	808	$25,000	$20,200,000
2	Diffuser / Header Pipe	Ea	1	$100,000	$100,000
3	Extend CSO (2-3mx3m box sections underwater)	m	40	$10,000	$400,000
4	Piles for Item 3, above on 3m Centres	Ea	20	$20,000	$400,000
5	Baffle Walls	Sq.f.m.	2400	$500	$1,200,000
6	Piping to Sherbourne Park	m	640	$400	$256,000
7	Decking (included in promenade price)	m^2	0	$600	$0
8	Landscaping	Allow	1	$1,000,000	$1,000,000
9	Control House - incl. driveway and landscape	Ea	1	$200,000	$200,000
10	UV system including pumps lights etc.	Ea	1	$1,300,000	$1,300,000
11	Inlet Pipe through dockwall	Ea	1	$100,000	$100,000
12	Fisheries Compensation	Allow	---	---	$200,000
			SUB-TOTAL		***$25,356,000***
Items to be REMOVED *(ie. Outside of Scope / Accounted for Elsewhere / No Longer Contemplated)*					
3	Extend CSO (2-3mx3m box sections underwater)	m	40	($10,000)	($400,000)
4	Piles for Item 3, above on 3m Centres	Ea	20	($20,000)	($400,000)
7	Decking (included in promenade price)	m^2	0	($600)	$0
8	Landscaping	Allow	1	($1,000,000)	($1,000,000)
12	Fisheries Compensation	Allow	---	---	($200,000)
			SUB-TOTAL		***($2,000,000)***
Items to be ADDED *(ie. To be included for comparative purpose to new pond scenario)*					
a	Dockwall repairs - Full Repair Cost	m	150	$17,095	$2,564,250
b	Dockwall repairs - Half Repair Cost	m	650	$8,548	$5,555,875
c	Recirculation Pipe & Chamber	Allow	1	$400,000	$400,000
d	Boardwalk support (included in Pond Wall)	m	650	$0	$0
e	Additional Decking above 9 m width	m^2	2,600	$600	$1,560,000
11*	Additional Cost - Inlet Pipe through Dockwall	Ea	1	$200,000	$200,000
			SUB-TOTAL		***$10,280,125***

Total Costs	**$33,636,125**
10% Engineering	$3,363,613
15% Contingency	$5,045,419

Total Estimated Pond Cost $42,000,000

Waterfront Toronto

East Bayfront 12-Dec-07
Revised *29-Jan-09*

Conceptual Stormwater Management Cost Comparison

OPTION B - *Pond in Lake - Offshore from Dockwall*

Assumptions
Pond Area = 8512
Runoff Coefficient 0.90
8m deep dockwall
UV Treatment included
Decking based on high-end wood structure
Dockwall repairs behind pond wall assumed to be half of full repair cost

Pond Dimensions		Forebay	Main Pond
Pond Length	m	200	144
Depth	m	8	8
Width	m	8	48
Wall Length	m	216	384
Deck Length	m	200	384
Deck Width	m	8	6
Deck Area	m^2	1600	2304

Item		Unit	Qty.	Unit Price	Total
ORIGINAL ESTIMATE					
1	Dockwall / Pond Wall	m	600	$30,000	$18,000,000
2	Diffuser / Header Pipe	Ea	1	$100,000	$100,000
3	Extend CSO (1-3mx3m box sections underwater)	m	0	$10,000	$0
4	Piles for Item 3, above on 3m Centres	Ea	0	$20,000	$0
5	Pipe from Forebay to Main Pond	m	100	$5,000	$500,000
6	Piles for Item 5, above on 3m Centres	Ea	33	$20,000	$660,000
7	150mm PE return line to UV, with anchors	m	500	$400	$200,000
8	Submerged berm over pipes	Cu.m.	3200	$400	$1,280,000
9	Decking incl furniture and railings	m^2	2,304	$600	$1,382,400
10	Landscaping	Allow	1	$1,000,000	$1,000,000
11	Control House - incl. driveway and landscape	Ea	1	$200,000	$200,000
12	UV system including pumps lights etc.	Ea	1	$1,300,000	$1,300,000
13	Inlet Pipe through dockwall	Ea	1	$100,000	$100,000
14	Fisheries Compensation	LS	---	---	$200,000
			SUB-TOTAL		***$24,922,400***
Items to be REMOVED *(ie. Outside of Scope / Accounted for Elsewhere / No Longer Contemplated)*					
3	Extend CSO (1-3mx3m box sections underwater)	m	0	$10,000	$0
4	Piles for Item 3, above on 3m Centres	Ea	0	$20,000	$0
10	Landscaping	Allow	1	($1,000,000)	($1,000,000)
14	Fisheries Compensation	Allow	---	---	($200,000)
			SUB-TOTAL		***($1,200,000)***
Items to be ADDED *(ie. To be included for comparative purpose to new pond scenario)*					
a	Dockwall repairs - Full Repair Cost	m	430	$17,095	$7,350,850
b	Dockwall repairs - Half Repair Cost	m	370	$8,548	$3,162,575
c	Recirculation Pipe & Chamber	Allow	1	$400,000	$400,000
d	Boardwalk support (outside of Forebay area)	m	430	$16,000	$6,880,000
13*	Additional Cost - Inlet Pipe through Dockwall	Ea	1	$200,000	$200,000
			SUB-TOTAL		***$17,993,425***

Total Costs	**$41,715,825**
10% Engineering	$4,171,583
15% Contingency	$6,257,374

Total Estimated Pond Cost $52,000,000

Waterfront Toronto

East Bayfront

12-Dec-07
Revised *29-Jan-09*

Conceptual Stormwater Management Cost Comparison

OPTION C - ***Tri-Cell Pond, east of CSO only***

Assumptions
Pond Area = 8550
Runoff Coefficient 0.90
8m deep dockwall
UV Treatment included
Decking based on high-end wood structure
Dockwall repairs behind pond wall assumed to be half of full repair cost
First cell cover based on concrete beams and flagstone

Pond Dimensions		
Pond Length	m	300
Depth	m	8
Width	m	28.5
Wall Length	m	414
Deck Length	m	200
Deck Width	m	6
Forebay Deck - L	m	100
Forebay Deck - W	m	28.5
Deck Area	m^2	4050

Item		**Unit**	**Qty.**	**Unit Price**	**Total**
ORIGINAL ESTIMATE					
1	Dockwall	m	443	$25,000	$11,062,500
2	Diffuser / Header Pipe	Ea	1	$100,000	$100,000
3	150mm PE return line to UV, with anchors	m	500	$400	$200,000
4	Decking incl furniture and railings	m^2	4,050	$600	$2,430,000
5	Landscaping	Allow	1	$1,000,000	$1,000,000
6	Control House - incl. driveway and landscape	Ea	1	$200,000	$200,000
7	UV system including pumps lights etc.	Ea	1	$1,300,000	$1,300,000
8	Cover for First Cell	m^2	2,850	$450	$1,282,500
9	Inlet Pipe through dockwall	Ea	1	$100,000	$100,000
10	Fisheries Compensation	LS	---	---	$200,000
			SUB-TOTAL		***$17,875,000***
Items to be <u>REMOVED</u> *(ie. Outside of Scope / Accounted for Elsewhere)*					
5	Landscaping	Allow	1	($1,000,000)	($1,000,000)
10	Fisheries Compensation	Allow	---	---	($200,000)
			SUB-TOTAL		***($1,200,000)***
Items to be <u>ADDED</u> *(ie. To be included for comparative purpose to new pond scenario)*					
a	Dockwall repairs - Full Repair Cost	m	560	$17,095	$9,573,200
b	Dockwall repairs - Half Repair Cost	m	370	$8,548	$3,162,575
c	Recirculation Pipe & Chamber	Allow	1	$400,000	$400,000
d	Boardwalk support (outside of Forebay area)	m	560	$16,000	$8,960,000
9*	Additional Cost - Inlet Pipe through Dockwall	Ea	1	$200,000	$200,000
			SUB-TOTAL		***$22,295,775***

Total Costs	**$38,970,775**
10% Engineering	$3,897,078
15% Contingency	$5,845,616

Total Estimated Pond Cost ***$49,000,000***

Waterfront Toronto

East Bayfront

12-Dec-07
Revised *29-Jan-09*

Conceptual Stormwater Management Cost Comparison

OPTION D - *In-Ground Tank*

Assumptions

2 Tanks, One at Sherbourne Park and One at Parliament Slip
Sized based on continuous simulation modeling
Runoff Coefficient 0.90
Allows for one overflow event per year
48 hours of detention in a 2.0m settling depth
1.2m of Sediment Storage Depth
Sherbourne tank based on 18.75 ha of tributary area
Parliament tank based on 5.41 ha of tributary area
Caissons spaced on 3m x 6m centres
6m clear around tank for earth
3m cover

Tank Dimensions		
Active Volume	m^3	12000
Active Depth	m	2
Tank Area	m^2	6000
Width	m	40
Length	m	150
Freeboard	m	0.3
Total Depth	m	3.5
Total Volume	m^3	21000
Depth to Invert	m	8
Excavation Vol.	m^3	57408
Support Piles	Ea	731
Sheeting required	$m^{2\ (face)}$	5858

Item		Unit	Qty.	Unit Price	Total
ORIGINAL ESTIMATE					
1	Earthworks-excavate and remove offsite potentially Contaminated	m^3	58,000	$100	$5,800,000
2	Shoring/sheet piling	$m^{2\ (face)}$	5,900	$350	$2,065,000
3	Support Piles	Ea	731	$25,000	$18,275,000
4	Dewatering	Allow	1	$600,000	$600,000
5	Concrete Floor - 0.6m Thick	m^3	3,600	$700	$2,520,000
6	Concrete Walls - 0.4m Thick	m^3	380	$850	$323,000
7	Concrete Roof Slab - 0.4m Thick	m^3	2,400	$1,100	$2,640,000
8	Internal Baffle Walls	$m^{2\ (face)}$	4,060	$350	$1,421,000
9	Diversion Structure	Ea	1	$100,000	$100,000
10	Granular Backfill	m^3	31,000	$25	$775,000
11	Control House - incl. driveway and landscape	Ea	1	$200,000	$200,000
12	Outlet Pipe through dockwall	Ea	1	$100,000	$100,000
13	UV system including pumps lights etc.	Ea	1	$750,000	$750,000
			SUB-TOTAL		***$35,569,000***
Items to be REMOVED *(ie. Outside of Scope / Accounted for Elsewhere)*					
3	Support Piles	Ea	731	($25,000)	($18,275,000)
			SUB-TOTAL		***($18,275,000)***
Items to be ADDED *(ie. To be included for comparative purpose to new pond scenario)*					
a	Dockwall repairs	m	800	$17,095	$13,676,000
b	Incremental Cost - Excavation & Removal	m^3	58,000	$30	$1,740,000
c	Additional Quantity - Excavation & Removal	m^3	5,900	$130	$767,000
d	Recirculation Pipe & Chamber	Allow	1	$400,000	$400,000
e	Boardwalk support	m	650	$16,000	$10,400,000
f	Support Slab under Tank	Ea	1	$2,500,000	$2,500,000
12*	Additional Cost - Inlet Pipe through Dockwall	Ea	1	$200,000	$200,000
			SUB-TOTAL		***$29,683,000***

Total Costs	**$46,977,000**
10% Engineering	$4,697,700
15% Contingency	$7,046,550

Total Estimated Tank Cost $59,000,000

APPENDIX B

Cost Estimate – Preferred SWM Facility Option

The
MUNICIPAL
INFRASTRUCTURE
Group

Waterfront Toronto

East Bayfront 29-Jan-09

Conceptual Stormwater Management Cost Comparison

PREFERRED OPTION - *Pond along Dockwall from Jarvis and into Parliament Slip*

Assumptions

Pond Area = 7830

Runoff Coefficient 0.90

Concrete box sections - 9 m wide by 8 m deep by 870 m long (includes extension into Parliament Slip)

UV Treatment included

Decking in Parliament Slip and along Boardwalk not included as it is a consistent cost to all scenarios

Landscaping & fisheries compensation not included as outside of scope

Pond Dimensions		
Pond Length	m	870
Depth	m	8
Avg. Width	m	9
Wall Length	m	870
Deck Area	m^2	4400

Item		**Unit**	**Qty.**	**Unit Price**	**Total**
ORIGINAL ESTIMATE					
1	Concrete Box Sections incl. Forebay Divider	m	870	$35,800	$31,146,000
2	Diffuser / Header Pipe	Ea	1	$100,000	$100,000
3	Piping to Sherbourne Park	m	640	$400	$256,000
4	Control House - incl. driveway and landscape	Ea	1	$200,000	$200,000
5	UV system including pumps lights etc.	Ea	1	$1,300,000	$1,300,000
6	Inlet Pipe through dockwall	Ea	1	$300,000	$300,000
7	Recirculation Pipe & Chamber	Allow	1	$400,000	$400,000
			SUB-TOTAL		***$33,702,000***
Items to be REMOVED ***(ie. Outside of Scope / Accounted for Elsewhere)***					
---	---	---	---	---	$0
			SUB-TOTAL		***$0***
Items to be ADDED ***(ie. To be included for comparative purpose to new pond scenario)***					
---	---	---	---	---	$0
			SUB-TOTAL		***$0***

Total Costs	**$33,702,000**
10% Engineering	$3,370,200
15% Contingency	$5,055,300
Total Estimated Pond Cost	***$42,000,000***

The **MUNICIPAL INFRASTRUCTURE** GROUP Ltd.

Appendix 2a

HVM Summary

Existing Pipes from HVM Summary

PROJECT: East Bayfront
JOB NO: 07 135

Branch to Sherbourne

Street	Link	Pipe Dia. (mm)	Capacity (l/s)	Area (ha)	Aggregate Area (ha)	Actual Flow (l/s)	Capacity Used
Queens Quay	3241	375	47	0.53	0.53	110	Surcharged
	3242	450	99	0.79	1.32	275	Surcharged
	3243	525	241	0.37	1.69	352	Surcharged
Jarvis	3236	375	83	0.72	0.72	150	Surcharged
	3237	400	156	0.7	1.42	296	Surcharged
	3238	600	201	0	1.42	296	Surcharged
	3239	600	188	0.51	1.93	402	Surcharged
	3240	600	237	0	1.93	402	Surcharged
Queens Quay	3244	825	464	0.48	4.1	854	Surcharged
Richardson	3245	375	99	0.73	0.73	152	Surcharged
	3246	525	146	0.62	1.35	281	Surcharged
	3247	525	230	0	1.35	281	Surcharged
Queen's Quay	3248	900	629	0.76	6.21	1293	Surcharged
	3249	1050	925	0.78	6.99	1456	Surcharged
	3250	1050		0	**6.99**	**1456**	Surcharged
Lakeshore	3202	525	128	0.32	0.32	53	41%
	3203	600	224	0.41	0.73	122	54%
	3204	675	314	0.22	0.95	158	50%
Jarvis	3197		->	*no data*	<-		
	3198		->	*no data*	<-		
	3199		->	*no data*	<-		
	3200	600	255	0	0	271	Surcharged
	3201	600	289	0	0	271	94%
Lakeshore	3205	900	591	0.3	1.25	428	72%
	3206	975	1331	0.63	1.88	533	40%
	3207	1050	1667	0.57	2.45		0%
	3208	1050	n/a	0	**2.45**	**649**	
Lakeshore	3209	600	404	0.18	0.18	38	9%
	3210	750	514	0.29	0.47	98	19%
	3211	900	746	0.33	0.8	167	22%
	3212	525	337	0.32	0.32	67	20%
	3213	600	493	0.25	0.57	119	24%
	3214	675	681	0.34	0.91	190	28%
	3215	675	679	0	0.91	190	28%
	3216	900	611	0	1.71	358	59%
	3217	900	576	0.37	2.08	435	76%
	3218	1050	643	0.64	2.72	569	88%
	3219	1050	645	0.49	3.21	671	Surcharged
	3220	1050	643	0.66	3.87	809	Surcharged
	3221	1050	631	0	**3.87**	**809**	Surcharged

Existing Pipes from HVM Summary

PROJECT: East Bayfront
JOB NO: 07 135

Branch to Sherbourne

Street	Link	Pipe Dia. (mm)	Capacity (l/s)	Area (ha)	Aggregate Area (ha)	Actual Flow (l/s)	Capacity Used
Lakeshore	3222	675	277	0.76	0.76	159	57%
	3223	750	365	0.59	1.35	282	77%
	3224	900	579	0.25	1.6	335	58%
	3225	300	136	0.3	0.3	63	46%
	3226	450	399	0	0.3	63	16%
	3227	900	571	0.31	2.21	462	81%
	3228	900	529	0	**2.21**	**462**	87%

Branch to Small St.

Street	Link	Pipe Dia. (mm)	Capacity (l/s)	Area (ha)	Aggregate Area (ha)	Actual Flow (l/s)	Capacity Used
Queen's Quay	3251	375	84	0.48	0.48	92	Surcharged
Bonnycastle	3252	375	82	0.28	0.28	54	66%
	3253	375	80	0.49	0.77	148	Surcharged
	3254	450	67	0	0.77	148	Surcharged
Queen's Quay	3255	525	196	0.64	1.89	363	Surcharged
	3256	600	292	0.73	2.62	503	Surcharged
	3257	600	2839	0	**2.62**	**503**	18%
Parliament	3460	375	172	0.28	0.28	54	31%
	3461	450	173	0.42	0.7	134	77%
	3462	525	195	0	0.7	134	69%
	3463	525	2570	0	**0.7**	**134**	5%
Lakeshore	3229	450	166	0.2	0.2	42	25%
	3230	525	239	0.09	0.29	61	26%
	3231	525	440	0.31	0.6	125	28%
	3232	525	134	0	0.6	125	93%
	3233	600	201	0.53	1.13	236	Surcharged
	3234	675	692	0	**1.13**	**236**	34%
Lakeshore	3456	675	481	0.36	0.36	125	26%
	3457	750	624	0.36	0.72	195	31%
	3458	750	363	0.39	1.11	276	76%
	3459	900	579	0.47	**1.58**	**375**	65%

Appendix 2b

Storm Sewer Design Sheets

The MUNICIPAL INFRASTRUCTURE Group

PROJECT: East Bayfront
SCENARIO New Storm Richardson to Sherbourne
LOCATION: Toronto, ON
JOB NO: 07 135

City of Toronto

STORM SEWER
PRELIMINARY DESIGN SHEET

SUBMISSION:
DESIGNED BY: CE
REVIEWED BY:
DATE: December-07
Revised-March-09

DESIGN PARAMETERS

N = 2.78 when "A" in ha & "I" in mm/hr
I = aT^c
t = 8.00 minutes (initial)

	2 year	100 Year
a =	21.8	59.7
c =	-0.78	-0.8

LOCATION			CATCHMENT					FLOW													
(1) STREET/ LOCATION	(2) FROM	(3) TO	(4) AREA "A" (ha)	ACCU- MULATED "A" (ha)	(5) RUNOFF CEFFICIENT "C"	(6) SECTION "CA" (ha)	(7) ACCUM- ULATED "CA" (ha)	(8) RAINFALL INTENSITY " I " (mm/hr)	(9) DISCHARGE "Q" (l/s)	(10) PIPE LENGTH (m)	(11) PIPE SLOPE (%)	(12) PIPE DIA. (mm)	(13) PIPE AREA (sq.m)	(14) Q/A 2 YEAR VELOCITY (m/s)	(15) TIME OF FLOW IN PIPE (min)	(16) TIME OF CONCEN- TRATION (min)	(17) MANNINGS SLOPE (m/m)	(18) delta HGL IN PIPE SECT. (m)	(19) DOWNSTREAM HGL (m)	(20) UPSTREAM HGL (m)	(21) MAX HGL <76.20 (m)	(22) 2 YEAR VELOCITY >0.70 (m/s)
Queens Quay		150	0.57	0.57	0.95	0.54	0.54															
Queens Quay	150	119	1.61	2.18	0.75	1.21	1.75	104.96	510.3	42.0	0.2	900.0	0.636	0.80	0.87	8.00	0.0008	0.03	75.79	75.82	YES	YES
Jarvis			0.06	0.06	0.95	0.06	0.06									8.00						
			0.79	0.79	0.95	0.75	0.75															
		119	0.71	1.56	0.78	0.55	1.36	104.96	397.2	190.0	0.2	750.0	0.442	0.90	3.52	8.00	0.0013	0.24	75.79	76.03	YES	YES
East Bayfront			0.13	0.13	0.44	0.06	0.06															
Queens Quay	119	117	0.45	4.32	0.95	0.43	3.60	96.81	967.6	123.0	0.2	1,200.0	1.131	0.86	2.40	8.87	0.0006	0.08	75.71	75.79	YES	YES
Richardson			0.06	0.06	0.95	0.06	0.06									8.00						
			1.86	1.86	0.78	1.45	1.45															
		117	0.25	2.17	0.95	0.24	1.75	104.96	509.2	170.0	0.2	900.0	0.636	0.80	3.54	8.00	0.0008	0.13	75.71	75.84	YES	YES
Street F		124	1.16	1.16	0.44	0.51	0.51															
	124	125	0.18	1.34	0.95	0.17	0.68	104.96	198.8	29.0	0.5	375.0	0.110	1.80	0.27	8.00	0.0129	0.37	75.79	76.17	YES	YES
		125	0.42	0.42	0.95	0.40	0.40															
	125	117	0.09	1.85	0.95	0.09	1.17	102.29	331.5	29.0	0.5	600.0	0.283	1.17	0.41	8.27	0.0029	0.08	75.71	75.79	YES	YES
Queens Quay	117	115	0.5	8.84	0.9	0.45	6.96	80.35	1553.8	94.0	0.2	1,500.0	1.767	0.88	1.78	11.27	0.0005	0.05	75.66	75.71	YES	YES
Street A North			0.07	0.07	0.95	0.07	0.07															
		115	0.17	0.24	0.95	0.16	0.23	104.96	67.6	140.0	0.5	375.0	0.110	0.61	3.81	8.00	0.0015	0.21	75.66	75.87	YES	NO
Street A South		115	0.31	0.31	0.95	0.29	0.29	104.96	85.9	140.0	0.2	375.0	0.110	0.78	3.00	8.00	0.0024	0.34	75.66	76.00	YES	YES
Queens Quay	115	114	0.35	9.74	0.95	0.33	7.82	71.65	1556.8	90.0	0.2	1,800.0	2.544	0.61	2.45	13.05	0.0002	0.02	75.65	75.66	YES	NO
Lower Sherbourne			0.07	0.07	0.95	0.07	0.07															
			1.00	1.00	0.78	0.78	0.78															
			0.27	0.27	0.95	0.26	0.26															
		114	0.41	1.75	0.5	0.21	1.31	104.96	382.8	40.0	0.2	900.0	0.636	0.60	1.11	8.00	0.0004	0.02	75.63	75.65	YES	NO
Street F		113	0.68	0.68	0.44	0.30	0.30															
		113	0.95	0.95	0.5	0.48	0.48															
	114	113	0.3	13.43	0.95	0.29	10.19	62.65	1774.1	55.0	0.2	1,800.0	2.544	0.70	1.31	15.50	0.0002	0.01	75.62	75.63	YES	NO
Sherbourne Park	113	110		13.43	0.95		10.19	58.80	1665.0	80.0	0.2	1,800.0	2.544	0.65	2.04	16.82	0.0002	0.02	75.60	75.62	YES	NO

PROJECT: East Bayfront
SCENARIO New Storm Richardson to Sherbourne
LOCATION: Toronto, ON
JOB NO: 07 135

City of Toronto

STORM SEWER
PRELIMINARY DESIGN SHEET

SUBMISSION:
DESIGNED BY: CE
REVIEWED BY:
DATE: December-07
Revised-March-09

DESIGN PARAMETERS

		2 year	100 Year
N = 2.78 when "A" in ha & "I" in mm/hr	a =	21.8	59.7
I = aT^c			
t = 8.00 minutes (initial)	c =	-0.78	-0.8

LOCATION			CATCHMENT					FLOW														
(1) STREET/ LOCATION	(2) FROM	(3) TO	(4) AREA "A" (ha)	ACCU-MULATED "A" (ha)	(5) RUNOFF CEFFICIENT "C"	(6) SECTION "CA" (ha)	(7) ACCUM-ULATED "CA" (ha)	(8) RAINFALL INTENSITY " I " (mm/hr)	(9) DISCHARGE "Q" (l/s)	(10) PIPE LENGTH (m)	(11) PIPE SLOPE (%)	(12) PIPE DIA. (mm)	(13) PIPE AREA (sq.m)	Q/A 100 YEAR VELOCITY (m/s)	(15) TIME OF FLOW IN PIPE (min)	(16) TIME OF CONCEN-TRATION (min)	(17) MANNINGS SLOPE (m/m)	(18) delta HGL IN PIPE SECT. (m)	(19) DOWNSTREAM HGL (m)	(20) UPSTREAM HGL (m)	(21) MAX HGL <76.00 (m)	(22) 2 YEAR VELOCITY >0.70 (m/s)
Queens Quay			0.21	0.21	0.95	0.20	0.20															
		115	0.17	0.38	0.44	0.07	0.27	104.96	80.0	50.0	0.5	375.0	0.110	0.72	1.15	8.00	0.0021	0.10	75.85	75.95	YES	YES
		0.38																				
Small Street			0.06	0.06	0.95	0.06	0.06															
			0.10	0.10	0.95	0.10	0.10															
		115	1.02	1.18	0.78	0.80	0.95	104.96	276.5	80.0	0.5	600.0	0.283	0.98	1.36	8.00	0.0020	0.16	75.85	76.01	YES	YES
		1.18																				
Small Street South			0.37	0.37	0.95	0.35	0.35															
		115	1.35	1.72	0.44	0.59	0.95	104.96	275.9	80.0	0.5	600.0	0.283	0.98	1.37	8.00	0.0020	0.16	75.85	76.01	YES	YES
		1.72																				
Queens Quay	115	114	0.5	3.78	0.95	0.48	2.64	92.81	681.8	100.0	0.2	900.0	0.636	1.07	1.55	9.37	0.0014	0.14	75.70	75.85	YES	YES
		3.78																				
Aitken Place North			0.29	0.29	0.95	0.28	0.28															
		114	0.72	1.01	0.78	0.56	0.84	104.96	244.2	80.0	0.5	600.0	0.283	0.86	1.54	8.00	0.0016	0.13	75.70	75.83	YES	YES
Aitken Place South			0.56	0.56	0.95	0.53	0.53															
		114	1.02	1.58	0.44	0.45	0.98	104.96	286.2	80.0	0.5	600.0	0.283	1.01	1.32	8.00	0.0022	0.17	75.70	75.88	YES	YES
Queens Quay	114	113	0.27	6.64	0.95	0.26	4.72	82.33	1079.6	100.0	0.2	1,200.0	1.131	0.95	1.75	10.92	0.0008	0.08	75.63	75.70	YES	YES
		6.64																				
Bonnycastle North			0.21	0.21	0.95	0.20	0.20															
		113	0.86	1.07	0.78	0.67	0.87	104.96	253.9	80.0	0.5	600.0	0.283	0.90	1.48	8.00	0.0017	0.14	75.63	75.76	YES	YES
			0.75	0.75	0.95	0.71	0.71															
BonnyCastle South	113	Facility	0.44	8.90	0.44	0.19	6.49	73.34	1323.8	80.0	0.2	1,500.0	1.767	0.75	1.78	12.67	0.0004	0.03	75.60	75.63	YES	YES
							16.68	total CA	2988.8	total 2 year inflow to facility												

6988.9 100 YEAR MAX FLOW - ASSUMES TOTAL CAPTURE 0F 100 YEAR

Appendix 2c

Sherbourne CSO Analysis

East Bayfront Functional Servicing Report

ANALYSIS OF MAJOR FLOW TO EXISTING SHERBOURNE CSO
COMPARISON OF NET EFFECTIVE RUNOFF "C" AND AREA "A"

IDFs based on City of Toronto Wet Weather Flow Master Plan, November 2006

Ex. Minor System Tributary Areas to Sherbourne CSO

Description	C	A	C100 x A
Queens Quay	0.95	1.88	1.79
Loblaws/LCBO	0.75	1.8	1.35
Loblaws/LCBO	0.95	0.52	0.49
Jarvis	0.95	1.04	0.99
Richardson	0.95	1.68	1.60
Fut St A North	0.95	1.22	1.16
Sherbourne	0.95	1.25	1.19
Phase 1 -Ex. Conditions	0.95	4.21	4.00
		Aggregate	12.56

2 Year 8 Min I =	104.96		
100 Year 8 Min I =	299.24	2.85	times 2 year
2 Year 12 Min I =	76.50		
100 Year 12 Min I =	216.35	2.83	times 2 year
2 Year 15 Min I =	64.28		
100 Year 15 Min I =	180.98	2.82	times 2 year

Post Development Conditions - Major System Only / **Minor System**

Description	C	A	C100 x A	C-2Year	C2 x A
Sherbourne -Buildings	0.89	0.5	0.45	0.78	0.39
Sherbourne - Roads	0.95	0.27	0.26	0.95	0.26
Sherbourne - Park North	0.75	0.41	0.31	0.5	0.21
Sherbourne - Park South	0.75	0.95	0.71	0.5	0.48
Phase 1 - Block 3	0.75	0.68	0.51	0.44	0.30
Phase 1 - Roads	0.95	0.3	0.29	0.95	0.29
Queens Quay - Road	0.95	0.52	0.49	0.95	0.49
		Aggregate	2.57	Aggregate	2.40

Multiply by 2.85 to account for increased intensity

to Convert to 2 Year equivalent = 7.31

Subtract Minor C2A from Major C100A for Net CA= 4.91

(The Minor C2A is assumed to get into the new sewers)

Which is less than Aggregate Existing, Therefore Reducing Flows
To existing CSO

Flow Comparison

Net Flow to the CSO at Sherbourne and Queens Quay

C2 x A to Inlet = 12.56
Time of Concentration to Node 106 = 11.09 minutes
(assumed the same)
2 Year I = 81.35 mm/hr
Q=2.78 Cai= 2840.5 l/s

Net Flow to the Total Capture inlet at Sherbourne and Queens Quay

C100 x A to Inlet = 2.57
Time of Concentration to Node 106 = 11.09 minutes
100 Year I = 230.44 mm/hr
Q=2.78 Cai= 1643.5 l/s

C2 x A to Inlet = 2.40
Time of Concentration to Node 106 = 11.09 minutes
2 Year I = 81.35 mm/hr
Q=2.78 Cai= 543.8 l/s

Net Flow to Inlet= 1099.6 l/s

Proposed System to Direct Major to CSO reduces 100 year peak flows by 1740.9 l/s

ANALYSIS OF MAJOR FLOW TO EXISTING SMALL STREET CSO
COMPARISON OF NET EFFECTIVE RUNOFF "C" AND AREA "A"

IDFs based on City of Toronto Wet Weather Flow Master Plan, November 2006

Ex. Minor System Tributary Areas to Small Street CSO

Description	C	A	C100 x A
Queens Quay	0.95	0.98	0.93
Bonnycastle Street	0.95	0.2	0.19
Small Street	0.95	0.2	0.19
Parliament Street	0.95	0.3	0.29
227 Lakeshore	0.95	0.3	0.29
229 Lakeshore	0.95	0.6	0.57
11 Small Street	0.95	0.5	0.48
45 Small Street	0.95	0.1	0.10
2 Small Street	0.95	0.1	0.10
198 Queens Quay	0.95	0.9	0.86
261 Queens Quay	0.95	4.4	4.18
		Aggregate	8.15

2 Year 8 Min I =	104.96		
100 Year 8 Min I =	299.24	2.85	times 2 year
2 Year 12 Min I =	76.50		
100 Year 12 Min I =	216.35	2.83	times 2 year
2 Year 15 Min I =	64.28		
100 Year 15 Min I =	180.98	2.82	times 2 year

Post Development Conditions - Major System Only

Description	C	A	C100 x A
Queens Quay - Road	0.95	0.98	0.93
Bonny Castle	0.95	0.1	0.10
Small Street	0.95	0.1	0.10
Parkside	0.89	0.4	0.36
Bayside - Roads	0.95	1.3	1.24
Bayside - Development	0.75	2.8	2.10
Street 'Z'	0.95	0.2	0.19
Development North of QQ	0.89	2.2	1.958

Minor System

C-2Year	C2 x A
0.95	0.93
0.95	0.10
0.95	0.10
0.78	0.31
0.95	1.24
0.44	1.23
0.95	0.19
0.78	1.72

Aggregate 6.96 Aggregate 5.81

Multiply by 2.85 to account for increased intensity

to Convert to 2 Year equivalent = 19.84

Subtract Minor C2A from Major C100A for Net CA= 14.04

(The Minor C2A is assumed to get into the new sewers)

Flow Comparison

Net Flow to the CSO at Sherbourne and Queens Quay

C2 x A to Inlet = 8.15

Time of Concentration to Small Street = 10.98 minutes

(assumed the same)

2 Year I = 81.99 mm/hr

Q=2.78 Cai= 1857.8 l/s

Net Flow to the Total Capture inlet at Sherbourne and Queens Quay

C100 x A to Inlet = 6.96

Time of Concentration to Small Street= 10.98 minutes

100 Year I = 232.28 mm/hr

Q=2.78 Cai= 4494.4 l/s

C2 x A to Inlet = 5.81

Time of Concentration to Node 106 = 10.98 minutes

2 Year I = 81.99 mm/hr

Q=2.78 Cai= 1323.3 l/s

Net Flow to Inlet= 3171.0 l/s

Proposed System to Direct Major to CSO reduces 100 year peak flows by -1313.2 l/s

The MUNICIPAL INFRASTRUCTURE Group

East Bayfront Functional Servicing Report

ANALYSIS OF MAJOR FLOW TO JARVIS STREET OVERFLOW
COMPARISON OF NET EFFECTIVE RUNOFF "C" AND AREA "A"

IDFs based on City of Toronto Wet Weather Flow Master Plan, November 2006

Post Development Conditions - Major System Only				**Minor System**	
Description	**C**	**A**	**C100 x A**	**C-2Year**	**C2 x A**
Queens Quay - Road	0.95	1.52	1.44	0.95	1.44
Development N/O QQ	0.89	3.07	2.73	0.78	2.39
Street 'A' North	0.95	0.17	0.16	0.95	0.16
Richardson	0.95	0.25	0.24	0.95	0.24
Jarvis	0.95	0.27	0.26	0.95	0.26
Existing Parking	0.95	1.52	1.44	0.95	1.44
Existing Commercial	0.75	1.61	1.21	0.75	1.21
Jarvis Park	0.95	0.42	0.40	0.95	0.40
Dockside Development	0.75	1.29	0.97	0.44	0.57
Dockside Roads	0.95	0.41	0.39	0.95	0.39

Aggregate 9.24 Aggregate 8.50
Multiply by 2.85 to account for increased intensity
to Convert to 2 Year equivalent = 26.34

Subtract Minor C2A from Major C100A for Net CA= 17.84
(The Minor C2A is assumed to get into the new sewers)

2 Year 8 Min I =	104.96	
100 Year 8 Min I =	299.24	2.85 times 2 year
2 Year 12 Min I =	76.50	
100 Year 12 Min I =	216.35	2.83 times 2 year
2 Year 15 Min I =	64.28	
100 Year 15 Min I =	180.98	2.82 times 2 year

Flow Comparison

Net Flow to the CSO at Sherbourne and Queens Quay
C2 x A to Inlet = 0.00
Time of Concentration to Small Street = 10.98 minutes
(assumed the same)
2 Year I = 81.99 mm/hr
Q=2.78 Cai= 0.0 l/s

Net Flow to the Total Capture inlet at Sherbourne and Queens Quay
C100 x A to Inlet = 9.24
Time of Concentration to Small Street= 10.98 minutes
100 Year I = 232.28 mm/hr
Q=2.78 Cai= 5966.2 l/s

C2 x A to Inlet = 8.50
Time of Concentration to Node 106 = 10.98 minutes
2 Year I = 81.99 mm/hr
Q=2.78 Cai= 1937.7 l/s

Net Flow to Inlet= 4028.5 l/s

Appendix 2d

Oil-Grit Separator Quality Controls

East Bayfront Functional Servicing Report

ANALYSIS OF OIL-GRIT SEPARATOR QUALITY CONTROLS
PHASE 1 DEVELOPMENT ONLY

1	Current Tributary Area Tributary to Sherbourne CSO =	13.43	ha	
2	Area of Phase 1 being Developed =	4.22	ha	
3	Area to OGS at Node 112 (South of Street F) =	13.43	ha	
4	Treatment Efficiency, as noted by City of Toronto =	50%		
5	Effective 100% treated Area =	6.71	ha	3 X 4
6	Total Effective 100% treated Area =	6.71	ha	5
7	Effective Treatment to Phase 1 Development Area =	159%		6 / 2
8	Allowable Development Area Considering 80% TSS Removal =	8.39	ha	6 / 80%
	(As per MOEE enhanced Treatment Criteria)			

Appendix 3a

Scott Street SPS Flow Data Review

Memo

DATE: January 30, 2009
TO: File
FROM: Kevin Brown
SUBJECT: Analysis of Scott Street SPS Flow Data

G:\Projects\2007\07135 - Waterfront Toronto - East Bayfront\Correspondence\Memo\Memo 013r1 KB to File - Analysis of Scott St SPS Flow Data.doc

Currency

This memo is an update to a memo originally filed November 29, 2007, based on Scott Street Pumping Station data from November 5th, 2006 through July 8th, 2007. That memo was included in the first draft of the East Bayfront Functional Servicing Plan (as Appendix 8-A).

Subsequent to the original memo, TMIG obtained additional flow and rainfall data, and have updated the flow data analysis and this memo accordingly.

This memo presents an analysis of the Scott Street Sewage Pumping Station (SPS) flow data that we received from Toronto Water November 28th, 2007 and January 13th, 2009. The data covers the following periods:

- November 5th, 2006 through July 8th, 2007; and
- September 27th, 2007 through November 11th, 2008.

Data Manipulation

The data received consisted of wet well level data and flow data for pumps 1 and 2. The data were provided at 5-minute intervals, and are reported to be instantaneous ‘snapshots’ rather than 5-minute averages. The result of such a data acquisition approach is that data values can fluctuate wildly over short periods of time (depending whether the “snapshot” was taken with the pump on or off as it cycles). Such fluctuations were observed in all of the data. Effectively, the data over-represent, then under-represent, then over-represent (etc., etc.) the incoming flow rate. Selecting a peak flow rate from such data would significantly overestimate the actual value.

To “smooth” the data and generate a better estimate of the actual flow rate at a particular time, the snapshots can be averaged over a time period. Figure 1 shows the results of averaging at 15-minute (three data sets) and 30-minute (six data sets) intervals. The peak flow rate can be seen to remain relatively steady and the form of the daily data is considerably more representative of what would be expected in such a facility.

Care must be taken whenever data are manipulated. Time-averaging will, eventually, drop the averaged peak below the actual value, resulting in underestimating of the peak flow rate.

Dry-Weather Flow Analysis

TMIG obtained daily precipitation data from Environment Canada for the City Centre Airport for the same period during which the flows were measured. Using the precipitation data, we identified a number of "dry-weather days" (see Table 1). A dry-weather day was a day with zero precipitation that was also preceded by three or more days with zero precipitation.

Some of the dry-weather days were excluded from the analysis as the data for those days was quite different than the average. This suggested that there might have been errors in the data, or other circumstances that resulted in 'unusual' flow conditions.

TABLE 1 DRY-WEATHER DAYS (NOVEMBER 5 2006 THROUGH JULY 8 2007)

Dry Weekdays						**Dry Weekend Days**	
21-Nov	~~22-Nov~~	23-Nov	24-Nov	27-Nov	28-Nov	25-Nov	26-Nov
~~29-Nov~~	6-Dec	7-Dec	~~8-Dec~~	~~18-Dec~~	19-Dec	9-Dec	10-Dec
20-Dec	~~21-Dec~~	~~30-Jan~~	~~31-Jan~~	~~1-Feb~~	~~2-Feb~~	17-Dec	~~3-Feb~~
~~5-Feb~~	6-Mar	7-Mar	~~8-Mar~~	~~9-Mar~~	21-Mar	~~4-Feb~~	~~10-Mar~~
9-Apr	~~10-Apr~~	7-May	8-May	9-May	~~21-May~~	~~8-Apr~~	16-Jun
22-May	23-May	24-May	18-Jun			17-Jun	
Note: Gray strikethrough indicates days that were excluded from the analysis							

Analysis of the dry-weather flow data revealed that the minimum dry-weather flow through the Scott Street SPS typically reaches 50 L/s at around 4:00 AM. Of this, it is assumed that 80 percent (40 L/s) represents base groundwater infiltration into the collection system. This is supported by the fact that the entire collection system draining to the Scott Street SPS is below the typical Lake Ontario water level of 75 m.

The base infiltration was then subtracted from the dry-weather data, and the adjusted weekday and weekend dry-weather data and averages are plotted in Figures 2a and 2b, respectively. These data represent the population-based flows, and do not include infiltration or storm inflow. The dry-weather data are summarised in Table 2. While this analysis was undertaken for the first period for which pumping station flow data were provided (November 5th, 2006 through July 8th, 2007), the dry-weather flows for the second period of data were comparable, so this analysis needs not be revised.

TABLE 2 SCOTT STREET SPS DRY-WEATHER FLOW DATA (NOVEMBER 5 2006 THROUGH JULY 8 2007)

		Dry Weekdays	**Dry Weekend Days**
Daily Average Flow [L/s] (1)	Maximum	100	96
	Average	**88**	90
	Minimum	79	84
Peak Flow [L/s] (1)	Maximum	**182**	166
	Average	155	140
	Minimum	119	125
Peaking Factor (2)		**2.1**	1.8
Time of Peak Flow		8:00 AM	1:00 PM

Notes:

1. Excludes base infiltration, estimated at 40 L/s
2. Peaking Factor is taken as the maximum peak flow divided by the average daily average flow

From the above table, we identify an average dry-weather flow of 88 L/s (assumed to be the minimum of the weekday and weekend average daily flows), and a peaking factor of 2.1 (based on a maximum daily peak flow of 182 L/s).

Of note, the weekday peak occurs at 8:00 AM, which is the typical timing of a residential peak. As such, it appears as though residential uses will govern the ultimate capacity of the Scott Street SPS.

Dry-Weather Flow Criteria Calibration

Analysis of 2006 Statistics Canada Census Data and the 2006 City of Toronto Employment Survey indicate that the Scott Street SPS service area has a residential population of 16,326 and an equivalent employment population of 14,317. The equivalent employment population is based on 11,961 full-time jobs, 4,712 part-time jobs, and the assumption that – from a flow perspective – one full-time job is roughly equivalent to two part-time jobs.

In a memorandum submitted to the City in October 2007, TMIG had proposed design criteria of 240 Lpcd for both residential and employment population, based on the East Bayfront Master Plan. While these numbers seem high (Toronto Water has released a Water Efficiency Study suggesting water consumption is 191 Lpcd for multi-unit residential; 160 to 170 Lpcd is commonly used in other municipalities for employment flows) they appear to be reasonable values for the Scott St SPS service area. Using these criteria results in a dry-weather flow of 85 L/s.

Using the higher residential and employment per capita flow rates also accounts for entertainment uses within the catchment area generated by restaurants, theatres, The Sony Centre, The Air Canada Centre, and similar facilities. While these are not strictly accounted for in the proposed design criteria, they are reflected in the slightly elevated per-capita flows. As the peak flows generated within the Scott Street SPS catchment appear to be strongly tied to residential uses, this approach for the entertainment flows is reasonable.

Of note, the Harmon Formula produces a peaking factor (2.5) that is approximately 20 percent greater than that which has been observed based on the measured flows. In theory, the peaking factor decreases as population increases, reflecting that the peakiness of a flow distribution decreases as the population increases. As such, the measured peaking factor of 2.1 is appropriate for existing conditions, and should be slightly conservative as a design guideline when considering future flow projections.

Wet-Weather Inflow Analysis

The Scott Street SPS flow data were also analysed for days with known rainfall in order to determine the extent of rainfall-derived inflow and infiltration (RDI/I) that could enter the collection system. A total of 18 rainfall events were considered, ranging in rainfall depth from 7.7 mm to 32.5 mm and in rainfall intensity from 2.4 mm/hr to 13.2 mm/hr. The statistics from these events are presented in Table 3.

During the period of record, the peak RDI/I flows into the system reached a maximum of 176 L/s (October 6, 2007), which amounts to 1.35 L/ha/s. During storm events, the peak flow rates at the Scott Street SPS occur a very short time after the rainfall peaks occur, and the rainfall-related flows tend to recede quite quickly once the rainfall has ended. This suggests that the majority of RDI/I flows are direct inflow, rather than infiltration-related flows (which generally have smaller peaks and longer durations).

TABLE 3 ANALYSIS OF RAINFALL EVENTS

Rainfall Event Date	Rainfall Depth (mm)	Peak Intensity (1) (mm/hr)	RDI/I (3) (L/s)	RDI/I (4) (L/ha/s)
November 16, 2006	31.0	- (2)	76	0.58
December 1, 2006	32.5	- (2)	154	1.18
December 22, 2006	16.5	- (2)	75	0.58
March 2, 2007	12.0	- (2)	99	0.76
April 3, 2007	8.5	- (2)	86	0.66
April 4, 2007	8.0	- (2)	42	0.32
May 15, 2007	27.0	7.2	146	1.12
May 16, 2007	11.0	4.8	155	1.19
May 27, 2007	9.5	5.4	135	1.04
June 19, 2007	9.5	9.4	154	1.18
October 6, 2007	**21.7**	**13.2**	**176**	**1.35**
October 23, 2007	16.5	2.4	52	0.40
November 21, 2007	31.1	- (2)	59	0.45
December 23, 2007	21.1	- (2)	106	0.81
April 11, 2008	22.0	3.4	139	1.07
July 20, 2008	24.9	7.0	172	1.32
September 30, 2008	8.3	3.6	111	0.85
October 25, 2008	7.7	3.9	151	1.16

Notes:

1. Peak intensity is based on hourly rainfall data collected at the “Toronto City” raingauge maintained by Environment Canada (Station ID: 6158355).
2. Hourly rainfall data are not generally available from November through April.
3. Calculated by subtracting the average dry-weather flow rate from the measured flow rate (see Figure 3)
4. Based on a partially-separated drainage area of 130.4 ha

When added to the base infiltration (40 L/s, or 0.3 L/ha/s), the peak extraneous flow into the system could amount to 1.65 L/ha/s. While this is much higher than what a typical sanitary sewer system would be designed for (typically in the range of 0.20 to 0.30 L/ha/s), this number can be justified somewhat:

- Virtually all of the Scott Street SPS collection system is completely submerged. A small percentage of the total pipe length lies above 75 m, which is the approximate elevation of Lake Ontario. When considering that the groundwater level slopes towards the Lake, then all pipes are at least partially-submerged. As a result, any crack would likely be a source of year-round infiltration of groundwater into the collection system.
- The pipes throughout the collection system are generally at least 60 years old, with many dating back almost 90 years. Pipes of this age are more likely to have developed cracks, and the joints between the pipes might also have deteriorated. These would provide opportunity for infiltration in any collection system, and the degree of infiltration that could be expected in this case is increased due to the location of the groundwater table.
- The Scott Street SPS collection system represents only a “partially-separated” sewer system. While separate storm sewers have now been installed throughout the Scott Street SPS service area to capture runoff from the streets, many of the buildings throughout the area have only a single service connection, to the sanitary sewer system. As such, storm flows collected in rooftop and foundation drainage systems are still conveyed to the sanitary sewers and the Scott Street SPS.

FIGURE 1 EXAMPLE OF THE EFFECTS OF DATA AVERAGING

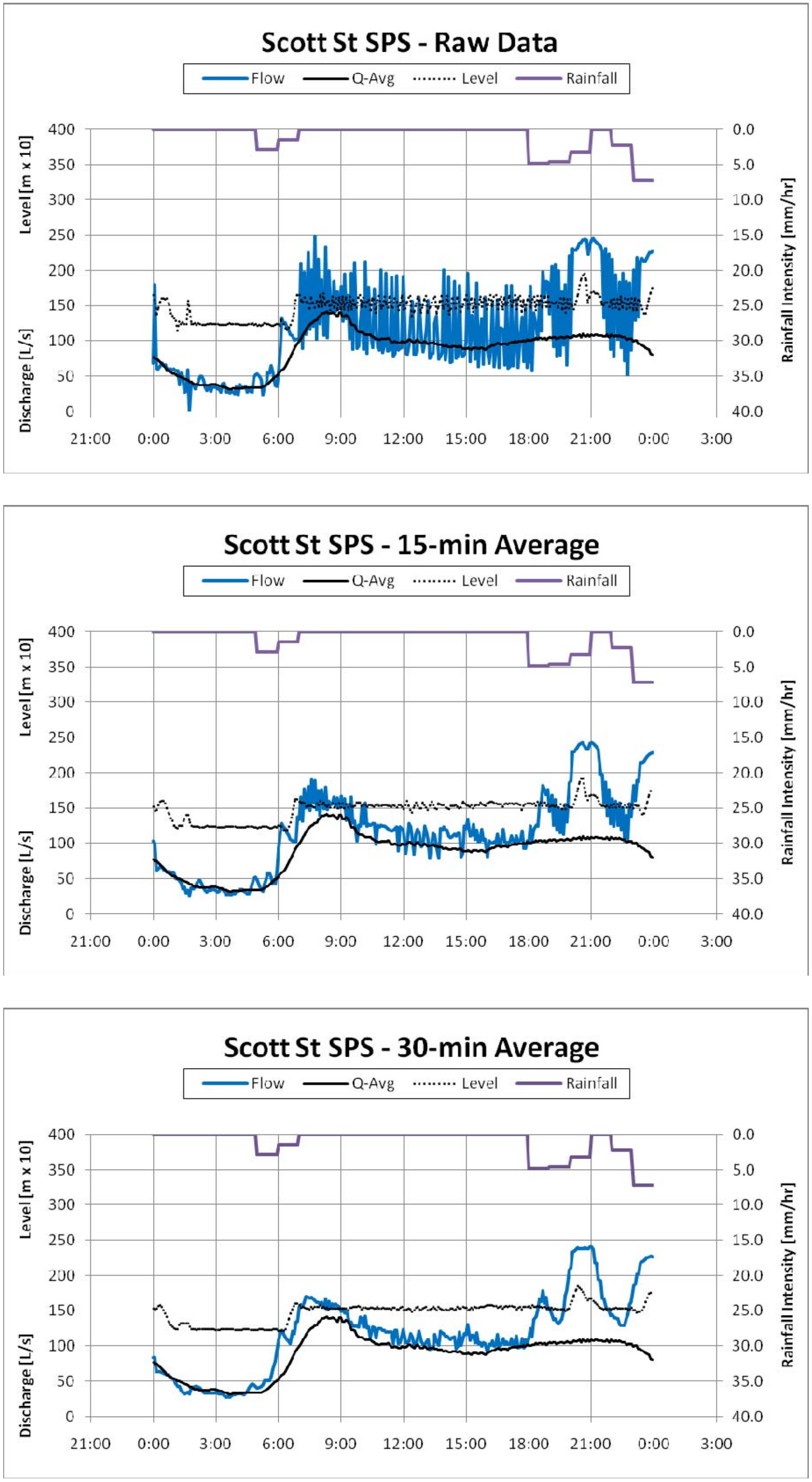
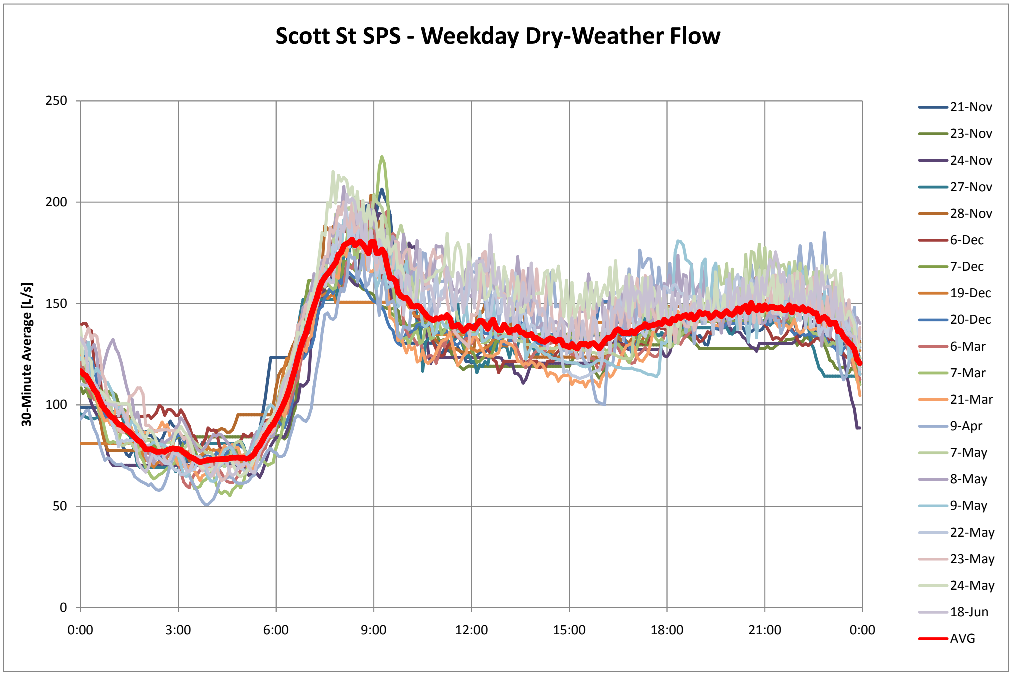


FIGURE 2 DRY-WEATHER FLOW DATA



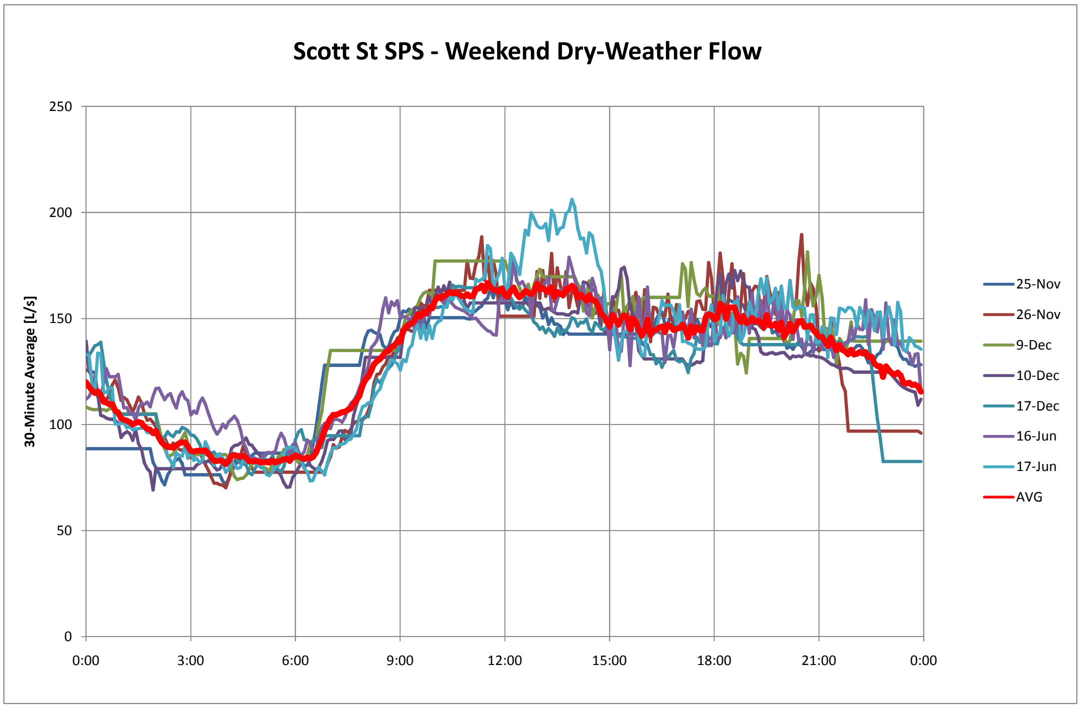
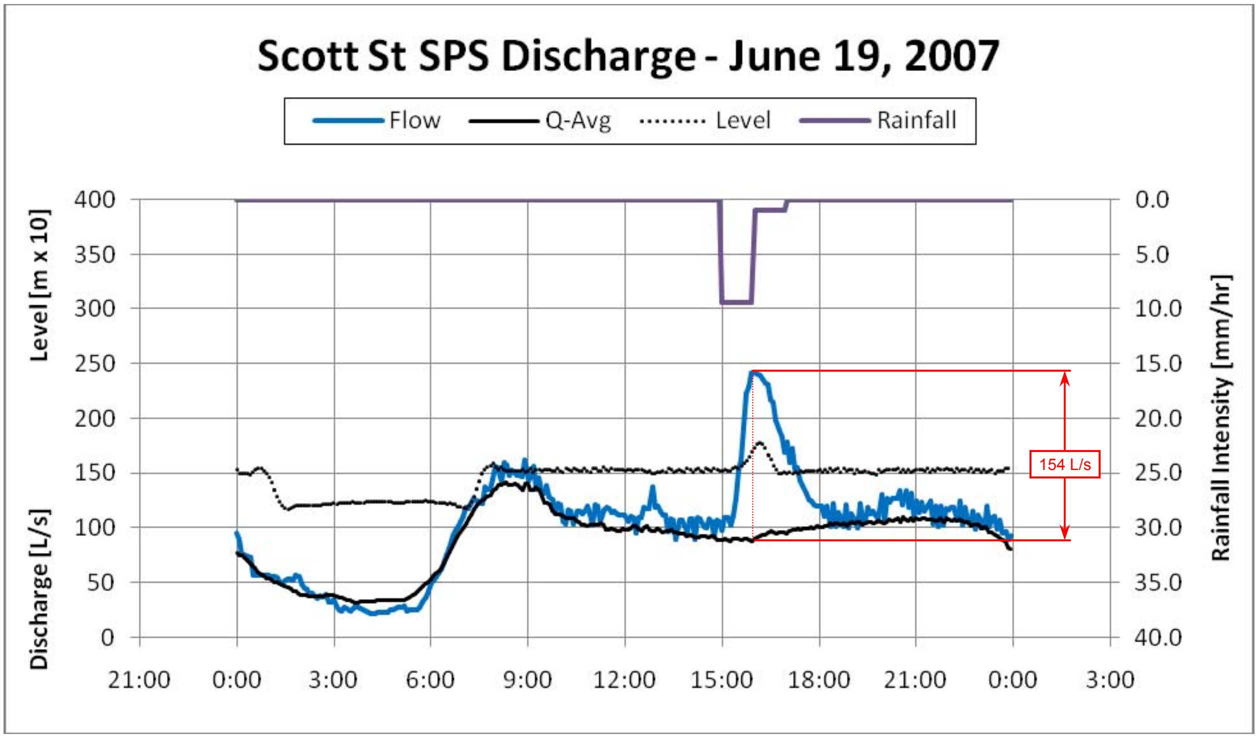


FIGURE 3 EXAMPLE OF HOW RDI/I FLOWS WERE DETERMINED



Appendix 3b

Scott Street Pumping Station Optimization Study

THE CITY OF TORONTO

Scott Street Pumping Station

Optimization Study

September 1995

G&S

G&S Holdings Corporation

September 27, 1995

Mr. David R. Bailey
Acting Commissioner
Public Works and the Environment
City of Toronto
City Hall
100 Queen Street West
Toronto, Ontario
M5H 2N2

Attention: Werner M. Wichmann, P.Eng.

Gentlemen:

Re: Letter of Retention
Scott Street Pumping Station
Capacity Assessment

We herewith present our report which covers the optimization of the above station without significant structural modification being required.

It would appear that the firm design capacity of the station can be increased by about 50%, solely by mechanical and electrical modifications to existing equipment, within a budget cost of ± $200,000.00.

Whatever work is done at Scott Street, maintaining operation is critical, so we have attempted to allow for "off-peak" working and unusual hours in the cost estimate, but the contractor's view of site conditions and limitations could vary considerably.

We are available to discuss the contents of the report with your staff at a mutually convenient time, and, if you have any queries or comments, please contact the undersigned.

Yours truly

Peter J Lord

Peter J. Lord
Project Manager

Encl.

Proj.No. 289.80

255 Consumers Road, North York, Ontario M2J 5B6 Telephone: (416) 499-9000 Telex: 06-986146 Fax: (416) 499-4687

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SCOTT STREET PUMPING STATION OPTIMIZATION STUDY

1.0 GENERAL

1.1 Background

The Scott Street Pumping Station houses three (3)-250 mm vertical spindle dry well pumps, each with a design capability of discharging 198 L/s against 7.3 m TDH. Firm station capacity should therefore be 396 L/s with two (2) pumps in operation.

Space within the station is very restricted, and is likely to become even more so when the work being performed at present to replace E-M drives with VFDs is completed.

Pumps Nos 1 and 3 are variable speed units, while Pump No. 2 is constant speed and is intended to act as a standby. Each pump is driven by a 30 HP, 875 RPM open frame motor. Each pump has individual suction and discharge piping (which includes magnetic flow meters on the duty pumps) and discharge into a chamber which outlets via a 2'2" x 3'3" egg-shaped brick sewer.

1.2 Requirement for Optimization

Information provided by the City suggests that the firm capacity of 398 L/s is adequate to handle peak D.W.F., at present averaging 250 L/s. However, in wet weather, flows to the station were found to increase substantially, monitored as high as 576 L/s during April 1995. Future developments such as:

• proposed Raptor Stadium	16.7 L/s
• Metro Convention Centre	38.0 L/s
• other proposed commercial and residential development	5.0 L/s

would add about 60 L/s for an approximate wet weather peak flow of 640 L/s. Further, I/I investigation is planned with a view to reducing wet weather flows but, for the purposes of this study, a wet weather peak of approximately 640 L/s has been assumed.

2.0 EXISTING FACILITY

2.1 Inlet/Discharge

Analysis of the inlet and outfall sewers is not part of our terms of reference. The existing 2'2" x 3'3" outfall sewer with a gradient of 1:122 should be able to handle a flow of 35 L/s or 990 L/s. We have assumed there is little or no point in modifying the pumps to deliver more than the outfall sewer can accommodate.

As the standby pump may operate occasionally during prolonged heavy rain, we suggest the best attainable condition would therefore be 3 pumps each rated at 330 L/s against a mean TDH of 8.0 m (6.0 m static head and 2.0 m friction losses in the discharge piping).

2.2 *Installed Equipment*

The station is equipped with three (3) Denver/Sala 250 mm vertical spindle dry well pumps, each driven by a 30 HP 875 RPM motor. Two of the pumps incorporate VFDs, whilst the third pump is constant speed. Each pump is fitted with a 360 mm diameter impeller and is rated at approximately 198 L/s against 7.3 m total dynamic head.

The existing pumps seem to operate well, running quietly and smoothly. Apparently, they have required minimal maintenance or parts replacement.

The level measurement and pump control systems have been upgraded and the motors and drives are recently purchased or upgraded.

Ventilation systems and a gas detection system were completed early this year.

3.0 ALTERNATIVES

3.1 *Alternatives Considered*

A number of possibilities to reach maximum pumping capacity within the confines of the existing station were reviewed and discarded. Lack of space precludes:

- adding a fourth pump, either at the same as or on a higher elevation than the existing pumps;
- replacing one or more of the existing pumps with a larger pump.

Consideration was given to increasing pump speed, but operational conditions are such that the pump would operate near run-out condition on the performance curve, with probable cavitation, excessive vibration and wear. Alternatively, retrofitting the existing pumps with larger impellers and drives would be possible.

3.2 *Preferred Alternative*

We have reviewed the performance curves with the manufacturer and, when retrofitted with a full size 400 mm diameter impeller running at 875 rpm, the pump should discharge between 290 and 300 L/s at a TDH of approximately 7.5 m, and require a 50 HP motor. This is fairly close to the optimum condition outlined in 1.3, with minimum capital expenditure. Depending on the success of the City's efforts to reduce extraneous flows, the firm capacity of 600 L/s may handle future wet weather peaks.

Refer to Appendix A for supporting data.

4.0 OTHER CONSIDERATIONS

- inlet sump - available volume is marginal for operation of constant speed 50 HP pumps at dry weather flow rates, and we would therefore suggest the retention of variable speed VFD units.
- C of A amendment - the increase in firm capacity of the station will require an amended C of A, and involve an application to the MOEE Sewage Works and Air Branches.
- ESR - we believe requirements for this aspect will be limited to Class "A" - the pre-approved status.
- MOL - as the station is not being physically changed, we do not believe that the MOL will be involved. If this should change, negotiation may be required for acceptance of pump room access.
- Hydro - the service will have to be upgraded to 600 A, 208 V, 60 Hz, 4 wire. We have contacted Toronto Hydro, who advise that this upgrade can be provided and the City's contribution to Volt Cost Sharing to cover external (street) transformer provisions would be a one-time payment of $3,500.00.

5.0 COST ESTIMATE

2 -	208 V VFDs and ancillaries	$30,000
3 -	50 HP 900 RPM vertical F/M motors	$15,000
3 -	400 mm impellers, shafts, bearings, etc.	$15,000
	Installation/electrical labour, including maintained station operation	$72,500
	Equipment rentals	$8,000
	Bonds and insurance	$3,000
1 -	Flow meter - Pump No. 2	$3,500
	Concrete repair and pipe modifications, etc.	$10,000
	Contractor margin	$40,000
TOTAL		$197,000

Budget allowance of $200,000, excluding engineering services and applicable taxes.

Consideration may be given to staging the work and, although it is difficult to anticipate how qualified contractors would view such a "piecemeal" approach, we would suggest a budget estimate of $80,000.00 for a variable speed pump unit and $70,000.00 for the fixed speed standby, on the same basis.

APPENDIX A - SUPPORTING DATA

CONTENTS

DENVER SALA CANADA
DIV. OF SVEDALA INDUSTRIES CANADA INC.
3136 MAVIS ROAD, MISSISSAUGA, ONTARIO L5C 1T8
CANADA
FAX No.: (905) 270-9996 PHONE No.: (905) 270-2170

Date: Sept 19. 95
Telefax Reference No.: 2020
Company: Gore & Storrie
Telefax No.: 416 499 4687
Attention: Peter Lord
cc.:
From: Eric Sveanman
Subject: STK 10103 @ Scott Station
Page 1 of 3
Transmitted by:

Peter, see enclosed curves.

At 7.5 m TDH, max Q ≈ 17500 l/min
with max. Dia imp. = 400 mm
Size motor req'd – 50 hp, it is possible that 40 hp might do, but can only verify by test.
If above is not satisfactory than only option for us would be installing one 14" pump with 75 hp motor. I doubt if space is available for that.

Any questions, please call.

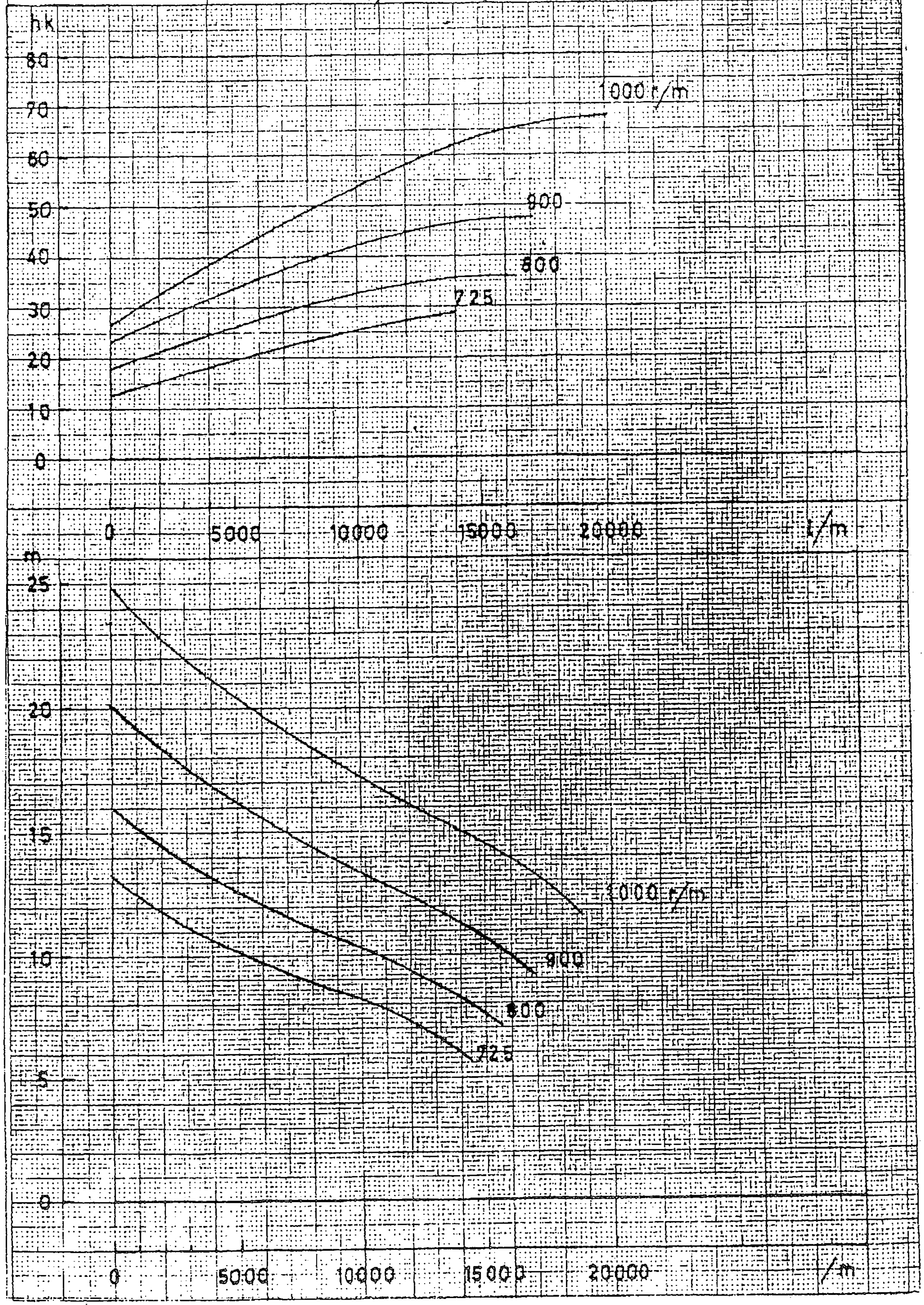
Regards

SALA

CENTRIFUGALPUMP
TYP ST-10103
impeller ϕ 400

10/07-10103

1000 - 725 r/m

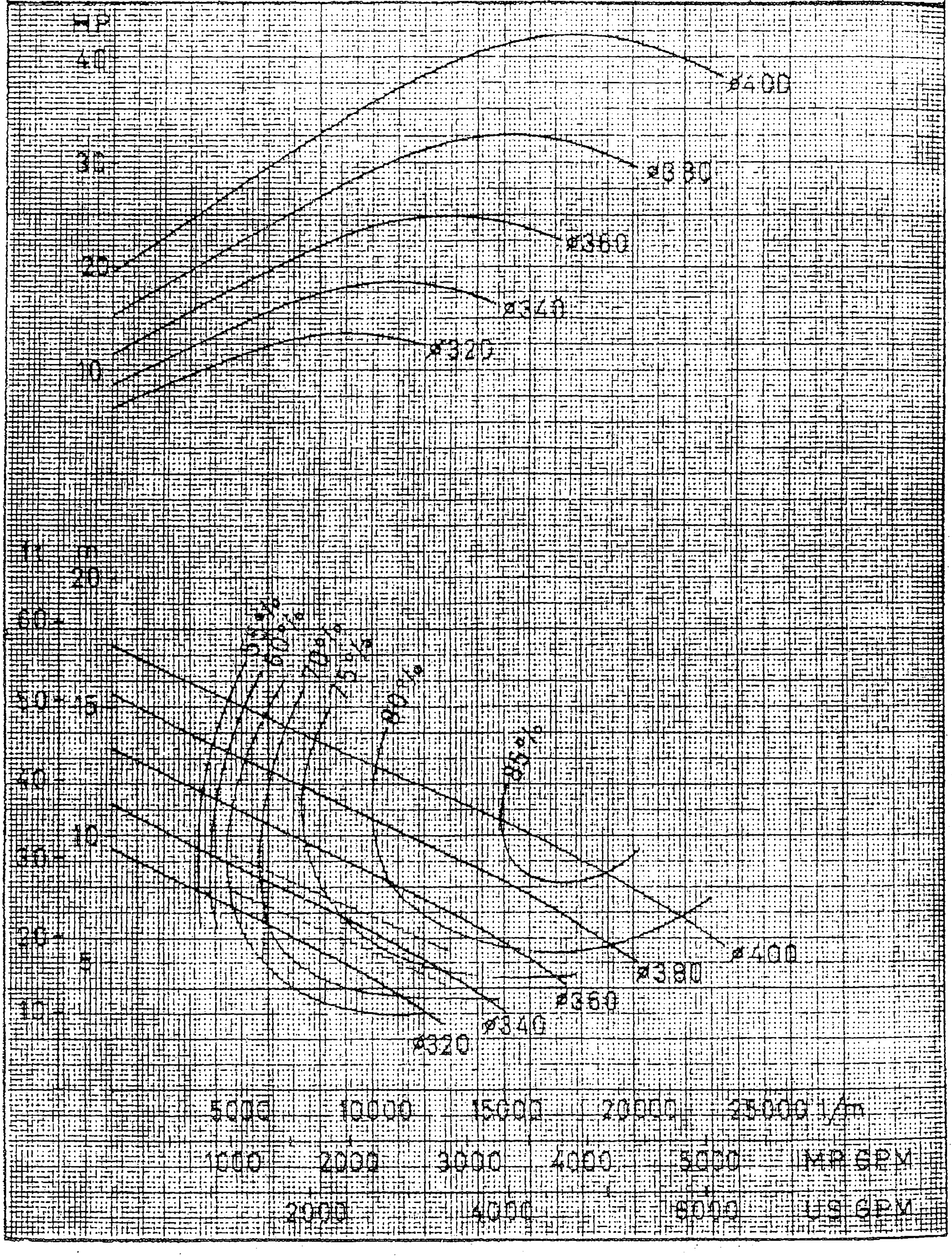


SALA

Sala Machine Works Ltd.
Mississauga, Ont.

ST 10103

870 RPM



SCOTT STREET PUMPING STATION

10" (250 mm) Pump 400 ϕ Imp.

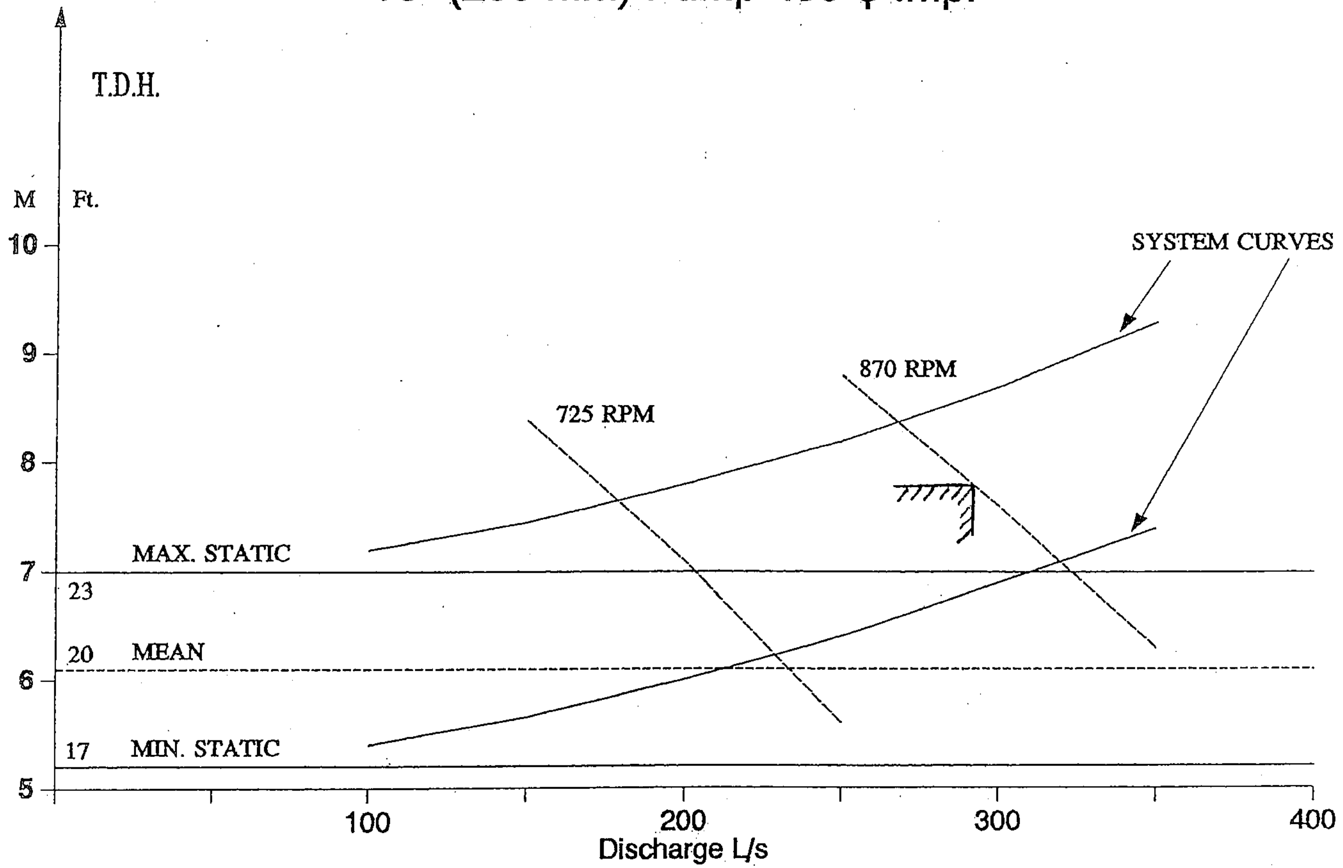


FIG. 289-80-01

G&S
Gore & Storrie Limited
Consulting Engineers

September 12, 1995

Mr. David R. Bailey
Acting Commissioner
Public Works and the Environment
City of Toronto
City Hall
100 Queen Street West
TORONTO, Ontario
M5H 2N2

Attention: Werner M. Wichmann, P.Eng.

Dear Mr. Bailey,

Re: Letter of Retention
Scott Street Pumping Station
Capacity Assessment

Enclosed is an original copy of the above-referenced letter, signed and witnessed, and with each page of Schedule "A" initialled, as required.

Yours very truly,

Janet Thompson
for
George G. Powell, P.Eng.
President

/jct

Encl.

Proj.No. 289.~~74~~ 80

255 Consumers Road, North York, Ontario M2J 5B6 Telephone: (416) 499-9000 Fax: (416) 499-4687

CITY OF
TORONTO

Public Works and the Environment

David R. Bailey
Acting Commissioner
Werner Wichmann, P. Eng.
Acting City Engineer

City Hall
Toronto, Ontario
M5H 2N2
Facsimile: (416) 392-0816

Address correspondence to the Acting Commissioner

Reply Attention: W. Wichmann

Dial Direct: 392-7701

August 29, 1995

Letter of Retention - Scott Street Pumping Station - Capacity Assessment

Mr. George Powell, P.Eng.,
President,
Gore & Storrie Limited,
255 Consumers Road,
4th Floor,
North York, Ontario.
M2J 5B6

Dear Mr. Powell:

I refer to your letter dated August 1, 1995 regarding the above.

Under the authority of the City of Toronto Municipal Code, Chapter 92 - Purchasing, I have been authorized to retain your company to provide consulting services in respect of the preparation of a report to evaluate the feasibility of increasing the capacity of the Scott Street Pumping Station. A complete description of services which you are to perform is set out in paragraph one of Schedule "A" attached hereto.

Your company will receive a fee in accordance with the current Schedule of Fees for Consulting Engineering Services, as recommended by the Association of Professional Engineers of the Province of Ontario, Fee Basis "A" - Time Plus Expenses, up to a maximum not exceeding $9,000.00 in return for the provision of such services; this amount represents the total fee which will be paid including any authorized disbursements and taxes (GST).

You may be dismissed by my Department at any time prior to the completion of the services with or without cause. In either case, you will receive payment proportionate to the services performed to the date your services are terminated or you are dismissed.

RECEIVED
SEP 5 1995
EXECUTIVE OFFICE

You will be required to indemnify the City against claims, actions, demands and expenses which are made or brought against you because of your failure to exercise reasonable care, skill or diligence in the performance of your services. A complete description of the indemnity which you are required to provide the City is set out in paragraph two of Schedule "A". If any subconsultants are retained by you, you will be responsible to the City for costs or damages arising from errors or omissions of such subconsultants, your agents or employees.

Upon completion of the services, early termination of the services or your dismissal, all material, information, studies, reports, designs, drawings, plans, etc. including all copyright therein shall become the sole property of the City. A complete description of the copyright provisions is set out in paragraph three of Schedule "A".

Confidential information obtained in connection with the fulfillment of the services shall not be disclosed in any manner without my approval as set out in paragraph four of Schedule "A".

You must also comply with the conditions of the Contract Compliance Programme of the City.

You must also maintain at your expense during the performance of the services, Comprehensive General Liability, Automobile, and Professional Liability policies of insurance in all respects and with deductible levels or self-retention amounts supported by financial guarantees satisfactory to the Commissioner of Finance and containing a $1,000,000.00 limit of coverage.

Schedule "A" forms part of this Letter of Retention.

If you are in agreement with the foregoing conditions, would you please execute and return one original copy of this Letter of Retention to me as soon as possible. Please ensure that each page of Schedule "A" is initialled.

I look forward to working with you on this project. Should you have any questions, please do not hesitate to contact D. Crichton of my Department at 392-7674.

Yours truly,

for Acting Commissioner.

_____vt
DSC

Attachment

I am in agreement with the preceding requirements and hereby agree to the terms of my retention.

Janet Thompson

Witness or
Corporate Seal

Powell

Mr. George Powell,
President,
Gore & Storrie Limited.

SCHEDULE "A"

1. The Consultant agrees to furnish and perform the services set out below:

Analyze the feasibility and cost of increasing the capacity of the Scott Street Pumping Station mechanical, electrical and pipe systems (without major structural modifications) to provide:

i. Additional capacity of 16.7 l/s to accommodate the proposed Raptor Stadium development; and

ii. Maximum additional capacity to accommodate new development in the drainage area of the Scott Street Pumping Station and to assist in utilizing only two (2) pumps during wet weather conditions and thereby keeping one pump as stand-by for emergency conditions (The City is also investigating Inflow/Infiltration flows to the station with a view of reducing wet weather flows).

The above analyses includes upgrades to the impellers and the pumps, piping, including the discharge forcemain and the electrical system are to be addressed. The Ministry of Labour regulations and any other approvals required for the upgrading are also to be addressed. The proposed tasks are as follows:

- Visit the Scott Street Pumping Station;
- Investigate suitable impellers and pumps;
- Assess the suitability of the wet well and pump operation at the higher expected flows;
- Assess the electrical requirements;
- Address Ministry of Labour requirements and other necessary approvals; and
- Prepare the report.

2. The Consultant hereby agrees, from time to time, and at all times hereafter, to well and truly save, keep harmless and fully indemnify the City, its successors and assigns, from and against all actions, claims and demands whatsoever which may be brought against or made upon the City and against all loss, liability, judgments, claims, costs, demands or expenses which the City may sustain, suffer or be put to resulting from or arising out of the Consultant's failure to exercise reasonable care, skill or diligence in the performance or rendering of any work or service required hereunder to be performed or rendered by the Consultant, its agents, employees or subconsultants or any of them.

Without limiting the generality of the foregoing, the Consultant hereby agrees to well and truly save, keep harmless and fully indemnify the City, its successors and assigns, from and against all actions, claims and demands whatsoever which may be brought against or made upon the City, its successors and assigns, for the infringement of or use of any intellectual property rights including any copyright or patent arising out of the reproduction or use in any manner of any plans, designs, drawings, specifications, information, negatives, data, material, sketches, notes, documents, memoranda or computer software furnished by the Consultant in the performance of the services.

For the purposes of this paragraph, "costs" shall mean those costs awarded in accordance with the order of a court of competent jurisdiction, the order of a board, tribunal or arbitrator or costs negotiated in the settlement of a claim or action.

3. Upon completion of the services, the early termination of the project or your dismissal, all information, negatives from original photography, computer software, data, material, sketches, plans, designs, notes, documents, memoranda, specifications or other paperwriting gathered, assembled or prepared by the Consultant, its employees, subconsultants or agents, for the purpose of the services, the "Material", shall thereupon become the sole property of the City including copyright with respect to all such Material. The Consultant represents and warrants to the City that it owns and/or shall own all copyright in the Material and no other person shall own any copyright therein. The Consultant does hereby transfer and assign and does hereby agree to transfer and assign and to sign all documents to give effect to such transfer and assignment to the City of all right, title and interest of the Consultant, including without limitation, all copyright in all the Material. The Consultant, its employees, subconsultants and agents shall forthwith deliver to the City any or all of the aforesaid subject matter and the City may use any such Material for the purposes of the services and for any other similar purpose determined by the Commissioner.

The Consultant waives in whole and in part any and all moral rights arising under the <u>Copyright Act</u> in the Material as against the City and anyone claiming rights of any such nature from or through the City. Further, the Consultant represents and warrants that its employees, subconsultants and agents have waived or shall waive in whole and in part any and all moral rights arising under the <u>Copyright Act</u> in the Material as against all parties including the Consultant and the City and anyone claiming rights of any such nature from or through the City.

The City hereby grants to the Consultant a non-exclusive, perpetual, irrevocable, paid-up, royalty-free license geographically limited to Canada, for the following uses only:

(a) to write, publish, distribute and sell books and articles dealing with the project;

(b) to promote itself as the creator of the project.

4. "Confidential Information" shall mean

(i) information disclosed to or obtained by the Consultant in connection with the fulfillment of the terms of this retainer and which has been identified by the City as information which should be treated as confidential;

(ii) all data, formulae, preliminary findings, and other material developed in pursuance of the project.

Upon termination or expiry of this retention, the Consultant shall return to the City all written or descriptive matter, including but not limited to drawings, prints, descriptions or other papers, documents or any other material which contains any Confidential Information.

Subject to the Freedom of Information and Protection of Individual Privacy Act and the Municipal Freedom of Information and Protection of Privacy Act and to any amendments thereto, and except as expressly provided in this paragraph, no Confidential Information shall be disclosed in any manner whatsoever without the approval in writing of the Commissioner, and

(a) the Consultant shall hold all Confidential Information obtained in trust and confidence for the City and shall not disclose any such Confidential Information, by publication or other means, to any person, company or other government agency nor use same for any other project other than for the benefit of the City as may be authorized by the Commissioner in writing;

(b) any request for such approval by the Commissioner shall specifically state the benefit to the City of disclosure of Confidential Information;

(c) any use of the Confidential Information shall be limited to the express purposes as set out in the approval of the Commissioner;

(d) the Consultant shall not, at any time during or after the term of this retention, use any Confidential Information for the benefit of anyone other than the City.

5. The Consultant also agrees, if required by the Commissioner, to provide insurance in an amount and form satisfactory to the Commissioner of Finance.

Appendix 3c

List of Utilized Plan/Profile Drawings

TMIG Drawing #	Date	Drawing Prepared By	Contract Number	Drawing Number	Sheet Number	Status	Street Name	From	To	Information Contained on Drawing (X = Detailed, + = Also on Plan)						Other
										Sanitay	Storm	Combined Sewer	Watermain	Gas Main	T.H.E.S Conduits	
1	Mar, 1930	City of Toronto		N-61		As-Constructed	Wilton Street	Church Street	Berkeley Street	X	X				+	
2	1901	City of Toronto				As-Constructed	Jarvis Street	The Esplanade	Charles Street	X	X	X				
3	1885-1901					As-Constructed	The Esplanade	Yonge Street	Parliament Street	+	+	+				
4	1925	City of Toronto				As-Constructed	Wilton Street	Church Street	Sherbourne Street	X	X					
4	1925	City of Toronto				As-Constructed	Sherbourne Street	Queens Quay	Wilton Street			X				
4	1925	City of Toronto				As-Constructed	Wilton Street	Sherbourne Street	Berkeley Street			X				
5	Jan, 1973		58522	J-53			Jarvis Street	Front Street	Queen Street	+	X		+	+	+	Cables and Conduits
6	July, 1930	City of Toronto		Q-31		As-Constructed	Queens Quay	John Street	Parliament Street	X	X					
7	Aug, 1977	City of Toronto	58746	R-522		As-Constructed	Wilton Street	Jarvis Street	Sherbourne Street	+	+		X			
8				SK-1625			Intersection of The Esplanade and Sherbourne			+	+		+			
9	Feb, 1996	City of Toronto	58490	E-260			The Esplanade	Church Street	Scott Street	+	X	+	+	+	+	Cables and Conduits
10	May, 1997	City of Toronto	58515	E261			The Esplanade	Church Street	Market Street	+	X	+	+	+	+	Cables and Conduits
11	August, 1980	City of Toronto	58820	E-222			The Esplanade	Princess Street	Berkeley Street	+	X		+	+	+	Cables and Conduits
12	October, 1980	City of Toronto		E-224			The Esplanade	Yonge Street	Scott Street	X	+		+	+	+	Cables and Conduits
13	? 1940 ?	City of Toronto					The Esplanade	Princess Street	Scott Street	X			+	+		
14	March, 1930	City of Toronto		S-146		As-Constructed	Sherbourne Street	Wilton Street	Queens Quay	X	+					
15	October, 1930	City of Toronto		S-200		As-Constructed	Sherbourne Street	Front Street	The Esplanade	X	+		+			
16	Sept, 2002	R.V. Anderson Associates Limited	02D1-81WS	U-3876-001			Sherbourne Street	Front Street	The Esplanade	+	+	+	X	+	+	Cables and Conduits
17	July, 1930	City of Toronto		J-37		As-Constructed	Jarvis Street	The Esplanade	Queens Quay	X	X		+	+	+	
18	June, 1926	City of Toronto		B-226		As-Constructed	Parliament Outlet			+	X					
19	October, 1952	City of Toronto		S-224			Small Street Outlet				X					
20	Aug, 1930	City of Toronto		B-115		As-Constructed	Small Street	Queens Quay	Lakeshore	X	+		+			
21	March, 1929	City of Toronto		P-102		As-Constructed	BonnyCastle	Queens Quay	Wilton Street	X	X		+			
22	Aug, 1930	City of Toronto		G-164		As-Constructed	Richardson	Queens Quay	Wilton Street	X	X		+			
23	June, 1930	City of Toronto		C-234		As-Constructed	Copper Street	Queens Quay	Wilton Street	X	X		+			
24	Aug, 1930	City of Toronto				As-Constructed	Freeland Street	Queens Quay	Wilton Street	X	X		+			
25	Nov, 1946			W-D-20			Freeland Street	Queens Quay	Lakeshore	+	+		X			
26	Feb, 2000	City of Toronto	00D1-07WP	S-453			Scott Street	The Esplanade	Front Street	X	+	+	+	+	+	Cables and Conduits
27	Jan, 1970	Municipality of Metropolitan Toronto	D-4-75	1269-D-8586	P5	N	Scott Street	The Esplanade	Wellington Street	+	+		+		+	Cables and Conduits
28	Jan, 1970	Municipality of Metropolitan Toronto	D-4-75	1269-D-8588	P7	N	Intersection of Front and Scott			+	+	+	+	+	+	Cables and Conduits
29	Oct, 1914	City of Toronto					Scott Street	Front Street	The Esplanade		X			+	+	Cables and Conduits
30	May, 1962	Municipality of Metropolitan Toronto		L-180-11	P-1082-230	As-Constructed	Gardiner Expressway	Jarvis Street	Parliament Street	+	+		+			
31	May, 1962	Municipality of Metropolitan Toronto		L-180-10	P-1082-229	As-Constructed	Gardiner Expressway	Jarvis Street	Parliament Street	+	+		+	+		
32	Mar, 1963	Municipality of Metropolitan Toronto		L-180-9	P-1082-259	As-Constructed	Gardiner Expressway	York Street	Jarvis Street	+	+		+	+		
33	October, 1962	Municipality of Metropolitan Toronto		L-180-27	U-110-61A	As-Constructed	Gardiner Expressway	York Street	Jarvis Street	X	X					
34	March, 1963	Municipality of Metropolitan Toronto		L-180-6	P-1082-256	As-Constructed	Gardiner Expressway	York Street	Jarvis Street	+	+		+	+		
35	March, 1963	Municipality of Metropolitan Toronto		L-180-5	P-1082-255	As-Constructed	Gardiner Expressway	York Street	Jarvis Street	+	+		+			
36	March, 1963	Municipality of Metropolitan Toronto		L-180-7	P-1082-257	As-Constructed	Gardiner Expressway	York Street	Jarvis Street	+	+		+			
37	March, 1963	Municipality of Metropolitan Toronto		L-180-8	P-1082-258	As-Constructed	Gardiner Expressway	York Street	Jarvis Street	+	+		+	+		
38	April, 1960	Municipality of Metropolitan Toronto		L-180-22	U-110-57	As-Constructed	Gardiner Expressway	Jarvis Street	Parliament Street	X	X					
39	Dec, 1962	Municipality of Metropolitan Toronto		L-180-25	U-110-60	As-Constructed	Gardiner Expressway	York Street	Jarvis Street	X	X					
40	Dec, 1961	Municipality of Metropolitan Toronto		L-180-14	P-1082-201	As-Constructed	Gardiner Expressway	Parliament Street	Cherry Street	+	+		+	+		
41	Dec, 1961	Municipality of Metropolitan Toronto		L-180-15	P-1082-202	As-Constructed	Gardiner Expressway	Parliament Street	Cherry Street	+	+		+	+		
42	Jan, 1962	Municipality of Metropolitan Toronto		L-180-19	U-110-54		Gardiner Expressway	Parliament Street	Cherry Street	X	X					
43	May, 1962	Municipality of Metropolitan Toronto		L-180-12	P-1082-231	As-Constructed	Gardiner Expressway	Jarvis Street	Parliament Street	+	+		+	+		
44	May, 1962	Municipality of Metropolitan Toronto		L-180-13	P-1082-232	As-Constructed	Gardiner Expressway	Jarvis Street	Parliament Street	+	+		+	+		
45	May, 1997	City of Toronto	58515	M-379			Market Street	Front Street	The Esplanade		X	+	+	+	+	Cables and Conduits
46	Aug, 1930	City of Toronto		M-171		As-Constructed	Market Street	Wilton Street	South Limit	X	X					

TMIG Drawing #	Other Drawing #	Project Number	Drawing Prepared By:	Date	Drawing Indicates "As Constructed"?	Street Name	From	To	Information Contained on Drawing (X = Detailed, + = Also on Plan) Sanitay	Storm	Combined Sewer	Watermain	Gas Main	T.H.E.S Conduits	Other
1	N-61			Mar, 1930	Y	Wilton Street	Church Street	Berkeley Street	X	X				+	
2				1901	Y	Jarvis Street	The Esplanade	Charles Street	X	X	X				
3				1885-1901	Y	The Esplanade	Yonge Street	Parliament Street	+	+	+				
4				1925	Y	Wilton Street	Church Street	Sherbourne Street	X	X					
4				1925	Y	Sherbourne Street	Queens Quay	Wilton Street			X				
4				1925	Y	Wilton Street	Sherbourne Street	Berkeley Street			X				
5	J-53			Jan, 1973		Jarvis Street	Front Street	Queen Street	+	X		+	+	+	Cables and Conduits
6	Q-31			July, 1930	Y	Queens Quay	John Street	Parliament Street	X	X					
7	R-522			Aug, 1977	Y	Wilton Street	Jarvis Street	Sherbourne Street	+	+		X			
8	SK-1625						Intersection of The Esplanade and Sherbourne		+	+		+			
9	E-260			Feb, 1996		The Esplanade	Church Street	Scott Street	+	X	+	+	+	+	Cables and Conduits
10	E261			May, 1997		The Esplanade	Church Street	Market Street	+	X	+	+	+	+	Cables and Conduits
11	E-222			August, 1980		The Esplanade	Princess Street	Berkeley Street	+	X		+	+	+	Cables and Conduits
12	E-224			October, 1980		The Esplanade	Yonge Street	Scott Street	X	+		+	+	+	Cables and Conduits
13				? 1940 ?		The Esplanade	Princess Street	Scott Street	X			+	+		
14	S-146			March, 1930	Y	Sherbourne Street	Wilton Street	Queens Quay	X	+					
15	S-200			October, 1930	Y	Sherbourne Street	Front Street	The Esplanade	X	+		+			
16	U-3876-001			Sept, 2002		Sherbourne Street	Front Street	The Esplanade	+	+	+	X	+	+	Cables and Conduits
17	J-37			July, 1930	Y	Jarvis Street	The Esplanade	Queens Quay	X	X		+	+	+	
18	B-226			June, 1926	Y	Parliament Outlet			+	X					
19	S-224			October, 1952		Small Street Outlet				X					
20	B-115			Aug, 1930	Y	Small Street	Queens Quay	Lakeshore	X	+		+			
21	P-102			March, 1929	Y	BonnyCastle	Queens Quay	Wilton Street	X	X		+			
22	G-164			Aug, 1930	Y	Richardson	Queens Quay	Wilton Street	X	X		+			
23	C-234			June, 1930	Y	Copper Street	Queens Quay	Wilton Street	X	X		+			
24				Aug, 1930	Y	Freeland Street	Queens Quay	Wilton Street	X	X		+			
25	W-D-20			Nov, 1946		Freeland Street	Queens Quay	Lakeshore	+	+		X			
26	S-453			Feb, 2000		Scott Street	The Esplanade	Front Street	X	+	+	+	+	+	Cables and Conduits
27	1269-D-8586			Jan, 1970	N	Scott Street	The Esplanade	Wellington Street	+	+		+		+	Cables and Conduits
28	1269-D-8588			Jan, 1970	N		Intersection of Front and Scott		+	+	+	+	+	+	Cables and Conduits
29				Oct, 1914		Scott Street	Front Street	The Esplanade		X			+	+	Cables and Conduits
30	L-180-11			May, 1962	Y	Gardiner Expressway	Jarvis Street	Parliament Street	+	+		+			
31	L-180-10			May, 1962	Y	Gardiner Expressway	Jarvis Street	Parliament Street	+	+		+	+		
32	I-180-9			Mar, 1963	Y	Gardiner Expressway	York Street	Jarvis Street	+	+		+	+		
33	L-180-27			October, 1962	Y	Gardiner Expressway	York Street	Jarvis Street	X	X					
34	L-180-6			March, 1963	Y	Gardiner Expressway	York Street	Jarvis Street	+	+		+	+		
35	L-180-5			March, 1963	Y	Gardiner Expressway	York Street	Jarvis Street	+	+		+			
36	L-180-7			March, 1963	Y	Gardiner Expressway	York Street	Jarvis Street	+	+		+			
37	L-180-8			March, 1963	Y	Gardiner Expressway	York Street	Jarvis Street	+	+		+	+		
38	L-180-22			April, 1960	Y	Gardiner Expressway	Jarvis Street	Parliament Street	X	X					
39	L-180-25			Dec, 1962	Y	Gardiner Expressway	York Street	Jarvis Street	X	X					
40	L-180-14			Dec, 1961	Y	Gardiner Expressway	Parliament Street	Cherry Street	+	+		+	+		
41	L-180-15			Dec, 1961	Y	Gardiner Expressway	Parliament Street	Cherry Street	+	+		+	+		
42	L-180-19			Jan, 1962		Gardiner Expressway	Parliament Street	Cherry Street	X	X					
43	L-180-12			May, 1962	Y	Gardiner Expressway	Jarvis Street	Parliament Street	+	+		+	+		
44	L-180-13			May, 1962	Y	Gardiner Expressway	Jarvis Street	Parliament Street	+	+		+	+		
45	M-379			May, 1997		Market Street	Front Street	The Esplanade		X	+	+	+	+	Cables and Conduits
46	M-171			Aug, 1930	Y	Market Street	Wilton Street	South Limit	X	X					

PRELIMINARY

Appendix 3d

Hydraulic Gradeline Analysis

RE-CALCULATION OF REQUIRED PIPE DIAMETERS

Scenario: Existing
Starting Link: 3165 (Queen's Quay, west of Sherbourne)

	EXISTING PIPE									NEW PIPE							BENEFIT TO EXISTING		
Pipe	Length	Diam	Area	Slope	n	Capacity	Q_{ADD}	$Cap_{80\%}$	$CAP_{REQ'D}$	$Slope_{NEW}$	n_{NEW}	$D_{REQ'D}$	D_{NEW}	$Area_{NEW}$	Cap_{NEW}	% Full	Cap_{EXIST}	Cap_{INCR}	Cap_{INCR}
-	[m]	[m]	[m²]	[%]	-	[L/s]	[L/s]	[L/s]	[L/s]	[%]	-	[m]	[m]	[m²]	[L/s]		[L/s]	[L/s]	[%]
3165	55.5	0.300	0.071	0.01	0.013	7		4	5	0.01	0.013	0.263	0.300	0.071	7	56.26%	7	0	0%
3166	61.0	0.300	0.071	0.25	0.013	24		4	5	0.25	0.013	0.250	0.300	0.071	48	10.32%	48	25	106%
3167	91.4	0.300	0.071	0.27	0.013	24		4	5	0.27	0.013	0.250	0.300	0.071	50	10.01%	50	26	112%
3168	84.7	0.300	0.071	0.31	0.013	24		4	5	0.31	0.013	0.250	0.300	0.071	54	9.24%	54	31	130%
3169	12.2	0.300	0.071	0.32	0.013	24		4	5	0.32	0.013	0.250	0.300	0.071	55	9.15%	55	31	132%
3173	39.6	0.300	0.071	0.11	0.013	24		31	38	0.11	0.013	0.321	0.300	0.071	32	120.17%	32	8	35%
3174	45.7	0.300	0.071	0.25	0.013	24		31	38	0.25	0.013	0.300	0.300	0.071	49	78.60%	49	25	107%
3175	16.8	0.300	0.071	0.27	0.013	24		31	38	0.27	0.013	0.300	0.300	0.071	51	75.68%	51	27	115%
3176	7.6	0.300	0.071	0.28	0.013	24		31	38	0.28	0.013	0.300	0.300	0.071	51	75.33%	51	27	116%
3177	50.3	0.300	0.071	0.26	0.013	24		31	38	0.26	0.013	0.300	0.300	0.071	49	77.59%	49	26	110%
3178	12.2	0.300	0.071	0.30	0.013	24		31	38	0.30	0.013	0.300	0.300	0.071	53	71.91%	53	30	126%
3181	15.2	0.300	0.071	0.40	0.013	24		31	38	0.40	0.013	0.300	0.300	0.071	61	62.51%	61	38	160%
3189	72.5	0.300	0.071	0.37	0.013	24		66	82	0.37	0.013	0.375	0.300	0.071	59	138.95%	59	36	151%
3190	77.7	0.300	0.071	0.29	0.013	24		66	82	0.29	0.013	0.375	0.300	0.071	52	156.83%	52	29	123%
3191	85.0	0.300	0.071	0.27	0.013	24		66	82	0.27	0.013	0.375	0.300	0.071	50	163.67%	50	27	113%
3192	15.2	0.300	0.071	0.06	0.013	24		66	82	0.06	0.013	0.479	0.300	0.071	24	349.13%	24	0	0%
3193	57.9	0.460	0.166	0.14	0.013	99		204	255	0.14	0.013	0.623	0.460	0.166	114	224.31%	114	15	15%
6159	40.2	0.460	0.166	0.11	0.013	99		204	255	0.11	0.013	0.675	0.460	0.166	99	258.11%	99	0	0%
6160	3.7	0.460	0.166	0.41	0.013	150		204	255	0.41	0.013	0.675	0.460	0.166	192	132.58%	192	42	28%
6161	34.4	0.460	0.166	0.25	0.013	150		204	255	0.25	0.013	0.675	0.460	0.166	150	169.82%	150	0	0%
6162	91.4	0.460	0.166	0.33	0.013	170		204	255	0.33	0.013	0.675	0.460	0.166	175	146.13%	175	5	3%
6163	28.6	0.460	0.166	0.41	0.013	170		204	255	0.41	0.013	0.675	0.460	0.166	193	132.55%	193	23	14%
6164	112.2	0.460	0.166	0.33	0.013	170		219	274	0.33	0.013	0.675	0.460	0.166	173	158.86%	173	3	2%
6165	61.0	0.460	0.166	0.31	0.013	170		219	274	0.31	0.013	0.675	0.460	0.166	170	161.72%	170	0	0%
6166	19.8	0.460	0.166	0.84	0.013	278		219	274	0.84	0.013	0.675	0.460	0.166	278	98.79%	278	0	0%
6169	32.0	1.070	0.899	1.08	0.013	4848		397	496	1.08	0.013	0.675	1.070	0.899	2982	16.63%	2982	-1866	-38%

							Min							Min
				Existing Pipe			2.5			New Pipe				2.5
		Station	Invert	Obvert	HGL	Ground Lvl	Cover		Invert	Obvert	HGL	Ground Lvl	Cover	
3165U	3165	1223.8	74.47	74.77	75.02	77.07	74.57	2.05	75.14	75.44	75.43	77.07	74.57	
3165D		1168.3	74.47	74.77	75.02	77.22	74.72		75.13	75.43	75.43	77.22	74.72	
3166U	3166	1168.3	74.47	74.77	75.02	77.22	74.72		75.10	75.40	75.25	77.22	74.72	
3166D		1107.3	74.31	74.61	75.02	76.87	74.37		74.95	75.25	75.25	76.87	74.37	
3167U	3167	1107.3	74.31	74.61	75.02	76.87	74.37		74.92	75.22	75.07	76.87	74.37	
3167D		1015.9	74.07	74.37	75.02	76.96	74.46		74.68	74.98	75.07	76.96	74.46	
3168U	3168	1015.9	74.07	74.37	75.02	76.96	74.46		74.65	74.95	75.07	76.96	74.46	
3168D		931.2	73.80	74.10	75.02	77.07	74.57		74.38	74.68	75.07	77.07	74.57	
3169U	3169	931.2	73.80	74.10	75.02	77.07	74.57		74.35	74.65	75.07	77.07	74.57	
3169D		919.0	73.77	74.07	75.02	77.01	74.51		74.31	74.61	75.07	77.01	74.51	
3173U	3173	919.0	73.70	74.00	75.02	77.01	74.51		74.28	74.58	75.07	77.01	74.51	
3173D		879.4	73.66	73.96	74.98	76.89	74.39		74.24	74.54	75.03	76.89	74.39	
3174U	3174	879.4	73.59	73.89	74.98	76.89	74.39		74.21	74.51	75.03	76.89	74.39	
3174D		833.7	73.48	73.78	74.93	76.90	74.40		74.09	74.39	74.99	76.90	74.40	
3175U	3175	833.7	73.48	73.78	74.93	76.90	74.40		74.06	74.36	74.99	76.90	74.40	
3175D		816.9	73.43	73.73	74.91	76.94	74.44		74.02	74.32	74.97	76.94	74.44	
3176U	3176	816.9	73.43	73.73	74.91	76.94	74.44		73.99	74.29	74.97	76.94	74.44	
3176D		809.3	73.41	73.71	74.91	76.94	74.44		73.97	74.27	74.96	76.94	74.44	
3177U	3177	809.3	73.41	73.71	74.91	76.94	74.44		73.94	74.24	74.96	76.94	74.44	
3177D		759.0	73.28	73.58	74.86	76.79	74.29		73.80	74.10	74.91	76.79	74.29	
3178U	3178	759.0	73.28	73.58	74.86	76.79	74.29		73.77	74.07	74.91	76.79	74.29	
3178D		746.8	73.24	73.54	74.84	76.83	74.33		73.74	74.04	74.90	76.83	74.33	
3181U	3181	746.8	73.24	73.54	74.84	76.83	74.33		73.71	74.01	74.90	76.83	74.33	
3181D		731.6	73.18	73.48	74.83	76.83	74.33		73.65	73.95	74.88	76.83	74.33	
3189U	3189	731.6	73.18	73.48	74.83	76.83	74.33		73.62	73.92	74.88	76.83	74.33	
3189D		659.1	72.91	73.21	74.49	76.84	74.34		73.35	73.65	74.55	76.84	74.34	
3190U	3190	659.1	72.91	73.21	74.49	76.84	74.34		73.32	73.62	74.55	76.84	74.34	
3190D		581.4	72.68	72.98	74.13	77.75	75.25		73.09	73.39	74.19	77.75	75.25	
3191U	3191	581.4	72.68	72.98	74.13	77.75	75.25		73.06	73.36	74.19	77.75	75.25	
3191D		496.4	72.45	72.75	73.74	77.18	74.68		72.83	73.13	73.80	77.18	74.68	
3192U	3192	496.4	72.45	72.75	73.74	77.18	74.68		72.80	73.10	73.80	77.18	74.68	
3192D		481.2	72.45	72.75	73.67	77.38	74.88		72.79	73.09	73.73	77.38	74.88	
3193U	3193	481.2	72.34	72.80	73.67	77.38	74.88		72.60	73.06	73.73	77.38	74.88	
3193D		423.3	72.25	72.71	73.41	77.28	74.78		72.52	72.98	73.46	77.28	74.78	
6159U	6159	423.3	72.25	72.71	73.41	77.28	74.78		72.49	72.95	73.46	77.28	74.78	
6159D		383.1	72.21	72.67	73.22	76.98	74.48		72.44	72.90	73.28	76.98	74.48	
6160U	6160	383.1	72.21	72.67	73.22	76.98	74.48		72.41	72.87	73.28	76.98	74.48	
6160D		379.4	72.20	72.66	73.21	76.92	74.42		72.40	72.86	73.26	76.92	74.42	
6161U	6161	379.4	72.20	72.66	73.21	76.92	74.42		72.37	72.83	73.26	76.92	74.42	
6161D		345.0	72.11	72.57	73.05	76.99	74.49		72.28	72.74	73.10	76.99	74.49	
6162U	6162	345.0	72.11	72.57	73.05	76.99	74.49		72.25	72.71	73.10	76.99	74.49	
6162D		253.6	71.81	72.27	72.63	76.99	74.49		71.95	72.41	72.69	76.99	74.49	
6163U	6163	253.6	71.81	72.27	72.63	76.99	74.49		71.92	72.38	72.69	76.99	74.49	
6163D		225.0	71.69	72.15	72.50	76.87	74.37		71.80	72.26	72.56	76.87	74.37	
6164U	6164	225.0	71.69	72.15	72.50	76.87	74.37		71.77	72.23	72.56	76.87	74.37	
6164D		112.8	71.32	71.78	71.91	76.77	74.27		71.41	71.87	71.97	76.77	74.27	
6165U	6165	112.8	71.32	71.78	71.91	76.77	74.27		71.38	71.84	71.97	76.77	74.27	
6165D		51.8	71.13	71.59	71.59	76.68	74.18		71.19	71.65	71.65	76.68	74.18	
6166U	6166	51.8	71.13	71.59	71.53	76.68	74.18		71.16	71.62	71.55	76.68	74.18	
6166D		32.0	70.96	71.42	71.42	76.69	74.19		70.99	71.45	71.45	76.69	74.19	
6169U	6169	32.0	70.35	71.42	71.08	76.69	74.19		70.35	71.42	71.08	76.69	74.19	
6169D		0.0	70.00	71.07	71.07	77.01	74.51		70.00	71.07	71.07	77.01	74.51	

HGL ANALYSIS

Legend:	71.073	Equal to pipe obvert
	472	Bad data - Needs to be revised
	70.003	Input

Additional Point Load: 0 L/s
Outlet Control? Yes

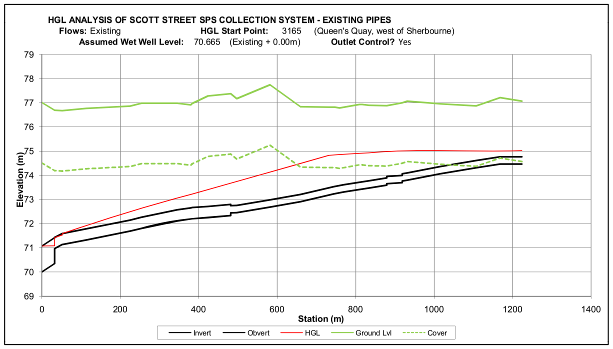
	EXISTING PIPE											
Pipe	$Invert_{DS}$	$Obvert_{DS}$	HGL_{DS}	Q_{MODEL}	Q_{TMIG}	S_{HGL}	d_s	Ground Lvl	Cover	Velocity	h_f	HGL_{US}
-	[m]	[m]	[m]	[L/s]	[L/s]	[%]	[m]	[m]	[m]	[m/s]	[m]	[m]
3165	74.466	74.766	75.021	0	4	0.00	0.25	77.07	2.05	0.06	0.001	75.022
3166	74.313	74.613	75.020	0	4	0.00	0.41	77.22	2.19	0.06	0.001	75.021
3167	74.069	74.369	75.018	0	4	0.00	0.65	76.87	1.85	0.06	0.002	75.020
3168	73.804	74.104	75.017	0	4	0.00	0.91	76.96	1.94	0.06	0.001	75.018
3169	73.765	74.065	75.017	0	4	0.00	0.95	77.07	2.05	0.06	0.000	75.017
3173	73.655	73.955	74.977	10	31	0.10	1.02	77.01	1.99	0.43	0.040	75.017
3174	73.478	73.778	74.931	11	31	0.10	1.15	76.89	1.91	0.43	0.046	74.977
3175	73.432	73.732	74.914	11	31	0.10	1.18	76.90	1.97	0.43	0.017	74.931
3176	73.411	73.711	74.907	11	31	0.10	1.20	76.94	2.02	0.43	0.008	74.914
3177	73.280	73.580	74.856	13	31	0.10	1.28	76.94	2.03	0.43	0.050	74.907
3178	73.243	73.543	74.844	15	31	0.10	1.30	76.79	1.94	0.43	0.012	74.856
3181	73.182	73.482	74.829	27	31	0.10	1.35	76.83	1.98	0.43	0.015	74.844
3189	72.911	73.211	74.494	45	66	0.46	1.28	76.83	2.00	0.93	0.335	74.829
3190	72.683	72.983	74.135	45	66	0.46	1.15	76.84	2.35	0.93	0.359	74.494
3191	72.454	72.754	73.742	45	66	0.46	0.99	77.75	3.61	0.93	0.393	74.135
3192	72.445	72.745	73.672	45	66	0.46	0.93	77.18	3.44	0.93	0.070	73.742
3193	72.253	72.713	73.408	110	204	0.46	0.69	77.38	3.71	1.23	0.264	73.672
6159	72.210	72.670	73.225	111	204	0.46	0.55	77.28	3.87	1.23	0.183	73.408
6160	72.195	72.655	73.208	112	204	0.46	0.55	76.98	3.76	1.23	0.017	73.225
6161	72.110	72.570	73.051	230	204	0.46	0.48	76.92	3.71	1.23	0.157	73.208
6162	71.805	72.265	72.634	230	204	0.46	0.37	76.99	3.94	1.23	0.417	73.051
6163	71.689	72.149	72.504	230	204	0.46	0.35	76.99	4.35	1.23	0.130	72.634
6164	71.323	71.783	71.912	230	219	0.53	0.13	76.87	4.37	1.32	0.591	72.504
6165	71.131	71.591	71.591	230	219	0.53	0.00	76.77	4.86	1.32	0.321	71.912
6166	70.964	71.424	71.424	229	219	0.53	0.00	76.68	5.15	1.32	0.104	71.528
6169	70.003	71.073	71.073	472	397	0.02	0.00	76.69	5.61	0.44	0.006	71.079

Assumed Wet Well Elevation: 70.665

Additional Point Load: 0 L/s
Outlet Control? Yes

NEW PIPE							
$Invert_{DS}$	$Obvert_{DS}$	HGL_{DS}	Q_{MODEL}	Q_{TMIG}	S_{HGL}	h_f	HGL_{US}
[m]	[m]	[m]	[L/s]	[L/s]	[%]	[m]	[m]
75.132	75.432	75.432	0	4	0.00	0.001	75.433
74.949	75.249	75.249	0	4	0.00	0.001	75.250
74.675	74.975	75.072	0	4	0.00	0.002	75.074
74.380	74.680	75.071	0	4	0.00	0.001	75.072
74.311	74.611	75.071	0	4	0.00	0.000	75.071
74.238	74.538	75.031	10	31	0.10	0.040	75.071
74.092	74.392	74.985	11	31	0.10	0.046	75.031
74.016	74.316	74.968	11	31	0.10	0.017	74.985
73.965	74.265	74.961	11	31	0.10	0.008	74.968
73.804	74.104	74.910	13	31	0.10	0.050	74.961
73.737	74.037	74.898	15	31	0.10	0.012	74.910
73.646	73.946	74.883	27	31	0.10	0.015	74.898
73.345	73.645	74.548	45	66	0.46	0.335	74.883
73.087	73.387	74.189	45	66	0.46	0.359	74.548
72.828	73.128	73.796	45	66	0.46	0.393	74.189
72.789	73.089	73.726	45	66	0.46	0.070	73.796
72.517	72.977	73.462	110	204	0.46	0.264	73.726
72.444	72.904	73.279	111	204	0.46	0.183	73.462
72.399	72.859	73.262	112	204	0.46	0.017	73.279
72.284	72.744	73.105	230	204	0.46	0.157	73.262
71.949	72.409	72.688	230	204	0.46	0.417	73.105
71.803	72.263	72.558	230	204	0.46	0.130	72.688
71.407	71.867	71.966	230	219	0.53	0.591	72.558
71.185	71.645	71.645	230	219	0.53	0.321	71.966
70.988	71.448	71.448	229	219	0.53	0.104	71.552
70.003	71.073	71.073	472	397	0.02	0.006	71.079

Assumed Wet Well Elevation: 70.665



HGL ANALYSIS OF SCOTT STREET SPS COLLECTION SYSTEM - EXISTING PIPES
Flows: Existing **HGL Start Point:** 3165 (Queen's Quay, west of Sherbourne)
Assumed Wet Well Level: 70.665 (Existing + 0.00m) **Outlet Control?** Yes

RE-CALCULATION OF REQUIRED PIPE DIAMETERS

Scenario: Corus-Jarvis
Starting Link: 3165 (Queen's Quay, west of Sherbourne)

Pipe	Length	Diam	Area	Slope	n	Capacity	Q$_{ADD}$	Cap$_{80\%}$	CAP$_{REQ'D}$	Slope$_{NEW}$	n$_{NEW}$	Upgrade	D$_{NEW}$	Area$_{NEW}$	Cap$_{NEW}$	% Full	Cap$_{EXIST}$	Cap$_{INCR}$	Cap$_{INCR}$
		EXISTING PIPE								NEW PIPE							BENEFIT TO EXISTING		
-	[m]	[m]	[m²]	[%]	-	[L/s]	[L/s]	[L/s]	[L/s]	[%]	-	???	[m]	[m²]	[L/s]		[L/s]	[L/s]	[%]
3165	55.5	0.300	0.071	0.01	0.013	7		3	3	0.005	0.013	N	0.300	0.071	7	46.83%	7	0	0%
3166	61.0	0.300	0.071	0.25	0.013	24		3	3	0.251	0.013	N	0.300	0.071	48	6.87%	48	25	106%
3167	91.4	0.300	0.071	0.27	0.013	24		3	3	0.267	0.013	N	0.300	0.071	50	6.66%	50	26	112%
3168	84.7	0.300	0.071	0.31	0.013	24		24	24	0.313	0.013	N	0.300	0.071	54	43.51%	54	31	130%
3169	12.2	0.300	0.071	0.32	0.013	24		24	24	0.320	0.013	N	0.300	0.071	55	43.05%	55	31	132%
3173	39.6	0.300	0.071	0.11	0.013	24		49	49	0.109	0.013	N	0.300	0.071	32	154.70%	32	8	35%
3174	45.7	0.300	0.071	0.25	0.013	24		49	49	0.254	0.013	N	0.300	0.071	49	101.18%	49	25	107%
3175	16.8	0.300	0.071	0.27	0.013	24		49	49	0.274	0.013	N	0.300	0.071	51	97.42%	51	27	115%
3176	7.6	0.300	0.071	0.28	0.013	24		49	49	0.276	0.013	N	0.300	0.071	51	96.98%	51	27	116%
3177	50.3	0.300	0.071	0.26	0.013	24		49	49	0.260	0.013	N	0.300	0.071	49	99.89%	49	26	110%
3178	12.2	0.300	0.071	0.30	0.013	24		49	49	0.303	0.013	N	0.300	0.071	53	92.57%	53	30	126%
3181	15.2	0.300	0.071	0.40	0.013	24		49	49	0.401	0.013	N	0.300	0.071	61	80.47%	61	38	160%
3189	72.5	0.300	0.071	0.37	0.013	24		85	85	0.374	0.013	N	0.300	0.071	59	142.93%	59	36	151%
3190	77.7	0.300	0.071	0.29	0.013	24		85	85	0.293	0.013	N	0.300	0.071	52	161.32%	52	29	123%
3191	85.0	0.300	0.071	0.27	0.013	24		85	85	0.200	0.013	Y	0.762	0.456	519	16.27%	519	496	2107%
3192	15.2	0.300	0.071	0.06	0.013	24		85	85	0.200	0.013	Y	0.762	0.456	519	16.27%	519	496	2107%
3193	57.9	0.450	0.159	0.14	0.013	99		231	231	0.200	0.013	Y	0.762	0.456	519	44.57%	519	421	425%
6159	40.2	0.450	0.159	0.11	0.013	99		231	231	0.200	0.013	Y	0.762	0.456	519	44.57%	519	421	425%
6160	3.7	0.450	0.159	0.41	0.013	150		231	231	0.200	0.013	Y	0.762	0.456	519	44.57%	519	369	246%
6161	34.4	0.450	0.159	0.25	0.013	150		231	231	0.200	0.013	Y	0.762	0.456	519	44.57%	519	369	246%
6162	91.4	0.450	0.159	0.33	0.013	170		231	231	0.200	0.013	Y	0.762	0.456	519	44.57%	519	350	206%
6163	28.6	0.450	0.159	0.41	0.013	170		231	231	0.200	0.013	Y	0.762	0.456	519	44.57%	519	350	206%
6164	112.2	0.450	0.159	0.33	0.013	170		255	255	0.200	0.013	Y	0.762	0.456	519	49.08%	519	350	206%
6165	61.0	0.450	0.159	0.31	0.013	170		255	255	0.200	0.013	Y	0.762	0.456	519	49.08%	519	350	206%
6166	19.8	0.450	0.159	0.84	0.013	278		255	255	0.200	0.013	Y	0.762	0.456	519	49.08%	519	242	87%
6169	32.0	1.070	0.899	1.08	0.013	4848		491	491	0.200	0.013	Y	0.762	0.456	519	94.44%	519	-4328	-89%

							Min						Min
				Existing Pipe			2.5	Existing		New Pipe			2.5
		Station	Invert	Obvert	HGL	Ground Lvl	Cover	HGL	Invert	Obvert	HGL	Ground Lvl	Cover
3165U	3165	1223.8	74.47	74.77	77.19	77.07	74.57	75.02	74.47	74.77	74.77	77.07	74.57
3165D		1168.3	74.47	74.77	77.19	77.22	74.72	75.02	74.47	74.77	74.77	77.22	74.72
3166U	3166	1168.3	74.47	74.77	77.19	77.22	74.72	75.02	74.47	74.77	74.68	77.22	74.72
3166D		1107.3	74.31	74.61	77.19	76.87	74.37	75.02	74.31	74.61	74.68	76.87	74.37
3167U	3167	1107.3	74.31	74.61	77.19	76.87	74.37	75.02	74.31	74.61	74.68	76.87	74.37
3167D		1015.9	74.07	74.37	77.19	76.96	74.46	75.02	74.07	74.37	74.67	76.96	74.46
3168U	3168	1015.9	74.07	74.37	77.19	76.96	74.46	75.02	74.07	74.37	74.67	76.96	74.46
3168D		931.2	73.80	74.10	77.14	77.07	74.57	75.02	73.80	74.10	74.62	77.07	74.57
3169U	3169	931.2	73.80	74.10	77.14	77.07	74.57	75.02	73.80	74.10	74.62	77.07	74.57
3169D		919.0	73.77	74.07	77.13	77.01	74.51	75.02	73.77	74.07	74.62	77.01	74.51
3173U	3173	919.0	73.70	74.00	77.13	77.01	74.51	75.02	73.70	74.00	74.62	77.01	74.51
3173D		879.4	73.66	73.96	77.03	76.89	74.39	74.98	73.66	73.96	74.51	76.89	74.39
3174U	3174	879.4	73.59	73.89	77.03	76.89	74.39	74.98	73.59	73.89	74.51	76.89	74.39
3174D		833.7	73.48	73.78	76.91	76.90	74.40	74.93	73.48	73.78	74.40	76.90	74.40
3175U	3175	833.7	73.48	73.78	76.91	76.90	74.40	74.93	73.48	73.78	74.40	76.90	74.40
3175D		816.9	73.43	73.73	76.87	76.94	74.44	74.91	73.43	73.73	74.35	76.94	74.44
3176U	3176	816.9	73.43	73.73	76.87	76.94	74.44	74.91	73.43	73.73	74.35	76.94	74.44
3176D		809.3	73.41	73.71	76.85	76.94	74.44	74.91	73.41	73.71	74.33	76.94	74.44
3177U	3177	809.3	73.41	73.71	76.85	76.94	74.44	74.91	73.41	73.71	74.33	76.94	74.44
3177D		759.0	73.28	73.58	76.71	76.79	74.29	74.86	73.28	73.58	74.20	76.79	74.29
3178U	3178	759.0	73.28	73.58	76.71	76.79	74.29	74.86	73.28	73.58	74.20	76.79	74.29
3178D		746.8	73.24	73.54	76.68	76.83	74.33	74.84	73.24	73.54	74.17	76.83	74.33
3181U	3181	746.8	73.24	73.54	76.68	76.83	74.33	74.84	73.24	73.54	74.17	76.83	74.33
3181D		731.6	73.18	73.48	76.64	76.83	74.33	74.83	73.18	73.48	74.13	76.83	74.33
3189U	3189	731.6	73.18	73.48	76.64	76.83	74.33	74.83	73.18	73.48	74.13	76.83	74.33
3189D		659.1	72.91	73.21	76.09	76.84	74.34	74.49	72.91	73.21	73.58	76.84	74.34
3190U	3190	659.1	72.91	73.21	76.09	76.84	74.34	74.49	72.91	73.21	73.58	76.84	74.34
3190D		581.4	72.68	72.98	75.50	77.75	75.25	74.13	72.68	72.98	72.98	77.75	75.25
3191U	3191	581.4	72.68	72.98	75.50	77.75	75.25	74.13	70.45	71.21	71.75	77.75	75.25
3191D		496.4	72.45	72.75	74.85	77.18	74.68	73.74	70.28	71.04	71.74	77.18	74.68
3192U	3192	496.4	72.45	72.75	74.85	77.18	74.68	73.74	70.24	71.00	71.74	77.18	74.68
3192D		481.2	72.45	72.75	74.73	77.38	74.88	73.67	70.21	70.97	71.74	77.38	74.88
3193U	3193	481.2	72.34	72.79	74.73	77.38	74.88	73.67	70.17	70.93	71.74	77.38	74.88
3193D		423.3	72.25	72.70	74.35	77.28	74.78	73.41	70.05	70.81	71.72	77.28	74.78
6159U	6159	423.3	72.25	72.70	74.35	77.28	74.78	73.41	70.01	70.77	71.72	77.28	74.78
6159D		383.1	72.21	72.66	74.08	76.98	74.48	73.22	69.93	70.69	71.70	76.98	74.48
6160U	6160	383.1	72.21	72.66	74.08	76.98	74.48	73.22	69.89	70.65	71.70	76.98	74.48
6160D		379.4	72.20	72.65	74.06	76.92	74.42	73.21	69.88	70.65	71.70	76.92	74.42
6161U	6161	379.4	72.20	72.65	74.06	76.92	74.42	73.21	69.84	70.61	71.70	76.92	74.42
6161D		345.0	72.11	72.56	73.83	76.99	74.49	73.05	69.78	70.54	71.69	76.99	74.49
6162U	6162	345.0	72.11	72.56	73.83	76.99	74.49	73.05	69.74	70.50	71.69	76.99	74.49
6162D		253.6	71.81	72.26	73.23	76.99	74.49	72.63	69.55	70.32	71.65	76.99	74.49
6163U	6163	253.6	71.81	72.26	73.23	76.99	74.49	72.63	69.51	70.28	71.65	76.99	74.49
6163D		225.0	71.69	72.14	73.04	76.87	74.37	72.50	69.46	70.22	71.64	76.87	74.37
6164U	6164	225.0	71.69	72.14	73.04	76.87	74.37	72.50	69.42	70.18	71.64	76.87	74.37
6164D		112.8	71.32	71.77	72.15	76.77	74.27	71.91	69.19	69.95	71.59	76.77	74.27
6165U	6165	112.8	71.32	71.77	72.15	76.77	74.27	71.91	69.15	69.91	71.59	76.77	74.27
6165D		51.8	71.13	71.58	71.66	76.68	74.18	71.59	69.03	69.79	71.56	76.68	74.18
6166U	6166	51.8	71.13	71.58	71.66	76.68	74.18	71.53	68.99	69.75	71.56	76.68	74.18
6166D		32.0	70.96	71.41	71.50	76.69	74.19	71.42	68.95	69.71	71.55	76.69	74.19
6169U	6169	32.0	70.35	71.42	71.50	76.69	74.19	71.08	68.91	69.67	71.55	76.69	74.19
6169D		0.0	70.00	71.07	71.49	77.01	74.51	71.07	68.85	69.61	71.49	77.01	74.51

Figure 8-13a:

HGL ANALYSIS OF SCOTT STREET SPS COLLECTION SYSTEM - EXISTING PIPES

Flows: Corus-Jarvis **HGL Start Point:** 3165 (Queen's Quay, west of Sherbourne)

Assumed Wet Well Level: 71.490 (Existing + 0.82m) **Outlet Control?** Yes

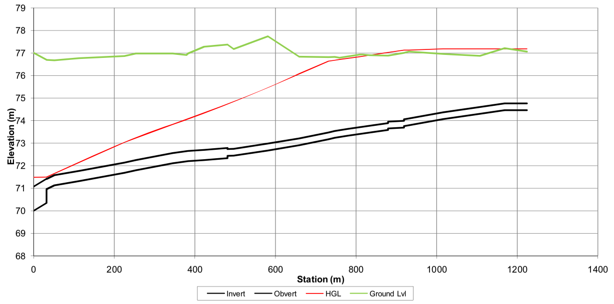
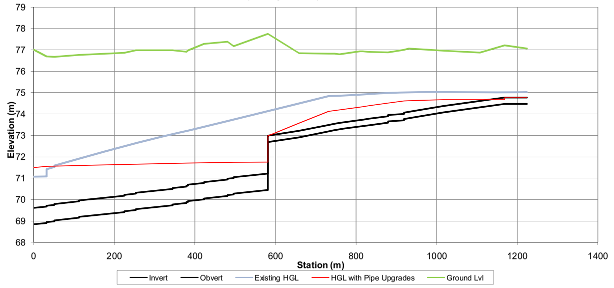


Figure 8-13b:

HGL ANALYSIS OF SCOTT STREET SPS COLLECTION SYSTEM - NEW PIPES

Flows: Existing plus Corus **HGL Start Point:** 3165 (Queen's Quay, west of Sherbourne)

Assumed Wet Well Level: 71.490 (Existing + 0.82m) **Outlet Control?** Yes



HGL ANALYSIS

Legend:	
71.073	Equal to pipe obvert
472	Bad data - Needs to be revised
70.003	Input

Additional Point Load: 0 L/s
Outlet Control? Yes

Pipe	Invert$_{DS}$	Obvert$_{DS}$	HGL$_{DS}$	Q$_{MODEL}$	Q$_{TMIG}$	S$_{HGL}$	d$_s$	Ground Lvl	Cover	Velocity	h$_f$	HGL$_{US}$
	EXISTING PIPE											
-	[m]	[m]	[m]	[L/s]	[L/s]	[%]	[m]	[m]	[m]	[m/s]	[m]	[m]
3165	74.466	74.766	77.190	0	3	0.00	2.42	77.07	-0.12	0.05	0.001	77.191
3166	74.313	74.613	77.189	0	3	0.00	2.58	77.22	0.03	0.05	0.001	77.190
3167	74.069	74.369	77.188	0	3	0.00	2.82	76.87	-0.32	0.05	0.001	77.189
3168	73.804	74.104	77.138	0	24	0.06	3.03	76.96	-0.23	0.33	0.050	77.188
3169	73.765	74.065	77.131	0	24	0.06	3.07	77.07	-0.07	0.33	0.007	77.138
3173	73.655	73.955	77.028	10	49	0.26	3.07	77.01	-0.12	0.70	0.103	77.131
3174	73.478	73.778	76.909	11	49	0.26	3.13	76.89	-0.14	0.70	0.119	77.028
3175	73.432	73.732	76.865	11	49	0.26	3.13	76.90	-0.01	0.70	0.044	76.909
3176	73.411	73.711	76.846	11	49	0.26	3.13	76.94	0.07	0.70	0.020	76.865
3177	73.280	73.580	76.715	13	49	0.26	3.13	76.94	0.09	0.70	0.131	76.846
3178	73.243	73.543	76.683	15	49	0.26	3.14	76.79	0.08	0.70	0.032	76.715
3181	73.182	73.482	76.644	27	49	0.26	3.16	76.83	0.14	0.70	0.039	76.683
3189	72.911	73.211	76.090	45	85	0.76	2.88	76.83	0.18	1.20	0.554	76.644
3190	72.683	72.983	75.497	45	85	0.76	2.51	76.84	0.75	1.20	0.593	76.090
3191	72.454	72.754	74.848	45	85	0.76	2.09	77.75	2.25	1.20	0.649	75.497
3192	72.445	72.745	74.732	45	85	0.76	1.99	77.18	2.33	1.20	0.116	74.848
3193	72.253	72.703	74.350	110	231	0.66	1.65	77.38	2.65	1.46	0.382	74.732
6159	72.210	72.660	74.085	111	231	0.66	1.42	77.28	2.93	1.46	0.265	74.350
6160	72.195	72.645	74.060	112	231	0.66	1.42	76.98	2.90	1.46	0.024	74.085
6161	72.110	72.560	73.834	230	231	0.66	1.27	76.92	2.86	1.46	0.227	74.060
6162	71.805	72.255	73.231	230	231	0.66	0.98	76.99	3.15	1.46	0.603	73.834
6163	71.689	72.139	73.043	230	231	0.66	0.90	76.99	3.75	1.46	0.189	73.231
6164	71.323	71.773	72.145	230	255	0.80	0.37	76.87	3.83	1.60	0.897	73.043
6165	71.131	71.581	71.658	230	255	0.80	0.08	76.77	4.62	1.60	0.488	72.145
6166	70.964	71.414	71.499	229	255	0.80	0.09	76.68	5.02	1.60	0.158	71.658
6169	70.003	71.073	71.490	472	491	0.03	0.42	76.69	5.19	0.55	0.009	71.499

Assumed Wet Well Elevation: 71.490

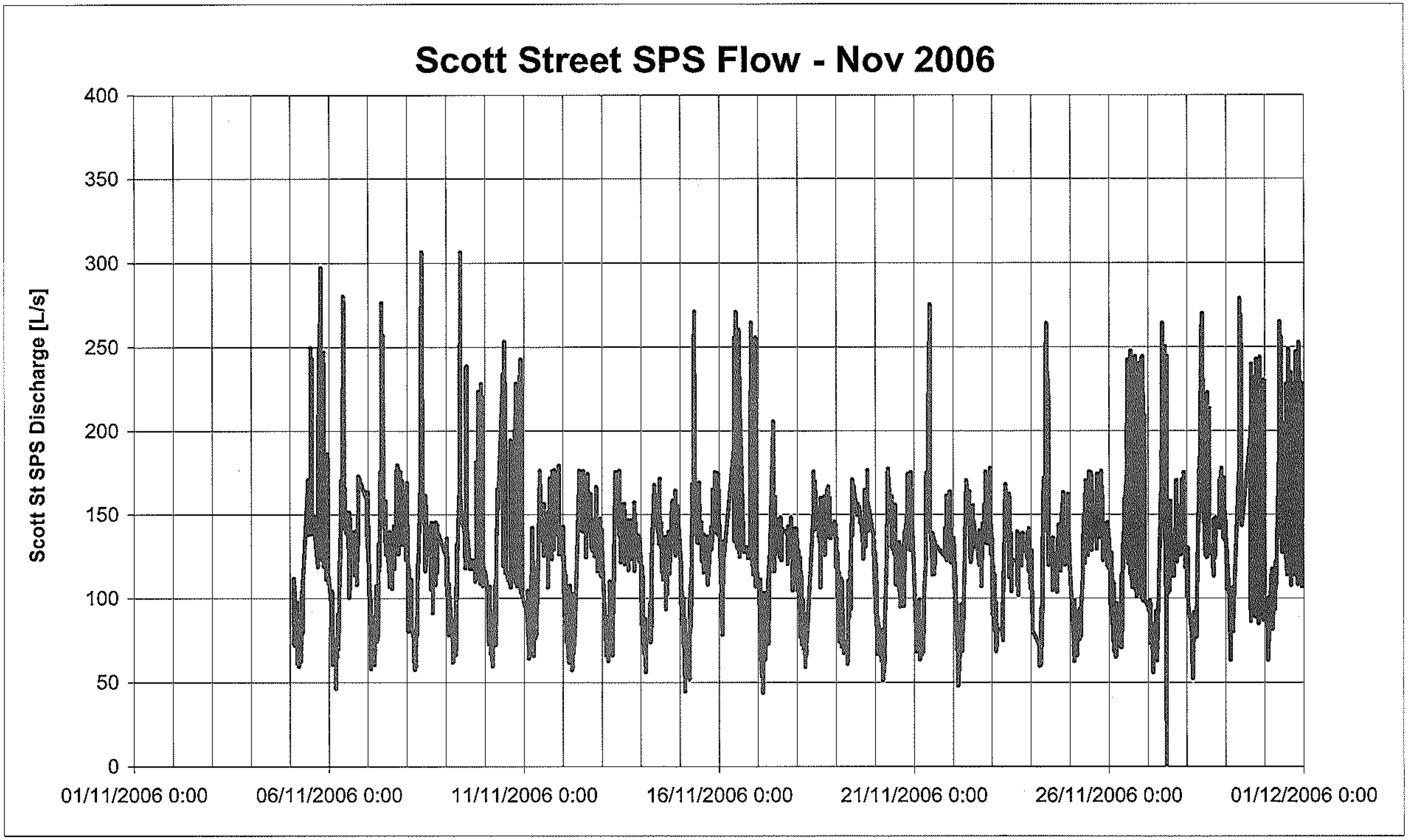
Additional Point Load: 0 L/s
Outlet Control? Yes

Invert$_{DS}$	Obvert$_{DS}$	HGL$_{DS}$	Q$_{MODEL}$	Q$_{TMIG}$	S$_{HGL}$	h$_f$	HGL$_{US}$	Existing HGL$_{US}$
NEW PIPE								
[m]	[m]	[m]	[L/s]	[L/s]	[%]	[m]	[m]	[m]
74.466	74.766	74.766	0	3	0.00	0.001	74.767	75.022
74.313	74.613	74.675	0	3	0.00	0.001	74.676	75.021
74.069	74.369	74.674	0	3	0.00	0.001	74.675	75.020
73.804	74.104	74.624	0	24	0.06	0.050	74.674	75.018
73.765	74.065	74.617	0	24	0.06	0.007	74.624	75.017
73.655	73.955	74.514	10	49	0.26	0.103	74.617	75.017
73.478	73.778	74.395	11	49	0.26	0.119	74.514	74.977
73.432	73.732	74.352	11	49	0.26	0.044	74.395	74.931
73.411	73.711	74.332	11	49	0.26	0.020	74.352	74.914
73.280	73.580	74.201	13	49	0.26	0.131	74.332	74.907
73.243	73.543	74.169	15	49	0.26	0.032	74.201	74.856
73.182	73.482	74.130	27	49	0.26	0.039	74.169	74.844
72.911	73.211	73.576	45	85	0.76	0.554	74.130	74.829
72.683	72.983	72.983	45	85	0.76	0.593	73.576	74.494
70.279	71.041	71.743	45	85	0.01	0.004	71.747	74.135
70.208	70.970	71.742	45	85	0.01	0.001	71.743	73.742
70.053	70.815	71.719	110	231	0.04	0.023	71.742	73.672
69.932	70.694	71.703	111	231	0.04	0.016	71.719	73.408
69.885	70.647	71.701	112	231	0.04	0.001	71.703	73.225
69.776	70.538	71.688	230	231	0.04	0.014	71.701	73.208
69.553	70.315	71.651	230	231	0.04	0.036	71.688	73.051
69.456	70.218	71.640	230	231	0.04	0.011	71.651	72.634
69.192	69.954	71.586	230	255	0.05	0.054	71.640	72.504
69.030	69.792	71.557	230	255	0.05	0.029	71.586	71.912
68.950	69.712	71.547	229	255	0.05	0.010	71.557	71.528
68.846	69.608	71.490	472	491	0.18	0.057	71.547	71.079

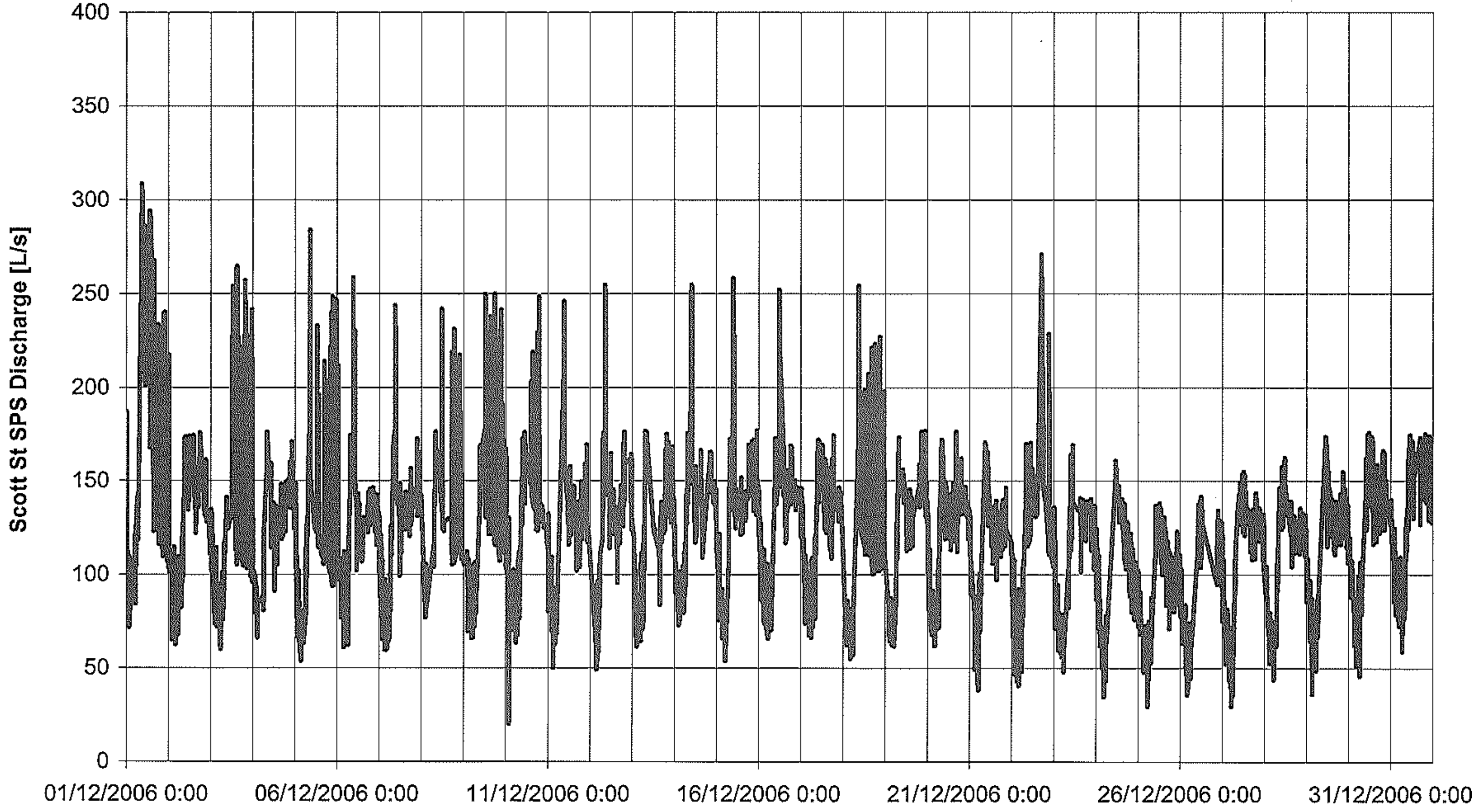
Assumed Wet Well Elevation: 71.490

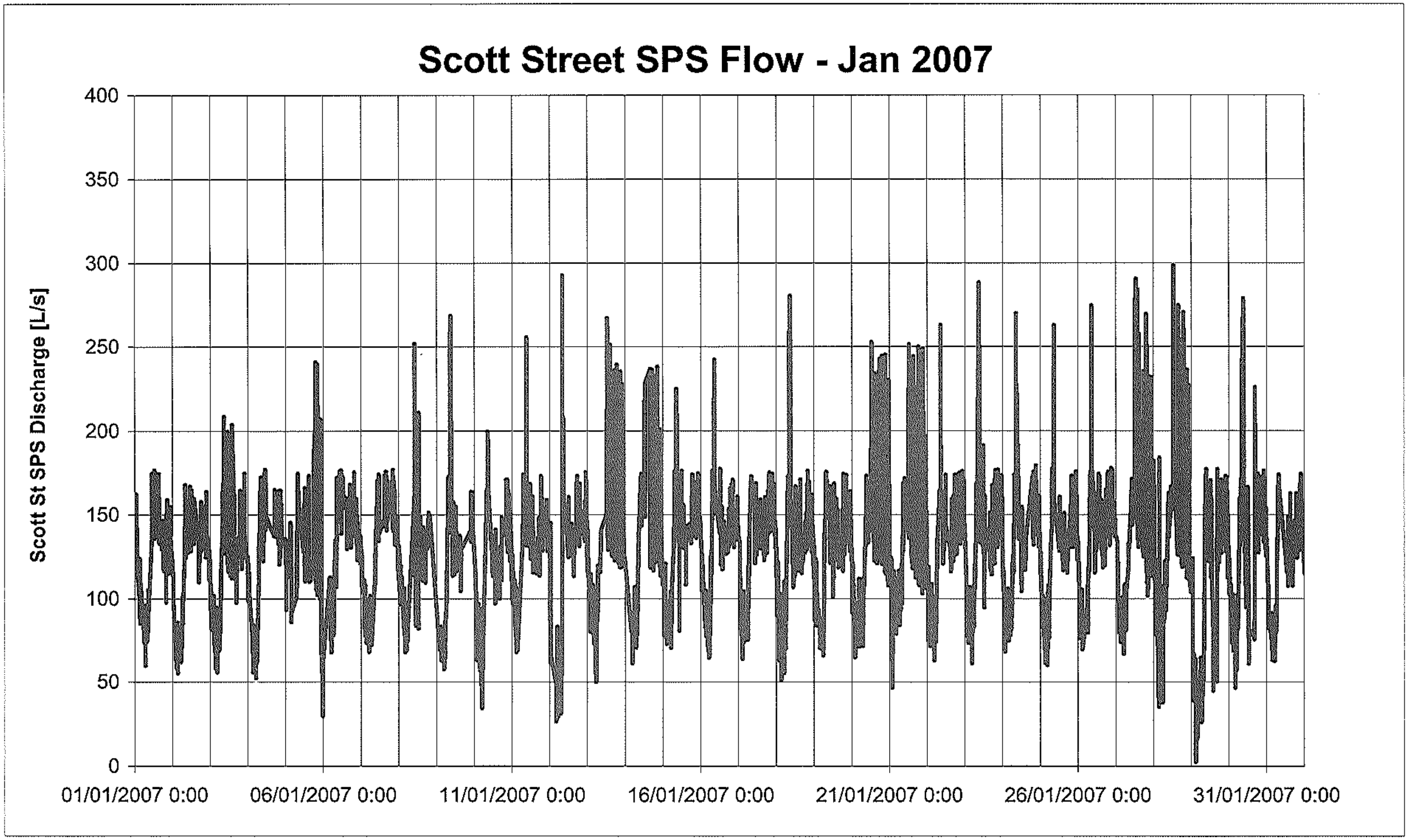
Appendix 3e

Scott Street SPS Flow Data

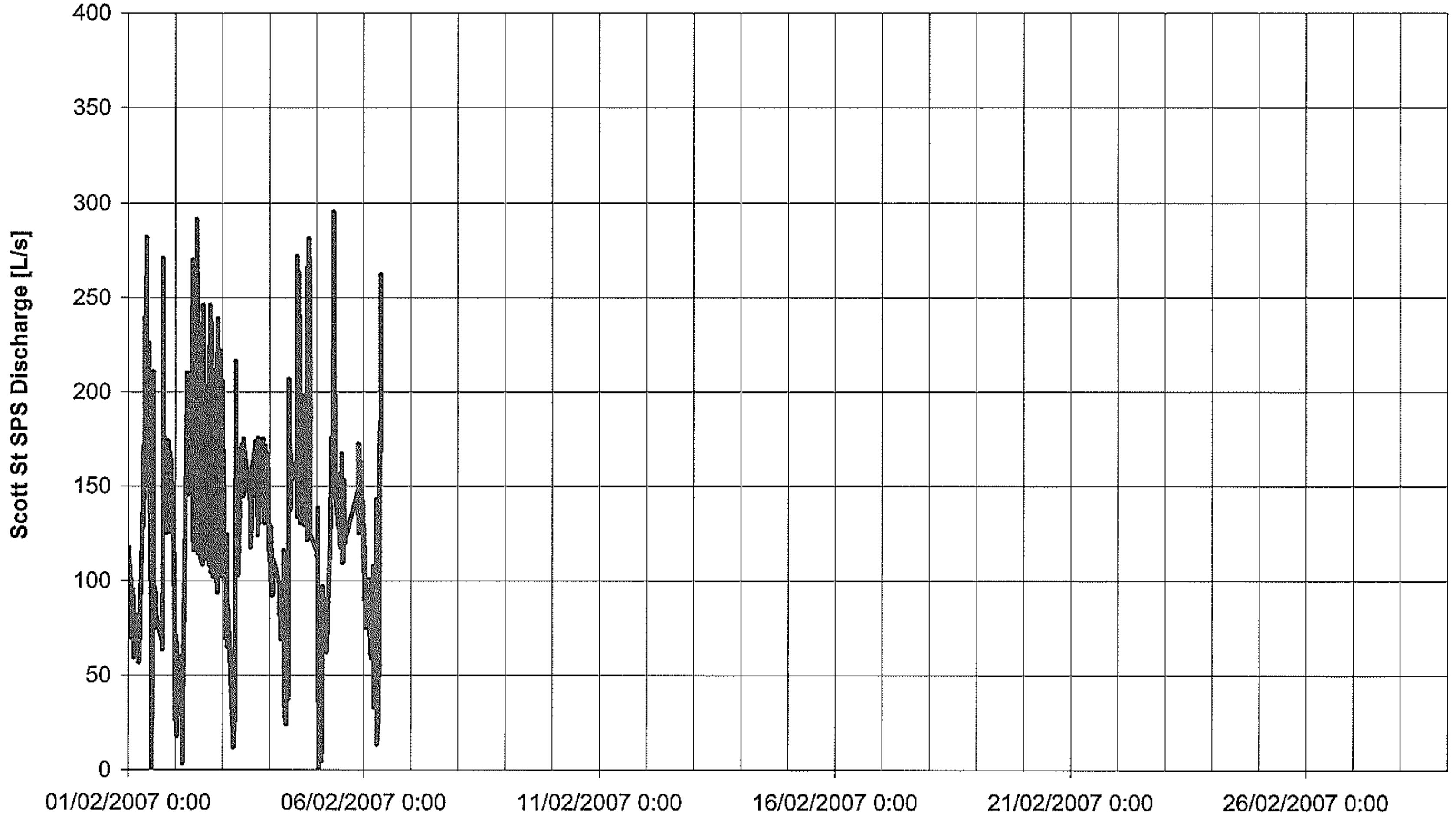

Scott Street SPS Flow - Nov 2006
Scott St SPS Discharge [L/s]
400
350
300
250
200
150
100
50
0
01/11/2006 0:00
06/11/2006 0:00
11/11/2006 0:00
16/11/2006 0:00
21/11/2006 0:00
26/11/2006 0:00
01/12/2006 0:00

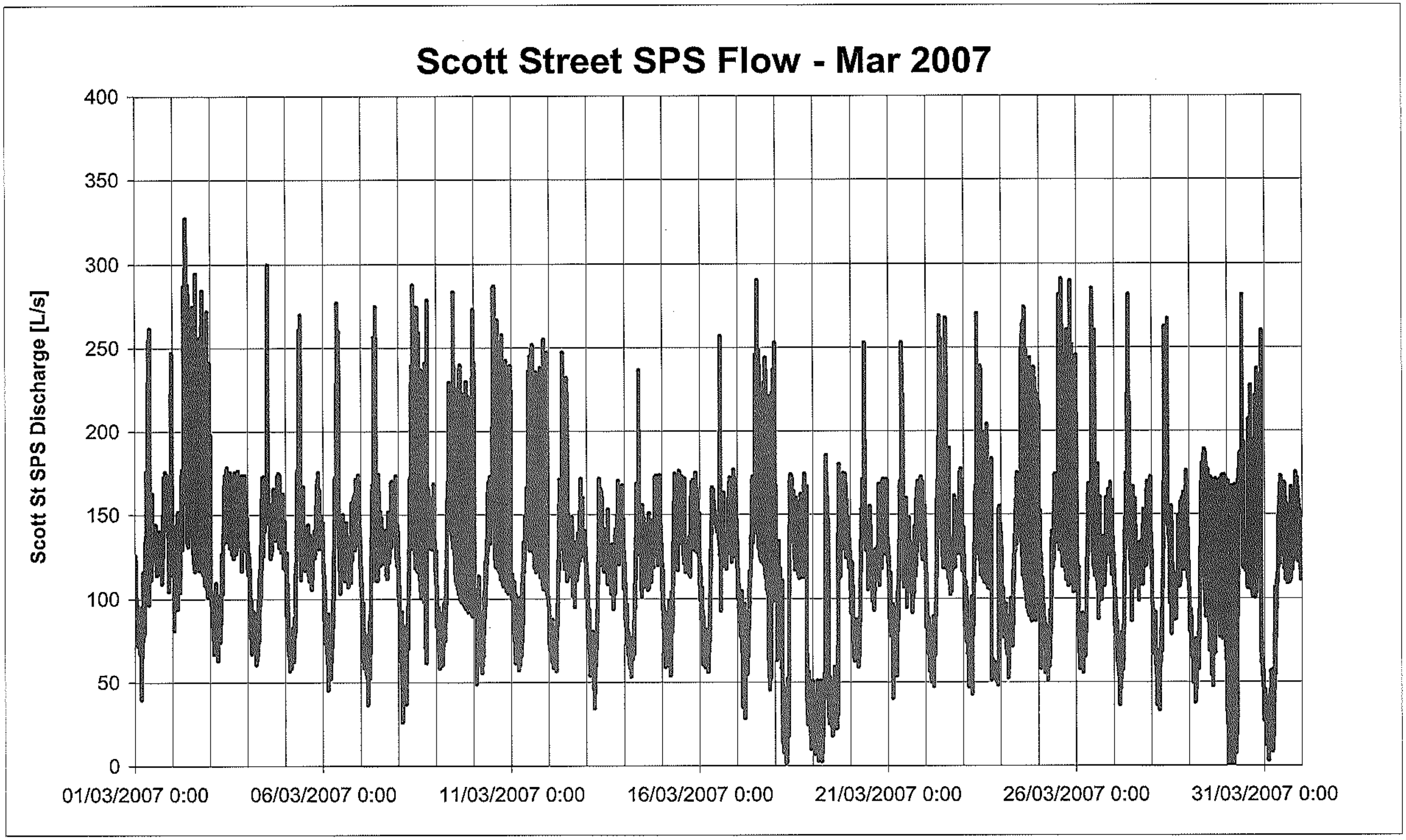
Scott Street SPS Flow - Dec 2006




Scott Street SPS Flow - Jan 2007
Scott St SPS Discharge [L/s]
400
350
300
250
200
150
100
50
0
01/01/2007 0:00
06/01/2007 0:00
11/01/2007 0:00
16/01/2007 0:00
21/01/2007 0:00
26/01/2007 0:00
31/01/2007 0:00

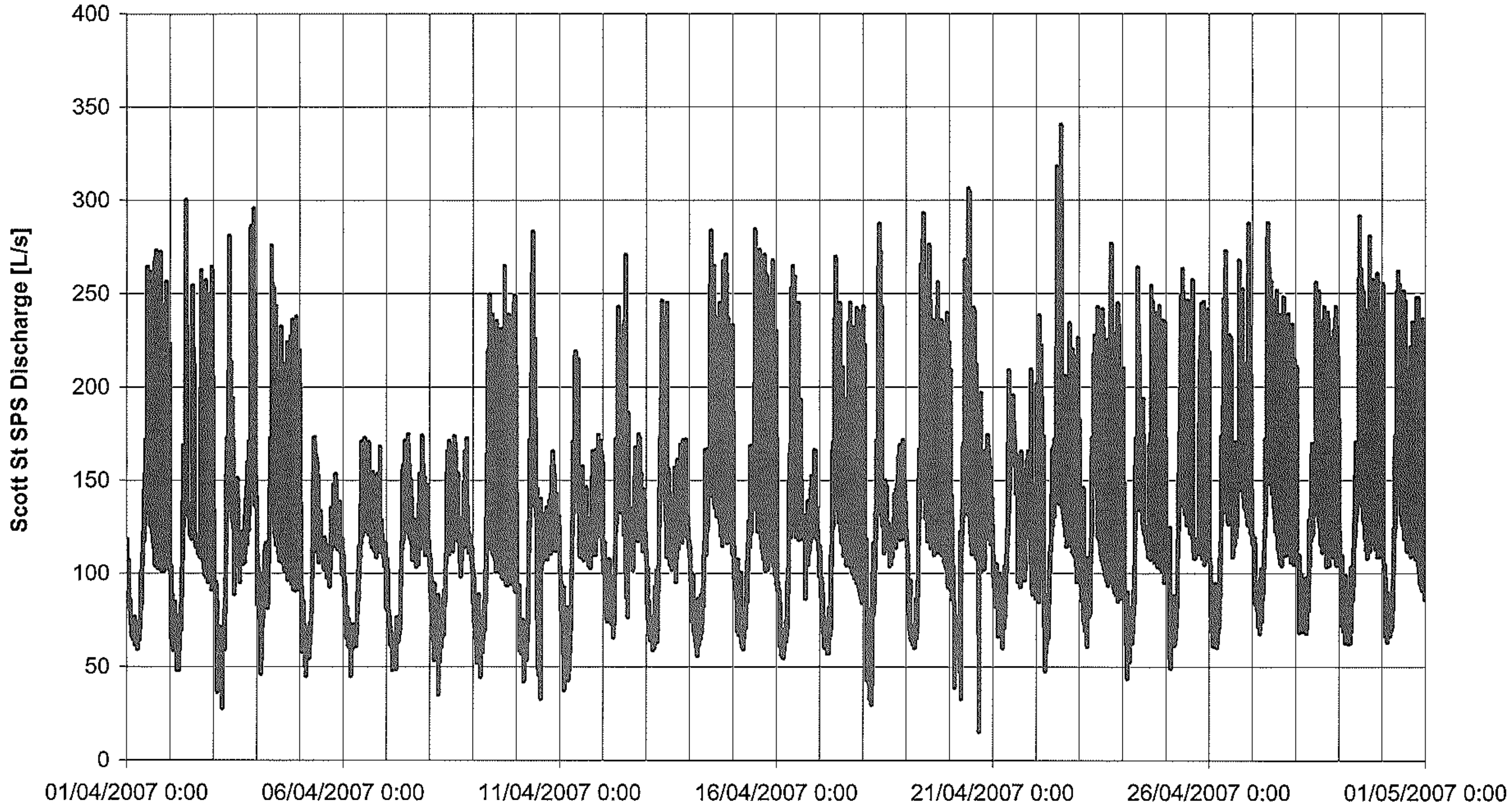
Scott Street SPS Flow - Feb 2007

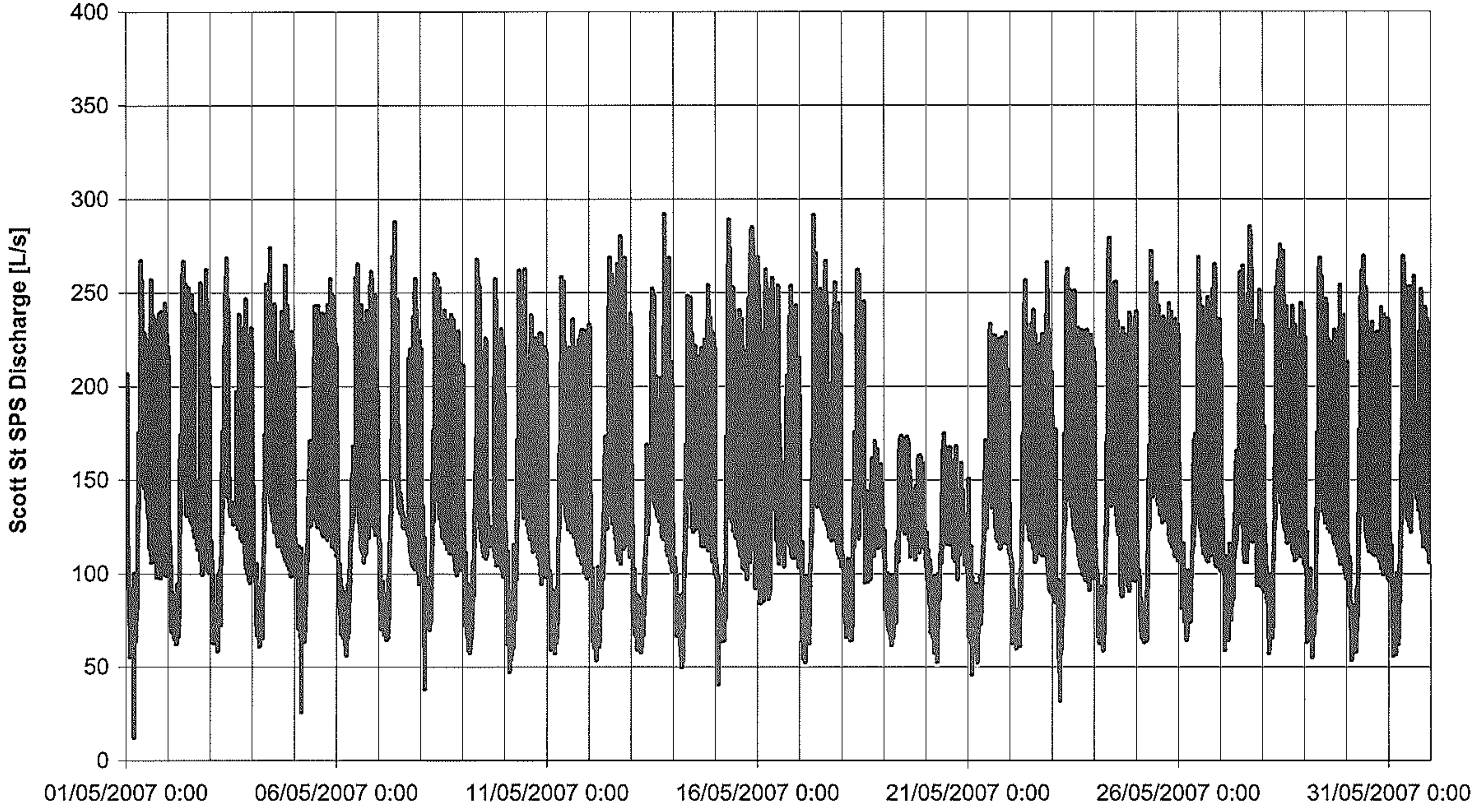




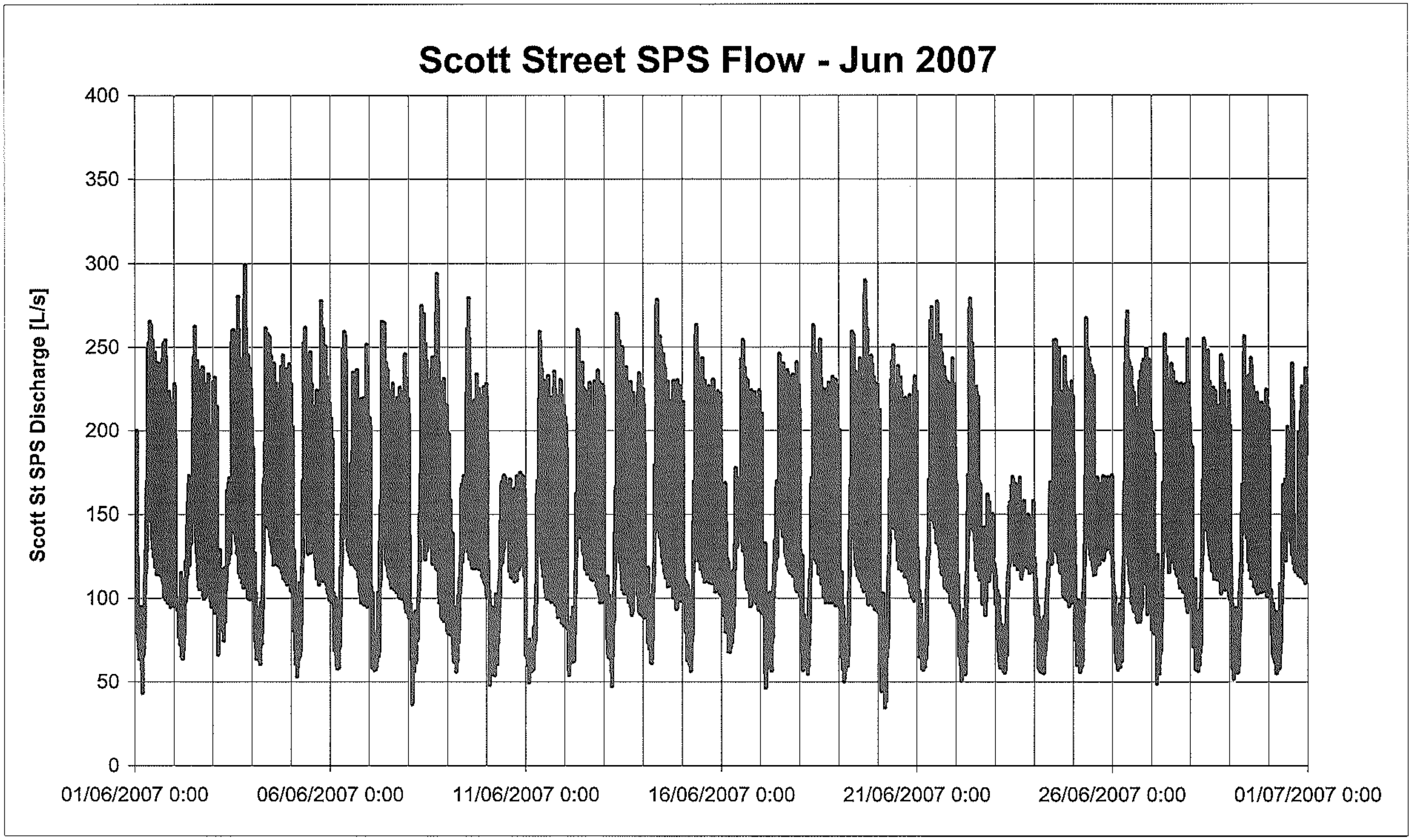
Scott Street SPS Flow - Mar 2007

Scott Street SPS Flow - Apr 2007

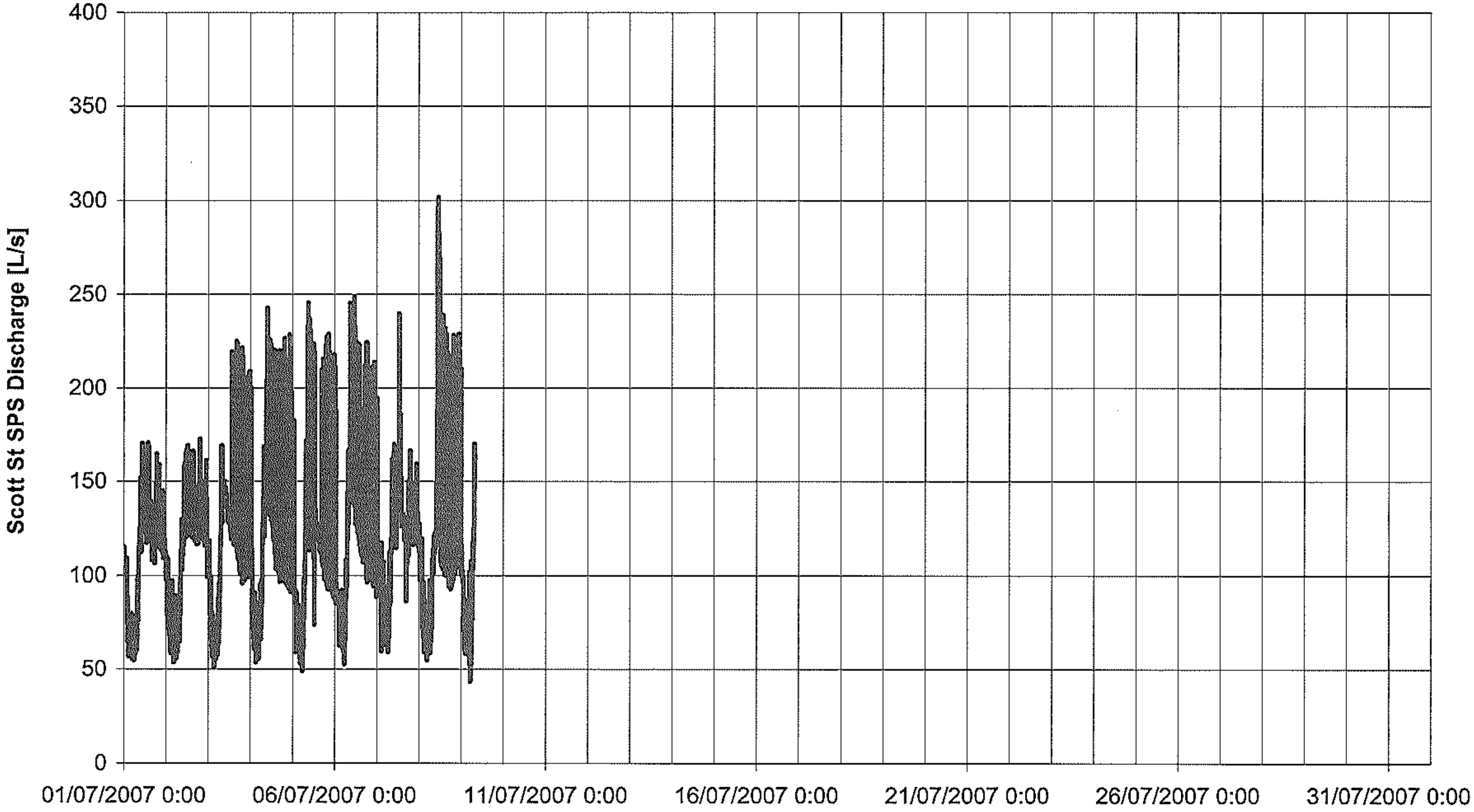




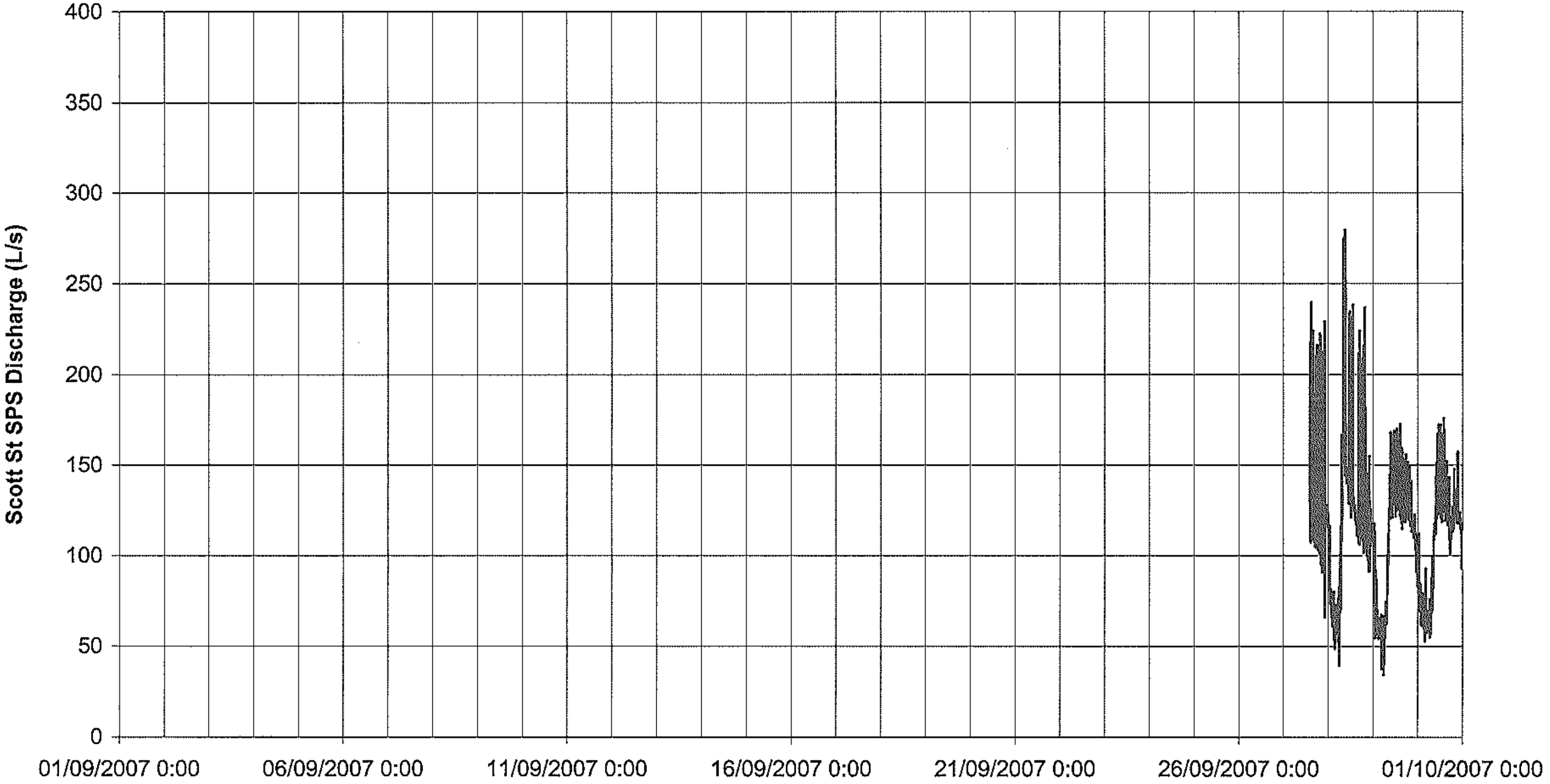
Scott Street SPS Flow - May 2007


Scott Street SPS Flow - Jun 2007
Scott St SPS Discharge [L/s]
400
350
300
250
200
150
100
50
0
01/06/2007 0:00
06/06/2007 0:00
11/06/2007 0:00
16/06/2007 0:00
21/06/2007 0:00
26/06/2007 0:00
01/07/2007 0:00

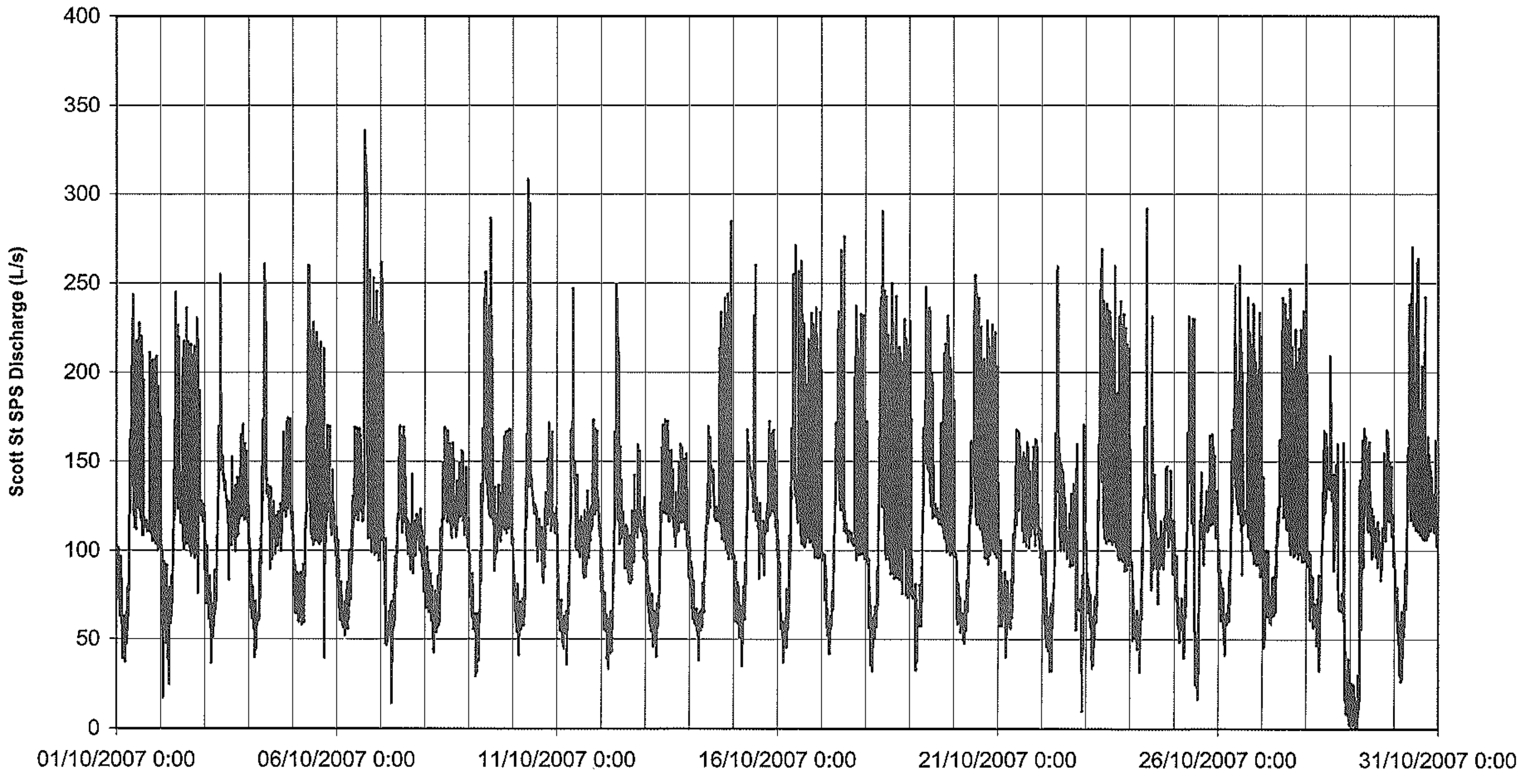
Scott Street SPS Flow - Jul 2007



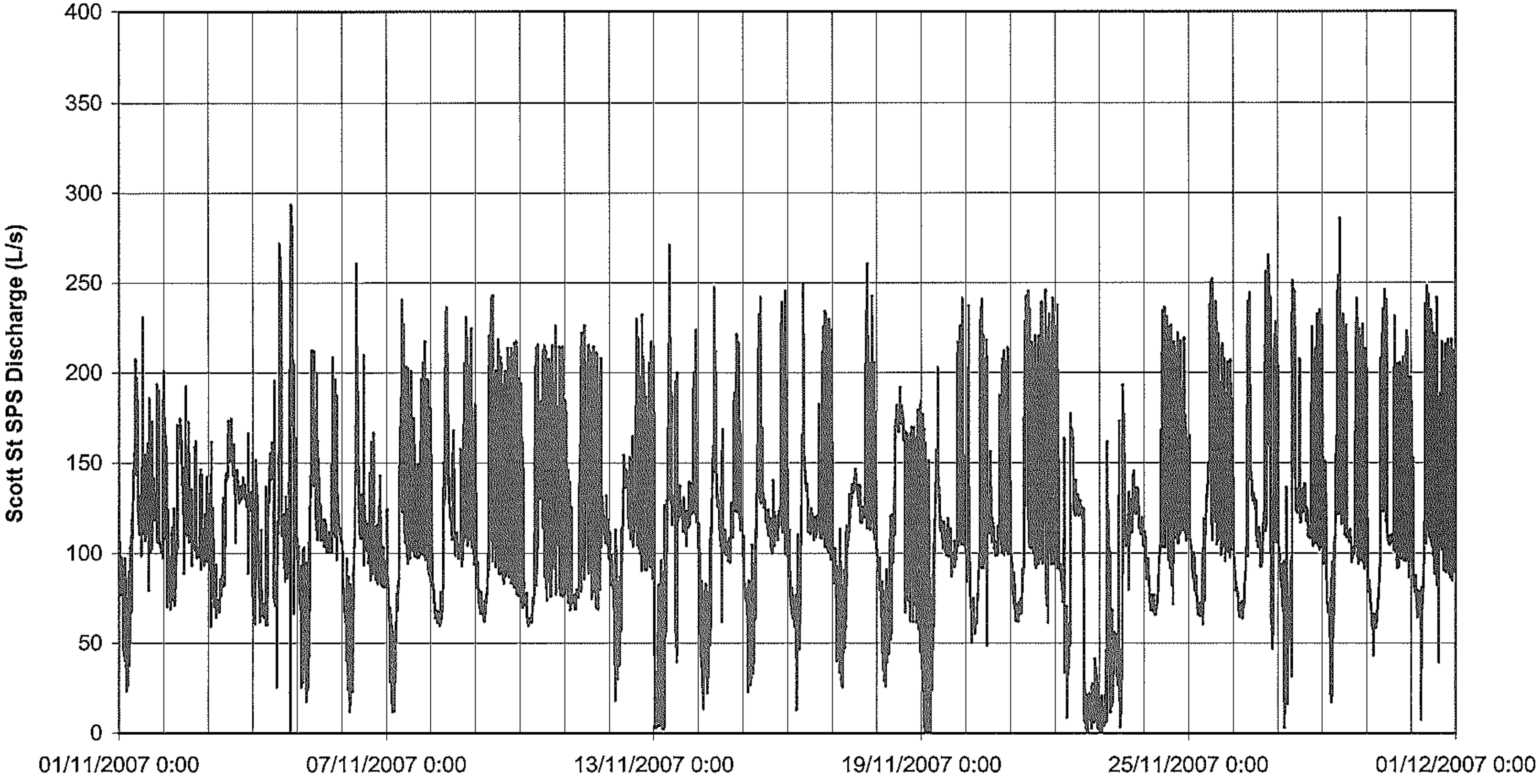
Scott St SPS Flow - Sept 2007



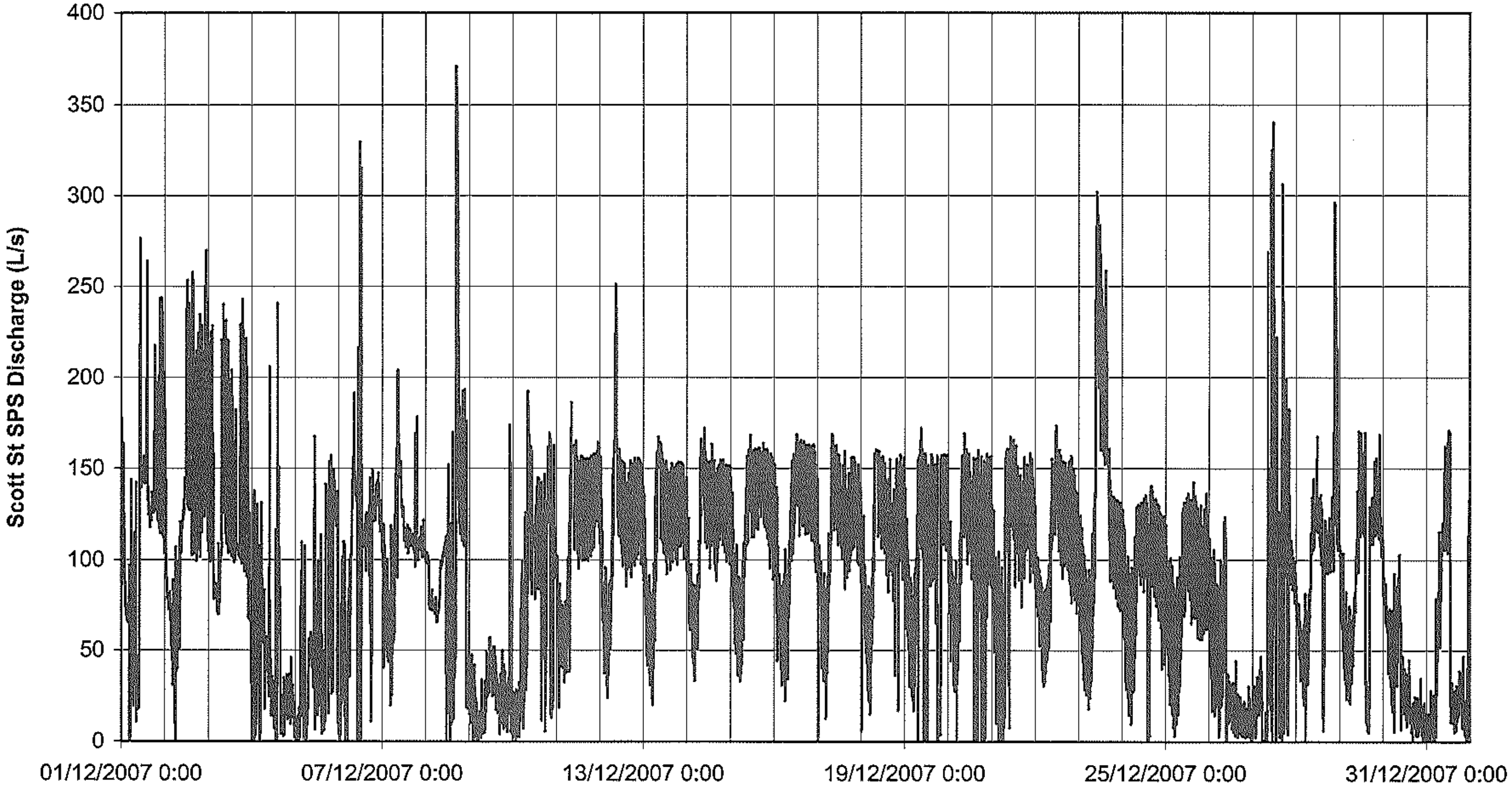
Scott St SPS Flow - October 2007



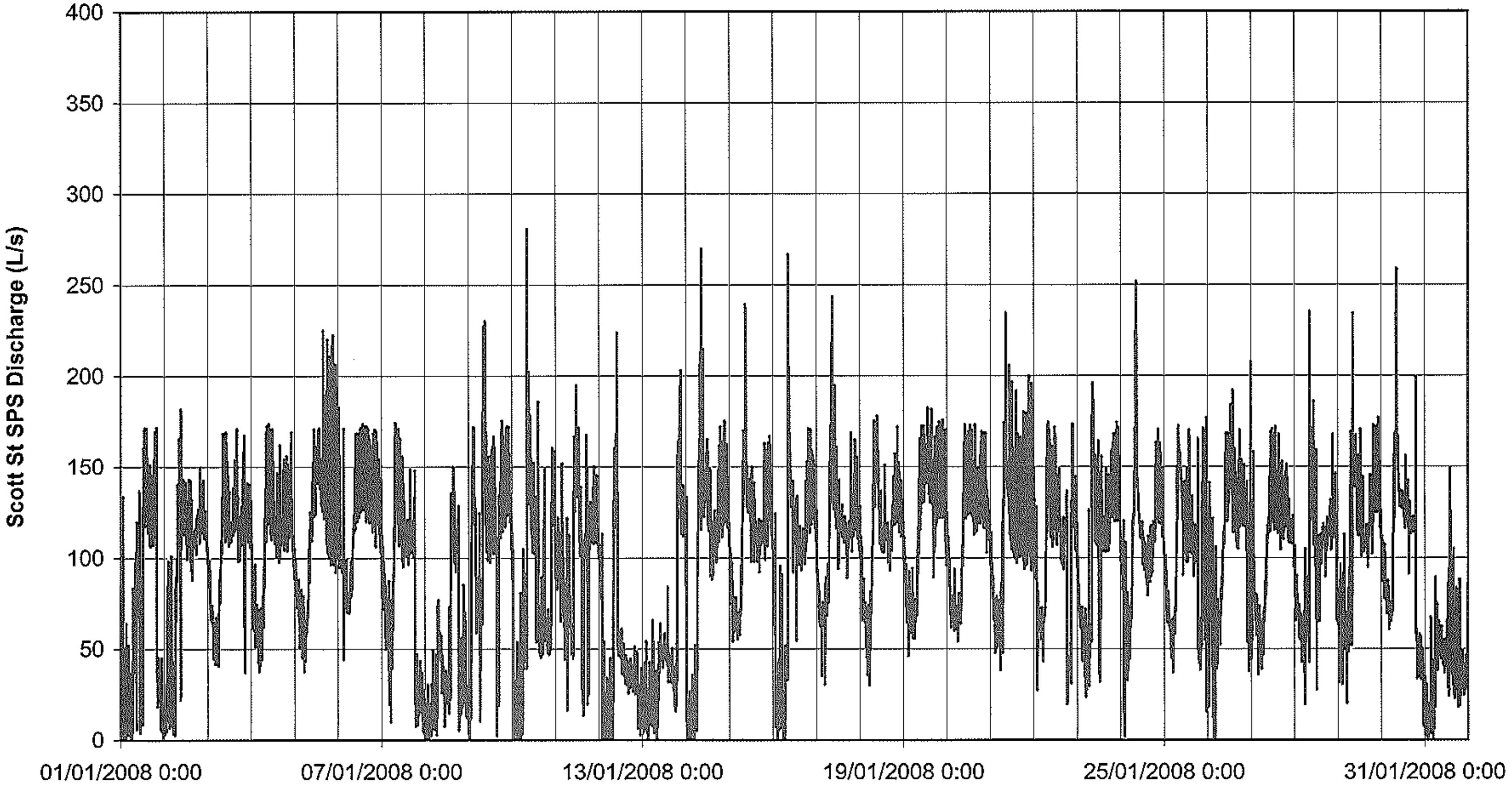
Scott St SPS Flow - November 2007



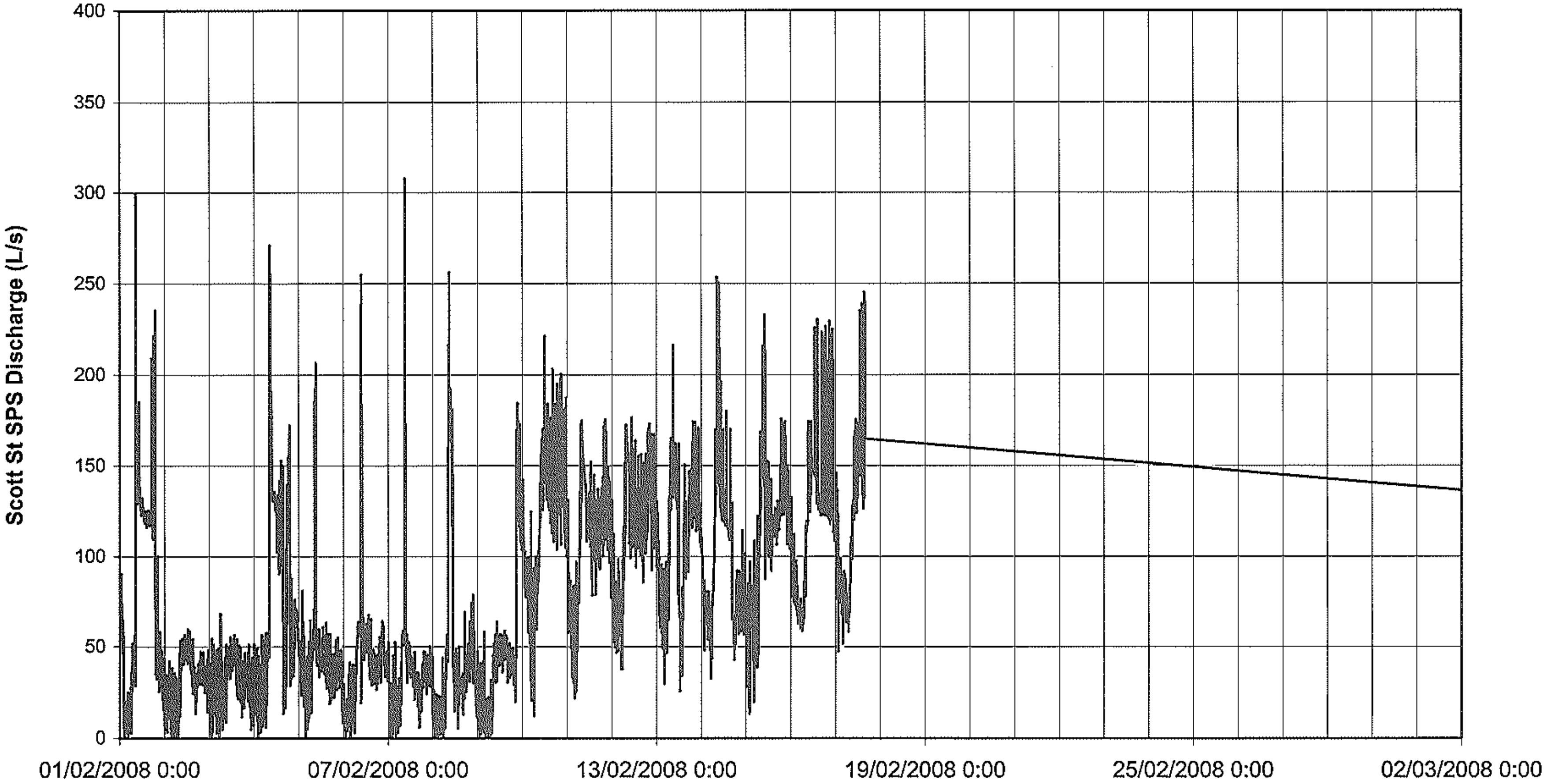
Scott St SPS Flow- December 2007



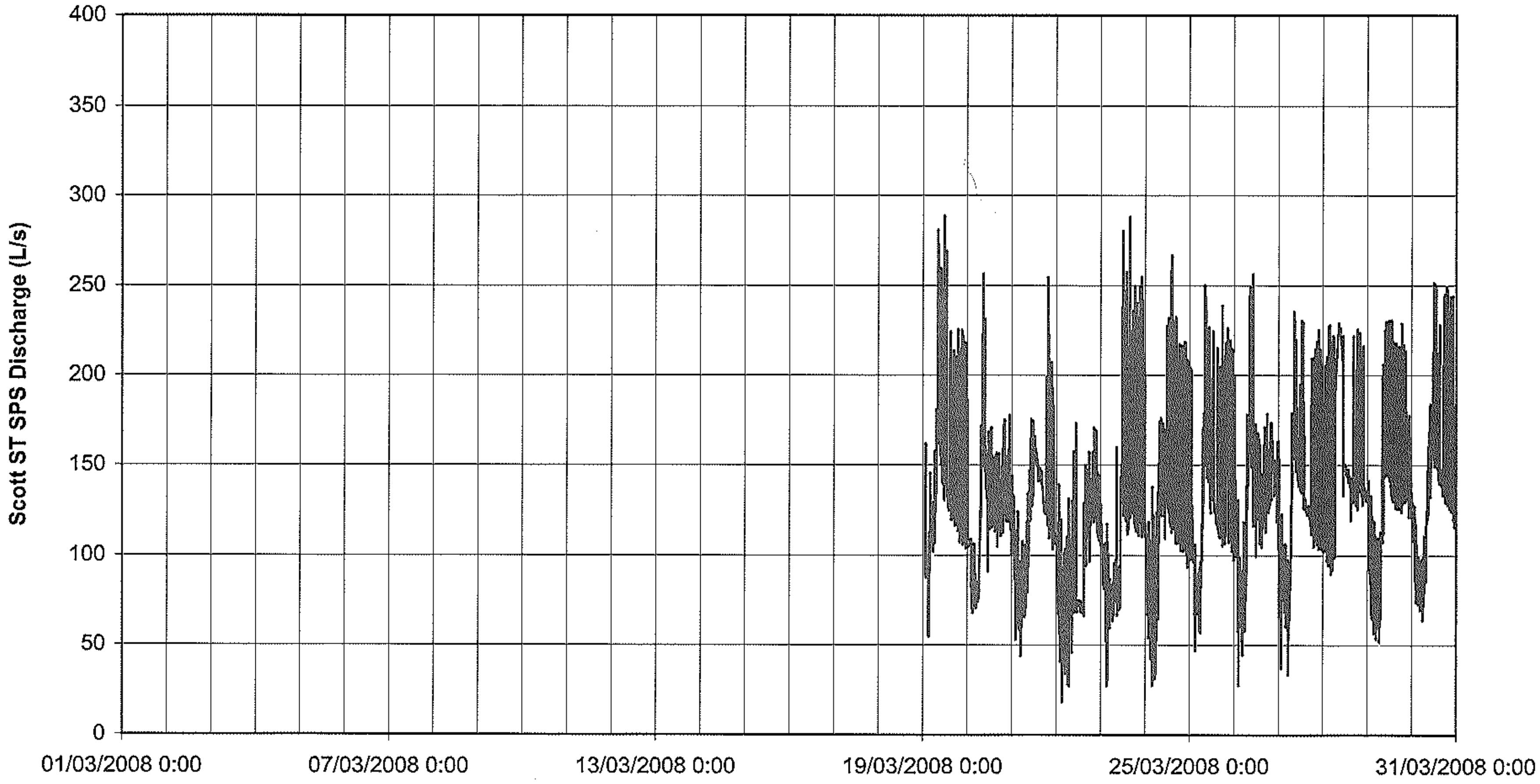
Scott St SPS Flow - January 2008

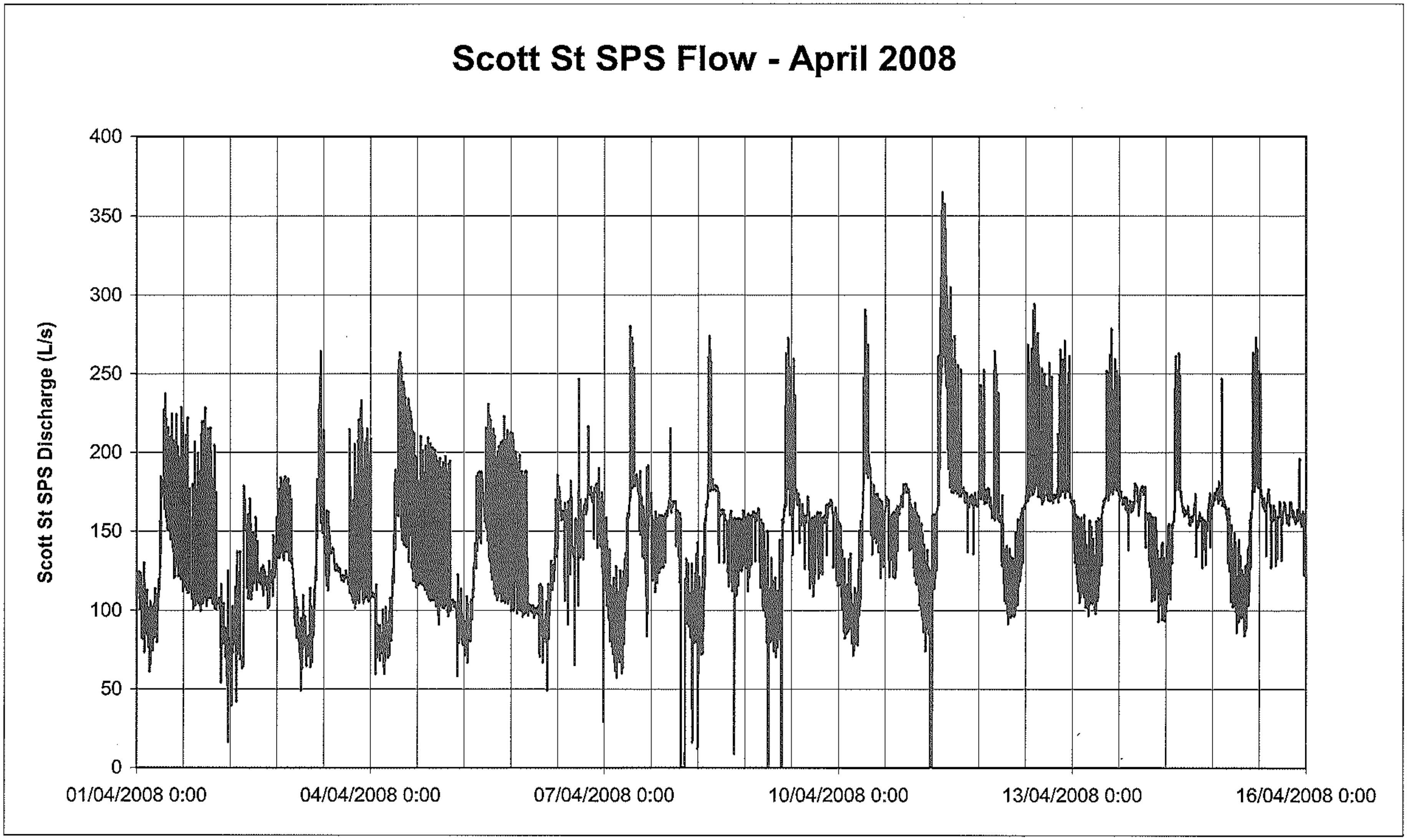


Scott St SPS Flow - February 2008



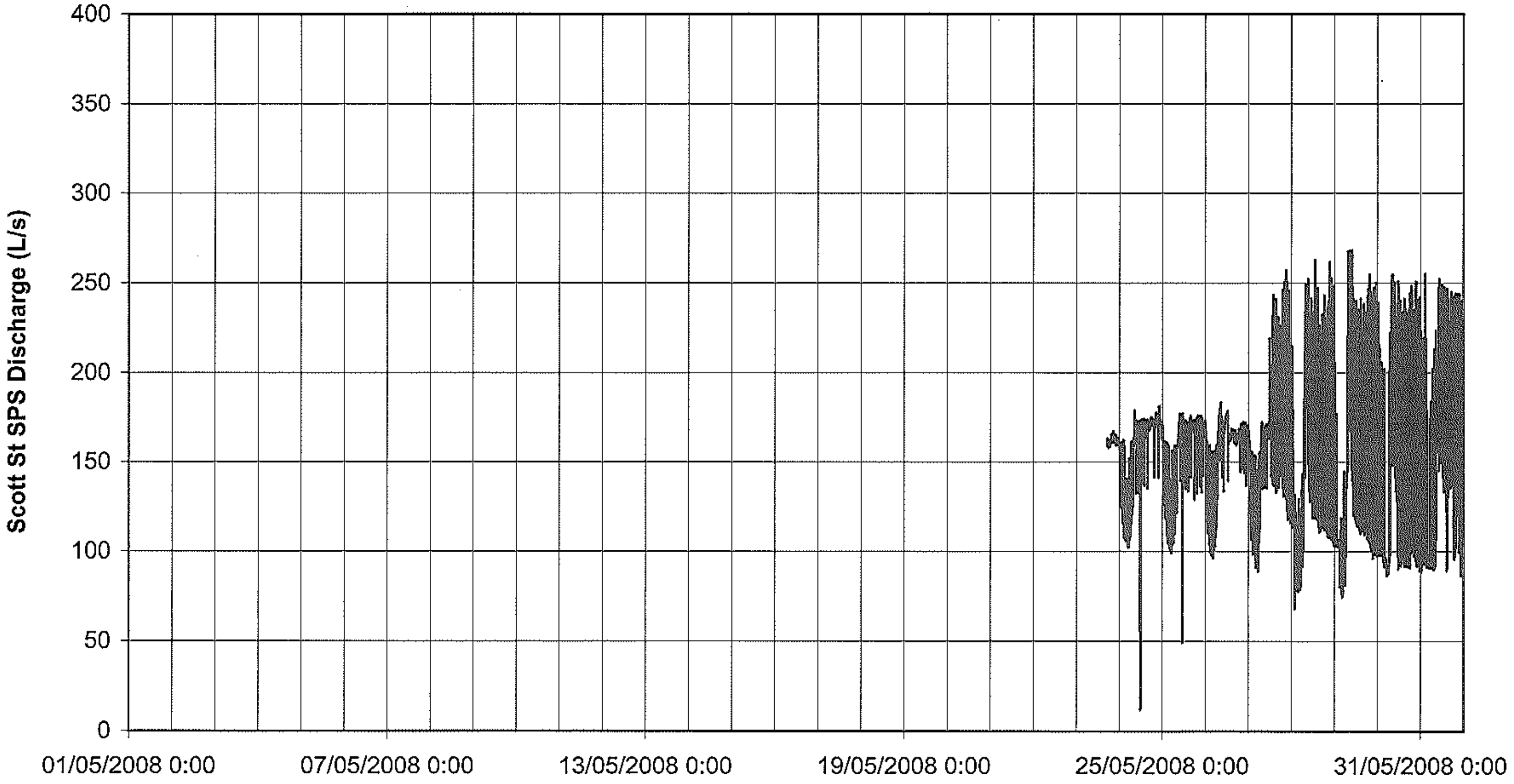
Scott St SPS Flow - March 2008

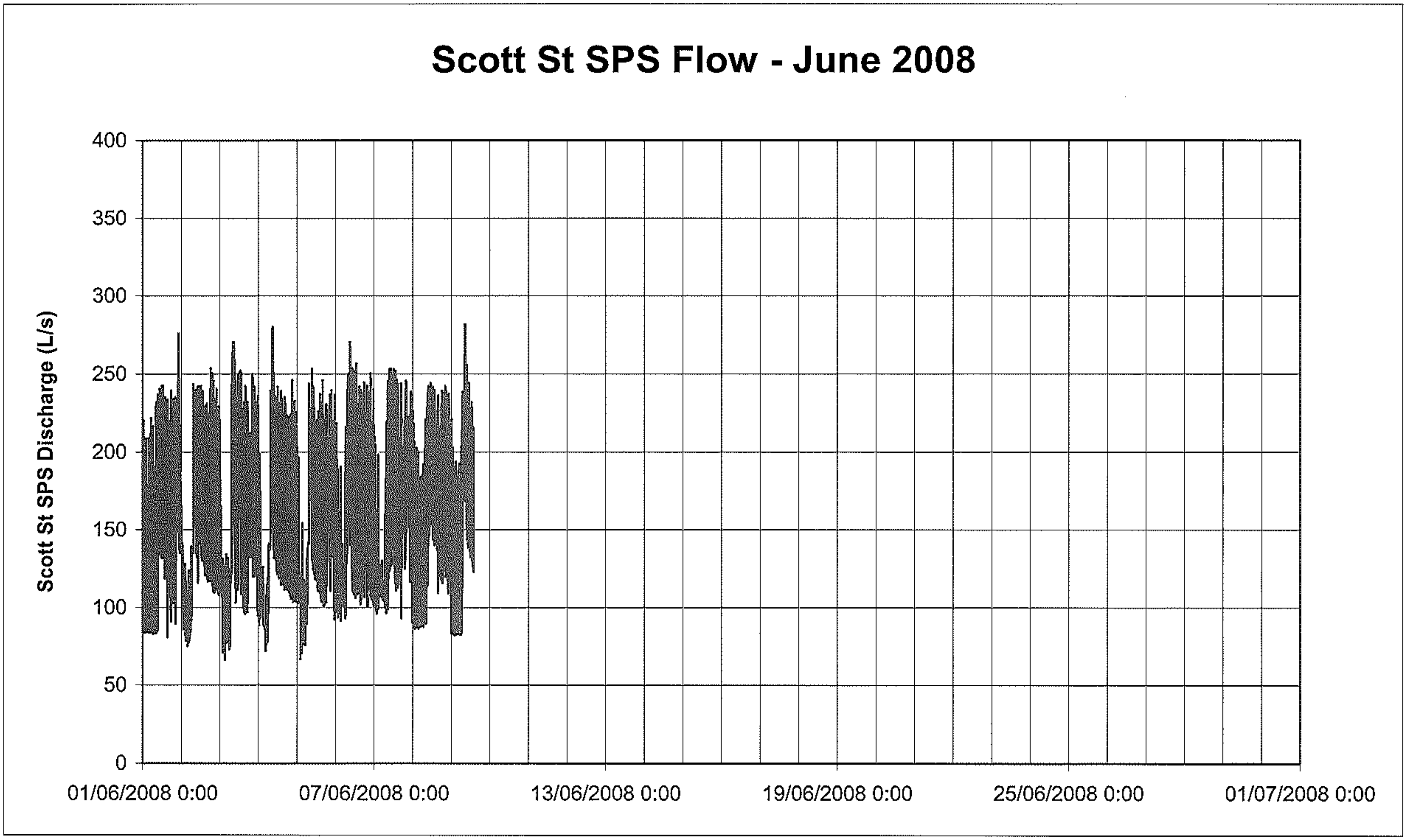




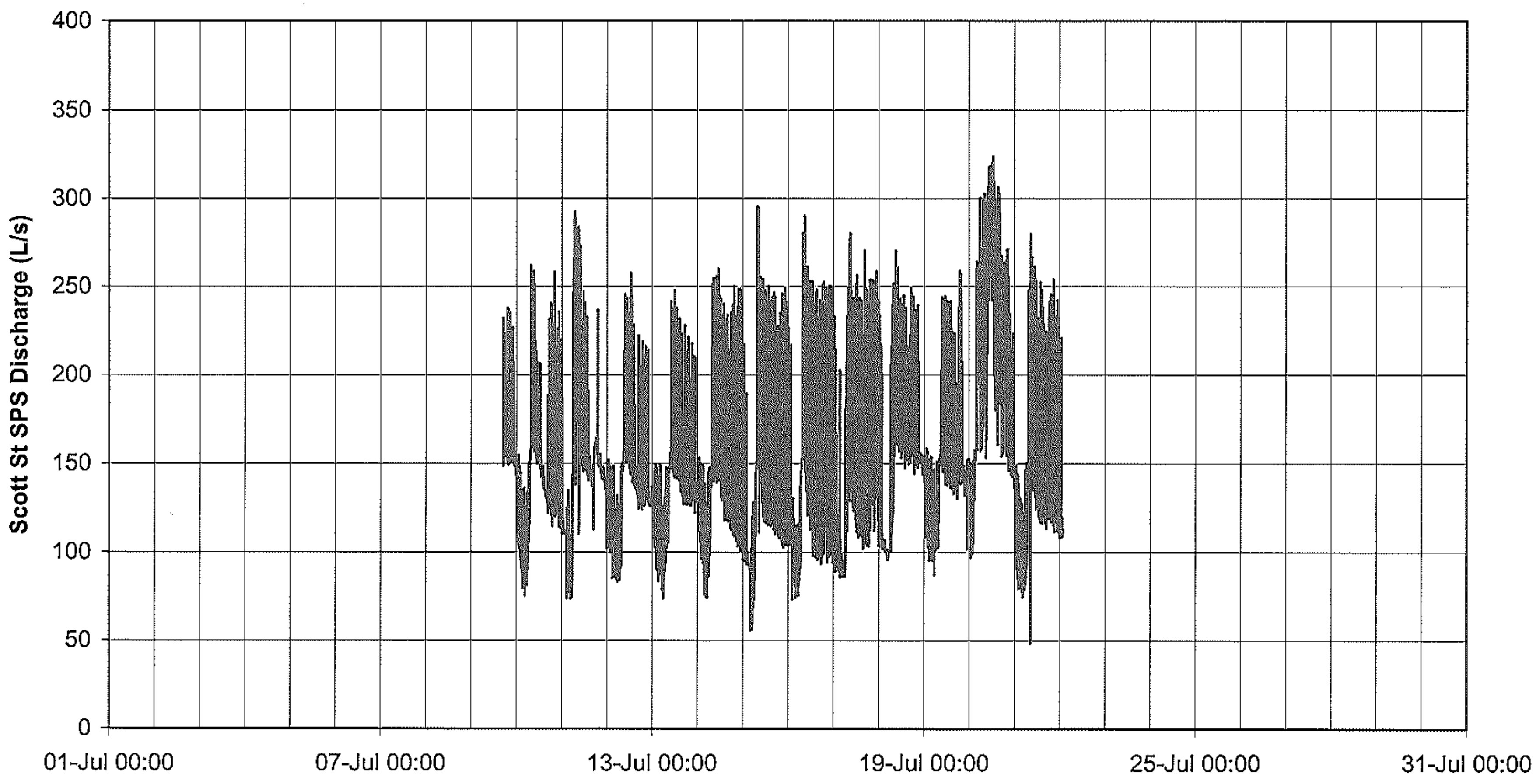
Scott St SPS Flow - April 2008

Scott St SPS Flow - May 2008

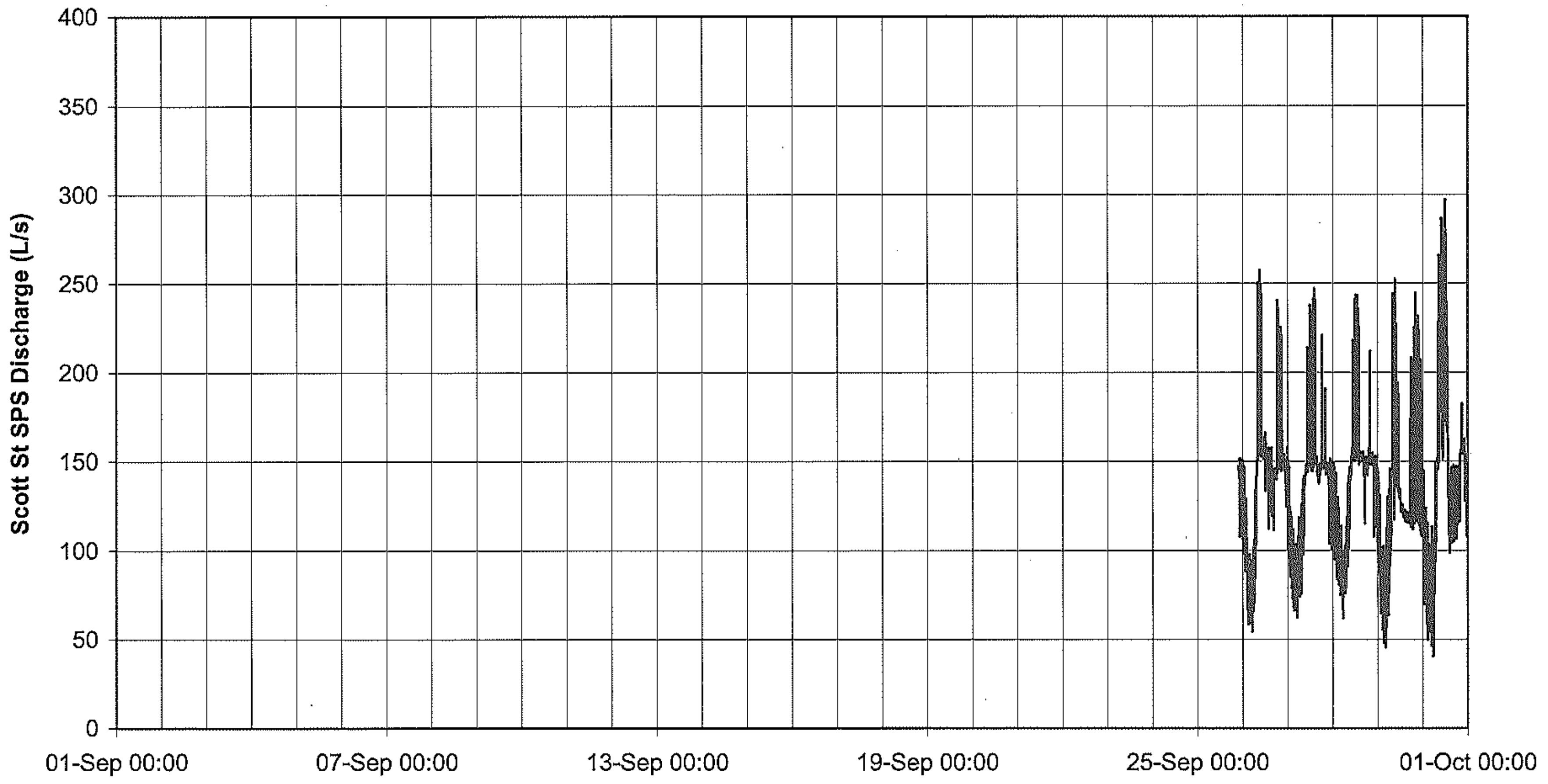


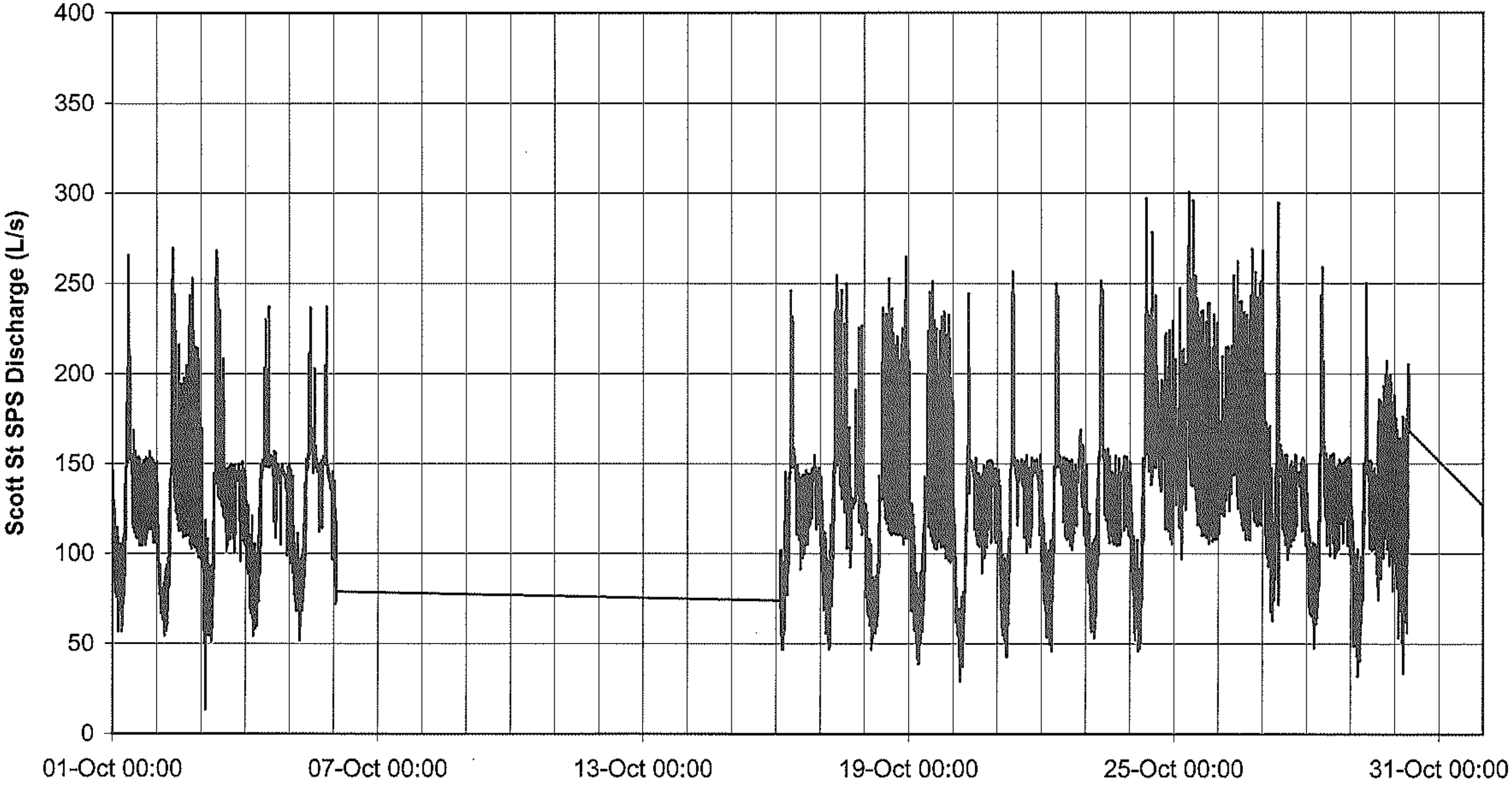

Scott St SPS Flow - June 2008
Scott St SPS Discharge (L/s)
400
350
300
250
200
150
100
50
0
01/06/2008 0:00
07/06/2008 0:00
13/06/2008 0:00
19/06/2008 0:00
25/06/2008 0:00
01/07/2008 0:00

Scott St SPS Flow - July 2008



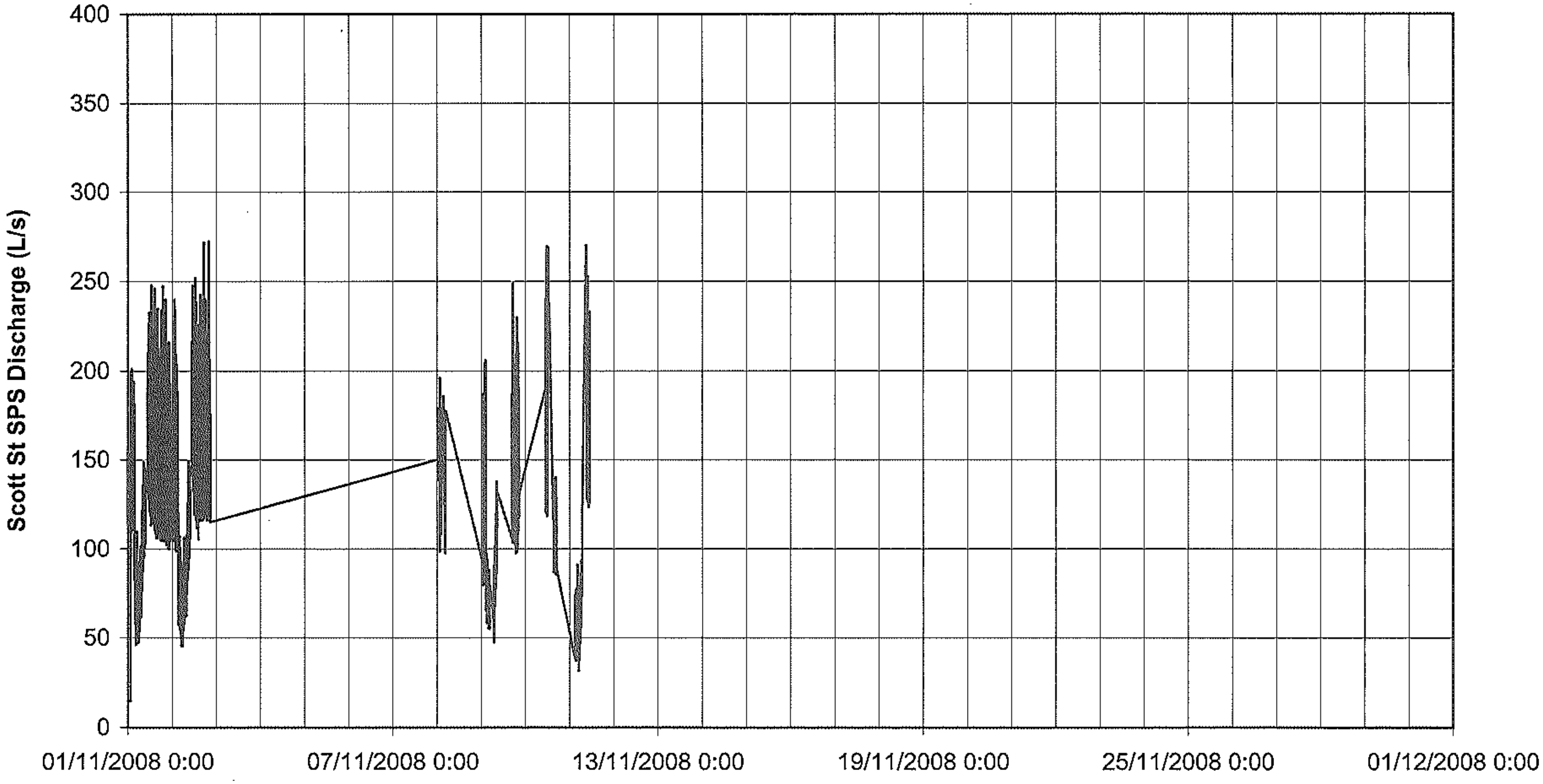
Scott St SPS Flow - September 2008





Scott St SPS Flow - October 2008

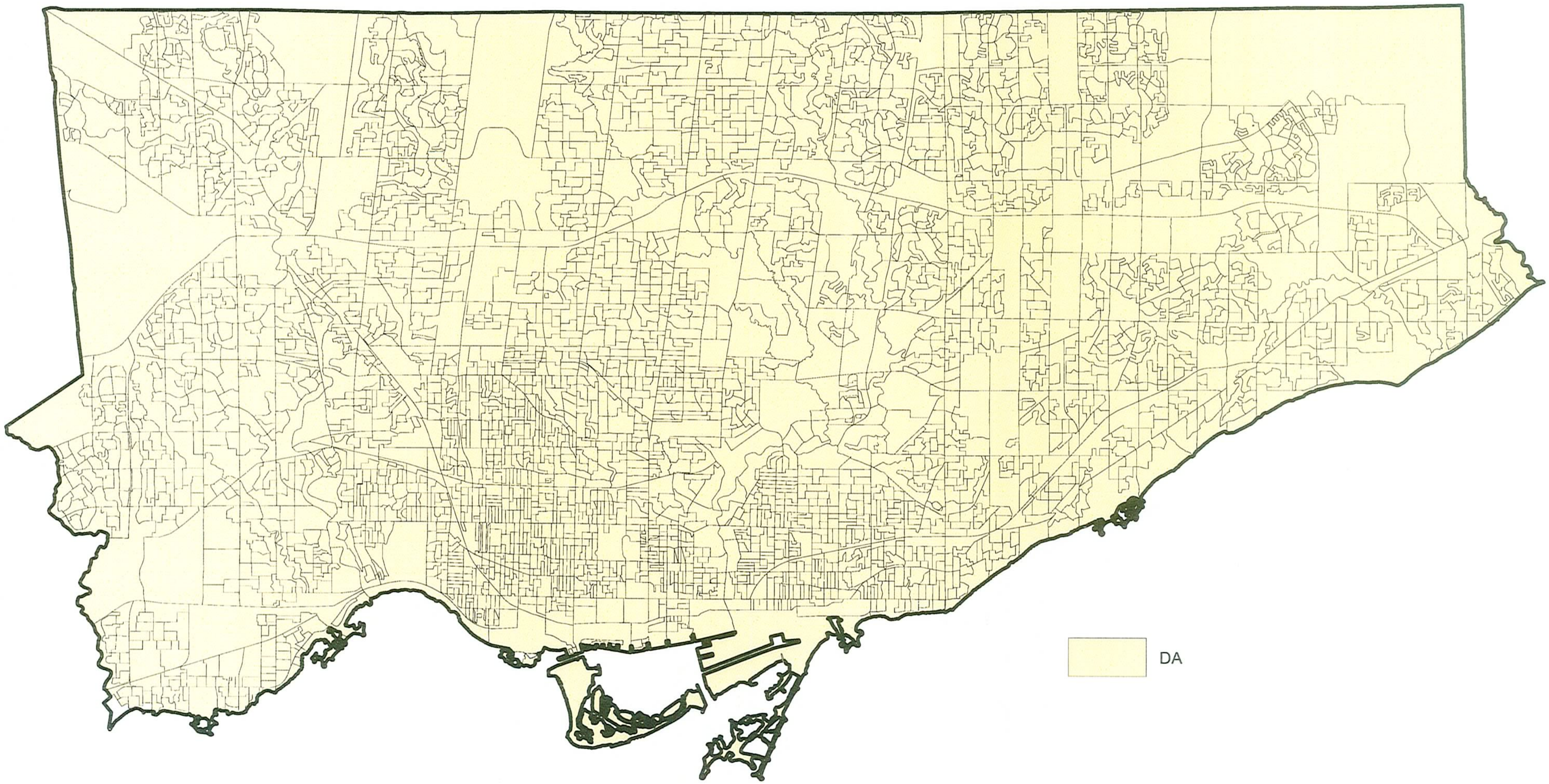
Scott St SPS Flow - November 2008



Appendix 3f

Census Data

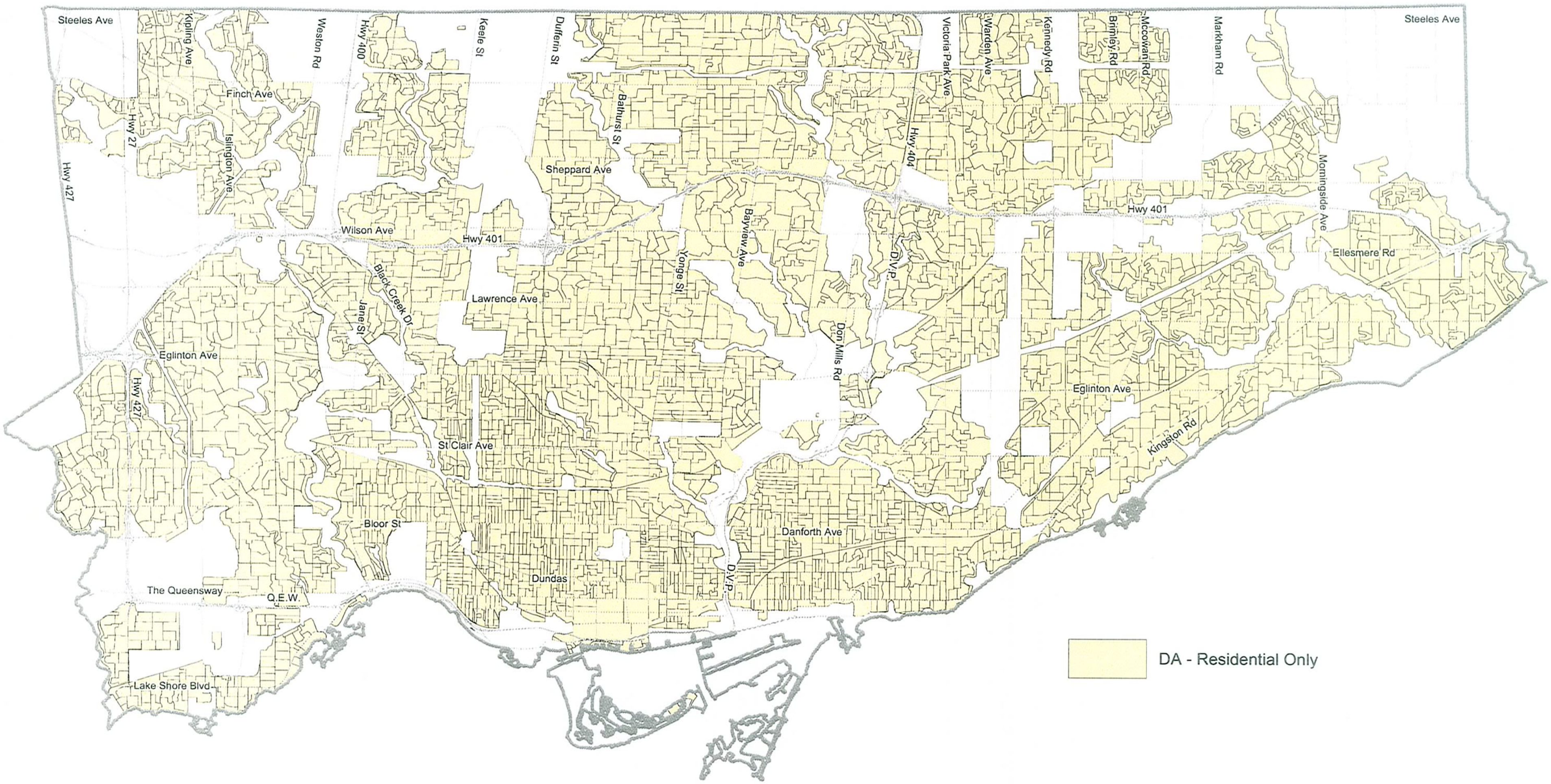
DA's of the City of Toronto



Source: Census of Canada 2006

Toronto City Planning, Research and Information - July 2007

DA's of the City of Toronto - Residential Only



Source: Census of Canada 2006

Toronto City Planning, Research and Information - July 2007

Scott Street Pumping Station Area - 2001 & 2006 Census Data

Source: Statistics Canada

DBUID		Area [ha]	ResArea [ha]	Pop2006	OccDwel06	TotDwel06	Pop2001	TotDwel01	Employ Area	FT Employ	PT Employ	Equiv Employ
3520082605	35200826			1070	599	634	966	633				
35200826	**35200826 Total**	1.5	1.5	1,070	599	634	966	633	0	0	0	0
3520082703	35200827			82	49	52	0	0				
3520082704	35200827			348	189	191	458	246				
35200827	**35200827 Total**	1.6	1.6	430	238	243	458	246	0	0	0	0
3520082801	35200828			574	291	301	589	302				
35200828	**35200828 Total**	1.6	1.6	574	291	301	589	302	0	0	0	0
3520082904	35200829			18	14	17	579	362				
35200829	**35200829 Total**	1.6	1.6	18	14	17	579	362	0	0	0	0
3520083005	35200830			429	232	237	461	237				
3520083006	35200830			0	0	0	0	0				
3520083007	35200830			0	0	0	0	0				
3520083008	35200830			868	491	513	353	167				
35200830	**35200830 Total**	6.0	6.0	1,297	723	750	814	404	0	0	0	0
3520083101	35200831			411	267	276	435	273				
3520083102	35200831			75	34	34	81	34				
3520083103	35200831			62	23	24	58	23				
35200831	**35200831 Total**	2.1	2.1	548	324	334	574	330	0	0	0	0
3520083204	35200832			0	0	0	0	0				
3520083205	35200832			0	0	0	0	0				
3520083207	35200832			0	0	0	0	0				
3520083208	35200832			0	0	0	0	0				
3520083209	35200832			0	0	0	0	0				
3520083210	35200832			0	0	0	0	0				
3520083212	35200832			0	0	0	0	0				
3520083216	35200832			621	346	365	683	365				
3520083217	35200832			0	0	0	0	0				
35200832	**35200832 Total**	28.1	1.3	621	346	365	683	365	27	5,204	2,050	6,229
3520083302	35200833			0	0	0	10	4				
3520083303	35200833			257	155	159	258	152				
3520083304	35200833			85	34	35	100	37				
3520083306	35200833			69	30	30	65	29				
3520083307	35200833			398	256	270	437	265				
35200833	**35200833 Total**	8.9	5.8	809	475	494	870	487	3	599	236	717
3520423004	35204230			221	114	118	126	80				
35204230	**35204230 Total**	12.9	12.9	221	114	118	126	80	0	0	0	0
3520465001	35204650			0	0	0	185	142				
3520465002	35204650			0	0	0	0	0				
3520465003	35204650			1,997	1,205	1,259	1,746	994				
35204650	**35204650 Total**	12.6	6.5	1,997	1,205	1,259	1,931	1,136	6	1,173	462	1,404
3520465101	35204651			368	285	307	303	259				
3520465102	35204651			0	0	0	168	129				
3520465103	35204651			0	0	0	0	0				
3520465104	35204651			0	0	0	0	0				
3520465105	35204651			0	0	1	0	0				
3520465106	35204651			72	36	36	0	0				
3520465107	35204651			0	0	0	0	0				
3520465108	35204651			0	0	0	0	0				
3520465109	35204651			0	0	0	0	0				
3520465110	35204651			0	0	0	0	0				
3520465111	35204651			0	0	0	0	0				
3520465112	35204651			0	0	0	15	0				
3520465113	35204651			0	0	0	0	0				
3520465115	35204651			0	0	0	0	0				
35204651	**35204651 Total**	55.4	33.0	440	321	344	486	388	22	4,344	1,711	5,200
3520465201	35204652			1,046	641	699	1,007	699				
35204652	**35204652 Total**	2.6	2.5	1,046	641	699	1,007	699	0	4	1	4
3520465301	35204653			0	0	0	0	0				
3520465302	35204653			2,832	1,679	1,951	2,941	1,955				
35204653	**35204653 Total**	6.2	6.2	2,832	1,679	1,951	2,941	1,955	0	0	0	0
3520465404	35204654			0	0	0	0	0				
3520465405	35204654			1,545	1,023	1,183	0	0				
3520465406	35204654			213	119	147	301	203				
3520465407	35204654			93	52	61	0	0				
3520465414	35204654			0	0	0	0	0				
35204654	**35204654 Total**	104.4	101.1	1,851	1,194	1,391	301	203	3	637	251	762
3520465501	35204655			2,572	1,599	1,817	999	641				
3520465502	35204655			0	1	1	629	443				
35204655	**35204655 Total**	5.1	5.1	2,572	1,600	1,818	1,628	1,084	0	0	0	0
	Grand Total			16,326	9,764	10,718	13,953	8,674	0	0	0	0
Total:				**48,978**	**29,292**	**32,154**	**41,859**	**26,022**	**62**	**11,961**	**4,712**	**14,317**

Scott Street Pumping Station Area - Employment

Source: Toronto Employment Survey 2006

Full time Employment	11,961
Part time Employment	4,712
Total	**16,673**

Appendix 3g

Hourly Rainfall Data

Station: TORONTO CITY CS ID: 6158355 Month: 04 Year: 2007 Chart Change: 0800 EST

TBRG RAIN RATE DATA

	Rainfall Rates (tenths of mm) For Specified Time Interval in Minutes								Hourly Rainfall (tenths of mm) In Specified Hour																								
DAY	5	10	15	30	60	120	360	720	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	Total
01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00000
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26	010	014	016	022	040	050	054	068	.	.	.	.	.	.	028	018	006	.	002	.	.	.	.	010	002	002	.	004	002	.	.	.	00074
27	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00000
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29	002	002	002	002	002	002	002	002	.	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00002
30	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00000

Notes: 1. (M) = Data not available 2. (.) = 0.0 mm Rainfall

Monthly Total (tenth of mm) = 76

Station: TORONTO CITY CS ID: 6158355 Month: 05 Year: 2007 Chart Change: 0800 EST

TBRG RAIN RATE DATA

Rainfall Rates (tenths of mm)
For Specified Time Interval in Minutes

Hourly Rainfall (tenths of mm)
In Specified Hour

DAY	5	10	15	30	60	120	360	720	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	Total
01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00000
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09	008	016	022	028	030	030	030	030	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	030	.	.	.	.	00030
10	002	002	002	002	002	002	002	002	.	.	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00002
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14	012	016	016	028	028	042	042	042	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	028	014	.	.	00042
15	036	046	048	058	080	110	226	316	.	.	.	.	.	.	.	.	.	048	046	032	.	022	072	010	.	006	028	048	004	.	.	.	00316
16	004	004	004	006	008	012	022	028	.	002	.	002	.	002	.	006	002	004	008	.	.	.	002	002	002	.	.	.	.	.	.	.	00032
17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00000
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26	006	010	010	010	010	010	016	016	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	010	.	006	.	.	.	.	00016
27	022	030	034	046	058	062	062	062	.	.	.	.	.	.	006	054	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00062
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30	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
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Notes: 1. (M) = Data not available 2. (.) = 0.0 mm Rainfall

Monthly Total (tenth of mm) = 500

Station: TORONTO CITY CS ID: 6158355 Month: 06 Year: 2007 Chart Change: 0800 EST

TBRG RAIN RATE DATA

	Rainfall Rates (tenths of mm) For Specified Time Interval in Minutes								Hourly Rainfall (tenths of mm) In Specified Hour																								
DAY	5	10	15	30	60	120	360	720	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	Total
01	002	002	002	002	002	002	002	002	.	.	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00002
02	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00000
03	018	026	040	062	076	076	086	088	.	.	.	.	.	.	.	.	.	002	074	.	004	.	002	004	.	.	.	.	.	002	010	008	00106
04	002	002	002	002	002	002	002	002	.	.	.	.	.	.	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00002
05	016	016	016	016	016	018	018	018	016	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00018
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08	026	042	044	050	060	064	064	064	.	.	.	.	.	.	.	.	060	004	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00064
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19	036	052	066	090	102	104	104	104	.	.	.	.	.	.	094	010	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00104
20	002	002	002	002	002	002	002	002	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00002
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28	002	002	002	002	002	002	002	002	.	.	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00002
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Notes: 1. (M) = Data not available 2. (.) = 0.0 mm Rainfall

Monthly Total (tenth of mm) = 318

Station: TORONTO CITY CS ID: 6158355 Month: 07 Year: 2007 Chart Change: 0800 EST

TBRG RAIN RATE DATA

	Rainfall Rates (tenths of mm) For Specified Time Interval in Minutes								Hourly Rainfall (tenths of mm) In Specified Hour																								
DAY	5	10	15	30	60	120	360	720	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	Total
01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00000
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03	004	006	006	008	010	010	010	010	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	010	00010
04	004	006	006	008	012	012	014	020	012	.	.	.	002	.	004	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	002	.	00022
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08	018	026	040	054	056	062	066	078	.	056	006	.	.	004	.	.	.	008	004	.	.	.	.	.	.	.	.	.	.	.	.	.	00078
09	002	002	002	002	002	002	002	002	.	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00002
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12	020	034	040	042	042	042	042	042	.	.	.	.	.	.	.	.	.	.	.	024	018	.	.	.	.	.	.	.	.	.	.	.	00042
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14	008	010	014	020	030	032	032	032	.	.	.	.	.	014	016	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00032
15	002	002	002	002	002	002	002	002	.	.	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00002
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19	056	090	124	136	136	138	154	154	.	.	.	.	.	136	002	.	.	.	016	.	.	.	.	.	.	.	.	.	.	.	.	.	00154
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23	004	006	006	008	008	010	012	012	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	002	008	002	.	.	.	.	.	00012
24	002	002	002	002	002	002	002	002	.	.	.	.	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00002
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29	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
30	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
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Notes: 1. (M) = Data not available 2. (.) = 0.0 mm Rainfall

Monthly Total (tenth of mm) = 356

Station: TORONTO CITY CS ID: 6158355 Month: 08 Year: 2007 Chart Change: 0800 EST

TBRG RAIN RATE DATA

	Rainfall Rates (tenths of mm) For Specified Time Interval in Minutes								Hourly Rainfall (tenths of mm) In Specified Hour																								
DAY	5	10	15	30	60	120	360	720	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	Total
01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00000
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07	004	004	004	004	004	006	008	008	.	.	.	.	.	.	.	.	.	002	002	004	.	.	.	.	.	.	.	.	.	.	.	.	00008
08	002	002	002	002	002	002	002	002	.	.	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00002
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12	006	008	010	016	020	028	034	034	.	.	.	.	.	010	016	006	.	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00034
13	002	002	002	002	002	002	002	002	.	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00002
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22	002	002	002	002	002	002	002	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	002	.	.	.	00002
23	008	012	016	026	036	038	038	038	.	.	.	.	.	008	030	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	002	00040
24	008	014	020	034	064	116	296	296	.	028	058	044	050	058	058	.	.	.	.	.	.	.	018	004	.	.	.	.	.	.	.	.	00318
25	038	054	076	100	102	102	108	110	002	.	002	004	.	.	.	100	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00110
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29	038	042	042	062	108	182	214	214	.	.	.	.	.	.	.	.	.	.	.	.	.	.	002	028	100	082	002	.	.	.	.	.	00214
30	002	002	002	002	002	002	002	002	.	.	.	.	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00002
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Notes: 1. (M) = Data not available 2. (.) = 0.0 mm Rainfall Monthly Total (tenth of mm) = 732

Station: TORONTO CITY CS   ID: 6158355   Month: 09   Year: 2007   Chart Change: 0800 EST

TBRG RAIN RATE DATA

	Rainfall Rates (tenths of mm) For Specified Time Interval in Minutes								Hourly Rainfall (tenths of mm) In Specified Hour																								
DAY	5	10	15	30	60	120	360	720	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	Total
01	004	006	006	010	012	012	012	012	.	.	.	.	.	.	006	006	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00012
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03	006	008	010	018	028	054	066	066	012	006	.	.	.	.	.	.	.	.	.	.	.	.	.	.	024	024	018	.	.	.	.	.	00084
04	006	008	010	016	020	028	028	032	.	.	.	002	.	.	.	.	.	.	.	.	.	.	004	.	.	.	.	004	018	006	.	.	00034
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08	004	006	008	010	020	028	028	028	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	002	014	012	.	00028
09	002	002	002	002	002	002	002	002	.	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00002
10	006	008	008	014	022	028	030	030	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	004	016	010	.	.	00030
11	030	040	042	052	052	052	052	052	.	.	.	.	.	.	.	.	.	.	.	052	.	.	.	.	.	.	.	.	.	.	.	.	00052
12	002	002	002	002	002	002	002	002	.	.	.	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00002
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14	060	116	158	158	158	158	158	244	.	158	.	.	.	.	.	.	.	048	032	006	.	.	.	.	.	.	.	.	.	.	.	.	00244
15	002	002	002	002	002	002	002	002	.	.	.	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00002
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26	010	016	020	024	026	030	032	032	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	002	020	006	004	.	.	.	.	.	00032
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Notes: 1. (M) = Data not available   2. (.) = 0.0 mm Rainfall   Monthly Total (tenth of mm) = 556

Station: TORONTO CITY CS   ID: 6158355   Month: 10   Year: 2007   Chart Change: 0800 EST

TBRG RAIN RATE DATA

Rainfall Rates (tenths of mm) For Specified Time Interval in Minutes

Hourly Rainfall (tenths of mm) In Specified Hour

DAY	5	10	15	30	60	120	360	720	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	Total
01	004	004	006	010	014	016	018	020	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	002	.	.	.	002	002	012	002	00020
02	002	002	002	002	002	002	002	002	.	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00002
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06	084	114	130	136	136	136	136	198	.	.	.	.	.	132	004	.	.	.	.	.	.	.	060	002	.	.	.	.	.	.	002	.	00200
07	002	002	002	002	002	002	002	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	002	.	00002
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10	008	014	016	024	030	036	042	042	.	.	.	.	.	.	.	006	030	002	002	002	.	.	.	.	.	.	.	.	002	.	.	.	00044
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18	002	004	004	004	004	004	004	004	.	.	.	.	.	.	.	.	004	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00004
19	004	006	006	006	006	006	008	010	002	002	.	.	.	.	006	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00010
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22	010	014	016	026	036	050	094	094	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	006	016	012	020	024	016	00094
23	004	006	008	014	024	032	048	052	018	012	006	006	006	.	004	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00052
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26	004	006	008	008	010	012	014	026	.	.	.	.	.	.	.	.	.	008	.	004	002	.	.	.	.	.	004	008	.	.	.	.	00026
27	002	002	002	002	002	002	002	002	.	.	.	.	.	.	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00002
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31	004	004	004	004	006	006	006	006	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	006	.	.	.	.	.	.	.	00006

Notes: 1. (M) = Data not available   2. (.) = 0.0 mm Rainfall

Monthly Total (tenth of mm) = 472

Station: TORONTO CITY CS   ID: 6158355   Month: 11   Year: 2007   Chart Change: 0800 EST

TBRG RAIN RATE DATA

	Rainfall Rates (tenths of mm) For Specified Time Interval in Minutes								Hourly Rainfall (tenths of mm) In Specified Hour																								
DAY	5	10	15	30	60	120	360	720	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	Total
01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00000
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05	008	008	010	012	018	032	034	040	.	.	.	.	004	002	.	.	.	004	012	016	002	.	.	.	.	.	.	.	.	.	004	.	00044
06	002	002	002	002	002	002	002	002	.	.	.	.	.	.	.	.	.	.	.	.	002	.	.	.	.	.	.	.	.	.	.	.	00002
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08	004	006	006	012	018	026	040	054	.	.	.	.	.	006	012	014	004	002	.	004	006	004	.	.	002	.	.	.	.	.	.	.	00054
09	004	004	004	006	008	014	016	020	.	.	.	.	.	.	.	.	.	002	006	006	002	.	.	.	.	004	.	.	.	.	.	.	00020
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11	004	004	004	004	004	004	004	006	.	.	.	.	.	.	.	.	.	.	.	.	.	002	.	.	.	.	.	.	.	.	.	004	00006
12	010	012	014	020	026	046	046	046	.	.	.	.	.	020	024	002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00046
13	006	006	006	006	006	006	006	006	.	.	.	.	.	006	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	00006
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30	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M

Notes: 1. (M) = Data not available   2. (.) = 0.0 mm Rainfall   Monthly Total (tenth of mm) = 178

Hourly Rainfall Data (tenths of mm) for Toronto City Raingauge (STA 6158355)

Source: Environment Canada

Date	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
01-Jan-08	8	12	8	0	6	0	0	11	0	21	25	11	23	7	0	12	0	0	0	0	0	0	0	0
02-Jan-08	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	7
07-Jan-08	0	0	0	0	0	0	0	0	0	0	8	11	0	0	0	0	0	0	0	0	0	0	0	0
08-Jan-08	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0
09-Jan-08	13	0	29	35	0	0	0	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-Jan-08	0	12	15	11	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Jan-08	9	0	13	0	7	0	8	0	0	0	0	0	0	0	0	0	0	0	0	7	M	0	0	0
15-Jan-08	0	0	0	0	0	0	6	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0
16-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Jan-08	9	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0
20-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22-Jan-08	0	0	0	0	0	0	0	0	0	14	0	0	0	7	0	0	0	9	0	0	0	0	0	0
23-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Jan-08	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0
27-Jan-08	0	7	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Jan-08	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	14	0
30-Jan-08	0	10	8	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Hourly Rainfall Data (tenths of mm) for Toronto City Raingauge (STA 6158355)

Source: Environment Canada

Date	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
01-Feb-08	0	0	0	0	0	0	18	21	25	15	0	12	7	11	17	16	0	9	0	15	28	0	12	0
02-Feb-08	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04-Feb-08	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	59	20
05-Feb-08	6	0	28	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06-Feb-08	9	11	40	36	29	11	8	0	7	0	0	0	0	0	0	6	0	9	16	28	26	16	15	0
07-Feb-08	14	0	0	0	13	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08-Feb-08	0	0	0	0	0	0	0	0	0	0	0	61	0	0	0	0	0	0	0	7	0	0	0	0
09-Feb-08	0	0	0	0	0	0	7	6	13	18	8	0	8	0	13	9	0	0	0	0	0	0	0	0
10-Feb-08	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0
11-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12-Feb-08	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	7	0	16	8	7	6	8	10	9
13-Feb-08	8	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	25	12	0	17	24	0	14	0	0	0	0	35
18-Feb-08	0	10	9	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0
19-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0
20-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0
22-Feb-08	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Feb-08	0	0	0	0	0	0	0	0	0	8	0	0	7	0	11	0	0	7	0	0	8	0	0	0
27-Feb-08	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	9	6	6	0	13	0	7

Hourly Rainfall Data (tenths of mm) for Toronto City Raingauge (STA 6158355)

Source: Environment Canada

Date	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
01-Mar-08	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02-Mar-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03-Mar-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	11	9
04-Mar-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	28
05-Mar-08	11	27	23	7	15	9	7	15	19	0	10	9	0	0	0	0	0	0	0	0	0	0	0	0
06-Mar-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07-Mar-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	6	6	0	11	0	0	7
08-Mar-08	6	0	0	0	6	0	0	0	0	0	27	15	14	0	6	6	13	20	19	30	0	9	0	0
09-Mar-08	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0
10-Mar-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-Mar-08	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12-Mar-08	0	10	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
13-Mar-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Mar-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-Mar-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16-Mar-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Mar-08	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Mar-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	12	11	13	0	10	0
19-Mar-08	0	0	10	13	6	0	9	8	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Mar-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0
21-Mar-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22-Mar-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Mar-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0
24-Mar-08	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
25-Mar-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	15	13	10	0	0	0	0
26-Mar-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Mar-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
28-Mar-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Mar-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Mar-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31-Mar-08	0	0	8	18	14	9	7	0	0	0	0	0	0	0	0	0	9	14	0	0	0	0	0	7

Hourly Rainfall Data (tenths of mm) for Toronto City Raingauge (STA 6158355)

Source: Environment Canada

Date	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
01-Apr-08	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02-Apr-08	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03-Apr-08	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04-Apr-08	0	0	0	0	0	0	10	8	9	17	12	12	0	0	0	0	0	0	0	0	0	0	0	0
05-Apr-08	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06-Apr-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07-Apr-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08-Apr-08	0	0	0	0	0	0	0	0	0	0	0	M	M	M	M	M	M	M	M	M	M	M	M	M
09-Apr-08	M	M	M	M	M	M	M	M	M	M	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-Apr-08	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-Apr-08	0	0	0	18	15	17	29	34	19	16	0	8	0	0	0	0	0	0	0	0	0	0	0	41
12-Apr-08	23	0	0	0	0	0	0	0	0	0	7	9	0	0	9	11	0	0	0	10	0	14	0	0
13-Apr-08	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Apr-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-Apr-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16-Apr-08	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Apr-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Apr-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Apr-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Apr-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Apr-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22-Apr-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Apr-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	0	0	0	0	0	0	0	0	0
24-Apr-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25-Apr-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Apr-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Apr-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28-Apr-08	0	0	0	0	0	18	20	30	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Apr-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Apr-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Hourly Rainfall Data (tenths of mm) for Toronto City Raingauge (STA 6158355)

Source: Environment Canada

Date	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
01-May-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	28
02-May-08	20	0	0	M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	10	0
03-May-08	0	0	0	0	0	0	0	0	0	0	0	0	0	24	8	0	17	61	14	0	0	0	0	0
04-May-08	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05-May-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06-May-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07-May-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	13	14	10	0	0	0	0
08-May-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09-May-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-May-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-May-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	8	0	0
12-May-08	0	0	11	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-May-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-May-08	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	7	0
15-May-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16-May-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-May-08	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0
18-May-08	0	0	0	0	0	0	0	0	0	0	7	16	44	25	0	21	0	0	0	0	0	0	0	0
19-May-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-May-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-May-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0
22-May-08	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-May-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-May-08	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0
25-May-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-May-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-May-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28-May-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-May-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-May-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	20
31-May-08	28	8	0	0	0	0	0	0	0	0	0	0	0	0	0	6	35	0	0	0	0	0	0	0

Hourly Rainfall Data (tenths of mm) for Toronto City Raingauge (STA 6158355)

Source: Environment Canada

Date	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
01-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03-Jun-08	0	0	0	0	0	0	0	12	8	0	0	13	11	0	0	0	0	0	0	0	7	0	0	0
04-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0
06-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0
09-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	25	0
10-Jun-08	88	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64	93	13
14-Jun-08	7	106	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	7	0	13	56	69	0	10	0
16-Jun-08	0	0	8	12	0	0	0	0	0	0	0	0	0	0	0	M	20	0	0	0	0	0	0	0
17-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0
19-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	M	14
22-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0
23-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	99	0	0	0	0	6	0	0	0
24-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28-Jun-08	0	0	12	9	0	51	130	0	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Jun-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Hourly Rainfall Data (tenths of mm) for Toronto City Raingauge (STA 6158355)

Source: Environment Canada

Date	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
01-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	7	0	0	0	0	0	0	0
03-Jul-08	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	171	350	0	0	0
09-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-Jul-08	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0
11-Jul-08	0	0	0	0	9	71	32	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-Jul-08	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0
16-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	0	8	0	0	0
20-Jul-08	0	13	26	27	70	31	41	34	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38	44
23-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Jul-08	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0
25-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0
28-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Jul-08	0	0	0	0	0	0	0	0	0	0	62	38	0	0	0	0	0	0	0	0	0	0	0	0
31-Jul-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Hourly Rainfall Data (tenths of mm) for Toronto City Raingauge (STA 6158355)

Source: Environment Canada

Date	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
01-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	52	0	6	29	27	0	0
06-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0
08-Aug-08	0	0	0	0	0	15	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	7	0	12	37	0	24	30	59	15	0	0	0
10-Aug-08	0	0	0	0	0	0	24	18	0	0	0	0	0	0	0	8	0	0	0	12	0	0	0	0
11-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	28	60	16	0	0	0	110	28	0	0	0
16-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	57	0	0	19
19-Aug-08	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	31
29-Aug-08	0	0	6	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	18	0
30-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31-Aug-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Hourly Rainfall Data (tenths of mm) for Toronto City Raingauge (STA 6158355)

Source: Environment Canada

Date	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
01-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06-Sep-08	0	0	0	0	0	13	7	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07-Sep-08	0	0	0	0	0	0	0	0	0	0	6	14	21	13	0	0	0	0	0	0	0	0	0	0
08-Sep-08	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	20	0	0	0
09-Sep-08	0	11	76	0	27	28	0	0	0	0	0	0	0	0	0	8	0	0	9	0	0	0	0	0
10-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	16	10	13	6	38	17	37
14-Sep-08	41	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33	20	0	0	0
15-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	19	0	0	0	0	0	0	0	0	0	9
28-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Sep-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Sep-08	0	0	0	0	13	0	0	0	19	36	0	21	0	0	0	0	0	0	0	0	0	0	0	0

Hourly Rainfall Data (tenths of mm) for Toronto City Raingauge (STA 6158355)

Source: Environment Canada

Date	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
01-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	38	25	0	0	0	0	0
03-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	M
05-Oct-08	M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	27	21	0	6	0	0	0	0
09-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16-Oct-08	8	7	0	10	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	11	8	17
21-Oct-08	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
25-Oct-08	12	13	0	0	0	6	20	39	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	10	0	0	0	0
27-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	17	0	0	14	0	0	0	0	0
28-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Oct-08	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Hourly Rainfall Data (tenths of mm) for Toronto City Raingauge (STA 6158355)

Source: Environment Canada

Date	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
01-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03-Nov-08	0	0	0	0	24	26	19	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08-Nov-08	14	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-Nov-08	0	0	0	0	9	13	13	0	7	16	20	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	9	0
15-Nov-08	8	0	10	0	0	13	8	11	19	12	15	15	6	17	10	8	0	23	17	6	65	0	0	29
16-Nov-08	26	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	11	0	7
20-Nov-08	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	10	12	7	0	7	7	0	0
25-Nov-08	7	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	8
26-Nov-08	0	7	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28-Nov-08	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	8	14	15	23	20

Hourly Rainfall Data (tenths of mm) for Toronto City Raingauge (STA 6158355)

Source: Environment Canada

Date	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
01-Dec-08	13	11	8	0	9	8	10	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0
02-Dec-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03-Dec-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04-Dec-08	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05-Dec-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06-Dec-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07-Dec-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08-Dec-08	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0
09-Dec-08	0	0	7	12	14	0	0	0	0	0	8	13	8	0	0	10	18	10	0	7	0	0	0	9
10-Dec-08	0	10	6	37	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-Dec-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12-Dec-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-Dec-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Dec-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-Dec-08	0	0	0	0	15	10	0	0	0	13	28	0	0	0	0	0	0	0	0	0	0	0	0	0
16-Dec-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	266	1902	0	0	0	0	0	0	0	10
17-Dec-08	14	13	7	14	10	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Dec-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Dec-08	0	0	0	0	0	0	0	0	0	11	12	14	16	12	21	25	10	10	0	0	0	0	0	0
20-Dec-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Dec-08	0	0	6	0	0	17	11	10	10	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0
22-Dec-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Dec-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	13	8	0	9	12	16
24-Dec-08	34	32	16	8	8	0	0	0	0	6	0	0	0	0	0	40	50	22	0	0	0	0	0	0
25-Dec-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Dec-08	0	0	0	0	0	0	0	0	0	0	9	14	0	0	0	0	0	0	0	0	0	0	0	0
27-Dec-08	0	0	0	0	17	7	9	10	8	8	0	0	0	19	8	0	0	0	0	0	0	0	0	6
28-Dec-08	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Dec-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Dec-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
31-Dec-08	9	7	0	12	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 3h

City of Toronto HVM Model Output

Contractions used in HVM Model Output

The HVM Model output contains the input data and the simulation results for every sewer system segment.

Header line:

eg. 3185	sewer segment number
eg. CIRCULAR	type of sewer cross-section
eg. 0.23/0.23 (m)	cross-sectional measurements (width/height)
INFLOW	inflow sewer segment numbers
OUTFLOW	outflow sewer segment numbers
B. NO.	block number
eg. EXIST. COMB.	type of sewer
3185	sewer segment number

First line:

YU, YL (m)	upper and lower invert elevations
QF (l/sec)	full-flow capacity
DQ (l/sec)	maximum storm runoff from tributary area (A)
QDLM (l/sec)	peak dry weather flow at lower end
VNIGHT (m/sec)	night dry-weather flow velocity
DUC, DLC (m)	difference between maximum hydraulic grade line elevation and section crown elevation at upper and lower ends (- means partial fill)
QLM (l/sec)	maximum flow rate at lower end
CAP (l/sec)	free capacity at lower end when loaded by QLM

Second line:

SU, SL (m)	upper and lower end surface elevations
AF (m**2)	cross-sectional area
DQD (l/sec)	dry-weather flow from tributary area (A)
HDLM (m)	flow depth corresponding to QDLM
HNIGHT (m)	night dry-weather flow depth difference between maximum hydraulic grade line elevation and surface elevation at upper and lower ends
RAIN	rain designation of storm
QLM/QF	ratio of maximum flow rate at lower end to full-flow capacity (loading ratio)

Third line:

RES (residents/ha)	population density
A (ha)	tributary area size
VF (m/sec)	flow velocity corresponding to QF
GAMMA	imperviousness ratio
VDLM (m/sec)	flow velocity corresponding to QDLM
VNORM (m/sec)	normal flow velocity for QDLM (other than zero only, if QDLM affected by backwater)
HU, HLM (m)	maximum flow depths (pressure head) above invert at upper and lower ends
QRQLM (l/sec)	portion of storm flow within QLM
DY (m)	difference between upper and lower invert elevation

Fourth line:

IW (l/sec)	industrial waste flow
S (m/m)	invert slope
N	Manning's n
SCOD	surface code of tributary area
DBW (m)	backwater build-up under QDLM
YUM, YLM (m)	maximum hydraulic grade line elevations at upper and lower ends
VLM (m/sec)	flow velocity corresponding to QLM
DH	indicator whether hydraulic grade line is steeper or flatter than invert slope DH = (YUM – YLM) – DY

```
      YU  83.290  YL  83.034   QF    226   DQ       0   QDLM    4  VNIGHTO.44  DUC   0.25   DLC   0.07    QLM       293   CAP 0000066
      SU  87.685  SL  87.569   AF 0.113    DQD    0.0   HDLM 0.03  HNIGHTO.01  DUS  -3.77   DLS  -4.09                    QLM/8601 30

      RES    221  A      0.0   VF   1.99   GAMMA 0.85   VDLM 0.79  VNORM 0.0   HUM   0.63   HLM   0.45    QRQLM     289   DY  0000 26
      IW     0.0  L     16.5   S                        SCOD    5  DWB    0.0  YUM  83.92   YLM  83.48    VLM      2.59   DH  0000 18

 996  EGG                0.61/0.91  INFLOW   988    991   995  OUTFLOW  W072       B.NO. 659700                          0000000
   *  YU  82.500  YL  82.138   QF    803   DQ      79   QDLM   34  VNIGHTO.61                                EXIST. COMB.0000996
      SU  87.569  SL  87.042   AF 0.422    DQD    1.1   HDLM 0.18  HNIGHTO.06  DUC   0.07   DLC   0.0     QLM       908   CAP 0000104
                                                                               DUS  -4.09   DLS  -3.99                    QLM/8601 13

      RES    221  A     0.47   VF   1.90   GAMMA 0.58   VDLM 0.73  VNORM 1.07  HUM   0.98   HLM   0.91    QRQLM     875   DY  0000 36
      IW     0.0  L     58.2   S                        SCOD    5  DWB   0.04  YUM  83.48   YLM  83.05    VLM      2.15   DH  0000 07

 997  EGG                0.61/0.91  INFLOW   W072          OUTFLOW  4102       B.NO. 659700                          0000000
   *  YU  82.138  YL  82.104   QF    491   DQ       0   QDLM   34  VNIGHTO.42  DUC  -0.20   DLC  -0.20    QLM       415   EXIST. COMB.0000997
      SU  87.042  SL  86.959   AF 0.422    DQD    0.0   HDLM 0.18  HNIGHTO.06  DUS  -4.19   DLS  -4.14                    CAP 0000076
                                                                                                                           QLM/8600 84

      RES    221  A      0.0   VF   1.16   GAMMA 0.58   VDLM 0.74  VNORM 0.0   HUM   0.71   HLM   0.71    QRQLM     399   DY  0000 03
      IW     0.0  L     14.6   S                        SCOD    5  DWB    0.0  YUM  82.85   YLM  82.82    VLM      1.22   DH  0000 00

 998  CIRCULAR           0.46/0.46  INFLOW                 OUTFLOW   999       B.NO. 175900                          0000000
      YU  82.811  YL  82.653   QF    185   DQ      59   QDLM    1  VNIGHTO.17  DUC  -0.34   DLC  -0.21    QLM        53   EXIST. COMB.0000998
      SU  85.435  SL  85.935   AF 0.166    DQD    1.0   HDLM 0.02  HNIGHTO.01  DUS  -2.50   DLS  -3.03                    CAP 0000131
                                                                                                                           QLM/8600 29

      RES    221  A     0.41   VF   1.11   GAMMA 0.50   VDLM 0.33  VNORM 0.0   HUM   0.12   HLM   0.25    QRQLM      52   DY  0000 16
      IW     0.0  L     42.1   S                        SCOD    5  DWB    0.0  YUM  82.93   YLM  82.90    VLM      0.58   DH  0000 13

 999  CIRCULAR           0.46/0.46  INFLOW   998           OUTFLOW  4100       B.NO. 175900                          0000000
      YU  82.637  YL  82.561   QF    125   DQ      42   QDLM    2  VNIGHTO.16  DUC  -0.19   DLC  -0.16    QLM        87   EXIST. COMB.0000999
      SU  85.935  SL  86.210   AF 0.166    DQD    0.7   HDLM 0.04  HNIGHTO.01  DUS  -3.03   DLS  -3.35                    CAP 0000037
                                                                                                                           QLM/8600 70

      RES    221  A     0.29   VF   0.75   GAMMA 0.50   VDLM 0.28  VNORM 0.0   HUM   0.27   HLM   0.30    QRQLM      86   DY  0000 08
      IW     0.0  L     44.5   S                        SCOD    5  DWB    0.0  YUM  82.90   YLM  82.86    VLM      0.80   DH  0000 03

1199  CIRCULAR           1.37/1.37  INFLOW                 OUTFLOW  1203  B202  B.NO. 310300  RECEIVING              0000000
   *  YU  73.795  YL  73.682   QF   1856   DQ       0   QDLM  772  VNIGHTO.66  DUC   2.55   DLC   2.58    QLM      1625   EXIST. COMB.0001199
      SU  80.101  SL  80.330   AF 1.472    DQD    0.0   HDLM 0.72  HNIGHTO.20  DUS  -2.38   DLS  -2.70                    CAP 0000231
                                                                                                                           QLM/8600 88

      RES      0  A     0.64   VF   1.26   GAMMA 0.0    VDLM 0.99  VNORM 1.21  HUM   3.92   HLM   3.95    QRQLM    1026   DY  0000 11
      IW     0.0  L    100.6   S                        SCOD  400  DWB   0.10  YUM  77.72   YLM  77.63    VLM      1.10   DH  0000 03
TORONTO SEWER SYSTEM STUDY AREA 7
                                                                                                                  CALCULATION NO 007546
EAST AREA
                                                                                                                         0000000
1201  EGG                0.81/1.22  INFLOW                 OUTFLOW  W156       B.NO. 149200  RECEIVING              0000000
   *  YU  75.261  YL  75.164   QF   2805   DQ       0   QDLM   34  VNIGHTO.87  DUC   0.30   DLC   0.26    QLM      3313   EXIST. COMB.0001201
      SU  80.184  SL  79.912   AF 0.759    DQD    0.0   HDLM 0.09  HNIGHTO.03  DUS  -3.40   DLS  -3.27                    CAP 0000507
                                                                                                                           QLM/8601 18

      RES      0  A      0.0   VF   3.70   GAMMA 0.0    VDLM 1.51  VNORM 0.0   HUM   1.52   HLM   1.48    QRQLM    3313   DY  0000 10
      IW     0.0  L      6.1   S                        SCOD  400  DWB    0.0  YUM  76.78   YLM  76.65    VLM      4.37   DH  0000 04

1202  CIRCULAR           0.30/0.30  INFLOW   W156          OUTFLOW  1203  B202  B.NO. 149200                         0000000
   *  YU  75.087  YL  74.825   QF    280   DQ       0   QDLM   34  VNIGHT1.48  DUC   2.19   DLC   2.45    QLM       279   EXIST. COMB.0001202
                                                                                                                           CAP 0000001
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     SU   79.912   SL   80.330    AF 0.071    DQD      0.0   HDLM 0.07   HNIGHT0.02    DUS   -2.34    DLS   -2.76
     RES         0   A       0.0    VF   3.97    GAMMA 0.0                                                                          QLM/8601 00
     IW        0.0   L       3.1    S                           VDLM 2.74   VNORM 0.0     HUM    2.49    HLM    2.75    QRQLM    279    DY   0000 26
                                                                SCOD 400    DWB    0.0    YUM   77.58    YLM   77.57    VLM     4.26    DH   0000 26

1204 CIRCULAR                 3.00/3.00   INFLOW   I204   B202                                                                          0000000
   * YU   73.383   YL   73.280    QF 47628    DQ          0           OUTFLOW               B.NO. 149200   RECEIVING          EXIST.  COMB.0001204
     SU   79.450   SL   79.450    AF 7.057    DQD       0.0  QDLM     0   VNIGHT2.23    DUC    0.12    DLC    0.12    QLM      3614    CAP 0044014
                                                             HDLM 0.0    HNIGHT0.0     DUS   -2.95    DLS   -3.05                      QLM/8600 08
     RES         0   A       0.0    VF   6.75    GAMMA 0.90
     IW        0.0   L       9.1    S                           VDLM 2.23   VNORM 0.0     HUM    3.12    HLM    3.12    QRQLM   3507    DY   0000 10
                                                                SCOD 211    DWB    0.0    YUM   76.50    YLM   76.40    VLM     0.51    DH   0000 00

1203 CIRCULAR                 1.45/1.45   INFLOW   1199   1202                                                                          0000000
   * YU   73.682   YL   73.652    QF  4518    DQ          0           OUTFLOW   1207        B.NO. 310400                      EXIST.  COMB.0001203
     SU   80.330   SL   80.245    AF 1.649    DQD       0.0  QDLM   806   VNIGHT0.59    DUC    2.62    DLC    2.65    QLM      1873    CAP 0002645
                                                             HDLM 0.74   HNIGHT0.21    DUS   -2.58    DLS   -2.49                      QLM/8600 41
     RES         0   A       0.0    VF   2.74    GAMMA 0.0
     IW        0.0   L       6.1    S                           VDLM 0.95   VNORM 2.10    HUM    4.07    HLM    4.10    QRQLM   1170    DY   0000 03
                                                                SCOD 400    DWB    0.33   YUM   77.75    YLM   77.75    VLM     1.14    DH   0000 03

1207 CIRCULAR                 1.45/1.45   INFLOW   1203                                                                                 0000000
     YU   73.652   YL   73.603    QF  1825    DQ          0           OUTFLOW   1208        B.NO. 310400                      EXIST.  COMB.0001207
     SU   80.245   SL   79.909    AF 1.649    DQD       0.0  QDLM   806   VNIGHT0.59    DUC    2.65    DLC    2.67    QLM      1822    CAP 0000004
                                                             HDLM 0.76   HNIGHT0.21    DUS   -2.49    DLS   -2.18                      QLM/8601 00
     RES         0   A       0.0    VF   1.11    GAMMA 0.0
     IW        0.0   L      61.0    S                           VDLM 0.92   VNORM 1.07    HUM    4.10    HLM    4.12    QRQLM   1167    DY   0000 05
                                                                SCOD 400    DWB    0.09   YUM   77.75    YLM   77.73    VLM     1.11    DH   0000 02

1208 CIRCULAR                 1.45/1.45   INFLOW   1207                                                                                 0000000
     YU   73.603   YL   73.542    QF  1861    DQ          0           OUTFLOW   1209        B.NO. 310402                      EXIST.  COMB.0001208
     SU   79.909   SL   79.909    AF 1.649    DQD       0.0  QDLM   806   VNIGHT0.60    DUC    2.67    DLC    2.70    QLM      1821    CAP 0000039
                                                             HDLM 0.78   HNIGHT0.22    DUS   -2.18    DLS   -2.21                      QLM/8600 98
     RES         0   A       0.0    VF   1.13    GAMMA 0.0
     IW        0.0   L      73.1    S                           VDLM 0.89   VNORM 1.09    HUM    4.12    HLM    4.15    QRQLM   1123    DY   0000 06
                                                                SCOD 400    DWB    0.12   YUM   77.73    YLM   77.70    VLM     1.10    DH   0000 03

1209 CIRCULAR                 1.45/1.45   INFLOW   1208                                                                                 0000000
     YU   73.542   YL   73.478    QF  1849    DQ          0           OUTFLOW   1210        B.NO. 310402                      EXIST.  COMB.0001209
     SU   79.909   SL   79.218    AF 1.649    DQD       0.0  QDLM   806   VNIGHT0.48    DUC    2.70    DLC    2.74    QLM      1821    CAP 0000028
                                                             HDLM 0.81   HNIGHT0.25    DUS   -2.21    DLS   -1.55                      QLM/8600 99
     RES         0   A       0.0    VF   1.12    GAMMA 0.0
     IW        0.0   L      77.7    S                           VDLM 0.85   VNORM 1.08    HUM    4.15    HLM    4.19    QRQLM   1069    DY   0000 06
                                                                SCOD 400    DWB    0.15   YUM   77.70    YLM   77.66    VLM     1.10    DH   0000 03
TORONTO SEWER SYSTEM STUDY AREA 7

EAST AREA                                                                                                               CALCULATION NO 007546

1210 CIRCULAR                 1.45/1.45   INFLOW   1209    225                                                                          0000000
   * YU   73.478   YL   73.466    QF  1348    DQ          0           OUTFLOW   1211        B.NO. 310600                                0000000
     SU   79.218   SL   79.818    AF 1.649    DQD       0.0  QDLM   807   VNIGHT0.48    DUC    2.73    DLC    2.73    QLM     EXIST.  COMB.0001210
                                                             HDLM 0.81   HNIGHT0.25    DUS   -1.56    DLS   -2.17             1821    CAP 0000473
     RES         0   A       0.0    VF   0.82    GAMMA 0.0                                                                          QLM/8601 35
     IW        0.0   L      27.4    S                           VDLM 0.85   VNORM 0.0     HUM    4.18    HLM    4.18    QRQLM   1053    DY   0000 01
                                                                SCOD 400    DWB    0.0    YUM   77.66    YLM   77.65    VLM     1.10    DH   0000 00

1211 CIRCULAR                 1.45/1.45   INFLOW   1210                                                                                 0000000
     YU   73.466   YL   73.359    QF  1862    DQ          0           OUTFLOW   1212        B.NO. 310600                      EXIST.  COMB.0001211
     SU   79.818   SL   78.995    AF 1.649    DQD       0.0  QDLM   807   VNIGHT0.60    DUC    2.73    DLC    2.78    QLM      1573    CAP 0000289
                                                             HDLM 0.69   HNIGHT0.21    DUS   -2.17    DLS   -1.40                      QLM/8600 84
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       IW      0.0  L      18.3    S                                  SCOD 400    DWB     0.11    YUM   73.64     YLM   73.64       VLM       0.01      DH   0000 76

3106   CIRCULAR              0.46/0.46   INFLOW   3103   3105               OUTFLOW   6161            B.NO.  292000                                             0000000
   *   YU   72.497   YL   72.219    QF      196    DQ           0     QDLM      43   VNIGHTO.52    DUC     0.69     DLC     0.94      QLM       EXIST.  COMB.0003106
       SU   76.889   SL   76.916    AF  0.166    DQD        0.0     HDLM 0.27    HNIGHTO.06    DUS    -3.24     DLS    -3.30                     75    CAP  0000121
                                                                                                                                                        QLM/8600  38
       RES       0   A       0.0     VF    1.18    GAMMA  0.0     VDLM 0.41    VNORM  0.96    HUM     1.15     HLM     1.40      QRQLM        28    DY   0000 28
       IW      0.0   L      65.5     S                             SCOD 400     DWB     0.13    YUM    73.65     YLM    73.62      VLM        0.45    DH   0000 25

3108   CIRCULAR              0.38/0.38   INFLOW   3092                       OUTFLOW                   B.NO.  309400   PASSING ON                              0000000
   *   YU   75.825   YL   75.764    QF      233    DQ           0     QDLM       0   VNIGHTO.0     DUC    -0.38     DLC    -0.38      QLM       EXIST.  STORM0003108
       SU   78.809   SL   78.797    AF  0.113    DQD        0.0     HDLM 0.0     HNIGHTO.0     DUS    -2.98     DLS    -3.03                      0    CAP  0000233
                                                                                                                                                        QLM/8600  00
       RES       0   A       0.0     VF    2.05    GAMMA  0.81    VDLM 0.0     VNORM  0.0     HUM     0.0      HLM     0.0       QRQLM         0    DY   0000 06
       IW      0.0   L       3.7     S                             SCOD 211     DWB     0.0     YUM    75.82     YLM    75.76      VLM        0.0     DH   0000 00

3128   CIRCULAR              0.38/0.38   INFLOW   6151                       OUTFLOW                   B.NO.  292000   PASSING ON                              0000000
   *   YU   74.630   YL   74.484    QF       97    DQ           0     QDLM       0   VNIGHTO.0     DUC    -0.38     DLC    -0.38      QLM       EXIST.  STORM0003128
       SU   76.764   SL   76.739    AF  0.113    DQD        0.0     HDLM 0.0     HNIGHTO.0     DUS    -2.13     DLS    -2.26                      0    CAP  0000097
                                                                                                                                                        QLM/8600  00
       RES       0   A       0.0     VF    0.86    GAMMA  0.65    VDLM 0.0     VNORM  0.0     HUM     0.0      HLM     0.0       QRQLM         0    DY   0000 15
       IW      0.0   L      50.9     S                             SCOD 305     DWB     0.0     YUM    74.63     YLM    74.48      VLM        0.0     DH   0000 00

3130   CIRCULAR              0.30/0.30   INFLOW                              OUTFLOW   3131            B.NO.  832600                                             0000000
       YU   75.142   YL   74.899    QF       48    DQ           0     QDLM       0   VNIGHTO.0     DUC    -0.30     DLC    -0.30      QLM       EXIST.  COMB.0003130
       SU   77.145   SL   76.992    AF  0.071    DQD        0.0     HDLM 0.0     HNIGHTO.0     DUS    -2.00     DLS    -2.09                      0    CAP  0000048
                                                                                                                                                        QLM/8600  00
       RES       0   A       0.0     VF    0.68    GAMMA  0.0     VDLM 0.0     VNORM  0.0     HUM     0.0      HLM     0.0       QRQLM         0    DY   0000 24
       IW      0.0   L      99.1     S                             SCOD 400     DWB     0.0     YUM    75.14     YLM    74.90      VLM        0.0     DH   0000 00

3131   CIRCULAR              0.30/0.30   INFLOW   3130                       OUTFLOW   3132            B.NO.  832600                                             0000000
       YU   74.899   YL   74.679    QF       46    DQ           0     QDLM       0   VNIGHTO.0     DUC    -0.30     DLC    -0.30      QLM       EXIST.  COMB.0003131
       SU   76.992   SL   76.794    AF  0.071    DQD        0.0     HDLM 0.0     HNIGHTO.0     DUS    -2.09     DLS    -2.12                      0    CAP  0000046
                                                                                                                                                        QLM/8600  00
       RES       0   A       0.0     VF    0.65    GAMMA  0.0     VDLM 0.0     VNORM  0.0     HUM     0.0      HLM     0.0       QRQLM         0    DY   0000 22
       IW      0.0   L      96.0     S                             SCOD 400     DWB     0.0     YUM    74.90     YLM    74.68      VLM        0.0     DH   0000 00

3132   CIRCULAR              0.30/0.30   INFLOW   3131                       OUTFLOW   3135            B.NO.  832600                                             0000000
       YU   74.679   YL   74.627    QF       47    DQ           0     QDLM       0   VNIGHTO.0     DUC    -0.30     DLC    -0.30      QLM       EXIST.  COMB.0003132
       SU   76.794   SL   76.736    AF  0.071    DQD        0.0     HDLM 0.0     HNIGHTO.0     DUS    -2.12     DLS    -2.11                      0    CAP  0000047
                                                                                                                                                        QLM/8600  00
       RES       0   A       0.0     VF    0.66    GAMMA  0.0     VDLM 0.0     VNORM  0.0     HUM     0.0      HLM     0.0       QRQLM         0    DY   0000 05
       IW      0.0   L      22.3     S                             SCOD 400     DWB     0.0     YUM    74.68     YLM    74.63      VLM        0.0     DH   0000 00
TORONTO SEWER SYSTEM STUDY AREA 7
                                                                                                                                        CALCULATION NO 002331
SCOTT STREET PUMPING STATION
                                                                                                                                                             0000000
3133   CIRCULAR              0.30/0.30   INFLOW   C615                       OUTFLOW   3134            B.NO.  619001                                             0000000
       YU   74.260   YL   74.100    QF       65    DQ           0     QDLM      18   VNIGHTO.06    DUC    -0.19     DLC    -0.08      QLM       EXIST.  COMB.0003133
       SU   77.710   SL   76.554    AF  0.071    DQD        0.0     HDLM 0.22    HNIGHTO.15    DUS    -3.34     DLS    -2.23                     19    CAP  0000046
                                                                                                                                                        QLM/8600  29
       RES       0   A       0.0     VF    0.92    GAMMA  0.0     VDLM 0.32    VNORM  0.80    HUM     0.11     HLM     0.22      QRQLM         0    DY   0000 16
       IW      0.0   L      35.0     S                             SCOD 400     DWB     0.11    YUM    74.37     YLM    74.32      VLM        0.34    DH   0000 11
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3134  CIRCULAR               0.30/0.30   INFLOW   3133
      YU  74.216  YL  73.887    QF     68    DQ              OUTFLOW   3135          B.NO. 619001                                    0000000
      SU  76.554  SL  76.736    AF 0.071     DQD        0   QDLM     18  VNIGHTO.45    DUC  -0.19    DLC   -0.19    QLM        EXIST. COMB.0003134
                                                        0.0 HDLM 0.10   HNIGHTO.03    DUS  -2.23    DLS   -2.74                19    CAP 0000049
      RES        0  A      0.0    VF   0.97    GAMMA 0.0                                                                            QLM/8600 28
      IW       0.0  L     65.5    S                          VDLM 0.82   VNORM 0.0     HUM   0.11    HLM    0.11    QRQLM       0   DY  0000 33
                                                             SCOD 400    DWB   0.0     YUM  74.32    YLM   73.99    VLM      0.84   DH  0000 00
3135  CIRCULAR               0.30/0.30   INFLOW   3132   3134
      YU  73.887  YL  73.740    QF     92    DQ              OUTFLOW   3136          B.NO. 619001                                    0000000
      SU  76.736  SL  76.755    AF 0.071     DQD        0   QDLM     18  VNIGHTO.55    DUC  -0.21    DLC   -0.21    QLM        EXIST. COMB.0003135
                                                        0.0 HDLM 0.09   HNIGHTO.03    DUS  -2.76    DLS   -2.92                19    CAP 0000073
      RES        0  A      0.0    VF   1.30    GAMMA 0.0                                                                            QLM/8600 21
      IW       0.0  L     16.1    S                          VDLM 1.02   VNORM 0.0     HUM   0.09    HLM    0.09    QRQLM       0   DY  0000 15
                                                             SCOD 400    DWB   0.0     YUM  73.98    YLM   73.83    VLM      1.04   DH  0000 00
3136  CIRCULAR               0.30/0.30   INFLOW   3135
      YU  73.740  YL  72.838    QF    102    DQ              OUTFLOW   3156          B.NO. 832500                                    0000000
      SU  76.755  SL  77.294    AF 0.071     DQD        0   QDLM     18  VNIGHTO.60    DUC  -0.21    DLC    0.45    QLM        EXIST. COMB.0003136
                                                        0.0 HDLM 0.18   HNIGHTO.05    DUS  -2.93    DLS   -3.71                21    CAP 0000081
      RES        0  A      0.0    VF   1.45    GAMMA 0.0                                                                            QLM/8600 21
      IW       0.0  L     80.5    S                          VDLM 0.42   VNORM 1.11    HUM   0.09    HLM    0.75    QRQLM       0   DY  0000 90
                                                             SCOD 400    DWB   0.09    YUM  73.83    YLM   73.58    VLM      0.43   DH  0000 66
3137  CIRCULAR               0.30/0.30   INFLOW
      YU  74.767  YL  74.630    QF     58    DQ              OUTFLOW   3138          B.NO. 641200                                    0000000
      SU  76.950  SL  76.962    AF 0.071     DQD        0   QDLM      0  VNIGHTO.0     DUC  -0.30    DLC   -0.30    QLM        EXIST. COMB.0003137
                                                        0.0 HDLM 0.0    HNIGHTO.0     DUS  -2.18    DLS   -2.33                 0    CAP 0000058
      RES        0  A      0.0    VF   0.82    GAMMA 0.0                                                                            QLM/8600 00
      IW       0.0  L     38.1    S                          VDLM 0.0    VNORM 0.0     HUM   0.0     HLM    0.0     QRQLM       0   DY  0000 14
                                                             SCOD 400    DWB   0.0     YUM  74.77    YLM   74.63    VLM      0.0    DH  0000 00
3138  CIRCULAR               0.30/0.30   INFLOW   3137
      YU  74.630  YL  74.432    QF     57    DQ              OUTFLOW   3139          B.NO. 641200                                    0000000
      SU  76.962  SL  76.901    AF 0.071     DQD        0   QDLM      0  VNIGHTO.0     DUC  -0.30    DLC   -0.30    QLM        EXIST. COMB.0003138
                                                        0.0 HDLM 0.0    HNIGHTO.0     DUS  -2.33    DLS   -2.47                 0    CAP 0000057
      RES        0  A      0.0    VF   0.81    GAMMA 0.0                                                                            QLM/8600 00
      IW       0.0  L     57.0    S                          VDLM 0.0    VNORM 0.0     HUM   0.0     HLM    0.0     QRQLM       0   DY  0000 20
                                                             SCOD 400    DWB   0.0     YUM  74.63    YLM   74.43    VLM      0.0    DH  0000 00
3139  CIRCULAR               0.30/0.30   INFLOW   3138
      YU  74.432  YL  74.124    QF     56    DQ              OUTFLOW   3140          B.NO. 641200                                    0000000
      SU  76.901  SL  76.855    AF 0.071     DQD        0   QDLM      0  VNIGHTO.0     DUC  -0.30    DLC   -0.30    QLM        EXIST. COMB.0003139
                                                        0.0 HDLM 0.0    HNIGHTO.0     DUS  -2.47    DLS   -2.73                 0    CAP 0000056
      RES        0  A      0.0    VF   0.79    GAMMA 0.0                                                                            QLM/8600 00
      IW       0.0  L     92.1    S                          VDLM 0.0    VNORM 0.0     HUM   0.0     HLM    0.0     QRQLM       0   DY  0000 31
                                                             SCOD 400    DWB   0.0     YUM  74.43    YLM   74.12    VLM      0.0    DH  0000 00
TORONTO SEWER SYSTEM STUDY AREA 7
SCOTT STREET PUMPING STATION                                                                                         CALCULATION NO 002331
3140  CIRCULAR               0.30/0.30   INFLOW   3139                                                                                 0000000
      YU  74.124  YL  74.121    QF     17    DQ              OUTFLOW   3141          B.NO. 641200                                    0000000
      SU  76.855  SL  76.916    AF 0.071     DQD        0   QDLM      0  VNIGHTO.0     DUC  -0.30    DLC   -0.30    QLM        EXIST. COMB.0003140
                                                        0.0 HDLM 0.0    HNIGHTO.0     DUS  -2.73    DLS   -2.79                 0    CAP 0000017
      RES        0  A      0.0    VF   0.24    GAMMA 0.0                                                                            QLM/8600 00
      IW       0.0  L      9.8    S                          VDLM 0.0    VNORM 0.0     HUM   0.0     HLM    0.0     QRQLM       0   DY  0000 00
                                                             SCOD 400    DWB   0.0     YUM  74.12    YLM   74.12    VLM      0.0    DH  0000 00
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                                                                                                                                      0000000
3141  CIRCULAR             0.30/0.30  INFLOW  3140                     OUTFLOW  3142          B.NO.  92100                      EXIST. COMB.0003141
      YU  74.121  YL  73.762    QF      58    DQ          0   QDLM      0  VNIGHTO.0    DUC  -0.30    DLC  -0.30    QLM         0   CAP 0000058
      SU  76.916  SL  76.871    AF 0.071      DQD       0.0   HDLM 0.0     HNIGHTO.0    DUS  -2.79    DLS  -3.11                        QLM/8600 00

      RES       0  A     0.0    VF   0.82     GAMMA 0.0       VDLM 0.0     VNORM 0.0    HUM   0.0     HLM   0.0     QRQLM       0   DY   0000 36
      IW      0.0  L    99.1    S                             SCOD 400     DWB    0.0   YUM  74.12    YLM  73.76    VLM    0.0      DH   0000 00

                                                                                                                                      0000000
3142  CIRCULAR             0.30/0.30  INFLOW  3141                     OUTFLOW  3147          B.NO.  92100                      EXIST. COMB.0003142
      YU  73.762  YL  73.740    QF      47    DQ          0   QDLM      0  VNIGHTO.0    DUC  -0.30    DLC  -0.30    QLM         0   CAP 0000047
      SU  76.871  SL  76.413    AF 0.071      DQD       0.0   HDLM 0.0     HNIGHTO.0    DUS  -3.11    DLS  -2.67                        QLM/8600 00

      RES       0  A     0.0    VF   0.67     GAMMA 0.0       VDLM 0.0     VNORM 0.0    HUM   0.0     HLM   0.0     QRQLM       0   DY   0000 02
      IW      0.0  L     9.1    S                             SCOD 400     DWB    0.0   YUM  73.76    YLM  73.74    VLM    0.0      DH   0000 00

                                                                                                                                      0000000
3143  CIRCULAR             0.30/0.30  INFLOW                           OUTFLOW  3144          B.NO. 717900                      EXIST. COMB.0003143
      YU  74.716  YL  74.411    QF      56    DQ          0   QDLM      0  VNIGHTO.0    DUC  -0.30    DLC  -0.30    QLM         0   CAP 0000056
      SU  76.999  SL  77.041    AF 0.071      DQD       0.0   HDLM 0.0     HNIGHTO.0    DUS  -2.28    DLS  -2.63                        QLM/8600 00

      RES       0  A     0.0    VF   0.79     GAMMA 0.0       VDLM 0.0     VNORM 0.0    HUM   0.0     HLM   0.0     QRQLM       0   DY   0000 31
      IW      0.0  L    91.4    S                             SCOD 400     DWB    0.0   YUM  74.72    YLM  74.41    VLM    0.0      DH   0000 00

                                                                                                                                      0000000
3144  CIRCULAR             0.30/0.30  INFLOW  3143                     OUTFLOW  3145          B.NO. 717900                      EXIST. COMB.0003144
      YU  74.411  YL  74.365    QF      70    DQ          0   QDLM      0  VNIGHTO.0    DUC  -0.30    DLC  -0.30    QLM         0   CAP 0000070
      SU  77.041  SL  76.627    AF 0.071      DQD       0.0   HDLM 0.0     HNIGHTO.0    DUS  -2.63    DLS  -2.26                        QLM/8600 00

      RES       0  A     0.0    VF   0.99     GAMMA 0.0       VDLM 0.0     VNORM 0.0    HUM   0.0     HLM   0.0     QRQLM       0   DY   0000 05
      IW      0.0  L     8.8    S                             SCOD 400     DWB    0.0   YUM  74.41    YLM  74.37    VLM    0.0      DH   0000 00

                                                                                                                                      0000000
3145  CIRCULAR             0.30/0.30  INFLOW  3144                     OUTFLOW  3146          B.NO. 460700                      EXIST. COMB.0003145
      YU  74.335  YL  74.015    QF      49    DQ          0   QDLM      0  VNIGHTO.0    DUC  -0.30    DLC  -0.30    QLM         0   CAP 0000049
      SU  76.627  SL  76.456    AF 0.071      DQD       0.0   HDLM 0.0     HNIGHTO.0    DUS  -2.29    DLS  -2.44                        QLM/8600 00

      RES       0  A     0.0    VF   0.69     GAMMA 0.0       VDLM 0.0     VNORM 0.0    HUM   0.0     HLM   0.0     QRQLM       0   DY   0000 32
      IW      0.0  L   124.1    S                             SCOD 400     DWB    0.0   YUM  74.34    YLM  74.01    VLM    0.0      DH   0000 00

                                                                                                                                      0000000
3146  CIRCULAR             0.30/0.30  INFLOW  3145                     OUTFLOW  3147          B.NO. 460700                      EXIST. COMB.0003146
      YU  73.984  YL  73.740    QF      52    DQ          0   QDLM      0  VNIGHTO.0    DUC  -0.30    DLC  -0.30    QLM         0   CAP 0000052
      SU  76.456  SL  76.413    AF 0.071      DQD       0.0   HDLM 0.0     HNIGHTO.0    DUS  -2.47    DLS  -2.67                        QLM/8600 00

      RES       0  A     0.0    VF   0.73     GAMMA 0.0       VDLM 0.0     VNORM 0.0    HUM   0.0     HLM   0.0     QRQLM       0   DY   0000 24
      IW      0.0  L    85.0    S                             SCOD 400     DWB    0.0   YUM  73.98    YLM  73.74    VLM    0.0      DH   0000 00
TORONTO SEWER SYSTEM STUDY AREA 7                                                                                         CALCULATION NO 002331

SCOTT STREET PUMPING STATION                                                                                                          0000000
                                                                                                                                      0000000
3147  CIRCULAR             0.30/0.30  INFLOW  3142  3146               OUTFLOW  3148          B.NO. 460600                      EXIST. COMB.0003147
      YU  73.710  YL  73.524    QF      45    DQ          0   QDLM      0  VNIGHTO.0    DUC  -0.30    DLC  -0.22    QLM         0   CAP 0000045
      SU  76.413  SL  76.962    AF 0.071      DQD       0.0   HDLM 0.04    HNIGHTO.0    DUS  -2.70    DLS  -3.36                        QLM/8600 01

      RES       0  A     0.0    VF   0.64     GAMMA 0.0       VDLM 0.0     VNORM 0.0    HUM   0.0     HLM   0.08    QRQLM       0   DY   0000 19
      IW      0.0  L    85.3    S                             SCOD 400     DWB    0.04  YUM  73.71    YLM  73.61    VLM    0.06     DH   0000 08

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3148  CIRCULAR             0.30/0.30  INFLOW  3147            OUTFLOW  3153          B.NO.  460600                       EXIST.  COMB.0003148
      YU  73.524  YL  73.445   QF      66   DQ          0  QDLM      0  VNIGHTO.0   DUC  -0.22   DLC  -0.14   QLM        0  CAP  0000066
      SU  76.962  SL  76.794   AF  0.071    DQD       0.0  HDLM  0.12  HNIGHTO.04  DUS  -3.36   DLS  -3.19                 QLM/8600  01
      RES      0  A      0.0   VF    0.94   GAMMA  0.0     VDLM  0.0   VNORM  0.0  HUM   0.08   HLM   0.16   QRQLM      0  DY   0000  08
      IW     0.0  L     16.8   S                           SCOD  400   DWB   0.12  YUM  73.61   YLM  73.60   VLM     0.02  DH   0000  08
                                                                                                                                0000000
3149  CIRCULAR             0.30/0.30  INFLOW                  OUTFLOW  3150          B.NO.  641100                       EXIST.  COMB.0003149
      YU  74.642  YL  74.350   QF      64   DQ          0  QDLM      0  VNIGHTO.0   DUC  -0.30   DLC  -0.30   QLM        0  CAP  0000064
      SU  77.056  SL  76.959   AF  0.071    DQD       0.0  HDLM  0.0   HNIGHTO.0   DUS  -2.41   DLS  -2.61                 QLM/8600  00
      RES      0  A      0.0   VF    0.91   GAMMA  0.0     VDLM  0.0   VNORM  0.0  HUM    0.0   HLM    0.0   QRQLM      0  DY   0000  29
      IW     0.0  L     66.1   S                           SCOD  400   DWB    0.0  YUM  74.64   YLM  74.35   VLM      0.0  DH   0000  00
                                                                                                                                0000000
3150  CIRCULAR             0.30/0.30  INFLOW  3149            OUTFLOW  3151          B.NO.  641100                       EXIST.  COMB.0003150
      YU  74.350  YL  74.292   QF      67   DQ          0  QDLM      0  VNIGHTO.0   DUC  -0.30   DLC  -0.25   QLM        0  CAP  0000067
      SU  76.959  SL  76.950   AF  0.071    DQD       0.0  HDLM  0.0   HNIGHTO.0   DUS  -2.61   DLS  -2.61                 QLM/8600  00
      RES      0  A      0.0   VF    0.94   GAMMA  0.0     VDLM  0.0   VNORM  0.0  HUM    0.0   HLM   0.05   QRQLM      0  DY   0000  06
      IW     0.0  L     12.2   S                           SCOD  400   DWB    0.0  YUM  74.35   YLM  74.34   VLM      0.0  DH   0000  05
                                                                                                                                0000000
3151  CIRCULAR             0.30/0.30  INFLOW  3150            OUTFLOW  3152          B.NO.  706400                       EXIST.  COMB.0003151
      YU  74.292  YL  73.963   QF      59   DQ         15  QDLM     15  VNIGHTO.38  DUC  -0.25   DLC  -0.19   QLM       16  CAP  0000043
      SU  76.950  SL  76.971   AF  0.071    DQD      14.7  HDLM  0.10  HNIGHTO.03  DUS  -2.61   DLS  -2.90                 QLM/8600  27
      RES      0  A      0.0   VF    0.84   GAMMA  0.0     VDLM  0.70  VNORM  0.0  HUM   0.05   HLM   0.11   QRQLM      0  DY   0000  33
      IW    14.7  L     87.8   S                           SCOD  400   DWB    0.0  YUM  74.34   YLM  74.07   VLM     0.72  DH   0000  06
                                                                                                                                0000000
3152  CIRCULAR             0.30/0.30  INFLOW  3151            OUTFLOW  3153          B.NO.  706500                       EXIST.  COMB.0003152
      YU  73.963  YL  73.762   QF      63   DQ          0  QDLM     15  VNIGHTO.40  DUC  -0.20   DLC  -0.20   QLM       16  CAP  0000047
      SU  76.971  SL  76.794   AF  0.071    DQD       0.0  HDLM  0.10  HNIGHTO.03  DUS  -2.91   DLS  -2.93                 QLM/8600  25
      RES      0  A      0.0   VF    0.89   GAMMA  0.0     VDLM  0.74  VNORM  0.0  HUM   0.10   HLM   0.10   QRQLM      0  DY   0000  20
      IW     0.0  L     46.9   S                           SCOD  400   DWB    0.0  YUM  74.07   YLM  73.86   VLM     0.75  DH   0000  00
                                                                                                                                0000000
3153  CIRCULAR             0.30/0.30  INFLOW  3148  3152      OUTFLOW  3154          B.NO.  706510                       EXIST.  COMB.0003153
      YU  73.445  YL  73.317   QF      41   DQ          0  QDLM     15  VNIGHTO.29  DUC  -0.14   DLC  -0.03   QLM       22  CAP  0000019
      SU  76.794  SL  76.794   AF  0.071    DQD       0.0  HDLM  0.12  HNIGHTO.04  DUS  -3.19   DLS  -3.21                 QLM/8600  53
      RES      0  A      0.0   VF    0.58   GAMMA  0.0     VDLM  0.54  VNORM  0.0  HUM   0.16   HLM   0.27   QRQLM      0  DY   0000  13
      IW     0.0  L     70.7   S                           SCOD  400   DWB    0.0  YUM  73.61   YLM  73.59   VLM     0.55  DH   0000  11
TORONTO SEWER SYSTEM STUDY AREA 7                                                                                   CALCULATION NO 002331

SCOTT STREET PUMPING STATION                                                                                                    0000000
                                                                                                                                0000000
3154  CIRCULAR             0.30/0.30  INFLOW  3153            OUTFLOW  3155          B.NO.  706520                       EXIST.  COMB.0003154
      YU  73.317  YL  73.112   QF      46   DQ          0  QDLM     15  VNIGHTO.32  DUC  -0.03   DLC   0.17   QLM       24  CAP  0000021
      SU  76.794  SL  76.633   AF  0.071    DQD       0.0  HDLM  0.12  HNIGHTO.04  DUS  -3.21   DLS  -3.05                 QLM/8600  53
      RES      0  A      0.0   VF    0.64   GAMMA  0.0     VDLM  0.58  VNORM  0.0  HUM   0.27   HLM   0.47   QRQLM      0  DY   0000  21
      IW     0.0  L     92.1   S                           SCOD  400   DWB    0.0  YUM  73.59   YLM  73.58   VLM     0.61  DH   0000  20
                                                                                                                                0000000
3155  CIRCULAR             0.30/0.30  INFLOW  3154            OUTFLOW  3156          B.NO.  706600                       EXIST.  COMB
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3155  YU  73.112  YL  72.862   QF     51   DQ        0   QDLM    15  VNIGHT0.34   DUC   0.17   DLC   0.42    QLM          24   CAP 0000026
      SU  76.633  SL  77.294   AF 0.071    DQD     0.0   HDLM 0.15   HNIGHT0.04   DUS  -3.05   DLS  -3.71                     QLM/8600 48

      RES      0  A     0.0    VF   0.72   GAMMA 0.0     VDLM 0.41   VNORM 0.63   HUM   0.47   HLM   0.72    QRQLM         0   DY  0000 25
      IW     0.0  L    90.8    S                         SCOD 400    DWB    0.04   YUM  73.58   YLM  73.58    VLM        0.42   DH  0000 25

3156  CIRCULAR           0.38/0.38  INFLOW  3136  3155       OUTFLOW  3159        B.NO. 832500                               0000000
      YU  72.838  YL  72.801   QF     97   DQ        0   QDLM    33  VNIGHT0.43   DUC   0.37   DLC   0.40          EXIST.  COMB.0003156
      SU  77.294  SL  77.139   AF 0.113    DQD     0.0   HDLM 0.20   HNIGHT0.06   DUS  -3.71   DLS  -3.56    QLM          44   CAP 0000053
                                                                                                                         QLM/8600 45
      RES      0  A     0.0    VF   0.86   GAMMA 0.0     VDLM 0.55   VNORM 0.78   HUM   0.75   HLM   0.78    QRQLM         0   DY  0000 04
      IW     0.0  L    12.8    S                         SCOD 400    DWB    0.05   YUM  73.58   YLM  73.58    VLM        0.56   DH  0000 04

3157  CIRCULAR           0.30/0.30  INFLOW                   OUTFLOW  3158        B.NO. 706600                               0000000
      YU  74.767  YL  74.463   QF     68   DQ        0   QDLM     0  VNIGHT0.0    DUC  -0.30   DLC  -0.30          EXIST.  COMB.0003157
      SU  76.983  SL  76.989   AF 0.071    DQD     0.0   HDLM 0.0    HNIGHT0.0    DUS  -2.22   DLS  -2.53    QLM           0   CAP 0000068
                                                                                                                         QLM/8600 00
      RES      0  A     0.0    VF   0.96   GAMMA 0.0     VDLM 0.0    VNORM 0.0    HUM   0.0    HLM   0.0     QRQLM         0   DY  0000 30
      IW     0.0  L    61.0    S                         SCOD 400    DWB    0.0    YUM  74.77   YLM  74.46    VLM         0.0   DH  0000 00

3158  CIRCULAR           0.30/0.30  INFLOW  3157         OUTFLOW  3159        B.NO. 706600                               0000000
      YU  74.463  YL  74.137   QF     68   DQ        0   QDLM     0  VNIGHT0.0    DUC  -0.30   DLC  -0.30          EXIST.  COMB.0003158
      SU  76.989  SL  77.139   AF 0.071    DQD     0.0   HDLM 0.0    HNIGHT0.0    DUS  -2.53   DLS  -3.00    QLM           0   CAP 0000068
                                                                                                                         QLM/8600 00
      RES      0  A     0.0    VF   0.97   GAMMA 0.0     VDLM 0.0    VNORM 0.0    HUM   0.0    HLM   0.0     QRQLM         0   DY  0000 33
      IW     0.0  L    65.2    S                         SCOD 400    DWB    0.0    YUM  74.46   YLM  74.14    VLM         0.0   DH  0000 00

3159  CIRCULAR           0.38/0.38  INFLOW  3156  3158       OUTFLOW  3160        B.NO. 832400                               0000000
      YU  72.801  YL  72.722   QF     66   DQ        0   QDLM    33  VNIGHT0.32   DUC   0.40   DLC   0.48          EXIST.  COMB.0003159
      SU  77.139  SL  77.280   AF 0.113    DQD     0.0   HDLM 0.24   HNIGHT0.07   DUS  -3.56   DLS  -3.70    QLM          47   CAP 0000019
                                                                                                                         QLM/8600 71
      RES      0  A     0.0    VF   0.58   GAMMA 0.0     VDLM 0.44   VNORM 0.58   HUM   0.78   HLM   0.86    QRQLM         0   DY  0000 08
      IW     0.0  L    59.4    S                         SCOD 400    DWB    0.05   YUM  73.58   YLM  73.58    VLM        0.47   DH  0000 08

3160  CIRCULAR           0.38/0.38  INFLOW  3159         OUTFLOW  C617        B.NO. 832400                               0000000
      YU  72.722  YL  72.680   QF     47   DQ        0   QDLM    33  VNIGHT0.25   DUC   0.48   DLC   0.52          EXIST.  COMB.0003160
      SU  77.280  SL  77.020   AF 0.113    DQD     0.0   HDLM 0.24   HNIGHT0.07   DUS  -3.70   DLS  -3.44    QLM          49   CAP 0000000
                                                                                                                         QLM/8601 03
      RES      0  A     0.0    VF   0.42   GAMMA 0.0     VDLM 0.44   VNORM 0.0    HUM   0.86   HLM   0.90    QRQLM         0   DY  0000 04
      IW     0.0  L    61.3    S                         SCOD 400    DWB    0.0    YUM  73.58   YLM  73.58    VLM        0.45   DH  0000 04
TORONTO SEWER SYSTEM STUDY AREA 7
                                                                                                          CALCULATION NO 002331
SCOTT STREET PUMPING STATION
                                                                                                                             0000000
3161  CIRCULAR           0.38/0.38  INFLOW  C617         OUTFLOW  3164        B.NO. 832400                               0000000
      YU  72.597  YL  72.521   QF     56   DQ        0   QDLM    38  VNIGHT0.30   DUC   0.60   DLC   0.68          EXIST.  COMB.0003161
      SU  76.860  SL  77.294   AF 0.113    DQD     0.0   HDLM 0.23   HNIGHT0.07   DUS  -3.28   DLS  -3.72    QLM          59   CAP 0000002
                                                                                                                         QLM/8601 05
      RES      0  A     0.0    VF   0.49   GAMMA 0.0     VDLM 0.52   VNORM 0.0    HUM   0.98   HLM   1.06    QRQLM         0   DY  0000 08
      IW     0.0  L    80.2    S                         SCOD 400    DWB    0.0    YUM  73.58   YLM  73.58    VLM        0.53   DH  0000 08

3162  CIRCULAR           0.30/0.30  INFLOW               OUTFLOW  3163        B.NO. 321100                               0000000
      YU  74.252  YL  74.002   QF     56   DQ        0   QDLM     0  VNIGHT0.0    DUC  -0.30   DLC  -0.30          EXIST.  COMB.0003162
                                                                                                               QLM           0   CAP 0000056
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     SU  76.971  SL   76.868   AF 0.071   DQD      0.0   HDLM 0.0    HNIGHTO.0    DUS  -2.72   DLS  -2.87                        QLM/8600 00

     RES       0  A      0.0   VF  0.79   GAMMA 0.0      VDLM 0.0    VNORM 0.0    HUM   0.0    HLM   0.0     QRQLM      0   DY  0000 25
     IW      0.0  L     74.1   S                         SCOD 400    DWB    0.0   YUM  74.25   YLM  74.00    VLM     0.0    DH  0000 00

3163 CIRCULAR           0.30/0.30  INFLOW   3162                OUTFLOW  3164           B.NO. 321100                            0000000
     YU  74.002  YL   73.844   QF     48   DQ          0   QDLM    0  VNIGHTO.0    DUC  -0.30   DLC  -0.30    QLM       0  EXIST. COMB.0003163
     SU  76.868  SL   77.294   AF 0.071    DQD       0.0   HDLM 0.0   HNIGHTO.0    DUS  -2.87   DLS  -3.45                      CAP 0000048
                                                                                                                              QLM/8600 00
     RES       0. A      0.0   VF  0.68    GAMMA 0.0       VDLM 0.0   VNORM 0.0    HUM   0.0    HLM   0.0    QRQLM      0   DY  0000 16
     IW      0.0  L     63.7   S                           SCOD 400   DWB    0.0   YUM  74.00   YLM  73.84   VLM     0.0    DH  0000 00

3164 CIRCULAR           0.38/0.38  INFLOW   3161  3163          OUTFLOW  3193           B.NO. 832300                            0000000
     YU  72.521  YL   72.335   QF     77   DQ          0   QDLM   38  VNIGHTO.38   DUC   0.68   DLC   0.86    QLM      65  EXIST. COMB.0003164
     SU  77.294  SL   77.383   AF 0.113    DQD       0.0   HDLM 0.26  HNIGHTO.08   DUS  -3.72   DLS  -3.81                      CAP 0000012
                                                                                                                              QLM/8600 84
     RES       0  A      0.0   VF  0.68    GAMMA 0.0       VDLM 0.45  VNORM 0.68   HUM   1.06   HLM   1.24   QRQLM      0   DY  0000 19
     IW      0.0  L    102.7   S                           SCOD 400   DWB   0.07   YUM  73.58   YLM  73.58   VLM     0.57   DH  0000 19

3165 CIRCULAR           0.30/0.30  INFLOW                       OUTFLOW  3166           B.NO. 641010                            0000000
     YU  74.469  YL   74.466   QF      7   DQ          0   QDLM    0  VNIGHTO.0    DUC  -0.30   DLC  -0.30    QLM       0  EXIST. COMB.0003165
     SU  77.069  SL   77.215   AF 0.071    DQD       0.0   HDLM 0.0   HNIGHTO.0    DUS  -2.60   DLS  -2.75                      CAP 0000007
                                                                                                                              QLM/8600 00
     RES       0  A      0.0   VF  0.10    GAMMA 0.0       VDLM 0.0   VNORM 0.0    HUM   0.0    HLM   0.0    QRQLM      0   DY  0000 00
     IW      0.0  L     55.5   S                           SCOD 400   DWB    0.0   YUM  74.47   YLM  74.47   VLM     0.0    DH  0000 00

3166 CIRCULAR           0.30/0.30  INFLOW   3165                OUTFLOW  3167           B.NO. 641010                            0000000
     YU  74.466  YL   74.313   QF     48   DQ          0   QDLM    0  VNIGHTO.0    DUC  -0.30   DLC  -0.30    QLM       0  EXIST. COMB.0003166
     SU  77.215  SL   76.874   AF 0.071    DQD       0.0   HDLM 0.0   HNIGHTO.0    DUS  -2.75   DLS  -2.56                      CAP 0000048
                                                                                                                              QLM/8600 00
     RES       0  A      0.0   VF  0.68    GAMMA 0.0       VDLM 0.0   VNORM 0.0    HUM   0.0    HLM   0.0    QRQLM      0   DY  0000 15
     IW      0.0  L     61.0   S                           SCOD 400   DWB    0.0   YUM  74.47   YLM  74.31   VLM     0.0    DH  0000 00

3167 CIRCULAR           0.30/0.30  INFLOW   3166                OUTFLOW  3168           B.NO. 641010                            0000000
     YU  74.313  YL   74.069   QF     50   DQ          0   QDLM    0  VNIGHTO.0    DUC  -0.30   DLC  -0.30    QLM       0  EXIST. COMB.0003167
     SU  76.874  SL   76.962   AF 0.071    DQD       0.0   HDLM 0.0   HNIGHTO.0    DUS  -2.56   DLS  -2.89                      CAP 0000050
                                                                                                                              QLM/8600 00
     RES       0  A      0.0   VF  0.71    GAMMA 0.0       VDLM 0.0   VNORM 0.0    HUM   0.0    HLM   0.0    QRQLM      0   DY  0000 24
     IW      0.0  L     91.4   S                           SCOD 400   DWB    0.0   YUM  74.31   YLM  74.07   VLM     0.0    DH  0000 00
TORONTO SEWER SYSTEM STUDY AREA 7
                                                                                                               CALCULATION NO 002331
SCOTT STREET PUMPING STATION
                                                                                                                                0000000
3168 CIRCULAR           0.30/0.30  INFLOW   3167                OUTFLOW  3169           B.NO. 640900                            0000000
     YU  74.069  YL   73.804   QF     54   DQ          0   QDLM    0  VNIGHTO.0    DUC  -0.30   DLC  -0.29    QLM       0  EXIST. COMB.0003168
     SU  76.962  SL   77.069   AF 0.071    DQD       0.0   HDLM 0.0   HNIGHTO.0    DUS  -2.89   DLS  -3.26                      CAP 0000054
                                                                                                                              QLM/8600 00
     RES       0  A      0.0   VF  0.76    GAMMA 0.0       VDLM 0.0   VNORM 0.0    HUM   0.0    HLM   0.01   QRQLM      0   DY  0000 26
     IW      0.0  L     84.7   S                           SCOD 400   DWB    0.0   YUM  74.07   YLM  73.81   VLM     0.0    DH  0000 01

3169 CIRCULAR           0.30/0.30  INFLOW   3168                OUTFLOW  3173           B.NO. 640900                            0000000
     YU  73.804  YL   73.765   QF     55   DQ          0   QDLM    0  VNIGHTO.0    DUC  -0.29   DLC  -0.25    QLM       0  EXIST. COMB.0003169
     SU  77.069  SL   77.008   AF 0.071    DQD       0.0   HDLM 0.04  HNIGHTO.0    DUS  -3.26   DLS  -3.20                      CAP 0000054
                                                                                                                              QLM/8600 00
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     RES       O  A      0.0    VF  0.77   GAMMA 0.0    VDLM 0.0   VNORM 0.0     HUM   0.01   HLM   0.05    QRQLM      O   DY  0000 04
     IW      0.0  L     12.2    S                       SCOD 400   DWB    0.04   YUM  73.81   YLM  73.81    VLM     0.01   DH  0000 04

3170 CIRCULAR            0.30/0.30  INFLOW                        OUTFLOW  3171        B.NO. 640700                                  0000000
     YU  74.338  YL  74.076   QF     50   DQ       8    QDLM     8  VNIGHT0.29   DUC  -0.26   DLC  -0.21     QLM         EXIST. COMB.0003170
     SU  76.919  SL  76.999   AF 0.071   DQD     8.2    HDLM 0.08   HNIGHT0.03   DUS  -2.54   DLS  -2.84               9   CAP 0000041
                                                                                                                          QLM/8600 18
     RES       O  A      0.0    VF  0.71   GAMMA 0.0    VDLM 0.53  VNORM 0.0     HUM   0.04   HLM   0.09    QRQLM      O   DY  0000 26
     IW      8.2  L     96.9    S                       SCOD 400   DWB    0.0    YUM  74.38   YLM  74.16    VLM     0.55   DH  0000 04

3171 CIRCULAR            0.30/0.30  INFLOW   3170                 OUTFLOW  3172        B.NO. 640700                                  0000000
     YU  74.076  YL  73.795   QF     52   DQ       O    QDLM     8  VNIGHT0.29   DUC  -0.21   DLC  -0.20     QLM         EXIST. COMB.0003171
     SU  76.999  SL  76.782   AF 0.071   DQD     0.0    HDLM 0.09   HNIGHT0.03   DUS  -2.84   DLS  -2.89              10   CAP 0000042
                                                                                                                          QLM/8600 19
     RES       O  A      0.0    VF  0.74   GAMMA 0.0    VDLM 0.55  VNORM 0.0     HUM   0.09   HLM   0.10    QRQLM      O   DY  0000 28
     IW      0.0  L     96.9    S                       SCOD 400   DWB    0.01   YUM  74.16   YLM  73.89    VLM     0.50   DH  0000 01

3172 CIRCULAR            0.30/0.30  INFLOW   3171                 OUTFLOW  3173        B.NO. 640700                                  0000000
     YU  73.795  YL  73.765   QF     41   DQ       O    QDLM     8  VNIGHT0.25   DUC  -0.20   DLC  -0.20     QLM         EXIST. COMB.0003172
     SU  76.782  SL  77.008   AF 0.071   DQD     0.0    HDLM 0.09   HNIGHT0.03   DUS  -2.89   DLS  -3.14              10   CAP 0000031
                                                                                                                          QLM/8600 24
     RES       O  A      0.0    VF  0.58   GAMMA 0.0    VDLM 0.46  VNORM 0.0     HUM   0.10   HLM   0.10    QRQLM      O   DY  0000 03
     IW      0.0  L     16.5    S                       SCOD 400   DWB    0.0    YUM  73.89   YLM  73.86    VLM     0.48   DH  0000 00

3173 CIRCULAR            0.30/0.30  INFLOW   3169  3172           OUTFLOW  3174        B.NO. 427300                                  0000000
     YU  73.698  YL  73.655   QF     32   DQ       O    QDLM     8  VNIGHT0.21   DUC  -0.19   DLC  -0.18     QLM         EXIST. COMB.0003173
     SU  77.008  SL  76.886   AF 0.071   DQD     0.0    HDLM 0.10   HNIGHT0.03   DUS  -3.20   DLS  -3.11              10   CAP 0000022
                                                                                                                          QLM/8600 32
     RES       O  A      0.0    VF  0.45   GAMMA 0.0    VDLM 0.38  VNORM 0.0     HUM   0.11   HLM   0.12    QRQLM      O   DY  0000 04
     IW      0.0  L     39.6    S                       SCOD 400   DWB    0.0    YUM  73.81   YLM  73.77    VLM     0.40   DH  0000 00

3174 CIRCULAR            0.30/0.30  INFLOW   3173                 OUTFLOW  3175        B.NO. 427300                                  0000000
     YU  73.594  YL  73.478   QF     49   DQ       O    QDLM     8  VNIGHT0.28   DUC  -0.21   DLC  -0.15     QLM         EXIST. COMB.0003174
     SU  76.886  SL  76.904   AF 0.071   DQD     0.0    HDLM 0.08   HNIGHT0.03   DUS  -3.20   DLS  -3.28              11   CAP 0000038
                                                                                                                          QLM/8600 22
     RES       O  A      0.0    VF  0.69   GAMMA 0.0    VDLM 0.52  VNORM 0.0     HUM   0.09   HLM   0.15    QRQLM      O   DY  0000 12
     IW      0.0  L     45.7    S                       SCOD 400   DWB    0.0    YUM  73.69   YLM  73.63    VLM     0.56   DH  0000 06
TORONTO SEWER SYSTEM STUDY AREA 7
                                                                                                                CALCULATION NO 002331
SCOTT STREET PUMPING STATION
                                                                                                                                 0000000
3175 CIRCULAR            0.30/0.30  INFLOW   3174                 OUTFLOW  3176        B.NO. 427300                                  0000000
     YU  73.478  YL  73.432   QF     51   DQ       O    QDLM     8  VNIGHT0.29   DUC  -0.15   DLC  -0.11     QLM         EXIST. COMB.0003175
     SU  76.904  SL  76.938   AF 0.071   DQD     0.0    HDLM 0.08   HNIGHT0.03   DUS  -3.28   DLS  -3.32              11   CAP 0000040
                                                                                                                          QLM/8600 21
     RES       O  A      0.0    VF  0.72   GAMMA 0.0    VDLM 0.53  VNORM 0.0     HUM   0.15   HLM   0.19    QRQLM      O   DY  0000 05
     IW      0.0  L     16.8    S                       SCOD 400   DWB    0.0    YUM  73.63   YLM  73.62    VLM     0.58   DH  0000 04

3176 CIRCULAR            0.30/0.30  INFLOW   3175                 OUTFLOW  3177        B.NO. 427300                                  0000000
     YU  73.432  YL  73.411   QF     51   DQ       O    QDLM     8  VNIGHT0.29   DUC  -0.11   DLC  -0.09     QLM         EXIST. COMB.0003176
     SU  76.938  SL  76.938   AF 0.071   DQD     0.0    HDLM 0.08   HNIGHT0.03   DUS  -3.32   DLS  -3.32              11   CAP 0000040
                                                                                                                          QLM/8600 21
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3176

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      RES        0  A       0.0     VF   0.72    GAMMA 0.0      VDLM 0.54   VNORM 0.0      HUM    0.19    HLM    0.21     QRQLM       0    DY   0000 02
      IW       0.0  L         7.6   S                           SCOD 400    DWB     0.00   YUM   73.62    YLM   73.62     VLM      0.58    DH   0000 02

3177  CIRCULAR               0.30/0.30  INFLOW   3176                                                                                        0000000
      YU   73.411   YL   73.280   QF      49    DQ          0             OUTFLOW   3178        B.NO.  427300                     EXIST.  COMB.0003177
      SU   76.938   SL   76.794   AF  0.071     DQD       0.0   QDLM      8   VNIGHTO.28   DUC   -0.09    DLC    0.04     QLM       13    CAP  0000036
                                                                HDLM 0.08   HNIGHTO.03   DUS   -3.32    DLS   -3.18                      QLM/8600 27

      RES        0  A       0.0     VF   0.70    GAMMA 0.0      VDLM 0.52   VNORM 0.0      HUM    0.21    HLM    0.34     QRQLM       0    DY   0000 13
      IW       0.0  L        50.3   S                           SCOD 400    DWB     0.0    YUM   73.62    YLM   73.62     VLM      0.54    DH   0000 13

3178  CIRCULAR               0.30/0.30  INFLOW   3177                                                                                        0000000
      YU   73.280   YL   73.243   QF      53    DQ          0             OUTFLOW   3181        B.NO.  427300                     EXIST.  COMB.0003178
      SU   76.794   SL   76.828   AF  0.071     DQD       0.0   QDLM      8   VNIGHTO.30   DUC    0.04    DLC    0.07     QLM       15    CAP  0000038
                                                                HDLM 0.11   HNIGHTO.03   DUS   -3.18    DLS   -3.21                      QLM/8600 29

      RES        0  A       0.0     VF   0.75    GAMMA 0.0      VDLM 0.55   VNORM 0.0      HUM    0.34    HLM    0.37     QRQLM       0    DY   0000 04
      IW       0.0  L        12.2   S                           SCOD 400    DWB     0.03   YUM   73.62    YLM   73.61     VLM      0.43    DH   0000 03

3179  CIRCULAR               0.30/0.30  INFLOW                                                                                               0000000
      YU   74.158   YL   74.094   QF      24    DQ          8             OUTFLOW   3180        B.NO.  460100                     EXIST.  COMB.0003179
      SU   76.712   SL   76.804   AF  0.071     DQD       8.2   QDLM      8   VNIGHTO.17   DUC   -0.19    DLC   -0.15     QLM       12    CAP  0000012
                                                                HDLM 0.12   HNIGHTO.04   DUS   -2.45    DLS   -2.56                      QLM/8600 51

      RES        0  A       0.0     VF   0.34    GAMMA 0.0      VDLM 0.31   VNORM 0.0      HUM    0.11    HLM    0.15     QRQLM       0    DY   0000 06
      IW       8.2  L       102.4   S                           SCOD 400    DWB     0.0    YUM   74.26    YLM   74.24     VLM      0.34    DH   0000 04

3180  CIRCULAR               0.30/0.30  INFLOW   3179                                                                                        0000000
      YU   74.094   YL   73.646   QF      64    DQ          0             OUTFLOW   3181        B.NO.  460100                     EXIST.  COMB.0003180
      SU   76.804   SL   76.828   AF  0.071     DQD       0.0   QDLM      8   VNIGHTO.34   DUC   -0.20    DLC   -0.19     QLM       17    CAP  0000046
                                                                HDLM 0.07   HNIGHTO.02   DUS   -2.61    DLS   -3.08                      QLM/8600 27

      RES        0  A       0.0     VF   0.90    GAMMA 0.0      VDLM 0.63   VNORM 0.0      HUM    0.10    HLM    0.11     QRQLM       0    DY   0000 45
      IW       0.0  L       103.0   S                           SCOD 400    DWB     0.0    YUM   74.19    YLM   73.75     VLM      0.77    DH   0000 01

3181  CIRCULAR               0.30/0.30  INFLOW   3178   3180                                                                                 0000000
      YU   73.243   YL   73.182   QF      61    DQ          0             OUTFLOW   3189        B.NO.  427400                     EXIST.  COMB.0003181
      SU   76.828   SL   76.825   AF  0.071     DQD       0.0   QDLM     16   VNIGHTO.40   DUC    0.07    DLC    0.13     QLM       27    CAP  0000034
                                                                HDLM 0.15   HNIGHTO.05   DUS   -3.21    DLS   -3.21                      QLM/8600 44

      RES        0  A       0.0     VF   0.86    GAMMA 0.0      VDLM 0.47   VNORM 0.74     HUM    0.37    HLM    0.43     QRQLM       0    DY   0000 06
      IW       0.0  L        15.2   S                           SCOD 400    DWB     0.04   YUM   73.62    YLM   73.62     VLM      0.76    DH   0000 06
TORONTO SEWER SYSTEM STUDY AREA 7
                                                                                                                          CALCULATION NO 002331
SCOTT STREET PUMPING STATION
                                                                                                                                             0000000
3182  CIRCULAR               0.30/0.30  INFLOW                                                                                               0000000
      YU   74.161   YL   73.823   QF      57    DQ          0             OUTFLOW   3183        B.NO.  460400                     EXIST.  COMB.0003182
      SU   77.060   SL   77.175   AF  0.071     DQD       0.0   QDLM      0   VNIGHTO.0    DUC   -0.30    DLC   -0.25     QLM        0    CAP  0000057
                                                                HDLM 0.0    HNIGHTO.0    DUS   -2.90    DLS   -3.30                      QLM/8600 00

      RES        0  A       0.0     VF   0.81    GAMMA 0.0      VDLM 0.0    VNORM 0.0      HUM    0.0     HLM    0.05     QRQLM       0    DY   0000 34
      IW       0.0  L        96.9   S                           SCOD 400    DWB     0.0    YUM   74.16    YLM   73.88     VLM      0.0     DH   0000 05

3183  CIRCULAR               0.30/0.30  INFLOW   3182                                                                                        0000000
      YU   73.823   YL   73.557   QF      51    DQ         13             OUTFLOW   3187        B.NO.  460400                     EXIST.  COMB.0003183
      SU   77.175   SL   77.133   AF  0.071     DQD      12.7   QDLM     13   VNIGHTO.33   DUC   -0.25    DLC   -0.19     QLM       14    CAP  0000037
                                                                HDLM 0.11   HNIGHTO.03   DUS   -3.30    DLS   -3.47                      QLM/8600 28

      RES        0  A       0.0     VF   0.72    GAMMA 0.0      VDLM 0.60   VNORM 0.0      HUM    0.05    HLM    0.11     QRQLM       0    DY   0000 27
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     IW     12.7  L      96.3    S                            SCOD 400    DWB    0.00    YUM   73.88    YLM   73.67     VLM      0.61    DH   0000 05

                                                                                                                                           0000000
3184  CIRCULAR             0.30/0.30  INFLOW                        OUTFLOW  3185          B.NO. 651500                    EXIST. COMB.0003184
      YU   74.359  YL   73.981   QF     74    DQ          0   QDLM     0  VNIGHTO.0    DUC   -0.30    DLC   -0.30     QLM         0    CAP 0000074
      SU   77.005  SL   77.145   AF 0.071     DQD       0.0   HDLM 0.0    HNIGHTO.0    DUS   -2.65    DLS   -3.16                        QLM/8600 00

      RES         0  A       0.0    VF   1.05    GAMMA 0.0    VDLM 0.0    VNORM 0.0    HUM    0.0     HLM    0.0      QRQLM       0    DY   0000 38
      IW        0.0  L      64.6    S                         SCOD 400    DWB    0.0     YUM   74.36    YLM   73.98     VLM      0.0     DH   0000 00

                                                                                                                                           0000000
3185  CIRCULAR             0.30/0.30  INFLOW   3184                 OUTFLOW  3186          B.NO. 651500                    EXIST. COMB.0003185
      YU   73.981  YL   73.658   QF     63    DQ          0   QDLM     0  VNIGHTO.0    DUC   -0.30    DLC   -0.29     QLM         0    CAP 0000063
      SU   77.145  SL   76.892   AF 0.071     DQD       0.0   HDLM 0.00   HNIGHTO.0    DUS   -3.16    DLS   -3.22                        QLM/8600 00

      RES         0  A       0.0    VF   0.89    GAMMA 0.0    VDLM 0.0    VNORM 0.0    HUM    0.0     HLM    0.01     QRQLM       0    DY   0000 32
      IW        0.0  L      76.5    S                         SCOD 400    DWB    0.00    YUM   73.98    YLM   73.67     VLM      0.04    DH   0000 01

                                                                                                                                           0000000
3186  CIRCULAR             0.30/0.30  INFLOW   3185                 OUTFLOW  3187          B.NO. 651500                    EXIST. COMB.0003186
      YU   73.658  YL   73.585   QF     64    DQ          0   QDLM     0  VNIGHTO.0    DUC   -0.29    DLC   -0.22     QLM         0    CAP 0000063
      SU   76.892  SL   77.133   AF 0.071     DQD       0.0   HDLM 0.08   HNIGHTO.01   DUS   -3.22    DLS   -3.46                        QLM/8600 00

      RES         0  A       0.0    VF   0.90    GAMMA 0.0    VDLM 0.0    VNORM 0.0    HUM    0.01    HLM    0.08     QRQLM       0    DY   0000 07
      IW        0.0  L      16.8    S                         SCOD 400    DWB    0.08    YUM   73.67    YLM   73.67     VLM      0.01    DH   0000 07

                                                                                                                                           0000000
3187  CIRCULAR             0.30/0.30  INFLOW   3183   3186          OUTFLOW  3188          B.NO. 460300                    EXIST. COMB.0003187
      YU   73.557  YL   73.347   QF     47    DQ          0   QDLM    13  VNIGHTO.31   DUC   -0.19    DLC   -0.03     QLM        16    CAP 0000031
      SU   77.133  SL   76.913   AF 0.071     DQD       0.0   HDLM 0.11   HNIGHTO.03   DUS   -3.46    DLS   -3.29                        QLM/8600 34

      RES         0  A       0.0    VF   0.67    GAMMA 0.0    VDLM 0.57   VNORM 0.0    HUM    0.11    HLM    0.27     QRQLM       0    DY   0000 21
      IW        0.0  L      86.6    S                         SCOD 400    DWB    0.0     YUM   73.67    YLM   73.62     VLM      0.59    DH   0000 16

                                                                                                                                           0000000
3188  CIRCULAR             0.30/0.30  INFLOW   3187                 OUTFLOW  3189          B.NO. 460300                    EXIST. COMB.0003188
      YU   73.347  YL   73.231   QF     78    DQ          0   QDLM    13  VNIGHTO.45   DUC   -0.03    DLC    0.08     QLM        17    CAP 0000061
      SU   76.913  SL   76.825   AF 0.071     DQD       0.0   HDLM 0.10   HNIGHTO.03   DUS   -3.29    DLS   -3.21                        QLM/8600 22

      RES         0  A       0.0    VF   1.11    GAMMA 0.0    VDLM 0.83   VNORM 0.0    HUM    0.27    HLM    0.38     QRQLM       0    DY   0000 12
      IW        0.0  L      17.7    S                         SCOD 400    DWB    0.02    YUM   73.62    YLM   73.62     VLM      0.70    DH   0000 11

TORONTO SEWER SYSTEM STUDY AREA 7                                                                                       CALCULATION NO 002331

SCOTT STREET PUMPING STATION                                                                                                               0000000
                                                                                                                                           0000000
3189  CIRCULAR             0.30/0.30  INFLOW   3181   3188          OUTFLOW  3190          B.NO. 427500                    EXIST. COMB.0003189
      YU   73.182  YL   72.911   QF     59    DQ          0   QDLM    29  VNIGHTO.46   DUC    0.13    DLC    0.37     QLM        45    CAP 0000013
      SU   76.825  SL   76.843   AF 0.071     DQD       0.0   HDLM 0.16   HNIGHTO.05   DUS   -3.21    DLS   -3.26                        QLM/8600 77

      RES         0  A       0.0    VF   0.84    GAMMA 0.0    VDLM 0.83   VNORM 0.0    HUM    0.43    HLM    0.67     QRQLM       0    DY   0000 27
      IW        0.0  L      72.5    S                         SCOD 400    DWB    0.01    YUM   73.61    YLM   73.58     VLM      0.88    DH   0000 24

                                                                                                                                           0000000
3190  CIRCULAR             0.30/0.30  INFLOW   3189                 OUTFLOW  3191          B.NO. 427510                    EXIST. COMB.0003190
      YU   72.911  YL   72.683   QF     52    DQ          0   QDLM    29  VNIGHTO.42   DUC    0.37    DLC    0.59     QLM        45    CAP 0000007
      SU   76.843  SL   77.748   AF 0.071     DQD       0.0   HDLM 0.17   HNIGHTO.05   DUS   -3.26    DLS   -4.18                        QLM/8600 87

      RES         0  A       0.0    VF   0.74    GAMMA 0.0    VDLM 0.76   VNORM 0.0    HUM    0.67    HLM    0.89     QRQLM       0    DY   0000 23
      IW        0.0  L      77.7    S                         SCOD 400    DWB    0.00    YUM   73.58    YLM   73.57     VLM      0.79    DH   0000 22
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3191  CIRCULAR            0.30/0.30  INFLOW  3190                OUTFLOW  3192         B.NO  427600                          0000000
      YU  72.683  YL  72.454  QF     50  DQ        0  QDLM   29  VNIGHTO.41  DUC   0.59  DLC   0.82  QLM     EXIST.  COMB.0003191
      SU  77.748  SL  77.178  AF 0.071   DQD     0.0  HDLM 0.30  HNIGHTO.07  DUS  -4.18  DLS  -3.61              45    CAP 0000005
                                                                                                                     QLM/8600 91
      RES      0  A     0.0   VF  0.71   GAMMA 0.0    VDLM 0.41  VNORM 0.73  HUM   0.89  HLM   1.12  QRQLM      0  DY  0000 23
      IW     0.0  L    85.0   S                       SCOD 400   DWB   0.14  YUM  73.57  YLM  73.57  VLM     0.64  DH  0000 23

3192  CIRCULAR            0.30/0.30  INFLOW  3191                OUTFLOW  3193         B.NO. 427600                          0000000
      YU  72.454  YL  72.445  QF     23  DQ        0  QDLM   29  VNIGHTO.24  DUC   0.82  DLC   0.83  QLM     EXIST.  COMB.0003192
      SU  77.178  SL  77.383  AF 0.071   DQD     0.0  HDLM 0.30  HNIGHTO.07  DUS  -3.61  DLS  -3.81              45    CAP 0000021
                                                                                                                     QLM/8601 94
      RES      0  A     0.0   VF  0.33   GAMMA 0.0    VDLM 0.41  VNORM 0.0   HUM   1.12  HLM   1.13  QRQLM      0  DY  0000 01
      IW     0.0  L    15.2   S                       SCOD 400   DWB   0.0   YUM  73.57  YLM  73.57  VLM     0.64  DH  0000 01

3193  CIRCULAR            0.46/0.46  INFLOW  3164  3192          OUTFLOW  6159         B.NO. 832200                          0000000
 *    YU  72.335  YL  72.253  QF    113  DQ        0  QDLM   67  VNIGHTO.40  DUC   0.78  DLC   0.86  QLM     EXIST.  COMB.0003193
      SU  77.383  SL  77.282  AF 0.166   DQD     0.0  HDLM 0.28  HNIGHTO.08  DUS  -3.81  DLS  -3.70             110    CAP 0000004
                                                                                                                     QLM/8600 97
      RES      0  A     0.0   VF  0.68   GAMMA 0.0    VDLM 0.71  VNORM 0.0   HUM   1.24  HLM   1.32  QRQLM      0  DY  0000 08
      IW     0.0  L    57.9   S                       SCOD 400   DWB   0.03  YUM  73.58  YLM  73.58  VLM     0.70  DH  0000 08

5886  CIRCULAR            0.30/0.30  INFLOW                      OUTFLOW  5887         B.NO. 641800                          0000000
      YU  74.868  YL  74.588  QF     50  DQ       20  QDLM   20  VNIGHTO.37  DUC  -0.23  DLC  -0.14  QLM     EXIST.  COMB.0005886
      SU  76.383  SL  76.413  AF 0.071   DQD    20.4  HDLM 0.14  HNIGHTO.04  DUS  -1.45  DLS  -1.67              23    CAP 0000028
                                                                                                                     QLM/8600 45
      RES      0  A     0.0   VF  0.71   GAMMA 0.0    VDLM 0.67  VNORM 0.0   HUM   0.07  HLM   0.16  QRQLM      0  DY  0000 28
      IW    20.4  L   103.9   S                       SCOD 400   DWB   0.01  YUM  74.93  YLM  74.74  VLM     0.67  DH  0000 09

5887  CIRCULAR            0.30/0.30  INFLOW  5886                OUTFLOW  5888         B.NO. 641800                          0000000
      YU  74.588  YL  74.423  QF     45  DQ        0  QDLM   20  VNIGHTO.35  DUC  -0.14  DLC  -0.07  QLM     EXIST.  COMB.0005887
      SU  76.413  SL  76.352  AF 0.071   DQD     0.0  HDLM 0.16  HNIGHTO.05  DUS  -1.67  DLS  -1.70              28    CAP 0000017
                                                                                                                     QLM/8600 63
      RES      0  A     0.0   VF  0.64   GAMMA 0.0    VDLM 0.63  VNORM 0.0   HUM   0.16  HLM   0.23  QRQLM      0  DY  0000 16
      IW     0.0  L    74.7   S                       SCOD 400   DWB   0.02  YUM  74.74  YLM  74.65  VLM     0.54  DH  0000 07
TORONTO SEWER SYSTEM STUDY AREA 7
                                                                                                    CALCULATION NO 002331
SCOTT STREET PUMPING STATION
                                                                                                                         0000000
5888  CIRCULAR            0.30/0.30  INFLOW  5887                OUTFLOW  5889         B.NO. 641800                          0000000
      YU  74.423  YL  74.310  QF     43  DQ       11  QDLM   31  VNIGHTO.38  DUC  -0.07  DLC   0.0   QLM     EXIST.  COMB.0005888
      SU  76.352  SL  76.566  AF 0.071   DQD    11.0  HDLM 0.19  HNIGHTO.06  DUS  -1.70  DLS  -1.96              44    CAP 0000000
                                                                                                                     QLM/8601 02
      RES      0  A     0.0   VF  0.61   GAMMA 0.0    VDLM 0.65  VNORM 0.0   HUM   0.23  HLM   0.30  QRQLM      0  DY  0000 11
      IW    11.0  L    56.7   S                       SCOD 400   DWB   0.0   YUM  74.65  YLM  74.61  VLM     0.66  DH  0000 07

5889  CIRCULAR            0.30/0.30  INFLOW  5888                OUTFLOW  5890         B.NO. 641800                          0000000
      YU  74.310  YL  74.152  QF     43  DQ        0  QDLM   31  VNIGHTO.38  DUC   0.0   DLC   0.0   QLM     EXIST.  COMB.0005889
      SU  76.566  SL  76.413  AF 0.071   DQD     0.0  HDLM 0.20  HNIGHTO.06  DUS  -1.96  DLS  -1.96              47    CAP 0000003
                                                                                                                     QLM/8601 10
      RES      0  A     0.0   VF  0.61   GAMMA 0.0    VDLM 0.65  VNORM 0.0   HUM   0.30  HLM   0.30  QRQLM      0  DY  0000 16
      IW     0.0  L    78.3   S                       SCOD 400   DWB   0.01  YUM  74.61  YLM  74.45  VLM     0.67  DH  0000 00
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3200  CIRCULAR             0.61/0.61  INFLOW  3199               OUTFLOW  3201          B.NO. 427500               EXIST. STORM0003200
      YU  74.725  YL  74.627  QF    255   DQ        0  QDLM     0  VNIGHTO.0     DUC   0.78   DLC   0.80   QLM      271   CAP 0000015
      SU  76.843  SL  76.837  AF 0.292   DQD     0.0  HDLM 0.0   HNIGHTO.0     DUS  -0.73   DLS  -0.80                    QLM/8601 06

      RES      0  A     0.0   VF  0.88   GAMMA 0.0    VDLM 0.0   VNORM 0.0     HUM   1.39   HLM   1.41   QRQLM    271   DY   0000 10
      IW     0.0  L    61.6   S                       SCOD 304   DWB    0.0    YUM  76.11   YLM  76.04   VLM     0.93   DH   0000 03

                                                                                                              0000000
3201  CIRCULAR             0.61/0.61  INFLOW  3200               OUTFLOW  3205          B.NO. 427500               EXIST. STORM0003201
      YU  74.569  YL  74.524  QF    289   DQ        0  QDLM     0  VNIGHTO.0     DUC   0.86   DLC   0.88   QLM      271   CAP 0000018
      SU  76.837  SL  76.925  AF 0.292   DQD     0.0  HDLM 0.08  HNIGHTO.08    DUS  -0.80   DLS  -0.91                    QLM/8600 94

      RES      0  A     0.0   VF  0.99   GAMMA 0.0    VDLM 0.0   VNORM 0.0     HUM   1.47   HLM   1.49   QRQLM    271   DY   0000 04
      IW     0.0  L    22.0   S                       SCOD 305   DWB    0.08   YUM  76.04   YLM  76.02   VLM     0.93   DH   0000 02

                                                                                                              0000000
3202  CIRCULAR             0.53/0.53  INFLOW                     OUTFLOW  3203          B.NO. 460100               EXIST. STORM0003202
      YU  74.880  YL  74.828  QF    128   DQ       67  QDLM     0  VNIGHTO.0     DUC   0.65   DLC   0.70   QLM       53   CAP 0000075
      SU  76.828  SL  76.883  AF 0.220   DQD     0.0  HDLM 0.0   HNIGHTO.0     DUS  -0.77   DLS  -0.83                    QLM/8600 42

      RES      0  A     0.32  VF  0.58   GAMMA 0.74   VDLM 0.0   VNORM 0.0     HUM   1.18   HLM   1.23   QRQLM     53   DY   0000 05
      IW     0.0  L    61.0   S                       SCOD 305   DWB    0.0    YUM  76.06   YLM  76.06   VLM     0.41   DH   0000 05

TORONTO SEWER SYSTEM STUDY AREA 7                                                                    CALCULATION NO 007126

JARVIS STREET TRUNK                                                                                           0000000
                                                                                                              0000000
3203  CIRCULAR             0.61/0.61  INFLOW  3202               OUTFLOW  3204          B.NO. 460100               EXIST. STORM0003203
      YU  74.752  YL  74.670  QF    224   DQ       85  QDLM     0  VNIGHTO.0     DUC   0.69   DLC   0.76   QLM      122   CAP 0000102
      SU  76.883  SL  76.791  AF 0.292   DQD     0.0  HDLM 0.0   HNIGHTO.0     DUS  -0.83   DLS  -0.75                    QLM/8600 54

      RES      0  A     0.41  VF  0.77   GAMMA 0.74   VDLM 0.0   VNORM 0.0     HUM   1.30   HLM   1.37   QRQLM    122   DY   0000 08
      IW     0.0  L    67.1   S                       SCOD 305   DWB    0.0    YUM  76.06   YLM  76.04   VLM     0.47   DH   0000 07

                                                                                                              0000000
3204  CIRCULAR             0.69/0.69  INFLOW  3203               OUTFLOW  3205          B.NO. 460100               EXIST. STORM0003204
      YU  74.594  YL  74.496  QF    314   DQ       46  QDLM     0  VNIGHTO.0     DUC   0.76   DLC   0.84   QLM      158   CAP 0000156
      SU  76.791  SL  76.925  AF 0.373   DQD     0.0  HDLM 0.10  HNIGHTO.10    DUS  -0.75   DLS  -0.90                    QLM/8600 50

      RES      0  A     0.22  VF  0.84   GAMMA 0.74   VDLM 0.0   VNORM 0.0     HUM   1.45   HLM   1.53   QRQLM    157   DY   0000 10
      IW     0.0  L    78.6   S                       SCOD 305   DWB    0.10   YUM  76.04   YLM  76.02   VLM     0.42   DH   0000 08

                                                                                                              0000000
3205  CIRCULAR             0.91/0.91  INFLOW  3201  3204         OUTFLOW  3206          B.NO. 460300               EXIST. STORM0003205
      YU  74.268  YL  74.164  QF    591   DQ       62  QDLM     0  VNIGHTO.0     DUC   0.84   DLC   0.89   QLM      428   CAP 0000163
      SU  76.925  SL  77.212  AF 0.649   DQD     0.0  HDLM 0.44  HNIGHTO.44    DUS  -0.91   DLS  -1.24                    QLM/8600 72

      RES      0  A     0.30  VF  0.91   GAMMA 0.74   VDLM 0.0   VNORM 0.0     HUM   1.75   HLM   1.80   QRQLM    388   DY   0000 10
      IW     0.0  L   103.0   S                       SCOD 305   DWB    0.44   YUM  76.02   YLM  75.97   VLM     0.66   DH   0000 06

                                                                                                              0000000
3206  CIRCULAR             0.99/0.99  INFLOW  3205               OUTFLOW  3207          B.NO. 460400               EXIST. STORM0003206
      YU  74.100  YL  73.789  QF   1331   DQ      131  QDLM     0  VNIGHTO.0     DUC   0.88   DLC   1.15   QLM      533   CAP 0000798
      SU  77.212  SL  77.206  AF 0.768   DQD     0.0  HDLM 0.81  HNIGHTO.81    DUS  -1.24   DLS  -1.28                    QLM/8600 40

      RES      0  A     0.63  VF  1.73   GAMMA 0.74   VDLM 0.0   VNORM 0.0     HUM   1.87   HLM   2.14   QRQLM    429   DY   0000 31
      IW     0.0  L    95.1   S                       SCOD 305   DWB    0.81   YUM  75.97   YLM  75.93   VLM     0.69   DH   0000 27
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                                                                           OUTFLOW  3208
3207  CIRCULAR              1.07/1.07  INFLOW  3206                                                DUC   1.15   DLC   1.44    QLM
      YU  73.704  YL  73.381    QF  1667    DQ      119   QDLM    0  VNIGHTO.0     DUS  -1.28   DLS  -1.17             QLM/8600 39
      SU  77.206  SL  77.060    AF 0.898    DQD     0.0   HDLM 1.22  HNIGHT1.22
                                                                                    HUM   2.22   HLM   2.51    QRQLM  344   DY  0000 32
      RES       0  A     0.57   VF  1.86    GAMMA 0.74    VDLM 0.0   VNORM 0.0      YUM  75.93   YLM  75.89    VLM   0.72   DH  0000 28
      IW      0.0  L     95.4   S                         SCOD 305   DWB    1.22
                                                                                                                                0000000
                                                              OUTFLOW   253         B.NO. 460400                 EXIST.  STORM0003208
3208  CIRCULAR              1.07/1.07  INFLOW  3207                                 DUC   1.44   DLC   1.80    QLM    649   CAP 0013499
      YU  73.381  YL  73.015    QF 14148    DQ        0   QDLM    0  VNIGHTO.0      DUS  -1.17   DLS  -1.17                 QLM/8600 05
      SU  77.060  SL  77.053    AF 0.898    DQD     0.0   HDLM 1.59  HNIGHT1.59
                                                                                    HUM   2.51   HLM   2.87    QRQLM  342   DY  0000 37
      RES       0  A      0.0   VF 15.76    GAMMA 0.74    VDLM 0.0   VNORM 0.0      YUM  75.89   YLM  75.89    VLM   0.72   DH  0000 37
      IW      0.0  L      1.5   S                         SCOD 305   DWB    1.59
                                                                                                                                0000000
                                                              OUTFLOW  3210         B.NO. 459800                 EXIST.  STORM0003209
3209  CIRCULAR              0.61/0.61  INFLOW                                       DUC   1.73   DLC   1.90    QLM     38   CAP 0000366
      YU  73.685  YL  73.515    QF   404    DQ       38   QDLM    0  VNIGHTO.0      DUS  -0.86   DLS  -0.93                 QLM/8600 09
      SU  76.889  SL  76.950    AF 0.292    DQD     0.0   HDLM 1.09  HNIGHT1.09
                                                                                    HUM   2.34   HLM   2.51    QRQLM   25   DY  0000 17
      RES       0  A     0.18   VF  1.38    GAMMA 0.74    VDLM 0.0   VNORM 0.0      YUM  76.03   YLM  76.02    VLM   0.13   DH  0000 17
      IW      0.0  L     42.7   S                         SCOD 304   DWB    1.09
                                                                                                              CALCULATION NO 007126
TORONTO SEWER SYSTEM STUDY AREA 7
                                                                                                                                0000000
JARVIS STREET TRUNK                                                                                                             0000000
                                                              OUTFLOW  3211         B.NO. 459800                 EXIST.  STORM0003210
3210  CIRCULAR              0.76/0.76  INFLOW  3209                                 DUC   1.90   DLC   2.07    QLM     98   CAP 0000415
      YU  73.362  YL  73.192    QF   514    DQ       61   QDLM    0  VNIGHTO.0      DUS  -0.93   DLS  -0.84                 QLM/8600 19
      SU  76.950  SL  76.864    AF 0.453    DQD     0.0   HDLM 1.41  HNIGHT1.41
                                                                                    HUM   2.66   HLM   2.83    QRQLM   49   DY  0000 17
      RES       0  A     0.29   VF  1.13    GAMMA 0.74    VDLM 0.0   VNORM 0.0      YUM  76.02   YLM  76.02    VLM   0.22   DH  0000 17
      IW      0.0  L     85.3   S                         SCOD 304   DWB    1.41
                                                                                                                                0000000
                                                              OUTFLOW  3216         B.NO. 459800                 EXIST.  STORM0003211
3211  CIRCULAR              0.91/0.91  INFLOW  3210                                 DUC   2.07   DLC   2.20    QLM    167   CAP 0000579
      YU  73.039  YL  72.905    QF   746    DQ       69   QDLM    0  VNIGHTO.0      DUS  -0.84   DLS  -0.84                 QLM/8600 22
      SU  76.864  SL  76.858    AF 0.649    DQD     0.0   HDLM 1.70  HNIGHT1.70
                                                                                    HUM   2.98   HLM   3.11    QRQLM   71   DY  0000 13
      RES       0  A     0.33   VF  1.15    GAMMA 0.74    VDLM 0.0   VNORM 0.0      YUM  76.02   YLM  76.02    VLM   0.26   DH  0000 13
      IW      0.0  L     83.2   S                         SCOD 304   DWB    1.70
                                                                                                                                0000000
                                                              OUTFLOW  3213         B.NO. 459800                 EXIST.  STORM0003212
3212  CIRCULAR              0.53/0.53  INFLOW                                       DUC   0.93   DLC   1.30    QLM     67   CAP 0000270
      YU  74.591  YL  74.216    QF   337    DQ       67   QDLM    0  VNIGHTO.0      DUS  -1.16   DLS  -1.16                 QLM/8600 20
      SU  77.206  SL  77.206    AF 0.220    DQD     0.0   HDLM 0.38  HNIGHTO.38
                                                                                    HUM   1.46   HLM   1.83    QRQLM   59   DY  0000 38
      RES       0  A     0.32   VF  1.53    GAMMA 0.74    VDLM 0.0   VNORM 0.0      YUM  76.05   YLM  76.04    VLM   0.30   DH  0000 37
      IW      0.0  L     64.0   S                         SCOD 304   DWB    0.38
                                                                                                                                0000000
                                                              OUTFLOW  3214         B.NO. 459800                 EXIST.  STORM0003213
3213  CIRCULAR              0.61/0.61  INFLOW  3212                                 DUC   1.29   DLC   1.66    QLM    119   CAP 0000374
      YU  74.140  YL  73.762    QF   493    DQ       52   QDLM    0  VNIGHTO.0      DUS  -1.16   DLS  -1.17                 QLM/8600 24
      SU  77.206  SL  77.206    AF 0.292    DQD     0.0   HDLM 0.84  HNIGHTO.84
                                                                                    HUM   1.90   HLM   2.27    QRQLM   89   DY  0000 38
      RES       0  A     0.25   VF  1.69    GAMMA 0.74    VDLM 0.0   VNORM 0.0      YUM  76.04   YLM  76.03    VLM   0.41   DH  0000 37
      IW      0.0  L     63.7   S                         SCOD 304   DWB    0.84
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MANAGEMENT SERVICES DEPARTMENT DATA PROCESSING CENTRE

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3214  CIRCULAR          0.69/0.69  INFLOW   3213              OUTFLOW  3215        B.NO. 459800                   EXIST. STORM0003214
      YU  73.685  YL  73.295   QF    681    DQ        71   QDLM     0  VNIGHT0.0    DUC    1.66   DLC    2.04    QLM      190    CAP 0000491
      SU  77.206  SL  77.053   AF 0.373    DQD       0.0   HDLM 1.31   HNIGHT1.31   DUS   -1.17   DLS   -1.03                   QLM/8600 28

      RES      0  A      0.34   VF   1.83   GAMMA 0.74     VDLM 0.0    VNORM 0.0    HUM    2.35   HLM    2.73    QRQLM    132    DY   0000 39
      IW     0.0  L      66.4   S                          SCOD 304    DWB    1.31  YUM   76.03   YLM   76.02    VLM     0.51    DH   0000 38

                                                                                                                                   0000000
3215  CIRCULAR          0.69/0.69  INFLOW   3214              OUTFLOW  3216        B.NO. 459800                   EXIST. STORM0003215
      YU  73.265  YL  73.073   QF    679    DQ         0   QDLM     0  VNIGHT0.0    DUC    2.07   DLC    2.25    QLM      190    CAP 0000489
      SU  77.053  SL  76.858   AF 0.373    DQD       0.0   HDLM 1.53   HNIGHT1.53   DUS   -1.03   DLS   -0.85                   QLM/8600 28

      RES      0  A       0.0   VF   1.82   GAMMA 0.74     VDLM 0.0    VNORM 0.0    HUM    2.76   HLM    2.94    QRQLM    115    DY   0000 19
      IW     0.0  L      32.9   S                          SCOD 304    DWB    1.53  YUM   76.02   YLM   76.01    VLM     0.51    DH   0000 18

                                                                                                                                   0000000
3216  CIRCULAR          0.91/0.91  INFLOW   3211   3215       OUTFLOW  3217        B.NO. 459800                   EXIST. STORM0003216
      YU  72.844  YL  72.817   QF    611    DQ         0   QDLM     0  VNIGHT0.0    DUC    2.26   DLC    2.28    QLM      358    CAP 0000253
      SU  76.858  SL  76.749   AF 0.649    DQD       0.0   HDLM 1.78   HNIGHT1.78   DUS   -0.85   DLS   -0.74                   QLM/8600 59

      RES      0  A       0.0   VF   0.94   GAMMA 0.74     VDLM 0.0    VNORM 0.0    HUM    3.17   HLM    3.19    QRQLM    167    DY   0000 03
      IW     0.0  L      25.0   S                          SCOD 304    DWB    1.78  YUM   76.01   YLM   76.00    VLM     0.55    DH   0000 02

TORONTO SEWER SYSTEM STUDY AREA 7                                                                                CALCULATION NO 007126

JARVIS STREET TRUNK                                                                                                                0000000
                                                                                                                                   0000000
3217  CIRCULAR          0.91/0.91  INFLOW   3216              OUTFLOW  3218        B.NO. 460200                   EXIST. STORM0003217
      YU  72.817  YL  72.783   QF    576    DQ        77   QDLM     0  VNIGHT0.0    DUC    2.28   DLC    2.30    QLM      435    CAP 0000141
      SU  76.749  SL  76.660   AF 0.649    DQD       0.0   HDLM 1.82   HNIGHT1.82   DUS   -0.74   DLS   -0.67                   QLM/8600 75

      RES      0  A      0.37   VF   0.89   GAMMA 0.74     VDLM 0.0    VNORM 0.0    HUM    3.19   HLM    3.21    QRQLM    221    DY   0000 03
      IW     0.0  L      35.4   S                          SCOD 304    DWB    1.82  YUM   76.00   YLM   75.99    VLM     0.67    DH   0000 02

                                                                                                                                   0000000
3218  CIRCULAR          1.07/1.07  INFLOW   3217              OUTFLOW  3219        B.NO. 460200                   EXIST. STORM0003218
      YU  72.707  YL  72.661   QF    643    DQ       134   QDLM     0  VNIGHT0.0    DUC    2.22   DLC    2.25    QLM      569    CAP 0000074
      SU  76.660  SL  76.599   AF 0.898    DQD       0.0   HDLM 1.94   HNIGHT1.94   DUS   -0.67   DLS   -0.62                   QLM/8600 89

      RES      0  A      0.64   VF   0.72   GAMMA 0.74     VDLM 0.0    VNORM 0.0    HUM    3.29   HLM    3.32    QRQLM    279    DY   0000 05
      IW     0.0  L      91.4   S                          SCOD 304    DWB    1.94  YUM   75.99   YLM   75.98    VLM     0.63    DH   0000 03

                                                                                                                                   0000000
3219  CIRCULAR          1.07/1.07  INFLOW   3218              OUTFLOW  3220        B.NO. 460200                   EXIST. STORM0003219
      YU  72.631  YL  72.594   QF    645    DQ       102   QDLM     0  VNIGHT0.0    DUC    2.28   DLC    2.29    QLM      671    CAP 0000025
      SU  76.599  SL  76.694   AF 0.898    DQD       0.0   HDLM 2.01   HNIGHT2.01   DUS   -0.62   DLS   -0.74                   QLM/8601 04

      RES      0  A      0.49   VF   0.72   GAMMA 0.74     VDLM 0.0    VNORM 0.0    HUM    3.35   HLM    3.36    QRQLM    322    DY   0000 04
      IW     0.0  L      72.9   S                          SCOD 304    DWB    2.01  YUM   75.98   YLM   75.95    VLM     0.75    DH   0000 02

                                                                                                                                   0000000
3220  CIRCULAR          1.07/1.07  INFLOW   3219              OUTFLOW  3221        B.NO. 460200                   EXIST. STORM0003220
      YU  72.564  YL  72.527   QF    643    DQ       138   QDLM     0  VNIGHT0.0    DUC    2.32   DLC    2.33    QLM      809    CAP 0000166
      SU  76.694  SL  76.621   AF 0.898    DQD       0.0   HDLM 2.07   HNIGHT2.07   DUS   -0.74   DLS   -0.70                   QLM/8601 26

      RES      0  A      0.66   VF   0.72   GAMMA 0.74     VDLM 0.0    VNORM 0.0    HUM    3.39   HLM    3.40    QRQLM    402    DY   0000 04
      IW     0.0  L      73.5   S                          SCOD 304    DWB    2.07  YUM   75.95   YLM   75.92    VLM     0.90    DH   0000 01

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3221  CIRCULAR          1.07/1.07  INFLOW   3220              OUTFLOW   252        B.NO. 460200                   EXIST. STORM0003221
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3221

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     YU  72.497  YL  72.481   QF   631   DQ       0   QDLM    0  VNIGHT0.0    DUC   2.36   DLC   2.36    QLM     809    CAP 0000177
     SU  76.621  SL  77.084   AF 0.898   DQD    0.0   HDLM 2.12  HNIGHT2.12   DUS  -0.70   DLS  -1.18                   QLM/8601 28

     RES      0  A      0.0   VF  0.70   GAMMA 0.74   VDLM 0.0   VNORM 0.0    HUM   3.43   HLM   3.43   QRQLM   374    DY   0000 02
     IW     0.0  L     32.9   S                       SCOD 304   DWB   2.12   YUM  75.92   YLM  75.91   VLM    0.90    DH   0000 00

                                                                                                                           0000000
3222 CIRCULAR          0.69/0.69  INFLOW                    OUTFLOW  3223       B.NO. 460500                   EXIST. STORM0003222
     YU  73.612  YL  73.521   QF   277   DQ     159   QDLM    0  VNIGHT0.0    DUC   1.68   DLC   1.76   QLM     159    CAP 0000118
     SU  76.538  SL  76.648   AF 0.373   DQD    0.0   HDLM 1.08  HNIGHT1.08   DUS  -0.55   DLS  -0.67                   QLM/8600 57

     RES      0  A     0.76   VF  0.74   GAMMA 0.74   VDLM 0.0   VNORM 0.0    HUM   2.37   HLM   2.45   QRQLM   125    DY   0000 09
     IW     0.0  L     93.9   S                       SCOD 304   DWB   1.08   YUM  75.98   YLM  75.98   VLM    0.43    DH   0000 08

                                                                                                                           0000000
3223 CIRCULAR          0.76/0.76  INFLOW  3222              OUTFLOW  3224       B.NO. 460500                   EXIST. STORM0003223
     YU  73.445  YL  73.359   QF   365   DQ     123   QDLM    0  VNIGHT0.0    DUC   1.77   DLC   1.84   QLM     282    CAP 0000083
     SU  76.648  SL  76.761   AF 0.453   DQD    0.0   HDLM 1.24  HNIGHT1.24   DUS  -0.67   DLS  -0.81                   QLM/8600 77

     RES      0  A     0.59   VF  0.81   GAMMA 0.74   VDLM 0.0   VNORM 0.0    HUM   2.53   HLM   2.60   QRQLM   207    DY   0000 09
     IW     0.0  L     85.3   S                       SCOD 304   DWB   1.24   YUM  75.98   YLM  75.96   VLM    0.62    DH   0000 07

TORONTO SEWER SYSTEM STUDY AREA 7                                                                           CALCULATION NO 007126

JARVIS STREET TRUNK                                                                                                        0000000
                                                                                                                           0000000
3224 CIRCULAR          0.91/0.91  INFLOW  3223              OUTFLOW  3227       B.NO. 460500                   EXIST. STORM0003224
     YU  73.207  YL  73.125   QF   579   DQ      52   QDLM    0  VNIGHT0.0    DUC   1.84   DLC   1.91   QLM     335    CAP 0000244
     SU  76.761  SL  76.770   AF 0.649   DQD    0.0   HDLM 1.48  HNIGHT1.48   DUS  -0.81   DLS  -0.83                   QLM/8600 58

     RES      0  A     0.25   VF  0.89   GAMMA 0.74   VDLM 0.0   VNORM 0.0    HUM   2.75   HLM   2.82   QRQLM   193    DY   0000 08
     IW     0.0  L     84.7   S                       SCOD 304   DWB   1.48   YUM  75.96   YLM  75.94   VLM    0.52    DH   0000 07

                                                                                                                           0000000
3225 CIRCULAR          0.30/0.30  INFLOW                    OUTFLOW  3226       B.NO. 460500                   EXIST. STORM0003225
     YU  74.874  YL  73.960   QF   136   DQ      63   QDLM    0  VNIGHT0.0    DUC   0.81   DLC   1.69   QLM      63    CAP 0000074
     SU  78.928  SL  77.578   AF 0.071   DQD    0.0   HDLM 0.64  HNIGHT0.64   DUS  -2.95   DLS  -1.63                   QLM/8600 46

     RES      0  A     0.30   VF  1.93   GAMMA 0.74   VDLM 0.0   VNORM 0.0    HUM   1.11   HLM   1.99   QRQLM    62    DY   0000 91
     IW     0.0  L     45.7   S                       SCOD 304   DWB   0.64   YUM  75.98   YLM  75.95   VLM    0.89    DH   0000 88

                                                                                                                           0000000
3226 CIRCULAR          0.46/0.46  INFLOW  3225              OUTFLOW  3227       B.NO. 460500                   EXIST. STORM0003226
     YU  73.884  YL  73.725   QF   399   DQ       0   QDLM    0  VNIGHT0.0    DUC   1.60   DLC   1.76   QLM      63    CAP 0000336
     SU  77.578  SL  76.770   AF 0.166   DQD    0.0   HDLM 0.88  HNIGHT0.88   DUS  -1.63   DLS  -0.83                   QLM/8600 16

     RES      0  A      0.0   VF  2.40   GAMMA 0.74   VDLM 0.0   VNORM 0.0    HUM   2.06   HLM   2.22   QRQLM    62    DY   0000 16
     IW     0.0  L      9.1   S                       SCOD 304   DWB   0.88   YUM  75.95   YLM  75.94   VLM    0.38    DH   0000 16

                                                                                                                           0000000
3227 CIRCULAR          0.91/0.91  INFLOW  3224  3226        OUTFLOW  3228       B.NO. 460500                   EXIST. STORM0003227
     YU  73.094  YL  73.054   QF   571   DQ      65   QDLM    0  VNIGHT0.0    DUC   1.93   DLC   1.96   QLM     462    CAP 0000109
     SU  76.770  SL  76.749   AF 0.649   DQD    0.0   HDLM 1.55  HNIGHT1.55   DUS  -0.83   DLS  -0.83                   QLM/8600 81

     RES      0  A     0.31   VF  0.88   GAMMA 0.74   VDLM 0.0   VNORM 0.0    HUM   2.84   HLM   2.87   QRQLM   290    DY   0000 04
     IW     0.0  L     42.4   S                       SCOD 304   DWB   1.55   YUM  75.94   YLM  75.92   VLM    0.71    DH   0000 03

                                                                                                                           0000000
3228 CIRCULAR          0.91/0.91  INFLOW  3227              OUTFLOW   251       B.NO. 460500                   EXIST. STORM0003228
     YU  73.051  YL  73.048   QF   529   DQ       0   QDLM    0  VNIGHT0.0    DUC   1.96   DLC   1.96   QLM     462    CAP 0000067
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     SU  76.749  SL  77.084  AF 0.649   DQD      0.0   HDLM 1.55  HNIGHT1.55   DUS  -0.83   DLS  -1.16                  QLM/8600 87

     RES       0  A     0.0  VF  0.81   GAMMA 0.74     VDLM 0.0   VNORM 0.0    HUM   2.87   HLM   2.87   QRQLM   287    DY  0000 00
     IW      0.0  L     3.7  S                         SCOD 304   DWB   1.55   YUM  75.92   YLM  75.92   VLM    0.71    DH  0000 00

                                                                                                                           0000000
3236 CIRCULAR           0.38/0.38  INFLOW                        OUTFLOW  3237         B.NO.  427300                 EXIST.  STORM0003236
     YU  74.941  YL  74.828  QF    83   DQ       150   QDLM    0  VNIGHTO.0    DUC   1.91   DLC   1.93   QLM     150     CAP 0000066
     SU  77.096  SL  77.130  AF 0.113   DQD      0.0   HDLM 0.0   HNIGHTO.0    DUS   0.14   DLS   0.01                    QLM/8601 80

     RES       0  A    0.72  VF  0.74   GAMMA 0.74     VDLM 0.0   VNORM 0.0    HUM   2.29   HLM   2.31   QRQLM   150    DY  0000 11
     IW      0.0  L    53.3  S                         SCOD 305   DWB   0.0    YUM  77.23   YLM  77.14   VLM    1.32    DH  0000 02

                                                                                                                           0000000
3237 CIRCULAR           0.46/0.46  INFLOW   3236                 OUTFLOW  3238         B.NO.  427300                 EXIST.  STORM0003237
     YU  74.752  YL  74.630  QF   156   DQ       146   QDLM    0  VNIGHTO.0    DUC   1.93   DLC   1.80   QLM     296     CAP 0000138
     SU  77.130  SL  77.063  AF 0.166   DQD      0.0   HDLM 0.0   HNIGHTO.0    DUS   0.01   DLS  -0.17                   QLM/8601 89

     RES       0  A    0.70  VF  0.94   GAMMA 0.74     VDLM 0.0   VNORM 0.0    HUM   2.39   HLM   2.26   QRQLM   296    DY  0000 12
     IW      0.0  L    45.4  S                         SCOD 305   DWB   0.0    YUM  77.14   YLM  76.89   VLM    1.78    DH  0000 13

TORONTO SEWER SYSTEM STUDY AREA 7                                                                            CALCULATION NO 007126

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JARVIS STREET TRUNK                                                                                                        0000000
3238 CIRCULAR           0.61/0.61  INFLOW   3237                 OUTFLOW  3239         B.NO.  427300                 EXIST.  STORM0003238
     YU  74.508  YL  74.499  QF   201   DQ         0   QDLM    0  VNIGHTO.0    DUC   1.78   DLC   1.77   QLM     296     CAP 0000093
     SU  77.063  SL  77.075  AF 0.292   DQD      0.0   HDLM 0.10  HNIGHTO.10   DUS  -0.17   DLS  -0.20                   QLM/8601 47

     RES       0  A     0.0  VF  0.69   GAMMA 0.74     VDLM 0.0   VNORM 0.0    HUM   2.39   HLM   2.38   QRQLM   296    DY  0000 01
     IW      0.0  L     9.1  S                         SCOD 305   DWB   0.10   YUM  76.89   YLM  76.88   VLM    1.01    DH  0000 01

                                                                                                                           0000000
3239 CIRCULAR           0.61/0.61  INFLOW   3238                 OUTFLOW  3240         B.NO.  427300                 EXIST.  STORM0003239
     YU  74.499  YL  74.453  QF   188   DQ       106   QDLM    0  VNIGHTO.0    DUC   1.77   DLC   1.65   QLM     402     CAP 0000213
     SU  77.075  SL  76.956  AF 0.292   DQD      0.0   HDLM 0.15  HNIGHTO.15   DUS  -0.20   DLS  -0.24                   QLM/8602 14

     RES       0  A    0.51  VF  0.64   GAMMA 0.74     VDLM 0.0   VNORM 0.0    HUM   2.38   HLM   2.26   QRQLM   402    DY  0000 05
     IW      0.0  L    53.3  S                         SCOD 305   DWB   0.15   YUM  76.88   YLM  76.72   VLM    1.38    DH  0000 11

                                                                                                                           0000000
3240 CIRCULAR           0.61/0.61  INFLOW   3239                 OUTFLOW  3244         B.NO.  427300                 EXIST.  STORM0003240
     YU  74.453  YL  74.435  QF   237   DQ         0   QDLM    0  VNIGHTO.0    DUC   1.65   DLC   1.62   QLM     402     CAP 0000164
     SU  76.956  SL  76.962  AF 0.292   DQD      0.0   HDLM 0.17  HNIGHTO.17   DUS  -0.24   DLS  -0.30                   QLM/8601 69

     RES       0  A     0.0  VF  0.81   GAMMA 0.74     VDLM 0.0   VNORM 0.0    HUM   2.26   HLM   2.23   QRQLM   402    DY  0000 02
     IW      0.0  L    13.1  S                         SCOD 305   DWB   0.17   YUM  76.72   YLM  76.67   VLM    1.38    DH  0000 03

                                                                                                                           0000000
3241 CIRCULAR           0.38/0.38  INFLOW                        OUTFLOW  3242         B.NO.  640700                 EXIST.  STORM0003241
     YU  74.844  YL  74.798  QF    47   DQ       110   QDLM    0  VNIGHTO.0    DUC   2.12   DLC   2.10   QLM     110     CAP 0000062
     SU  76.819  SL  77.060  AF 0.113   DQD      0.0   HDLM 0.0   HNIGHTO.0    DUS   0.53   DLS   0.22                    QLM/8602 35

     RES       0  A    0.53  VF  0.42   GAMMA 0.74     VDLM 0.0   VNORM 0.0    HUM   2.50   HLM   2.48   QRQLM   110    DY  0000 05
     IW      0.0  L    68.3  S                         SCOD 305   DWB   0.0    YUM  77.34   YLM  77.28   VLM    0.97    DH  0000 02

                                                                                                                           0000000
3242 CIRCULAR           0.46/0.46  INFLOW   3241                 OUTFLOW  3243         B.NO.  640700                 EXIST.  STORM0003242
     YU  74.722  YL  74.646  QF    99   DQ       165   QDLM    0  VNIGHTO.0    DUC   2.10   DLC   1.89   QLM     275     CAP 0000175
     SU  77.060  SL  76.962  AF 0.166   DQD      0.0   HDLM 0.0   HNIGHTO.0    DUS   0.22   DLS   0.03                    QLM/8602 77
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        RES        O  A        0.79   VF   0.60    GAMMA 0.74     VDLM 0.0     VNORM 0.0      HUM    2.56    HLM    2.35     QRQLM     275     DY   0000 08
        IW       0.0  L        70.1   S                           SCOD 305     DWB    0.0     YUM   77.28    YLM   76.99     VLM      1.66     DH   0000 21

3243    CIRCULAR              0.53/0.53  INFLOW   3242                 OUTFLOW   3244              B.NO. 640700                                     0000000
        YU   74.618  YL   74.423    QF     241    DQ         77   QDLM      O  VNIGHTO.0      DUC    1.85    DLC    1.71               EXIST.  STORM0003243
        SU   76.962  SL   76.962    AF  0.220     DQD       0.0   HDLM 0.18    HNIGHTO.18     DUS    0.03    DLS   -0.30     QLM       352      CAP  0000110
                                                                                                                                              QLM/8601 46
        RES        O  A        0.37   VF   1.09    GAMMA 0.74     VDLM 0.0     VNORM 0.0      HUM    2.38    HLM    2.24     QRQLM     352     DY   0000 19
        IW       0.0  L        64.9   S                           SCOD 305     DWB    0.18    YUM   76.99    YLM   76.67     VLM      1.60     DH   0000 13

3244    CIRCULAR              0.84/0.84  INFLOW   3240   3243          OUTFLOW   3248              B.NO. 640900                                     0000000
        YU   74.185  YL   74.085    QF     464    DQ        100   QDLM      O  VNIGHTO.0      DUC    1.64    DLC    1.44               EXIST.  STORM0003244
        SU   76.962  SL   77.008    AF  0.553     DQD       0.0   HDLM 0.51    HNIGHTO.51     DUS   -0.30    DLS   -0.64     QLM       854      CAP  0000388
                                                                                                                                              QLM/8601 84
        RES        O  A        0.48   VF   0.84    GAMMA 0.74     VDLM 0.0     VNORM 0.0      HUM    2.48    HLM    2.28     QRQLM     822     DY   0000 10
        IW       0.0  L       104.6   S                           SCOD 305     DWB    0.51    YUM   76.67    YLM   76.37     VLM      1.54     DH   0000 20
TORONTO SEWER SYSTEM STUDY AREA 7
                                                                                                                           CALCULATION NO 007126
JARVIS STREET TRUNK
                                                                                                                                                  0000000
3245    CIRCULAR              0.38/0.38  INFLOW                        OUTFLOW   3246              B.NO. 651500                                     0000000
        YU   75.020  YL   74.816    QF      99    DQ        152   QDLM      O  VNIGHTO.0      DUC    1.37    DLC    1.45               EXIST.  STORM0003245
        SU   77.178  SL   77.072    AF  0.113     DQD       0.0   HDLM 0.0     HNIGHTO.0      DUS   -0.41    DLS   -0.43     QLM       152      CAP  0000052
                                                                                                                                              QLM/8601 54
        RES        O  A        0.73   VF   0.87    GAMMA 0.74     VDLM 0.0     VNORM 0.0      HUM    1.75    HLM    1.83     QRQLM     152     DY   0000 20
        IW       0.0  L        68.9   S                           SCOD 305     DWB    0.0     YUM   76.77    YLM   76.65     VLM      1.34     DH   0000 08

3246    CIRCULAR              0.53/0.53  INFLOW   3245                 OUTFLOW   3247              B.NO. 651500                                     0000000
        YU   74.667  YL   74.591    QF     146    DQ        129   QDLM      O  VNIGHTO.0      DUC    1.45    DLC    1.36               EXIST.  STORM0003246
        SU   77.072  SL   77.047    AF  0.220     DQD       0.0   HDLM 0.01    HNIGHTO.01     DUS   -0.43    DLS   -0.57     QLM       281      CAP  0000134
                                                                                                                                              QLM/8601 93
        RES        O  A        0.62   VF   0.66    GAMMA 0.74     VDLM 0.0     VNORM 0.0      HUM    1.98    HLM    1.89     QRQLM     281     DY   0000 08
        IW       0.0  L        69.2   S                           SCOD 305     DWB    0.01    YUM   76.65    YLM   76.48     VLM      1.28     DH   0000 09

3247    CIRCULAR              0.53/0.53  INFLOW   3246                 OUTFLOW   3248              B.NO. 651500                                     0000000
        YU   74.591  YL   74.542    QF     230    DQ          0   QDLM      O  VNIGHTO.0      DUC    1.36    DLC    1.33               EXIST.  STORM0003247
        SU   77.047  SL   77.008    AF  0.220     DQD       0.0   HDLM 0.06    HNIGHTO.06     DUS   -0.57    DLS   -0.60     QLM       281      CAP  0000051
                                                                                                                                              QLM/8601 22
        RES        O  A         0.0   VF   1.04    GAMMA 0.74     VDLM 0.0     VNORM 0.0      HUM    1.89    HLM    1.86     QRQLM     281     DY   0000 05
        IW       0.0  L        18.0   S                           SCOD 305     DWB    0.06    YUM   76.48    YLM   76.40     VLM      1.28     DH   0000 02

3248    CIRCULAR              0.91/0.91  INFLOW   3244   3247          OUTFLOW   3249              B.NO. 641010                                     0000000
        YU   74.008  YL   73.893    QF     629    DQ        158   QDLM      O  VNIGHTO.0      DUC    1.41    DLC    1.10               EXIST.  STORM0003248
        SU   77.008  SL   76.941    AF  0.649     DQD       0.0   HDLM 0.71    HNIGHTO.71     DUS   -0.68    DLS   -1.04     QLM      1293      CAP  0000664
                                                                                                                                              QLM/8602 06
        RES        O  A        0.76   VF   0.97    GAMMA 0.74     VDLM 0.0     VNORM 0.0      HUM    2.32    HLM    2.01     QRQLM    1204     DY   0000 11
        IW       0.0  L       100.6   S                           SCOD 305     DWB    0.71    YUM   76.33    YLM   75.90     VLM      1.99     DH   0000 31

3249    CIRCULAR              0.99/0.99  INFLOW   3248                 OUTFLOW   3250              B.NO. 641010                                     0000000
        YU   73.816  YL   73.658    QF     925    DQ        162   QDLM      O  VNIGHTO.0      DUC    1.10    DLC    1.03               EXIST.  STORM0003249
        SU   76.941  SL   76.932    AF  0.768     DQD       0.0   HDLM 0.94    HNIGHTO.94     DUS   -1.04    DLS   -1.25     QLM      1456      CAP  0000529
                                                                                                                                              QLM/8601 57
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     RES       0  A      0.78    VF   1.20   GAMMA 0.74   VDLM 0.0    VNORM 0.0     HUM    2.09   HLM    2.02    QRQLM   1267    DY   0000 16
     IW      0.0  L    100.0     S                        SCOD 305    DWB    0.94   YUM   75.90   YLM   75.68    VLM     1.89    DH   0000 07

                                                                                                                                  0000000
3250 CIRCULAR           0.99/0.99  INFLOW   3249                 OUTFLOW    257        B.NO. 641010                   EXIST. STORM0003250
     YU  73.658  YL   73.201    QF 10861    DQ          0  QDLM      0  VNIGHT0.0    DUC    1.03   DLC    1.48    QLM     1456    CAP 0009405
     SU  76.932  SL   76.840    AF 0.768    DQD       0.0  HDLM 1.40   HNIGHT1.40    DUS   -1.25   DLS   -1.16                  QLM/8600 13

     RES       0  A      0.0     VF  14.13   GAMMA 0.74   VDLM 0.0    VNORM 0.0     HUM    2.02   HLM    2.47    QRQLM   1264    DY   0000 46
     IW      0.0  L      2.1     S                        SCOD 305    DWB    1.40   YUM   75.68   YLM   75.68    VLM     1.89    DH   0000 45

                                                                                                                                  0000000
3291 CIRCULAR           0.38/0.38  INFLOW                        OUTFLOW   3292        B.NO.  71300                   EXIST. COMB.0003291
     YU  74.283  YL   74.048    QF   128    DQ          0  QDLM      0  VNIGHT0.0    DUC    2.77   DLC    3.00    QLM        0    CAP 0000128
     SU  77.940  SL   78.196    AF 0.113    DQD       0.0  HDLM 0.0    HNIGHT0.0     DUS   -0.51   DLS   -0.77                  QLM/8600 00

     RES       0  A      0.0     VF   1.13   GAMMA 0.0    VDLM 0.0    VNORM 0.0     HUM    3.15   HLM    3.38    QRQLM      0    DY   0000 24
     IW      0.0  L     46.9     S                        SCOD 400    DWB    0.0    YUM   77.43   YLM   77.43    VLM     0.0     DH   0000 24

TORONTO SEWER SYSTEM STUDY AREA 7                                                                               CALCULATION NO 007126

JARVIS STREET TRUNK                                                                                                               0000000
                                                                                                                                  0000000
3292 CIRCULAR           0.38/0.38  INFLOW   3291                 OUTFLOW   3293        B.NO.  71300                   EXIST. COMB.0003292
     YU  74.048  YL   73.783    QF   128    DQ          0  QDLM      0  VNIGHT0.0    DUC    3.00   DLC    3.27    QLM        0    CAP 0000128
     SU  78.196  SL   79.025    AF 0.113    DQD       0.0  HDLM 0.0    HNIGHT0.0     DUS   -0.77   DLS   -1.60                  QLM/8600 00

     RES       0  A      0.0     VF   1.13   GAMMA 0.0    VDLM 0.0    VNORM 0.0     HUM    3.38   HLM    3.65    QRQLM      0    DY   0000 26
     IW      0.0  L     53.0     S                        SCOD 400    DWB    0.0    YUM   77.43   YLM   77.43    VLM     0.0     DH   0000 26

                                                                                                                                  0000000
3293 CIRCULAR           0.38/0.38  INFLOW   3292                 OUTFLOW   1219        B.NO.  71300                   EXIST. COMB.0003293
     YU  73.783  YL   73.673    QF   131    DQ          0  QDLM      0  VNIGHT0.0    DUC    3.27   DLC    3.38    QLM        0    CAP 0000131
     SU  79.025  SL   79.605    AF 0.113    DQD       0.0  HDLM 0.08   HNIGHT0.00    DUS   -1.60   DLS   -2.18                  QLM/8600 00

     RES       0  A      0.0     VF   1.16   GAMMA 0.0    VDLM 0.0    VNORM 0.0     HUM    3.65   HLM    3.76    QRQLM      0    DY   0000 11
     IW      0.0  L     21.0     S                        SCOD 400    DWB    0.08   YUM   77.43   YLM   77.43    VLM     0.01    DH   0000 11

                                                                                                                                  0000000
3699 EGG                0.61/0.91  INFLOW                        OUTFLOW    140        B.NO. 321800                   EXIST. COMB.0003699
     YU  81.272  YL   80.897    QF   892    DQ          0  QDLM      0  VNIGHT0.0    DUC   -0.51   DLC   -0.13    QLM        0    CAP 0000892
     SU  84.774  SL   84.686    AF 0.422    DQD       0.0  HDLM 0.01   HNIGHT0.00    DUS   -3.10   DLS   -3.01                  QLM/8600 00

     RES     137  A      0.0     VF   2.11   GAMMA 1.00   VDLM 0.0    VNORM 0.0     HUM    0.40   HLM    0.78    QRQLM      0    DY   0000 38
     IW      0.0  L     48.8     S                        SCOD  15    DWB    0.01   YUM   81.67   YLM   81.67    VLM     0.0     DH   0000 37

                                                                                                                                  0000000
3700 CIRCULAR           0.30/0.30  INFLOW    206  7171           OUTFLOW   3701        B.NO. 554100                   EXIST. COMB.0003700
     YU  86.197  YL   85.207    QF   201    DQ          0  QDLM      0  VNIGHT0.0    DUC   -0.30   DLC   -0.25    QLM        0    CAP 0000201
     SU  88.636  SL   88.605    AF 0.071    DQD       0.0  HDLM 0.0    HNIGHT0.0     DUS   -2.44   DLS   -3.35                  QLM/8600 00

     RES      82  A      0.0     VF   2.84   GAMMA 1.00   VDLM 0.0    VNORM 0.0     HUM    0.0    HLM    0.05    QRQLM      0    DY   0000 99
     IW      0.0  L     22.9     S                        SCOD 101    DWB    0.0    YUM   86.20   YLM   85.26    VLM     0.0     DH   0000 05

                                                                                                                                  0000000
3701 CIRCULAR           0.38/0.38  INFLOW   3700                 OUTFLOW   3702        B.NO. 554100                                0003701
     YU  85.161  YL   84.620    QF   188    DQ        149  QDLM      0  VNIGHT0.26   DUC   -0.28   DLC   -0.12    QLM      146    CAP 0000042
     SU  88.605  SL   88.190    AF 0.113    DQD       0.5  HDLM 0.01   HNIGHT0.00    DUS   -3.34   DLS   -3.31                  QLM/8600 78

     RES      82  A      0.50    VF   1.66   GAMMA 1.00   VDLM 0.39   VNORM 0.0     HUM    0.10   HLM    0.26    QRQLM    146    DY   0000 54
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     YU  74.731  YL  74.289   QF     73   DQ        0   QDLM     0  VNIGHTO.0    DUC    2.75   DLC    3.19    QLM          0   CAP 0000073
     SU  77.002  SL  77.249   AF 0.071    DQD     0.0   HDLM 0.0    HNIGHTO.0    DUS    0.78   DLS    0.53                   QLM/8600 00

     RES      0  A      0.0   VF   1.03   GAMMA 0.0     VDLM 0.0    VNORM 0.0    HUM    3.05   HLM    3.49    QRQLM        0   DY   0000 44
     IW     0.0  L     77.4   S                         SCOD 400    DWB    0.0   YUM   77.78   YLM   77.78    VLM      0.0     DH   0000 44

3407 CIRCULAR           0.30/0.30  INFLOW  3406                                                                                   0000000
                                                          OUTFLOW  3408               B.NO. 143520                     EXIST. COMB.0003407
     YU  74.289  YL  74.076   QF     71   DQ        0   QDLM     0  VNIGHTO.0    DUC    3.19   DLC    3.40    QLM          1   CAP 0000070
     SU  77.249  SL  77.154   AF 0.071    DQD     0.0   HDLM 0.08   HNIGHTO.0    DUS    0.53   DLS    0.63                   QLM/8600 01

     RES      0  A      0.0   VF   1.00   GAMMA 0.0     VDLM 0.0    VNORM 0.0    HUM    3.49   HLM    3.70    QRQLM        0   DY   0000 21
     IW     0.0  L     39.6   S                         SCOD 400    DWB   0.08   YUM   77.78   YLM   77.78    VLM     0.06     DH   0000 21
TORONTO SEWER SYSTEM STUDY AREA 7
                                                                                                                        CALCULATION NO 007546
EAST AREA
                                                                                                                                  0000000
3408 CIRCULAR           0.30/0.30  INFLOW  3407                                                                                   0000000
                                                          OUTFLOW  3423               B.NO. 143520                     EXIST. COMB.0003408
     YU  74.076  YL  73.612   QF     73   DQ        0   QDLM     0  VNIGHTO.0    DUC    3.40   DLC    3.87    QLM          0   CAP 0000073
     SU  77.154  SL  76.800   AF 0.071    DQD     0.0   HDLM 0.54   HNIGHTO.04   DUS    0.63   DLS    0.98                   QLM/8600 00

     RES      0  A      0.0   VF   1.04   GAMMA 0.0     VDLM 0.0    VNORM 0.0    HUM    3.70   HLM    4.17    QRQLM        0   DY   0000 46
     IW     0.0  L     80.2   S                         SCOD 400    DWB   0.54   YUM   77.78   YLM   77.78    VLM      0.0     DH   0000 46

3409 CIRCULAR           0.30/0.30  INFLOW                                                                                         0000000
                                                          OUTFLOW  3413               B.NO. 460800                     EXIST. COMB.0003409
     YU  74.831  YL  74.615   QF     49   DQ        0   QDLM     0  VNIGHTO.0    DUC    3.93   DLC    4.15    QLM          0   CAP 0000049
     SU  76.715  SL  76.749   AF 0.071    DQD     0.0   HDLM 0.82   HNIGHTO.0    DUS    2.35   DLS    2.32                   QLM/8600 00

     RES      0  A      0.0   VF   0.70   GAMMA 0.0     VDLM 0.0    VNORM 0.0    HUM    4.23   HLM    4.45    QRQLM        0   DY   0000 22
     IW     0.0  L     83.2   S                         SCOD 400    DWB   0.82   YUM   79.06   YLM   79.06    VLM      0.0     DH   0000 22

3410 CIRCULAR           0.30/0.30  INFLOW                                                                                         0000000
                                                          OUTFLOW  3411               B.NO. 598000                     EXIST. COMB.0003410
     YU  74.966  YL  74.853   QF     39   DQ        0   QDLM     0  VNIGHTO.0    DUC    3.80   DLC    3.91    QLM          0   CAP 0000039
     SU  76.575  SL  76.755   AF 0.071    DQD     0.0   HDLM 0.58   HNIGHTO.0    DUS    2.49   DLS    2.31                   QLM/8600 00

     RES      0  A      0.0   VF   0.55   GAMMA 0.0     VDLM 0.0    VNORM 0.0    HUM    4.10   HLM    4.21    QRQLM        0   DY   0000 11
     IW     0.0  L     69.8   S                         SCOD 400    DWB   0.58   YUM   79.06   YLM   79.06    VLM      0.0     DH   0000 11

3411 CIRCULAR           0.30/0.30  INFLOW  3410                                                                                   0000000
                                                          OUTFLOW  3412               B.NO. 598000                     EXIST. COMB.0003411
     YU  74.853  YL  74.673   QF     50   DQ        0   QDLM     0  VNIGHTO.0    DUC    3.91   DLC    4.09    QLM          0   CAP 0000050
     SU  76.755  SL  76.791   AF 0.071    DQD     0.0   HDLM 0.76   HNIGHTO.0    DUS    2.31   DLS    2.27                   QLM/8600 00

     RES      0  A      0.0   VF   0.71   GAMMA 0.0     VDLM 0.0    VNORM 0.0    HUM    4.21   HLM    4.39    QRQLM        0   DY   0000 18
     IW     0.0  L     67.1   S                         SCOD 400    DWB   0.76   YUM   79.06   YLM   79.06    VLM      0.0     DH   0000 18

3412 CIRCULAR           0.30/0.30  INFLOW  3411                                                                                   0000000
                                                          OUTFLOW  3413               B.NO. 598000                     EXIST. COMB.0003412
     YU  74.642  YL  74.585   QF     56   DQ        0   QDLM     0  VNIGHTO.0    DUC    4.12   DLC    4.18    QLM          0   CAP 0000056
     SU  76.791  SL  76.749   AF 0.071    DQD     0.0   HDLM 0.85   HNIGHTO.0    DUS    2.27   DLS    2.32                   QLM/8600 00

     RES      0  A      0.0   VF   0.80   GAMMA 0.0     VDLM 0.0    VNORM 0.0    HUM    4.42   HLM    4.48    QRQLM        0   DY   0000 06
     IW     0.0  L     16.8   S                         SCOD 400    DWB   0.85   YUM   79.06   YLM   79.06    VLM      0.0     DH   0000 06

3413 CIRCULAR           0.30/0.30  INFLOW  3409  3412                                                                             0000000
                                                          OUTFLOW  3418               B.NO. 460800                     EXIST. COMB.0003413
     YU  74.585  YL  74.530   QF     69   DQ        0   QDLM     0  VNIGHTO.0    DUC    4.18   DLC    4.23    QLM          0   CAP 0000069
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3413

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      SU  76.749  SL  76.922   AF 0.071   DQD      0.0   HDLM 0.91  HNIGHTO.0    DUS    2.32   DLS    2.14                      QLM/8600 00

      RES      0  A      0.0   VF  0.98   GAMMA 0.0      VDLM 0.0   VNORM 0.0    HUM    4.48   HLM    4.53    QRQLM       0   DY  0000 06
      IW     0.0  L     10.7   S                         SCOD 400   DWB    0.91  YUM   79.06   YLM   79.06    VLM      0.0    DH  0000 06

                                                                                                                                 0000000
3414  CIRCULAR          0.23/0.23  INFLOW                    OUTFLOW  3415         B.NO. 598110                  EXIST. COMB.0003414
      YU  76.468  YL  76.185   QF    28   DQ         0   QDLM     0  VNIGHTO.0    DUC    2.37   DLC    2.65    QLM         0   CAP 0000028
      SU  77.020  SL  76.770   AF 0.041   DQD      0.0   HDLM 0.0   HNIGHTO.0    DUS    2.04   DLS    2.29                      QLM/8600 00

      RES      0  A      0.0   VF  0.68   GAMMA 0.0      VDLM 0.0   VNORM 0.0    HUM    2.60   HLM    2.88    QRQLM       0   DY  0000 28
      IW     0.0  L     79.2   S                         SCOD 400   DWB    0.0   YUM   79.06   YLM   79.06    VLM      0.0    DH  0000 28

TORONTO SEWER SYSTEM STUDY AREA 7                                                                          CALCULATION NO 007546

EAST AREA                                                                                                                        0000000
                                                                                                                                 0000000
3415  CIRCULAR          0.23/0.23  INFLOW  3414              OUTFLOW  3416         B.NO. 598110                  EXIST. COMB.0003415
      YU  76.185  YL  75.999   QF    28   DQ         0   QDLM     0  VNIGHTO.0    DUC    2.65   DLC    2.84    QLM         0   CAP 0000028
      SU  76.770  SL  76.773   AF 0.041   DQD      0.0   HDLM 0.0   HNIGHTO.0    DUS    2.29   DLS    2.29                      QLM/8600 00

      RES      0  A      0.0   VF  0.68   GAMMA 0.0      VDLM 0.0   VNORM 0.0    HUM    2.88   HLM    3.07    QRQLM       0   DY  0000 19
      IW     0.0  L     52.7   S                         SCOD 400   DWB    0.0   YUM   79.06   YLM   79.06    VLM      0.0    DH  0000 19

                                                                                                                                 0000000
3416  CIRCULAR          0.23/0.23  INFLOW  3415              OUTFLOW  3417         B.NO. 598100                  EXIST. COMB.0003416
      YU  75.999  YL  75.792   QF    32   DQ         0   QDLM     0  VNIGHTO.0    DUC    2.84   DLC    3.04    QLM         0   CAP 0000032
      SU  76.773  SL  76.846   AF 0.041   DQD      0.0   HDLM 0.0   HNIGHTO.0    DUS    2.29   DLS    2.22                      QLM/8600 00

      RES      0  A      0.0   VF  0.78   GAMMA 0.0      VDLM 0.0   VNORM 0.0    HUM    3.07   HLM    3.27    QRQLM       0   DY  0000 21
      IW     0.0  L     44.2   S                         SCOD 400   DWB    0.0   YUM   79.06   YLM   79.06    VLM      0.0    DH  0000 21

                                                                                                                                 0000000
3417  CIRCULAR          0.23/0.23  INFLOW  3416              OUTFLOW  3418         B.NO. 598100                  EXIST. COMB.0003417
      YU  75.536  YL  75.444   QF    52   DQ         0   QDLM     0  VNIGHTO.0    DUC    3.30   DLC    3.39    QLM         0   CAP 0000052
      SU  76.846  SL  76.922   AF 0.041   DQD      0.0   HDLM 0.0   HNIGHTO.0    DUS    2.22   DLS    2.14                      QLM/8600 00

      RES      0  A      0.0   VF  1.26   GAMMA 0.0      VDLM 0.0   VNORM 0.0    HUM    3.53   HLM    3.62    QRQLM       0   DY  0000 09
      IW     0.0  L      7.6   S                         SCOD 400   DWB    0.0   YUM   79.06   YLM   79.06    VLM      0.0    DH  0000 09

                                                                                                                                 0000000
3418  CIRCULAR          0.30/0.30  INFLOW  3413  3417        OUTFLOW  3419         B.NO. 460900                  EXIST. COMB.0003418
      YU  74.530  YL  74.338   QF    47   DQ        15   QDLM    15  VNIGHTO.33   DUC    4.23   DLC    4.40    QLM        15   CAP 0000032
      SU  76.922  SL  76.776   AF 0.071   DQD     15.0   HDLM 1.09  HNIGHTO.04   DUS    2.14   DLS    2.26                      QLM/8600 32

      RES      0  A      0.0   VF  0.67   GAMMA 0.0      VDLM 0.21  VNORM 0.60   HUM    4.53   HLM    4.70    QRQLM       0   DY  0000 19
      IW    15.0  L     79.2   S                         SCOD 400   DWB    0.98  YUM   79.06   YLM   79.03    VLM     0.21    DH  0000 16

                                                                                                                                 0000000
3419  CIRCULAR          0.30/0.30  INFLOW  3418              OUTFLOW  3420         B.NO. 460900                  EXIST. COMB.0003419
      YU  74.338  YL  74.124   QF    47   DQ        54   QDLM    69  VNIGHTO.49   DUC    4.40   DLC    4.44    QLM        69   CAP 0000021
      SU  76.776  SL  76.868   AF 0.071   DQD     53.8   HDLM 1.14  HNIGHTO.08   DUS    2.26   DLS    1.99                      QLM/8601 47

      RES      0  A      0.0   VF  0.66   GAMMA 0.0      VDLM 0.97  VNORM 0.97   HUM    4.70   HLM    4.74    QRQLM       0   DY  0000 21
      IW    53.8  L     91.4   S                         SCOD 400   DWB    0.84  YUM   79.03   YLM   78.86    VLM     0.97    DH  0000 04

                                                                                                                                 0000000
3420  CIRCULAR          0.30/0.30  INFLOW  3419              OUTFLOW  3421         B.NO. 460900                  EXIST. COMB.0003420
      YU  74.124  YL  73.899   QF    48   DQ         0   QDLM    69  VNIGHTO.51   DUC    4.44   DLC    4.20    QLM        69   CAP 0000020
      SU  76.868  SL  76.947   AF 0.071   DQD      0.0   HDLM 0.90  HNIGHTO.08   DUS    1.99   DLS    1.45                      QLM/8601 43
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      RES       0  A      0.0     VF  0.68    GAMMA 0.0     VDLM 0.97   VNORM 0.97    HUM    4.74    HLM    4.50     QRQLM      0    DY   0000 22
      IW      0.0  L     90.5     S                         SCOD 400    DWB    0.60   YUM   78.86    YLM   78.40     VLM     0.97    DH   0000 24

3421  CIRCULAR                0.30/0.30  INFLOW   3420              OUTFLOW  3422            B.NO.  460900                                  0000000
      YU   73.899  YL   73.701    QF      51    DQ          0   QDLM    69   VNIGHTO.53   DUC     4.20    DLC     4.05    QLM        EXIST.  COMB.0003421
      SU   76.947  SL   76.901    AF  0.071     DQD       0.0   HDLM 0.74    HNIGHTO.09   DUS     1.45    DLS     1.15                 69     CAP  0000016
                                                                                                                                             QLM/8601 34
      RES       0  A      0.0     VF  0.73    GAMMA 0.0     VDLM 0.97   VNORM 0.97    HUM    4.50    HLM    4.35     QRQLM      0    DY   0000 20
      IW      0.0  L     69.5     S                         SCOD 400    DWB    0.44   YUM   78.40    YLM   78.05     VLM     0.97    DH   0000 16
TORONTO SEWER SYSTEM STUDY AREA 7

EAST AREA                                                                                                                      CALCULATION NO 007546

3422  CIRCULAR                0.30/0.30  INFLOW   3421              OUTFLOW  3423            B.NO.  460900                                  0000000
      YU   73.701  YL   73.597    QF      41    DQ          0   QDLM    69   VNIGHTO.45   DUC     4.05    DLC     3.86                          0000000
      SU   76.901  SL   76.800    AF  0.071     DQD       0.0   HDLM 0.55    HNIGHTO.09   DUS     1.15    DLS     0.95    QLM        EXIST.  COMB.0003422
                                                                                                                                 69     CAP  0000027
                                                                                                                                             QLM/8601 68
      RES       0  A      0.0     VF  0.58    GAMMA 0.0     VDLM 0.97   VNORM 0.97    HUM    4.35    HLM    4.16     QRQLM      0    DY   0000 10
      IW      0.0  L     57.6     S                         SCOD 400    DWB    0.25   YUM   78.05    YLM   77.75     VLM     0.97    DH   0000 19

3423  CIRCULAR                0.30/0.30  INFLOW   3408   3422       OUTFLOW  3424            B.NO.  460900                                  0000000
      YU   73.597  YL   73.353    QF      93    DQ          0   QDLM    69   VNIGHTO.41   DUC     3.86    DLC     3.97    QLM        EXIST.  COMB.0003423
      SU   76.800  SL   76.148    AF  0.071     DQD       0.0   HDLM 0.66    HNIGHTO.09   DUS     0.95    DLS     1.47                 69     CAP  0000024
                                                                                                                                             QLM/8600 74
      RES       0  A      0.0     VF  1.31    GAMMA 0.0     VDLM 0.97   VNORM 1.40    HUM    4.16    HLM    4.27     QRQLM      0    DY   0000 24
      IW      0.0  L     26.5     S                         SCOD 400    DWB    0.47   YUM   77.75    YLM   77.62     VLM     0.97    DH   0000 11

3424  CIRCULAR                0.38/0.38  INFLOW   3405   3423       OUTFLOW  3425            B.NO.  143600                                  0000000
      YU   73.353  YL   73.277    QF      63    DQ         20   QDLM    97   VNIGHTO.25   DUC     3.89    DLC     3.84    QLM        EXIST.  COMB.0003424
      SU   76.148  SL   76.163    AF  0.113     DQD      20.4   HDLM 0.60    HNIGHTO.15   DUS     1.47    DLS     1.34                105     CAP  0000041
                                                                                                                                             QLM/8601 66
      RES       0  A      0.0     VF  0.56    GAMMA 0.0     VDLM 0.85   VNORM 0.85    HUM    4.27    HLM    4.22     QRQLM      0    DY   0000 08
      IW     20.4  L     62.5     S                         SCOD 400    DWB    0.22   YUM   77.62    YLM   77.50     VLM     0.93    DH   0000 04

3425  CIRCULAR                0.46/0.46  INFLOW   3424              OUTFLOW  3426            B.NO.  143601                                  0000000
      YU   73.277  YL   73.259    QF      45    DQ          0   QDLM    97   VNIGHTO.22   DUC     3.76    DLC     3.71    QLM        EXIST.  COMB.0003425
      SU   76.163  SL   76.304    AF  0.166     DQD       0.0   HDLM 0.53    HNIGHTO.15   DUS     1.34    DLS     1.12                105     CAP  0000059
                                                                                                                                             QLM/8602 35
      RES       0  A      0.0     VF  0.27    GAMMA 0.0     VDLM 0.58   VNORM 0.58    HUM    4.22    HLM    4.17     QRQLM      0    DY   0000 02
      IW      0.0  L     81.7     S                         SCOD 400    DWB    0.07   YUM   77.50    YLM   77.43     VLM     0.63    DH   0000 05

3426  CIRCULAR                0.46/0.46  INFLOW   3425              OUTFLOW  3434            B.NO.  143601                                  0000000
      YU   73.259  YL   73.186    QF      95    DQ          0   QDLM    97   VNIGHTO.39   DUC     3.71    DLC     3.72    QLM        EXIST.  COMB.0003426
      SU   76.304  SL   76.883    AF  0.166     DQD       0.0   HDLM 0.53    HNIGHTO.13   DUS     1.12    DLS     0.48                105     CAP  0000009
                                                                                                                                             QLM/8601 10
      RES       0  A      0.0     VF  0.57    GAMMA 0.0     VDLM 0.58   VNORM 0.58    HUM    4.17    HLM    4.18     QRQLM      0    DY   0000 07
      IW      0.0  L     73.1     S                         SCOD 400    DWB    0.07   YUM   77.43    YLM   77.36     VLM     0.63    DH   0000 01

3427  CIRCULAR                0.30/0.30  INFLOW                     OUTFLOW  3428            B.NO.  531300                                  0000000
      YU   74.767  YL   74.463    QF      56    DQ          0   QDLM     0   VNIGHTO.0    DUC     2.32    DLC     2.63    QLM        EXIST.  COMB.0003427
      SU   77.736  SL   77.630    AF  0.071     DQD       0.0   HDLM 0.0     HNIGHTO.0    DUS    -0.35    DLS    -0.24                  0     CAP  0000056
                                                                                                                                             QLM/8600 00
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     RES      O  A     0.0     VF  0.81    GAMMA 1.00  VDLM 0.0   VNORM 0.0    HUM   0.05   HLM   0.23    QRQLM      0   DY  0000 18
     IW     0.0  L    69.2     S                       SCOD 102   DWB   0.0    YUM  75.88   YLM  75.88    VLM      0.0   DH  0000 18

                                                                                                                           0000000
6144 CIRCULAR          0.38/0.38  INFLOW  6143               OUTFLOW  6145        B.NO. 696800                  EXIST. COMB.0006144
     YU  75.648  YL  75.395   QF   137    DQ      173  QDLM    0  VNIGHTO.0    DUC  -0.15   DLC   0.0     QLM      160     CAP 0000022
     SU  76.593  SL  76.919   AF 0.113    DQD     0.0  HDLM 0.0   HNIGHTO.0    DUS  -0.71   DLS  -1.14                     QLM/8601 17

     RES      O  A     0.59    VF  1.21    GAMMA 1.00  VDLM 0.0   VNORM 0.0    HUM   0.23   HLM   0.38    QRQLM    160   DY  0000 25
     IW     0.0  L    44.2     S                       SCOD 102   DWB   0.0    YUM  75.88   YLM  75.77    VLM     1.41   DH  0000 15

                                                                                                                           0000000
6145 CIRCULAR          0.38/0.38  INFLOW  6144               OUTFLOW  6146        B.NO. 696800                  EXIST. COMB.0006145
     YU  75.395  YL  75.100   QF   178    DQ        0  QDLM    0  VNIGHTO.0    DUC  -0.06   DLC  -0.00    QLM      151     CAP 0000027
     SU  76.919  SL  77.367   AF 0.113    DQD     0.0  HDLM 0.0   HNIGHTO.0    DUS  -1.21   DLS  -1.89                     QLM/8600 85

     RES      O  A     0.0     VF  1.57    GAMMA 1.00  VDLM 0.0   VNORM 0.0    HUM   0.32   HLM   0.38    QRQLM    151   DY  0000 29
     IW     0.0  L    30.5     S                       SCOD 102   DWB   0.0    YUM  75.71   YLM  75.48    VLM     1.37   DH  0000 06

                                                                                                                           0000000
6146 CIRCULAR          0.38/0.38  INFLOW  6145               OUTFLOW  W440        B.NO. 696900                  EXIST. COMB.0006146
   * YU  75.100  YL  74.804   QF   148    DQ        0  QDLM    0  VNIGHTO.0    DUC   0.0    DLC  -0.03    QLM      146     CAP 0000002
     SU  77.367  SL  76.615   AF 0.113    DQD     0.0  HDLM 0.0   HNIGHTO.0    DUS  -1.89   DLS  -1.46                     QLM/8600 99

     RES      O  A     0.0     VF  1.30    GAMMA 1.00  VDLM 0.0   VNORM 0.0    HUM   0.38   HLM   0.35    QRQLM    146   DY  0000 30
     IW     0.0  L    44.5     S                       SCOD 102   DWB   0.0    YUM  75.48   YLM  75.15    VLM     1.38   DH  0000 03

TORONTO SEWER SYSTEM STUDY AREA 7                                                                           CALCULATION NO 002331

SCOTT STREET PUMPING STATION                                                                                               0000000
                                                                                                                           0000000
6147 CIRCULAR          0.38/0.38  INFLOW  W440               OUTFLOW              B.NO. 696900  PASSING ON      EXIST. STORM0006147
   * YU  74.999  YL  74.697   QF   131    DQ        0  QDLM    0  VNIGHTO.0    DUC  -0.38   DLC  -0.38    QLM        0     CAP 0000131
     SU  76.615  SL  76.831   AF 0.113    DQD     0.0  HDLM 0.0   HNIGHTO.0    DUS  -1.62   DLS  -2.13                     QLM/8600 00

     RES      O  A     0.0     VF  1.16    GAMMA 1.00  VDLM 0.0   VNORM 0.0    HUM   0.0    HLM   0.0     QRQLM      0   DY  0000 30
     IW     0.0  L    57.9     S                       SCOD 102   DWB   0.0    YUM  75.00   YLM  74.70    VLM      0.0   DH  0000 00

                                                                                                                           0000000
6149 CIRCULAR          0.38/0.38  INFLOW                     OUTFLOW  6150        B.NO. 515900                  EXIST. COMB.0006149
     YU  75.657  YL  75.063   QF   212    DQ        0  QDLM    0  VNIGHTO.0    DUC  -0.38   DLC  -0.01    QLM        0     CAP 0000212
     SU  78.446  SL  76.959   AF 0.113    DQD     0.0  HDLM 0.0   HNIGHTO.0    DUS  -2.79   DLS  -1.53                     QLM/8600 00

     RES      O  A     0.0     VF  1.87    GAMMA 1.00  VDLM 0.0   VNORM 0.0    HUM   0.0    HLM   0.37    QRQLM      0   DY  0000 59
     IW     0.0  L    43.3     S                       SCOD   2   DWB   0.0    YUM  75.66   YLM  75.43    VLM      0.0   DH  0000 37

                                                                                                                           0000000
6150 CIRCULAR          0.38/0.38  INFLOW  6149               OUTFLOW  W158        B.NO. 515900                  EXIST. COMB.0006150
   * YU  75.063  YL  74.679   QF   161    DQ      208  QDLM    0  VNIGHTO.0    DUC  -0.01   DLC   0.23    QLM      196     CAP 0000034
     SU  76.959  SL  76.770   AF 0.113    DQD     0.0  HDLM 0.0   HNIGHTO.0    DUS  -1.53   DLS  -1.48                     QLM/8601 22

     RES      O  A     0.71    VF  1.42    GAMMA 1.00  VDLM 0.0   VNORM 0.0    HUM   0.37   HLM   0.61    QRQLM    196   DY  0000 38
     IW     0.0  L    48.8     S                       SCOD   2   DWB   0.0    YUM  75.43   YLM  75.29    VLM     1.73   DH  0000 24

                                                                                                                           0000000
6151 CIRCULAR          0.38/0.38  INFLOW  W158               OUTFLOW  3128        B.NO. 515900                  EXIST. STORM0006151
   * YU  74.679  YL  74.630   QF   108    DQ        0  QDLM    0  VNIGHTO.0    DUC  -0.38   DLC  -0.38    QLM        0     CAP 0000108
     SU  76.770  SL  76.764   AF 0.113    DQD     0.0  HDLM 0.0   HNIGHTO.0    DUS  -2.09   DLS  -2.13                     QLM/8600 00
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     RES       0  A      0.0     VF   0.96   GAMMA  1.00   VDLM 0.0   VNORM 0.0   HUM   0.0    HLM   0.0    QRQLM      0   DY  0000 05
     IW      0.0  L     13.7     S                         SCOD 305   DWB   0.0   YUM  74.68   YLM  74.63   VLM     0.0    DH  0000 00

6152 CIRCULAR          0.30/0.30  INFLOW  W158                  OUTFLOW  6153       B.NO. 515900                              0000000
  *  YU  74.676  YL   74.380  QF     186    DQ          0  QDLM    0  VNIGHTO.0   DUC  0.00   DLC    0.0    QLM         EXIST. COMB.0006152
     SU  76.770  SL   76.846  AF 0.071    DQD       0.0  HDLM 0.0   HNIGHTO.0   DUS  -1.79   DLS  -2.17                  187     CAP  0000000
                                                                                                                          QLM/8601 00
     RES       0  A      0.0     VF   2.64   GAMMA  1.00   VDLM 0.0   VNORM 0.0   HUM   0.30   HLM   0.30   QRQLM    187   DY  0000 30
     IW      0.0  L      7.9     S                         SCOD   2   DWB   0.0   YUM  74.98   YLM  74.68   VLM     2.84   DH  0000 00

6153 CIRCULAR          0.30/0.30  INFLOW  6152                  OUTFLOW  6161       B.NO. 515900                              0000000
     YU  72.960  YL   72.899  QF      77    DQ          0  QDLM    0  VNIGHTO.0   DUC  0.52   DLC   0.33    QLM         EXIST. COMB.0006153
     SU  76.846  SL   76.916  AF 0.071    DQD       0.0  HDLM 0.0   HNIGHTO.0   DUS  -3.06   DLS  -3.39                  187     CAP  0000109
                                                                                                                          QLM/8602 42
     RES       0  A      0.0     VF   1.10   GAMMA  0.0    VDLM 0.0   VNORM 0.0   HUM   0.82   HLM   0.63   QRQLM    187   DY  0000 06
     IW      0.0  L      9.4     S                         SCOD 400   DWB   0.0   YUM  73.78   YLM  73.53   VLM     2.65   DH  0000 20

6154 CIRCULAR          0.30/0.30  INFLOW                        OUTFLOW  6155       B.NO. 148900                              0000000
     YU  74.380  YL   74.021  QF      64    DQ          0  QDLM    0  VNIGHTO.0   DUC  -0.30   DLC  -0.30   QLM         EXIST. COMB.0006154
     SU  77.261  SL   77.148  AF 0.071    DQD       0.0  HDLM 0.0   HNIGHTO.0   DUS  -2.88   DLS  -3.13                    0     CAP  0000064
                                                                                                                          QLM/8600 00
     RES       0  A      0.0     VF   0.91   GAMMA  0.0    VDLM 0.0   VNORM 0.0   HUM   0.0    HLM   0.0    QRQLM      0   DY  0000 36
     IW      0.0  L     81.7     S                         SCOD 400   DWB   0.0   YUM  74.38   YLM  74.02   VLM     0.0    DH  0000 00
TORONTO SEWER SYSTEM STUDY AREA 7                                                                               CALCULATION NO 002331

SCOTT STREET PUMPING STATION                                                                                                  0000000
6155 CIRCULAR          0.30/0.30  INFLOW  6154                  OUTFLOW  6156       B.NO. 148900                              0000000
     YU  74.021  YL   74.002  QF      69    DQ          0  QDLM    0  VNIGHTO.0   DUC  -0.30   DLC  -0.30   QLM         EXIST. COMB.0006155
     SU  77.148  SL   77.209  AF 0.071    DQD       0.0  HDLM 0.0   HNIGHTO.0   DUS  -3.13   DLS  -3.21                    0     CAP  0000069
                                                                                                                          QLM/8600 00
     RES       0  A      0.0     VF   0.98   GAMMA  0.0    VDLM 0.0   VNORM 0.0   HUM   0.0    HLM   0.0    QRQLM      0   DY  0000 02
     IW      0.0  L      3.7     S                         SCOD 400   DWB   0.0   YUM  74.02   YLM  74.00   VLM     0.0    DH  0000 00

6156 CIRCULAR          0.30/0.30  INFLOW  6155                  OUTFLOW  6157       B.NO. 832100                              0000000
     YU  74.002  YL   73.612  QF      70    DQ          0  QDLM    0  VNIGHTO.0   DUC  -0.30   DLC  -0.30   QLM         EXIST. COMB.0006156
     SU  77.209  SL   76.721  AF 0.071    DQD       0.0  HDLM 0.0   HNIGHTO.0   DUS  -3.21   DLS  -3.11                    0     CAP  0000070
                                                                                                                          QLM/8600 00
     RES       0  A      0.0     VF   0.99   GAMMA  0.0    VDLM 0.0   VNORM 0.0   HUM   0.0    HLM   0.0    QRQLM      0   DY  0000 39
     IW      0.0  L     74.4     S                         SCOD 400   DWB   0.0   YUM  74.00   YLM  73.61   VLM     0.0    DH  0000 00

6157 CIRCULAR          0.30/0.30  INFLOW  6156                  OUTFLOW  6159       B.NO. 832100                              0000000
     YU  73.612  YL   73.167  QF      74    DQ          0  QDLM    0  VNIGHTO.0   DUC  -0.30   DLC   0.10   QLM         EXIST. COMB.0006157
     SU  76.721  SL   77.282  AF 0.071    DQD       0.0  HDLM 0.0   HNIGHTO.0   DUS  -3.11   DLS  -3.71                    0     CAP  0000074
                                                                                                                          QLM/8600 00
     RES       0  A      0.0     VF   1.05   GAMMA  0.0    VDLM 0.0   VNORM 0.0   HUM   0.0    HLM   0.40   QRQLM      0   DY  0000 44
     IW      0.0  L     75.0     S                         SCOD 400   DWB   0.0   YUM  73.61   YLM  73.57   VLM     0.0    DH  0000 40

6158 CIRCULAR          0.30/0.30  INFLOW                        OUTFLOW  6159       B.NO. 515700                              0000000
     YU  74.292  YL   73.798  QF      72    DQ          0  QDLM    0  VNIGHTO.0   DUC  -0.30   DLC  -0.30   QLM         EXIST. COMB.0006158
     SU  77.291  SL   77.282  AF 0.071    DQD       0.0  HDLM 0.0   HNIGHTO.0   DUS  -3.00   DLS  -3.48                    0     CAP  0000072
                                                                                                                          QLM/8600 00
     RES       0  A      0.0     VF   1.02   GAMMA  0.0    VDLM 0.0   VNORM 0.0   HUM   0.0    HLM   0.0    QRQLM      0   DY  0000 49
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     IW      0.0  L      88.1   S                            SCOD 400    DWB    0.0    YUM  74.29   YLM  73.80    VLM      0.0     DH  0000 00

6159 CIRCULAR              0.46/0.46  INFLOW  6157   6158   3193    OUTFLOW  6160        B.NO.  515800                                  0000000
     YU  72.253  YL  72.210    QF      99    DQ          0   QDLM    67  VNIGHTO.36    DUC   0.86    DLC    0.91    QLM     EXIST.  COMB.0006159
     SU  77.282  SL  76.980    AF 0.166     DQD        0.0   HDLM 0.29   HNIGHTO.08    DUS  -3.70    DLS   -3.40              111    CAP 0000012
                                                                                                                                   QLM/8601 13
     RES         0  A       0.0    VF   0.59    GAMMA 0.0    VDLM 0.63   VNORM 0.0     HUM    1.32   HLM    1.37    QRQLM      0    DY  0000 04
     IW      0.0  L      40.2   S                            SCOD 400    DWB    0.00   YUM  73.58   YLM  73.58    VLM     0.67     DH  0000 04

6160 CIRCULAR              0.46/0.46  INFLOW  6159                  OUTFLOW  6161        B.NO.  515800                                  0000000
     YU  72.210  YL  72.195    QF     193    DQ          0   QDLM    67  VNIGHTO.58    DUC   0.91    DLC    0.92    QLM     EXIST.  COMB.0006160
     SU  76.980  SL  76.916    AF 0.166     DQD        0.0   HDLM 0.30   HNIGHTO.09    DUS  -3.40    DLS   -3.34              112    CAP 0000081
                                                                                                                                   QLM/8600 58
     RES         0  A       0.0    VF   1.16    GAMMA 0.0    VDLM 0.59   VNORM 1.06    HUM    1.37   HLM    1.38    QRQLM      0    DY  0000 01
     IW      0.0  L       3.7   S                            SCOD 400    DWB    0.11   YUM  73.58   YLM  73.58    VLM     0.70     DH  0000 01

6161 CIRCULAR              0.46/0.46  INFLOW  3106   6153   6160    OUTFLOW  6162        B.NO.  291900                                  0000000
     YU  72.195  YL  72.110    QF     150    DQ          0   QDLM   110  VNIGHTO.56    DUC   0.87    DLC    0.75    QLM     EXIST.  COMB.0006161
     SU  76.916  SL  76.986    AF 0.166     DQD        0.0   HDLM 0.30   HNIGHTO.09    DUS  -3.39    DLS   -3.66              230    CAP 0000079
                                                                                                                                   QLM/8601 54
     RES         0  A       0.0    VF   0.90    GAMMA 0.0    VDLM 0.96   VNORM 0.0     HUM    1.33   HLM    1.21    QRQLM    183    DY  0000 09
     IW      0.0  L      34.4   S                            SCOD 400    DWB    0.0    YUM  73.53   YLM  73.32    VLM     1.39     DH  0000 12
TORONTO SEWER SYSTEM STUDY AREA 7
                                                                                                                         CALCULATION NO 002331
SCOTT STREET PUMPING STATION
                                                                                                                                        0000000
6162 CIRCULAR              0.46/0.46  INFLOW  6161                  OUTFLOW  6163        B.NO.  291900                                  0000000
     YU  72.110  YL  71.805    QF     174    DQ          0   QDLM   110  VNIGHTO.62    DUC   0.75    DLC    0.52    QLM     EXIST.  COMB.0006162
     SU  76.986  SL  76.986    AF 0.166     DQD        0.0   HDLM 0.27   HNIGHTO.08    DUS  -3.66    DLS   -4.20              230    CAP 0000055
                                                                                                                                   QLM/8601 32
     RES         0  A       0.0    VF   1.05    GAMMA 0.0    VDLM 1.10   VNORM 0.0     HUM    1.21   HLM    0.98    QRQLM    183    DY  0000 31
     IW      0.0  L      91.4   S                            SCOD 400    DWB    0.0    YUM  73.32   YLM  72.78    VLM     1.39     DH  0000 23

6163 CIRCULAR              0.46/0.46  INFLOW  6162                  OUTFLOW  6164        B.NO.  291900                                  0000000
     YU  71.805  YL  71.689    QF     192    DQ          0   QDLM   110  VNIGHTO.67    DUC   0.52    DLC    0.46    QLM     EXIST.  COMB.0006163
     SU  76.986  SL  76.871    AF 0.166     DQD        0.0   HDLM 0.27   HNIGHTO.08    DUS  -4.20    DLS   -4.26              230    CAP 0000037
                                                                                                                                   QLM/8601 20
     RES         0  A       0.0    VF   1.16    GAMMA 0.0    VDLM 1.19   VNORM 0.0     HUM    0.98   HLM    0.92    QRQLM    182    DY  0000 12
     IW      0.0  L      28.6   S                            SCOD 400    DWB    0.02   YUM  72.78   YLM  72.61    VLM     1.39     DH  0000 05

6164 CIRCULAR              0.46/0.46  INFLOW  6163   6234           OUTFLOW  6165        B.NO.  291800                                  0000000
     YU  71.689  YL  71.323    QF     172    DQ          0   QDLM   110  VNIGHTO.62    DUC   0.46    DLC    0.17    QLM     EXIST.  COMB.0006164
     SU  76.871  SL  76.770    AF 0.166     DQD        0.0   HDLM 0.27   HNIGHTO.08    DUS  -4.26    DLS   -4.82              230    CAP 0000057
                                                                                                                                   QLM/8601 34
     RES         0  A       0.0    VF   1.04    GAMMA 1.00   VDLM 1.09   VNORM 0.0     HUM    0.92   HLM    0.63    QRQLM    175    DY  0000 37
     IW      0.0  L     112.2   S                            SCOD 102    DWB    0.00   YUM  72.61   YLM  71.95    VLM     1.39     DH  0000 29

6165 CIRCULAR              0.46/0.46  INFLOW  6164                  OUTFLOW  6166        B.NO.  291800                                  0000000
     YU  71.323  YL  71.131    QF     169    DQ          0   QDLM   110  VNIGHTO.61    DUC   0.17    DLC    0.0     QLM     EXIST.  COMB.0006165
     SU  76.770  SL  76.679    AF 0.166     DQD        0.0   HDLM 0.27   HNIGHTO.08    DUS  -4.82    DLS   -5.09              230    CAP 0000060
                                                                                                                                   QLM/8601 36
     RES         0  A       0.0    VF   1.02    GAMMA 1.00   VDLM 1.07   VNORM 0.0     HUM    0.63   HLM    0.46    QRQLM    169    DY  0000 19
     IW      0.0  L      61.0   S                            SCOD 102    DWB    0.0    YUM  71.95   YLM  71.59    VLM     1.39     DH  0000 17
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                                                                                                                              0000000
6166  CIRCULAR             0.46/0.46  INFLOW   6165                 OUTFLOW  6169          B.NO. 291800               EXIST. COMB.0006166
      YU  71.131  YL  70.964  QF   277  DQ          0  QDLM  110  VNIGHTO.87  DUC  -0.12   DLC  -0.13   QLM     229   CAP 0000048
      SU  76.679  SL  76.694  AF 0.166  DQD       0.0  HDLM 0.20  HNIGHTO.06  DUS  -5.21   DLS  -5.40                 QLM/8600 83

      RES      0  A    0.0   VF  1.67   GAMMA  1.00   VDLM 1.58  VNORM 0.0   HUM   0.34   HLM   0.33   QRQLM   167   DY  0000 17
      IW     0.0  L   19.8   S                        SCOD 102   DWB    0.0  YUM  71.47   YLM  71.30   VLM    1.79   DH  0000 00

                                                                                                                              0000000
6167  CIRCULAR             0.61/0.61  INFLOW   5978                 OUTFLOW  6169          B.NO. 291700               EXIST. COMB.0006167
      YU  70.583  YL  70.488  QF   347  DQ          0  QDLM   99  VNIGHTO.56  DUC  -0.31   DLC  -0.31   QLM     169   CAP 0000178
      SU  76.864  SL  76.694  AF 0.292  DQD       0.0  HDLM 0.22  HNIGHTO.07  DUS  -5.98   DLS  -5.91                 QLM/8600 49

      RES      0  A    0.0   VF  1.19   GAMMA  0.0    VDLM 1.03  VNORM 0.0   HUM   0.30   HLM   0.30   QRQLM     0   DY  0000 09
      IW     0.0  L   32.3   S                        SCOD 400   DWB    0.0  YUM  70.88   YLM  70.79   VLM    1.18   DH  0000 00

                                                                                                                              0000000
6168  CIRCULAR             0.30/0.30  INFLOW   W440                 OUTFLOW  6169          B.NO. 696900               EXIST. COMB.0006168
  *   YU  74.804  YL  74.566  QF   196  DQ          0  QDLM    0  VNIGHTO.0   DUC  -0.10   DLC  -0.10   QLM     144   CAP 0000051
      SU  76.615  SL  76.694  AF 0.071  DQD       0.0  HDLM 0.0   HNIGHTO.0   DUS  -1.62   DLS  -1.93                 QLM/8600 74

      RES      0  A    0.0   VF  2.77   GAMMA  1.00   VDLM 0.0   VNORM 0.0   HUM   0.20   HLM   0.20   QRQLM   144   DY  0000 24
      IW     0.0  L    5.8   S                        SCOD 102   DWB    0.0  YUM  75.00   YLM  74.76   VLM    2.96   DH  0000 00

TORONTO SEWER SYSTEM STUDY AREA 7                                                                             CALCULATION NO 002331

SCOTT STREET PUMPING STATION                                                                                                  0000000
                                                                                                                              0000000
6169  BASKET HANDLE H      1.07/1.37  INFLOW   6166   6167   6168   OUTFLOW  6225          B.NO. 696900               EXIST. COMB.0006169
      YU  70.348  YL  70.003  QF  4604  DQ          0  QDLM  209  VNIGHTO.86  DUC  -1.16   DLC  -0.99   QLM     472   CAP 0004132
      SU  76.694  SL  77.014  AF 1.290  DQD       0.0  HDLM 0.12  HNIGHTO.03  DUS  -6.13   DLS  -6.63                 QLM/8600 10

      RES      0  A    0.0   VF  3.57   GAMMA  1.00   VDLM 1.77  VNORM 0.0   HUM   0.21   HLM   0.38   QRQLM   281   DY  0000 35
      IW     0.0  L   32.0   S                        SCOD 102   DWB    0.0  YUM  70.56   YLM  70.38   VLM    2.17   DH  0000 16

                                                                                                                              0000000
6193  CIRCULAR             0.30/0.30  INFLOW                        OUTFLOW  6194          B.NO. 460000               EXIST. COMB.0006193
      YU  74.173  YL  73.944  QF    48  DQ          0  QDLM    0  VNIGHTO.0   DUC  -0.30   DLC  -0.30   QLM       0   CAP 0000048
      SU  76.782  SL  76.794  AF 0.071  DQD       0.0  HDLM 0.0   HNIGHTO.0   DUS  -2.61   DLS  -2.85                 QLM/8600 00

      RES      0  A    0.0   VF  0.69   GAMMA  0.0    VDLM 0.0   VNORM 0.0   HUM   0.0    HLM   0.0    QRQLM     0   DY  0000 23
      IW     0.0  L   90.8   S                        SCOD 400   DWB    0.0  YUM  74.17   YLM  73.94   VLM    0.0    DH  0000 00

                                                                                                                              0000000
6194  CIRCULAR             0.30/0.30  INFLOW   6193                 OUTFLOW  6195          B.NO. 460000               EXIST. COMB.0006194
      YU  73.944  YL  73.734  QF    74  DQ          0  QDLM    0  VNIGHTO.0   DUC  -0.30   DLC  -0.30   QLM       0   CAP 0000074
      SU  76.794  SL  76.776  AF 0.071  DQD       0.0  HDLM 0.0   HNIGHTO.0   DUS  -2.85   DLS  -3.04                 QLM/8600 00

      RES      0  A    0.0   VF  1.04   GAMMA  0.0    VDLM 0.0   VNORM 0.0   HUM   0.0    HLM   0.0    QRQLM     0   DY  0000 21
      IW     0.0  L   36.0   S                        SCOD 400   DWB    0.0  YUM  73.94   YLM  73.73   VLM    0.0    DH  0000 00

                                                                                                                              0000000
6195  CIRCULAR             0.30/0.30  INFLOW   6194                 OUTFLOW  6196          B.NO. 460000               EXIST. COMB.0006195
      YU  73.704  YL  73.691  QF    42  DQ          0  QDLM    0  VNIGHTO.0   DUC  -0.30   DLC  -0.30   QLM       0   CAP 0000042
      SU  76.776  SL  76.992  AF 0.071  DQD       0.0  HDLM 0.0   HNIGHTO.0   DUS  -3.07   DLS  -3.30                 QLM/8600 00

      RES      0  A    0.0   VF  0.59   GAMMA  0.0    VDLM 0.0   VNORM 0.0   HUM   0.0    HLM   0.0    QRQLM     0   DY  0000 01
      IW     0.0  L    7.0   S                        SCOD 400   DWB    0.0  YUM  73.70   YLM  73.69   VLM    0.0    DH  0000 00
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6222  CIRCULAR              0.30/0.30  INFLOW   6221                      OUTFLOW   6223          B.NO. 309700                         EXIST.  COMB.0006222
      YU   73.765  YL  73.637    QF     39    DQ          0   QDLM     0  VNIGHTO.0     DUC   -0.30    DLC   -0.30     QLM          0     CAP 0000039
      SU   76.779  SL  76.871    AF  0.071    DQD       0.0   HDLM 0.0    HNIGHTO.0     DUS   -3.01    DLS   -3.23                        QLM/8600 00

      RES       0  A      0.0    VF   0.55    GAMMA 0.0       VDLM 0.0    VNORM 0.0     HUM    0.0     HLM    0.0     QRQLM        0    DY   0000 13
      IW      0.0  L     78.0    S                            SCOD 400    DWB     0.0   YUM   73.76    YLM   73.64    VLM     0.0        DH   0000 00

                                                                                                                                           0000000
6223  CIRCULAR              0.30/0.30  INFLOW   6222                      OUTFLOW   6224          B.NO. 640500                         EXIST.  COMB.0006223
      YU   73.542  YL  73.320    QF     56    DQ          0   QDLM     0  VNIGHTO.0     DUC   -0.30    DLC   -0.30     QLM          0     CAP 0000056
      SU   76.871  SL  76.992    AF  0.071    DQD       0.0   HDLM 0.0    HNIGHTO.0     DUS   -3.33    DLS   -3.67                        QLM/8600 00

      RES       0  A      0.0    VF   0.79    GAMMA 0.0       VDLM 0.0    VNORM 0.0     HUM    0.0     HLM    0.0     QRQLM        0    DY   0000 22
      IW      0.0  L     66.1    S                            SCOD 400    DWB     0.0   YUM   73.54    YLM   73.32    VLM     0.0        DH   0000 00

                                                                                                                                           0000000
6224  CIRCULAR              0.30/0.30  INFLOW   6223                      OUTFLOW   5965          B.NO. 640500                         EXIST.  COMB.0006224
      YU   73.320  YL  73.265    QF     27    DQ          0   QDLM     0  VNIGHTO.0     DUC   -0.30    DLC   -0.30     QLM          0     CAP 0000027
      SU   76.992  SL  76.477    AF  0.071    DQD       0.0   HDLM 0.0    HNIGHTO.0     DUS   -3.67    DLS   -3.21                        QLM/8600 00

      RES       0  A      0.0    VF   0.39    GAMMA 0.0       VDLM 0.0    VNORM 0.0     HUM    0.0     HLM    0.0     QRQLM        0    DY   0000 06
      IW      0.0  L     68.3    S                            SCOD 400    DWB     0.0   YUM   73.32    YLM   73.26    VLM     0.0        DH   0000 00
TORONTO SEWER SYSTEM STUDY AREA 7
                                                                                                                            CALCULATION NO 002331
SCOTT STREET PUMPING STATION
                                                                                                                                           0000000
                                                                                                                                           0000000
6225  CIRCULAR              0.39/0.39  INFLOW   6169                      OUTFLOW                     B.NO. 696900  PASSING ON          IMAGIN.SEGM.0006225
   *  YU   69.470  YL  39.470    QF    434    DQ          0   QDLM   209  VNIGHT2.00    DUC    0.19    DLC    0.0      QLM        472     CAP 0000037
      SU   77.014  SL  77.166    AF  0.119    DQD       0.0   HDLM 0.19   HNIGHTO.06    DUS   -6.97    DLS  -37.31                        QLM/8601 09

      RES       0  A      0.0    VF   3.64    GAMMA 0.0       VDLM 3.61   VNORM 0.0     HUM    0.58    HLM    0.39    QRQLM      269    DY   0030 00
      IW      0.0  L    600.0    S                            SCOD 400    DWB     0.0   YUM   70.05    YLM   39.86    VLM     3.96       DH   0000 19

                                                                                                                                           0000000
6229  CIRCULAR              0.30/0.30  INFLOW                             OUTFLOW   6230          B.NO. 149100                         EXIST.  COMB.0006229
      YU   73.856  YL  73.387    QF     92    DQ          0   QDLM     0  VNIGHTO.0     DUC   -0.30    DLC   -0.30     QLM          0     CAP 0000092
      SU   79.038  SL  77.044    AF  0.071    DQD       0.0   HDLM 0.0    HNIGHTO.0     DUS   -5.18    DLS   -3.66                        QLM/8600 00

      RES       0  A      0.0    VF   1.30    GAMMA 0.0       VDLM 0.0    VNORM 0.0     HUM    0.0     HLM    0.0     QRQLM        0    DY   0000 47
      IW      0.0  L     51.5    S                            SCOD 400    DWB     0.0   YUM   73.86    YLM   73.39    VLM     0.0        DH   0000 00

                                                                                                                                           0000000
6230  CIRCULAR              0.30/0.30  INFLOW   6229                      OUTFLOW   6233          B.NO. 149100                         EXIST.  COMB.0006230
      YU   73.387  YL  73.018    QF     97    DQ          0   QDLM     0  VNIGHTO.0     DUC   -0.30    DLC   -0.30     QLM          0     CAP 0000097
      SU   77.044  SL  76.675    AF  0.071    DQD       0.0   HDLM 0.0    HNIGHTO.0     DUS   -3.66    DLS   -3.66                        QLM/8600 00

      RES       0  A      0.0    VF   1.37    GAMMA 0.0       VDLM 0.0    VNORM 0.0     HUM    0.0     HLM    0.0     QRQLM        0    DY   0000 37
      IW      0.0  L     36.6    S                            SCOD 400    DWB     0.0   YUM   73.39    YLM   73.02    VLM     0.0        DH   0000 00

                                                                                                                                           0000000
6231  CIRCULAR              0.30/0.30  INFLOW                             OUTFLOW   6232          B.NO. 149100                         EXIST.  COMB.0006231
      YU   74.895  YL  73.816    QF    134    DQ          0   QDLM     0  VNIGHTO.0     DUC   -0.30    DLC   -0.30     QLM          0     CAP 0000134
      SU   77.489  SL  76.651    AF  0.071    DQD       0.0   HDLM 0.0    HNIGHTO.0     DUS   -2.59    DLS   -2.84                        QLM/8600 00

      RES       0  A      0.0    VF   1.90    GAMMA 0.0       VDLM 0.0    VNORM 0.0     HUM    0.0     HLM    0.0     QRQLM        0    DY   0001 08
      IW      0.0  L     55.8    S                            SCOD 400    DWB     0.0   YUM   74.90    YLM   73.82    VLM     0.0        DH   0000 00

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6232  CIRCULAR              0.30/0.30  INFLOW   6231                      OUTFLOW   6233          B.NO. 149100                         EXIST.  COMB.0006232
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     YU  73.076  YL  73.018  QF     72  DQ        0  QDLM     0  VNIGHTO.0    DUC  -0.30   DLC  -0.30   QLM          0  CAP 0000072
     SU  76.651  SL  76.675  AF 0.071   DQD     0.0  HDLM 0.0    HNIGHTO.0    DUS  -3.57   DLS  -3.66                  QLM/8600 00

     RES      0  A      0.0  VF   1.02  GAMMA 0.0    VDLM 0.0    VNORM 0.0    HUM    0.0   HLM    0.0   QRQLM        0  DY   0000 06
     IW     0.0  L     10.4  S                       SCOD 400    DWB    0.0   YUM  73.08   YLM  73.02   VLM        0.0  DH   0000 00

                                                                                                                          0000000
6233 CIRCULAR          0.30/0.30  INFLOW  6232  6230        OUTFLOW  6234       B.NO. 149100            EXIST. COMB.0006233
     YU  73.018  YL  72.817  QF    112  DQ        0  QDLM     0  VNIGHTO.0    DUC  -0.30   DLC  -0.30   QLM          0  CAP 0000112
     SU  76.675  SL  76.627  AF 0.071   DQD     0.0  HDLM 0.0    HNIGHTO.0    DUS  -3.66   DLS  -3.81                  QLM/8600 00

     RES      0  A      0.0  VF   1.58  GAMMA 0.0    VDLM 0.0    VNORM 0.0    HUM    0.0   HLM    0.0   QRQLM        0  DY   0000 20
     IW     0.0  L     14.9  S                       SCOD 400    DWB    0.0   YUM  73.02   YLM  72.82   VLM        0.0  DH   0000 00

                                                                                                                          0000000
6234 CIRCULAR          0.30/0.30  INFLOW  6233              OUTFLOW  6164       B.NO. 149100            EXIST. COMB.0006234
     YU  72.817  YL  71.802  QF    333  DQ        0  QDLM     0  VNIGHTO.0    DUC  -0.30   DLC   0.51   QLM          0  CAP 0000332
     SU  76.627  SL  76.871  AF 0.071   DQD     0.0  HDLM 0.16   HNIGHTO.0    DUS  -3.81   DLS  -4.26                  QLM/8600 00

     RES      0  A      0.0  VF   4.71  GAMMA 0.0    VDLM 0.0    VNORM 0.0    HUM    0.0   HLM   0.81   QRQLM        0  DY   0001 01
     IW     0.0  L      8.5  S                       SCOD 400    DWB   0.16   YUM  72.82   YLM  72.61   VLM       0.00  DH   0000 81

TORONTO SEWER SYSTEM STUDY AREA 7                                                                     CALCULATION NO 002331

SCOTT STREET PUMPING STATION                                                                                              0000000
                                                                                                                          0000000
C593 CIRCULAR          0.38/0.38  INFLOW                    OUTFLOW  C594       B.NO. 320               EXIST. SAN.  0003593
     YU  74.520  YL  74.250  QF    147  DQ        1  QDLM     1  VNIGHTO.22   DUC  -0.36   DLC  -0.36   QLM          1  CAP 0000145
     SU  77.390  SL  76.650  AF 0.114   DQD     1.1  HDLM 0.02   HNIGHTO.01   DUS  -2.85   DLS  -2.37                  QLM/8600 01

     RES    100  A     1.00  VF   1.29  GAMMA 1.00   VDLM 0.41   VNORM 0.0    HUM   0.02   HLM   0.03   QRQLM        0  DY   0000 27
     IW     0.0  L     41.8  S                       SCOD 400    DWB    0.0   YUM  74.54   YLM  74.28   VLM       0.44  DH   0000 01

                                                                                                                          0000000
C594 CIRCULAR          0.31/0.31  INFLOW  C593  3101        OUTFLOW  3102       B.NO. 320               EXIST. COMB.0003594
     YU  73.240  YL  73.150  QF     45  DQ        0  QDLM     1  VNIGHTO.15   DUC   0.25   DLC   0.34   QLM          3  CAP 0000042
     SU  76.650  SL  77.040  AF 0.073   DQD     0.0  HDLM 0.03   HNIGHTO.01   DUS  -2.85   DLS  -3.25                  QLM/8600 07

     RES      0  A     1.00  VF   0.62  GAMMA 1.00   VDLM 0.27   VNORM 0.0    HUM   0.56   HLM   0.64   QRQLM        0  DY   0000 09
     IW     0.0  L     45.2  S                       SCOD 400    DWB    0.0   YUM  73.80   YLM  73.79   VLM       0.34  DH   0000 08

                                                                                                                          0000000
C608 CIRCULAR          0.30/0.30  INFLOW                    OUTFLOW  C609       B.NO. 918               EXIST. SAN.  0003608
     YU  75.410  YL  75.370  QF     61  DQ        0  QDLM     0  VNIGHTO.0    DUC  -0.30   DLC  -0.30   QLM          0  CAP 0000061
     SU  77.900  SL  77.530  AF 0.071   DQD     0.0  HDLM 0.0    HNIGHTO.0    DUS  -2.49   DLS  -2.16                  QLM/8600 00

     RES    100  A      0.0  VF   0.86  GAMMA 1.00   VDLM 0.0    VNORM 0.0    HUM    0.0   HLM    0.0   QRQLM        0  DY   0000 04
     IW     0.0  L     10.1  S                       SCOD 400    DWB    0.0   YUM  75.41   YLM  75.37   VLM        0.0  DH   0000 00

                                                                                                                          0000000
C609 CIRCULAR          0.30/0.30  INFLOW  C608              OUTFLOW  C611       B.NO. 918               EXIST. SAN.  0003609
     YU  75.330  YL  74.900  QF     65  DQ        4  QDLM     4  VNIGHTO.28   DUC  -0.29   DLC  -0.23   QLM          5  CAP 0000060
     SU  77.530  SL  77.830  AF 0.071   DQD     3.9  HDLM 0.07   HNIGHTO.02   DUS  -2.19   DLS  -2.86                  QLM/8600 07

     RES    350  A     1.00  VF   0.92  GAMMA 1.00   VDLM 0.52   VNORM 0.0    HUM   0.01   HLM   0.07   QRQLM        0  DY   0000 43
     IW     0.0  L     95.2  S                       SCOD 400    DWB   0.02   YUM  75.34   YLM  74.97   VLM       0.37  DH   0000 06

                                                                                                                          0000000
C610 CIRCULAR          0.30/0.30  INFLOW                    OUTFLOW  C611       B.NO. 190               EXIST. SAN.  0003610
     YU  75.900  YL  74.920  QF    114  DQ        4  QDLM     4  VNIGHTO.42   DUC  -0.29   DLC  -0.25   QLM          4  CAP 0000110
```

Appendix 3i

Minutes of Oct 22 2007 Scott Street SPS Meeting with City

November 2, 2007
Project 07135

MINUTES OF SCOTT STREET SPS MEETING

The
MUNICIPAL
INFRASTRUCTURE
Group

1:00 pm October 22, 2007

Metro Hall – 17th Floor Commissioner's Boardroom

In Attendance:

Greg Horgan	City of Toronto
Ilona Tarvydas	City of Toronto
Richard Boyd	City of Toronto
Richard Rawlinson	City of Toronto
Doug ----- (for Elio Buccella)	City of Toronto
Les Arishenkoff (partial attendance)	City of Toronto
Kevin Brown	The Municipal Infrastructure Group Ltd. (TMIG)
Steve Byberg	The Municipal Infrastructure Group
Mark Tarras (partial attendance)	The Municipal Infrastructure Group

---

Item	**Description**	**Action by**
1.	The Scott St SPS has three vertical-turbine pumps: 1. 190 L/s variable-speed (lead/lag) 2. 292 L/s constant-speed (standby) 3. 190 L/s variable-speed (lag/lead) The firm pumping capacity of the station is therefore 380 L/s. Only Pump #2 (292 L/s) can be operated on stand-by power. There is no wet well; system sewers are used for storage. There is no Certificate of Approval for the existing facility.	Info
2.	One of the three pumps is currently undergoing refurbishment.	Info
3.	The City noted that it is possible to increase the firm pumping capacity from 380 L/s (2x190) to 584 L/s (2x292). The pumps and impellors are no longer manufactured, so a cast would have to be made of the impellor from Pump #2. The City also noted that the station could be further upgraded by converting the existing dry well into a wet well, and installing new higher-capacity submersible pumps. This would result in increased storage, and would require a control panel at a higher level. The courtyard at the Sony Centre (formerly Hummingbird Centre) has been designated as a heritage centre.	Info

4.	The peak flows measured at the station were as follows: – 309 L/s for the period from November 2006 through February 2007 – 340 L/s for the period from February 2007 through July 2007	Info
5.	The two duty pumps (190 L/s each) are reported to operate together at full speed from 6AM to 8AM during dry weather.	Info
6.	The station has never overflowed. As such, it is believed that the flows do not exceed 380 L/s. This is consistent with the flow monitoring results. Steve Byberg will meet with Richard Boyd to evaluate specific flow and level data.	TMIG
7.	It was reported that there are existing odour issues along The Esplanade.	Info
8.	Pumped flows from the Scott St SPS are discharged to the Low-Level Interceptor (LLI) immediately downstream of the Victoria Street Interceptor (which connects the LLI to the Mid-Toronto Interceptor (MTI). The gravity sewer between the forcemain discharge point and the LLI has a capacity of approximately 990 L/s (G&S, 1995). The remaining capacity in that sewer is therefore 610 L/s (990 – 380 = 610).	Info
9.	All of the flow in the LLI upstream of Victoria Street is diverted to the MTI. Dry-Weather flows in the LLI are reportedly 25-30% of its rated capacity. This would indicate that there is remaining capacity in the LLI, but this has not been confirmed. During dry weather, the depth in the LLI is reportedly 13-14 inches (pipe depth is 60 inches).	Info
10.	TMIG will assess how the Scott Street SPS might be impacted by the East Bayfront flows as part of their upcoming Functional Servicing Report. The City will conduct a study of the LLI flows and remaining capacity.	TMIG City
11.	Historically, capacity allocation at the Scott St SPS for new development was provided by installing storm sewers and reducing the storm flow rate by more than the increase in sanitary flow rate. Because the portion of the Scott St SPS drainage area downstream of the East Bayfront lands is fully-separated, there is limited opportunity to remove storm flows from the sanitary sewer in this case.	Info
12.	There might be some building dewatering that contributes flow to the sanitary system. Parking lot trench drains are connected to sanitary (as they must be), as is Enwave condensation distillate (due to the elevated temperatures). The magnitude of these flows is not known, and there is no way of assessing how much capacity could be re-gained by disconnecting any foundation drains.	Info
13.	The City has conducted CCTV inspections in the past. TMIG will contact Rick Rawlinson regarding pipes of interest.	TMIG
14.	Candace Au would have an inventory of any watermain breaks in the area. TMIG will contact Candace.	TMIG

Please report any errors or omissions within five business days.

Minutes Prepared By:

The Municipal Infrastructure Group Ltd.

Kevin Brown, P.Eng
Distribution: All Present

G:\Projects\2007\07135 - Waterfront Toronto - East Bayfront\Correspondence\Meetings\Minutes\2007-10-22 Scott Street SPS Meeting.doc

Appendix 3j

Population and Employment Projections – Build-Out Conditions

06/02/2009

Scott Street SPS Flows - Build-Out Projection

-East Bayfront Population and Employment Projections based on the Phase I Planning Context Report (Urban Strategies Inc, 2007).

																							DESIGN CRITERIA									
																						300		300						1.65	0.26	
																						Lpcd		Lpcd						L/ha/s	L/ha/s	
	Drainage	Percentage of "Waterfront East - Population and Employment Summary" Sub-Zones														Area [ha] (1)		Residential Population (2)		Employment Population (2)		Avgrage Res DWF		Avgrage Empl DWF		Total	Equiv.	Peaking	Peak	Extraneous Flow (5)		Total
	Area	210	224	5011	5012	5013	241	5014	5015	5016	5017	5018	240	480	243	Total	Fully Separated	Projected [-]	Existing [-]	Projected [-]	Existing [-]	New (3) [L/s]	Existing [L/s]	New (3) [L/s]	Existing [L/s]	DWF [L/s]	Pop (4) [-]	Factor [-]	Flow [L/s]	Partial Sep [L/s]	Fully Sep [L/s]	Flow [L/s]
	A	100%	31%	100%	100%											47.5	0.0	13,030	8,444	14,211	2,451	16	23	41	7	87	28,794	2.49	217	78	0	**295**
	B					100%	100%		61%							15.9	0.0	2,742	144	4,706	1,704	9	0	10	5	25	7,154	3.10	76	26	0	**102**
	C							100%	39%							10.1	0.0	92	92	1,087	1,087	0	0	0	3	3	1,179	3.75	12	17	0	**29**
EAST BAYFRONT	**D (7)**											53%				6.2	6.2	1,478	21	2,200	215	5	0	7	1	13	3,641	3.37	42	0	2	**42**
	E (8)											47%				5.4	5.4	1,287	21	1,916	215	4	0	6	1	11	3,167	3.42	38	0	1	**38**
	F (9)									100%						8.3	8.3	5,481	262	2,103	2,626	18	1	0	7	26	7,601	3.07	80	0	2	**80**
	G (9)										100%					7.2	7.2	4,754	196	1,824	1,967	16	1	0	5	22	6,341	3.15	69	0	2	**69**
	H												19%			2.8	0.0	1,294	334	1,147	398	3	1	3	1	8	2,419	3.52	28	5	0	**33**
	I												34%			5.0	0.0	1,657	589	1,497	705	4	2	3	2	10	3,116	3.43	34	8	0	**43**
	J												47%			6.9	0.0	2,064	1,136	2,065	1,025	3	3	4	3	13	4,154	3.32	43	11	0	**54**
	K													49%	5%	11.6	0.0	3,104	3,104	1,459	717	0	9	3	2	13	4,748	3.27	43	19	0	**62**
	L													41%		9.7	0.0	1,983	1,983	1,206	1,206	0	6	0	3	9	3,189	3.42	30	16	0	**46**
	X		69%											10%	95%	Area X does not contribute flow to Scott Street SPS																
	TOTALS	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**136.6**	**27.1**	**38,966**	**16,326**	**35,421**	**14,317**	**79**	**45**	**76**	**40**	**239**	**75,504**	2.10	**503**	**181**	**7**	**691**
																													Note (6)			Note (6)

🟧 Designates cells where data was input directly.

Notes:

(1) Total Area represents the entire Drainage Area; Fully Separated Area indicatres where all storm drainage (CBs and roof downspouts) are directed to dedicated storm sewers.
(2) Residential Unit and Employment Population projections are based on "Waterfront East - Population and Employment Summary" (City of Toronto), and have been distributed based on area.
(3) New Residential and Employment DWF is based on the Projected population minus the Existing (2006) population. In cases where the population is projected to drop, the "New Flow" was set to zero (rather than a negative value).
(4) Equivalent Population is computed based on Total DWF divided by the Design Criteria for New Residential Development (300 Lpcd).
(5) The existing Drainange Areas are Partially-Separated (street CBs to storm, building drainage to sanitary). East Bayfront will be completely redeveloped as a fully-separated system.
(6) Above Totals are based on the Peaking Factor calculated for the entire Scott Street SPS Drainage Area. As such, these are lower than the sum of the individual Drainage Area contributions.
(7) Residential Units and Employment Population projections for Drainage Area D are based on the East Bayfront Phase I Projections (Urban Strategies Inc, 2007).
(8) Residential Units and Employment Population projections for Drainage Area E are based on the densities from Drainage Area D.
(9) Residential Units and Employment Population projections for Drainage Areas F and G are based in the total East Bayfront projections, less Drainage Areas D and E.

References:

Koetter Kim & Associates et al, November 2005: "East Bayfront Precinct Plan".
LEA et al, January 2006: "East Bayfront Class Environmental Assessment Master Plan".
LEA, February 2005: "East Bayfront Precinct Plan - Municipal Services Engineering Report".
MOE: "Guidelines for the Design of Municipal Water and Sewage Systems".
Urban Strategies Inc, May 2007: "Phase I Planning Context Report".
Waterfront Toronto Website: *www.waterfrontoronto.com*

Sample Calculations:

Appendix 3k

Population and Employment Projections – Existing Conditions plus East Bayfront Phase 1

Scott Street SPS Flows - Existing Conditions Plus East Bayfront Phase I

-Residential Population of Drainage Area D (East Bayfront Phase I) was based on a Residential Gross Floor Area of 68,745 m² (Urban Strategies Inc, 2007), a unit density of 93 m²/unit (Lea, 2005), and a population density of 2.0 persons/unit (Lea, 2005).

-Drainage Area D Employment Population was based on an Employment Gross Floor Area of 51,000 m² (Urban Straegies Inc, 2007), and an Employment Density of 1 per 23 m² (Lea, 2006).

	Drainage	Percentage of Dissemination Areas (1)														
	Area	35200826	35200827	35200828	35200829	35200830	35200831	35200832	35200833	35204650	35204651	35204652	35204653	35204654	35204655	35204230
	A										32%	100%	100%	100%	100%	
	B									0%	33%					
	C									0%	21%					
EAST BAYFRONT	**D**							3%								
	E							3%								
	F							42%	0%							
	G							32%								
	H									16%	3%					
	I									28%	6%					
	J									56%	5%					
	K	100%	100%	100%					100%							100%
	L				100%	100%	100%	19%								
	TOTALS	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

	Drainage	Area [ha] (2)		Residential Population (3)		Employment Population (4)		Avgrage Res DWF		Avgrage Empl DWF		Total	Equiv.	Peaking	Peak	Extraneous Flow (6)		Total
								DESIGN CRITERIA										
								300 Lpcd		300 Lpcd						1.65 L/ha/s	0.26 L/ha/s	
	Area	Total	Fully Separated	Projected [-]	Existing [-]	Build-Out [-]	Existing [-]	New (5) [L/s]	Existing [L/s]	New (5) [L/s]	Existing [L/s]	DWF [L/s]	Pop [-]	Factor [-]	Flow [L/s]	Partial Sep [L/s]	Fully Sep [L/s]	Flow [L/s]
	A	47.5	0.0	13,030	8,444	2,480	2,451	16	23	0	7	46	15,316	2.77	128	78	0	**207**
	B	15.9	0.0	2,742	144	1,704	1,704	9	0	0	5	14	4,120	3.32	47	26	0	**73**
	C	10.1	0.0	92	92	1,087	1,087	0	0	0	3	3	1,179	3.75	12	17	0	**29**
EAST BAYFRONT	**D**	6.2	6.2	1,478	21	2,200	215	5	0	7	1	13	3,642	3.37	42	0	2	**44**
	E	5.4	0.0	21	21	215	215	0	0	0	1	1	237	4.12	3	9	0	**12**
	F	8.3	0.0	262	262	2,626	2,626	0	1	0	7	8	2,888	3.46	28	14	0	**41**
	G	7.2	0.0	196	196	1,967	1,967	0	1	0	5	6	2,163	3.56	21	12	0	**33**
	H	2.8	0.0	1,294	334	1,147	398	3	1	3	1	8	2,419	3.52	28	5	0	**33**
	I	5.0	0.0	1,657	589	752	705	4	2	0	2	7	2,314	3.54	26	8	0	**35**
	J	6.9	0.0	2,064	1,136	1,055	1,025	3	3	0	3	9	3,019	3.44	32	11	0	**43**
	K	11.6	0.0	3,104	3,104	717	717	0	9	0	2	11	3,821	3.35	36	19	0	**55**
	L	9.7	0.0	1,983	1,983	1,206	1,206	0	6	0	3	9	3,189	3.42	30	16	0	**46**
	TOTALS	**136.6**	**6.2**	**27,923**	**16,326**	**17,157**	**14,317**	**40**	**45**	**10**	**40**	**135**	**44,307**	2.10	**284**	**215**	**2**	**501**
															Note (7)			Note (7)
				17,616														

▨ Designates cells where data was input directly.

Notes:

(1) Some Drainage Areas were manually assigned smaller percentages of Dissemination Areas to better reflect the estimated population and employment densities in those areas.

(2) Total Area represents the entire Drainage Area; Fully Separated Area indicatres where all storm drainage (CBs and roof downspouts) are directed to dedicated storm sewers.

(3) Populations are based on 2006 Census Data (Statistics Canada), and have been distributed based on area.

(4) Employment figures are based on the 2006 Toronto Employment Survey, and have been distributed based on area.

(5) New Residential and Employment DWF is based on the Projected minus the Existing (2006) population. In cases where the population is projected to drop, the "New Flow" was set to zero (rather than a negative value).

(6) The existing Drainange Areas are Partially-Separated (street CBs to storm, building drainage to sanitary). East Bayfront will be completely redeveloped as a fully-separated system.

(7) Above Totals are based on the Peaking Factor calculated for the entire Scott Street SPS Drainage Area. As such, these are lower than the sum of the individual Drainage Area contributions.

References:

Koetter Kim & Associates et al, November 2005: "East Bayfront Precinct Plan".
LEA et al, January 2006: "East Bayfront Class Environmental Assessment Master Plan".
LEA, February 2005: "East Bayfront Precinct Plan - Municipal Services Engineering Report".
MOE: "Guidelines for the Design of Municipal Water and Sewage Systems".
Urban Strategies Inc, May 2007: "Phase I Planning Context Report".
Waterfront Toronto Website: *www.waterfrontoronto.com*

Appendix 3I

Population and Employment Projections – Existing Conditions Plus Corus Entertainment Building

Scott Street SPS Flows - Existing Conditions Plus Corus Building

-Employment Population in Drainage Area D (East Bayfront Phase I) was increased by 1,826 to reflect the development of the Corus Building.
-Corus Employment Population was based on a Gross Floor Area of 42,000 m² (Urban Strategies Inc, 2007), and an Employment Density of 1 per 23 m² (Lea, 2006).

DESIGN CRITERIA

300	300	1.65	0.26
Lpcd	Lpcd	L/ha/s	L/ha/s

	Drainage Area	Percentage of Dissemination Areas [1]														
		35200826	35200827	35200828	35200829	35200830	35200831	35200832	35200833	35204650	35204651	35204652	35204653	35204654	35204655	35204230
	A										32%	100%	100%	100%	100%	
	B									0%	33%					
	C									0%	21%					
EAST BAYFRONT	D							3%								
	E							3%								
	F							42%	0%							
	G							32%								
	H									16%	3%					
	I									28%	6%					
	J									56%	5%					
	K	100%	100%	100%					100%							100%
	L				100%	100%	100%	19%								
	TOTALS	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Drainage Area	Area [ha] [2]		Residential Population [3]		Employment Population [4]		Avgrage Res DWF		Avgrage Empl DWF		Total	Equiv.	Peaking	Peak	Extraneous Flow [6]		Total
	Total	Fully Separated	Projected [-]	Existing [-]	Build-Out [-]	Existing [-]	New [5] [L/s]	Existing [L/s]	New [5] [L/s]	Existing [L/s]	DWF [L/s]	Pop [-]	Factor [-]	Flow [L/s]	Partial Sep [L/s]	Fully Sep [L/s]	Flow [L/s]
A	47.5	0.0	13,030	8,444	2,480	2,451	16	23	0	7	46	15,316	2.77	128	78	0	**207**
B	15.9	0.0	2,742	144	1,704	1,704	9	0	0	5	14	4,120	3.32	47	26	0	**73**
C	10.1	0.0	92	92	1,087	1,087	0	0	0	3	3	1,179	3.75	12	17	0	**29**
D	6.2	6.2	21	21	2,041	215	0	0	6	1	7	2,519	3.51	25	0	2	**26**
E	5.4	0.0	21	21	215	215	0	0	0	1	1	237	4.12	3	9	0	**12**
F	8.3	0.0	262	262	2,626	2,626	0	1	0	7	8	2,888	3.46	28	14	0	**41**
G	7.2	0.0	196	196	1,967	1,967	0	1	0	5	6	2,163	3.56	21	12	0	**33**
H	2.8	0.0	1,294	334	1,147	398	3	1	3	1	8	2,419	3.52	28	5	0	**33**
I	5.0	0.0	1,657	589	752	705	4	2	0	2	7	2,314	3.54	26	8	0	**35**
J	6.9	0.0	2,064	1,136	1,055	1,025	3	3	0	3	9	3,019	3.44	32	11	0	**43**
K	11.6	0.0	3,104	3,104	717	717	0	9	0	2	11	3,821	3.35	36	19	0	**55**
L	9.7	0.0	1,983	1,983	1,206	1,206	0	6	0	3	9	3,189	3.42	30	16	0	**46**
TOTALS	**136.6**	**6.2**	**26,466**	**16,326**	**16,998**	**14,317**	**35**	**45**	**9**	**40**	**130**	**43,184**	2.10	**272**	**215**	**2**	**489**
														Note (7)			Note (7)

▨ Designates cells where data was input directly.

Notes:

(1) Some Drainage Areas were manually assigned smaller percentages of Dissemination Areas to better reflect the estimated population and employment densities in those areas.
(2) Total Area represents the entire Drainage Area; Fully Separated Area indicatres where all storm drainage (CBs and roof downspouts) are directed to dedicated storm sewers.
(3) Populations are based on 2006 Census Data (Statistics Canada), and have been distributed based on area.
(4) Employment figures are based on the 2006 Toronto Employment Survey, and have been distributed based on area.
(5) New Residential and Employment DWF is based on the Projected minus the Existing (2006) population. In cases where the population is projected to drop, the "New Flow" was set to zero (rather than a negative value).
(6) The existing Drainange Areas are Partially-Separated (street CBs to storm, building drainage to sanitary). East Bayfront will be completely redeveloped as a fully-separated system.
(7) Above Totals are based on the Peaking Factor calculated for the entire Scott Street SPS Drainage Area. As such, these are lower than the sum of the individual Drainage Area contributions.

References:

Koetter Kim & Associates et al, November 2005: "East Bayfront Precinct Plan".
LEA et al, January 2006: "East Bayfront Class Environmental Assessment Master Plan".
LEA, February 2005: "East Bayfront Precinct Plan - Municipal Services Engineering Report".
MOE: "Guidelines for the Design of Municipal Water and Sewage Systems".
Urban Strategies Inc, May 2007: "Phase I Planning Context Report".
Waterfront Toronto Website: *www.waterfrontoronto.com*

Appendix 3m

Population and Employment Projections – Existing

Scott Street SPS Flows - Existing Conditions

																							DESIGN CRITERIA						
																					240	240					1.65	0.26	
																					Lpcd	Lpcd					L/ha/s	L/ha/s	
	Drainage Area	Percentage of Dissemination Area Populations and Jobs (4)															Area [ha]		Residential Population (1) [-]	Employ. Pop (2,3) [-]	Res DWF [L/s]	Employ. DWF [L/s]	Total DWF [L/s]	Equiv. Pop [-]	Peaking Factor [-]	Peak Flow [L/s]	Extraneous Flow (6)		Total Flow [L/s]
		35200826	35200827	35200828	35200829	35200830	35200831	35200832	35200833	35204650	35204651	35204652	35204653	35204654	35204655	35204230	Total	Fully Separated									Partial Sep [L/s]	Fully Sep [L/s]	
	A										32%	100%	100%	100%	100%		47.5	0.0	8,444	2,451	23	7	30	10,894	2.92	88	78	0	167
	B									0%	33%						15.9	0.0	144	1,704	0	5	5	1,849	3.61	19	26	0	45
	C									0%	21%						10.1	0.0	92	1,087	0	3	3	1,179	3.75	12	17	0	29
EAST BAYFRONT	**D**							3%									6.2	0.0	21	215	0	1	1	237	4.12	3	10	0	13
	E							3%									5.4	0.0	21	215	0	1	1	237	4.12	3	9	0	12
	F							42%	0%								8.3	0.0	262	2,626	1	7	8	2,888	3.46	28	14	0	41
	G							32%									7.2	0.0	196	1,967	1	5	6	2,163	3.56	21	12	0	33
	H									16%	3%						2.8	0.0	334	398	1	1	2	732	3.88	8	5	0	13
	I									28%	6%						5.0	0.0	589	705	2	2	4	1,294	3.73	13	8	0	22
	J									56%	5%						6.9	0.0	1,136	1,025	3	3	6	2,161	3.56	21	11	0	33
	K	100%	100%	100%					100%							100%	11.6	0.0	3,104	717	9	2	11	3,821	3.35	36	19	0	55
	L				100%	100%	100%	19%									9.7	0.0	1,983	1,206	6	3	9	3,189	3.42	30	16	0	46
	TOTALS	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**136.6**	**0.0**	**16,326**	**14,317**	**45**	**40**	**85**	**30,643**	2.10	**179** Note (6)	**225**	**0**	**404** Note (6)

▨ Designates cells where data was input directly.

Notes:

(1) Populations are based on 2006 Census Data (Statistics Canada), and have been distributed based on area.
(2) Employment figures are based on the 2006 Toronto Employment Survey, and have been distributed based on area.
(3) Equivalent Employment was calculated by considering two Part-Time jobs as equivalent to one Full-Time job.
(4) Some Drainage Areas were manually assigned smaller percentages of Dissemination Areas to better reflect the estimated population and employment densities in those areas.
(5) Extraneous Flow has been calculated using the City's standard allowance of 0.26 L/ha/s.
(6) Above Totals are based on the Peaking Factor calculated for the entire Scott Street SPS Drainage Area. As such, these are lower than the sum of the individual Drainage Area contributions.

References:

Koetter Kim & Associates et al, November 2005: "East Bayfront Precinct Plan".
LEA et al, January 2006: "East Bayfront Class Environmental Assessment Master Plan".
LEA, February 2005: "East Bayfront Precinct Plan - Municipal Services Engineering Report".
MOE: "Guidelines for the Design of Municipal Water and Sewage Systems".
Urban Strategies Inc, May 2007: "Phase I Planning Context Report".
Waterfront Toronto Website: *www.waterfronttoronto.com*

Appendix 3n

Transportation Population Data

Waterfront East - Population and Employment Summary

			2001 FF (TTS Dist)		2021 Ultimate Growth		2021 Ultimate Growth + Retainment where bolded	
	1996 GTA TZ	Waterfront Sub-Zone	Population	Employment	Population	Employment	Population	Employment
WEST	153	153	-	-			-	-
		5002	-	72	-	923	-	923
		5003	-	90	-	976	-	976
		5004	-	22	-	1,177	-	1,177
		5005	-	1,170	-	4,823	-	4,823
		5006	16	1,494	3,941	3,675	**3,956**	**5,169**
		5007	-	366	4,200	1,576	**4,200**	**1,942**
		5008	-	232	1,120	-	**1,120**	**232**
		5009	1,329	824	2,962	1,649	**4,291**	**2,474**
	Sub-total West		1,345	4,270	12,222	14,799	13,567	17,715
CENTRAL	211	**211**	-	2,972	5,152	409	**5,152**	**3,382**
		5010	-	5,693	2,184	5,029	**2,184**	**10,722**
	225	**225**	-	2,080	-	765	**-**	**2,845**
	224	**224**	-	1,448	-	-	**-**	**1,448**
		5011	775	2,433	560	5,441	**1,335**	**7,875**
		5012	3,101	1,049	2,626	1,918	**5,726**	**2,967**
	241	**241**	**323**	340	1,984	271	**2,307**	**611**
		5013	-	2,339	-	1,612	**-**	**3,951**
		5014	-	355	-	-	**-**	**355**
		5015	-	236	-	-	**-**	**236**
	242	242	19	102	5,312	727	5,312	727
		5016	-	490	3,877	976	3,877	976
		5017	-	323	2,982	751	2,982	751
		5018	-	225	3,203	1,871	3,203	1,871
		5019	481	379	2,216	593	**2,697**	**972**
		5020	-	108	4,338	180	4,338	180
		5021	-	128	-	-	**-**	**128**
	207	207	-	-	8,216	-	8,216	-
	208	**208**	321	335	2,957	1,757	**3,278**	**2,092**
	210	**210**	1,664	2,140	2,813	785	**4,477**	**2,925**
	252	**252**	779	2,200	1,368	113	**2,147**	**2,313**
	Sub-total Central		7,463	25,374	49,787	23,200	57,231	47,327
EAST	253	253	-	19	-	-	-	-
		478	244	1,356	-	-	**244**	**1,356**
		479	-	123	2,288	444	2,288	444
		5022	-	59	6,864	1,330	6,864	1,330
		5023	-	515	-	-	-	-
		5024	-	312	6,368	1,235	6,368	1,235
		5025	-	891	6,197	4,397	6,197	4,397
		5026**	-	64	413	3,889	413	3,889
		5027	-	210	1,237	2,157	1,237	2,157
		5028	-	1,000	659	5,457	659	5,457
		5029* **	-	80	1,338	140	**1,338**	**219**
		5030	-	150	4,323	1,770	4,323	1,770
		5031	-	53	3,166	1,382	3,166	1,382
		5032	-	-	-	2,417	-	2,417
		5033	590	1,950	-	-	**590**	**1,950**
	Sub-total East		834	6,780	32,853	24,616	33,687	28,001
	TOTAL		9,642	36,424	94,862	62,615	104,486	93,043

East Bayfront	-	1,145	14,400	3,778	14,400	3,778
West Don Lands	1,279	2,809	8,896	1,434	10,156	4,141
Port Lands	-	3,474	32,853	24,616	32,853	24,696

Sub Zones in Waterfront Area

Appendix 3o

Sanitary Design Sheets

PROJECT: Waterfront Toronto - East Bayfront
SCENARIO: Full Build-Out - SAN Sewer Design - Using PVC Series Pipes
LOCATION: Toronto, ON
JOB NO: 07135

SANITARY SEWER DESIGN SHEET

SUBMISSION: 1
DESIGNED BY: AA
REVIEWED BY: KB
DATE: 30-Jan-09

DESIGN PARAMETERS
HARMON PEAKING FACTOR = 1+(14/(4+P^0.5))
P = Population in 1000's
AVG. DAILY PER CAPITA FLOW = 300.00 l/cap/d

LOCATION					FLOW							SEWER DESIGN									
(1) STREET	(2) FROM MH	(3) TO MH	(4) POPU-LATION	(5) ACCUM. POP.	(6) PEAKING FACTOR (M)	(7) PEAK FLOW (l/s)	(8) SECTION AREA (ha)	(9) TOTAL AREA (ha)	(10) INFIL - TRATION ALLOWANCE (l/s/ha)	(11) INFIL-TRATION (l/s)	(12) DESIGN FLOW (l/s)	(13) UPSTREAM INV ELEV. (m)	(14) DOWN - STREAM INV ELEV. (m)	(15) PIPE LENGTH (m)	(16) NOMINAL PIPE DIA. (mm)	(17) ACTUAL PIPE DIA. (mm)	(18) PIPE SLOPE (%)	(19) FULL FLOW CAPACITY (l/s)	(20) FULL FLOW VELOCITY (m/s)	(21) DESIGN VELOCITY (m/s)	CAPACITY (%)
Queens Quay	32A	31A	3,261	3,261	3.41	39	4.20	4.20	0.26	1	40	74.850	74.609	120.3	350	337	0.20	59	0.7	0.7	67%
	31A	30A	3,261	6,522	3.14	71	4.20	8.40	0.26	2	73	74.561	74.387	87.2	400	385	0.20	84	0.7	0.8	87%
	30A	29A	3,261	9,783	2.96	101	6.97	15.37	0.26	4	105	74.338	74.113	112.4	450	434	0.20	116	0.8	0.9	90%
	29A	28A	11,172	20,955	2.63	192	4.13	19.50	0.26	5	197	73.969	73.779	95.1	600	578	0.20	248	1.0	1.1	79%
	28A	27A	2,528	23,483	2.58	211	2.77	22.27	0.26	6	216	72.240	72.032	103.8	600	578	0.20	249	1.0	1.1	87%
	27A	26A	4,186	27,669	2.51	241	2.07	24.34	0.26	6	248	72.002	71.851	75.7	600	578	0.20	248	1.0	1.1	100%
	26A	25A	0	27,669	2.51	241	2.77	27.11	0.26	7	248	71.791	71.710	40.2	600	578	0.20	249	1.0	1.1	100%
Lower Jarvis Street	25A	24A	943	28,612	2.50	248	10.10	37.21	1.65	61	310	71.527	71.448	39.5	750	762	0.20	519	1.1	1.2	60%
	24A	23A	0	28,612	2.50	248	0.00	37.21	1.65	61	310	71.418	71.334	42.0	750	762	0.20	519	1.1	1.2	60%
	23A	22A	0	28,612	2.50	248	0.00	37.21	1.65	61	310	71.304	71.252	26.0	750	762	0.20	519	1.1	1.2	60%
	22A	21A	0	28,612	2.50	248	0.00	37.21	1.65	61	310	71.222	71.080	70.7	750	762	0.20	521	1.1	1.2	59%
	21A	20A	0	28,612	2.50	248	0.00	37.21	1.65	61	310	71.050	70.914	68.0	750	762	0.20	519	1.1	1.2	60%
	20A	19A	0	28,612	2.50	248	0.00	37.21	1.65	61	310	70.884	70.853	15.4	750	762	0.20	521	1.1	1.2	59%
	19A	18A	0	28,612	2.50	248	0.00	37.21	1.65	61	310	70.823	70.754	34.9	750	762	0.20	516	1.1	1.2	60%
	18A	17A	0	28,612	2.50	248	0.00	37.21	1.65	61	310	70.724	70.708	7.9	750	762	0.20	523	1.1	1.2	59%
	17A	16A	0	28,612	2.50	248	0.00	37.21	1.65	61	310	70.678	70.446	116.2	750	762	0.20	519	1.1	1.2	60%
	16A	15A	0	28,612	2.50	248	0.00	37.21	1.65	61	310	70.416	70.377	19.4	750	762	0.20	521	1.1	1.2	59%
Wilton Street	15A	14A	6,350	34,962	2.41	293	21.30	58.51	1.65	97	389	70.347	70.328	9.2	750	762	0.21	528	1.1	1.2	74%
	14A	13A	0	34,962	2.41	293	0.00	58.51	1.65	97	389	70.268	70.178	45.0	750	762	0.20	519	1.1	1.2	75%
Market Street	Ex.SAN MH	13A	3,697	3,697	3.36	43	6.90	6.90	1.65	11	55	72.500	72.485	7.7	750	762	0.19	513	1.1	0.7	11%
	13A	12A	0	38,659	2.37	318	0.00	65.41	1.65	108	426	70.118	70.069	24.5	750	762	0.20	519	1.1	1.3	82%
	12A	11A	0	38,659	2.37	318	0.00	65.41	1.65	108	426	70.039	70.025	7.2	750	762	0.20	521	1.1	1.3	82%

PROJECT: Waterfront Toronto - East Bayfront
SCENARIO: Full Build-Out - SAN Sewer Design - Using PVC Series Pipes
LOCATION: Toronto, ON
JOB NO: 07135

SANITARY SEWER DESIGN SHEET

SUBMISSION: 1
DESIGNED BY: AA
REVIEWED BY: KB
DATE: 30-Jan-09

DESIGN PARAMETERS
HARMON PEAKING FACTOR = 1+(14/(4+P^0.5))
P = Population in 1000's
AVG. DAILY PER CAPITA FLOW = 300.00 l/cap/d

LOCATION					FLOW							SEWER DESIGN									
(1) STREET	(2) FROM MH	(3) TO MH	(4) POPU-LATION	(5) ACCUM. POP.	(6) PEAKING FACTOR (M)	(7) PEAK FLOW (l/s)	(8) SECTION AREA (ha)	(9) TOTAL AREA (ha)	(10) INFIL - TRATION ALLOWANCE (l/s/ha)	(11) INFIL-TRATION (l/s)	(12) DESIGN FLOW (l/s)	(13) UPSTREAM INV ELEV. (m)	(14) DOWN - STREAM INV ELEV. (m)	(15) PIPE LENGTH (m)	(16) NOMINAL PIPE DIA. (mm)	(17) ACTUAL PIPE DIA. (mm)	(18) PIPE SLOPE (%)	(19) FULL FLOW CAPACITY (l/s)	(20) FULL FLOW VELOCITY (m/s)	(21) DESIGN VELOCITY (m/s)	CAPACITY (%)
	11A	9A	0	38,659	2.37	318	0.00	65.41	1.65	108	426	69.965	69.941	11.9	750	762	0.20	522	1.1	1.3	82%
	10A	9A	0	0	4.50	0	0.00	0.00	1.65	0	0	71.500	71.414	4.3	450	434	2.00	366	2.5	0.0	0%
	9A	8A	0	38,659	2.37	318	0.00	65.41	1.65	108	426	69.911	69.711	100.4	750	762	0.20	518	1.1	1.3	82%
The	8A	7A	0	38,659	2.37	318	0.00	65.41	1.65	108	426	69.681	69.668	6.5	750	762	0.20	519	1.1	1.3	82%
Esplanade	7A	6A	0	38,659	2.37	318	0.00	65.41	1.65	108	426	69.638	69.551	43.4	750	762	0.20	520	1.1	1.3	82%
	6A	5A	2,895	41,554	2.34	338	5.00	70.41	1.65	116	454	69.521	69.408	56.3	750	762	0.20	520	1.1	1.3	87%
	5A	4A	0	41,554	2.34	338	0.00	70.41	1.65	116	454	69.378	69.324	27.1	750	762	0.20	518	1.1	1.3	88%
	4A	3A	0	41,554	2.34	338	0.00	70.41	1.65	116	454	69.294	69.123	85.3	750	762	0.20	520	1.1	1.3	87%
Scott	3A	2A	0	41,554	2.34	338	0.00	70.41	1.65	116	454	69.063	69.036	13.6	750	762	0.20	517	1.1	1.3	88%
Street	2A	1A	0	41,554	2.34	338	0.00	70.41	1.65	116	454	68.976	68.918	29.0	750	762	0.20	519	1.1	1.3	87%
	1A	SPS	0	41,554	2.34	338	0.00	70.41	1.65	116	454	68.858	68.846	6.1	750	762	0.20	515	1.1	1.3	88%

G:\Projects\2007\07135 - Waterfront Toronto - East Bayfront\Design\Sanitary\Sanitary Sewer Design Sheets - East Bayfront Full Development - Jan 27 2009
San Design (Series Pipe)

Appendix 4a

Water Calculations

Water Flow Calculations
Domestic and Fire

The MUNICIPAL INFRASTRUCTURE Group

Waterfront Toronto

East Bayfront

7-Dec-07 Revised 23-Mar-09

Domestic Flow Calculation

Average Day Flow

Flow based on		
	191	lpcd - Residential
	2.0	persons/unit
	191.0	lpcd - Employment Use

Phase	Location		Area	Residential Population		Employment Population (Equivalent Persons)	Total Population (Equivalent Persons)	Average Day Flow		City of Toronto Design Criteria - Peak Adjustments				
			(ha)	Units	Persons			(l/d)	(l/s)	Minimum Hour Factor	Maximum Day Factor	Max Day Flow	Peak Hour Factor	Flow
1-SW(Dockside)	Richardson	Queens Quay	6.3	739	1478	2200	3678	702,498	8.1	0.7	1.65	13.42	2.5	20.33
SE (Bayside)	Bonnycastle	Queens Quay	5.3	622	1287	1916	3203	611,773	7.1	0.7	1.65	11.68	2.5	17.70
NW	Richardson	Lakeshore	8.3	2788	5481	2103	7584	1,448,544	16.8	0.7	1.65	27.66	2.5	41.91
NE(Parkside)	Bonnycastle	Lakeshore	7	2351	4754	1824	6578	1,256,398	14.5	0.7	1.65	23.99	2.5	36.35
Totals for Entire East Bayfront			26.9	6500	13000	8043	21043	4,019,213	46.5			76.8		116.3

Waterfront Toronto

East Bayfront

16-Nov-07 Revised 23-Mar-09

Fire Flow Calculation

Fire Underwriters Survey

Calc

1	**Fire Flow Formula F=220C(A^0.5)**		F=	32,927	l/m	F=	24,890	l/m
	C= Construction Coefficient		C=	0.8		C=	0.8	
	1.5 wood frame							
	1.0 ordinary - brick walls, combustible interio							
	0.8 Non-combustible (metal structure, masonry or metal walls)							
	0.6 Fire resistive				7000 sq.m floor plate			4000 sq.m floor plate
				Corus	8 storeys tall		High Rise	30 storeys tall
	A=Total Floor Area in Sq.m.		A=	35,000	sq.m.		20,000	sq.m.
	Consider the Two largest Floors plus 50% of each floor above to a total of eight							
2	**Reduction/Surcharge for Occupancy**		Charge =	-10%		Charge =	-10%	
	Non Combustible contents -25%		Reduction =	-3293	l/m	Reduction =	-2489	l/m
	Limited Combustible -10%							
	Combustible No Charge							
	Free Burning +15%							
	Rapid Burning + 25%		Revised F =	36,219	l/m	Revised F =	27,379	l/m
3	**Sprinklered**		Reduction =	50%		Reduction =	50%	
	The Revised F from No. 2 may be reduced up to:							
	50% for a complete automatic sprinkler system							
	30% for a sprinkler system conforming to NFPA 13							
			Revised F =	18,110	l/m	Revised F =	13,690	l/m
4	**Exposure Surcharges**							
	0 to 3.0m	25%	North Charge	15%	18m	North Charge	25%	3m
	3.1 to 10m	20%	South Charge	0	Lake	South Charge	25%	3m
	10.1 to 20m	15%	East Charge	15%	18m	East Charge	25%	3m
	20.1 to 30m	10%	West Charge	0	Park	West Charge	15%	18m
	30.1 to 45m	5%						
			Total Charge for Exposure = 75% maximum	30%		Total Charge for Exposure = 75% maximum	75%	
			Revised F =	23,543	l/min	Revised F =	23,957	l/min
			Rounded =	23,600	l/min	Rounded	24,000	l/min
			Corrected, Max = 45,000, min = 2,000 =	23,600	l/min	Corrected, Max = 45,000, min = 2,000 =	24,000	l/min
				393	l/s		400	l/s

WaterCad Modelling Summary

The
MUNICIPAL
INFRASTRUCTURE
Group

DATE: February 9, 2009 Project: 07135
TO: Chris Ewen
CC: Steve Byberg
FROM: Lauren Homuth

SUBJECT: East Bayfront Water Distribution System

A WaterCAD analysis has been completed for the East Bayfront (EBF) lands to assess the proposed system under a three-phase development buildout: Corus Entertainment, Phase 1 lands, and Full EBF lands.

The water distribution system, as designed with a 300mm diameter watermain on Queens Quay, provides the required minimum pressures of 20psi during a fire and 40psi during peak hour demands; minimum fire flows of 400l/s; and maximum velocity of 3.2m/s for all phases of buildout for the East Bayfront lands.

The water distribution system was modeled using the demands provided and attached here. A maximum day factor of 1.65 and a peak hour factor of 2.5 were applied to the average day demands.

For all analysis, the system was tested to ensure that during firefighting efforts a minimum of 20psi (140kPa) is provided throughout the system and 40psi (280kPa) is provided at all other times; and that the velocity within the pipes are maintained under 5m/s. Fire demands within this area are calculated at 400l/s using FUS calculations. It was assumed that during firefighting efforts, 6 hydrants would be used due to the capacity of a hydrant. To conservatively model this, the fire demand was divided equally amongst only four nodes surrounding the area and the residual pressures were assessed. A network diagram, **Figures1 to 3**, along with the pipe and node tables for each of the scenarios, Appendices A to C, listed below have been attached.

Corus Scenario

The system was analyzed using the demands that will be placed upon the system at the time Corus becomes operational and the watermains that will be in place to service the area at that time.

A fire flow analysis was completed which applied 400l/s demand to each node in turn in addition to the max day flow for the entire system, to determine the areas of the system which were the design constraints. As noted previously, when fighting a fire, it is likely that 6 hydrants will be used. To more accurately model this situation, the four nodes surrounding Corus (nodes J-880, J-900, J-910, and J-920) were used with a 100l/s additional demand applied to each of them. The resulting residual pressures within the system were all greater than 20psi as per the attached, **Appendix A**.

For this scenario, fire flows of 400l/s can be provided with minimum residual pressure of 37psi.

Phase 1 Buildout Scenario

The system was analyzed using the demands that will be placed upon the system at the time that development of the East Bayfront Phase 1 lands are completed and the watermains that will be in place to service the area at that time.

A fire flow analysis was completed which applied 400l/s demand to each node in turn in addition to the max day flow for the entire system, to determine the areas of the system which were the design constraints. As noted previously, when fighting a fire, it is likely that 6 hydrants will be used. To more accurately model this situation, the four nodes surrounding the future George Brown campus (nodes J-880, J-890, J-900, and J-1170) were used with a 100l/s additional demand applied to each of them. The resulting residual pressures within the system were all greater than 20psi as per the attached, **Appendix B**.

For this scenario, fire flows of 400l/s can be provided with minimum residual pressure of 46psi.

Full East Bayfront Buildout Scenario

The system was analyzed using the demands that will be placed upon the system at the time that development of the East Bayfront lands are completed and the watermains that will be in place to service the area at that time.

A fire flow analysis was completed which applied 400l/s demand to each node in turn in addition to the max day flow for the entire system, to determine the areas of the system which were the design constraints. As noted previously, when fighting a fire, it is likely that 6 hydrants will be used. To more accurately model this situation the nodes and demands in the table below were used.

Fire Scenario	Node	Demand (l/s)
Fire A	1110	100
	1230	100
	1250	100
	1600	100
Fire B	1100	100
	1230	100
	1580	100
	1600	100
Fire C	1100	100
	1240	100
	1580	200

The resulting residual pressures within the system were all greater than 20psi as per the attached, **Appendix C**.

For this scenario, fire flows of 400l/s can be provided with minimum residual pressure of 48psi.

Conclusions

As noted above and summarized below, the water distribution system, as designed, provides the required pressures and fire flows for all phases of buildout for the East Bayfront lands.

Phase	Scenario	Minimum Pressure (psi)	Maximum Pressure (psi)
Corus	Max Day + Fire @ Corus	37	64
	Peak Hour	64	64
Phase 1	Max Day + Fire @ George Brown	46	64
	Peak Hour	64	64
Full Buildout	Fire A	51	64
	Fire B	51	64
	Fire C	48	64
	Peak Hour	64	64

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Per

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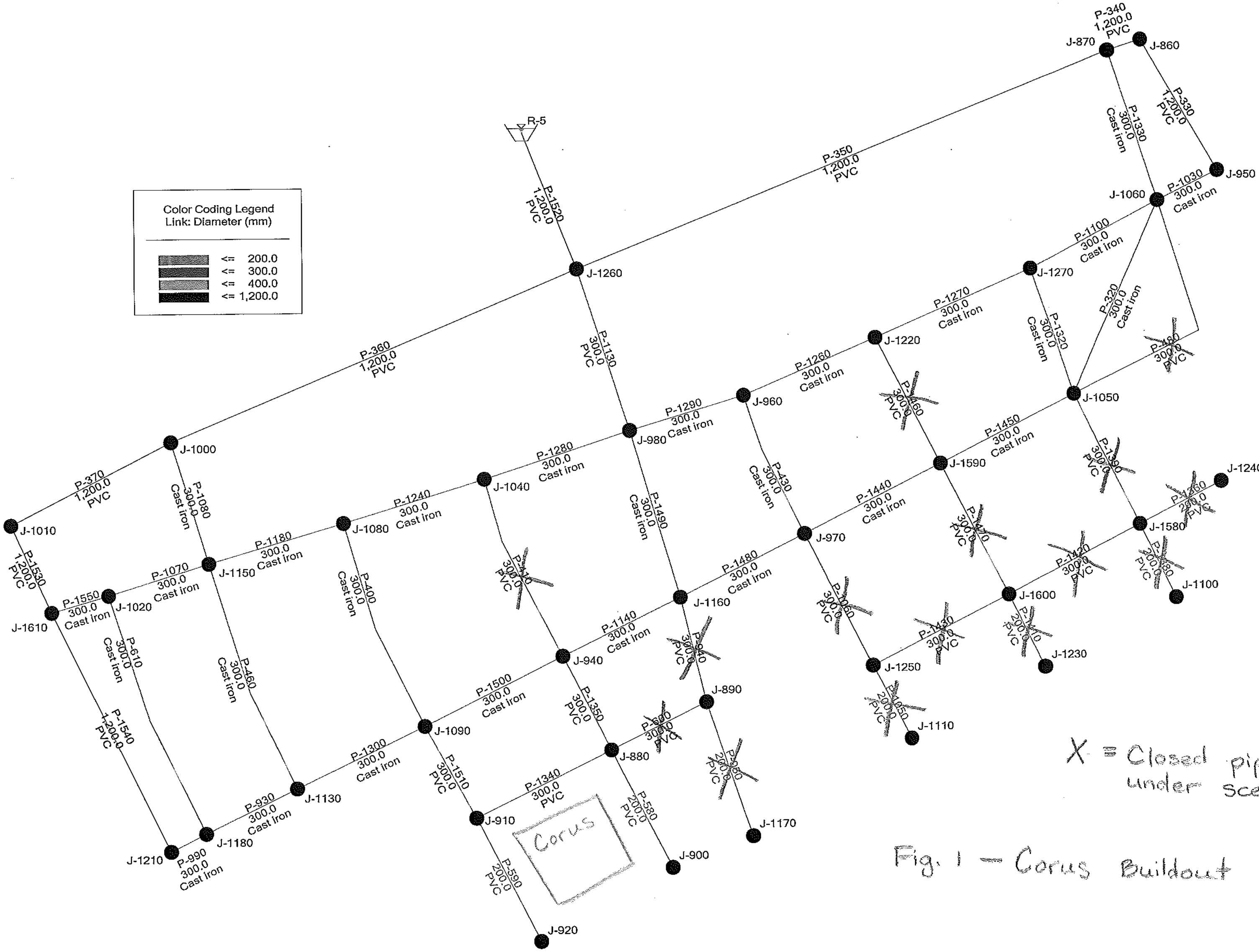
Scenario: Base



X = Closed pipe under scenario

Fig. 1 — Corus Buildout

Title: East Bayfront
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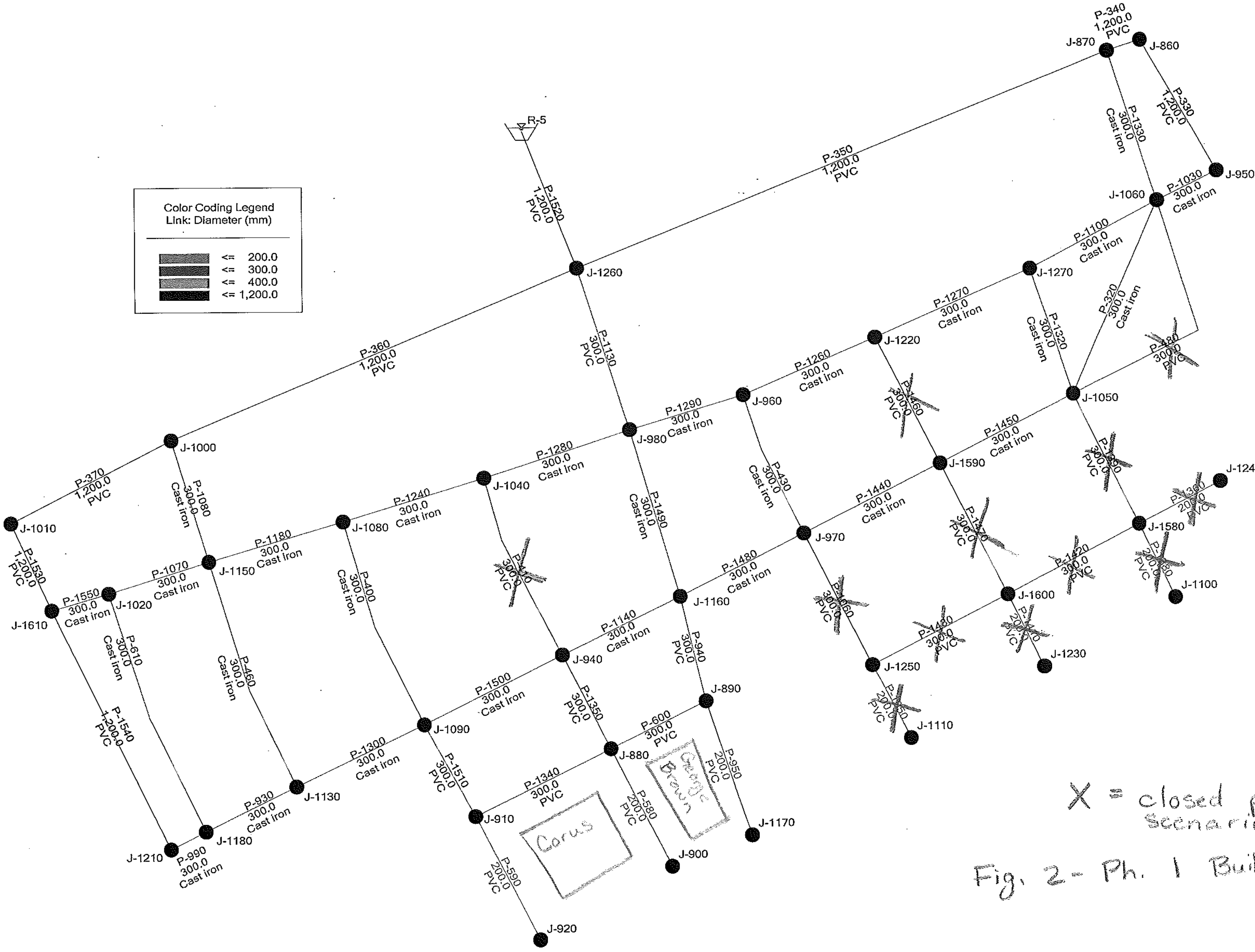
Project Engineer: Abdul
WaterCAD v7.0 [07.00.061.00]

Scenario: Base



X = closed pipe under scenario

Fig. 2 - Ph. 1 Buildout

Title: East Bayfront
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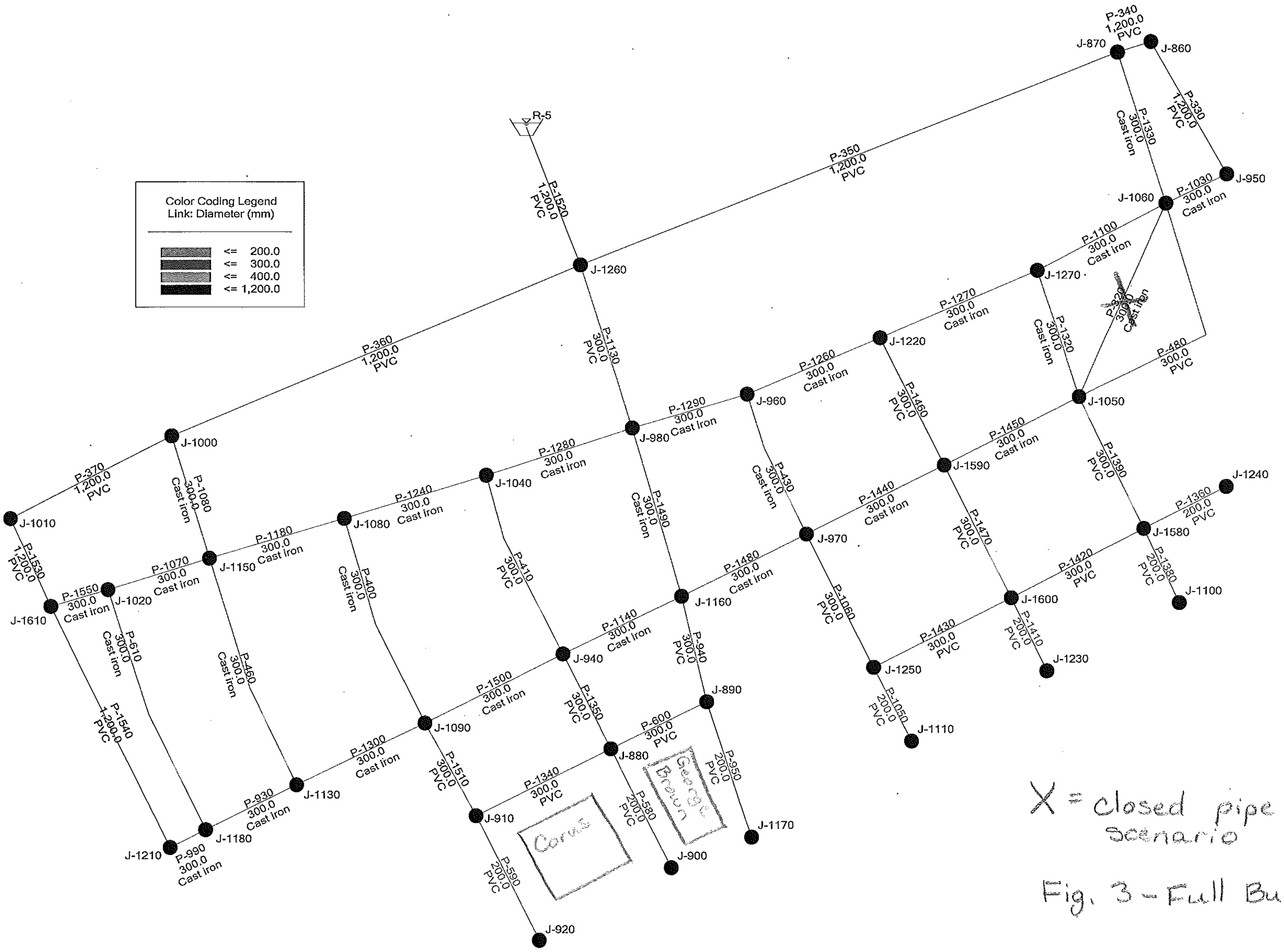
Scenario: Base



X = closed pipe under scenario

Fig. 3 - Full Buildout

Title: East Bayfront
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Appendix A-1

Peak hour demands for Corus buildout only

Scenario: Corus - Peak Hour
Steady State Analysis
Junction Report

Label	Elevation (m)	Zone	Type	Base Flow (l/s)	Pattern	Demand (Calculated) (l/s)	Calculated Hydraulic Grade (m)	Pressure (psi)
J-910	77.00	Zone - A	Demand	20.00	Fixed	20.00	122.30	64.308
J-920	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.30	64.308
J-900	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.31	64.318
J-880	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.31	64.318
J-940	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.32	64.325
J-1090	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.32	64.326
J-890	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.33	64.341
J-1170	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.33	64.341
J-1160	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.364
J-1080	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.368
J-1130	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.368
J-1040	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.373
J-970	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.375
J-1110	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.377
J-1250	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.377
J-1150	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.378
J-960	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.379
J-1230	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.379
J-1600	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.379
J-1590	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.379
J-980	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.379
J-1220	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.380
J-1580	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.380
J-1240	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.380
J-1100	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.380
J-1050	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.382
J-1270	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.382
J-1180	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.382
J-1020	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.383
J-1060	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.385
J-1210	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.387
J-1010	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.387
J-1610	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.387
J-1000	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.387
J-860	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.387
J-950	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.387
J-870	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.387
J-1260	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.387

Appendix A-1

Peak hour demands for Corus buildout only

Scenario: Corus - Peak Hour
Steady State Analysis
Pipe Report

Label	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Control Status	Discharge (l/s)	Upstream Structure Hydraulic Grade (m)	Downstream Structure Hydraulic Grade (m)	Pressure Pipe Headloss (m)	Velocity (m/s)
P-1510	77.72	300.0	PVC	120.0	Open	12.39	122.32	122.30	0.01	0.18
P-1340	110.95	300.0	PVC	120.0	Open	-7.61	122.30	122.31	0.01	0.11
P-1350	77.42	300.0	PVC	120.0	Open	-7.61	122.31	122.32	0.00	0.11
P-1300	103.63	300.0	Cast iron	50.0	Open	7.21	122.35	122.32	0.03	0.10
P-1140	96.62	300.0	Cast iron	50.0	Open	-7.13	122.32	122.34	0.03	0.10
P-1130	124.66	300.0	PVC	120.0	Open	6.38	122.36	122.35	0.01	0.09
P-400	161.54	300.0	Cast iron	50.0	Open	5.66	122.35	122.32	0.03	0.08
P-930	75.59	300.0	Cast iron	50.0	Open	4.74	122.36	122.35	0.01	0.07
P-990	28.65	300.0	Cast iron	50.0	Open	4.23	122.36	122.36	0.00	0.06
P-1490	128.02	300.0	Cast iron	50.0	Open	-3.61	122.34	122.35	0.01	0.05
P-1480	102.11	300.0	Cast iron	50.0	Open	3.52	122.35	122.34	0.01	0.05
P-1180	103.02	300.0	Cast iron	50.0	Open	3.36	122.35	122.35	0.01	0.05
P-1080	93.27	300.0	Cast iron	50.0	Open	-3.23	122.35	122.36	0.01	0.05
P-1550	43.59	300.0	Cast iron	50.0	Open	-3.12	122.36	122.36	0.00	0.04
P-1070	77.42	300.0	Cast iron	50.0	Open	2.60	122.36	122.35	0.00	0.04
P-460	178.31	300.0	Cast iron	50.0	Open	-2.47	122.35	122.35	0.01	0.03
P-1240	108.81	300.0	Cast iron	50.0	Open	-2.30	122.35	122.35	0.00	0.03
P-1280	112.47	300.0	Cast iron	50.0	Open	-2.30	122.35	122.35	0.00	0.03
P-1030	48.77	300.0	Cast iron	50.0	Open	-1.87	122.36	122.36	0.00	0.03
P-1450	110.64	300.0	Cast iron	50.0	Open	-1.78	122.35	122.36	0.00	0.03
P-1440	112.17	300.0	Cast iron	50.0	Open	-1.78	122.35	122.35	0.00	0.03
P-430	111.86	300.0	Cast iron	50.0	Open	1.74	122.35	122.35	0.00	0.02
P-1100	106.98	300.0	Cast iron	50.0	Open	1.65	122.36	122.36	0.00	0.02
P-320	155.75	300.0	Cast iron	50.0	Open	-1.39	122.36	122.36	0.00	0.02
P-1270	124.97	300.0	Cast iron	50.0	Open	-1.26	122.36	122.36	0.00	0.02
P-1260	105.77	300.0	Cast iron	50.0	Open	-1.26	122.35	122.36	0.00	0.02
P-1520	108.81	1,200.0	PVC	120.0	Open	20.00	122.36	122.36	0.00	0.02
P-1330	116.13	300.0	Cast iron	50.0	Open	1.17	122.36	122.36	0.00	0.02
P-360	324.92	1,200.0	PVC	120.0	Open	10.57	122.36	122.36	0.00	0.01
P-610	190.20	300.0	Cast iron	50.0	Open	0.52	122.36	122.36	0.00	0.01
P-1500	113.69	300.0	Cast iron	50.0	Open	-0.48	122.32	122.32	0.00	0.01
P-1290	88.09	300.0	Cast iron	50.0	Open	0.47	122.35	122.35	0.00	0.01
P-370	132.89	1,200.0	PVC	120.0	Open	7.35	122.36	122.36	0.00	0.01
P-1530	70.71	1,200.0	PVC	120.0	Open	7.35	122.36	122.36	0.00	0.01
P-1320	97.54	300.0	Cast iron	50.0	Open	-0.39	122.36	122.36	0.00	0.01
P-1540	196.60	1,200.0	PVC	120.0	Open	4.23	122.36	122.36	0.00	0.00
P-350	423.98	1,200.0	PVC	120.0	Open	-3.05	122.36	122.36	0.00	0.00
P-330	111.25	1,200.0	PVC	120.0	Open	-1.87	122.36	122.36	0.00	0.00
P-340	25.30	1,200.0	PVC	120.0	Open	-1.87	122.36	122.36	0.00	0.00
P-580	97.84	200.0	PVC	120.0	Open	0.00	122.31	122.31	0.00	0.00
P-590	102.11	200.0	PVC	120.0	Open	0.00	122.30	122.30	0.00	0.00
P-1420	110.34	300.0	PVC	120.0	Closed	0.00	122.36	122.35	0.00	0.00
P-1410	59.74	200.0	PVC	120.0	Closed	0.00	122.35	122.35	0.00	0.00
P-950	105.16	200.0	PVC	120.0	Closed	0.00	122.33	122.33	0.00	0.00
P-1430	112.17	300.0	PVC	120.0	Closed	0.00	122.35	122.35	0.00	0.00
P-1390	107.29	300.0	PVC	120.0	Closed	0.00	122.36	122.36	0.00	0.00
P-1380	60.05	200.0	PVC	120.0	Closed	0.00	122.36	122.36	0.00	0.00
P-1360	67.36	200.0	PVC	120.0	Closed	0.00	122.36	122.36	0.00	0.00
P-1060	109.42	300.0	PVC	120.0	Closed	0.00	122.35	122.35	0.00	0.00
P-1470	109.12	300.0	PVC	120.0	Closed	0.00	122.35	122.35	0.00	0.00
P-600	78.03	300.0	PVC	120.0	Closed	0.00	122.33	122.31	0.00	0.00

Scenario: Corus - Peak Hour
Steady State Analysis
Pipe Report

Label	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Control Status	Discharge (l/s)	Upstream Structure Hydraulic Grade (m)	Downstream Structure Hydraulic Grade (m)	Pressure Pipe Headloss (m)	Velocity (m/s)
P-1460	104.24	300.0	PVC	120.0	Closed	0.00	122.36	122.35	0.00	0.00
P-940	78.94	300.0	PVC	120.0	Closed	0.00	122.34	122.33	0.00	0.00
P-1050	60.05	200.0	PVC	120.0	Closed	0.00	122.35	122.35	0.00	0.00
P-480	204.22	300.0	PVC	120.0	Closed	0.00	122.36	122.36	0.00	0.00
P-410	143.56	300.0	PVC	120.0	Closed	0.00	122.35	122.32	0.00	0.00

Appendix A-2

Scenario: Corus - Max Day + Fire
Fire Flow Analysis
Fire Flow Report

Fire flow analysis for Corus buildout only

(400 l/s /node)

Label	Zone	Needed Fire Flow (l/s)	Available Fire Flow (l/s)	Total Flow Needed (l/s)	Total Flow Available (l/s)	Residual Pressure (psi)	Calculated Residual Pressure (psi)	Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Calculated Minimum System Pressure (psi)
~~J-890~~	~~Zone - A~~	~~400.00~~	~~0.00~~	~~400.00~~	~~0.00~~	~~20.000~~	~~64.366~~	~~20.000~~	~~64.351~~	~~64.351~~
~~J-1250~~	~~Zone - A~~	~~400.00~~	~~0.00~~	~~400.00~~	~~0.00~~	~~20.000~~	~~64.382~~	~~20.000~~	~~64.351~~	~~64.351~~
~~J-1580~~	~~Zone - A~~	~~400.00~~	~~0.00~~	~~400.00~~	~~0.00~~	~~20.000~~	~~64.384~~	~~20.000~~	~~64.351~~	~~64.351~~
~~J-1600~~	~~Zone - A~~	~~400.00~~	~~0.00~~	~~400.00~~	~~0.00~~	~~20.000~~	~~64.383~~	~~20.000~~	~~64.351~~	~~64.351~~
~~J-1100~~	~~Zone - A~~	~~400.00~~	~~0.00~~	~~400.00~~	~~0.00~~	~~20.000~~	~~64.384~~	~~20.000~~	~~64.351~~	~~64.351~~
~~J-1230~~	~~Zone - A~~	~~400.00~~	~~0.00~~	~~400.00~~	~~0.00~~	~~20.000~~	~~64.383~~	~~20.000~~	~~64.351~~	~~64.351~~
~~J-1240~~	~~Zone - A~~	~~400.00~~	~~0.00~~	~~400.00~~	~~0.00~~	~~20.000~~	~~64.384~~	~~20.000~~	~~64.351~~	~~64.351~~
~~J-1170~~	~~Zone - A~~	~~400.00~~	~~0.00~~	~~400.00~~	~~0.00~~	~~20.000~~	~~64.366~~	~~20.000~~	~~64.351~~	~~64.351~~
~~J-1110~~	~~Zone - A~~	~~400.00~~	~~0.00~~	~~400.00~~	~~0.00~~	~~20.000~~	~~64.382~~	~~20.000~~	~~64.351~~	~~64.351~~
J-920	Zone - A	400.00	229.87	400.00	229.87	20.000	20.001	20.000	56.368	56.368
J-900	Zone - A	400.00	233.72	400.00	233.72	20.000	20.001	20.000	55.937	55.937
J-1590	Zone - A	400.00	466.03	400.00	466.03	20.000	20.000	20.000	34.286	34.286
J-1220	Zone - A	400.00	470.36	400.00	470.36	20.000	20.000	20.000	49.862	49.862
J-1040	Zone - A	400.00	514.78	400.00	514.78	20.000	20.000	20.000	49.933	49.933
J-880	Zone - A	400.00	588.34	400.00	588.34	20.000	20.002	20.000	20.002	20.002
J-910	Zone - A	400.00	599.12	413.20	612.32	20.000	20.000	20.000	20.000	20.000
J-1050	Zone - A	400.00	604.08	400.00	604.08	20.000	20.000	20.000	27.770	27.770
J-940	Zone - A	400.00	613.66	400.00	613.66	20.000	20.002	20.000	23.449	23.449
J-970	Zone - A	400.00	627.78	400.00	627.78	20.000	20.000	20.000	27.478	27.478
J-1270	Zone - A	400.00	631.79	400.00	631.79	20.000	20.000	20.000	37.034	37.034
J-1080	Zone - A	400.00	660.86	400.00	660.86	20.000	20.000	20.000	39.221	39.221
J-960	Zone - A	400.00	666.26	400.00	666.26	20.000	20.000	20.000	33.648	33.648
J-1090	Zone - A	400.00	669.94	400.00	669.94	20.000	20.000	20.000	21.304	21.304
J-1160	Zone - A	400.00	687.19	400.00	687.19	20.000	20.001	20.000	32.091	32.091
J-1130	Zone - A	400.00	754.14	400.00	754.14	20.000	20.001	20.000	46.000	46.000
J-1020	Zone - A	400.00	995.74	400.00	995.74	20.000	20.000	20.000	52.943	52.943
J-860	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	63.907	20.000	63.907	63.907
J-950	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	63.813	20.000	63.907	63.907
J-1010	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	63.898	20.000	63.898	63.898
J-870	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	63.928	20.000	63.928	63.928
J-1210	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	63.676	20.000	63.768	63.768
J-1150	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	21.616	20.000	43.023	43.023
J-1060	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	20.806	20.000	31.845	31.845
J-980	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	31.272	20.000	41.456	41.456
J-1610	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	63.839	20.000	63.840	63.840
J-1000	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	64.009	20.000	64.009	64.009
J-1260	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	64.289	20.000	64.253	64.253
J-1180	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	25.298	20.000	46.192	46.192

Pipes closed under this scenario

} available fire flow < 400 l/s

Appendix A-3

Scenario: Corus - Max Day + 100 Fire @ J880 900 910 920
Steady State Analysis
Junction Report

Fire demands of 100l/a @ four nodes around Corus for Corus buildi only.

Label	Elevation (m)	Zone	Type	Base Flow (l/s)	Pattern	Demand (Calculated) (l/s)	Calculated Hydraulic Grade (m)	Pressure (psi)
J-920	77.00	Zone - A	Demand	100.00	Fixed	100.00	102.73	36.529
J-900	77.00	Zone - A	Demand	100.00	Fixed	100.00	102.95	36.835
J-880	77.00	Zone - A	Demand	100.00	Fixed	100.00	108.20	44.294
J-910	77.00	Zone - A	Demand	113.20	Fixed	113.20	108.22	44.314
J-940	77.00	Zone - A	Demand	0.00	Fixed	0.00	110.08	46.953
J-1090	77.00	Zone - A	Demand	0.00	Fixed	0.00	110.81	47.986
J-890	77.00	Zone - A	Demand	0.00	Fixed	0.00	113.02	51.135
J-1170	77.00	Zone - A	Demand	0.00	Fixed	0.00	113.02	51.135
J-1160	77.00	Zone - A	Demand	0.00	Fixed	0.00	117.84	57.976
J-1080	77.00	Zone - A	Demand	0.00	Fixed	0.00	118.75	59.265
J-1130	77.00	Zone - A	Demand	0.00	Fixed	0.00	118.81	59.355
J-1040	77.00	Zone - A	Demand	0.00	Fixed	0.00	119.74	60.673
J-970	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.06	61.119
J-1110	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.40	61.604
J-1250	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.40	61.604
J-1150	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.70	62.037
J-960	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.72	62.057
J-1230	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.74	62.089
J-1600	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.74	62.089
J-1590	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.74	62.092
J-980	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.77	62.128
J-1220	77.00	Zone - A	Demand	0.00	Fixed	0.00	121.06	62.536
J-1100	77.00	Zone - A	Demand	0.00	Fixed	0.00	121.08	62.570
J-1580	77.00	Zone - A	Demand	0.00	Fixed	0.00	121.08	62.570
J-1240	77.00	Zone - A	Demand	0.00	Fixed	0.00	121.08	62.570
J-1050	77.00	Zone - A	Demand	0.00	Fixed	0.00	121.42	63.051
J-1270	77.00	Zone - A	Demand	0.00	Fixed	0.00	121.46	63.103
J-1180	77.00	Zone - A	Demand	0.00	Fixed	0.00	121.51	63.174
J-1020	77.00	Zone - A	Demand	0.00	Fixed	0.00	121.62	63.330
J-1060	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.02	63.904
J-1210	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.33	64.344
J-1610	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.33	64.346
J-1010	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.33	64.348
J-1000	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.352
J-950	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.366
J-860	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.366
J-870	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.366
J-1260	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.368

Pressure > 20psi ∴ okay

Appendix A-3

Fire demands of 100 l/s @ four nodes around Corus for Corus Buildout only

Scenario: Corus - Max Day + 100 Fire @ J880 900 910 920
Steady State Analysis
Pipe Report

Label	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Control Status	Discharge (l/s)	Upstream Structure Hydraulic Grade (m)	Downstream Structure Hydraulic Grade (m)	Pressure Pipe Headloss (m)	Velocity (m/s)
P-590	102.11	200.0	PVC	120.0	Open	100.00	108.22	102.73	5.48	3.18
P-580	97.84	200.0	PVC	120.0	Open	100.00	108.20	102.95	5.26	3.18
P-1510	77.72	300.0	PVC	120.0	Open	224.35	110.81	108.22	2.59	3.17
P-1350	77.42	300.0	PVC	120.0	Open	-188.85	108.20	110.08	1.87	2.67
P-1140	96.62	300.0	Cast iron	50.0	Open	-150.47	110.08	117.84	7.77	2.13
P-1300	103.63	300.0	Cast iron	50.0	Open	147.31	118.81	110.81	8.01	2.08
P-1130	124.66	300.0	PVC	120.0	Open	133.13	122.35	120.77	1.58	1.88
P-400	161.54	300.0	Cast iron	50.0	Open	115.42	118.75	110.81	7.95	1.63
P-930	75.59	300.0	Cast iron	50.0	Open	96.93	121.51	118.81	2.69	1.37
P-990	28.65	300.0	Cast iron	50.0	Open	86.43	122.33	121.51	0.82	1.22
P-1490	128.02	300.0	Cast iron	50.0	Open	-76.29	117.84	120.77	2.92	1.08
P-1480	102.11	300.0	Cast iron	50.0	Open	74.17	120.06	117.84	2.21	1.05
P-1180	103.02	300.0	Cast iron	50.0	Open	68.97	120.70	118.75	1.95	0.98
P-1080	93.27	300.0	Cast iron	50.0	Open	-66.03	120.70	122.34	1.63	0.93
P-1550	43.59	300.0	Cast iron	50.0	Open	-63.83	121.62	122.33	0.72	0.90
P-1070	77.42	300.0	Cast iron	50.0	Open	53.33	121.62	120.70	0.91	0.75
P-460	178.31	300.0	Cast iron	50.0	Open	-50.39	118.81	120.70	1.89	0.71
P-1280	112.47	300.0	Cast iron	50.0	Open	-46.45	119.74	120.77	1.03	0.66
P-1240	108.81	300.0	Cast iron	50.0	Open	-46.45	118.75	119.74	0.99	0.66
P-1030	48.77	300.0	Cast iron	50.0	Open	-39.23	122.02	122.35	0.33	0.55
P-1500	113.69	300.0	Cast iron	50.0	Open	-38.39	110.08	110.81	0.73	0.54
P-1440	112.17	300.0	Cast iron	50.0	Open	-37.43	120.06	120.74	0.69	0.53
P-1450	110.64	300.0	Cast iron	50.0	Open	-37.43	120.74	121.42	0.68	0.53
P-430	111.86	300.0	Cast iron	50.0	Open	36.75	120.72	120.06	0.66	0.52
P-1100	106.98	300.0	Cast iron	50.0	Open	34.59	122.02	121.46	0.56	0.49
P-320	155.75	300.0	Cast iron	50.0	Open	-29.20	121.42	122.02	0.60	0.41
P-1260	105.77	300.0	Cast iron	50.0	Open	-26.36	120.72	121.06	0.34	0.37
P-1270	124.97	300.0	Cast iron	50.0	Open	-26.36	121.06	121.46	0.40	0.37
P-1520	108.81	1,200.0	PVC	120.0	Open	413.20	122.36	122.35	0.01	0.37
P-1330	116.13	300.0	Cast iron	50.0	Open	24.56	122.35	122.02	0.33	0.35
P-360	324.92	1,200.0	PVC	120.0	Open	216.28	122.35	122.34	0.01	0.19
P-1340	110.95	300.0	PVC	120.0	Open	11.15	108.22	108.20	0.01	0.16
P-610	190.20	300.0	Cast iron	50.0	Open	10.50	121.62	121.51	0.11	0.15
P-1290	88.09	300.0	Cast iron	50.0	Open	10.38	120.77	120.72	0.05	0.15
P-370	132.89	1,200.0	PVC	120.0	Open	150.25	122.34	122.33	0.00	0.13
P-1530	70.71	1,200.0	PVC	120.0	Open	150.25	122.33	122.33	0.00	0.13
P-1320	97.54	300.0	Cast iron	50.0	Open	-8.23	121.42	121.46	0.04	0.12
P-1540	196.60	1,200.0	PVC	120.0	Open	86.43	122.33	122.33	0.00	0.08
P-350	423.98	1,200.0	PVC	120.0	Open	-63.79	122.35	122.35	0.00	0.06
P-330	111.25	1,200.0	PVC	120.0	Open	-39.23	122.35	122.35	0.00	0.03
P-340	25.30	1,200.0	PVC	120.0	Open	-39.23	122.35	122.35	0.00	0.03
P-1420	110.34	300.0	PVC	120.0	Closed	0.00	121.08	120.74	0.00	0.00
P-1360	67.36	200.0	PVC	120.0	Closed	0.00	121.08	121.08	0.00	0.00
P-1060	109.42	300.0	PVC	120.0	Closed	0.00	120.40	120.06	0.00	0.00
P-1430	112.17	300.0	PVC	120.0	Closed	0.00	120.74	120.40	0.00	0.00
P-1390	107.29	300.0	PVC	120.0	Closed	0.00	121.08	121.42	0.00	0.00
P-1380	60.05	200.0	PVC	120.0	Closed	0.00	121.08	121.08	0.00	0.00
P-1410	59.74	200.0	PVC	120.0	Closed	0.00	120.74	120.74	0.00	0.00
P-1050	60.05	200.0	PVC	120.0	Closed	0.00	120.40	120.40	0.00	0.00
P-1470	109.12	300.0	PVC	120.0	Closed	0.00	120.74	120.74	0.00	0.00
P-480	204.22	300.0	PVC	120.0	Closed	0.00	121.42	122.02	0.00	0.00

Scenario: Corus - Max Day + 100 Fire @ J880 900 910 920
Steady State Analysis
Pipe Report

Label	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Control Status	Discharge (l/s)	Upstream Structure Hydraulic Grade (m)	Downstream Structure Hydraulic Grade (m)	Pressure Pipe Headloss (m)	Velocity (m/s)
P-600	78.03	300.0	PVC	120.0	Closed	0.00	113.02	108.20	0.00	0.00
P-1460	104.24	300.0	PVC	120.0	Closed	0.00	121.06	120.74	0.00	0.00
P-950	105.16	200.0	PVC	120.0	Closed	0.00	113.02	113.02	0.00	0.00
P-410	143.56	300.0	PVC	120.0	Closed	0.00	119.74	110.08	0.00	0.00
P-940	78.94	300.0	PVC	120.0	Closed	0.00	117.84	113.02	0.00	0.00

Appendix B-1

Scenario: Phase 1 - Peak Hour
Steady State Analysis
Junction Report

Peak hour demands for Phase 1 buildout

Label	Elevation (m)	Zone	Type	Base Flow (l/s)	Pattern	Demand (Calculated) (l/s)	Calculated Hydraulic Grade (m)	Pressure (psi)
J-920	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.33	64.349
J-910	77.00	Zone - A	Demand	10.00	Fixed	10.00	122.33	64.349
J-1170	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.33	64.350
J-890	77.00	Zone - A	Demand	10.25	Fixed	10.25	122.33	64.350
J-880	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.33	64.351
J-900	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.33	64.351
J-940	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.353
J-1090	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.355
J-1160	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.360
J-970	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.371
J-1080	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.373
J-1040	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.373
J-1110	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.373
J-1250	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.373
J-980	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.373
J-960	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.373
J-1230	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.375
J-1600	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.375
J-1590	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.375
J-1220	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.376
J-1130	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.377
J-1100	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.378
J-1240	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.378
J-1580	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.378
J-1050	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.380
J-1270	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.380
J-1150	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.381
J-1180	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.384
J-1060	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.384
J-1020	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.384
J-1210	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.387
J-1610	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.387
J-1010	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.387
J-1000	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.387
J-950	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.387
J-870	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.387
J-860	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.387
J-1260	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.387

Pressure > 40psi

Appendix ~~B-4~~ B-1

Peak hour demands
for Phase 1
buildout

Scenario: Phase 1 - Peak Hour
Steady State Analysis
Pipe Report

Label	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Control Status	Discharge (l/s)	Upstream Structure Hydraulic Grade (m)	Downstream Structure Hydraulic Grade (m)	Pressure Pipe Headloss (m)	Velocity (m/s)
P-940	78.94	300.0	PVC	120.0	Open	8.94	122.34	122.33	0.01	0.13
P-1130	124.66	300.0	PVC	120.0	Open	8.45	122.36	122.35	0.01	0.12
P-1490	128.02	300.0	PVC	120.0	Open	-8.25	122.34	122.35	0.01	0.12
P-1510	77.72	300.0	PVC	120.0	Open	7.11	122.34	122.33	0.00	0.10
P-1300	103.63	300.0	Cast iron	50.0	Open	4.99	122.35	122.34	0.02	0.07
P-1350	77.42	300.0	PVC	120.0	Open	-4.20	122.33	122.34	0.00	0.06
P-400	161.54	300.0	Cast iron	50.0	Open	3.51	122.35	122.34	0.01	0.05
P-1480	102.11	300.0	Cast iron	50.0	Open	3.51	122.35	122.34	0.01	0.05
P-930	75.59	300.0	Cast iron	50.0	Open	3.38	122.36	122.35	0.01	0.05
P-990	28.65	300.0	Cast iron	50.0	Open	3.11	122.36	122.36	0.00	0.04
P-1180	103.02	300.0	Cast iron	50.0	Open	3.04	122.36	122.35	0.01	0.04
P-1340	110.95	300.0	PVC	120.0	Open	-2.89	122.33	122.33	0.00	0.04
P-1140	96.62	300.0	Cast iron	50.0	Open	-2.82	122.34	122.34	0.00	0.04
P-1080	93.27	300.0	Cast iron	50.0	Open	-2.54	122.36	122.36	0.00	0.04
P-1550	43.59	300.0	Cast iron	50.0	Open	-2.38	122.36	122.36	0.00	0.03
P-1030	48.77	300.0	Cast iron	50.0	Open	-2.32	122.36	122.36	0.00	0.03
P-1070	77.42	300.0	Cast iron	50.0	Open	2.11	122.36	122.36	0.00	0.03
P-1100	106.98	300.0	Cast iron	50.0	Open	2.06	122.36	122.36	0.00	0.03
P-1440	112.17	300.0	Cast iron	50.0	Open	-2.05	122.35	122.35	0.00	0.03
P-1450	110.64	300.0	Cast iron	50.0	Open	-2.05	122.35	122.36	0.00	0.03
P-1260	105.77	300.0	Cast iron	50.0	Open	-1.72	122.35	122.35	0.00	0.02
P-1270	124.97	300.0	Cast iron	50.0	Open	-1.72	122.35	122.36	0.00	0.02
P-320	155.75	300.0	Cast iron	50.0	Open	-1.71	122.36	122.36	0.00	0.02
P-460	178.31	300.0	Cast iron	50.0	Open	-1.61	122.35	122.36	0.00	0.02
P-430	111.86	300.0	Cast iron	50.0	Open	1.45	122.35	122.35	0.00	0.02
P-1330	116.13	300.0	Cast iron	50.0	Open	1.45	122.36	122.36	0.00	0.02
P-1500	113.69	300.0	Cast iron	50.0	Open	-1.38	122.34	122.34	0.00	0.02
P-600	78.03	300.0	PVC	120.0	Open	-1.31	122.33	122.33	0.00	0.02
P-1520	108.81	1,200.0	PVC	120.0	Open	20.25	122.36	122.36	0.00	0.02
P-360	324.92	1,200.0	PVC	120.0	Open	8.03	122.36	122.36	0.00	0.01
P-1280	112.47	300.0	Cast iron	50.0	Open	-0.47	122.35	122.35	0.00	0.01
P-1240	108.81	300.0	Cast iron	50.0	Open	-0.47	122.35	122.35	0.00	0.01
P-370	132.89	1,200.0	PVC	120.0	Open	5.48	122.36	122.36	0.00	0.00
P-1530	70.71	1,200.0	PVC	120.0	Open	5.48	122.36	122.36	0.00	0.00
P-1320	97.54	300.0	Cast iron	50.0	Open	-0.34	122.36	122.36	0.00	0.00
P-610	190.20	300.0	Cast iron	50.0	Open	0.27	122.36	122.36	0.00	0.00
P-1290	88.09	300.0	Cast iron	50.0	Open	-0.27	122.35	122.35	0.00	0.00
P-350	423.98	1,200.0	PVC	120.0	Open	-3.77	122.36	122.36	0.00	0.00
P-1540	196.60	1,200.0	PVC	120.0	Open	3.11	122.36	122.36	0.00	0.00
P-340	25.30	1,200.0	PVC	120.0	Open	-2.32	122.36	122.36	0.00	0.00
P-330	111.25	1,200.0	PVC	120.0	Open	-2.32	122.36	122.36	0.00	0.00
P-590	102.11	200.0	PVC	120.0	Open	0.00	122.33	122.33	0.00	0.00
P-580	97.84	200.0	PVC	120.0	Open	0.00	122.33	122.33	0.00	0.00
P-950	105.16	200.0	PVC	120.0	Open	0.00	122.33	122.33	0.00	0.00
P-1460	104.24	300.0	PVC	120.0	Closed	0.00	122.35	122.35	0.00	0.00
P-1470	109.12	300.0	PVC	120.0	Closed	0.00	122.35	122.35	0.00	0.00
P-1430	112.17	300.0	PVC	120.0	Closed	0.00	122.35	122.35	0.00	0.00
P-1420	110.34	300.0	PVC	120.0	Closed	0.00	122.35	122.35	0.00	0.00
P-1410	59.74	200.0	PVC	120.0	Closed	0.00	122.35	122.35	0.00	0.00
P-410	143.56	300.0	PVC	120.0	Closed	0.00	122.35	122.34	0.00	0.00
P-480	204.22	300.0	PVC	120.0	Closed	0.00	122.36	122.36	0.00	0.00

Scenario: Phase 1 - Peak Hour
Steady State Analysis
Pipe Report

Label	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Control Status	Discharge (l/s)	Upstream Structure Hydraulic Grade (m)	Downstream Structure Hydraulic Grade (m)	Pressure Pipe Headloss (m)	Velocity (m/s)
P-1390	107.29	300.0	PVC	120.0	Closed	0.00	122.35	122.36	0.00	0.00
P-1380	60.05	200.0	PVC	120.0	Closed	0.00	122.35	122.35	0.00	0.00
P-1360	67.36	200.0	PVC	120.0	Closed	0.00	122.35	122.35	0.00	0.00
P-1050	60.05	200.0	PVC	120.0	Closed	0.00	122.35	122.35	0.00	0.00
P-1060	109.42	300.0	PVC	120.0	Closed	0.00	122.35	122.35	0.00	0.00

Appendix B-2

Scenario: Phase 1 - Max Day + Fire
Fire Flow Analysis
Fire Flow Report

Fire flow analysis for Phase 1 buildout (400 l/s per node)

Label	Zone	Needed Fire Flow (l/s)	Available Fire Flow (l/s)	Total Flow Needed (l/s)	Total Flow Available (l/s)	Residual Pressure (psi)	Calculated Residual Pressure (psi)	Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Calculated Minimum System Pressure (psi)
J-1600	Zone - A	400.00	0.00	400.00	0.00	20.000	64.382	20.000	64.369	64.369
J-1250	Zone - A	400.00	0.00	400.00	0.00	20.000	64.381	20.000	64.369	64.369
J-1100	Zone - A	400.00	0.00	400.00	0.00	20.000	64.383	20.000	64.369	64.369
J-1240	Zone - A	400.00	0.00	400.00	0.00	20.000	64.383	20.000	64.369	64.369
J-1110	Zone - A	400.00	0.00	400.00	0.00	20.000	64.381	20.000	64.369	64.369
J-1580	Zone - A	400.00	0.00	400.00	0.00	20.000	64.383	20.000	64.369	64.369
J-1230	Zone - A	400.00	0.00	400.00	0.00	20.000	64.382	20.000	64.369	64.369
J-1170	Zone - A	400.00	237.40	400.00	237.40	20.000	20.000	20.000	59.758	59.758
J-920	Zone - A	400.00	238.91	400.00	238.91	20.000	20.000	20.000	59.061	59.061
J-900	Zone - A	400.00	246.42	400.00	246.42	20.000	20.000	20.000	59.637	59.637
J-1590	Zone - A	400.00	470.21	400.00	470.21	20.000	20.000	20.000	34.526	34.526
J-1220	Zone - A	400.00	472.12	400.00	472.12	20.000	20.000	20.000	50.077	50.077
J-1040	Zone - A	400.00	515.02	400.00	515.02	20.000	20.000	20.000	50.121	50.121
J-1050	Zone - A	400.00	607.10	400.00	607.10	20.000	20.000	20.000	27.959	27.959
J-1270	Zone - A	400.00	634.53	400.00	634.53	20.000	20.000	20.000	37.299	37.299
J-970	Zone - A	400.00	652.19	400.00	652.19	20.000	20.000	20.000	27.449	27.449
J-960	Zone - A	400.00	672.27	400.00	672.27	20.000	20.000	20.000	33.761	33.761
J-1080	Zone - A	400.00	672.57	400.00	672.57	20.000	20.000	20.000	38.606	38.606
J-910	Zone - A	400.00	773.43	406.60	780.03	20.000	20.001	20.000	20.001	20.001
J-940	Zone - A	400.00	783.24	400.00	783.24	20.000	20.003	20.000	31.020	31.020
J-1130	Zone - A	400.00	784.62	400.00	784.62	20.000	20.000	20.000	52.008	52.008
J-890	Zone - A	400.00	831.60	406.77	838.37	20.000	20.001	20.000	20.001	20.001
J-1090	Zone - A	400.00	844.86	400.00	844.86	20.000	20.000	20.000	24.832	24.832
J-880	Zone - A	400.00	849.87	400.00	849.87	20.000	20.000	20.000	20.000	20.000
J-1160	Zone - A	400.00	977.40	400.00	977.40	20.000	20.000	20.000	22.967	22.967
J-1020	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	20.077	20.000	53.566	53.566
J-950	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	63.813	20.000	63.908	63.908
J-1010	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	63.902	20.000	63.902	63.902
J-870	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	63.928	20.000	63.928	63.928
J-1210	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	63.681	20.000	63.788	63.788
J-1150	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	23.110	20.000	45.247	45.247
J-1000	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	64.013	20.000	64.013	64.013
J-980	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	35.260	20.000	41.755	41.755
J-860	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	63.907	20.000	63.907	63.907
J-1610	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	63.844	20.000	63.844	63.844
J-1260	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	64.289	20.000	64.271	64.271
J-1180	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	26.043	20.000	47.905	47.905
J-1060	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	21.037	20.000	32.244	32.244

Pipes closed under Phase 1 scenario

available fire flow <400 l/s

Title: East Bayfront
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Project Engineer: Abdul
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Appendix B-3

Scenario: Phase 1 - Max Day + 100 Fire @ J880 890 900 1170
Steady State Analysis
Junction Report

Fire demands of 100 l/s @ four nodes around George Brown for Phase 1 Buildout

Label	Elevation (m)	Zone	Type	Base Flow (l/s)	Pattern	Demand (Calculated) (l/s)	Calculated Hydraulic Grade (m)	Pressure (psi)
J-1170	77.00	Zone - A	Demand	100.00	Fixed	100.00	109.42	46.026
J-900	77.00	Zone - A	Demand	100.00	Fixed	100.00	109.84	46.608
J-890	77.00	Zone - A	Demand	106.76	Fixed	106.76	115.07	54.043
J-880	77.00	Zone - A	Demand	100.00	Fixed	100.00	115.09	54.068
J-940	77.00	Zone - A	Demand	0.00	Fixed	0.00	115.73	54.973
J-910	77.00	Zone - A	Demand	6.60	Fixed	6.60	116.07	55.456
J-920	77.00	Zone - A	Demand	0.00	Fixed	0.00	116.07	55.456
J-1090	77.00	Zone - A	Demand	0.00	Fixed	0.00	116.83	56.540
J-1160	77.00	Zone - A	Demand	0.00	Fixed	0.00	117.04	56.831
J-970	77.00	Zone - A	Demand	0.00	Fixed	0.00	119.25	59.971
J-1110	77.00	Zone - A	Demand	0.00	Fixed	0.00	119.69	60.594
J-1250	77.00	Zone - A	Demand	0.00	Fixed	0.00	119.69	60.594
J-1080	77.00	Zone - A	Demand	0.00	Fixed	0.00	119.71	60.619
J-1040	77.00	Zone - A	Demand	0.00	Fixed	0.00	119.72	60.635
J-980	77.00	Zone - A	Demand	0.00	Fixed	0.00	119.73	60.652
J-960	77.00	Zone - A	Demand	0.00	Fixed	0.00	119.74	60.667
J-1600	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.13	61.217
J-1230	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.13	61.217
J-1590	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.13	61.221
J-1220	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.33	61.504
J-1130	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.56	61.832
J-1580	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.56	61.835
J-1100	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.56	61.835
J-1240	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.56	61.835
J-1050	77.00	Zone - A	Demand	0.00	Fixed	0.00	121.00	62.454
J-1270	77.00	Zone - A	Demand	0.00	Fixed	0.00	121.03	62.494
J-1150	77.00	Zone - A	Demand	0.00	Fixed	0.00	121.33	62.923
J-1060	77.00	Zone - A	Demand	0.00	Fixed	0.00	121.87	63.687
J-1180	77.00	Zone - A	Demand	0.00	Fixed	0.00	121.90	63.731
J-1020	77.00	Zone - A	Demand	0.00	Fixed	0.00	121.93	63.770
J-1210	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.355
J-1610	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.356
J-1010	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.357
J-1000	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.359
J-950	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.364
J-860	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.365
J-870	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.365
J-1260	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.35	64.368

Pressure >20psi ∴ okay

Appendix B-3

Scenario: Phase 1 - Max Day + 100 Fire @ J880 890 900 1170

Steady State Analysis

Pipe Report

Fire demands of 100% @ four nodes around George Brown for Phase 1 Buildout

Label	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Control Status	Discharge (l/s)	Upstream Structure Hydraulic Grade (m)	Downstream Structure Hydraulic Grade (m)	Pressure Pipe Headloss (m)	Velocity (m/s)
P-580	97.84	200.0	PVC	120.0	Open	100.00	115.09	109.84	5.26	3.18
P-950	105.16	200.0	PVC	120.0	Open	100.00	115.07	109.42	5.65	3.18
P-940	78.94	300.0	PVC	120.0	Open	191.71	117.04	115.07	1.96	2.71
P-1490	128.02	300.0	PVC	120.0	Open	-175.09	117.04	119.73	2.69	2.48
P-1130	124.66	300.0	PVC	120.0	Open	174.95	122.35	119.73	2.62	2.48
P-1510	77.72	300.0	PVC	120.0	Open	116.08	116.83	116.07	0.76	1.64
P-1340	110.95	300.0	PVC	120.0	Open	109.48	116.07	115.09	0.98	1.55
P-1350	77.42	300.0	PVC	120.0	Open	-105.57	115.09	115.73	0.64	1.49
P-1300	103.63	300.0	Cast iron	50.0	Open	97.49	120.56	116.83	3.73	1.38
P-1480	102.11	300.0	Cast iron	50.0	Open	74.13	119.25	117.04	2.21	1.05
P-400	161.54	300.0	Cast iron	50.0	Open	66.65	119.71	116.83	2.87	0.94
P-930	75.59	300.0	Cast iron	50.0	Open	66.47	121.90	120.56	1.34	0.94
P-1180	103.02	300.0	Cast iron	50.0	Open	62.43	121.33	119.71	1.62	0.88
P-990	28.65	300.0	Cast iron	50.0	Open	61.51	122.34	121.90	0.44	0.87
P-1140	96.62	300.0	Cast iron	50.0	Open	-57.52	115.73	117.04	1.31	0.81
P-1080	93.27	300.0	Cast iron	50.0	Open	-51.01	121.33	122.34	1.01	0.72
P-1030	48.77	300.0	Cast iron	50.0	Open	-48.27	121.87	122.34	0.48	0.68
P-1500	113.69	300.0	Cast iron	50.0	Open	-48.05	115.73	116.83	1.10	0.68
P-1550	43.59	300.0	Cast iron	50.0	Open	-47.40	121.93	122.34	0.41	0.67
P-1100	106.98	300.0	Cast iron	50.0	Open	42.86	121.87	121.03	0.84	0.61
P-1440	112.17	300.0	Cast iron	50.0	Open	-42.86	119.25	120.13	0.88	0.61
P-1450	110.64	300.0	Cast iron	50.0	Open	-42.86	120.13	121.00	0.87	0.61
P-1070	77.42	300.0	Cast iron	50.0	Open	42.43	121.93	121.33	0.60	0.60
P-1260	105.77	300.0	Cast iron	50.0	Open	-35.64	119.74	120.33	0.59	0.50
P-1270	124.97	300.0	Cast iron	50.0	Open	-35.64	120.33	121.03	0.70	0.50
P-320	155.75	300.0	Cast iron	50.0	Open	-35.63	121.00	121.87	0.87	0.50
P-430	111.86	300.0	Cast iron	50.0	Open	31.28	119.74	119.25	0.49	0.44
P-460	178.31	300.0	Cast iron	50.0	Open	-31.01	120.56	121.33	0.77	0.44
P-1330	116.13	300.0	Cast iron	50.0	Open	30.22	122.34	121.87	0.48	0.43
P-1520	108.81	1,200.0	PVC	120.0	Open	413.36	122.36	122.35	0.01	0.37
P-600	78.03	300.0	PVC	120.0	Open	-15.05	115.07	115.09	0.02	0.21
P-360	324.92	1,200.0	PVC	120.0	Open	159.92	122.35	122.34	0.01	0.14
P-1320	97.54	300.0	Cast iron	50.0	Open	-7.23	121.00	121.03	0.03	0.10
P-370	132.89	1,200.0	PVC	120.0	Open	108.90	122.34	122.34	0.00	0.10
P-1530	70.71	1,200.0	PVC	120.0	Open	108.90	122.34	122.34	0.00	0.10
P-610	190.20	300.0	Cast iron	50.0	Open	4.97	121.93	121.90	0.03	0.07
P-350	423.98	1,200.0	PVC	120.0	Open	-78.49	122.34	122.35	0.00	0.07
P-1290	88.09	300.0	Cast iron	50.0	Open	-4.36	119.73	119.74	0.01	0.06
P-1280	112.47	300.0	Cast iron	50.0	Open	-4.22	119.72	119.73	0.01	0.06
P-1240	108.81	300.0	Cast iron	50.0	Open	-4.22	119.71	119.72	0.01	0.06
P-1540	196.60	1,200.0	PVC	120.0	Open	61.51	122.34	122.34	0.00	0.05
P-340	25.30	1,200.0	PVC	120.0	Open	-48.27	122.34	122.34	0.00	0.04
P-330	111.25	1,200.0	PVC	120.0	Open	-48.27	122.34	122.34	0.00	0.04
P-590	102.11	200.0	PVC	120.0	Open	0.00	116.07	116.07	0.00	0.00
P-1360	67.36	200.0	PVC	120.0	Closed	0.00	120.56	120.56	0.00	0.00
P-1430	112.17	300.0	PVC	120.0	Closed	0.00	120.13	119.69	0.00	0.00
P-1420	110.34	300.0	PVC	120.0	Closed	0.00	120.56	120.13	0.00	0.00
P-1470	109.12	300.0	PVC	120.0	Closed	0.00	120.13	120.13	0.00	0.00
P-1460	104.24	300.0	PVC	120.0	Closed	0.00	120.33	120.13	0.00	0.00
P-1410	59.74	200.0	PVC	120.0	Closed	0.00	120.13	120.13	0.00	0.00
P-480	204.22	300.0	PVC	120.0	Closed	0.00	121.00	121.87	0.00	0.00

Scenario: Phase 1 - Max Day + 100 Fire @ J880 890 900 1170
Steady State Analysis
Pipe Report

Label	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Control Status	Discharge (l/s)	Upstream Structure Hydraulic Grade (m)	Downstream Structure Hydraulic Grade (m)	Pressure Pipe Headloss (m)	Velocity (m/s)
P-1050	60.05	200.0	PVC	120.0	Closed	0.00	119.69	119.69	0.00	0.00
P-1060	109.42	300.0	PVC	120.0	Closed	0.00	119.69	119.25	0.00	0.00
P-1380	60.05	200.0	PVC	120.0	Closed	0.00	120.56	120.56	0.00	0.00
P-1390	107.29	300.0	PVC	120.0	Closed	0.00	120.56	121.00	0.00	0.00
P-410	143.56	300.0	PVC	120.0	Closed	0.00	119.72	115.73	0.00	0.00

Appendix C-1

Scenario: Ultimate - Peak Hour
Steady State Analysis
Junction Report

Peak hour demands for Full EBF Buildout

Label	Elevation (m)	Zone	Type	Base Flow (l/s)	Pattern	Demand (Calculated) (l/s)	Calculated Hydraulic Grade (m)	Pressure (psi)
J-1220	77.00	Zone - A	Demand	12.50	Fixed	12.50	122.16	64.105
J-1230	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.16	64.106
J-1600	77.00	Zone - A	Demand	17.75	Fixed	17.75	122.16	64.106
J-1250	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.16	64.110
J-1110	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.16	64.110
J-960	77.00	Zone - A	Demand	11.25	Fixed	11.25	122.16	64.110
J-1590	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.17	64.112
J-970	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.17	64.113
J-1580	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.17	64.116
J-1100	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.17	64.116
J-1240	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.17	64.116
J-1270	77.00	Zone - A	Demand	12.50	Fixed	12.50	122.17	64.123
J-1050	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.18	64.126
J-890	77.00	Zone - A	Demand	10.25	Fixed	10.25	122.18	64.129
J-1170	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.18	64.129
J-900	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.18	64.133
J-880	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.18	64.133
J-1160	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.18	64.133
J-920	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.18	64.133
J-910	77.00	Zone - A	Demand	10.00	Fixed	10.00	122.18	64.133
J-1040	77.00	Zone - A	Demand	10.00	Fixed	10.00	122.18	64.135
J-940	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.18	64.135
J-1080	77.00	Zone - A	Demand	10.00	Fixed	10.00	122.19	64.145
J-1090	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.19	64.147
J-980	77.00	Zone - A	Demand	10.00	Fixed	10.00	122.20	64.165
J-1130	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.24	64.215
J-1150	77.00	Zone - A	Demand	11.00	Fixed	11.00	122.25	64.230
J-1060	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.26	64.245
J-1020	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.32	64.333
J-1180	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.32	64.334
J-1210	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.384
J-1610	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.384
J-1010	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.384
J-1000	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.384
J-950	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.384
J-860	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.384
J-870	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.384
J-1260	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.36	64.385

Pressure > ~~≥~~ 40psi ∴ ok.

Title: East Bayfront
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The Municipal Infrastructure Group

Project Engineer: Abdul
WaterCAD v7.0 [07.00.061.00]

Appendix C-1

Peak hour demands for full EBF buildout

Scenario: Ultimate - Peak Hour
Steady State Analysis
Pipe Report

Label	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Control Status	Discharge (l/s)	Upstream Structure Hydraulic Grade (m)	Downstream Structure Hydraulic Grade (m)	Pressure Pipe Headloss (m)	Velocity (m/s)
P-1130	124.66	300.0	PVC	120.0	Open	38.04	122.36	122.20	0.16	0.54
P-1300	103.63	300.0	PVC	120.0	Open	22.26	122.24	122.19	0.05	0.31
P-480	204.22	300.0	PVC	120.0	Open	-20.92	122.18	122.26	0.08	0.30
P-1030	48.77	300.0	Cast iron	50.0	Open	-20.56	122.26	122.36	0.10	0.29
P-990	28.65	300.0	Cast iron	50.0	Open	15.73	122.36	122.32	0.04	0.22
P-1080	93.27	300.0	Cast iron	50.0	Open	-15.30	122.25	122.36	0.11	0.22
P-930	75.59	300.0	Cast iron	50.0	Open	14.90	122.32	122.24	0.08	0.21
P-1070	77.42	300.0	Cast iron	50.0	Open	13.57	122.32	122.25	0.07	0.19
P-1490	128.02	300.0	PVC	120.0	Open	-13.24	122.18	122.20	0.02	0.19
P-1330	116.13	300.0	Cast iron	50.0	Open	12.87	122.36	122.26	0.10	0.18
P-1550	43.59	300.0	Cast iron	50.0	Open	-12.74	122.32	122.36	0.04	0.18
P-1100	106.98	300.0	Cast iron	50.0	Open	12.51	122.26	122.17	0.09	0.18
P-1480	102.11	300.0	PVC	120.0	Open	-11.51	122.17	122.18	0.01	0.16
P-1510	77.72	300.0	PVC	120.0	Open	11.11	122.19	122.18	0.01	0.16
P-1180	103.02	300.0	Cast iron	50.0	Open	10.51	122.25	122.19	0.06	0.15
P-1450	110.64	300.0	PVC	120.0	Open	-9.19	122.17	122.18	0.01	0.13
P-1290	88.09	300.0	Cast iron	50.0	Open	9.06	122.20	122.16	0.04	0.13
P-1500	113.69	300.0	PVC	120.0	Open	-8.40	122.18	122.19	0.01	0.12
P-1420	110.34	300.0	PVC	120.0	Open	7.66	122.17	122.16	0.01	0.11
P-1390	107.29	300.0	PVC	120.0	Open	-7.66	122.17	122.18	0.01	0.11
P-460	178.31	300.0	PVC	120.0	Open	-7.36	122.24	122.25	0.01	0.10
P-1520	108.81	1,200.0	PVC	120.0	Open	115.25	122.36	122.36	0.00	0.10
P-1460	104.24	300.0	PVC	120.0	Open	-6.28	122.16	122.17	0.00	0.09
P-1280	112.47	300.0	Cast iron	50.0	Open	-5.75	122.18	122.20	0.02	0.08
P-1470	109.12	300.0	PVC	120.0	Open	5.68	122.17	122.16	0.00	0.08
P-940	78.94	300.0	PVC	120.0	Open	5.16	122.18	122.18	0.00	0.07
P-600	78.03	300.0	PVC	120.0	Open	-5.09	122.18	122.18	0.00	0.07
P-1430	112.17	300.0	PVC	120.0	Open	-4.41	122.16	122.16	0.00	0.06
P-1060	109.42	300.0	PVC	120.0	Open	-4.41	122.16	122.17	0.00	0.06
P-430	111.86	300.0	PVC	120.0	Open	-4.33	122.16	122.17	0.00	0.06
P-1270	124.97	300.0	Cast iron	50.0	Open	-4.08	122.16	122.17	0.01	0.06
P-1320	97.54	300.0	PVC	120.0	Open	4.07	122.18	122.17	0.00	0.06
P-1350	77.42	300.0	PVC	120.0	Open	-3.98	122.18	122.18	0.00	0.06
P-1140	96.62	300.0	PVC	120.0	Open	3.43	122.18	122.18	0.00	0.05
P-1240	108.81	300.0	Cast iron	50.0	Open	3.27	122.19	122.18	0.01	0.05
P-1440	112.17	300.0	PVC	120.0	Open	2.77	122.17	122.17	0.00	0.04
P-400	161.54	300.0	PVC	120.0	Open	-2.75	122.19	122.19	0.00	0.04
P-360	324.92	1,200.0	PVC	120.0	Open	43.77	122.36	122.36	0.00	0.04
P-1260	105.77	300.0	Cast iron	50.0	Open	2.14	122.16	122.16	0.00	0.03
P-350	423.98	1,200.0	PVC	120.0	Open	-33.43	122.36	122.36	0.00	0.03
P-370	132.89	1,200.0	PVC	120.0	Open	28.48	122.36	122.36	0.00	0.03
P-1530	70.71	1,200.0	PVC	120.0	Open	28.48	122.36	122.36	0.00	0.03
P-340	25.30	1,200.0	PVC	120.0	Open	-20.56	122.36	122.36	0.00	0.02
P-330	111.25	1,200.0	PVC	120.0	Open	-20.56	122.36	122.36	0.00	0.02
P-1340	110.95	300.0	PVC	120.0	Open	1.11	122.18	122.18	0.00	0.02
P-410	143.56	300.0	PVC	120.0	Open	-0.99	122.18	122.18	0.00	0.01
P-1540	196.60	1,200.0	PVC	120.0	Open	15.73	122.36	122.36	0.00	0.01
P-610	190.20	300.0	Cast iron	50.0	Open	-0.83	122.32	122.32	0.00	0.01
P-590	102.11	200.0	PVC	120.0	Open	0.00	122.18	122.18	0.00	0.00
P-950	105.16	200.0	PVC	120.0	Open	0.00	122.18	122.18	0.00	0.00
P-1050	60.05	200.0	PVC	120.0	Open	0.00	122.16	122.16	0.00	0.00

Scenario: Ultimate - Peak Hour
Steady State Analysis
Pipe Report

Label	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Control Status	Discharge (l/s)	Upstream Structure Hydraulic Grade (m)	Downstream Structure Hydraulic Grade (m)	Pressure Pipe Headloss (m)	Velocity (m/s)
P-1410	59.74	200.0	PVC	120.0	Open	0.00	122.16	122.16	0.00	0.00
P-1360	67.36	200.0	PVC	120.0	Open	0.00	122.17	122.17	0.00	0.00
P-580	97.84	200.0	PVC	120.0	Open	0.00	122.18	122.18	0.00	0.00
P-1380	60.05	200.0	PVC	120.0	Open	0.00	122.17	122.17	0.00	0.00
P-320	155.75	300.0	Cast iron	50.0	Closed	0.00	122.18	122.26	0.00	0.00

Appendix C-2

Scenario: Ultimate - Max Day + Fire
Fire Flow Analysis
Fire Flow Report

Fire flow analysis for full EBF Buildout (400 l/s /node)

Label	Zone	Needed Fire Flow (l/s)	Available Fire Flow (l/s)	Total Flow Needed (l/s)	Total Flow Available (l/s)	Residual Pressure (psi)	Calculated Residual Pressure (psi)	Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Calculated Minimum System Pressure (psi)
J-1170	Zone - A	400.00	240.66	400.00	240.66	20.000	20.000	20.000	60.774	60.774
J-920	Zone - A	400.00	243.54	400.00	243.54	20.000	20.000	20.000	60.476	60.476
J-900	Zone - A	400.00	251.21	400.00	251.21	20.000	20.000	20.000	61.077	61.077
J-1240	Zone - A	400.00	292.74	400.00	292.74	20.000	20.000	20.000	57.544	57.544
J-1100	Zone - A	400.00	308.61	400.00	308.61	20.000	20.000	20.000	56.904	56.904
J-1110	Zone - A	400.00	309.29	400.00	309.29	20.000	20.000	20.000	57.054	57.054
J-1230	Zone - A	400.00	313.94	400.00	313.94	20.000	20.000	20.000	57.900	57.900
J-1220	Zone - A	400.00	850.17	408.25	858.42	20.000	20.000	20.000	38.846	38.846
J-1580	Zone - A	400.00	850.61	400.00	850.61	20.000	20.000	20.000	20.000	20.000
J-1250	Zone - A	400.00	863.36	400.00	863.36	20.000	20.000	20.000	20.000	20.000
J-1270	Zone - A	400.00	877.86	408.25	886.11	20.000	20.000	20.000	38.358	38.358
J-1080	Zone - A	400.00	906.47	406.60	913.07	20.000	20.000	20.000	45.946	45.946
J-1040	Zone - A	400.00	912.79	406.60	919.39	20.000	20.000	20.000	45.166	45.166
J-960	Zone - A	400.00	925.51	407.43	932.93	20.000	20.000	20.000	39.258	39.258
J-1600	Zone - A	400.00	951.60	411.72	963.32	20.000	20.000	20.000	20.000	20.000
J-910	Zone - A	400.00	986.80	406.60	993.40	20.000	20.000	20.000	20.000	20.000
J-1610	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	63.820	20.000	63.820	63.820
J-950	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	63.792	20.000	63.855	63.855
J-1130	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	31.160	20.000	46.167	46.167
J-1180	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	28.712	20.000	55.860	55.860
J-1060	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	32.045	20.000	42.050	42.050
J-1050	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	25.337	20.000	28.926	28.926
J-890	Zone - A	400.00	1,000.00	406.77	1,006.77	20.000	22.168	20.000	22.168	22.168
J-1150	Zone - A	400.00	1,000.00	407.26	1,007.26	20.000	33.167	20.000	48.666	48.666
J-980	Zone - A	400.00	1,000.00	406.60	1,006.60	20.000	40.082	20.000	48.409	48.409
J-1210	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	63.657	20.000	63.743	63.743
J-870	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	63.906	20.000	63.906	63.906
J-1090	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	35.172	20.000	37.992	37.992
J-1160	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	38.096	20.000	40.529	40.529
J-1590	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	25.462	20.000	28.940	28.940
J-1020	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	20.795	20.000	55.556	55.556
J-940	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	35.447	20.000	39.988	39.988
J-860	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	63.885	20.000	63.885	63.885
J-1260	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	64.277	20.000	64.148	64.148
J-1000	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	63.989	20.000	63.985	63.985
J-1010	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	63.878	20.000	63.878	63.878
J-880	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	29.008	20.000	29.008	29.008
J-970	Zone - A	400.00	1,000.00	400.00	1,000.00	20.000	30.221	20.000	32.437	32.437

available fire flow < 400 l/s.

Appendix C-3

Scenario: Ultimate - Max Day + 100 Fire @ J1110 1250 1600 1230
Steady State Analysis
Junction Report

Fire demand (Fire A) @ four nodes (100 l/s each for full EBF buildout.

Label	Elevation (m)	Zone	Type	Base Flow (l/s)	Pattern	Demand (Calculated) (l/s)	Calculated Hydraulic Grade (m)	Pressure (psi)
J-1110	77.00	Zone - A	Demand	100.00	Fixed	100.00	112.73	50.718
J-1230	77.00	Zone - A	Demand	100.00	Fixed	100.00	112.89	50.939
J-1250	77.00	Zone - A	Demand	100.00	Fixed	100.00	115.96	55.296
J-1600	77.00	Zone - A	Demand	111.71	Fixed	111.71	116.09	55.493
J-1240	77.00	Zone - A	Demand	0.00	Fixed	0.00	117.02	56.803
J-1100	77.00	Zone - A	Demand	0.00	Fixed	0.00	117.02	56.803
J-1580	77.00	Zone - A	Demand	0.00	Fixed	0.00	117.02	56.803
J-1590	77.00	Zone - A	Demand	0.00	Fixed	0.00	117.68	57.741
J-1220	77.00	Zone - A	Demand	8.25	Fixed	8.25	117.81	57.925
J-1050	77.00	Zone - A	Demand	0.00	Fixed	0.00	117.91	58.077
J-970	77.00	Zone - A	Demand	0.00	Fixed	0.00	117.95	58.124
J-1270	77.00	Zone - A	Demand	8.25	Fixed	8.25	118.04	58.260
J-960	77.00	Zone - A	Demand	7.42	Fixed	7.43	118.15	58.409
J-1160	77.00	Zone - A	Demand	0.00	Fixed	0.00	119.98	61.010
J-1060	77.00	Zone - A	Demand	0.00	Fixed	0.00	119.98	61.015
J-1170	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.12	61.201
J-890	77.00	Zone - A	Demand	6.76	Fixed	6.76	120.12	61.201
J-900	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.29	61.446
J-880	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.29	61.446
J-940	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.30	61.460
J-1040	77.00	Zone - A	Demand	6.60	Fixed	6.60	120.35	61.534
J-980	77.00	Zone - A	Demand	6.60	Fixed	6.60	120.36	61.545
J-920	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.44	61.667
J-910	77.00	Zone - A	Demand	6.60	Fixed	6.60	120.44	61.667
J-1090	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.59	61.871
J-1080	77.00	Zone - A	Demand	6.60	Fixed	6.60	120.62	61.915
J-1130	77.00	Zone - A	Demand	0.00	Fixed	0.00	121.21	62.761
J-1150	77.00	Zone - A	Demand	7.26	Fixed	7.26	121.44	63.087
J-1020	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.02	63.906
J-1180	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.02	63.907
J-950	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.33	64.344
J-860	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.33	64.346
J-870	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.33	64.346
J-1210	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.352
J-1610	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.353
J-1010	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.354
J-1000	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.355
J-1260	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.363

Pressure > 20 psi!, okay.

Scenario: Ultimate - Max Day + 100 Fire @ J1110 1250 1600 1230 (Fire A)
Steady State Analysis
Pipe Report

Label	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Control Status	Discharge (l/s)	Upstream Structure Hydraulic Grade (m)	Downstream Structure Hydraulic Grade (m)	Pressure Pipe Headloss (m)	Velocity (m/s)
P-1050	60.05	200.0	PVC	120.0	Open	-100.00	112.73	115.96	3.23	3.18
P-1410	59.74	200.0	PVC	120.0	Open	100.00	116.09	112.89	3.21	3.18
P-1480	102.11	300.0	PVC	120.0	Open	-169.97	117.95	119.98	2.03	2.40
P-1060	109.42	300.0	PVC	120.0	Open	-161.99	115.96	117.95	1.99	2.29
P-1130	124.66	300.0	PVC	120.0	Open	150.67	122.34	120.36	1.99	2.13
P-1470	109.12	300.0	PVC	120.0	Open	143.30	117.68	116.09	1.58	2.03
P-480	204.22	300.0	PVC	120.0	Open	-118.06	117.91	119.98	2.07	1.67
P-1030	48.77	300.0	Cast iron	50.0	Open	-114.03	119.98	122.33	2.35	1.61
P-1390	107.29	300.0	PVC	120.0	Open	-106.41	117.02	117.91	0.90	1.51
P-1420	110.34	300.0	PVC	120.0	Open	106.41	117.02	116.09	0.92	1.51
P-1300	103.63	300.0	PVC	120.0	Open	89.36	121.21	120.59	0.63	1.26
P-1290	88.09	300.0	Cast iron	50.0	Open	80.23	120.36	118.15	2.21	1.14
P-1330	116.13	300.0	Cast iron	50.0	Open	71.40	122.33	119.98	2.35	1.01
P-1100	106.98	300.0	Cast iron	50.0	Open	67.36	119.98	118.04	1.94	0.95
P-1140	96.62	300.0	PVC	120.0	Open	64.27	120.30	119.98	0.32	0.91
P-1490	128.02	300.0	PVC	120.0	Open	-60.58	119.98	120.36	0.38	0.86
P-1500	113.69	300.0	PVC	120.0	Open	-56.00	120.30	120.59	0.29	0.79
P-1440	112.17	300.0	PVC	120.0	Open	54.31	117.95	117.68	0.27	0.77
P-600	78.03	300.0	PVC	120.0	Open	-51.89	120.12	120.29	0.17	0.73
P-990	28.65	300.0	Cast iron	50.0	Open	51.28	122.34	122.02	0.31	0.73
P-1450	110.64	300.0	PVC	120.0	Open	-50.94	117.68	117.91	0.24	0.72
P-930	75.59	300.0	Cast iron	50.0	Open	50.60	122.02	121.21	0.81	0.72
P-1080	93.27	300.0	Cast iron	50.0	Open	-47.71	121.44	122.34	0.89	0.67
P-1510	77.72	300.0	PVC	120.0	Open	47.18	120.59	120.44	0.14	0.67
P-430	111.86	300.0	PVC	120.0	Open	46.33	118.15	117.95	0.20	0.66
P-940	78.94	300.0	PVC	120.0	Open	-45.13	119.98	120.12	0.13	0.64
P-1180	103.02	300.0	Cast iron	50.0	Open	43.34	121.44	120.62	0.83	0.61
P-1070	77.42	300.0	Cast iron	50.0	Open	41.66	122.02	121.44	0.58	0.59
P-1550	43.59	300.0	Cast iron	50.0	Open	-40.97	122.02	122.34	0.31	0.58
P-1340	110.95	300.0	PVC	120.0	Open	40.58	120.44	120.29	0.16	0.57
P-1320	97.54	300.0	PVC	120.0	Open	-39.29	117.91	118.04	0.13	0.56
P-460	178.31	300.0	PVC	120.0	Open	-38.76	121.21	121.44	0.23	0.55
P-1460	104.24	300.0	PVC	120.0	Open	38.06	117.81	117.68	0.13	0.54
P-1430	112.17	300.0	PVC	120.0	Open	38.01	116.09	115.96	0.14	0.54
P-1520	108.81	1,200.0	PVC	120.0	Open	476.06	122.36	122.34	0.02	0.42
P-1260	105.77	300.0	Cast iron	50.0	Open	26.48	118.15	117.81	0.34	0.37
P-1240	108.81	300.0	Cast iron	50.0	Open	22.92	120.62	120.35	0.27	0.32
P-1270	124.97	300.0	Cast iron	50.0	Open	-19.83	117.81	118.04	0.24	0.28
P-410	143.56	300.0	PVC	120.0	Open	19.58	120.35	120.30	0.05	0.28
P-400	161.54	300.0	PVC	120.0	Open	13.82	120.62	120.59	0.03	0.20
P-350	423.98	1,200.0	PVC	120.0	Open	-185.43	122.33	122.34	0.01	0.16
P-1350	77.42	300.0	PVC	120.0	Open	-11.31	120.29	120.30	0.01	0.16
P-360	324.92	1,200.0	PVC	120.0	Open	139.96	122.34	122.34	0.01	0.12
P-340	25.30	1,200.0	PVC	120.0	Open	-114.03	122.33	122.33	0.00	0.10
P-330	111.25	1,200.0	PVC	120.0	Open	-114.03	122.33	122.33	0.00	0.10
P-1530	70.71	1,200.0	PVC	120.0	Open	92.25	122.34	122.34	0.00	0.08
P-370	132.89	1,200.0	PVC	120.0	Open	92.25	122.34	122.34	0.00	0.08
P-1280	112.47	300.0	Cast iron	50.0	Open	-3.26	120.35	120.36	0.01	0.05
P-1540	196.60	1,200.0	PVC	120.0	Open	51.28	122.34	122.34	0.00	0.05
P-610	190.20	300.0	Cast iron	50.0	Open	-0.69	122.02	122.02	0.00	0.01
P-580	97.84	200.0	PVC	120.0	Open	0.00	120.29	120.29	0.00	0.00

Scenario: Ultimate - Max Day + 100 Fire @ J1110 1250 1600 1230
Steady State Analysis
Pipe Report

Label	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Control Status	Discharge (l/s)	Upstream Structure Hydraulic Grade (m)	Downstream Structure Hydraulic Grade (m)	Pressure Pipe Headloss (m)	Velocity (m/s)
P-1360	67.36	200.0	PVC	120.0	Open	0.00	117.02	117.02	0.00	0.00
P-590	102.11	200.0	PVC	120.0	Open	0.00	120.44	120.44	0.00	0.00
P-1380	60.05	200.0	PVC	120.0	Open	0.00	117.02	117.02	0.00	0.00
P-950	105.16	200.0	PVC	120.0	Open	0.00	120.12	120.12	0.00	0.00
P-320	155.75	300.0	Cast iron	50.0	Closed	0.00	117.91	119.98	0.00	0.00

Appendix
C-3

Scenario: Ultimate - Max Day + 100 Fire @ J1100 1230 1580 1600
Steady State Analysis
(Fire B)
Junction Report

Label	Elevation (m)	Zone	Type	Base Flow (l/s)	Pattern	Demand (Calculated) (l/s)	Calculated Hydraulic Grade (m)	Pressure (psi)
J-1100	77.00	Zone - A	Demand	100.00	Fixed	100.00	112.59	50.515
J-1230	77.00	Zone - A	Demand	100.00	Fixed	100.00	112.80	50.814
J-1240	77.00	Zone - A	Demand	0.00	Fixed	0.00	115.81	55.093
J-1580	77.00	Zone - A	Demand	100.00	Fixed	100.00	115.81	55.093
J-1600	77.00	Zone - A	Demand	111.71	Fixed	111.71	116.01	55.369
J-1250	77.00	Zone - A	Demand	0.00	Fixed	0.00	117.10	56.925
J-1110	77.00	Zone - A	Demand	0.00	Fixed	0.00	117.10	56.925
J-1590	77.00	Zone - A	Demand	0.00	Fixed	0.00	117.56	57.574
J-1050	77.00	Zone - A	Demand	0.00	Fixed	0.00	117.59	57.622
J-1220	77.00	Zone - A	Demand	8.25	Fixed	8.25	117.70	57.771
J-1270	77.00	Zone - A	Demand	8.25	Fixed	8.25	117.79	57.898
J-970	77.00	Zone - A	Demand	0.00	Fixed	0.00	118.17	58.443
J-960	77.00	Zone - A	Demand	7.42	Fixed	7.43	118.30	58.618
J-1060	77.00	Zone - A	Demand	0.00	Fixed	0.00	119.83	60.789
J-1160	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.09	61.161
J-1170	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.21	61.341
J-890	77.00	Zone - A	Demand	6.76	Fixed	6.76	120.21	61.341
J-880	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.38	61.573
J-900	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.38	61.573
J-940	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.39	61.586
J-1040	77.00	Zone - A	Demand	6.60	Fixed	6.60	120.44	61.655
J-980	77.00	Zone - A	Demand	6.60	Fixed	6.60	120.44	61.664
J-910	77.00	Zone - A	Demand	6.60	Fixed	6.60	120.53	61.782
J-920	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.53	61.782
J-1090	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.66	61.978
J-1080	77.00	Zone - A	Demand	6.60	Fixed	6.60	120.69	62.019
J-1130	77.00	Zone - A	Demand	0.00	Fixed	0.00	121.26	62.829
J-1150	77.00	Zone - A	Demand	7.26	Fixed	7.26	121.48	63.140
J-1020	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.03	63.925
J-1180	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.04	63.926
J-950	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.33	64.343
J-860	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.33	64.345
J-870	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.33	64.345
J-1210	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.353
J-1610	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.353
J-1010	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.354
J-1000	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.356
J-1260	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.363

Fire demand @ four nodes (100 l/s each) for full EBF buildout

Pressure > 20psi ∴ okay

Appendix C-3

Scenario: Ultimate - Max Day + 100 Fire @ J1100 1230 1580 1600 (Fire B)
Steady State Analysis
Pipe Report

Fire demand @ four nodes (100 l/s each) for full EBF buildout

Label	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Control Status	Discharge (l/s)	Upstream Structure Hydraulic Grade (m)	Downstream Structure Hydraulic Grade (m)	Pressure Pipe Headloss (m)	Velocity (m/s)
P-1410	59.74	200.0	PVC	120.0	Open	100.00	116.01	112.80	3.21	3.18
P-1380	60.05	200.0	PVC	120.0	Open	-100.00	112.59	115.81	3.23	3.18
P-1480	102.11	300.0	PVC	120.0	Open	-164.58	118.17	120.09	1.91	2.33
P-1390	107.29	300.0	PVC	120.0	Open	-154.13	115.81	117.59	1.78	2.18
P-1130	124.66	300.0	PVC	120.0	Open	147.19	122.34	120.44	1.90	2.08
P-1470	109.12	300.0	PVC	120.0	Open	141.83	117.56	116.01	1.55	2.01
P-480	204.22	300.0	PVC	120.0	Open	-122.94	117.59	119.83	2.23	1.74
P-1030	48.77	300.0	Cast iron	50.0	Open	-118.12	119.83	122.33	2.50	1.67
P-1060	109.42	300.0	PVC	120.0	Open	-115.76	117.10	118.17	1.07	1.64
P-1430	112.17	300.0	PVC	120.0	Open	-115.76	116.01	117.10	1.10	1.64
P-1300	103.63	300.0	PVC	120.0	Open	87.22	121.26	120.66	0.60	1.23
P-1440	112.17	300.0	PVC	120.0	Open	84.51	118.17	117.56	0.61	1.20
P-1290	88.09	300.0	Cast iron	50.0	Open	78.98	120.44	118.30	2.15	1.12
P-1330	116.13	300.0	Cast iron	50.0	Open	73.96	122.33	119.83	2.51	1.05
P-1100	106.98	300.0	Cast iron	50.0	Open	69.13	119.83	117.79	2.04	0.98
P-1140	96.62	300.0	PVC	120.0	Open	62.32	120.39	120.09	0.30	0.88
P-1490	128.02	300.0	PVC	120.0	Open	-58.61	120.09	120.44	0.35	0.83
P-1500	113.69	300.0	PVC	120.0	Open	-54.53	120.39	120.66	0.28	0.77
P-600	78.03	300.0	PVC	120.0	Open	-50.42	120.21	120.38	0.16	0.71
P-990	28.65	300.0	Cast iron	50.0	Open	50.12	122.34	122.04	0.30	0.71
P-930	75.59	300.0	Cast iron	50.0	Open	49.43	122.04	121.26	0.77	0.70
P-1320	97.54	300.0	PVC	120.0	Open	-49.08	117.59	117.79	0.19	0.69
P-1080	93.27	300.0	Cast iron	50.0	Open	-46.63	121.48	122.34	0.86	0.66
P-1510	77.72	300.0	PVC	120.0	Open	46.03	120.66	120.53	0.14	0.65
P-1420	110.34	300.0	PVC	120.0	Open	-45.87	115.81	116.01	0.19	0.65
P-940	78.94	300.0	PVC	120.0	Open	-43.65	120.09	120.21	0.13	0.62
P-1180	103.02	300.0	Cast iron	50.0	Open	42.31	121.48	120.69	0.79	0.60
P-1070	77.42	300.0	Cast iron	50.0	Open	40.73	122.03	121.48	0.55	0.58
P-1550	43.59	300.0	Cast iron	50.0	Open	-40.04	122.03	122.34	0.30	0.57
P-1340	110.95	300.0	PVC	120.0	Open	39.43	120.53	120.38	0.15	0.56
P-1460	104.24	300.0	PVC	120.0	Open	39.42	117.70	117.56	0.14	0.56
P-460	178.31	300.0	PVC	120.0	Open	-37.79	121.26	121.48	0.22	0.53
P-1260	105.77	300.0	Cast iron	50.0	Open	35.87	118.30	117.70	0.60	0.51
P-430	111.86	300.0	PVC	120.0	Open	35.69	118.30	118.17	0.12	0.50
P-1520	108.81	1,200.0	PVC	120.0	Open	476.06	122.36	122.34	0.02	0.42
P-1240	108.81	300.0	Cast iron	50.0	Open	22.37	120.69	120.44	0.26	0.32
P-410	143.56	300.0	PVC	120.0	Open	18.77	120.44	120.39	0.05	0.27
P-1450	110.64	300.0	PVC	120.0	Open	-17.90	117.56	117.59	0.03	0.25
P-400	161.54	300.0	PVC	120.0	Open	13.34	120.69	120.66	0.03	0.19
P-350	423.98	1,200.0	PVC	120.0	Open	-192.08	122.33	122.34	0.01	0.17
P-1270	124.97	300.0	Cast iron	50.0	Open	-11.80	117.70	117.79	0.09	0.17
P-1350	77.42	300.0	PVC	120.0	Open	-10.98	120.38	120.39	0.01	0.16
P-360	324.92	1,200.0	PVC	120.0	Open	136.79	122.34	122.34	0.01	0.12
P-340	25.30	1,200.0	PVC	120.0	Open	-118.12	122.33	122.33	0.00	0.10
P-330	111.25	1,200.0	PVC	120.0	Open	-118.12	122.33	122.33	0.00	0.10
P-370	132.89	1,200.0	PVC	120.0	Open	90.16	122.34	122.34	0.00	0.08
P-1530	70.71	1,200.0	PVC	120.0	Open	90.16	122.34	122.34	0.00	0.08
P-1540	196.60	1,200.0	PVC	120.0	Open	50.12	122.34	122.34	0.00	0.04
P-1280	112.47	300.0	Cast iron	50.0	Open	-3.01	120.44	120.44	0.01	0.04
P-610	190.20	300.0	Cast iron	50.0	Open	-0.69	122.03	122.04	0.00	0.01
P-590	102.11	200.0	PVC	120.0	Open	0.00	120.53	120.53	0.00	0.00

Scenario: Ultimate - Max Day + 100 Fire @ J1100 1230 1580 1600

Steady State Analysis

Pipe Report

Label	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Control Status	Discharge (l/s)	Upstream Structure Hydraulic Grade (m)	Downstream Structure Hydraulic Grade (m)	Pressure Pipe Headloss (m)	Velocity (m/s)
P-1050	60.05	200.0	PVC	120.0	Open	0.00	117.10	117.10	0.00	0.00
P-950	105.16	200.0	PVC	120.0	Open	0.00	120.21	120.21	0.00	0.00
P-1360	67.36	200.0	PVC	120.0	Open	0.00	115.81	115.81	0.00	0.00
P-580	97.84	200.0	PVC	120.0	Open	0.00	120.38	120.38	0.00	0.00
P-320	155.75	300.0	Cast iron	50.0	Closed	0.00	117.59	119.83	0.00	0.00

Appendix C-3

Scenario: Ultimate - Max Day + Fire @ J1100 1240 1580
Steady State Analysis
Junction Report

(Fire)
Fire demand @ three nodes (100 l/s @ 1240 & 1100, 200 l/s @ 1580) for full EBF buildout

Label	Elevation (m)	Zone	Type	Base Flow (l/s)	Pattern	Demand (Calculated) (l/s)	Calculated Hydraulic Grade (m)	Pressure (psi)
J-1240	77.00	Zone - A	Demand	100.00	Fixed	100.00	110.51	47.568
J-1100	77.00	Zone - A	Demand	100.00	Fixed	100.00	110.90	48.125
J-1580	77.00	Zone - A	Demand	200.00	Fixed	200.00	114.13	52.703
J-1600	77.00	Zone - A	Demand	11.71	Fixed	11.72	116.71	56.368
J-1230	77.00	Zone - A	Demand	0.00	Fixed	0.00	116.71	56.368
J-1050	77.00	Zone - A	Demand	0.00	Fixed	0.00	117.42	57.370
J-1250	77.00	Zone - A	Demand	0.00	Fixed	0.00	117.51	57.498
J-1110	77.00	Zone - A	Demand	0.00	Fixed	0.00	117.51	57.498
J-1590	77.00	Zone - A	Demand	0.00	Fixed	0.00	117.52	57.517
J-1220	77.00	Zone - A	Demand	8.25	Fixed	8.25	117.64	57.694
J-1270	77.00	Zone - A	Demand	8.25	Fixed	8.25	117.67	57.724
J-970	77.00	Zone - A	Demand	0.00	Fixed	0.00	118.28	58.601
J-960	77.00	Zone - A	Demand	7.42	Fixed	7.43	118.38	58.734
J-1060	77.00	Zone - A	Demand	0.00	Fixed	0.00	119.74	60.669
J-1160	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.14	61.237
J-890	77.00	Zone - A	Demand	6.76	Fixed	6.76	120.26	61.411
J-1170	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.26	61.411
J-900	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.42	61.637
J-880	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.42	61.637
J-940	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.43	61.651
J-1040	77.00	Zone - A	Demand	6.60	Fixed	6.60	120.48	61.717
J-980	77.00	Zone - A	Demand	6.60	Fixed	6.60	120.48	61.725
J-920	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.57	61.841
J-910	77.00	Zone - A	Demand	6.60	Fixed	6.60	120.57	61.841
J-1090	77.00	Zone - A	Demand	0.00	Fixed	0.00	120.70	62.032
J-1080	77.00	Zone - A	Demand	6.60	Fixed	6.60	120.73	62.072
J-1130	77.00	Zone - A	Demand	0.00	Fixed	0.00	121.29	62.863
J-1150	77.00	Zone - A	Demand	7.26	Fixed	7.26	121.50	63.167
J-1020	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.04	63.935
J-1180	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.04	63.936
J-950	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.33	64.342
J-860	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.33	64.344
J-870	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.33	64.345
J-1210	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.353
J-1610	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.354
J-1010	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.354
J-1000	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.356
J-1260	77.00	Zone - A	Demand	0.00	Fixed	0.00	122.34	64.363

Pressure >20psi ∴ okay

Appendix C-3

Scenario: Ultimate - Max Day + Fire @ J1100 1240 1580 (Fire C)
Steady State Analysis
Pipe Report

Label	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Control Status	Discharge (l/s)	Upstream Structure Hydraulic Grade (m)	Downstream Structure Hydraulic Grade (m)	Pressure Pipe Headloss (m)	Velocity (m/s)
P-1380	60.05	200.0	PVC	120.0	Open	-100.00	110.90	114.13	3.23	3.18
P-1360	67.36	200.0	PVC	120.0	Open	-100.00	110.51	114.13	3.62	3.18
P-1390	107.29	300.0	PVC	120.0	Open	-214.54	114.13	117.42	3.29	3.04
P-1420	110.34	300.0	PVC	120.0	Open	-185.46	114.13	116.71	2.58	2.62
P-1480	102.11	300.0	PVC	120.0	Open	-161.90	118.28	120.14	1.86	2.29
P-1130	124.66	300.0	PVC	120.0	Open	145.38	122.34	120.48	1.86	2.06
P-480	204.22	300.0	PVC	120.0	Open	-125.70	117.42	119.74	2.32	1.78
P-1030	48.77	300.0	Cast iron	50.0	Open	-120.24	119.74	122.33	2.59	1.70
P-1470	109.12	300.0	PVC	120.0	Open	99.77	117.52	116.71	0.81	1.41
P-1060	109.42	300.0	PVC	120.0	Open	-97.41	117.51	118.28	0.78	1.38
P-1430	112.17	300.0	PVC	120.0	Open	-97.41	116.71	117.51	0.80	1.38
P-1440	112.17	300.0	PVC	120.0	Open	95.22	118.28	117.52	0.76	1.35
P-1300	103.63	300.0	PVC	120.0	Open	86.12	121.29	120.70	0.59	1.22
P-1290	88.09	300.0	Cast iron	50.0	Open	78.21	120.48	118.38	2.11	1.11
P-1330	116.13	300.0	Cast iron	50.0	Open	75.29	122.33	119.74	2.59	1.07
P-1100	106.98	300.0	Cast iron	50.0	Open	69.83	119.74	117.67	2.07	0.99
P-1140	96.62	300.0	PVC	120.0	Open	61.35	120.43	120.14	0.29	0.87
P-1490	128.02	300.0	PVC	120.0	Open	-57.64	120.14	120.48	0.34	0.82
P-1320	97.54	300.0	PVC	120.0	Open	-56.17	117.42	117.67	0.25	0.79
P-1500	113.69	300.0	PVC	120.0	Open	-53.77	120.43	120.70	0.27	0.76
P-600	78.03	300.0	PVC	120.0	Open	-49.67	120.26	120.42	0.16	0.70
P-990	28.65	300.0	Cast iron	50.0	Open	49.51	122.34	122.04	0.29	0.70
P-930	75.59	300.0	Cast iron	50.0	Open	48.83	122.04	121.29	0.76	0.69
P-1080	93.27	300.0	Cast iron	50.0	Open	-46.08	121.50	122.34	0.84	0.65
P-1510	77.72	300.0	PVC	120.0	Open	45.45	120.70	120.57	0.13	0.64
P-940	78.94	300.0	PVC	120.0	Open	-42.91	120.14	120.26	0.12	0.61
P-1180	103.02	300.0	Cast iron	50.0	Open	41.77	121.50	120.73	0.77	0.59
P-1070	77.42	300.0	Cast iron	50.0	Open	40.25	122.04	121.50	0.54	0.57
P-1260	105.77	300.0	Cast iron	50.0	Open	40.05	118.38	117.64	0.73	0.57
P-1550	43.59	300.0	Cast iron	50.0	Open	-39.56	122.04	122.34	0.30	0.56
P-1340	110.95	300.0	PVC	120.0	Open	38.85	120.57	120.42	0.14	0.55
P-460	178.31	300.0	PVC	120.0	Open	-37.29	121.29	121.50	0.21	0.53
P-1460	104.24	300.0	PVC	120.0	Open	37.22	117.64	117.52	0.12	0.53
P-1450	110.64	300.0	PVC	120.0	Open	32.67	117.52	117.42	0.10	0.46
P-430	111.86	300.0	PVC	120.0	Open	30.74	118.38	118.28	0.09	0.43
P-1520	108.81	1,200.0	PVC	120.0	Open	476.07	122.36	122.34	0.02	0.42
P-1240	108.81	300.0	Cast iron	50.0	Open	22.07	120.73	120.48	0.25	0.31
P-410	143.56	300.0	PVC	120.0	Open	18.40	120.48	120.43	0.05	0.26
P-400	161.54	300.0	PVC	120.0	Open	13.10	120.73	120.70	0.03	0.19
P-350	423.98	1,200.0	PVC	120.0	Open	-195.53	122.33	122.34	0.01	0.17
P-1350	77.42	300.0	PVC	120.0	Open	-10.83	120.42	120.43	0.01	0.15
P-360	324.92	1,200.0	PVC	120.0	Open	135.15	122.34	122.34	0.00	0.12
P-330	111.25	1,200.0	PVC	120.0	Open	-120.24	122.33	122.33	0.00	0.11
P-340	25.30	1,200.0	PVC	120.0	Open	-120.24	122.33	122.33	0.00	0.11
P-1530	70.71	1,200.0	PVC	120.0	Open	89.07	122.34	122.34	0.00	0.08
P-370	132.89	1,200.0	PVC	120.0	Open	89.07	122.34	122.34	0.00	0.08
P-1270	124.97	300.0	Cast iron	50.0	Open	-5.42	117.64	117.67	0.02	0.08
P-1540	196.60	1,200.0	PVC	120.0	Open	49.51	122.34	122.34	0.00	0.04
P-1280	112.47	300.0	Cast iron	50.0	Open	-2.93	120.48	120.48	0.01	0.04
P-610	190.20	300.0	Cast iron	50.0	Open	-0.69	122.04	122.04	0.00	0.01
P-1410	59.74	200.0	PVC	120.0	Open	0.00	116.71	116.71	0.00	0.00

Scenario: Ultimate - Max Day + Fire @ J1100 1240 1580
Steady State Analysis
Pipe Report

Label	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Control Status	Discharge (l/s)	Upstream Structure Hydraulic Grade (m)	Downstream Structure Hydraulic Grade (m)	Pressure Pipe Headloss (m)	Velocity (m/s)
P-590	102.11	200.0	PVC	120.0	Open	0.00	120.57	120.57	0.00	0.00
P-1050	60.05	200.0	PVC	120.0	Open	0.00	117.51	117.51	0.00	0.00
P-950	105.16	200.0	PVC	120.0	Open	0.00	120.26	120.26	0.00	0.00
P-580	97.84	200.0	PVC	120.0	Open	0.00	120.42	120.42	0.00	0.00
P-320	155.75	300.0	Cast iron	50.0	Closed	0.00	117.42	119.74	0.00	0.00

Hydrant Flow Testing Summary

C-FACTOR TEST SUMMARY

	OWNER:	Toronto		Queens Quay East			DATE:	July 4th 2008	
	Pipe Diameter in Inches	12			Flowed			Lower Sherbourne	
	Material (Where Known)				Residual Hydrant (R1)			178 Queens Quay E	
					Residual Hydrant (R2)			162 Queens Quay E	
		R2			R1			Flow	
		89.3		m					
	R1-R2 Distance (M)	89.3		Static Pressures	R1	R2		Correction Factor	
	R1-R2 Distance (ft)	293			88	84		-4	
TEST	Nozzles Used	Pitot 1	Pitot 2	U.S.G.P.M.	R1	R2		MGD (U.S.)	Cu. Ft/sec
A	1 Port (1-3/4 Playpipe)	62		716	78	75		1030676	1.595
B	1 Port (1-1/8 Playpipe)							0	0.000
C	1 Port (1-2-1/2 Port)	40		1059	68	68		1524572	2.359
D	2 Port (2-2-1/2 Port)	10		1059	58	57		1524572	2.359
	Headloss across pipe from R2 to R1 (in PSI)							Loss (ft/1000)	Loss (ft/ft)
A	1							7.882	0.0079
B	4							31.529	0.0315
C	4							31.529	0.0315
D	3							23.646	0.0236
	TEST			C-Factor				AVG C-Factor	
	A			50.38278195				#REF!	
	B			0					
	C			35.2529504					
	D			41.17772869					

A-1 Hydrant Services Ltd.
Scarborough • Sudbury • Cambridge

10 Estate Drive
Toronto, Ontario M1H 2Z1
(416) 282-1665

SITE NAME: Queen's Quay E, municipal infrastructure DATE: July 4th 2008.

LOCATION: Queen's Quay E @ Lower Sherbourne st, Toronto

TEST DATA

TIME OF TEST: 11:15am

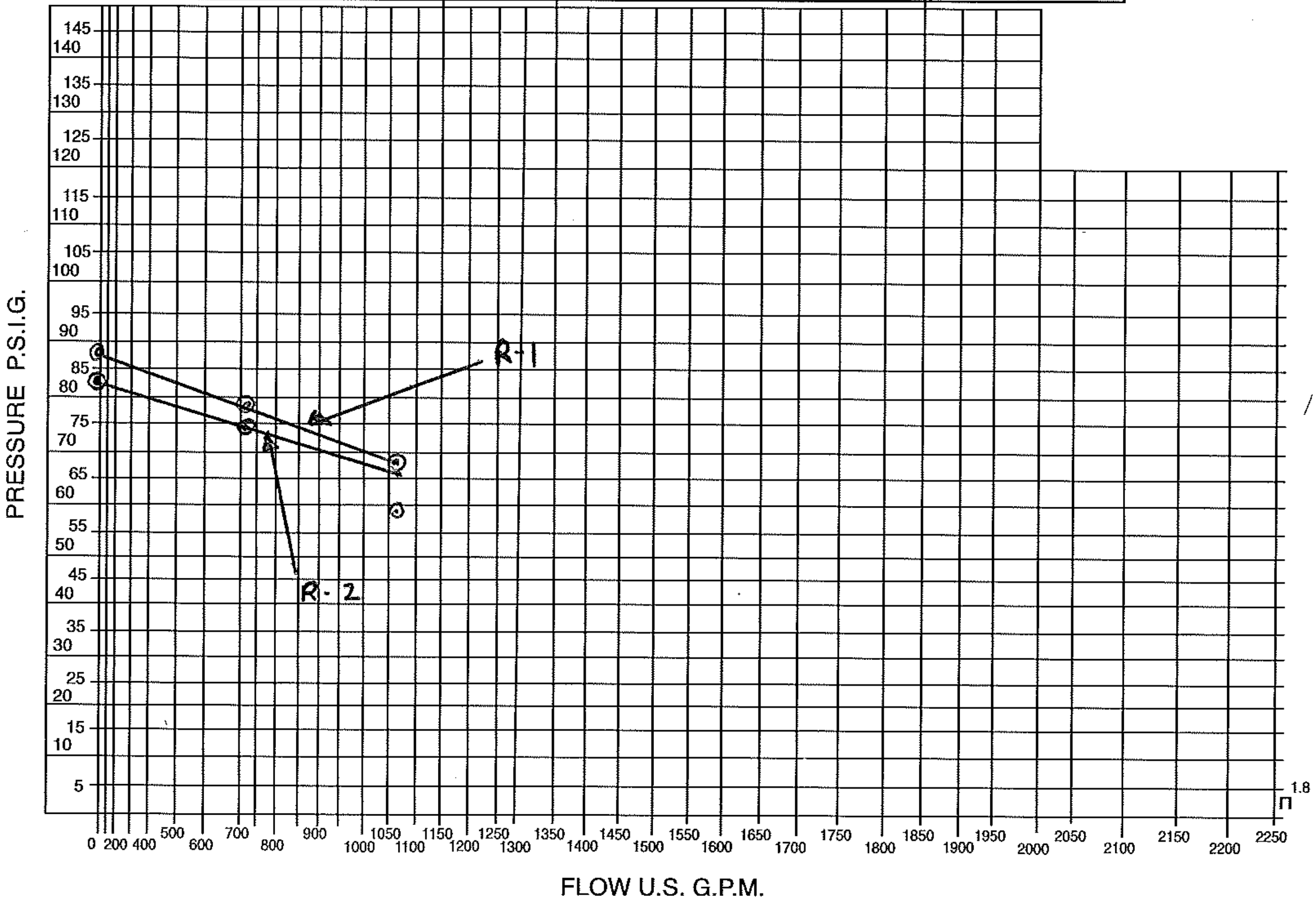
LOCATION OF TEST: (FLOW) Queen's Quay E @ Lower Sherbourne st. (Tww3P)

(RESIDUAL) R-1, 178 Queen's Quay E, R-2, 162 Queen's Quay E.

MAIN SIZE: 300mm

STATIC PRESSURE: (R-1) 88psi (R-2) 84psi

	NUMBER OF OUTLETS & ORIFICE SIZE	PITOT PRESSURE	FLOW (U.S. G.P.M.)	RESIDUAL PRESSURE	
# 1	1 x 1 3/4"	62	716	78	75
# 2	1 x 2 1/2"	40	1059	68	68
# 3	2 x 2 1/2"	10	1059	58	57
# 4				R1	R2



COMMENTS: Performed a complete C-factor test as required.

Authorized Signature ______________ A-1 HYDRANT Signature

A-1 Hydrant Services Ltd.
Scarborough • Sudbury • Cambridge

10 Estate Drive
Toronto, Ontario M1H 2Z1
(416) 282-1665

SITE NAME: Queens Quay East, Municipal Infastructure Group DATE: July 4, 2008

LOCATION: Queens Quay East @ Lower Jarvis ST. TORONTO

TEST DATA

TIME OF TEST: 10:30 AM

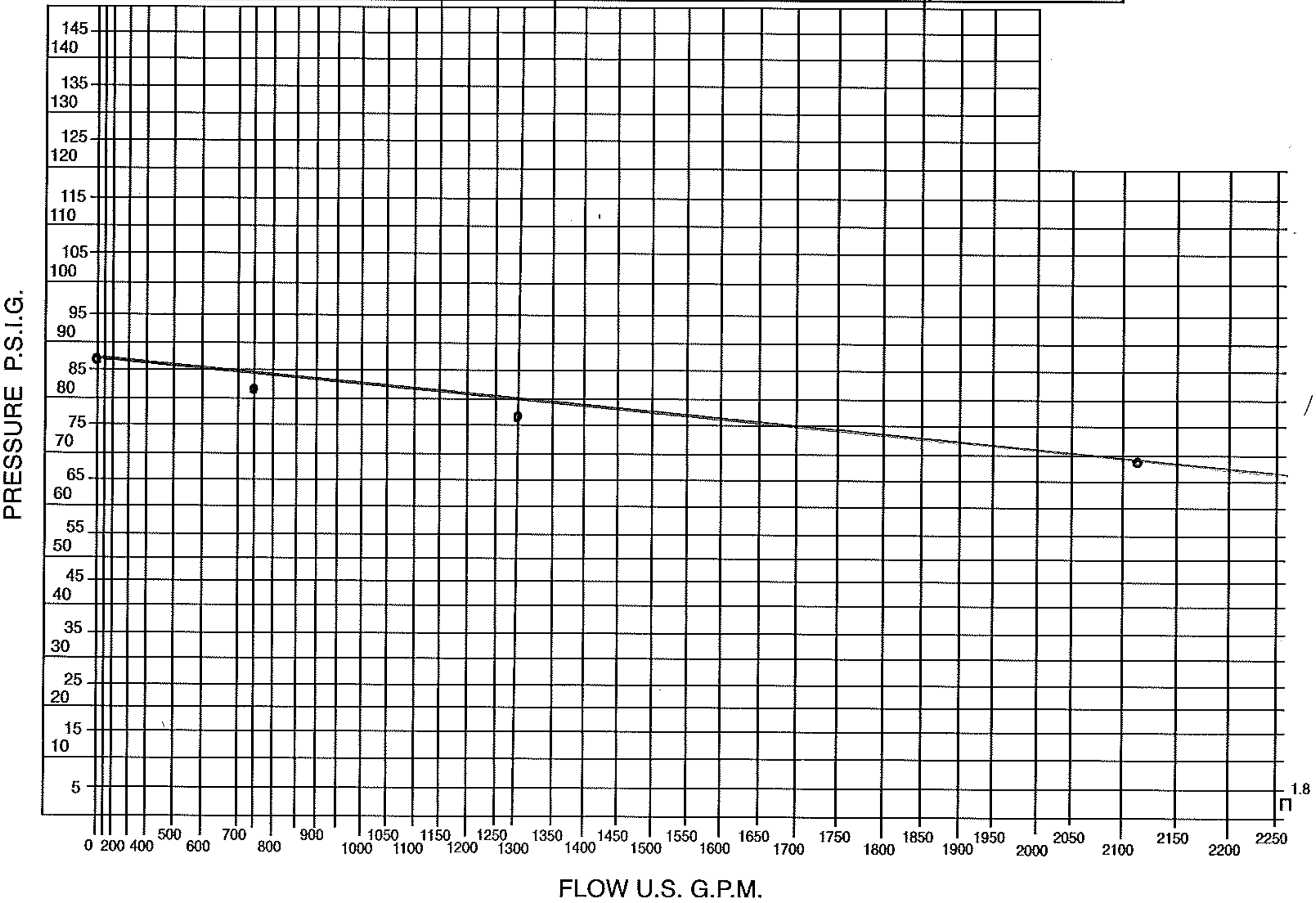
LOCATION OF TEST: (FLOW) 162 Queen Quay East @ Richardson ST. (Mueller 3P)

(RESIDUAL) Queens Quay East @ Lower Jarvis. ST. (Mueller 3P)

MAIN SIZE: 300 MM

STATIC PRESSURE: 87 PSI

	NUMBER OF OUTLETS & ORIFICE SIZE	PITOT PRESSURE	FLOW (U.S. G.P.M.)	RESIDUAL PRESSURE
# 1	1 x 1¾	68	750	81
# 2	1 x 2½	60	1297	77
# 3	2 x 2½	40	2117	64
# 4				



COMMENTS: Performed one complete NFPA 291, Flow test
Conducted by Senthu Suntharalingam.

Authorized Signature ____________ A-1 HYDRANT Signature ____________

A-1 Hydrant Services Ltd.
Scarborough • Sudbury • Cambridge

10 Estate Drive
Toronto, Ontario M1H 2Z1
(416) 282-1665

SITE NAME: Queens Quay East, Municipal Infastructure Group DATE: July 4, 2008

LOCATION: Queens Quay East @ Lower Sherbourne, Toronto

TEST DATA

TIME OF TEST: 9:50 AM

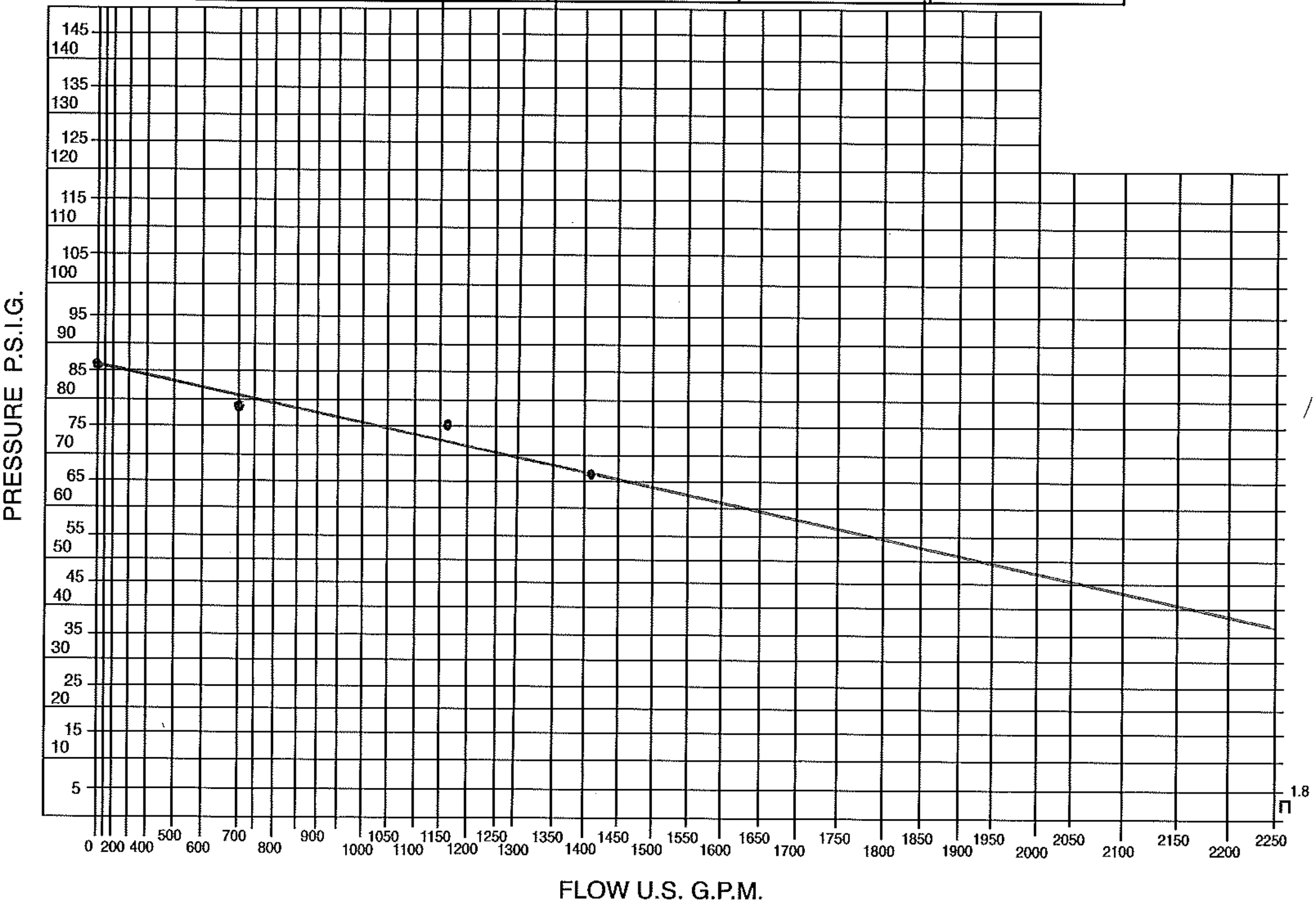
LOCATION OF TEST: (FLOW) Queens Quay East @ Lower Sherbourne St, Toronto (TWW 3P

(RESIDUAL) 178 Queens Quay East McAvity (3P M67)

MAIN SIZE: 300 MM

STATIC PRESSURE: 86 PSI

	NUMBER OF OUTLETS & ORIFICE SIZE	PITOT PRESSURE	FLOW (U.S. G.P.M.)	RESIDUAL PRESSURE
# 1	1 x 1¾	59	698	79
# 2	1 x 2½	48	1160	75
# 3	2 x 2½	18	1420	66
# 4				



COMMENTS: Performed One complete NFPA 291, FLOW TEST
Conducted by Senthu Suntharalingam.

Authorized Signature ______ A-1 HYDRANT Signature ______

A-1 Hydrant Services Ltd.
Scarborough • Sudbury • Cambridge

10 Estate Drive
Toronto, Ontario M1H 2Z1
(416) 282-1665

SITE NAME: QUEENS QUAY EAST, MUNICIPAL INFRASTRUCTURE DATE: JULY 4, 2008

LOCATION: QUEENS QUAY EAST @ BONNYCASTLE ST. TORONTO

TEST DATA

TIME OF TEST: 9:20 AM

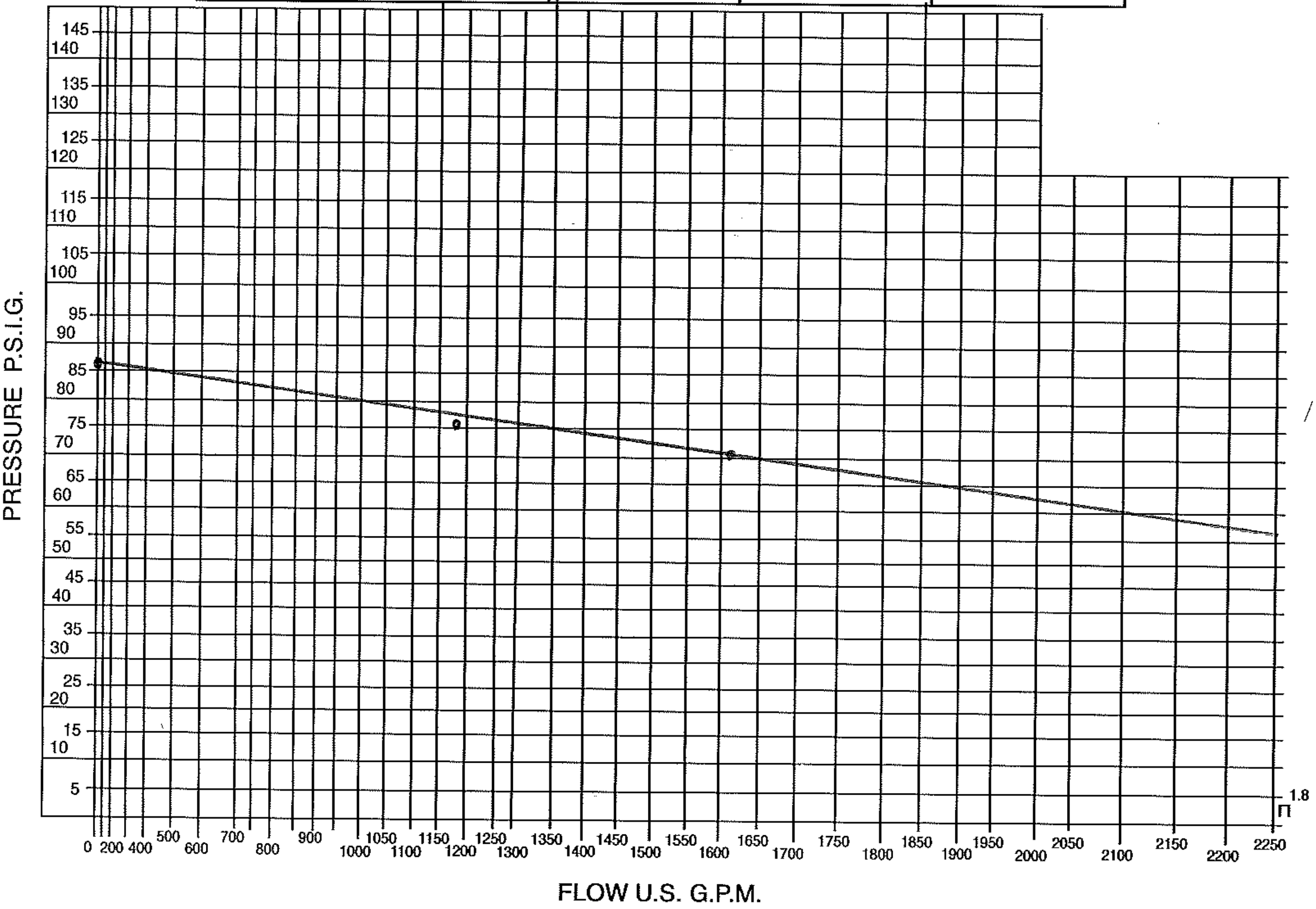
LOCATION OF TEST: (FLOW) QUEENS QUAY E. @ BONNYCASTLE ST. (TWW 3P)

(RESIDUAL) QUEENS QUAY E. @ LOWER SHERBOURNE ST. (TWW 3P)

MAIN SIZE: 300 MM

STATIC PRESSURE: 86 PSI

	NUMBER OF OUTLETS & ORIFICE SIZE	PITOT PRESSURE	FLOW (U.S. G.P.M.)	RESIDUAL PRESSURE
# 1	1 x 2½	50	1184	76
# 2	2 x 2½	23	1606	72
# 3				
# 4				



COMMENTS: PERFORM ONE COMPLETE NFPA 291 FLOW TEST
CONDUCTED BY SENTHU SUNTHARALINGAM

Authorized Signature ____________ A-1 HYDRANT Signature

A-1 Hydrant Services Ltd.
Scarborough • Sudbury • Cambridge

10 Estate Drive
Toronto, Ontario M1H 2Z1
(416) 282-1665

SITE NAME: QUEENS QUAY EAST, MUNACIDAL INFASTRUCTURE GROUP. DATE: JULY 4, 2008

LOCATION: QUEENS QUAY EAST @ RICHARDSON ST, TORONTO

TEST DATA

TIME OF TEST: 10:10 AM

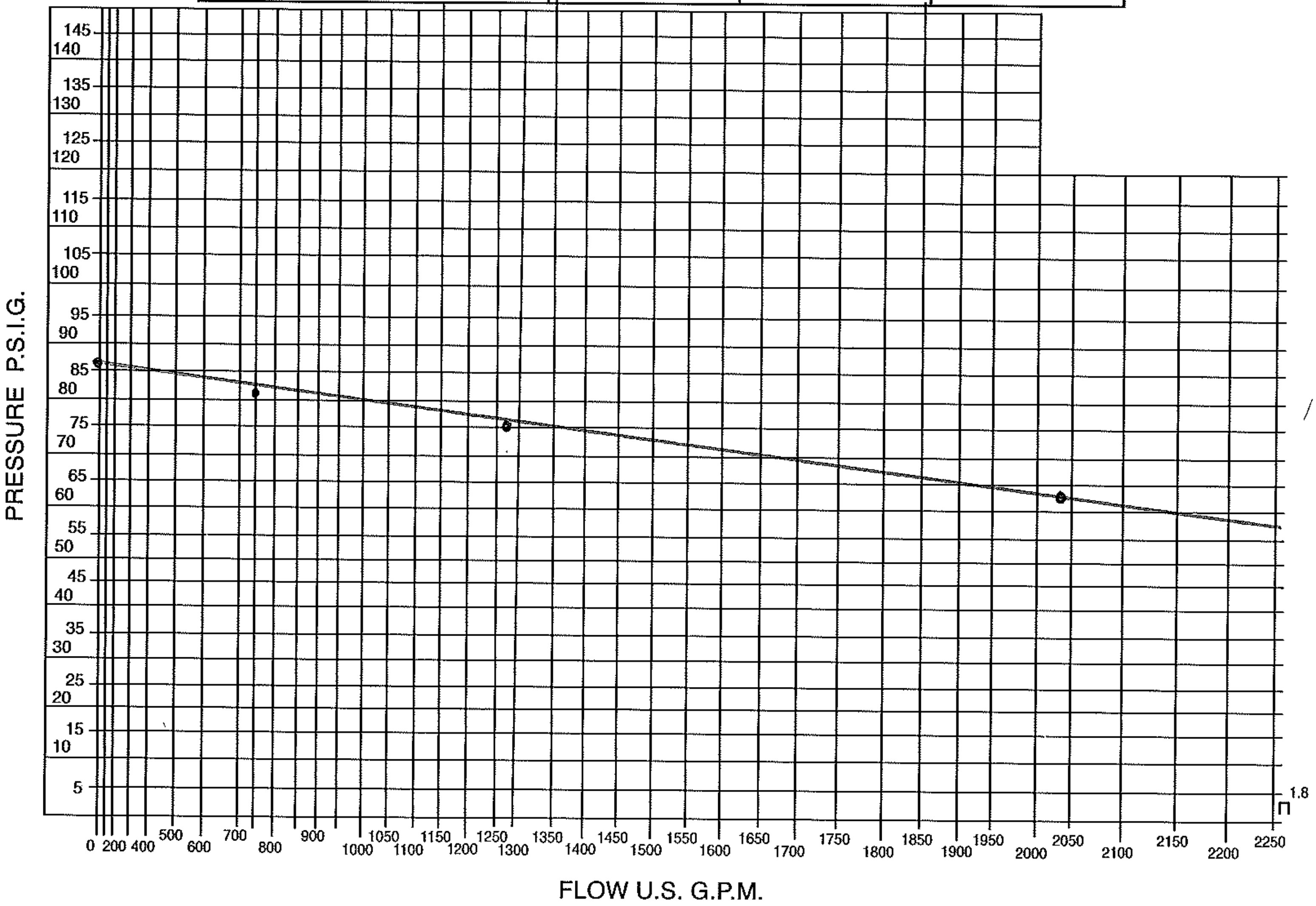
LOCATION OF TEST: (FLOW) 178 QUEENS QUAY EAST, McAVITY M67 (3P)

(RESIDUAL) 162 QUEENS QUAY EAST @ RICHARDSON ST, TORONTO (McAVITY M-67)

MAIN SIZE: 300 PSI

STATIC PRESSURE: 86 PSI

	NUMBER OF OUTLETS & ORIFICE SIZE	PITOT PRESSURE	FLOW (U.S. G.P.M.)	RESIDUAL PRESSURE
# 1	1 x 1 3/4	68	750	81
# 2	1 x 2 1/2	58	1275	75
# 3	2 x 2 1/2	37	2037	63
# 4				



COMMENTS: PERFORM ONE COMPLETE NFPA 291 FLOW TEST
CONDUCTED BY SENTHU SUNTHARALINGAM

Authorized Signature ______________ A-1 HYDRANT Signature

Appendix 5a

Relevant Correspondence

A. K.

TORONTO

R. Bedrosyan, P.Eng.
Director, Development Engineering

Technical Services Division
Development Engineering
Toronto and East York District
Metro Hall, 16th Floor
55 John Street
Toronto, Ontario M5V 3C6

Doug Bleaney, P. Eng.
Manager, Toronto & East York District
Reply Attention of:
Greg Horgan, Sr. Engineer
Tel: (416) 338-1068
Fax: (416) 392-4426
ghorgan@toronto.ca

April 7, 2008

The Municipal Infrsstructure Group
2300 Steeles Avenue West
Suite 120
Vaughan, Ontario
L4K 5X6

Attention: Mark Tarras, P. Eng.
Partner

Dear Mr. Tarras:

Re: Waterfront Toronto
East Bayfront Development
Functional Servicing Plan
First Engineering Submission

The Functional Servicing Plan (FSP) was received in a meeting on January 20, 2008 followed by the First Engineering Submission February 25, 2008. Staff from Toronto Water and Development Engineering have been involved in the review of the FSP while Development Engineering has performed the review of the first submission documents with input from other departments as required. The following comments have been assembled for your update of the document as required.

A. FUNCTIONAL SERVICING PLAN

The FSP has provided a very detailed analysis of the servicing needs for the East Bayfront development and the surrounding areas in this area of the City. It expands and updates the findings of the EA Master Servicing Plan and provides new and innovative solutions for this development. On the whole it has been well considered and does form the basis of development design and phasing.

The East Bayfront Development is a very complex development and as such there has been a fair amount of change in the development that has occurred in the past year and it continues to evolve as more design input is received from the many design partners and as each of the Environmental Assessments in the area advance. In that sense the results of the various EA's may revise the current planning and may affect the current document.

Within the City, staff have also advanced the analysis of the critical infrastructure for this development, especially in the analysis of the Scott Sewage Pumping Station and are in the process of developing a program for the upgrade of the facility to meet the needs of expanding development, both from East Bayfront and also from the other developments which are under way in this area.

However, it is essential that the first phase of development proceed to meet the demands of development, especially that of Corus which is under final site plan review and is scheduled for occupancy in 2009.

1. Stormwater Management Section Comments

Overall
The generally imaginative concept of using a portion of the Inner Harbour for a Dunkers or equivalent facility has been retained; the Consultants are congratulated on this major innovation in their design, as well as commitment to water management on future private property. Such as commitment will improve the environmental sustainability of the development, as per Waterfront Toronto and Toronto Water mandates

Literature Review - Stormwater Management
Provide data on where such innovative facilities are located both internationally and locally. This information, provided in a functional servicing report, will assist providing context and examples for other subsequent users of this report.

Section 4.6 Stormwater Management Strategy
A functional servicing report must show how 'annual' Water balance will be attained, and what the targets are for specific land blocks (units mm /year) A qualitative description of potential on-site measures (section 4.3) and anticipated performance (Section 6.0) is insufficient for a functional servicing report

The report must establish:

- what baseline water balance is currently, (units annual mm/year),
- how proposed conditions (without source control measures) will alter water balance (which is one basis for establishing post development targets)
- post development targets, and
- calculate with illustrative measures, how site controls will achieve water balance targets.

The City recognizes that as specific blocks are developed, the example measures illustrated in the functional servicing report may change. But the number, type, and density of measures provided in the Functional Servicing Report will provide a guide to the Developer for the Block and City on level of expectation when specific applications are put forward.

The calculations also will provide a realistic picture of what can and cannot be achieved; if the targets cannot be met, then off- site compensatory measures may be needed, which are established at time of submittal and acceptance by the City of the Functional Servicing Report. Especially for redevelopment applications directly adjoining the waterfront, unique opportunities exist.

In addition, the report should specify applicable peak flow requirements, based on the WWF guidelines, and comment on how storage for such peak flow storage and rain-water harvesting can/cannot be made mutually compatible. It should comment on whether such stored water could be used for summer air conditioned systems.

Conveyance controls
Potential Use of OGS's are suggested for upstream of the EOP, potentially on an interim basis for the first few blocks. It is noted that the OGS locations, detailed analysis, maintenance provisions and back up design data will be required to be provided with the submission of each phase of development.

Review of Section 5.1 Stormwater Facility

1) Page 24
    i) A quoted E Coli levels of 10,000 to 30,000 is inappropriately low. For waterfront and associated areas, monitoring data and the WWFMMP modeling analyses used about 400,000 as the representative range. Please revise your calculations according and re-size the storage requirements estimated in Table 5-3
    ii) Please provide references which indicate the die-off rate cited in the first sentence. This die-off rate is optimistic.
    iii) Please provide estimates of storage required if the half-time (50 % reduction) is 48 hours.
    iv) Summarize the above on page 24.

2) In appendix Provide a summary of EOP facilities proposed in EA report, and how drainage redesign necessitated resizing and what the size would be commensurate with cost estimates for Option 4 outlined in Page 34
3) Describe O and M aspects with options A to C in a separate section- perhaps page 26 , as a separate section 5.4, before section 5.3.5
4) Include shipping lane that Port Authority uses as a reserve in front of East Bayfront to get to Redpath Sugar, and comment on how Option B (Figure 5.4) would interfere with that reserve.
5) Subject to further internal discussion and future confirmation, Toronto Water will not accept a facility such as Option B to assume responsibility for operations and maintenance of such a facility after commissioning. Toronto Water is prepared to accept a facility such as Option C

Fish Habitat

1) Provide information on fish habitat compensation measures which are needed to address taking of habitat.
2) Provide design opportunities of say Option C to address habitat taking issues.
3) Actually, it would be opportune to discuss what habitat enhance opportunities could devolve from say option C
4) Provide a new "Recommendations - Section 16.3 – Fish Habitat" section

Marine Uses
We need a section somewhere that addresses marine uses associated with any of the Options, and whether any of them are neutral or enhance such uses. That is, address them to the extent that such issues of impact / enhance can be addressed with present knowledge and lack of precision in providing an outlook for such uses.

Summary of Options – Page 34

1) 'water within the facility will be cleaner that the water already in the harbour" this is highly doubtful. With stormwater runoff TP levels of 200 ug/L and approximately 50 % removal expected in the EOP facility, that amounts to about 100 ug?L expected in the effluent. This permits "green-pea soup' to develop in the EOP facility. Monitoring data from this past summer had detection limit data for the Harbour – less than 20 ug?L TP. Please revise statement
2) Why is Option C so much less money that Option A?

Section 5.4 U V Disinfection Methodology.

The City accepts the commitment to install such as system as necessary to met the SWM criteria and WWF objectives for this site. The City will accept and assume responsibility for operations and maintenance of such a facility, once built and commissioned; we may provide additional evaluation of pages 5.4 in the future, and on how such details should be further developed into a detailed design brief.

Other benefits - Sustainability

A total summary of how the redevelopment of East Bayfront (perhaps as a new section) contributes to 'water infrastructure and habitat based sustainability' would be useful, rather than forcing the reader to attempt to glean the information from the current report Pertinent aspects include:

i) Energy for SWM, - will power produced by site scale developments be feed to the grid amount to a sufficient amount to off-set future power requirements for pumping potable water East Bayfront and for lifting it in high –rise buildings, wastewater lift stations and treatment plant requirements, and any pumping and treatment associated with the stormwater collection / management system

ii) Water Efficiency- reduction in sanitary sewage flow through use of efficient washers, showerheads, etc.'
iii) Reuse of rainwater as substitute for potable water
iv) Fish Habitat enhancement consistent with TWAHRS and RAP delisting targets and any new fishing piers
v) Recreational uses of the waterfront and the associated aquatic resources.

2 Sewer Asset Planning Comments

1) It is not clear whether all future developments, other than the East Bayfront Development, have been included in the sanitary flow analysis? Does East Bayfront include all future developments in the area draining to Scott Street PS?
2) Same comment as (1), when the report says "Full Buildout" of East Bayfront (Section 8.3.1), does it include all future developments or just East Bayfront?
3) The report concluded that there are no overflows at Scott St PS (Section 8.1.2). However, there are several weir overflows upstream. The reason no overflows have been observed at the pumping station could be due to overflows upstream thus relieving the pumping station. Therefore, it may not be totally accurate to say that the SSPS system does not have any overflow problems, especially during major storm events. The Sony Centre next to SSPS had flooding occurred before.
4) Using flow data collected for the June 19, 2007 rain event, the report determined that the extraneous infiltration rate during rain events was 1.19 L/ha/s. The report asserted that this was a "typical" event, therefore this infiltration rate was used as the representative rate for

design. What was the basis of saying that this was a "typical" event? Was it based on statistical analysis of all the rain events? I assume that a bigger event could result in greater than 1.19 L/ha/s, which would make the extraneous flow calculations higher for design. Could a more severe event causing higher extraneous infiltration rates be used?

5) Could they add a column to show the "Projected Year" of the development in Table 8-10 page 86 so that it is more clear on timing:
   - Existing - 2007
   - Corus - 2010
   - Phase 1 - 2015
   - Full Buildout – 2031

(See Development Engineering Comments in support of these questions)

3. Water Asset Planning

The FSP anticipates that the City will take information provided by the consultant, run a model and provide results to be used to finalize recommendations for watermain infrastructure. However, staff expects the consultant to combine their data (actual field tests and preliminary recommendations for proposed infrastructure) with that provided by the City, to run their own modeling exercise and use the results to finalize recommendations for watermain infrastructure. The City can provide a cut-out of the area's existing data to the Consultant and they would need to complete their own minor modeling exercise in conjunction with field testing to see whether their works are suitable.

4. Operations and Maintenance

Operation staff have asked for an optimization of the number of OGS structures, consolidated to fewer larger structures improve the effectiveness of both the performance of the units and the maintenance effort required.

Maintenance manuals are to be provided detailing the expected oil/grit separator cleaning frequency and the expected yearly volume/weight of sediment, as well as the volume/weight of floatables. Detail as well the maintenance area around each unit and the type of equipment required to maintain them. If specialized equipment is required, a maintenance fund will also be required.

With respect to the end of pipe facility provide:

1) Expected dredging frequency and expected volume of accumulated silt before material must be removed.
2) Address how access to each cell of the proposed end-of-pipe stormwater management facility is to be provided
3) Address whether specialized equipment is needed to carry out the cleaning of the stormwater management facility. Who will pay for this equipment?
4) Provide access to the proposed stormwater management facility's pumping equipment and UV treatment facility with equipment
5) Provision of operating manuals for all operations
6) Detail the method to carry out dredging operations, -is the dredging to be carried out from land, or must it be done from lake side?

7) Can material from the stormwater management facility be disposed of further out within the lake or must it be disposed of at a landfill site (on land)
8) Will heavy equipment be able to enter the pond, or must it be supported on a barge.

5. Policy and Asset Management

Figure 7.2 and 7.3, Section 15.0:
Flooding is anticipated under major rainfall events along Lakeshore. Confirm that proposed grading within EBF will not make flooding worse. A proposed full topographic survey should include Lakeshore to confirm its profile and overland flow routing. Reconfirm any opportunities to alleviate flooding on Lakeshore by taking major flows through EBF or otherwise, without adversely affecting existing CSOs or the proposed lake pond, under interim and ultimate conditions.

Appendix 15-A:
Grades on Drawing G1 are missing. Drawing G1 should be expanded to include all of EBF.

6. Development Engineering

The proposed phasing of the development is generally acceptable. It is noted however that Waterfront Toronto assumes the risk of developing in advance of the completion of the various EA studies and any OMB appeals for the zoning. It is also acknowledged that this risk must be mitigated wherever possible.

Development Engineering has been assisting Sewer Asset Management in providing data for the known developments that will be tributary to the Scott Pumping Station. This has helped to provide a measure of expected flows to support the determination of capacity of the plant to accommodate Corus, Phase 1 development and the ultimate East Bayfront Development. The attached chart has been provided to Toronto Water recently and is still being reviewed. It is provided to you in order for you to refine the downstream sewer improvements, to ensure that all known development has been accommodated and not just the East Bayfront Development.

At this time the City is considering proposing physical improvements to the Scott Pumping Station in the near future to coincide with an adjacent development. These would prepare the station for an ultimate expansion without increasing its current capacity. Toronto Water will also initiate the process to prepare the EA Study for the expansion of capacity of the plant.

The City is in the process of preparing standard design guidelines for development. This proposed document is unavailable at this time however the proposal is to establish a set flow per capita determination for new sanitary sewer design. This has been set at the present time as 300 l/cap/day which is notably higher than the 190 l/cap/day and 170l/cap/day contained in the FSP for residential and non-residential flows.

In performing the recommendations for downstream improvements, a sensitivity analysis is to be performed to address comparative sizing for both scenarios. Downstream improvements design will also be required to address proposed location of new sewers, existing connections, utilities and crossings. This will greatly affect sizing as well.

At this point there is no mention as to how the downstream improvements will be funded or whether Waterfront Toronto will facilitate the improvements. It is anticipated that Development Charge funds would be used where the legislation permits it to assist in funding of these improvements.

Parks, Forestry and Recreation cite that City policy prohibits the encumbrance of new parks with infrastructure. While it is thought that the current proposal of Sherbourne Park design may feature the UV treatment, the servicing in the park must be minimized. Any proposed servicing through park property must be approved by Parks Forestry and Receation. However, Toronto Water must also have access and ability to maintain the infrastructure on a regular basis and this may affect the design of the promenade and the park.

Toronto Fire requires fire protection of the dockside and marine activities. Whereas Building Code dictates a certain procedure for building sites, Toronto Fire requires dockside access for fire protection for marine needs and well as secondary support for fires within East Bayfront and for the Redpath refinery across the Jarvis Slip from East Bayfront. Toronto Fire has indicated that hydrants can be provided at approximate 100m intervals in proximity of the promenade. In phase one this would coincide with the public access corridors on private lands. If used for fire needs only, ie no domestic use, fire lines will require check valves to maintain domestic water quality and to minimize maintenance requirements. This willalso require the use of service easements on the private access lands in Phase 1 as well as coordination with and approval from Parks Forestry and Recreation.

Pavement widths for all new City roads and private driveways must conform to the spirit of the DIPS policy especially where access for fire vehicles is being provided.

Detailed comments for issues under Transportation Services purview are not provided in the FSP but are under separate reporting directly to Transportation Services and Transportation Planning. Coordination and timing of the construction of Queens Quay East, the realignment of Lower Sherbourne Street, the treatment of the existing rail spur are all still topics that need to be addressed and are not covered in this document.

Detailed comments under each development phase will be provided as each is presented.

If you have any concerns or questions please contact Greg Horgan.

Yours truly,

DBleg

Doug Bleaney, P. Eng.
Manager, Development Engineering

DB/GPH

Copy to: Toronto Water, Attn: Ted Bowering
Toronto Fire: Attention: Chief Bob Leek
Waterfront Secretariat, Attn: Jayne Naimann,

RECENT AND PROJECTED DEVELOPMENTS DISCHARGING TO THE SCOTT STREET PUMPING STATION

The highest recently recorded flows at the P. S. were on April 22, 2007 (per the East Bayfront Functional Report). Flows were recorded of **340 lps**

The following projects, currently just completed or under construction, will be contributing flows by 2009.

Address	Status	Res Units	Comm (m^2)	Office (m2)	Population (1)	Daily Flow L/d (2)	Average Flow L/s	Peaking Factor (3)	Peak Flow L/s	Notes
18 Yonge Street	Constructed	493	485		991	297,401	3.44			occupied in 2007
33 Bay Street Phase 1	Constructed	900	1,100		1,812	543,630	6.29			occupied in 2007
33 Bay Street Phase 2	Under Construction	900	1,100		1,812	543,630	6.29			Phase 2 2008 - 2012
East Bayfront - Corus *	Under Construction		10,583	34,407	1,252	375,553	4.35			occupancy by 2009
40 The Esplanade	Under Construction	410			820	246,000	2.85			occupancy by 2009
Est. totals from now to the end of 2009		**2,703**	**13,268**	**34,407**	**6,687**	**2,006,214**	**23.22**	**3.13**	**72.58**	
Using our "standard" City values in the calculation above (300 lpcd and Harmon peaking factor) , it would appear that the pumping										
station would be in a surcharged condition. 340 lps + 73 lps = 419 lps										
However, if we utilize the "observed" values found in the East Bayfront Report (240 lpcd generation and a peaking factor of 2.1)										
					6,687	**1,604,880**	**18.58**	**2.10**	**39.01**	
340 lps + 39 lps = 379 lps Still within the capacity of the station.										

Additional developments on the planning horizon.

Address	Status	Res Units	Comm (m^2)	Office (m2)	Population (1)	Daily Flow L/d (2)	Average Flow L/s	Peaking Factor (3)	Peak Flow L/s	Notes
70 The Esplanade	rezoning application	124	4,256		295	88,445	1.02			occ. 2010 - 2012
25 Queens Quay E	rezoning application	1,299			2,598	779,400	9.02			occ. 2010 - 2015
5 The Esplanade	site plan application			19,000	627	188,100	2.18			occ. 2010 - 2011
1 Front St	rezoning application	480		3,685	1,082	324,482	3.76			occ. 2010 - 2011
18 Lower Jarvis	rezoning application	464	2,684		958	287,257	3.32			occ. 2010 - 2012
East Bayfront Phase 1**	planning process	**	**	**	1,634	490,200	5.67			occ. 2010 - 2012
Total for the period 2009 - 2012					**7,193**	**2,157,884**	**24.98**	3.10	77.30	
90 Harbour Street	possible	500			1,000	300,000	3.47			2012 - 2015
Five Parking Lots	possible	2,500			7,000	2,100,000	24.31			2012 - 2020
East Bayfront Phase 2***	planning process	***	***	***	12,896	3,868,800	44.78			2020 - 2025
Total for the period 2012 - 2025					**20,896**	**6,268,800**	**72.56**	**2.63**	**191.07**	

Based on City "standard" values, there is the possibility of an additional 268 lps to be added during the period 2010 - 2025. (77.30 + 191.07 = 268 lps) Under this scenario, flows at the P. S. would be 340 + 268 = 608 lps in 2025.

Using, the "observed" values noted earlier (240 lpcd generation and P.F. of 2.1), this would equate to an additional 164 lps. ((20,896 + 7193) x 240) / (60 x 60 x 24) = 78.02 Then 78.02 x 2.1 = 163.85 Under this scenario, flows at the station would be 340 + 164 = 504 lps in 2025.

Notes:

(1) population is based on occupancy of 2.0 persons per unit
population equivalent: commercial - 1.1 persons/100m2
population equivalent: office - 3.3 persons/100m2
(2) based on 300 lpcd
(3) peaking factor based on Harmon: 1+(14/(4+SQRT(P/1000)))

* Average flows for Corus Building based on City design standards noted above
** Using population and employment projections for Phase 1 from the East Bayfront Functional Servicing Plan
*** Using population and employment projections for Phase 2 from the East Bayfront Functional Servicing Plan

N.B. Several buildings that were shown in the April 14, 2004 summary have been removed from the above list. Their occupancy occurred during the period 2004 - 2006 and their flows are considered to be included in the "observed' flow rate of 340 lps recorded at the pumping station on April 22, 2007

these buildings are:	10 York Street - 3 buildings	1,081 units
	228 - 230 Queens Quay West	517 units
	410 Queens Quay West	273 units

original information prepared by Chris Mills April 14, 2004
updated by Cecil Lindsay April 2, 2008

The
MUNICIPAL
INFRASTRUCTURE
Group

October 6, 2008
Our File: 07135

City of Toronto
Metro Hall, 18th Floor
55 John Street
Toronto, Ontario
M2N 5V7

Attention: Dr. William Snodgrass

Re: East Bayfront Stormwater Management Facility
Preliminary Design Considerations

Dear Dr. Snodgrass,

As you are aware, we are proceeding with the preliminary design of the proposed end-of-pipe stormwater management facility for the East Bayfront redevelopment precinct. This letter is intended to provide additional information and dialogue with respect to questions you have raised through our recent meetings and related discussions.

To recap, the stormwater management strategy for East Bayfront presently contemplates pre-treatment with water quality manholes prior and an end-of-pipe facility that includes a concrete cellular network integrated within the future boardwalk, leading to a wetland element within Parliament Slip. The wetland element then discharges to a UV disinfection facility to reduce the concentration of e.coli to required levels before (eventual) release to the lake. The sizing of the facility considers capture and treatment for events up to and including the 25mm (first flush) event, as well as a fluctuating depth within the facility governed by existing lake levels and upstream hydraulic gradeline constraints. Preliminary sizing has yielded a facility footprint requirement of 0.85 ha (8,500 m^2), to be refined through detailed design.

1. Operations and maintenance

Our design efforts include considerable attention to both the short and long-term/life-cycle operational and maintenance (O+M) characteristics of the facility, yielding incorporation of O+M features in the design, within our understanding of the City's requirements. As part of this effort, preparation of an Operations and Maintenance report for the facility is being undertaken in parallel with the design process, which will also document O+M requirements associated with the proposed oil-grit separators and UV disinfection system. The figure on the following page lists the table of contents presently contemplated for the O+M report.

In brief, we have commenced with an evaluation of the following facility O+M considerations:

- Assessment of the rate of anticipated sediment accumulation, with consideration for the Wet Weather Flow particle size distribution, accumulation rates provided by MOE, and evaluation of settling velocities and distances.
- Provision and evaluation of 'deliberate' sediment accumulation areas, which include all flow or velocity transitions such as inlets, corners, and piped segments (where CSO's are to be traversed, etc).
- Provision and evaluation of mechanisms needed for access to sediment accumulation areas, to facilitate cleanout. Elements of this evaluation include the need for vehicular access, maintenance hatches, and potentially pipe leads connected to junction box headers.
- Identification of maintenance schedules and triggers guiding both periodic visual inspections and facility cleanouts.

We acknowledge that input from City staff is both desirable and necessary to ensure that the maintenance requirements of the facility are reasonable and realistic. To this end, we would like to arrange a meeting at your earliest convenience to delve further into the details of the facility and associated O+M characteristics.

2. Geometry

As described previously, a portion of the facility is proposed to integrate with the future boardwalk along the frontage of East Bayfront on Lake Ontario. We understand that there is concern over this long, narrow configuration due to potential challenges associated with maintenance and cleanout. However, we are confident that our efforts to incorporate operations and maintenance (O+M) features in the design of the facility, as described above, will address this concern.

Furthermore, we are of the opinion that the multiple objectives to be realized through the integration of the SWM facility with the boardwalk, treatment of storm runoff, structural support of the proposed boardwalk, and reduction in the extent of required dockwall repairs, yield a community feature that is consistent with both Waterfront Toronto’s Sustainability Framework and the Central Waterfront Master Plan, and therefore worth pursuing.

O+M TABLE OF CONTENTS

3. Salt

Given the use of salt within the community to ensure road safety in winter conditions, the potential exists for dissolved salt to accumulate and stratify within the facility. This stratification, yielding a brackish water layer near the bottom, can encourage anaerobic biological processes that generate foul odour as a by-product. Our research efforts have yielded the following general observations:

- The application of road salt for winter accident prevention serves as the primary anthropogenic source of chloride to the environment. Road salt is considered to be a toxic substance in Canada under the Canadian Environmental Protection Act (CEPA). However, while Environment Canada has acknowledged the environmental implications of road salt usage, emphasis has been placed on the management of salt usage to minimize quantities while maintaining the safety of the public.
- Discussion with Mr. Peter Noehammer, Director of Transportation for the City of Toronto, revealed that the City is presently managing salt applications, and is making efforts to improve their salt management processes through on-going studies at both the University of Guelph and the Canadian Centre for Inland Waters (CCIW). Notwithstanding these efforts, the application of salt is still required to maintain road safety during the winter.
- CCIW is also participating with the Town of Richmond Hill on a 2-year monitoring study of a pilot salt management system. Mr. John Nemeth, Manager of Water Resources at the Town, provided an overview and tour of the system, which consists of a large flat parking area to which snow clearing vehicles deposit collected snow. The area has ditch inlets that convey runoff to a water quality manhole, which then discharges to a stormwater wetland. Due to slow melt conditions and subsequently low velocities, it has been observed that much of the debris and salt remain on the parking lot, and the receiving water quality manhole traps much of the finer materials with inherent salt content. The visible health of the receiving wetland suggests that the system is thus far effective; the salt concentration within the wetland is below the threshold that results in adverse impacts to vegetation. It could be expected that the SWM plan for East Bayfront could yield a similar benefit with respect to the health of the proposed Parliament Slip wetland.

- Dr. Bahram Gharabaghi of the University of Guelph is working with the City of Toronto to investigate the effectiveness of a 'treatment tank' for salt-laden runoff. In brief, it is expected that the salt-laden runoff will stratify within the tank, allowing for removal of the majority of salt content prior to discharge downstream.
- Other research indicates that chloride-rich water can adversely impact aquatic organisms, roadside vegetation, and wetland plants. In addition, increased salt concentrations in lakes can lead to stratification that retards or prevents the seasonal mixing of water, thereby affecting the distribution of oxygen and nutrients. An increase in the level of the Cl- ion has also been noted to have a dramatic effect on the heavy metal bio-availability of sediment within a detention pond. In other words, high salt content may affect sediment transport and the capacity of settled sediments to adhere to pollutants.
- A study of three wet ponds in Canada, namely the Heritage Estates Wet Pond, the Harding Park Wet Extended Detention Pond with Wetland, and the Rouge River Wet Extended Detention Pond, indicated that the SWM Pond has little effect on the control of chloride levels. Winter chloride inputs continued to have a strong influence on the ponds during the summer months. There was evidence of gradual accumulation of chlorides in the bottom of the permanent pool over time, and a strong chemical stratification was caused by a dense layer of chloride-rich water that entered the pond in the winter and persisted at the bottom of the pond throughout the summer months. During summer, the salt concentration also increased with reduced precipitation and increasing air temperature.
- Our investigations have indicated that the primary concern with road salt is the discharge of chloride-rich water into the natural stream system; stratification of the salt layer, leading to odour issues, does not appear to be the prevalent concern. Furthermore, there is no economical way to remove applied roadway salt from the resulting runoff.
- Nevertheless, we are presently reviewing facility features that could counter the potential for stratification due to salt accumulation. Measures that would encourage 'mixing' of the stratified layers will also undermine the intended function of the facility to settle out particulate matter. As such, we are currently exploring methods that would allow for periodic draw from the bottom of the facility into the sanitary sewage system, to remove the salt-laden water. We will continue to consult with you on this matter as the design progresses.

4. Expansion potential of facility service area

Our review of the potential to expand the treatment area of the proposed East Bayfront stormwater management facility to service additional waterfront redevelopment areas, with respect to technical feasibility, has been documented in a memo to Waterfront Toronto. Our review generally concludes that, from a functional perspective, the UV component of the facility can be shared to treat a larger service area, but use of the storage component of the facility to service a larger area poses significant challenges, including:

- Challenges with respect to gravity drainage of runoff from the external area to East Bayfront, particularly with respect to the crossing of existing infrastructure. Pumping runoff would require some form of attenuation (and hence storage) local to the external area.
- Implications to the hydraulic gradeline, potentially increasing the frequency and/or severity of nuisance flooding within the community.
- Further compromise of the public realm vision for the community.

The potential for facility service area expansion, within the context of public realm considerations, will be reviewed in a separate memo by the public realm consultant (West 8 + DTAH), and encapsulated along with our technical memo in a letter from Waterfront Toronto to the City.

5. Aquatic habitat compensation and rehabilitation

As you are aware, our design process includes consultation with Aquatic Habitat Toronto (formerly TWAHRS), to ensure that the aquatic habitat losses that are expected to result from installation of the facility will be compensated. More specifically, we are presently working with TRCA and DFO to assess the anticipated compensation requirements based on the current facility configuration.

In addition, the design is to incorporate features that will supplement and improve existing aquatic habitat in the area surrounding the facility. Some of the features currently being contemplated include:

- The placement of rock rubble along the outer wall of the facility/boardwalk to increase habitat diversity and provide spaces in which fish can find food and hide from predators
- Submerged planting pods within Parliament Slip
- Plantings within the wetland component of the facility to promote phytoremediation and encourage 'contributing' fish habitat

As with the compensation, Aquatic Habitat Toronto will be consulted for input to the design of these features.

We trust that the foregoing addresses your immediate concerns, such that we may proceed with our preliminary design of the facility in its present form. We look forward to continuing our collaboration with you on the design of this new and innovative approach to treating storm runoff. Please contact me if you have any questions or further input.

Sincerely,
THE MUNICIPAL INFRASTRUCTURE GROUP LTD.

David F. Ashfield, P.Eng.
Principal

The
MUNICIPAL
INFRASTRUCTURE
Group

memorandum

DATE: September 29, 2008
OUR FILE: 07135
TO: Antonio Medeiros, Waterfront Toronto
CC:
FROM: Abe Khademi
SUBJECT: East Bayfront – Evaluation of Stormwater Management System to Accommodate External Areas

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Tony,

Further to our meeting with representatives of the City on August 5, 2008, we have evaluated the proposed stormwater management strategy for East Bayfront with respect to expansion opportunities to provide runoff treatment for other adjacent waterfront redevelopment areas, specifically lands to the east identified as the West Don lands. The evaluation considers the implications to the proposed end-of-pipe stormwater management facility if the existing East Bayfront treatment area of about 25 ha was increased to 50ha to accommodate this external area.

To recap, the stormwater management strategy for East Bayfront presently contemplates an end-of-pipe facility that includes a concrete cellular network integrated within the future boardwalk, leading to a wetland element within Parliament Slip. The wetland element then discharges to a UV disinfection facility to reduce the concentration of e.coli to required levels before (eventual) release to the lake. The sizing of the facility considers a number of factors:

- Capture and treatment for events up to and including the 25mm event – this represents the ‘first flush’, which contains most of the particulate matter and contaminants;
- The active volume within the facility was further assessed through continuous simulation using available precipitation data to ensure that overflows from the facility would, on average, be less frequent than once every two years;
- The fluctuating active depth within the facility, during storm events, limited to a maximum of 0.5 metres, which is governed by the existing average lake level as well as upstream hydraulic gradeline constraints within the community;

The investigations associated with the above considerations yielded a facility footprint requirement of 0.85 ha (8,500 m^2), to be refined through detailed design. The evaluation of expansion potential included review of a series of considerations, as described in the following bullets:

- Based on review of preliminary topographic information from the City of Toronto, gravity drainage of the West Don Lands to the East Bayfront is possible. However, gravity drainage is only achievable to minimum (2.0m) cover at Cherry and Lakeshore. Drainage from the West Don lands would have to be pumped under the railway to this area for gravity drainage. At minimum cover, there is potential for the storm sewer to interfere with existing utilities at this location, most notably the existing Hydro One oil filled transmission conduit under Lakeshore, which cannot be moved at a reasonable cost. There is also a large CSO at Small Street, suspected to be founded on wooden piles in an area of potential coal tar contamination. Expansion to the larger service area may require a storm sewer that traverses under this CSO. Depending on the alignment selected for the sewer, the conveyance of runoff from the West Don lands to East Bayfront would also need to consider the future configuration of the Parliament Street Slip, implications associated with the potential removal of the Gardiner Expressway, and the findings of the TTC EA for the Queens Quay right-of-way. Generally, these challenges suggest that some degree of equalization/attenuation would be required within the West Don lands prior to conveyance to East Bayfront.

- The current volumetric requirement for the facility is based on capture and treatment of the 25mm event. For the East Bayfront lands, this equates to an 'active' volume requirement of about 5,000 m^3. This value was confirmed through continuous simulation to ensure that facility overflows would occur less than once every two years. By doubling the treatment area to 50 ha, the frequency of direct discharge of storm runoff to the lake would increase, and the water conveyed to the UV treatment system might not have the required clarity for effective disinfection. As a result, expansion of the treatment area without modifying the stormwater management system is not recommended.
- For the expanded area (including East Bayfront) of 50 ha, the active volume requirement increases by 5,000 m^3, which could be accommodated by increasing the allowable depth of fluctuation. However, we have noted that the allowable depth of fluctuation is governed by the combination of existing lake levels and the upstream hydraulic gradeline limitations. Allowing for an increased depth of fluctuation would require compromise with respect to the extent of 'nuisance' flooding to be observed within the community.
- Any other modification to the configuration of the facility to accommodate the additional area has implications with respect to the Public Realm design.
- An alternative approach could have the external area independently provide the storage component of the treatment system, which could then convey pre-treated runoff to the East Bayfront UV system and receiving Sherbourne Park water features. This approach may be desirable from the perspective of having additional sources of treated runoff for the proposed water features within Sherbourne Park.
- If the storage component of the treatment system for the external area is provided independent of the East Bayfront facility, the volumetric requirements could be established on a similar basis. For a 25 ha treatment area, this would yield an active storage requirement of about 5,000 m^3, along with a permanent pool of about 5,000 m^3. The permanent pool portion would inherently be satisfied by an 'in-lake' solution as proposed for East Bayfront.

Appendix 5b

Research on Similar Facilities

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Inactivation of indigenous coliform bacteria in unfiltered surface water by ultraviolet light

*Raymond E. Cantwell, Ron Hofmann**

Department of Civil Engineering, University of Toronto, 35 St. George Street, Toronto, Ontario, Canada M5S 1A4

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ABSTRACT

This study examined the potential for naturally occurring particles to protect indigenous coliform from ultraviolet (UV) disinfection in four surface waters. Tailing in the UV dose–response curve of the bacteria was observed in 3 of the 4 water samples after 1.3–2.6-log of log-linear inactivation, implying particle-related protection. The impact of particles was confirmed by comparing coliform UV inactivation data for parallel filtered (11 μm pore-size nylon filters) and unfiltered surface water. In samples from the Grand River (UVT: 65%/cm; 5.4 nephelometric turbidity units (NTU)) and the Rideau Canal (UVT: 60%/cm; 0.84 NTU), a limit of ~2.5 log inactivation was achieved in the unfiltered samples for a UV dose of 20 mJ/cm^2 while both the filtered samples exhibited >3.4-log inactivation of indigenous coliform bacteria. The results suggest that particles as small as 11 μm, naturally found in surface water with low turbidity (<3 NTU), are able to harbor indigenous coliform bacteria and offer protection from low-pressure UV light.

1. Introduction

In surface waters, there is evidence that microorganisms such as *Cryptosporidium*, *Escherichia coli*, coliforms, and aerobic spores are routinely attached to the surface of particles or embedded within (Medema et al., 1998; Grimes, 1975; Borst and Selvakumar, 2003). When such water is treated in a drinking water treatment plant (WTP) employing ultraviolet (UV) disinfection, there is a concern that the organisms could survive by being shielded from the UV light. Many jurisdictions accordingly recommend that UV be applied after filtration. There are instances, however, when surface waters may be permitted to be treated by UV without filtration. So-called "filtration exclusion" or "filter avoidance" criteria exist in Canada and the USA and permit waters of high quality (often turbidity <1 nephelometric turbidity units (NTU)) to be treated solely by disinfection (USEPA, 2006; Health Canada, 2003). These rules generally predate the recent widespread growth in UV disinfection and therefore may not be appropriate in the context of UV, particularly given that the presence of particles is often not well correlated with turbidity (Brazos and O'Connor, 1996; Bridgeman et al., 2002). Even in filtered waters there is the potential for particles to be present. Particles in the 7–10 μm size range—large enough to potentially harbor pathogens—routinely pass through media filtration during filter operation (O'Melia and Shin, 2001; Huck et al., 2002), and in practice filters are sometimes operated under upset conditions where particle breakthrough may occur more regularly. There is therefore a need to understand the ability of UV to disinfect waters containing particles during drinking water treatment.

Previous research has tried to simulate the effectiveness of UV when treating water containing particles by seeding microorganisms into particle-laden water (e.g. Batch et al., 2004; Amoah et al., 2005; Passantino et al., 2004). These studies demonstrate that particles have little impact on UV effectiveness at turbidities ranging as high as 12 NTU. However, seeded microorganisms do not necessarily associate

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*Corresponding author. Tel.: +1 416 946 7508; fax: +1 416 978 3674.
E-mail address: hofmann@ecf.utoronto.ca (R. Hofmann).

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with particles in the same way as indigenous microorganisms in the environment, which may enter the environment already embedded within particulate matter, or may become more deeply entrained within particles over time.

Recent research by Carson et al. (2007) focused on exploring UV inactivation kinetics of organisms under more natural conditions by applying UV to raw water samples exhibiting a range of particle content, and monitoring the inactivation of indigenous aerobic spores. The results indicated that the UV dose required for 2-log inactivation of the spores was correlated to the concentration of particles greater than 8 μm in diameter. This work expanded on similar wastewater research where experiments demonstrated that coliform bacteria in secondary effluent were routinely protected from UV by particles greater than 7 μm in diameter, which is slightly larger than the typical 1–6 μm size of the coliforms (Emerick et al., 2000; Jolis et al., 2001).

Such previous research illustrates the potential for particles to shield microorganisms from UV disinfection during drinking water treatment; however, there is a need to provide more information on the inactivation of actual indigenous microorganisms in real waters containing particles to illustrate the potential under more representative conditions. The overall goal of this research was therefore to build on the previous work by undertaking a case study of four unfiltered surface waters to explore the possible protection of microorganisms by particles. Ideally, organisms such as *Cryptosporidium* would have been monitored given their relevance to UV treatment, however, the typically very low indigenous concentrations of *Cryptosporidium* and similar pathogens coupled with limitations in enumeration techniques would prevent such an approach. Instead, the study focused on the inactivation of indigenous coliforms under different conditions to explore evidence of particle protection. Coliform bacteria are an appropriate surrogate since, like *Cryptosporidium* and *Giardia*, they are sensitive to UV disinfection: 3-log inactivation of cultured coliform bacteria is achieved with UV doses as low as 4–9.6 mJ/cm^2 (Hijnen et al., 2006). Coliform bacteria are also the same order of magnitude in size as *Cryptosporidium* and *Giardia*, which range from 4 to 6 μm (Percival et al., 2004), and may therefore experience the same degree of protection from particles.

2. Materials and methods

2.1. Description of waters considered

Unfiltered surface water was collected from the intake of four drinking water treatment facilities between May and August 2006, all with an indigenous total coliform count of 100 CFU/100 mL or greater. Samples were obtained from the Grand River (Mannheim WTP), the Otonabee River (Peterborough WTP), the Rideau River (Smiths Falls WTP), and the St. Lawrence River (Cornwall WTP) in Ontario, Canada. Table 1 summarizes typical water quality parameters of the water samples. The turbidity ranged from 0.79 to 2.9 NTU and TOC from 2.6 to 7.3 mg/L. The UV transmittance at 254 nm ranged from 60% to 96%/cm.

Samples were collected, chilled on ice, and shipped overnight to the laboratory. All samples were collected in clean containers and stored in the dark prior to the experiments, which were initiated within 24 h of sampling.

2.2. Description of flow-through UV apparatus

UV light was applied to the water samples in the laboratory using a flow-though low-pressure UV apparatus. This system allowed large volumes of water to be treated so that several logs of inactivation of indigenous coliform bacteria could be measured. The apparatus (Suntec Environmental, Concord, ON) contained a narrow quartz tube (I.D. 7 mm, O.D. 10 mm) surrounded by four low-pressure mercury lamps (Light Sources Inc., Orange, CT) that were suspended parallel to the quartz tube. A vertical lamp distance of 11 cm from the quartz tube was selected to minimize any non-linear effect reported to occur due to quartz tube shading at distances <10 cm (Dykstra et al., 2002). The sample was propelled through the bench-scale apparatus (tubing, static mixer, reactor, and tubing) using a variable speed peristaltic pump set at a constant flow rate of 130 ± 4 mL/min. The UV dose was controlled by adjusting the length of shading of the quartz tube. The amount of shading was adjusted between each exposure to allow the effective reactor length to be controlled. Typical reactor lengths were 0, 2, 4, 6, 8, 10, 15, and 20 cm.

Table 1 – Typical water quality parameters for flow-through trials

Source water[a]	pH	Turbidity (NTU)	TOC (mg/L)	TSS (mg/L)	UVT (%/cm)	Total coliforms (CFU/100 mL)	*E. coli* (CFU/100 mL)
Grand River	8.2	2.9	6.1	5.0	60.8	5200	820
Rideau Canal	7.7	0.84	7.3	1.2	60.1	380	1–5
Otonabee River	7.8	0.79	5.1	0.67	72.1	2000	7
St. Lawrence River	8.4	0.85	2.6	0.77	93.3	360	9
E. coli in distilled water	7.0	0.11	0.3	<0.1	98.0	550	550

[a] Measurements performed on day of experiments.

The UV dose was proportional to the reactor length with a proportionality constant of ~2 mJ/cm^2 per cm of exposed quartz tube. A static in-line six-element mixer (Koflo Corporation, Carey, IL) was placed immediately upstream of the inlet of the quartz tube to ensure sample mixing and prevent a jet effect from changes in tubing diameter. Using an identical flow-through UV apparatus, Dykstra et al., (2002) reported near plug flow conditions and a mean residence time of 190 s for a sample flow rate of 130 mL/min. The flow-through reactor is described in greater detail by Dykstra et al. (2002).

The UV dose and dose distribution delivered by the flow-through UV reactor was determined through the measured inactivation of MS2 and *E. coli* with known inactivation kinetics obtained in each water matrix using a low-pressure UV collimated beam test, following methods described by Bolton and Linden (2003). In calculating the UV doses in the collimated beam tests, the UV transmittance of the water was measured using a CE3055 spectrophotometer (Cecil Instruments Ltd., Cambridge, UK) equipped with a fixed 11° centre-mounted integrating sphere accessory (Labsphere, North Sutton, NH). Integrating sphere UV transmittance measurements were necessary due to scatter of light from the particles in the unfiltered surface water, which would interfere with normal spectrophotometric measurements of UV transmittance.

2.3. *Analytical methods*

Turbidity was measured in NTU using a Hach 2100N turbidimeter (Hach Company, Loveland, CO). The sample pH was measured with a VWR pH meter Model 8015 (VWR, Mississauga, ON). Total organic carbon (TOC) measurement was performed according to standard method 5310-D (APHA et al., 2005) using an O-I Corporation Model 1010 TOC analyzer (College Station, TX) calibrated with a potassium phthalate solution. Total suspended solids (TSS) measurements were made according to standard methods 2540-D (APHA et al., 2005) using 47 mm diameter GF/C glass-fibre filters (Whatman International Ltd., UK). Particle size distribution was measured by a Multisizer 3 particle analyzer (Beckman Coulter Canada, Mississauga, ON), using a 0.9% sodium chloride solution prepared in Milli-Q® water. The Multisizer 3 was fitted with a tube with an aperture of 280 μm in diameter, with a size detection limit of 2 μm (~2% of aperture size).

2.4. *Microbial methods*

Total coliforms and *E. coli* in all samples were enumerated according to Method 1604 (USEPA, 2002) by membrane filtration using nitrocellulose 0.45 μm pore-size filters with absorbent pads (Fisher Scientific, Pittsburgh, PA) with MI broth as a growth medium. Colonies were enumerated under ambient and long wave UV light (365 nm). Because the MI broth is highly selective and differential, *E. coli* colonies can be counted on plates with heavy particulates or high concentrations of total bacteria (USEPA, 2002). This means the sample volume need not be restricted to the normal 100 mL. Typical and atypical coliform colonies were confirmed using brilliant green lactose bile (2%) broth and Lauryl tryptose broth according to standard method 9222-B (APHA et al., 2005).

In general, surface water sample volumes for coliform enumeration were limited to 400 mL to avoid any negative impact of particles on coliform colony growth. Excessive solid material on the filter paper has been reported to hinder colony formation with other growth media (e.g. m-endo media (USEPA, 2002)). There was no indication that particulate matter on the filters reduced the colony count (e.g. the 500 mL plates typically had 5 times the number of colonies found on the 100 mL plates). In samples with low solids content (i.e. <1.2 mg/L TSS) larger sample volumes up to 1000 mL were passed through the filters.

The methods used to grow and enumerate coliphage MS2 and the host *E. coli* have been described elsewhere (Templeton et al., 2006a).

3. Results and discussion

3.1. *Biovalidation of the flow-through UV reactor*

Prior to beginning the experiments, the UV dose delivered by the flow-through reactor for different reactor lengths needed to be determined (reactor length was varied to adjust the dose). UV doses were obtained by measuring the inactivation of MS2 across the system, and then calculating the reduction equivalent dose (RED) using the known dose-response of that strain of MS2 based on collimated beam tests. Typical MS2 dose–response data and the correlation between flow-through reactor length and log inactivation of MS2 are presented in Figs. 1 and 2, respectively. The resulting correlations between reactor length and MS2 RED for each of the water matrices are presented in Fig. 3.

An MS2 challenge of a flow-through reactor does not provide any information on the UV dose distribution of that reactor; a complex phenomenon that is described elsewhere (e.g. Lin and Blatchley, 2001) but must be considered when interpreting the results of UV inactivation tests in reactors with non-ideal hydraulics. It is desirable to have a narrow dose distribution, meaning that all organisms traveling through the reactor receive the same dose. In this work, the

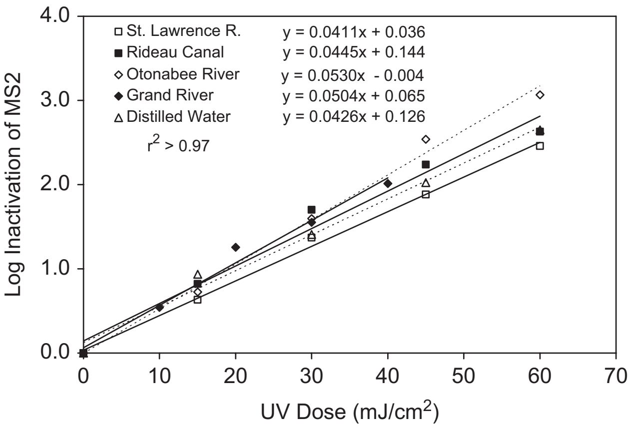

Fig. 1 – MS2 dose–response curves for each sample water.

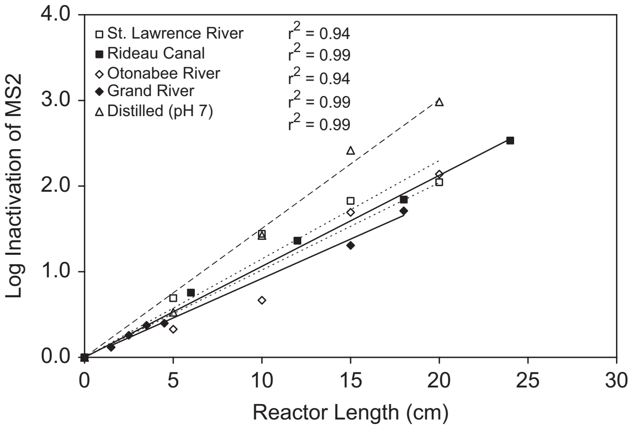

Fig. 2 – Correlation between log inactivation of MS2 phage and flow-through UV reactor length for each water sample.

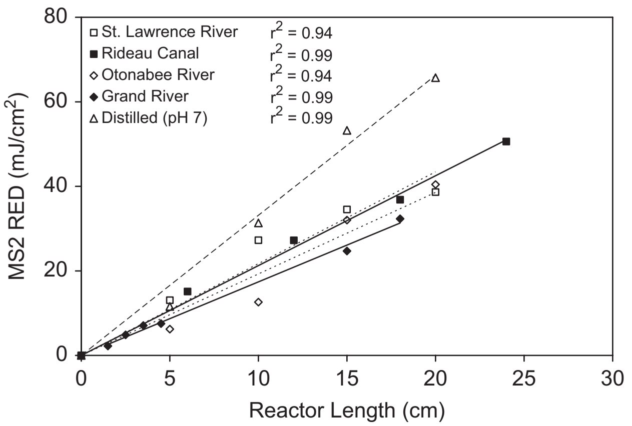

Fig. 3 – Correlation between flow-through UV reactor length and MS2 reduction equivalent dose (MS2 RED) for each water sample. Correlation based on log reduction of MS2 phage at specific reactor lengths in each water matrix.

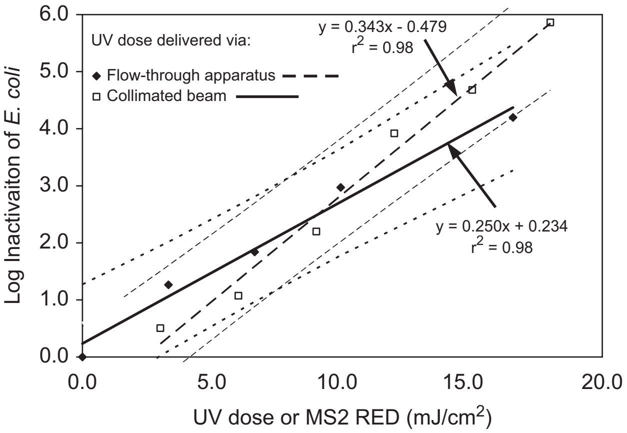

Fig. 4 – Log inactivation of *E. coli* (ATCC® 15597) in distilled water (pH 7) by low-pressure UV light with a collimated beam (UV dose) and with the flow-through UV apparatus (MS2 RED). Dashed lines represent 95% confidence level for the slopes.

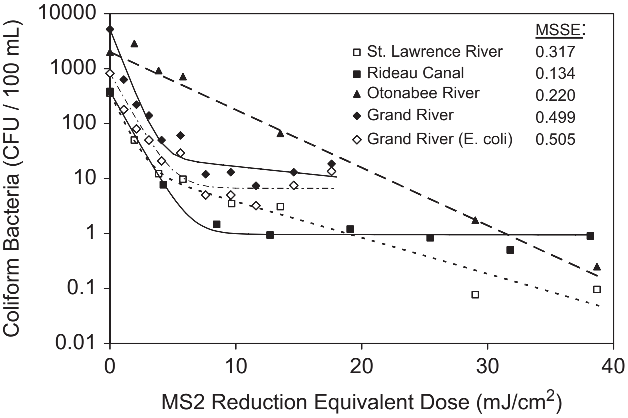

Fig. 5 – UV inactivation kinetics of indigenous coliform bacteria in unfiltered surface water model with the double-exponential model.

dose distribution was semi-quantitatively evaluated by determining two dose–response curves for *E. coli.* (ATCC 15997): one using the collimated beam and the other using the flow-through reactor with the dose expressed in terms of MS2 RED. In brief, if the two dose–response curves are drawn on the same figure and overlap (Fig. 4), then the reactor has a narrow dose distribution. The data in Fig. 4 show that the two curves overlap reasonably well, with slopes that cannot be statistically differentiated. It was therefore concluded that the reactor had a reasonably good "narrow" dose distribution, removing a potential confounding factor from interpretation of the subsequent experimental results.

3.2. *UV inactivation kinetics*

The inactivation of indigenous coliform in the four surface waters using low-pressure UV light (254 nm) is shown in Fig. 5. Significant tailing was observed in three of the four waters, with UV doses beyond approximately 10 mJ/cm^2 yielding no further coliform inactivation. Such tailing is consistent with particle protection, although other factors may also be contributing (discussed later). Interestingly, the turbidities in the three waters exhibiting tailing were 0.84, 0.85, and 2.9 NTU (Table 1), demonstrating that low turbidity waters can experience difficulty being disinfected with UV under certain conditions.

Also shown in Fig. 5 is the inactivation curve for *E. coli* in the Grand River (the other water sources did not contain sufficiently high *E. coli* concentrations to allow reporting). The *E. coli* curve shows a tailing effect that is very consistent with the tailing in the total coliform from the same river. This suggests that the tailing phenomenon observed for highly mixed populations (coliforms) may also be observed for less mixed populations (*E. coli*).

To allow for a quantitative assessment of the inactivation curves in Fig. 5, the data were fit to a double-exponential tailing model (Farnood, 2004). The equation is mathematically expressed as

$$N = N_0((1-\beta)e^{-k_1 D} + \beta\, e^{-k_2 D}), \qquad (1)$$

where N_0 is the initial concentration of the target microorganism (CFU/100 mL), D is UV dose in mJ/cm^2, β is the

Table 2 – Parameters of double-exponential model for coliform inactivation

	Source	k_1 (cm^2/mJ)	$-\log(\beta)$	k_2 (cm^2/mJ)
This study	Grand River	1.34	2.3	0.055
	Rideau Canal	0.93	2.6	0.001
	Otonabee River	0.24	–	–
	E. coli in distilled water	0.58[a]	–	–
	St. Lawrence River	1.16	1.3	0.151
Wastewater	Cantwell (2007)	0.30–65	2.5–3.1	0.022–0.050
	Loge et al. (2001)	0.55	–	–
	Emerick et al. (2000)	0.54	–	–
	Andreadakis et al. (1999)	0.11–0.33	–	–

[a] $\beta = 0$; $k_2 = 0$.

fraction of UV-resistant organisms (e.g. particle-associated microorganisms), and k_1 and k_2 are the UV inactivation constants for the non-resistant and resistant fractions of organisms, respectively, with units of cm^2/mJ. The values for the parameters obtained from the data are shown in Table 2, and were solved simultaneously by minimizing the sum of squares error (MSSE) between the log of the model and the log of the data, using the solver feature of Microsoft Excel. The parameters were constrained to positive values with $k_1 > k_2$.

The model was used to analyze the data in two ways: first, the first-order UV inactivation rate constant (k_1, the initial straight-line slopes in Fig. 5) was compared among the waters tested to determine if there were significant differences in the populations of coliform bacteria in the different waters. Second, the presence of tailing in the inactivation curves (i.e. $\beta > 0$) was evaluated, which is a potential indicator of particle protection.

3.2.1. *Comparison of inactivation rate constants*

The UV inactivation rate constants for the log-linear region of the UV inactivation curves are presented in Table 2. For comparison, similar constants from the literature for total coliform in wastewater are also provided. The results indicate that the coliform bacteria in the surface waters from this study tended to be more UV sensitive (0.24–1.34 cm^2/mJ) than coliforms in wastewater secondary effluent (0.11–0.55 cm^2/mJ) (Andreadakis et al., 1999; Loge et al., 2001). Interestingly, the greatest inactivation rate constant, k_1, was found for indigenous coliform bacteria in the Grand River (1.34 cm^2/mJ), which also had the highest initial concentration of coliform bacteria (CFU). A similar relationship between initial microbial concentration and inactivation rate constants has been reported for chemical disinfectants (Haas and Kaymak, 2003).

The coliform bacteria indigenous to the Otonabee River ($k_1 = 0.24$ cm^2/mJ) were approximately 4 times more UV resistant than the other coliform bacteria ($k_1 = 0.93$–1.34 cm^2/mJ). This degree of resistance to UV light is not common for coliforms. One hypothesis for the increased resistance to UV light is organic coating of the organisms. Templeton et al. (2006b) and Cantwell et al. (2008) have shown that humic matter can interact with the surface of certain viruses and bacteria to reduce their susceptibility to UV light. The Otonabee River sample had the highest organic content of all the surface waters considered (7.3 mg/L TOC) and the lowest UVT$_{254}$ (60%/cm). It is hypothesized that the dissolved organics may have offered protection to the coliform bacteria independent of the presence of particles, as indicated by the high value for k_1 in this water.

3.2.2. *Fraction of UV-resistant microorganisms*

The fraction of UV-resistant microorganisms, β, was calculated as part of the kinetic model and is listed in Table 2 for each data set. The value of $-\log(\beta)$ provides an indication of the point at which tailing is observed on the inactivation curve. It is theorized that tailing may be due to the presence of particles that entrain and protect microorganisms. Such tailing was present in the water samples collected from the Rideau Canal, the Grand River, and the St. Lawrence River, but not from the Otonabee River (Fig. 5). Interestingly, the tailing in the UV inactivation curves for both the Rideau Canal and the Grand River samples was observed at roughly 2.5-log inactivation. In other words, for each of these waters about 99.7% of the colony-forming units was log-linearly inactivated with incremental increases in UV dose. The remaining CFUs (~0.3% of initial number of CFUs) in the tailing region were at least 20 times more UV resistant. These results are consistent with the results reported for the inactivation of coliform bacteria by UV light in wastewater secondary effluent in which approximately 2–3 log inactivation was observed prior to tailing in the dose–response curve (Emerick et al., 2000).

Tailing does not immediately imply protection from UV, but can also be due to heterogeneity of the target organism population, poor dose distribution, or aggregation of the target organism (Cerf, 1977). Heterogeneity is expected for coliform bacteria but sub-populations of coliforms are not expected to be highly UV resistant and therefore it is argued that this is not a suitable explanation for the significant survival in Fig. 5. Poor dose distribution is not believed to be a factor as shown by the *E. coli* reactor control tests that confirmed a narrow dose distribution, summarized in Fig. 4. Aggregation of microorganisms, wherein the organisms themselves group together, may negatively impact UV disinfection kinetics (Craik and Uvbiama, 2005; Bohrerova and Linden, 2006), however, the impact of aggregation is

Table 3 – Typical water quality parameters for raw water used in filtration trials

Source water	pH	Turbidity (NTU)	TOC (mg/L)	TSS (mg/L)	UVT (%/cm)
Grand River	8.3	5.4	5.8	4.3	65.3
Rideau Canal	7.7	0.84	7.3	1.2	60.1
St. Lawrence River	8.2	1.7	2.7	2.3	96.4

considered in concert with particle association for the purposes of this study. Both particulate material and microorganisms can absorb UV light (Loge et al., 1999; Cantwell, 2007; Jagger, 1967) so the distinction is not helpful in this discussion. Both are considered to represent "particle-related" shielding.

3.3. *Confirmation of particle-related shielding*

To confirm the impact of particles on the UV inactivation kinetics of the indigenous coliform bacteria, subsequent inactivation trials were conducted to compare the inactivation of coliforms in unfiltered and filtered water sampled from the Rideau, Grand, and St. Lawrence rivers. The raw source water was passed through 11 μm filters that were shown to remove in excess of 92% of all particles greater than 11 μm, measured using a Multisizer 3 particle counter. The final water quality for the samples is given in Table 3. The rationale for this test was that filtration with an 11 μm filter should remove all coliform bacteria that are entrained within larger particles, so that all coliforms in the filtered water are presumably not associated with particles. The inactivation kinetics of these "free-floating" coliforms can then be compared with the kinetics of the same coliforms in the water containing particles, so that any differences in the inactivation kinetics can be confidently attributed to the particles. For these tests, both the original and the filtered water samples were exposed to UV light at doses of 5, 10, and 20 mJ/cm^2 in the collimated beam apparatus, modified to allow 250 mL volumes of water to be exposed in 100 mm diameter, 50 mm high Petri dishes.

For UV doses of 5 and 10 mJ/cm^2, there was no statistically significant difference in the log inactivation of total coliform between the filtered and unfiltered samples, with inactivations reaching approximately 2–2.5 log at the 10 mJ/cm^2 doses (Fig. 6). With the UV dose increasing to 20 mJ/cm^2, the Grand River and Rideau Canal samples showed much greater inactivation in the filtered samples than in the unfiltered samples (no conclusions could be drawn from the St. Lawrence River sample: too few coliforms survived to permit enumeration). In other words, this test confirmed that the majority of coliforms that survived the UV exposure at 20 mJ/cm^2 were associated with particles >11 μm in size. The observation that there was no difference between filtered and unfiltered waters for the lower UV doses might be explained if only a small percentage (e.g. $<1\%$) of the coliforms were particle associated. At low UV doses, inactivation to 1- or 2-log would be controlled by free-floating bacteria in both the filtered and unfiltered samples, so the kinetics would be almost identical. It would only be when the number of particle-protected bacteria started to become numerically significant compared with the number of free-floating bacteria that differences would start to be seen. For the Grand and Rideau samples, this difference appeared to occur once approximately 99–99.7% (2–2.5-log) inactivation of the coliforms had been achieved.

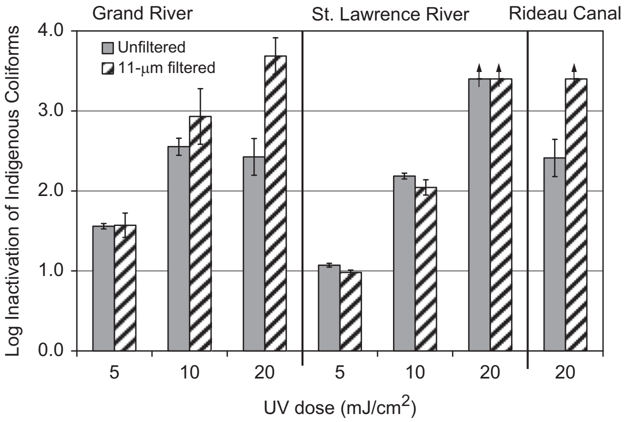

Fig. 6 – Log inactivation of indigenous coliform bacteria by UV light for filtered and unfiltered samples from the Rideau Canal. The initial coliform concentration was adjusted to account for any removal of coliform bacteria by 11 μm filtration (arrows indicate the actual inactivation was greater).

4. Conclusions

This research suggests that particles naturally occurring in surface water as small as 11 μm are able to harbor indigenous coliform bacteria and *E. coli*, subsequently offering protection from UV light at a wavelength of 254 nm and up to a dose of 40 mJ/cm^2—the highest dose applied. This phenomenon was observed in water with turbidities as low as 0.8 NTU. Despite the occurrence of particle-related protection, at least 2.5-log inactivation of total coliform was still achieved for each of the four unfiltered surface waters considered. UV disinfection is only partially inhibited under these somewhat challenging conditions.

Acknowledgments

The authors gratefully acknowledge the utilities that willingly supplied water used for this research and Carole Baxter and Agnes Durlik of the Drinking Water Research Group

(University of Toronto) for their assistance in the laboratory. This research was funded by the Canadian Water Network (CWN) through the Integrated Disinfection Strategies Optimization Project.

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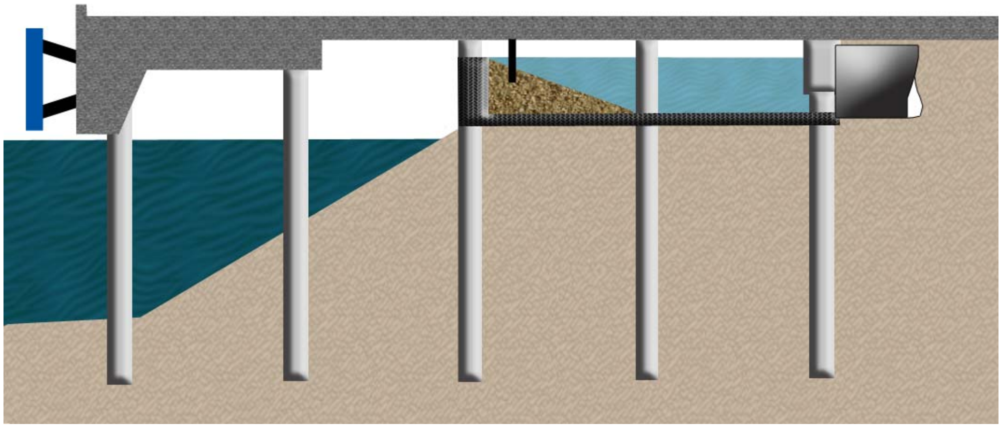
Port Redwing Container Terminal Development,
Tampa, Florida

Owner: Tampa Port Authority



Schematic Underwharf Stormwater Detention/Treatment Facility

Moffatt & Nichol provided planning, analysis, permitting, and conceptual design for a new wharf (4000 ft long) with ~110 acres of paved backlands for container or break bulk cargo operations, dredging, and associated mitigation. As part of the project, Moffatt & Nichol designed and successfully permitted an underwharf stormwater detention/treatment facility to handle drainage from the majority of the site (72.5 acres). An underwharf basin was beneficial because no additional structure was required for a retention basin because it was integrated directly into the new wharf thereby reducing overall project costs.

The underwharf stormwater detention/treatment basin was created by constructing a grade slab just above the low tide elevation with concrete containment walls. The seaward concrete wall was notched to provide an emergency overflow weir to prevent wharf/yard flooding from backwater build up through the trench drain system. Weirs included aluminum skimmers and utilized baffles to prevent any floatables (debris or oils) from exiting the system. Weir length/elevation were specified to handle a 25-yr return period, 24-hr design storm.

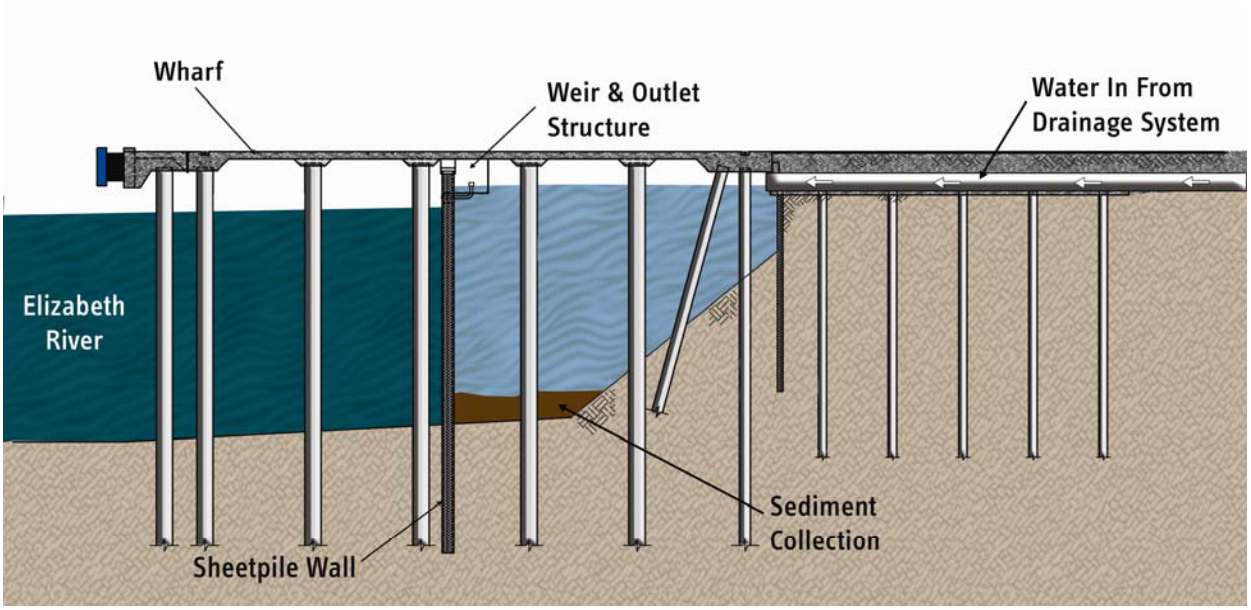
The bottom of the detention basin utilized a sand filter to clean stormwater before discharge to the Port Redwing Channel. Sand filter length was designed to allow several years between maintenance intervals. A perforated PVC pipe was incorporated into the filter to allow controlled basin drawdown; PVC discharged through outlets in the wall capped with check valve to prevent backflow.

Grade slab elevation resulted in a detention basin volume large enough to store the 100 year storm event and provided enough headroom beneath the wharf to allow sand filter maintenance (removal & replacement) by skid-steer loaders which reduced maintenance costs. Stormwater detention basin was accessed via backland ramp closed off using removable bulkheads. (4884.01)

Stormwater Management Systems, South Terminal Renovation, Norfolk International Terminals

Norfolk, Virginia

Owner: Virginia Port Authority

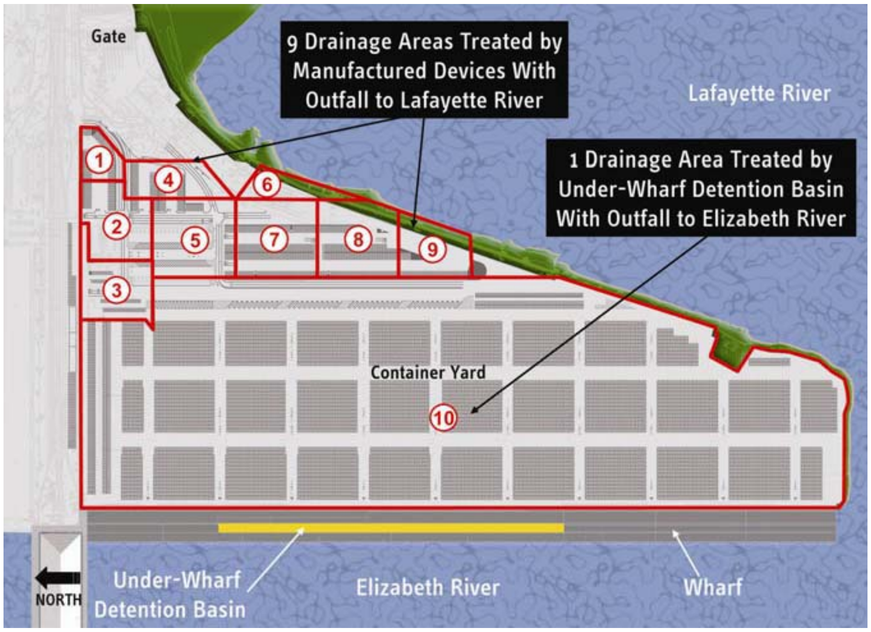


Moffatt & Nichol developed innovative stormwater management solutions to accommodate conflicting requirements that arose during renovation of the South Terminal of Norfolk International Terminals. In renovating the terminal, the Virginia Port Authority could not afford to sacrifice valuable area within the container storage yard for traditional stormwater treatment ponds. However, it also required that the terminal redevelopment meet or exceed state requirements for stormwater treatment. In response to these conflicting requirements, Moffatt & Nichol developed an innovative stormwater treatment system consisting of two different treatment methods - a trench drain system leading to a state-of-the-art underwharf detention basin, and a piped inlet system with a series of Vortechnics units. In order to gain approval for the underwharf detention basin concept, Moffatt & Nichol worked with various government and regulatory agencies including the Virginia Department of Environmental Quality, the Virginia Department of Conservation and Recreation, the Virginia Institute of Marine Science, and U.S. Army Corps of Engineers. It was also necessary to work with members of an adjacent neighborhood in order to ensure community acceptance of the project. (4552)

Stormwater Management Systems, South Terminal Renovation, Norfolk International Terminals

Norfolk, Virginia

Owner: Virginia Port Authority



The underwharf detention basin was a radical new idea in that it called for a 450,000-cubic-foot capacity impoundment area with sheet pile walls to be built under the wharf. The system provides an oil/water separation and collection area for suspended solids. The detention bulkhead utilizes a series of perforated drawdown pipes to slowly release the retained volume over 30 hours. Once the retention volume is exceeded, water flows out through a series of weirs located above the storage volume elevation. The underwharf detention basin will treat more than 100 acres and will remove ~318 pounds of pollutants per year.

While the underwharf stormwater treatment system handled ~100 acres, a piped inlet stormwater management system was designed to treat the remaining 30 acres utilizing Vortechnic units. Eleven of these EPA-award-winning units were used throughout the 30 acres to efficiently remove sediment, floating hydrocarbons, and debris from stormwater. Various-sized Vortechnic units were used to accommodate peak flows for the various sub-areas with storage volumes ranging from 4-7 cubic yards of sediment and 1200-2500 gallons of oil. This system terminates in a pile-supported outfall capped with a check valve to prevent back flow. Together, these units will remove 55 pounds of pollutants per year.

These new stormwater management systems, combined with existing systems at both the North and South terminals of NIT, will result in a total planned pollutant removal 1,560 pounds per year – 46% greater than the amount required by the Virginia Department of Conservation and Recreation. (4552)

Appendix 5c

SWM Strategy Energy Requirements

Waterfront Toronto - East Bayfront

APPENDIX Sherbourne Park - Water Feature and Pavillion Mechanical Power Requirements

TMIG Project No. 07135

Water Feature (Scrim Wall) Pump Power Requirements:

P = r * g * h * Q / e

r =	1000	kg/m³	
g =	9.806	m/s2	
h =	11.10	m	
Q =	0.024	m³/s	
ep =	71%	-	
em =	85%	-	(assumed)
P =	4,329	W	
=	4.3	kW	
Daily Pumping:	14	Hours	
Annual Operation:	182	Days	
Annual Energy:	11,029	kW-h	
Power Cost:	$0.08	/kW-h	
Annual Operating Cost:	$882		

Irrigation Pump Power Requirements:

P = r * g * h * Q / e

r =	1000	kg/m³	
g =	9.806	m/s2	
h =	42.30	m	
Q =	0.0019	m³/s	
ep =	49%	-	
em =	85%	-	(assumed)
P =	1,892	W	
=	1.9	kW	
Daily Pumping:	1	Hour/Week	
Annual Operation:	26	Weeks	
Annual Energy:	49	kW-h	
Power Cost:	$0.08	/kW-h	
Annual Operating Cost:	$4		

Submersible Pump Power Requirements (Day):

Daytime Operation

P = r * g * h * Q / e

r =	1000	kg/m³	
g =	9.806	m/s2	
h =	9.90	m	
Q =	0.11	m³/s	
ep =	69%	-	
em =	88%	-	
P =	17,816	W	
=	17.8	kW	(1 pump)
=	35.6	kW	(2 pumps)
Daily Pumping:	14	Hours	
Annual Operation:	182	Days	
Annual Energy:	90,793	kW-h	(2 pumps)
Power Cost:	$0.08	/kW-h	
Annual Operating Cost:	$7,263		

Submersible Pump Power Requirements (Night):

Nighttime Operation

P = r * g * h * Q / e

r =	1000	kg/m³	
g =	9.806	m/s2	
h =	9.90	m	
Q =	0.07	m³/s	
ep =	69%	-	
em =	88%	-	
P =	11,338	W	
=	11.2	kW	(1 pump)
Daily Pumping:	4	Hours	
Annual Operation:	30	Days	
Annual Energy:	1,344	kW-h	(1 pump)
Power Cost:	$0.06	/kW-h	
Annual Operating Cost:	$81		

UV Power Requirements:

P =	37.2	kW	(2 units)
Daily Pumping:	14	Hours	
Annual Operation:	182	Days	
Annual Energy:	94,786	kW-h	(2 units)
Power Cost:	$0.08	/kW-h	
Annual Operating Cost:	$7,583		
Number of lamps per year:	36		
Cost per lamp:	$292.50		
Annual Lamp Replacement Cost:	$10,530		

Summary of Estimated Annual Operating Costs (Labour Excluded)

Water Feature (Scrim Wall) Pump Power Requirements:	$882
Irrigation Pump Power Requirements:	$4
Submersible Pump Power Requirements (Day):	$7,263
Submersible Pump Power Requirements (Night):	$81
UV Power Requirements:	$7,583
Annual UV Lamp Replacement Cost:	$10,530
Subtotal:	**$26,300**

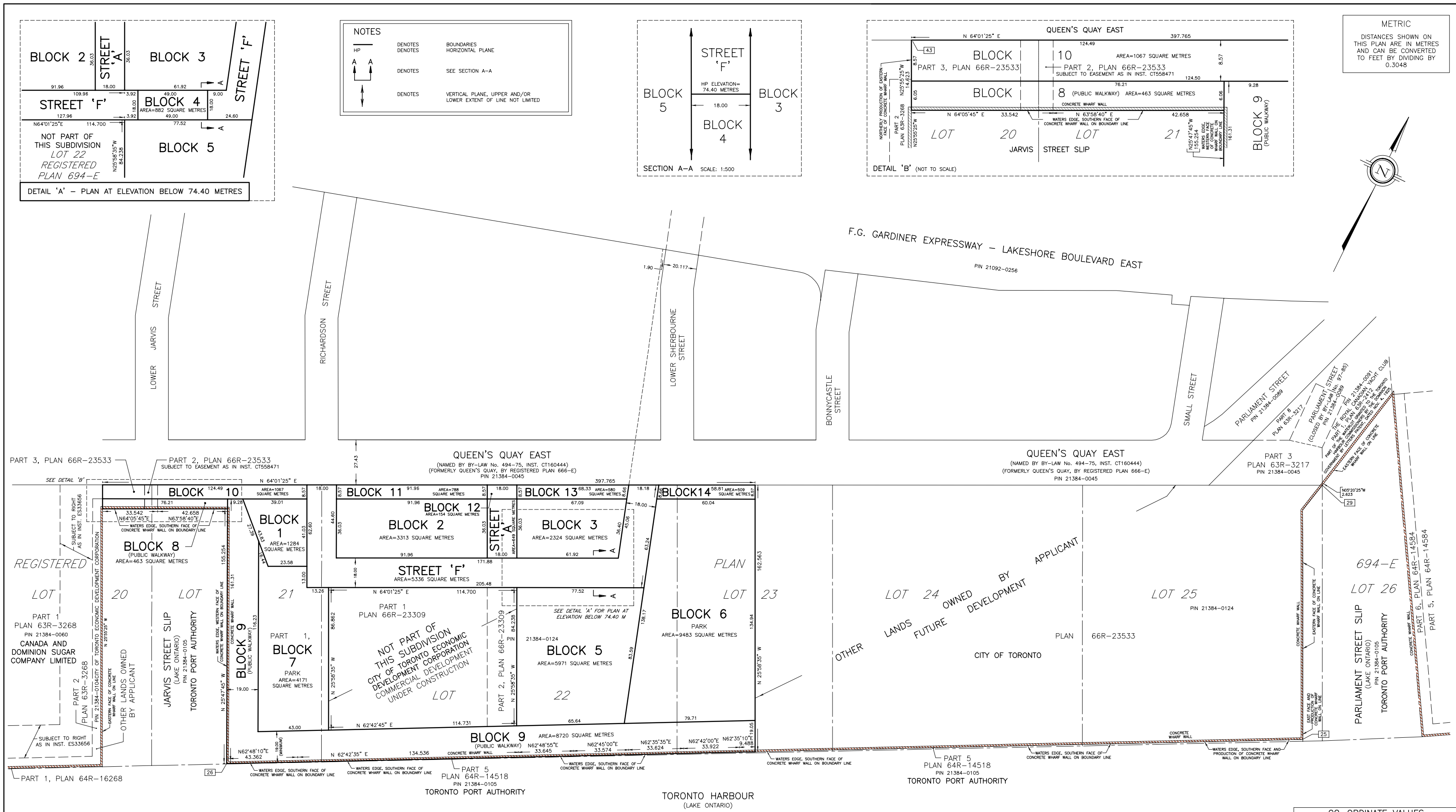
Appendix 5d

East Bayfront Draft Plan

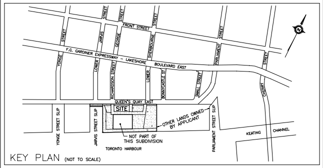
DRAFT PLAN OF SUBDIVISION OF

PART OF LOTS 20, 21, 22, 23, 24 AND 25 REGISTERED PLAN 694-E CITY OF TORONTO

METRIC
DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048



PLAN AT ELEVATION ABOVE 74.40 METRES



KEY PLAN (NOT TO SCALE)

SCALE 1 : 1000
20 10 0 20 40 60 METRES
HOLDING JONES VANDERVEEN INC.
ONTARIO LAND SURVEYORS

ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT R.S.O. 1990 C.P.13

a) AS SHOWN ON DRAFT PLAN
b) AS SHOWN ON DRAFT PLAN
c) AS SHOWN ON DRAFT AND KEY PLAN
d) LAND TO BE USED IN ACCORDANCE WITH SCHEDULE OF LAND USE
e) AS SHOWN ON DRAFT PLAN
f) AS SHOWN ON DRAFT PLAN
g) AS SHOWN ON DRAFT PLAN
h) MUNICIPAL PIPED WATER AVAILABLE AT TIME OF DEVELOPMENT
i) SOIL FILL
j) AS SHOWN ON DRAFT PLAN
k) FULL MUNICIPAL SERVICES
l) AS SHOWN ON DRAFT PLAN

SCHEDULE OF LAND USE

	LAND USE	AREA (SQ. METRES)	
		ABOVE 74.40 M	BELOW 74.40 M
BLOCKS 1 TO 3 AND 5	MIXED USE	12892	12892
BLOCK 4			882
BLOCKS 6 AND 7	PARKS	13654	13654
BLOCKS 8 AND 9	PUBLIC WALKWAYS	9183	9183
BLOCKS 10, 11, 12, 13 AND 14	PUBLIC HIGHWAYS	3098	3098
STREETS 'A' AND 'F'	FUTURE STREETS	5985	5103
TOTAL		44812	44812

OWNER'S AUTHORIZATION

WE, BEING THE REGISTERED OWNERS OF THE SUBJECT LANDS, HEREBY AUTHORIZE THE TORONTO WATERFRONT REVITALIZATION CORPORATION, TO ACT ON OUR BEHALF AND TO SUBMIT THIS DRAFT PLAN OF SUBDIVISION TO THE CITY OF TORONTO FOR APPROVAL.

CITY OF TORONTO

X
AUTHORIZED SIGNING OFFICER

DATE

SURVEYOR'S CERTIFICATE

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LAND TO BE SUBDIVIDED AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN ON THIS PLAN.

DATE

GARY B. VANDERVEEN
ONTARIO LAND SURVEYOR

REVISION SCHEDULE

REVISION	DATE	COMMENTS
B	FEB. 14, 2008	EXTEND RICHARDSON STREET AND STREET 'B' TO QUEEN'S QUAY EAST,
		REMOVE BLOCKS 6, 7 & 8, RENAME PROMENADES TO PUBLIC WALKWAYS
		AND MAKE STREET 'A' A BLOCK.
C	MAR. 11, 2008	RENAME RICHARDSON STREET AND STREET 'B' TO STREET 'F'
D	MAY 06, 2008	REMOVE BLOCK 4 LANDS FROM PLAN AND RENUMBER BLOCK 15 TO
		BLOCK 4. PROPERTY OWNERSHIP UPDATED.
E	AUG. 22, 2008	RENAME BLOCK 4 TO STREET 'A' AND ADD STRATA BLOCK 4, BELOW
		74.40 M, UNDER STREET 'F' BETWEEN BLOCKS 3 AND 5

CO-ORDINATE VALUES

HORIZONTAL DATUM: TOR_H-1974 (MTM ZONE 10) BASED ON CLARKE 1866 ELLIPSOID

STATION	EASTING	NORTHING
25	4833717.177	316061.157
26	4833416.511	315478.167
29	4833861.666	316003.995
43	4833536.065	315335.723

HOLDING JONES VANDERVEEN INC.
ONTARIO LAND SURVEYORS
1700 LANGSTAFF ROAD, SUITE 1002
VAUGHAN, ON L4K 3S3
PHONE: 905-660-4000, 416-445-3800. EMAIL: hjv@hjv-ols.ca

SCALE: 1:1000 | DATE: MAY 14, 2007 | JOB NO: 06-1750-DRAFT-REV-E