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Stormwater Management Report 2555 Sheffield Road, Ottawa

Submitted to:
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REPORT

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Golder Associates

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by American Iron and Metal (AIM) to carry out a design for storm water management and a roller-compacted concrete (RCC) pad at their metal recycling facility located at 2555 Sheffield Road in Ottawa (the Site).

A Surface Water Management Plan was previously prepared by Golder and J.L. Richards and Associates and submitted to Bakermet Inc. in June 2004 ("Surface Water Management Plan"). The report identified proposed stormwater management quality control measures. A copy of this report is provided in Appendix A. The report was prepared to fulfill the requirements of Provincial Officer Order EST-760-021-03, issued by the Ministry of Environment (MOE) Environmental SWAT Team dated December 2, 2003, which required that the company shall "retain the services of a qualified person to assess all surface water discharges and develop a plan, in accordance with the Ministry of Environment's technical document entitled "Stormwater Management Planning and Design Manual" (March 2003)".

This report provides updated recommendations and additional improvements for stormwater quality management and conveyance at this Site based on revisions to the site, including: removal of existing structures, installation of a rolled compacted concrete pad and grading work. This report has been prepared to accompany an application for an Environmental Compliance Approval (ECA) from the Ministry of the Environment and Climate Change (MOECC) under Section 53 or the Ontario Water Resources Act.

1.1 Description of Site

The Site is located on the east side of Sheffield Road opposite Bantree Street and is about 4 hectares in size. It is located within a large Industrial Park area within the City of Ottawa. Other industrial facilities are located to the north, south and west; to the immediate east is a CN Rail right of way and elevated track, and approximately 30 to 80 metres from its east property boundary is Ramsay Creek. The Industrial Park is fully serviced with water, storm and sanitary sewers.

The Site is a scrap metal processing facility. The site is currently occupied by an office and warehouse building in its southwest portion and a garage in the northwest. The area between the office/warehouse building and the street is landscaped and grass covered. Access to the site for truck and other vehicle traffic is from Sheffield Road, through a scale and into the yard area. The access/scale area has a paved surface, while most of the remainder of the yard area is currently unpaved. The shredder and associated buildings were located in the central portion towards the east boundary; however, have since been removed. The remainder of the yard is essentially used for temporary storage of scrap material to be processed, and for stockpiles of the end products. There is also a rail spur that enters the yard at the southeast corner. These features are shown on the Site Servicing Plan, Drawing 1 in Appendix F.

2.0 STORMWATER MANAGEMENT

2.1 Existing Site

Currently, stormwater runoff generated by the Site (i.e. totalling 4.16 ha) sheet flows to two main outlets, namely a 1,350 mm diameter Sheffield Road storm sewer system (servicing the western portion of the site) and a 450 mm diameter CSP storm sewer (servicing the eastern portion of the property). Based on the previous Surface Water Management Plan, approximately 2.37 ha is tributary to the 450 mm diameter CSP storm sewer, while 1.79 ha was found to be tributary to the 1,350 mm diameter Sheffield Road storm sewer.

The existing Site was modelled using Visual Otthymo using the NASH instantaneous unit hydrograph method with a 6-hour, modified Chicago distribution for a 25 mm, 1:5 year and 1:100 year return period storms. The storm events are based on local MTO IDF curves, using a modified Chicago Storm distribution, and are provided in Appendix B. The model inputs are provided in the following Table 1 and the existing conditions is provided on the Site Drainage Area Plan, Figure 4 in the Surface Water Management Plan.

Table 1: Existing Conditions

Drainage Area ID	Discharge Location	Area (ha)	SCS Curve Number	Initial Abstraction (mm)
100	1,350 mm diameter Storm Sewer	1.79	90	5.0
200	450 mm diameter CSP	2.37	90	5.0

The results and inputs from the Visual Otthymo existing conditions model are provided in Appendix C. The resulting peak flows for the existing site conditions are presented in the following Table 2.

Table 2: Existing Condition Peak Flows

Drainage Area ID	Discharge Location	Area (ha)	25 mm Peak Flow (L/s)	1:5 year Peak Flow (L/s)	1:100 year Peak Flow (L/s)
100	1,350 mm diameter Storm Sewer	1.79	32	92	219
200	450 mm diameter CSP	2.37	43	121	290
	Total	**4.16**	**75**	**213**	**509**

2.2 Proposed Site

The proposed site design has been completed in general accordance with the Surface Water Management Plan with some modifications to improve operation of the site and based on revisions to the site features.

The proposed Site Servicing Plan, Drawing 1 is provided in Appendix F. Modifications from the Surface Water Management Plan and existing site conditions include the addition of a 1.38 hectare roller compacted concrete (RCC) pad, which replaces some of the existing compacted gravel and asphalt surfaces. This pad will improve site conditions by allowing for containment of surface runoff, metals, total suspended solids (TSS), petroleum hydrocarbons, volatile organic compounds (VOC's), etc. associated with the industrial activities performed on site.

Stormwater from the RCC pad will be collected by catchbasins and maintenance holes and conveyed in a HDPE pipe storm sewer system sized to convey runoff from a 1:5 year return period storm event. A swale is proposed along the north and east property lines, in accordance with the Surface Water Management Plan, to collect stormwater runoff from the 1.319 hectare area of the site that is proposed to remain mostly a gravel surface (Drainage Area I.D. 8, Drawing 3). The swale will outlet into a ditch inlet catchbasin, which will then connect to the storm sewer system and convey stormwater runoff to the proposed oil/grit separator. To maximize efficiency of TSS and oil removal an orifice restriction will be added upstream of the proposed oil/girt separator to limit the inlet flow.

The addition of the RCC pad and regrading of the lot will result in some of the stormwater runoff, which originally discharged to the 1,350 mm municipal storm sewer, being redirected toward the rear of the property and collected by the 450 mm storm sewer. An area of 1.483 hectares of the site including the main building, driveway, garage and landscaped areas on the West (front) side of the property fronting on Sheffield Road is proposed to continue to drain uncontrolled and be collected by the 1,350 mm Municipal storm system.

All surface runoff collected from the RCC pad and gravel areas at the rear of the site (total of 2.677 hectares) will be directed to a proposed oil/grit separator prior to discharge to the existing 450 mm diameter CSP storm sewer located along the south side of the property, traversing the CN property to the east prior to discharging to Ramsey Creek.

The proposed conditions were modeled using Visual Otthymo Modelling including a 25 mm 6 hour modified Chicago distribution storm, a 1:5 year return period storm and a 1:100 year return period storm. The proposed Site modeling included the following inputs provided in Table 3, with Drainage Area 100 being the building, garage, entrance, and landscaped areas to the front of the site (Drainage Area I.D. 9 on Drawing 3), and Drainage Area 200A being the RCC pad which is collected by catchbasins, maintenance holes and the storm sewer system (Drainage Area I.D. 1, 2, 3, 4, 5, 6, and 7 on Drawing 3) and Drainage Area 200B being the mostly gravel area to the rear of the site which is collected by the swale to the north and east and directed to a catchbasin (Drainage Area I.D. 8 on Drawing 3):

Table 3: Proposed Conditions

Drainage Area I.D.	Discharge Location	Area (ha)	SCS Curve Number	Initial Abstraction (mm)
100	1,350 mm diameter Storm Sewer	1.483	90	5.0
200A	450 mm diameter CSP	1.358	98	1.0
200B	450 mm diameter CSP	1.319	90	5.0

Stormwater discharge to the 450 mm diameter CSP (from areas 200A and 200B) will be attenuated using a 115 mm diameter orifice plug upstream of the oil/grit separator which will limit the peak flows to the 450 mm diameter CSP storm sewer and allow for proper function of the oil/grit separator. Table 4 below provides a summary of proposed condition peak flows from the catchment areas, prior to any storage or attenuation by an orifice plate is provided.

Table 4: Proposed Condition Peak Flows

Drainage Area I.D.	Area (ha)	Outlet	25 mm Peak Flow (L/s)	1:5 year Peak Flow (L/s)	1:100 year Peak Flow (L/s)
100	1.483	1,350 mm diameter storm sewer	27	76	181
200A	1.358	450 mm diameter CSP	75	142	254
200B	1.319	450 mm diameter CSP	24	68	161
Total	**4.16**		**126**	**286**	**596**

The stormwater discharge rates noted above discharging to the 1,350 mm municipal storm sewer will remain slightly lower than existing peak flows to that sewer.

The following Stage-Storage-Discharge values presented in Table 5 were determined using upstream storm sewers and surface ponding for storage based on a proposed 115 mm diameter orifice plug installed at an invert elevation of 64.28 m, upstream of the oil/grit separator.

Table 5: Stage-Storage-Discharge

Depth (m)	Storage (ha m)	Discharge (m^3/s)
0	0	0
1.42	0.0108	0.0327
2.02	0.0212	0.0388
2.05*	0.0275*	0.4150*

*Values selected for overflow from the catchment area.

The resulting attenuated outlet flows to the 450 mm diameter CSP storm sewer are as shown in Table 6. Any overflow from the catchment area will also be collected by the 450 mm diameter CSP storm sewer downstream of the connection location and; therefore, is included in the values below.

Table 6: Outlet Peak Flows to 450 mm diameter CSP

Drainage Area I.D.	Area (ha)	25 mm Peak Flow (L/s)	1:5 year Peak Flow (L/s)	1:100 year Peak Flow (L/s)
200A and 200B	2.677	35	167	403

The results and inputs from the Visual Otthymo proposed conditions model are provided in Appendix D.

2.3 Quantity Control

The site servicing design includes storm sewers sized to convey the uncontrolled peak flow rates from the 1:5 year storm event. The proposed storm sewers are larger than the outlet storm sewer from the site; however, this has been proposed as it is a City of Ottawa standard. As well, should the RVCA or MOECC require additional storage volume for quantity control of the stormwater runoff from the site, the storm sewers will need to convey the runoff to another detention facility. The calculations for the storm sewer sizing are provided in Appendix E.

2.4 Quality Control

The quality control of stormwater runoff from the site is managed through a Watergate, Model WG100, by Wilkinson Heavy Precast. This unit provides oil separation through a lamella device installed between the two compartments of the structure. The Watergate unit has a maximum flow rate of 46 L/s for treatment of oil. The 115 mm diameter orifice has been selected to restrict stormwater runoff into the Watergate unit, as this diameter will allow a maximum flow rate of 38.8 L/s at the overflow elevation of 66.30 m from the site. With the restricted flow rate, the Watergate unit will provide superior removal of TSS, as the maximum flow for removal of TSS is listed at 105 L/s. The Watergate unit also does not have a bypass; therefore, all runoff that enters the unit will be treated.

Upstream storage is provided within the proposed storm sewers and in the onsite ditches to accommodate the restricted release rate. The 25 mm 6 hour Chicago storm distribution has been used to model the stormwater runoff and resultant storage requirements for quality control of site runoff.

3.0 CONCLUSION

The Site has been designed to provide quality control and quantity control of stormwater runoff. A 115 mm diameter orifice will be installed to restrict the flow rate to the existing 450 mm diameter storm sewer and provide quality control of stormwater runoff through the proposed oil/grit separator.

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APPENDIX A

Surface Water Management Plan, June 2004

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REPORT ON

SURFACE WATER MANAGEMENT PLAN

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) were retained by Bakermet Inc. (Bakermet) to prepare a surface water management plan for their property located at 2555 Sheffield Road in Ottawa, Ontario (refer to Key Plan, Figure 1).

This surface water management plan has been prepared to fulfill the requirements of Items 8 and 9 of Provincial Officer Order EST-760-021-03, issued by the Ministry of Environment (MOE) Environmental SWAT Team and dated December 3, 2003, as follows:

- *8. By January 9, 2004, the company shall retain the services of a qualified person to assess all surface water discharges and develop a plan, in accordance with the Ministry of Environment's technical document entitled "Stormwater Management Planning and Design Manual"(March 2003) at www.ene.gov.on.ca/envision/gp/4329eindex.htm The company shall notify the undersigned provincial officer in writing with the name and affiliation of the qualified person by the same date.*

- *9. By February 20, 2004, the company shall submit a copy of the completed plan identified under Condition 8 of this Order to the undersigned for review.*

In a letter from Bakermet Inc. dated January 5, 2004 , the MOE were advised that Golder had been retained to prepare the surface water plan and requested that the due date for submission under Item 9 be extended to June 30, 2004 in order to allow time to assess the site after the winter season. In a response letter from MOE dated January 6, 2004 the extension was granted and it was requested that Bakermet submit an interim surface water plan to prevent discharge of contaminants from the Bakermet site during the spring period. The interim plan was submitted by Bakermet in their letter dated March 30, 2004.

This report contains the surface water management plan required under Items 8 and 9. The report has been prepared by Golder in association with J.L. Richards & Associates (JLR).

2.0 DESCRIPTION OF SITE

The Bakermet site is located on the east side of Sheffield Road opposite Bantree Street and is about 4 hectares in size. It is located within a large Industrial Park area within the City of Ottawa. Other industrial facilities are located to the north, south and west; to the immediate east is a CN rail right of way and elevated track, and about 30 to 80 metres from its east property boundary is Ramsay Creek. The Industrial Park is fully serviced with water, storm and sanitary sewers.

Bakermet is a scrap metal processing facility, wherein it receives scrap metal (scrap autos, shreddable steel, etc.) and through a hammer mill shredding process produces separated ferrous and non-ferrous recyclable product, with auto shredder fluff as a residue. All three of these products are then transported off-site for their respective uses.

The site is occupied by an office and warehouse building in its southwest portion and a garage in the northwest. The area between the office/warehouse building and the street is landscaped and grass covered. Access to the site for truck and other vehicle traffic is from Sheffield Road, through a scale and into the yard area. The access/scale area has a paved surface, while most of the remainder of the yard area is unpaved. The shredder and associated buildings are located in the central portion towards the east boundary. The remainder of the yard is essentially used for temporary storage of scrap material to be processed, and for stockpiles of the end products. There is also a rail spur that enters the yard at the southeast corner. These features are shown on the Site Plan, Figure 2.

3.0 STUDY PROCEDURE

The main steps involved in preparing the surface water management plan were as follows:

- Obtain information and drawings from the City of Ottawa on storm sewer and drainage systems in the vicinity of the Bakermet site (described in Section 4.0 of this report)

- Document the existing surface water runoff patterns and drainage on the Bakermet site, and how and where it discharges off-site and enters the off-site drainage and sewer systems (also described in Section 4.0 of this report). This was accomplished by carrying out a detailed total station survey of the property in early April 2004, as well as surveying to tie in the relevant adjacent storm sewer system and storm sewer discharge components. The survey was carried out at a time when there was a rainfall event occurring so that the surface drainage on-site and off-site could be observed and the patterns defined.

- Using the detailed knowledge from the preceding tasks, a surface water sampling plan was designed. The purpose of this program was to systematically obtain surface water samples from the sewer and ditch systems upstream from the Bakermet site, from the runoff from the Bakermet property, and from the ditches and sewers downstream from the site. The samples were analyzed for a selected group of parameters that represent potential concerns associated with the site activities, i.e., metals, total suspended solids (TSS), petroleum hydrocarbons and volatile organic compounds (VOC's). In order to gain an appreciation for the water quality in Ramsay Creek, historical surface water quality data was obtained from the City of Ottawa as part of their ongoing program of surface water quality monitoring within the city. The findings are described in Section 5.0 of this report.

- Using the factual information from these activities and with guidance from the MOE Stormwater Design Manual, a surface water management plan for the site was developed (presented in Section 6.0 of this report).

4.0 STORM SEWER AND DRAINAGE SYSTEM

Surface water drainage within the Industrial Park is accommodated by means of roadside ditching and use of catch basins and ditch inlets connected to the main storm sewer system located within the roadways. The Bakermet site drains into two distinct and separate storm sewer systems. The northwesterly portion of the site drains overland toward the new Sheffield Road sewer network and the southeasterly portion of the site drains overland toward the original 450mm CSP storm sewer system. Both sewer systems outlet to Ramsay Creek. The total area captured by the two storm drainage systems located within the northeast section of the Industrial Park, known as the Sheffield Road Subbasin Area including the Bakermet property, is approximately 36.2 hectares, and is shown on Figure 3. The Bakermet property represents approximately 11 per cent of this serviced Industrial Park drainage area.

Details of the sewer and ditching system in the vicinity of the Bakermet site are shown on Figure 4. The main storm sewer in Sheffield Road in front of the site is 900 millimetre (mm) to 1200 mm diameter; this sewer flows from both the north and south towards the Bakermet site. The main outlet for the entire storm sewer system for this part of the Industrial Park area is a 1350 mm pipe in an alignment along the south boundary of the site that flows eastward and crosses below the CN rail line and outlets directly to Ramsay Creek. Storm drainage from along Bantree Street enters the Sheffield Road sewer by means of two ditch inlet catch basins.

There is also a 450mm CSP sewer along the south boundary of the site that commences at the roadside ditch on Sheffield Road and flows eastward, also passing beneath the CN rail line and discharging into a swale that leads to Ramsay Creek just north of the discharge from the main 1350 mm sewer. It is considered that this is an old sewer that existed prior to the installation of the 1350 mm sewer, but was left in place.

There is also a rail side drainage ditch between the east boundary of the site and the rail line. This ditch flows southward and enters the 450 mm sewer via a ditch inlet at the manhole just before the sewer passes under the tracks.

Based on the results of the detailed topographic survey, nine drainage sub-areas were identified on the Bakermet site as shown on Figure 4. Also shown on this figure are the off-site discharge points for each of these sub-areas. The relationship between each of these on-site areas and the off-site drainage and sewer networks is described as follows:

- Runoff from the Bakermet site to the 1350 mm sewer in Sheffield Road is limited to the front portion of the site. Runoff from the northwest portion of the site enters a vegetation-filled ditch along the north property boundary and leaves the site at the northwest corner into a ditch inlet catch basin. Runoff from the site access and scale area (which is paved) exits the site at the site entrance and enters a road catch basin. Runoff from the landscaped southwest area is also towards Sheffield Road and into a ditch inlet catch basin.

- Drainage from the south central area is via a shallow ditch around the warehouse, which discharges off-site into an opening in a catch basin located along the 450 mm CSP sewer.

- Runoff from the southeast area occurs via sheet drainage primarily towards the east property boundary, from where it enters the rail side ditch and then a ditch inlet to the manhole along the 450 mm sewer.

- The small northeast area drains to an on-site ditch that flows eastward along the north property line and then southward along the east boundary. The east central main yard area drains overland towards the east boundary. Both of these sub-drainage areas enter an oil-water separator tank, from where the water is pumped to the rail side ditch that flows southward to the ditch inlet to the manhole along the 450 mm sewer.

In summary, surface drainage from the western portion of the Bakermet site (about 45 percent of the total site area, a portion of which is buildings and landscaped area) accesses the main storm sewer that drains the Industrial Park. The Bakermet site and the neighbouring site to the south are the last properties to drain into this main storm sewer before it discharges to Ramsay Creek. Drainage from the remainder of the Bakermet site enters the 450 mm local CSP sewer by two different routes; this sewer receives drainage from the Bakermet Site and a small area of the adjoining property to the north and east before discharging into Ramsay Creek.

As illustrated on Figure 3, there is also another storm sewer outlet to Ramsay Creek located to the south of the 1350 mm outlet sewer. There is an 1800 mm sewer outlet that drains approximately 104 hectares from what is known as the Leeds Avenue Subbasin area.

5.0 SURFACE WATER SAMPLING PROGRAM

5.1 Sampling Program

Using the previously described surface water drainage information in the vicinity of the Bakermet site, a surface water sampling program was designed. The intent was to obtain a 'snapshot' of surface water discharge from the Bakermet site from a storm event, as well as surface water quality in the off-site sewer and ditch systems that receive runoff from the site. The surface water sampling locations are shown on Figure 5 and are described below:

Location	Description
A	Runoff at main paved site access to Sheffield Road catchbasin (1350 mm sewer)
B	Runoff at northwest corner of site to Sheffield Road catchbasin (1350 mm sewer)
C	Runoff ditch at south central side of site as enters manhole along the 450 mm CSP sewer
D	Discharge from 450 mm sewer on east side of railway tracks
E	Off-site rail side ditch, upstream (north) of Bakermet site
F	On-site ditch at northeast corner of site
G	On-site ditch along north part of east boundary, before entering oil-water separator
H	Off-site rail side ditch along east boundary before it enters 450 mm sewer
I	Oil-water separator discharge from the site to the off-site rail side ditch
J	Outlet swale from 450 mm sewer before it enters Ramsay Creek
K	900 mm Sheffield Road sewer at manhole upstream (north) of Bakermet site
L-1 and L-2	Ditch inlets from Bantree Street ditches to Sheffield Road storm sewer
M	900 mm Sheffield Road sewer at manhole upstream (south) of Bakermet site
N	Off-site manhole on 1350 mm sewer near southeast corner of site

The sampling program was carried out on May 5, 2004 at which time the samples were collected by Golder staff. The sampling was carried out several hours after a rainfall event commenced and runoff was occurring; the meteorological report from the Ottawa International Airport reports that this was a 6 mm rainfall event. The samples were collected using the required protocols (preservatives, bottles, filtering) and delivered in person under Chain of Custody to Accutest Laboratories for the following analyses:

Analytical Parameters	Sample Preparation
Metal Scan (total metals)	plastic bottle, unfiltered and preserved to pH<2 with nitric acid
Aluminum	plastic bottle, lab filtered to 0.45 microns and preserved to pH<2 with nitric acid
Total Suspended Solids (TSS)	plastic bottle, unfiltered and unpreserved
Total Petroleum Hydrocarbons in the gas/diesel and heavy oils ranges [TPH (g/d) and TPH (ho)]	glass amber bottle, unfiltered and unpreserved
Volatile Organic Compounds [VOC] – USEPA 624 scan	glass amber bottle, zero headspace, unfiltered and unpreserved

Field measurements of temperature, conductance and pH were also taken for each sample.
The laboratory reports of analyses are provided in Appendix A.

5.2 Results of Sampling Program

As detailed in Section 4.0, there are two off-site sewer systems that receive surface water runoff from the Bakermet property. This section details the chemical analytical results for each of these separate drainage systems. Water quality discussion is limited to inorganic chemical parameters for which a Provincial Water Quality Objective or City of Ottawa Sewer Use By-law criteria exist. Not all of the organic chemical parameters analysed, such as total petroleum hydrocarbons (TPH) and volatile organic compounds (VOCs), have PWQO or Sewer Use By-law criteria and thus have only been included for discussion if they were observed to be persistent throughout the drainage system. All of the laboratory chemical results are provided in the laboratory reports of analysis provided in Appendix A.

The location of each sampling station is shown on Figure 5.

5.2.1 1350 mm Storm Sewer Drainage System

A summary of selected chemical results for the 1350 mm sewer is presented in Table 1, which should be read in conjunction with this text.

Background or "up-stream" water quality for this drainage system is represented by the four sampling stations K, L1, L2 and M. These sampling locations represent the water quality in the storm sewer system before receiving any contribution from the Bakermet site. The up-stream water quality in the storm sewers along Sheffield Road and Bantree Street is marked by several exceedances of PWQO and/or the Sewer Use By-law (cadmium, cobalt, copper, iron, lead, manganese, nickel, zinc and TSS). Sample location M in the large diameter storm sewer on Sheffield Road, south of the site, reported a TPH diesel concentration of 0.4 mg/L. The TPH heavy oil concentration in the four up-stream locations ranged between 2 and 9 mg/L. VOC's were not detected at these locations.

The two catch basins along Sheffield Road which receive surface water runoff from the Bakermet site and which drain into the storm sewer on Sheffield Road are denoted by the sampling locations A and B. Water quality at these two locations exceeded the PWQO and/or the Sewer Use By-law for boron, cadmium, cobalt, copper, iron, lead, manganese, nickel, vanadium (A only), zinc, TSS, benzene, ethylbenzene, toluene and xylenes. In most instances, the parameter concentrations at sample location A and B were elevated compared to the up-stream water quality. This was more so at sample location A compared to B.

The storm sewer along Sheffield Road discharges into the 1350 mm sewer that parallels the southern property boundary of the Bakermet site and discharges into Ramsay Creek. Water quality at sample station N is representative of the water quality discharging into Ramsey Creek. Water quality at sample station N exceeds PWQO for cadmium, cobalt, copper, iron, lead, nickel and zinc. The concentrations of cadmium, cobalt, copper, iron, lead, zinc, TSS and TPH (diesel) at sample location N were at concentrations marginally greater than up-stream conditions in the storm sewer.

With the exception of iron and lead (approximately 75% and 40% increase in concentration, respectively, compared to the maximum up-stream water quality concentrations), the contribution of stations A and B did not result in a significant increase above up-stream water quality.

The field measured parameters collected at the time of sampling for the seven sampling locations along this drainage system ranged between 7.1 and 8.2 for pH, 8.5°C and 13.1°C for temperature and 1400 to 2800 μS/cm for electrical conductivity.

5.2.2 450 mm Sewer and Rail Side Ditch System

A summary of selected chemical results for the 450 mm sewer and rail side ditch is presented in Table 2, which should be read in conjunction with this text.

Background or "up-stream" water quality for this drainage system is represented by the sampling station E, located in the rail side drainage ditch north of the Bakermet site. This sampling location represents the water quality in the drainage ditch adjacent to the railway tracks before passing the Bakermet site. The up-stream water quality in the rail side ditch is marked by several exceedances of PWQO and/or the Sewer Use By-law (boron, cadmium, cobalt, copper, iron, lead, manganese, zinc and TSS). No TPH or VOCs were reported at this station.

As the rail side ditch passes the Bakermet site, the outlet at the eastern fence line of the site discharges surface water from the site to the rail side ditch via an oil/water separator tank. The oil/water separator restricts the flow from the on-site ditch through an opening at the base of a steel baffle with the intent to remove any floating product with an adsorption sock at the top of the barrier. A hydrocarbon product was observed leaving the site through the opening at the base of the oil/water separator. Water quality in the on-site drainage ditch before reaching the oil/water separator is denoted by the sampling locations F and G. The water quality in the on-site ditch exceeded PWQO and/or the Sewer Use By-law for boron, cadmium, cobalt, copper, iron, lead, manganese, nickel, zinc, TSS, benzene, toluene, ethylbenzene and xylene (these latter four VOC hydrocarbon parameters are commonly referred as BTEX). The cadmium, cobalt, iron, nickel and zinc concentrations at sample station G were higher than at up-stream station F, while the BTEX and TPH concentrations were reported at lower concentrations.

Water quality leaving the site via the oil/water separator, but before reaching the rail side ditch is denoted as the water quality at sampling station I. Water quality at this location exceeded the PWQO and/or the Sewer Use By-law for boron, cadmium, cobalt, copper, iron, lead, manganese, nickel, vanadium, zinc, TSS, benzene, toluene, ethylbenzene and xylene. The concentration of most inorganic parameters as well as the TPH concentration in sample I were elevated compared to sample G, taken before entering the oil/water separator. It appears that the design of the oil/water separator is having a concentrating effect for most parameters.

Sample station H is located in the off-site rail side ditch south (down-stream) of the outlet from the site. Water quality at this location exceeded PWQO and/or the Sewer Use By-law for boron, cadmium, cobalt, copper, iron, lead, manganese, nickel, silver, zinc, TSS, toluene and xylene. When compared to the up-stream water quality at station E, it can be seen that the outlet from the site has contributed to a number of parameter concentration increases including, boron, cadmium, chromium, cobalt, iron, lead, manganese, nickel, zinc, TPH and BTEX. It is noted that the TSS is lower at Station H than Station E.

Prior to passing beneath the railway and eventually discharging to Ramsay Creek, the rail side ditch drains into the 450 mm diameter sewer which receives runoff from the southern portion of the Bakermet site. A separate contributor to the 450 mm diameter sewer is at the catch basin south of the main building. Water quality at this location is represented by sample location C. Water quality entering the 450 mm diameter sewer at sample location C exceeds PWQO and/or the Sewer Use By-law for boron, cadmium, cobalt, copper, iron, lead, manganese, nickel, zinc and TSS. TPH concentrations of 0.6 mg/L diesel range and 9 mg/L heavy oil range were also reported at sample location C.

The combined waters from the rail side ditch and the 450 mm diameter sewer pass under the railway and discharge into a small watercourse leading to Ramsay Creek. Sampling locations D and J are located in this watercourse. Sample location J was collected from the watercourse immediately before discharging to Ramsay Creek and in is considered representative of the water quality discharging to Ramsay Creek. Water quality at sampling station J exceeds PWQO for boron, cobalt, iron, nickel, zinc, and toluene. No TPH was reported in the discharge water at sampling location J. Compared to up-stream water quality in the rail side ditch, boron, cadmium, chromium, cobalt, iron, manganese, molybdenum, nickel, zinc, benzene, toluene, ethylbenzene and xylene concentrations at the point of discharge are higher. Water quality at sample location J is similar to the water quality at sample location D, closer to the railway, with the exception of cadmium, nickel and zinc which are at lower concentrations. Other than the rail side ditch, no other contributors to this discharging watercourse exist; therefore, the higher parameter concentrations compared to up-stream water quality are indicated to be the result of surface water runoff from the Bakermet site.

The field measured parameters collected at the time of sampling for the eight sampling locations along this drainage system ranged between 7.2 and 7.8 for pH, 6.3°C and 9.7°C for temperature and 800 to 4200 μS/cm for electrical conductivity.

5.3 Ramsay Creek Quality Data

Water quality data was provided by the City of Ottawa (the City) for a water quality sampling program carried out by the City for Ramsay Creek and Green Creek during sewer sampling sessions in the summer (June to August) of 2001. The parameters of interest (inorganic parameters discussed in Section 5.2) compared to the PWQO are presented in Table 3.

Sample locations CK21-007 and CK21-006 are shown on Figure 5 and are the closest sample locations up-stream and downstream from the Bakermet property. Sample location CK21-007 is located in Ramsay Creek approximately 400 metres north of Walkley Road up-stream of the Bakermet site. Sample location CK21-006 is located in Ramsay Creek south of Innes Road down-stream of the Bakermet site. There are only three contributors to Ramsay Creek between these two sample locations, the 1350 mm sewer (Section 5.2.1), the drainage watercourse from the 450 mm sewer that drains a portion of the Bakermet site (Section 5.2.2) and an 1800 mm storm sewer outlet south of the Bakermet property (as described in Section 4.0) In terms of drainage area contributions to this stretch of Ramsay Creek, the Bakermet site represents 4 out of 140 hectares, or 3 percent.

Water quality in Ramsay Creek exceeds PWQO for aluminum, cadmium, chromium, cobalt, copper, iron, silver and thallium. With the exception of thallium these exceedances were present in both up-stream water quality and downstream water quality in at least one of the sampling sessions. Water quality at the down-stream sampling location CK21-006 is very similar to up-stream location CK21-007, and has a marginally higher beryllium, cadmium, cobalt, iron, lead, manganese, nickel and vanadium concentration range compared to up-stream water quality. Of these parameters only cadmium, cobalt and iron exceed PWQO.

Although this historic data does not coincide with the May 2004 detailed sampling program, it is relevant for several reasons. Firstly, the water quality in Ramsay Creek up-stream of this large Industrial Park area exceeds PWQO for a number of parameters. Secondly, the discharge of storm water from the Industrial Park has little effect on Ramsay Creek water quality, with only slight increases in certain parameters measured; this is considered typical of water courses as the contributing urbanized area increases. Lastly, considering both water quality data and relative contributing areas, the Bakermet site is not indicated or expected to have a measurable effect on the Ramsay Creek receiving water.

5.4 MOE Runoff Sampling Results

The MOE collected five samples of surface water runoff during their Bakermet site inspection on November 5, 2003. The MOE provided the results to Bakermet on April 1, 2004. The MOE sample locations were provided in the form of GPS coordinates and a general description. The coordinates were plotted such that these locations corresponded approximately to those of the Golder sampling program conducted on May 5, 2004, and allowed comparison of the MOE results to the Golder results. The purpose was to obtain some idea of runoff quality at these two different times.

It is recognized that both sets of runoff sample results are 'snapshots' of the runoff quality at some point in a rainfall event of a certain magnitude. Also, it is not certain that exactly the same sampling protocols were followed. Therefore the runoff quality results at these two times have the potential to be different due to a number of factors.

There are two sampling locations that appear to approximately coincide:

- the runoff ditch along the south central part of the site as it enters the manhole along the 450 mm CSP sewer- MOE location 0005 and Golder location C

- the off-site rail side ditch along the east boundary -MOE location 0003 and Golder location H

The results of metals analyses from these two locations are provided in Table 4. Although the individual values are different, for most parameters the results are of the same magnitude, with the biggest differences for iron and copper at location 0005/C and iron at location 0003/H. In terms of organics, the suite of analytical parameters are somewhat different between the MOE laboratory and the private laboratory. However, in general the occurrence and magnitude of the parameters that are common between the two suites are similar for each of the location pairs.

Although it is expected that there are variations in runoff quality at a particular location depending on a number of factors including the characteristics of the storm event, the point in the storm when the water is sampled and the activities ongoing at the site, this partial comparison of data from November 2003 and May 2004 suggests that the results may be reasonably representative of the parameters and their order of magnitude concentration.

5.5 Discussion

Stormwater quality in the Sheffield Road sewer system exceeds the City storm sewer bylaw, and PWQO, for a number of parameters prior to receiving any contribution from the front portion of the Bakermet site. Although the concentration of certain parameters in the site runoff is higher than the upstream concentration range in the sewer, the Bakermet site is indicated to have limited effect on the resultant sewer water quality prior to its discharge to Ramsay Creek. Even though the Bakermet site is near the endpoint of runoff contributions to this main sewer prior to its discharge, there are still other contributing sources of potential impact in this section; i.e., the typically heavy truck traffic along Sheffield Road that can affect runoff quality that enters the sewer via the roadside catchbasins, and the activities on the neighbouring site to the south from which runoff enters the 1350 mm sewer in via a series of catchbasins (parking, vehicle washing, etc.).

Discharge from the rail side ditch and the 450 mm CSP sewer, which receives the majority of its flow from the rear eastern and central portions of the Bakermet site, contains a number of elevated parameters compared to the upstream ditch water quality. The potential effects of runoff from this part of the site is considered to be at least in part due to the oil-water separator tank, which appears to be ineffective in removing hydrocarbons and which appears to concentrate and discharge suspended solids, which in turn increases the total metals concentrations.

The receiving watercourse for stormwater runoff from the large Industrial Park within which the Bakermet site is located is Ramsay Creek. The quality of surface water in Ramsay Creek exceeds the PWQO for a number of metal parameters, which is as expected for a watercourse that receives discharge in an urban setting. Based on available historical (2001) data, there is no significant change in water quality due to inputs from the large Industrial Park sewer discharges (that includes the small contribution from the Bakermet site drainage area). This is, in our opinion, better than might be expected, since there is expected to be quite limited stormwater management works in place on the many industrial properties that comprise the drainage subareas.

The above discussion relates primarily to the physical setting (sewers, ditching and receiving water) in which the Bakermet site is located, and the effects of mixing the current quality of runoff discharge from the Bakermet site into these features. It is recognized, however, that the intent of stormwater management on an individual site is to control the quantity and quality of the runoff from the site. It is considered that there is room for improvement in the management of stormwater runoff from the Bakermet site. However, the degree of improvement that is warranted at this industrial site should be viewed in the context of the site's physical setting, the position of the site relative to the drainage area of the storm sewer and ditching systems, the characteristics of the receiving water, and the relative contribution of the site to the overall off-site drainage subarea. The rationale for the Stormwater Management Plan proposed for the Bakermet site, and its preliminary design, are provided in Section 6.0.

6.0 STORMWATER MANAGEMENT PLAN

6.1 General

As presented in Section 1.0 of this Report, the MOE has requested that a Stormwater Management Plan that assesses all surface water discharges in accordance with the Ministry's publication entitled "Stormwater Management Planning and Design Manual, March, 2003" be prepared. The preface of this publication reads as follows:

> "The manual provides guidance which has been found effective in specific circumstances. However, users must exercise judgment and flexibility to adapt the guidance provided. Stormwater management solutions need to consider specific site conditions and this must be recognized when applying the guidance provided in the manual".

The objective of the Stormwater Management Plan developed for the Bakermet site and presented herein, is to reduce both sediment and contaminant impacts on Ramsay Creek/Greens Creek.

6.2 Current Policies and Objectives

Based on review of the current Policies and/or Objectives, it would appear that there are no specific design criteria applicable to sites having these types of operations. However, there are a number of existing Policies and/or Objectives pertaining to surface water quality in Ontario.

6.2.1 Surface Water Quality Control

The surface water quality objectives for the Province are contained in the Ministry of the Environment's publication "Water Management: Goals, Policies, Objectives and Implementation Procedures (M.O.E., 1984)". The "blue book" sets out specific water-quality objectives and policies for attaining the following overall goal: "To ensure that the surface waters of the Province are of a quality which is satisfactory for aquatic life and recreation". The "blue book" provides a list of water-quality parameters with specific limits.

6.2.2 Federal Fisheries Act

The Federal Fisheries Act prohibits "the deposit of a deleterious substance of any type in water frequented by fish or in any place under any conditions where the deleterious substance or any other deleterious substance that results from the deposit of the deleterious substance may enter any such water (subsection 36(3))". Any substance that exhibits a potentially harmful chemical, physical or biological effect on fish or fish habitat is considered to be deleterious.

The "first-order" impacts of stormwater runoff are primarily related to suspended solids (SS) and, therefore, the design of facilities should be based on the long-term removal of SS from the stormwater discharge. The Federal Fisheries Act does not differentiate between different types of habitat, but Fisheries and Oceans Canada (Fish Habitat Management) does recognize that some habitats are more resilient to perturbation. Based on the above, the levels of protection should be chosen to maintain or enhance the existing aquatic habitat.

6.2.3 Stormwater Management Planning and Design Manual, MOE, March 2003 and June 1994

In June 1994 the MOE published a document entitled "Stormwater Management Practices Planning and Design Manual" which provided technical and procedural guidance for the planning, design, and review of stormwater management practices (SWMPs). In March of 2003, this Manual was updated based on feedback received from a number of sources (refer to Stormwater Management Planning and Design Manual, SWMPDM).

Based on the types of protection level developed by Fisheries and Oceans Canada (Fish Habitat Management), the above manuals provided specific objectives to be achieved to maintain or enhance existing aquatic habitat with regards to suspended solids removal. These levels of protection are based on a general relationship between the long-term average suspended solids removal of the end-of-pipe stormwater management facilities and the lethal and chronic effect of suspended solids on aquatic life. The following levels of protection correspond to the "long-term average suspended solids removals" and were based on the entire range of rainfall events included in a long period of time (i.e., a long term simulation of at least 10 years):

- Enhanced protection corresponds to the end-of-pipe storage volumes required for the long-term average removal of 80% of suspended solids;

- Normal protection corresponds to the end-of-pipe storage volumes required for the long-term average removal of 70% of suspended solids; and

- Basic protection corresponds to the end-of-pipe storage volumes required for the long-term average removal of 60% of suspended solids.

As part of the 1994 SWMPPDM, a review of the existing water quality criteria in Canada and the United States was carried out. This review determined that the primary criteria used in most jurisdictions in the above countries were volumetric (i.e. runoff from a specified design storm was to be captured and treated). In most cases, the selected design storm events ranged from 12.5 mm to 25.0 mm. The use of this type of volumetric design storm criteria remains prevalent today, although some jurisdictions have established methods for refining the size of the design event, based on area-specific conditions such as climate or the receiving water body.

6.2.4 Water Quality Objectives for the Rideau River

In 1992, the Regional Municipality of Ottawa-Carleton (now the City of Ottawa) in consultation with the local district office of the MOE formulated a Stormwater Control Objective for the Rideau River. Stormwater discharges to the Rideau River or tributaries are to meet the following MOE District Office requirements for protecting recreational water quality in the Rideau River:

- Fecal coliform levels in stormwater discharges to be 100 no/dl or less during the recreational water-use season (May 15 to September 15); and

- Total Suspended Solids (TSS) should be below 25 mg/l or less during the recreational water-use season (May 15 to September 15).

The MOE currently allows for the exceedance of the above bacteriological criterion, on average four (4) times per swimming season.

1997 Combined Sewer Overflow Policy (Wastewater Master Plan, 1997)

In 1997, the Regional Municipality of Ottawa-Carleton (now the City of Ottawa) developed a Combined Sewer Overflow (CSO) Policy in consultation with the MOE. This policy, described in detail in the 1997 Wasterwater Master Plan, was designed to recognize local issues and to ensure compliance with MOE Procedure F5-5, dealing with combined and partially separated sewer systems. The Policy states that:

> "During a seven month period commencing within 15 days of April 1, capture and treat for an average year all the dry weather flow plus 90% of the volume resulting from wet weather flow that is above the dry weather flow. The volumetric control criterion is applied to the flows collected by the sewer system immediately above each overflow location unless it can be shown, through modeling and ongoing monitoring, that the criterion is being achieved on a system-wide basis. No increase in Combined Sewer Overflow volumes above existing levels at each outfall will be allowed except where the increase is due to the elimination of upstream CSO outfalls. During the remainder of the year, at least the same storage and treatment capacity should be maintained for treating wet weather flow. The treatment level for the controlled volume is described in Section 7.0 of the Policy Document".

6.3 Criterion Development

The review of the current Policies and Objectives has shown that treatment of a significant portion of the volumetric runoff is targeted in all instances. The water objective, developed specifically for the Rideau River watershed, specifies that TSS concentrations discharged to the river be below 25 mg/l during recreational water-usage (i.e., May to September) with an allowance of 4 exceedances per average year. As the Bakermet site is not tributary to the Rideau River watershed, and that both Ramsay Creek and Greens Creek (i.e. the receiving streams) do not have recreational water-usage (i.e. no public swimming areas) along their reach, the objectives derived for the Rideau River are not appropriate for this site.

Storm guidelines developed as part of the SWMPDM (March, 2003) recommended that the following measures be implemented:

1) Stormwater management practices (SWMPs) should be implemented to remove suspended solids (SS) from urban storm runoff. On an annual basis, a removal rate ranging from a minimum of 60% to a maximum of 80% should be targeted depending on the sensitivity of the downstream fish habitat; and

2) Treatment of design storms should be carried out for precipitation events ranging from 12.5 mm to 25.0 mm based on site specific conditions and type of receiving body (refer to Page 3-5 of the SWMPDM).

On the other hand, the CSO´Policy stipulates that during a seven (7) month period, 90% of the volumetric flow resulting from wet weather events should be captured and treated. Based on the synthesis of the above policies and guidelines, it was decided to consider the most stringent criteria as follows:

- Provide a level of treatment reaching or exceeding the volumetric requirements of the CSO Policy (i.e. treatment of 90% of the annual runoff, based on a 12 month period); or

- Provide a level of treatment for all storm events up to 25 mm as recommended on Page 3-5 of the SWMPDM.

To determine which of the above criteria is the most stringent, a review of various statistical analyses was conducted. As part of the Rideau River Stormwater Management Study (RMOC, 1992) a statistical analysis using 29 years of precipitation data during the summer months (i.e., from May to September) in the Ottawa area was carried out using two meteorological stations. This analysis revealed that, on an average year, there are 45 rainfall events during the summer using a six (6) hour inter-event time (refer to Appendix "B" for Summary Table). The review of this table indicates that capture of all storm events up to 20 mm would result in the treatment of 90% of all summer storm events (i.e., 45 events x 90% = 40 events).

As part of Appendix "C" of the June, 1994 MOE SWMPPDM (refer to Appendix "C"), a statistical analysis revealed that a 25 mm precipitation event occurs approximately 4 times per year and that a daily capture of 25 mm would result in an annual capture rate of 95% of the annual precipitation. Based on the above analyses, the daily capture of a 25 mm storm event was found to correspond to a capture of 95% of the annual volumetric runoff, and was found to exceed the CSO Policy. Therefore, the use of a 25 mm storm event (using a 4 hour Chicago design storm distribution) was used to carry out the storage volume requirements for the Bakermet site and was deemed adequate for the protection of a receiving stream with warm water fisheries. Furthermore, a 25 mm storm event was found to significantly exceed the "first flush" volume as defined in the literature. On this basis, the QUALHYMO user manual (release 2.1, by Rowney and MacRae, October, 1992) defines the "first flush" as follows:

> "The first flush effect is characterized by a rapid rise in pollutant concentration to a local or absolute maximum on the pollutograph shortly after initiation of runoff but prior to the hydrograph peak (refer to Appendix "D" for Figures 9.3a and 9.3b of the QUALHYMO manual). These peaks are typically 2 to 3 orders of magnitude larger than baseflow concentrations and may represent a "shock" loading to the receiving water body. After peaking, concentrations typically decline exponentially through the course of the storm event. These observations and those by others (Weatherbe and Novak, 1977; Field and Gardner, 1978) imply that pollutants demonstrating this behaviour may "build-up" or accumulate through time-dependent processes such as atmospheric fallout, waste from vehicular traffic, etc., which are subsequently entrained in runoff as "washoff".

The above principle (i.e. "build-up" and "washoff" of pollutants) constitutes the basis of the water quality algorithms included in models such as QUALHYMO, SWMM and STORM. By providing the retention and treatment of all precipitation events up to 25 mm, 95% of the annual runoff will be detained and treatment of the first flush of all storm events will be achieved.

6.4 Proposed Stormwater Management Plan

6.4.1 General

There are numerous Stormwater Management Practices (SWMPs) that have been utilized in the past to provide compliance with various water quality criteria and objectives. This Stormwater Management Plan was prepared to provide an integrated approach to surface runoff management that is premised on maximizing the control of pollution at the source. Therefore, this Stormwater Management Plan was developed to include the following SWMPs:

1) Stormwater source control; and

2) End-of-pipe treatment.

6.4.2 Stormwater Source Control

Currently, storm runoff generated by the Bakermet site (i.e. totalling 4.16 ha) sheet flows to two main outlets, namely the 1350 mm diameter Sheffield Road storm sewer system (i.e., for the front part of the site) and a 450 mm CSP culvert (i.e., for the back portion of the property) as discussed in greater detail in Section 4.0. Based on the tabulation of the on-site drainage areas (refer to Figure 4), approximately 2.37 ha is tributary to the 450 mm diameter CSP culvert while 1.79 ha was found to be tributary to the 1350 mm diameter Sheffield Road storm sewer. Since the 4.16 ha site drains to two separate outlets and these areas have different contaminant impacts, the SWMP developed for the Bakermet site was based on the above two outlets.

As presented above, the Bakermet site utilizes two outlets, namely the Sheffield Road storm sewer system for the front part of the site and the 450 mm CSP culvert for the back of the property. Since the front portion of the property (i.e., 1.79 ha) includes some landscaped areas and rooftops while the scrap storage, shredding and conveyance of ferrous and non-ferrous metal is carried out at the back of the property, source control measures are proposed for the front of the property. It is proposed to mechanically sweep the front part of the property at least twice a day (depending on the vehicular traffic) to remove sediment build-up along the hard surfaces. The owners of Bakermet have already purchased a vacuum assisted mechanical sweeper (refer to Appendix "E" for details on the Tennant Model 810 street sweeper) to remove sediments from their entrance. The sweeper is currently being used twice a day, and this frequency of cleaning will be maintained.

In 1997, a study conducted by Kurahashi and Associates, Inc. and published by the U.S. Federal Department of Transportation – Federal Highway Administration was carried out to evaluate the effectiveness of pavement sweepers. The results of this study (refer to Appendix "F") showed that sweeping on a frequency of twice weekly provided a removal rate ranging between 45-70% and 30-60% for TSS and metals, respectively.

Bakermet will also employ operational measures related to control of hydrocarbons from specific operations or areas. These will consist of the use of 1) Marwick Plus absorbent rolls to ensure that oil does not migrate from the garage, warehouse and shredder buildings; 2) hydrophobic socks on the property and in the main ditches to absorb hydrocarbons in runoff, and; 3) oil dry general purpose absorbent when and where needed.

6.4.3 End-of-Pipe Treatment

Currently, storm runoff generated by the Bakermet site (i.e., totalling 4.16 ha) sheet flows to the four (4) sides of the property. Storm runoff from approximately 1.47 ha is currently tributary to the Sheffield Road storm sewer system, 0.22 ha to an open ditch system along the northern perimeter of the property, 1.18 ha to an open ditch system along the CN railway (i.e., the eastern perimeter) and 0.97 ha to an existing 450 mm CSP culvert located along the southern perimeter of the site.

Since the 4.16 ha site drains to two separate outlets, i.e., the 450 mm CSP (approximately 2.37 ha) and the 1350 mm storm sewer (approximately 1.79 ha), the Stormwater Management Plan will deal with the two outlets separately.

Oil/grit separators are generally used to separate free phase oil from storm runoff, trap sediments or to provide a reliable means for the control of spills. The Subsection of SWMPDM pertaining to oil/grit separators reads as follows

> "They are typically used for small sites but sizing and design are dependent on the function they are to fulfill. There are a variety of both proprietary and non-proprietary oil/grit separators on the market ranging from chambered designs to manhole-types."

For the Bakermet site, the manufactured oil/grit separator selected was the Wilkinson Waterbox System (refer to Appendix "G" for product brochure and summary table). This product uses the coalescent plate separation principle to provide the high level of treatment associated with enhanced fish habitat protection (i.e., formerly referred to as Level 1 protection). As presented on the Summary Table of Appendix "G", Model 3 requires that maximum flow rates of 43 L/s and 19 L/s be provided for the control of suspended solids and oil, respectively. The comparison between the above flows shows that the critical parameter for the design and implementation of these units is the removal of free phase oil from runoff. Based on a telephone conversation with a representative of Wilkinson, when designed using the restricted flows, these devices will remove total suspended solids that are equal to or exceed 20 microns in size. A synthesis of water quality monitoring was carried out in the United States (refer to the extensive National Urban Runoff Program, N.U.R.P., EPA, 1983). This study indicated that less than 20% of particle mass was found to have a particle size less than 20 microns (refer to Appendix "H" for Table 5-1), with similar sampling results also found in Canada. Based on the above, the provision of a Waterbox designed for the removal of free phase oil should, as a minimum, remove 80% of the total suspended solids using particle size distributions published in the literature.

6.4.4 Storage Volume Requirements

To estimate the storage volume requirements necessary to provide the treatment for 95% of all storm events, the SWMHYMO Hydrological Model (Version 4.02, July, 1999) was utilized. Storage volume requirements were calculated using the 4 hour - 25 mm Chicago storm event (refer to APPENDIX "I" for rainfall hyetograph). To simulate the hydrological response of the site, the DESIGN STANDHYD command was utilized with the following parameters:

Area Tributary (A_T) = 2.37 ha (6 sub-areas, i.e., 0.49, 0.37, 0.11, 0.25, 0.93 and 0.22 ha)
Assumed Total Imperviousness (TIMP) = 95%
Time to peak (T_p): calculated by SWMHYMO
Modified Curve Number (CN^*) = 75
Initial Abstraction for Impervious surfaces = 0.8 mm
Initial Abstraction for Pervious surfaces = 1.5 mm

A runoff hydrograph was generated for a catchment exhibiting the above hydrological properties and was routed through a detention facility. Based on this simulation, a storage volume requirement of approximately 345 m^3 (refer to Appendix "J" for SWMHYMO data and output files) was calculated based on a maximum release rate of 15 L/s (i.e., release rate less than the maximum recommended release rate of 19 L/s for free phase oil).

6.4.5 Storm Servicing

To provide end-of-pipe treatment for the back portion of the property (i.e., area totalling 2.37 ha) where all of the scrap storage, shredding and product stockpiling operations occur, it is proposed to implement the following storm servicing:

- Provision of a new open ditch system (approximately 150 m) located along the eastern perimeter of the site which outlets to a ditch inlet catch basin. Grading of the open ditch will be carried out such that runoff will be directed to the ditch inlet catch basin, where it will be captured and conveyed by means of a 450 mm diameter storm sewer to a dry detention facility for attenuation of flow;
- Provision of a new open ditch system (approximately 105 m) located along the southern perimeter of the site which outlets to a dry detention facility for attenuation of flow;
- Provision of a 380 m^3 dry detention facility located near the southwestern corner of the site. This facility was sized to detain runoff generated from the back of the property (i.e., 2.37 ha) during a 4 hour, 25 mm Chicago design storm event while releasing a maximum

outflow rate of 15 L/s (i.e., release rate less than the maximum recommended release rate of 19 L/s for free phase oil). The preliminary sizing of the facility is as follows:

i) Bottom of facility at elevation 63.60 m
ii) Top of facility at 65.60 m
iii) Length approximately 60 m
iv) Width of 3 m

- Provision of a Waterbox (Model 3) to provide the containment of dry weather spills, to separate free phase oil and to remove TSS. From this point, a manhole junction and pipe is proposed to connect to the 1350 mm diameter storm sewer. With this arrangement, the rail side ditch and the 450 mm CSP sewer will no longer receive runoff from the Bakermet site. The 450 mm sewer will essentially serve as an outlet for the rail side ditch.

6.5 System Operation and Maintenance

As part of detailed design of the works presented herein, a detailed Operation and Maintenance Manual will be prepared. This manual will include specific recommendations pertaining to the following items:

6.5.1 Waterbox

To ensure long-term environmental protection, the Waterbox system must be serviced at least to the frequency recommended by the manufacturer. During detailed design, recommendations from the manufacturer will be incorporated in the Stormwater Management Plan. However, since the recycling operations carried out are site specific, regular inspections of the Waterbox will be recommended.

6.5.2 Dry Detention Facility

The dry detention facility is part of the overall solution to attenuate storm flows during frequent storm events. In terms of suspended solid removal, these types of facility are known not to provide highly efficient removal. However, some removal is anticipated. To ensure that the deposited sediments are not re-suspended during the next precipitation event, specific guidance pertaining to the removal of sediments will be included in the final Stormwater Management Plan design. Furthermore, routine inspection activities will be included in the Plan. Routine inspection of the facility should be made to ensure that the structure is performing adequately (i.e., no flow blockages or back-ups due to debris accumulation). Litter, debris, obstructions, when observed, should be removed from the detention facility.

6.5.3 Ditch Inlet/Storm Sewer System

To ensure long-term efficiency of this system, a list of inspection activities will be recommended. Inspection such as grit in ditch inlet sumps, ice blockage of the inlets, etc. will be recommended along with remedial measures.

6.5.4 Overflow Spillway

To provide a defined flow path during storm events exceeding a precipitation of 25 mm, a spillway will be incorporated in the final design of the dry detention facility. This spillway will likely be designed using the pond's perimeter grading to evacuate storm runoff generated by storm events exceeding 25 mm. The spillway will be designed with adequate conveyance capacity to evacuate the 1:100 year peak flow rate.

6.6 Safety Procedures

As part of the Stormwater Management Plan final design, a list of safety procedures will be included such as confined space entry, safety equipment, entry procedures, etc. in accordance with the following documents:

- "Confined Space Entry Workshop" prepared by the Ontario Ministry of Environment and Energy.
- Ontario Ministry of Environment and Energy Health and Safety Act Manual.

7.0 CLOSURE

In response to the Provincial Officer Order, a systematic engineering approach has been followed to determine the surface drainage characteristics of the Bakermet property and the adjacent off-site drainage and sewer systems in terms of both the physical system and surface water quality. A surface water management plan has been developed and is proposed to be implemented following receipt of concurrence from the MOE. The steps involved in implementation are the preparation of the final design, obtaining the required regulatory approvals, tendering, construction and commissioning. This surface water plan will result in considerable improvement to the quality of the storm water that leaves the Bakermet site, especially when viewed in the context of the location of this property within a large Industrial Park and at the downstream end of the storm sewer system that services this area.

Should there be any questions, please do not hesitate to contact us.

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TABLE 1
Water Quality Results - 1350 mm Storm Sewer System

"Surface Water Flow Direction"

Parameter	PWQO[1]	Storm Sewer Discharge Criteria[2]	"Up-Stream" Contributers				"Up-Stream" Water Quality	Bakermet Contribution		1350 mm Storm Sewer Discharge
			Sample Location K	Sample Location L1	Sample Location L2	Sample Location M	Sample Locations K, L1, L2, M	Sample Location B	Sample Location A	Sample Location N
Inorganics										
Aluminum	0.075	nv	<0.010	0.04	0.01	<0.010	<0.010 - 0.04	<0.010	0.02	<0.010
Beryllium	1.1*	nv	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.2	nv	0.06	0.11	0.08	0.04	0.04 - 0.11	0.49	0.62	0.08
Cadmium	0.0002	0.008	0.0008	0.0011	0.0005	0.0028	0.0005 - 0.0028	0.0005	0.0311	0.0034
Chromium	nv	0.08	0.003	0.005	0.005	<0.010	<0.01 - 0.003	0.002	0.002	<0.010
Cobalt	0.0009	nv	0.0029	0.0015	0.0009	0.0039	0.0009 - 0.0039	0.015	0.0212	0.0041
Copper	0.005	0.04	0.059	0.151	0.051	0.203	0.051 - 0.203	0.026	0.973	0.271
Iron	0.3	nv	1.45	1.76	0.82	2.44	0.82 - 2.44	22.8	5.47	4.31
Lead	0.005**	0.12	0.05	0.172	0.065	0.263	0.05 - 0.263	0.02	1.78	0.368
Manganese	nv	0.05	**0.48**	**0.14**	**0.06**	**0.46**	**0.06 - 0.48**	**2.33**	**3.02**	**0.47**
Molybdenum	0.04	nv	<0.005	0.01	0.017	<0.005	<0.005 - 0.017	0.015	0.006	0.005
Nickel	0.025	0.08	0.011	0.013	0.011	0.03	0.011 - 0.03	0.044	0.157	0.028
Silver	0.0001	0.12	<0.0001	<0.0001	<0.0001	0.0001	<0.0001 - 0.0001	0.0001	<0.0001	0.0001
Thallium	0.0003	nv	<0.00100	<0.00100	<0.00100	<0.00100	<0.00100	<0.00100	<0.00100	<0.00100
Vanadium	0.006	nv	0.003	0.004	0.001	0.005	0.001 - 0.005	0.001	0.012	0.005
Zinc	0.03	0.04	0.46	0.57	0.22	1.05	0.22 - 1.05	0.25	14.3	1.29
TSS	nv	15	**104**	**277**	**43**	**566**	**43 - 566**	**51**	**34200**	**798**
Conductivity	nv	nv	1400	1400	1500	-	1400 - 1500	2800	1700	1400
Total Petroleum Hydrocarbons										
TPH-Diesel	nv	nv	<0.2	<0.2	<0.2	0.4	<0.2 - 0.4	0.3	0.3	0.8
TPH-Gasoline	nv	nv	<0.2	<0.2	<0.2	<0.2	<0.2	0.9	<0.2	<0.2
TPH-Gasoline/Diesel	nv	nv	<0.2	<0.2	<0.2	0.4	<0.2 - 0.4	1.2	0.3	0.8
TPH-Heavy Oils	nv	nv	4	19	2	10	2 - 19	<1	4	8
VOC's:										
Benzene	0.1	0.002	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	**0.0471**	0.001	<0.0005
Ethylbenzene	0.008	0.002	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	**0.0065**	**0.0044**	<0.0005
Toluene	0.0008	0.002	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0823	0.013	0.0005
Xylene-m/p	0.032	0.0044	<0.001	<0.001	<0.001	<0.001	<0.001	**0.0249**	**0.0147**	<0.001
Xylene-o	0.04		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	**0.0173**	**0.0079**	<0.0005

Notes:

All values reported in mg/L unless specified

([1]) PWQO criteria taken from the Ontario Ministry of the Environment "the Provincial Water Quality Objectives", July 1994

([2]) Sewer-Use criteria taken from City of Ottawa By-Law No.2003-514

(*) Assumes a hardness (as $CaCO_3$) of greater than 75 mg/L. A criteria 0.011 mg/L would apply for locations with a hardness less than 75 mg/L

(**) Assumes a hardness (as $CaCO_3$) of greater than 80 mg/L. A criteria 0.003 mg/L would apply for locations with a hardness less than 80 mg/L and greater than 30 mg/L

(nv) no value exists

Shaded results represent an exceedance of PWQO criteria

Bold Bolded results represent an exceedance of Storm Sewer Discharge criteria

Underlined Discharge results are greater than upstream water quality

TABLE 2
Water Quality Results - 450 mm Storm Sewer and Rail Side Ditch System

"Surface Water Flow Direction"

Parameter	PWQO[1]	Storm Sewer Disharge Criteria[2]	"Up-Stream" Contributer	Bakermet Contribution					Discharge From 450 mm Storm Sewer and Rail Side Ditch	
			Sample Location E	Sample Location C	Sample Location F	Sample Location G	Sample Location I	Sample Location H	Sample Location D	Sample Location J
Inorganics										
Aluminum	0.075	nv	<0.010	0.03	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Beryllium	1.1*	nv	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.2	nv	0.65	0.22	1.56	1.37	1.64	1.12	0.85	0.9
Cadmium	0.0002	0.008	0.0004	0.0023	0.0019	0.003	0.0033	0.0011	0.0021	0.0001
Chromium	nv	0.08	<0.001	<0.001	<0.005	<0.001	<0.010	<0.005	0.002	0.002
Cobalt	0.0009	nv	0.0028	0.0021	0.006	0.0079	0.0347	0.0044	0.0044	0.0035
Copper	0.005	0.04	0.018	0.603	0.025	0.024	0.028	0.017	0.011	0.003
Iron	0.3	nv	3.91	2.72	3.73	10.4	30.1	14.1	9.46	9.92
Lead	0.005**	0.12	0.018	0.362	0.056	0.06	0.076	0.047	0.007	0.004
Manganese	nv	0.05	**0.68**	**0.12**	**1.26**	**1.2**	**1.8**	**1.51**	**1.4**	**1.39**
Molybdenum	0.04	nv	0.019	0.016	0.022	0.02	0.005	0.017	0.018	0.024
Nickel	0.025	0.08	0.014	0.032	0.045	0.063	0.298	0.033	0.048	0.032
Silver	0.0001	0.12	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.0002	<0.0001	<0.0001
Thallium	0.0003	nv	<0.00100	<0.00100	<0.00100	<0.00100	<0.00100	<0.00100	<0.00100	<0.00100
Vanadium	0.006	nv	0.003	0.003	0.002	0.001	0.009	<0.0010	0.001	<0.0010
Zinc	0.03	0.04	0.23	0.64	2.17	5.59	30	1.24	1.03	0.29
TSS	nv	15	**188**	**32**	**55**	**31**	**1530**	**34**	**22**	**22**
Conductivity (uS/cm)	nv	nv	1400	800	2400	3600	4200	2600	2700	2400
Total Petroleum Hydrocarbons										
TPH-Diesel	nv	nv	<0.2	0.6	0.6	0.5	1	0.3	0.3	<0.2
TPH-Gasoline	nv	nv	<0.2	<0.2	0.3	0.2	0.5	<0.2	<0.2	<0.2
TPH-Gasoline/Diesel	nv	nv	<0.2	0.6	0.9	0.7	1.5	0.3	0.3	<0.2
TPH-Heavy Oils	nv	nv	<1	9	1	<1	7	<1	<1	<1
VOC's:										
Benzene	0.1	0.002	<0.0005	<0.0005	**0.0075**	**0.0082**	**0.0141**	0.0008	0.0005	0.0006
Ethylbenzene	0.008	0.002	<0.0005	<0.0005	**0.0104**	**0.0067**	**0.0102**	0.0008	0.0006	0.0009
Toluene	0.0008	0.002	<0.0005	<0.0005	**0.0611**	**0.0565**	**0.0623**	**0.0051**	0.0037	0.0049
Xylene-m/p	0.032	0.0044	<0.001	<0.001	**0.037**	**0.023**	**0.0342**	**0.0029**	0.002	0.003
Xylene-o	0.04		<0.0005	<0.0005	**0.0182**	**0.0123**	**0.0192**	**0.0016**	0.0012	0.0017

Notes:

All values reported in mg/L unless specified

([1]) PWQO criteria taken from the Ontario Ministry of the Environment "the Provincial Water Quality Objectives", July 1994

([2]) Sewer-Use criteria taken from City of Ottawa By-Law No.2003-514

(*) Assumes a hardness (as $CaCO_3$) of greater than 75 mg/L. A criteria 0.011 mg/L would apply for locations with a hardness less than 75 mg/L

(**) Assumes a hardness (as $CaCO_3$) of greater than 80 mg/L. A criteria 0.003 mg/L would apply for locations with a hardness less than 80 mg/L and greater than 30 mg/L

(nv) no value exists

Shaded results represent an exceedance of PWQO criteria

Bold Bolded results represent an exceedance of Storm Sewer Discharge criteria

Underlined Discharge results are greater than upstream water quality

TABLE 3
Water Quality Results - Ramsay Creek

"Surface Water Flow Direction" →

Parameter	PWQO[1]	City of Ottawa Sampling Station CK21-007 "Up-Stream" [2]	Discharge from 1350 mm Storm Sewer (Industrial Park) Bakermet Site and 1800 mm Storm Sewer (Industrial Park)	City of Ottawa Sampling Station CK21-006 "Down-Stream" [2]
Inorganics				
Aluminum	0.075	0.69 - 1.62		0.067 - 1.17
Beryllium	1.1*	<0.0005 - 0.0006		<0.0005 - 0.0009
Boron	0.2	nm		nm
Cadmium	0.0002	<0.0005 - 0.0008		<0.0005 - 0.0009
Chromium	nv	0.0016 - 0.0034		<0.0005 - 0.0038
Cobalt	0.0009	0.001 - 0.0014		<0.0005 - 0.002
Copper	0.005	0.0009 - 0.0172		0.0005 - 0.0103
Iron	0.3	0.89 - 1.69		0.22 - 2.2
Lead	0.005**	<0.001		<0.001 - 0.001
Manganese	nv	0.094 - 0.2		0.118 - 0.34
Molybdenum	0.04	0.004 - 0.0053		0.0022 - 0.0039
Nickel	0.025	0.002 - 0.003		0.002 - 0.004
Silver	0.0001	<0.0005 - 0.028		<0.0005 - 0.021
Thallium	0.0003	<0.005 - 0.012		<0.005
Vanadium	0.006	0.0035 - 0.0052		0.0019 - 0.0057
Zinc	0.03	0.007 - 0.024		0.006 - 0.022
TSS	nv	19 - 128		6 - 41
Conductivity	nv	1190 - 1510		1100 - 1630

Notes: Data from City of Ottawa; range shown from 7 sampling events June - August 2001
All values reported in mg/L unless specified
([1]) PWQO criteria taken from the Ontario Ministry of the Environment "the Provincial Water Quality Objectives", July 1994
([2]) Surface water qualtiy sampling carried out by the City of Ottawa on June 6, 12, 21, 2001/July 19, 2001/ August 7, 13, 21, 2001
(*) Assumes a hardness (as $CaCO_3$) of greater than 75 mg/L. A criteria 0.011 mg/L would apply for locations with a hardness less than 75 mg/L
(**) Assumes a hardness (as $CaCO_3$) of greater than 80 mg/L. A criteria 0.003 mg/L would apply for locations with a hardness less than 80 mg/L and greater than 30 mg/L
(nv) no value exists
(nm) no measured
Shaded results represent an exceedance of PWQO criteria
Underlined Results are greater than upstream water quality

TABLE 4

COMPARISON OF NOVEMBER 2003 AND MAY 2004 RUNOFF ANALYSES

Parameter	Nov. 5/03[1] Location C111060-0005	May 5/04[2] Location C	Nov. 5/03 Location C111060-0003	May 5/04 Location H
Aluminum	0.03	0.03	0.17	<0.01
Barium	0.038	0.8	0.078	0.11
Baryllium	0.000021	<0.001	0.000023	<0.001
Cadmium	0.0018	0.0023	0.0013	0.0011
Chromium	0.004	<0.001	N.D.	<0.005
Cobalt	N.D.	0.0021	0.0018	0.0044
Copper	0.077	0.603	0.0097	0.017
Iron	0.23	2.72	1.00	14.1
Lead	N.D.	0.362	N.D.	0.047
Manganese	0.42	0.12	0.75	1.51
Molybdenum	0.036	0.016	0.0046	0.017
Nickel	0.035	0.032	0.022	0.033
Zinc	0.23	0.64	1.5	1.24

Notes: All values reported in mg/L

(1) November 5, 2003 results from MOE sampling, Report No. C111060, Nov. 25, 2003

(2) May 5, 2004 results from Golder sampling

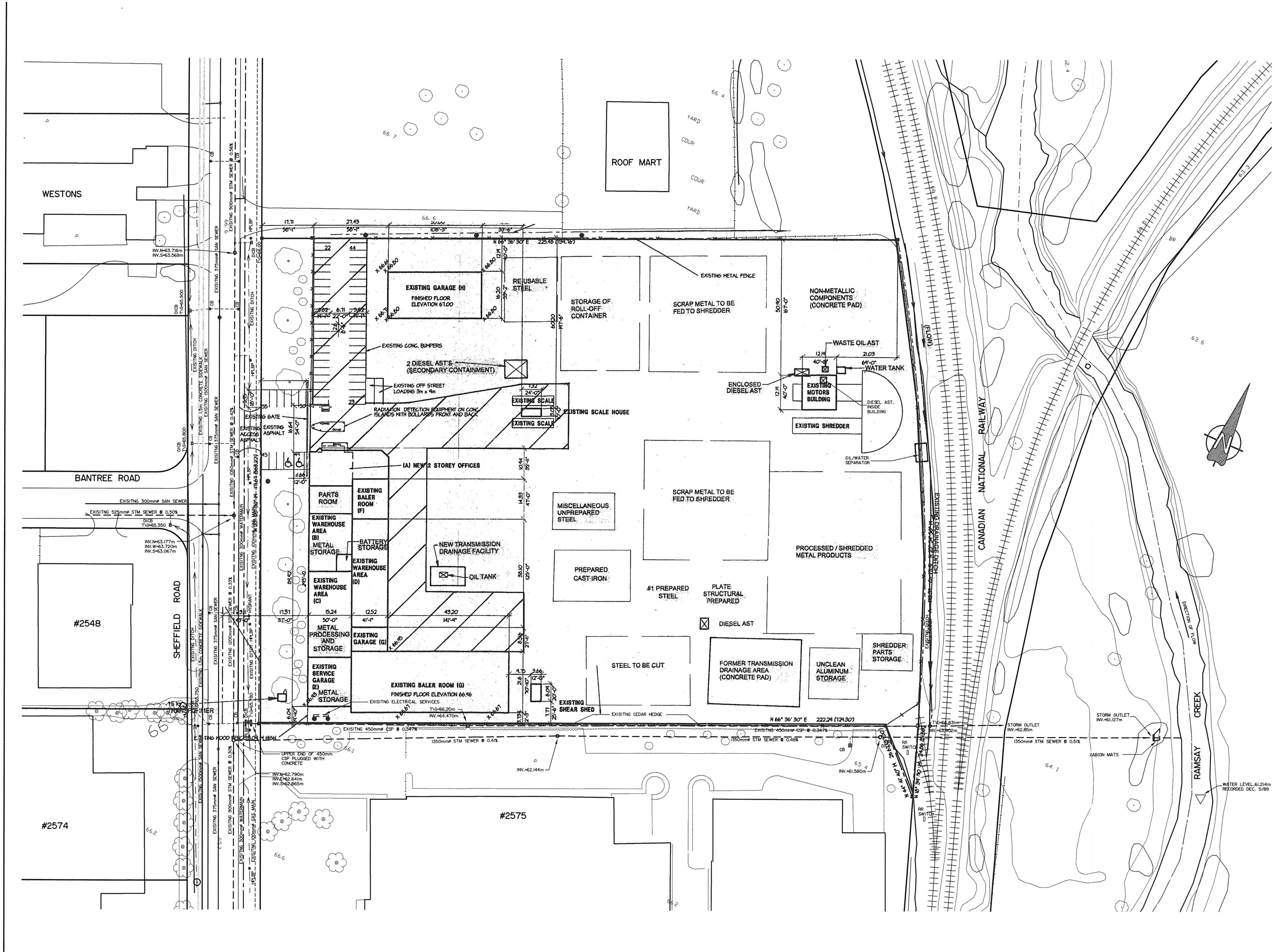
N.D. = not detected

SPECIAL NOTE
THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING REPORT

Golder Associates
Ottawa, Ontario

SCALE	1:15,000	TITLE	KEY PLAN
DATE	06/21/04		
DESIGN			
CADD	J.M.		
FILE No. 0311208956000-01	CHECK P.A.S.	2555 SHEFFIELD ROAD OTTAWA, ONTARIO	FIGURE 1
PROJECT No. 03-1120-895 REV.	REVIEW		

Drawing file: 03-1120-895-6000-01.dwg Jun 22, 2004 - 8:42am



LEGEND:

- EXISITNG SANITARY SEWER & MANHOLE
- EXISITNG STORM SEWER & MANHOLE
- EXISITNG WATERMAIN, VALVE & HYDRANT
- EXISTING CATCH BASIN
- EXISTING DITCH INLET CATCH BASIN
- EXISTING SIDEWALK

NO.	REVISION	DATE

NO.	ISSUE	DATE

Golder Associates Ltd.
OTTAWA, ONTARIO, CANADA

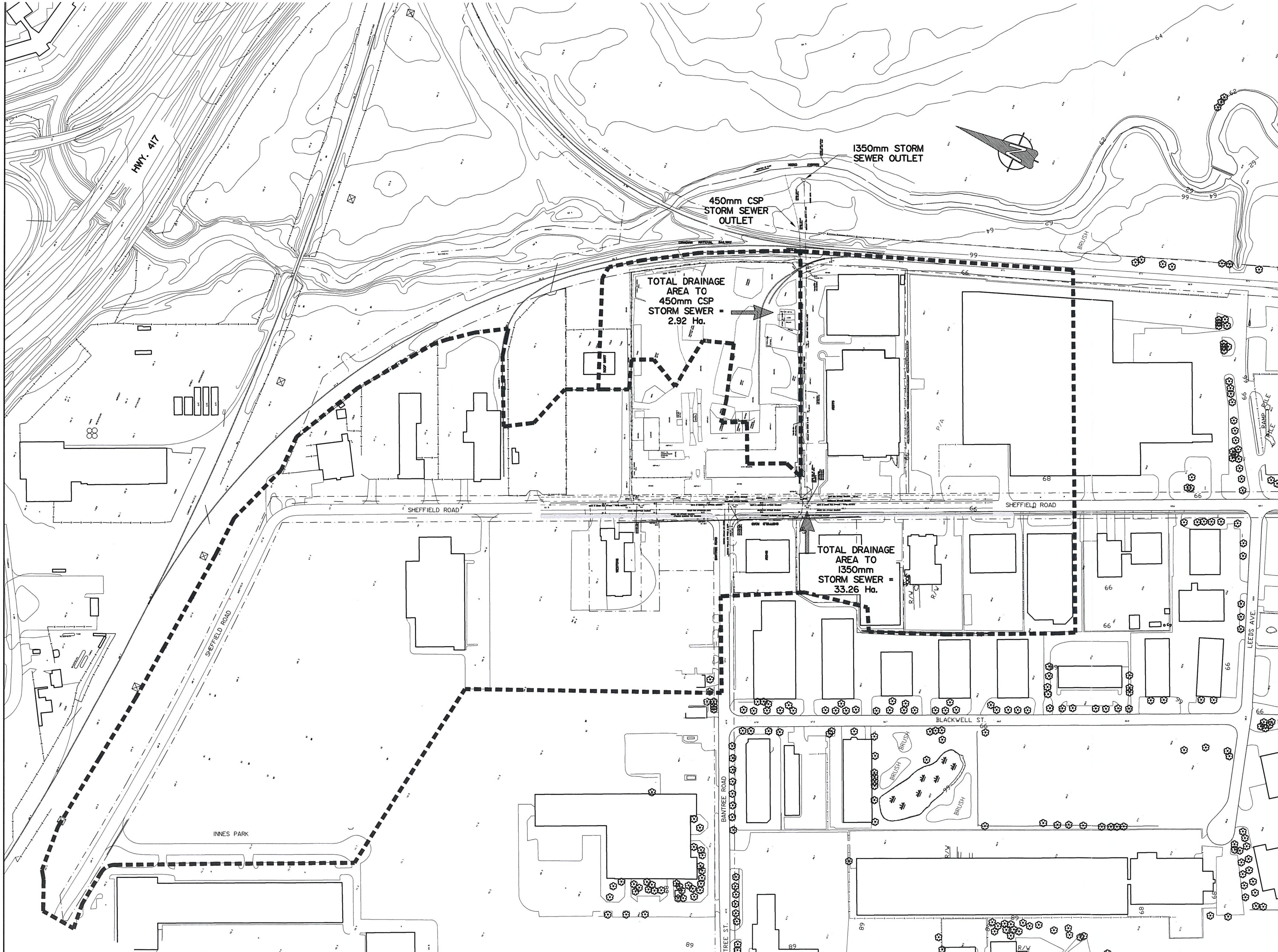
J.L.Richards & Associates Limited
Consulting Engineers, Architects & Planners
864 LADY ELLEN PLACE, OTTAWA, CANADA K1Z 5M2

PROJECT: BAKERMET INC.

2555 SHEFFIELD ROAD

DRAWING: SITE PLAN

DESIGN:	REVISION NO.:
DRAWN: DU	DRAWING NO.:
CHECKED: JC	FIGURE 2
DATE: MARCH 2004	
SCALE: N.T.S.	JOB NO.: 19612



LEGEND:

EXISITNG SANITARY SEWER & MANHOLE
EXISITNG STORM SEWER & MANHOLE
EXISITNG WATERMAIN, VALVE & HYDRANT
EXISTING CATCH BASIN
EXISTING DITCH INLET CATCH BASIN
EXISTING SIDEWALK
DRAINAGE AREA BOUNDARY

NO.	REVISION	DATE

NO.	ISSUE	DATE

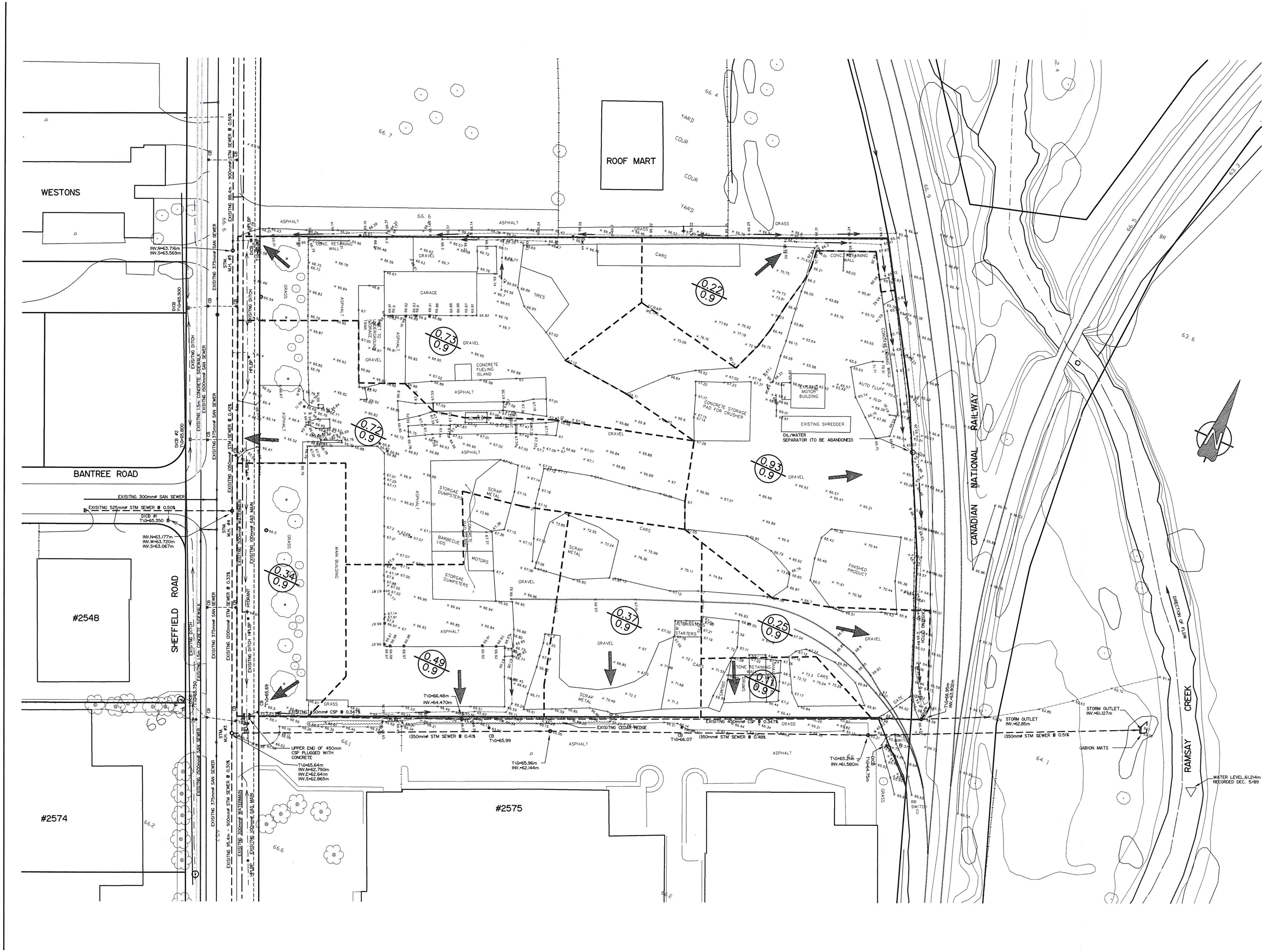
Golder Associates Ltd.
OTTAWA, ONTARIO, CANADA

J.L.Richards & Associates Limited
Consulting Engineers, Architects & Planners
864 LADY ELLEN PLACE, OTTAWA, CANADA K1Z 5M2

PROJECT:
BAKERMET INC.
2555 SHEFFIELD ROAD

DRAWING:
DRAINAGE AREA PLAN

DESIGN: JC	REVISION NO.:
DRAWN: DU	DRAWING NO.:
CHECKED: JC	FIGURE 3
DATE: MARCH 2004	
SCALE: N.T.S.	JOB NO.: 19612



LEGEND:

- EXISTING SANITARY SEWER & MANHOLE
- EXISITNG STORM SEWER & MANHOLE
- EXISITNG WATERMAIN, VALVE & HYDRANT
- EXISITNG CATCH BASIN
- EXISITNG DITCH INLET CATCH BASIN
- EXISITNG SIDEWALK
- SITE DRAINAGE AREA BOUNDARY
- 0.93 — DRAINAGE AREA (Ha.)
- 0.9 — RUNOFF COEFFICIENT

NO.	REVISION	DATE

NO.	ISSUE	DATE

Golder Associates Ltd.
OTTAWA, ONTARIO, CANADA

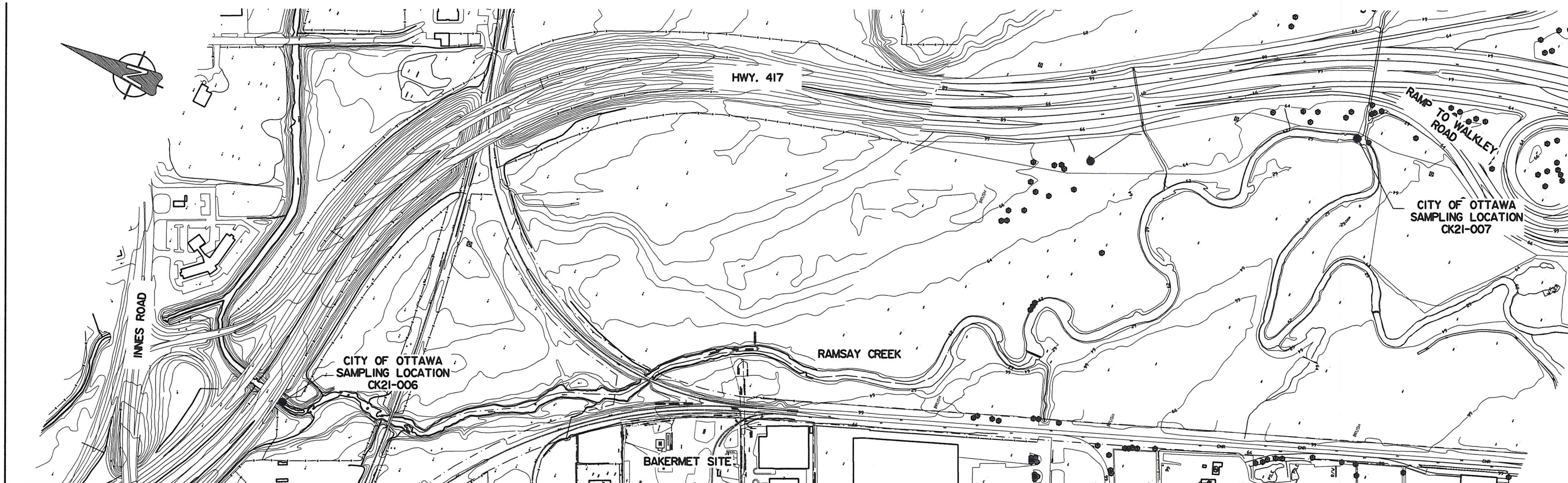
J.L.Richards & Associates Limited
Consulting Engineers, Architects & Planners
864 LADY ELLEN PLACE, OTTAWA, CANADA K1Z 5M2

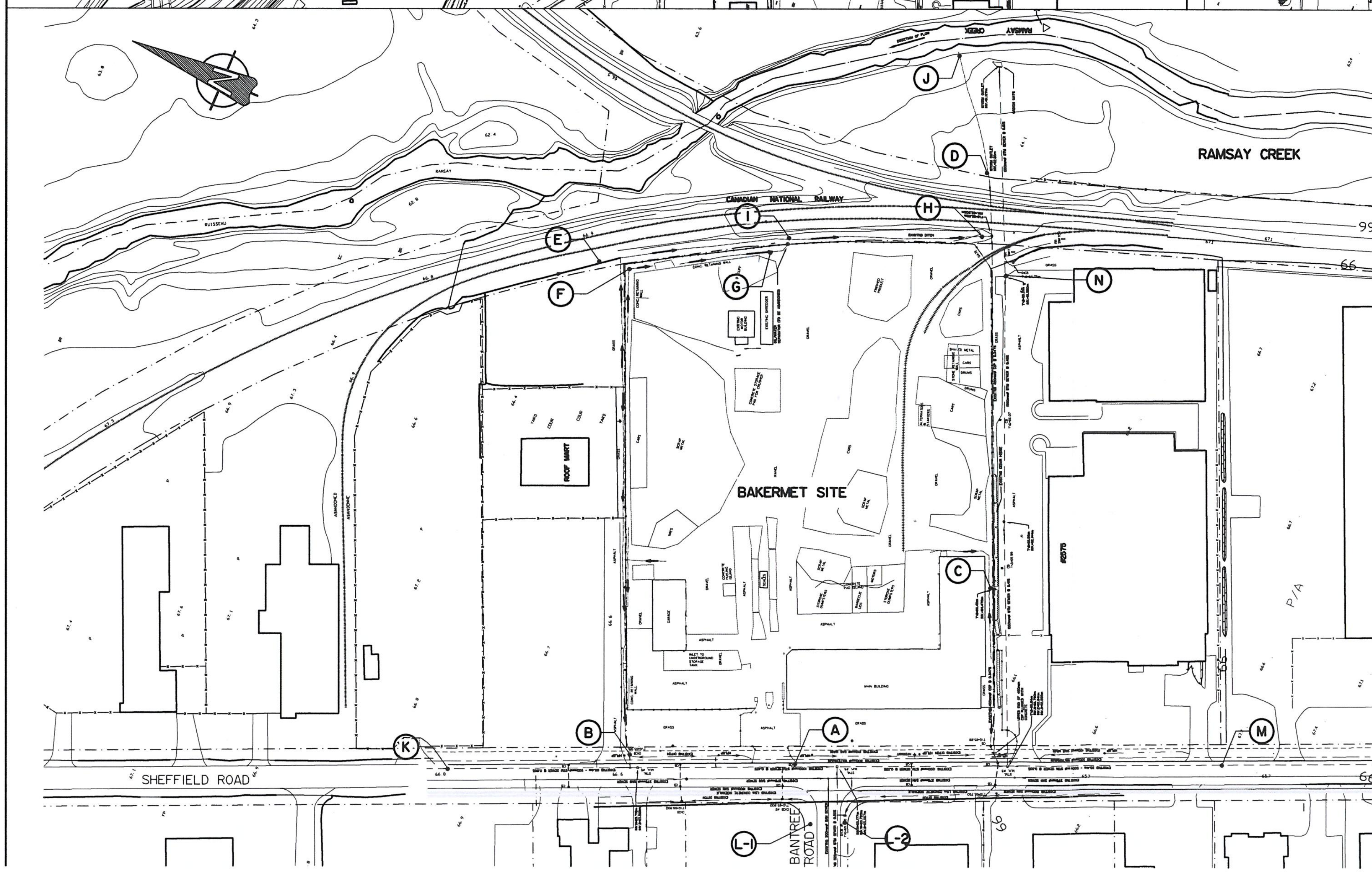
PROJECT:
BAKERMET INC.

2555 SHEFFIELD ROAD

DRAWING:
SITE DRAINAGE AREA PLAN

DESIGN: JC		REVISION NO.:
DRAWN: DU		DRAWING NO.:
CHECKED: JC		FIGURE 4
DATE: MARCH 2004		
SCALE: N.T.S.		JOB NO.: 19612





LOCATION	DESCRIPTION OF SURFACE WATER SAMPLING LOCATION (MAY 5, 2004)
A	Runoff at main paved site access to Sheffield Road catchbasin (1350 mm sewer)
B	Runoff at northwest corner of site to Sheffield Road catchbasin (1350 mm sewer)
C	Runoff ditch at south central side of site as enters manhole along the 450 mm CSP sewer
D	Discharge from 450 mm sewer on east side of railway tracks
E	Off-site railside ditch, upstream (north) of Bakermet site
F	On-site ditch at northeast corner of site
G	On-site ditch along north part of east boundary, before entering oil-water separator
H	Off-site railside ditch along east boundary before it enters 450 mm sewer
I	Oil-water separator discharge from the site to the off-site railside ditch
J	Outlet swale from 450 mm sewer before it enters Ramsay Creek
K	900 mm Sheffield Road sewer at manhole upstream (north) of Bakermet site
L-1 and L-2	Ditch inlets from Bantree Road ditches to Sheffield Road storm sewer
M	900 mm Sheffield Road sewer at manhole upstream (south) of Bakermet site
N	Off-site manhole on 1350 mm sewer near southeast corner of site

LEGEND:

- EXISTING SANITARY SEWER & MANHOLE
- EXISTING STORM SEWER & MANHOLE
- EXISTING WATERMAIN, VALVE & HYDRANT
- EXISTING CATCH BASIN
- EXISTING DITCH INLET CATCH BASIN
- EXISTING SIDEWALK

NO.	REVISION	DATE

NO.	ISSUE	DATE

Golder Associates Ltd.
OTTAWA, ONTARIO, CANADA

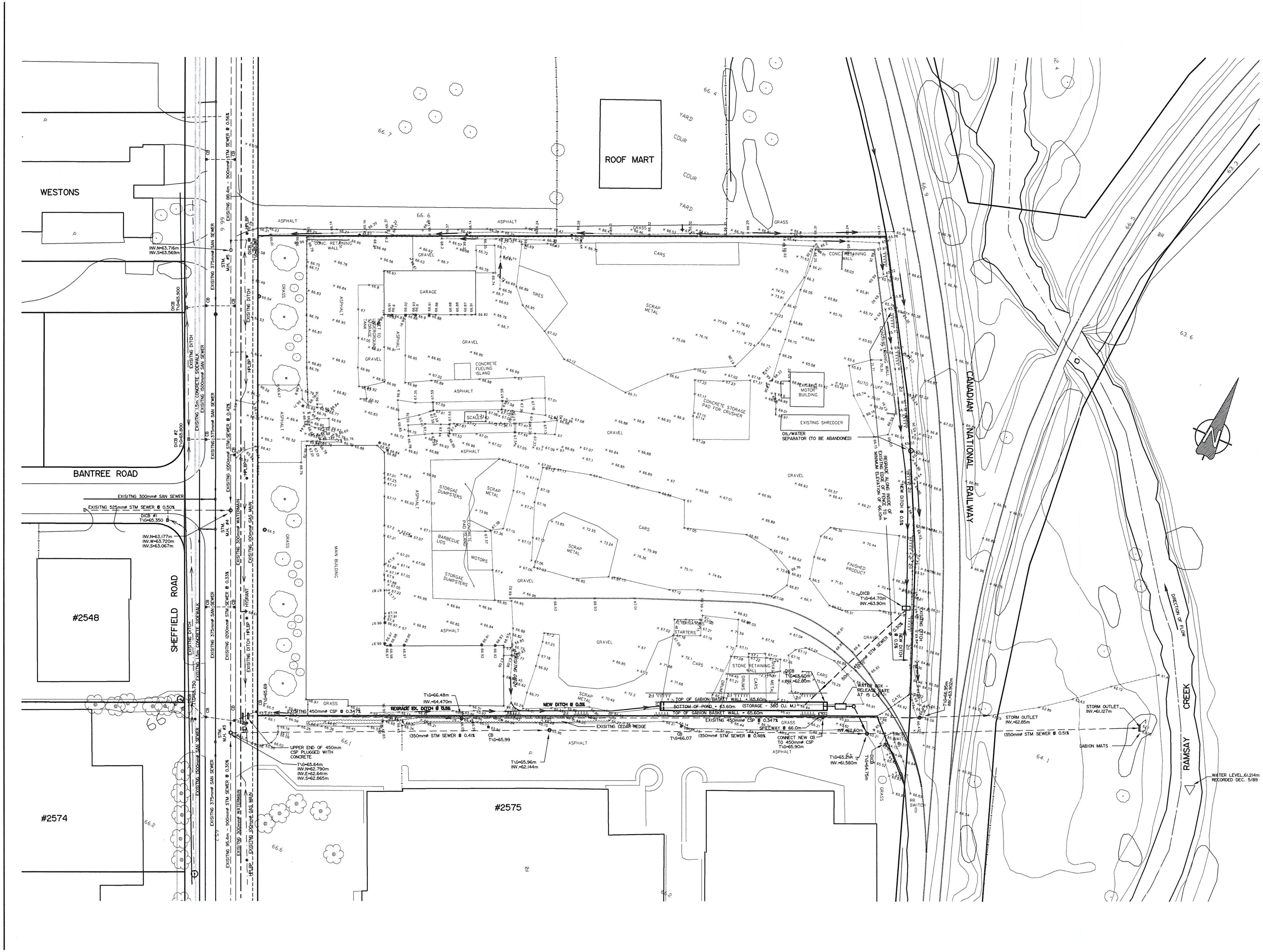
J.L.Richards & Associates Limited
Consulting Engineers, Architects & Planners
864 LADY ELLEN PLACE, OTTAWA, CANADA K1Z 5M2

PROJECT:
BAKERMET INC.

2555 SHEFFIELD ROAD

DRAWING:
SURFACE WATER SAMPLING LOCATION PLAN

DESIGN: JC	REVISION NO.:
DRAWN: DU	DRAWING NO.:
CHECKED: JC	FIGURE 5
DATE: MARCH 2004	
SCALE: N.T.S.	JOB NO.: [illegible]



LEGEND:

- EXISTING SANITARY SEWER & MANHOLE
- EXISTING STORM SEWER & MANHOLE
- EXISTING WATERMAIN, VALVE & HYDRANT
- EXISTING CATCH BASIN
- EXISTING DITCH INLET CATCH BASIN
- EXISTING SIDEWALK

NO.	REVISION	DATE

NO.	ISSUE	DATE

Golder Associates Ltd.
OTTAWA, ONTARIO, CANADA

J.L.Richards & Associates Limited
Consulting Engineers, Architects & Planners
864 LADY ELLEN PLACE, OTTAWA, CANADA K1Z 5M2

PROJECT: BAKERMET INC.

2555 SHEFFIELD ROAD

DRAWING: PROPOSED SURFACE WATER MANAGEMENT PLAN

DESIGN: JC	REVISION NO.:
DRAWN: DU	DRAWING NO.:
CHECKED: JC	FIGURE 6
DATE: MARCH 2004	
SCALE: N.T.S.	JOB NO.: 19612

APPENDIX A

ACCUTEST LABORATORIES REPORTS OF ANALYSES

ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

Client: **Golder Associates Ltd.**
1796 Courtwood Cr.
Ottawa, ON
K2C 2B5
Attention: **Mr. Keith Holmes**

Report Number: 2407943
Date: 2004-05-07
Date Submitted: 2004-05-05

Project: 03-1120-895

P.O. Number:
Matrix: Surfacewater

		LAB ID:	315961	315962	315963	315964	315965	**GUIDELINE**		
		Sample Date:	2004-05-05	2004-05-05	2004-05-05	2004-05-05	2004-05-05			
		Sample ID:	SA-A	SA-B	SA-C	SA-D	SA-E			
PARAMETER	**UNITS**	**MDL**						**TYPE**	**LIMIT**	**UNITS**
Total Suspended Solids	mg/L	2	34200	51	32	22	188			
Aluminum	mg/L	0.01	0.02	<0.01	0.03	<0.01	<0.01			
Barium	mg/L	0.01	0.33	0.24	0.08	0.09	0.07			
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001			
Boron	mg/L	0.01	0.62	0.49	0.22	0.85	0.65			
Cadmium	mg/L	0.0001	0.0311	0.0005	0.0023	0.0021	0.0004			
Chromium	mg/L	0.001	0.002	0.002	<0.001	0.002	<0.001			
Cobalt	mg/L	0.0002	0.0212	0.0150	0.0021	0.0044	0.0028			
Copper	mg/L	0.001	0.973	0.025	0.603	0.011	0.018			
Iron	mg/L	0.01	5.47	22.8	2.72	9.46	3.91			
Lead	mg/L	0.001	1.78	0.020	0.362	0.007	0.018			
Manganese	mg/L	0.01	3.02	2.33	0.12	1.40	0.68			
Molybdenum	mg/L	0.005	0.006	0.015	0.016	0.018	0.019			
Nickel	mg/L	0.005	0.157	0.044	0.032	0.048	0.014			
Silicon	mg/L	0.1	6.0	4.8	1.7	4.7	5.1			
Silver	mg/L	0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001			
Strontium	mg/L	0.001	2.84	2.42	0.392	1.94	0.615			
Thallium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001			
Titanium	mg/L	0.01	0.02	<0.01	0.02	<0.01	<0.01			
Vanadium	mg/L	0.001	0.012	0.001	0.003	0.001	0.003			
Zinc	mg/L	0.01	14.3	0.25	0.64	1.03	0.23			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:
315961: MDL for some Cr results increased due to interference.

APPROVAL:
Ewan McRobbie
Inorganic Lab Supervisor

ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

Client: **Golder Associates Ltd.**
1796 Courtwood Cr.
Ottawa, ON
K2C 2B5
Attention: **Mr. Keith Holmes**

Report Number: 2407943
Date: 2004-05-07
Date Submitted: 2004-05-05
Project: 03-1120-895
P.O. Number:
Matrix: Surfacewater

		LAB ID:	315966	315967	315968	315969	315970	**GUIDELINE**		
		Sample Date:	2004-05-05	2004-05-05	2004-05-05	2004-05-05	2004-05-05			
		Sample ID:	SA-F	SA-G	SA-H	SA-I	SA-J			
PARAMETER	**UNITS**	**MDL**						**TYPE**	**LIMIT**	**UNITS**
Total Suspended Solids	mg/L	2	55	31	34	1530	22			
Aluminum	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Barium	mg/L	0.01	0.07	0.10	0.11	0.24	0.08			
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001			
Boron	mg/L	0.01	1.56	1.37	1.12	1.64	0.90			
Cadmium	mg/L	0.0001	0.0019	0.0030	0.0011	0.0033	0.0001			
Chromium	mg/L	0.001	<0.005	<0.001	<0.005	<0.01	0.002			
Cobalt	mg/L	0.0002	0.0060	0.0079	0.0044	0.0347	0.0035			
Copper	mg/L	0.001	0.025	0.024	0.017	0.028	0.003			
Iron	mg/L	0.01	3.73	10.4	14.1	80.1	9.92			
Lead	mg/L	0.001	0.056	0.060	0.047	0.076	0.004			
Manganese	mg/L	0.01	1.26	1.20	1.51	1.80	1.39			
Molybdenum	mg/L	0.005	0.022	0.020	0.017	0.005	0.024			
Nickel	mg/L	0.005	0.045	0.063	0.033	0.298	0.032			
Silicon	mg/L	0.1	3.1	3.7	4.4	6.6	4.8			
Silver	mg/L	0.0001	<0.0001	<0.0001	0.0002	0.0001	<0.0001			
Strontium	mg/L	0.001	1.38	2.46	2.70	2.30	1.96			
Thallium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001			
Titanium	mg/L	0.01	0.01	<0.01	<0.01	0.02	<0.01			
Vanadium	mg/L	0.001	0.002	0.001	<0.001	0.009	<0.001			
Zinc	mg/L	0.01	2.17	5.59	1.24	30.0	0.29			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL: ____________
Ewan McRobbie
Inorganic Lab Supervisor

ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

Client: Golder Associates Ltd.
1796 Courtwood Cr.
Ottawa, ON
K2C 2B5
Attention: Mr. Keith Holmes

Report Number: 2407943
Date: 2004-05-07
Date Submitted: 2004-05-05

Project: 03-1120-895

P.O. Number:
Matrix: Surfacewater

PARAMETER	UNITS	MDL	315971	315972				GUIDELINE TYPE	GUIDELINE LIMIT	GUIDELINE UNITS
Sample Date:			2004-05-05	2004-05-05						
Sample ID:			SA-K	SA-L-1						
Total Suspended Solids	mg/L	2	104	277						
Aluminum	mg/L	0.01	<0.01	0.04						
Barium	mg/L	0.01	0.09	0.08						
Beryllium	mg/L	0.001	<0.001	<0.001						
Boron	mg/L	0.01	0.06	0.11						
Cadmium	mg/L	0.0001	0.0008	0.0011						
Chromium	mg/L	0.001	0.003	0.005						
Cobalt	mg/L	0.0002	0.0029	0.0015						
Copper	mg/L	0.001	0.059	0.151						
Iron	mg/L	0.01	1.45	1.75						
Lead	mg/L	0.001	0.050	0.172						
Manganese	mg/L	0.01	0.48	0.14						
Molybdenum	mg/L	0.005	<0.005	0.010						
Nickel	mg/L	0.005	0.011	0.013						
Silicon	mg/L	0.1	2.5	3.3						
Silver	mg/L	0.0001	<0.0001	<0.0001						
Strontium	mg/L	0.001	1.33	0.356						
Thallium	mg/L	0.001	<0.001	<0.001						
Titanium	mg/L	0.01	0.01	0.02						
Vanadium	mg/L	0.001	0.003	0.004						
Zinc	mg/L	0.01	0.46	0.57						

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL: ____________
Ewan McRobbie
Inorganic Lab Supervisor

ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

Client: Golder Associates Ltd.
1796 Courtwood Cr.
Ottawa, ON
K2C 2B5
Attention: Mr. Keith Holmes

Report Number: 2407943
Date: 2004-05-14
Date Submitted: 2004-05-05

Project: 03-1120-895

P.O. Number:
Matrix: Surfacewater

		LAB ID:	315961	315962	315963	315964	315965	GUIDELINE		
		Sample Date:	2004-05-05	2004-05-05	2004-05-05	2004-05-05	2004-05-05			
		Sample ID:	SA-A	SA-B	SA-C	SA-D	SA-E			
PARAMETER	**UNITS**	**MDL**						**TYPE**	**LIMIT**	**UNITS**
VOLATILE ORGANIC COMPOUNDS - VOCs										
1,1,1,2-tetrachloroethane	ug/L	0.6	<0.6	<0.6	<0.6	<0.6	<0.6			
1,1,1-trichloroethane	ug/L	0.4	<0.4	<2.1	<0.4	<0.4	<0.4			
1,1,2,2-tetrachloroethane	ug/L	0.6	<0.6	<3.4	<0.6	<0.6	<0.6			
1,1,2-trichloroethane	ug/L	0.4	<0.4	<1.9	<0.4	<0.4	<0.4			
1,1-dichloroethane	ug/L	0.4	<0.4	<3.5	<0.4	<0.4	<0.4			
1,1-dichloroethylene	ug/L	0.5	<0.5	<1.6	<0.5	<0.5	<0.5			
1,2-dibromoethane	ug/L	1.0	<1.0	<3.8	<1.0	<1.0	<1.0			
1,2-dichlorobenzene	ug/L	0.4	<0.4	<1.9	<0.4	<0.4	<0.4			
1,2-dichloroethane	ug/L	0.5	<0.5	<2.9	<0.5	<0.5	<0.5			
1,2-dichloropropane	ug/L	0.7	<0.7	<2.4	<0.7	<0.7	<0.7			
1,3,5-trimethylbenzene	ug/L	0.3	3.3	<1.6	<0.3	<0.3	<0.3			
1,3-dichlorobenzene	ug/L	0.4	<0.4	<2.4	<0.4	<0.4	<0.4			
1,4-dichlorobenzene	ug/L	0.4	<0.4	<2.4	<0.4	<0.4	<0.4			
Benzene	ug/L	0.5	1.0	47.1	<0.5	0.5	<0.5			
Bromodichloromethane	ug/L	0.3	<0.3	<2.0	<0.3	<0.3	<0.3			
Bromoform	ug/L	0.4	<0.4	<1.9	<0.4	<0.4	<0.4			
Bromomethane	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5			
c-1,2-Dichloroethylene	ug/L	0.4	<0.4	<1.2	<0.4	<0.4	<0.4			
c-1,3-Dichloropropylene	ug/L	0.2	<0.2	<2.6	<0.2	<0.2	<0.2			
Carbon Tetrachloride	ug/L	0.5	<0.5	<1.3	<0.5	<0.5	<0.5			
Chloroethane	ug/L	1.0	<1.0	<1.0	<1.0	<1.0	<1.0			
Chloroform	ug/L	0.5	<0.5	<1.4	<0.5	<0.5	<0.5			
Chloromethane	ug/L	1.0	<1.0	<1.0	<1.0	<1.0	<1.0			
Dibromochloromethane	ug/L	0.3	<0.3	<2.3	<0.3	<0.3	<0.3			
Dichloromethane	ug/L	4.0	<4.0	<4.8	<4.0	<4.0	<4.0			
Ethylbenzene	ug/L	0.5	4.4	6.5	<0.5	0.6	<0.5			
m/p-xylene	ug/L	1.0	14.7	24.9	<1.0	2.0	<1.0			
Monochlorobenzene	ug/L	0.2	<0.2	<2.0	<0.2	<0.2	<0.2			
o-xylene	ug/L	0.5	7.9	17.3	<0.5	1.2	<0.5			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:
315961: MDL for some Cr results increased due to interference.

APPROVAL:
Mina Nasirai
O[illegible] Lab Su[illegible]

Client: **Golder Associates Ltd.**
1796 Courtwood Cr.
Ottawa, ON
K2C 2B5
Attention: **Mr. Keith Holmes**

Report Number: 2407943
Date: 2004-05-14
Date Submitted: 2004-05-05

Project: 03-1120-895

P.O. Number:
Matrix: Surfacewater

		LAB ID:	315961	315962	315963	315964	315965	**GUIDELINE**		
		Sample Date:	2004-05-05	2004-05-05	2004-05-05	2004-05-05	2004-05-05			
		Sample ID:	SA-A	SA-B	SA-C	SA-D	SA-E			
PARAMETER	**UNITS**	**MDL**						**TYPE**	**LIMIT**	**UNITS**
Styrene	ug/L	0.5	0.9	<4.2	<0.5	<0.5	<0.5			
t-1,2-Dichloroethylene	ug/L	0.4	<0.4	<1.1	<0.4	<0.4	<0.4			
t-1,3-Dichloropropylene	ug/L	0.2	<0.2	<2.1	<0.2	<0.2	<0.2			
Tetrachloroethylene	ug/L	0.3	<0.3	<2.2	<0.3	<0.3	<0.3			
Toluene	ug/L	0.5	13.0	82.3	<0.5	3.7	<0.5			
Trichloroethylene	ug/L	0.3	<0.3	<1.9	<0.3	<0.3	<0.3			
Trichlorofluoromethane	ug/L	0.5	7.9	<2.0	<0.5	0.6	<0.5			
Vinyl Chloride	ug/L	0.2	<0.2	<4.9	<0.2	<0.2	<0.2			
VOC SURROGATES										
1,2-dichloroethane-d4	%		107	97	111	106	107			
4-bromofluorobenzene	%		99	102	96	99	97			
Toluene-d8	%		103	100	102	100	102			
Total Petroleum Hydrocarbons										
GRO (<C10)	mg/L	0.2	<0.2	0.9	<0.2	<0.2	<0.2			
DRO (C10-C24)	mg/L	0.2	0.3	0.3	0.6	0.3	<0.2			
GRO + DRO	mg/L	0.2	0.3	1.2	0.6	0.3	<0.2			
Oil & Grease										
Oil & Grease - Mineral	mg/L	1	4	<1	9	<1	<1			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:
Mina Nasirai
Organic Lab Supervisor

ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

Client: Golder Associates Ltd.
1796 Courtwood Cr.
Ottawa, ON
K2C 2B5
Attention: Mr. Keith Holmes

Report Number: 2407943
Date: 2004-05-14
Date Submitted: 2004-05-05

Project: 03-1120-895

P.O. Number:
Matrix: Surfacewater

		LAB ID:	315966	315967	315968	315969	315970	GUIDELINE		
		Sample Date:	2004-05-05	2004-05-05	2004-05-05	2004-05-05	2004-05-05			
		Sample ID:	SA-F	SA-G	SA-H	SA-I	SA-J			
PARAMETER	**UNITS**	**MDL**						**TYPE**	**LIMIT**	**UNITS**
VOLATILE ORGANIC COMPOUNDS - VOCs										
1,1,1,2-tetrachloroethane	ug/L	0.6	<0.6	<0.6	<0.6	<0.6	<0.6			
1,1,1-trichloroethane	ug/L	0.4	<0.4	<0.4	<0.4	<0.4	<0.4			
1,1,2,2-tetrachloroethane	ug/L	0.6	<0.6	<0.6	<0.6	<0.6	<0.6			
1,1,2-trichloroethane	ug/L	0.4	<0.4	<0.4	<0.4	<0.4	<0.4			
1,1-dichloroethane	ug/L	0.4	<0.4	<0.4	<0.4	<0.4	<0.4			
1,1-dichloroethylene	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5			
1,2-dibromoethane	ug/L	1.0	<1.0	<1.0	<1.0	<1.0	<1.0			
1,2-dichlorobenzene	ug/L	0.4	<0.4	<0.4	<0.4	<0.4	<0.4			
1,2-dichloroethane	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5			
1,2-dichloropropane	ug/L	0.7	<0.7	<0.7	<0.7	<0.7	<0.7			
1,3,5-trimethylbenzene	ug/L	0.3	3.8	1.6	0.3	2.8	0.4			
1,3-dichlorobenzene	ug/L	0.4	<0.4	<0.4	<0.4	<0.4	<0.4			
1,4-dichlorobenzene	ug/L	0.4	<0.4	<0.4	<0.4	<0.4	<0.4			
Benzene	ug/L	0.5	7.5	8.2	0.8	14.1	0.6			
Bromodichloromethane	ug/L	0.3	<0.3	<0.3	<0.3	<0.3	<0.3			
Bromoform	ug/L	0.4	<0.4	<0.4	<0.4	<0.4	<0.4			
Bromomethane	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5			
c-1,2-Dichloroethylene	ug/L	0.4	0.5	<0.4	<0.4	<0.4	<0.4			
c-1,3-Dichloropropylene	ug/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2			
Carbon Tetrachloride	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5			
Chloroethane	ug/L	1.0	<1.0	<1.0	<1.0	<1.0	<1.0			
Chloroform	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5			
Chloromethane	ug/L	1.0	<1.0	<1.0	<1.0	<1.0	<1.0			
Dibromochloromethane	ug/L	0.3	<0.3	<0.3	<0.3	<0.3	<0.3			
Dichloromethane	ug/L	4.0	<4.0	<4.0	<4.0	<4.0	<4.0			
Ethylbenzene	ug/L	0.5	10.4	6.7	0.8	10.2	0.9			
m/p-xylene	ug/L	1.0	37.0	23.0	2.9	34.2	3.0			
Monochlorobenzene	ug/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2			
o-xylene	ug/L	0.5	18.2	12.3	1.6	19.2	1.7			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:
Mina Nasirai
Or... Lab Su...

Client: **Golder Associates Ltd.**
1796 Courtwood Cr.
Ottawa, ON
K2C 2B5
Attention: **Mr. Keith Holmes**

Report Number: 2407943
Date: 2004-05-14
Date Submitted: 2004-05-05

Project: 03-1120-895

P.O. Number:
Matrix: Surfacewater

PARAMETER	UNITS	MDL	315966	315967	315968	315969	315970	GUIDELINE TYPE	GUIDELINE LIMIT	GUIDELINE UNITS
Sample Date:			2004-05-05	2004-05-05	2004-05-05	2004-05-05	2004-05-05			
Sample ID:			SA-F	SA-G	SA-H	SA-I	SA-J			
Styrene	ug/L	0.5	3.2	2.2	<0.5	3.5	<0.5			
t-1,2-Dichloroethylene	ug/L	0.4	<0.4	<0.4	<0.4	<0.4	<0.4			
t-1,3-Dichloropropylene	ug/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2			
Tetrachloroethylene	ug/L	0.3	0.4	<0.3	<0.3	0.3	<0.3			
Toluene	ug/L	0.5	61.1	56.5	5.1	62.3	4.9			
Trichloroethylene	ug/L	0.3	<0.3	<0.3	<0.3	<0.3	<0.3			
Trichlorofluoromethane	ug/L	0.5	11.8	12.8	0.7	8.9	<0.5			
Vinyl Chloride	ug/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2			
VOC SURROGATES										
1,2-dichloroethane-d4	%		107	107	108	101	106			
4-bromofluorobenzene	%		103	101	99	98	99			
Toluene-d8	%		100	100	103	99	104			
Total Petroleum Hydrocarbons										
GRO (<C10)	mg/L	0.2	0.3	0.2	<0.2	0.5	<0.2			
DRO (C10-C24)	mg/L	0.2	0.6	0.5	0.3	1.0	<0.2			
GRO + DRO	mg/L	0.2	0.9	0.7	0.3	1.5	<0.2			
Oil & Grease										
Oil & Grease - Mineral	mg/L	1	1	<1	<1	7	<1			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:
Mina Nasirai
Organic Lab Supervisor

ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

Client: **Golder Associates Ltd.**
1796 Courtwood Cr.
Ottawa, ON
K2C 2B5
Attention: **Mr. Keith Holmes**

Report Number: 2407943
Date: 2004-05-14
Date Submitted: 2004-05-05

Project: 03-1120-895

P.O. Number:
Matrix: Surfacewater

		LAB ID:	315971	315972				**GUIDELINE**		
		Sample Date:	2004-05-05	2004-05-05						
		Sample ID:	SA-K	SA-L-1						
PARAMETER	**UNITS**	**MDL**						**TYPE**	**LIMIT**	**UNITS**
VOLATILE ORGANIC COMPOUNDS - VOCs										
1,1,1,2-tetrachloroethane	ug/L	0.6	<0.6	<0.6						
1,1,1-trichloroethane	ug/L	0.4	<0.4	<0.4						
1,1,2,2-tetrachloroethane	ug/L	0.6	<0.6	<0.6						
1,1,2-trichloroethane	ug/L	0.4	<0.4	<0.4						
1,1-dichloroethane	ug/L	0.4	<0.4	<0.4						
1,1-dichloroethylene	ug/L	0.5	<0.5	<0.5						
1,2-dibromoethane	ug/L	1.0	<1.0	<1.0						
1,2-dichlorobenzene	ug/L	0.4	<0.4	<0.4						
1,2-dichloroethane	ug/L	0.5	<0.5	<0.5						
1,2-dichloropropane	ug/L	0.7	<0.7	<0.7						
1,3,5-trimethylbenzene	ug/L	0.3	<0.3	<0.3						
1,3-dichlorobenzene	ug/L	0.4	<0.4	<0.4						
1,4-dichlorobenzene	ug/L	0.4	<0.4	<0.4						
Benzene	ug/L	0.5	<0.5	<0.5						
Bromodichloromethane	ug/L	0.3	<0.3	<0.3						
Bromoform	ug/L	0.4	<0.4	<0.4						
Bromomethane	ug/L	0.5	<0.5	<0.5						
c-1,2-Dichloroethylene	ug/L	0.4	<0.4	<0.4						
c-1,3-Dichloropropylene	ug/L	0.2	<0.2	<0.2						
Carbon Tetrachloride	ug/L	0.5	<0.5	<0.5						
Chloroethane	ug/L	1.0	<1.0	<1.0						
Chloroform	ug/L	0.5	<0.5	<0.5						
Chloromethane	ug/L	1.0	<1.0	<1.0						
Dibromochloromethane	ug/L	0.3	<0.3	<0.3						
Dichloromethane	ug/L	4.0	<4.0	<4.0						
Ethylbenzene	ug/L	0.5	<0.5	<0.5						
m/p-xylene	ug/L	1.0	<1.0	<1.0						
Monochlorobenzene	ug/L	0.2	<0.2	<0.2						
o-xylene	ug/L	0.5	<0.5	<0.5						

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL: ______
Mina Nasirai
O[illegible] Lab S[illegible]

Client: **Golder Associates Ltd.**
1796 Courtwood Cr.
Ottawa, ON
K2C 2B5
Attention: **Mr. Keith Holmes**

Report Number: 2407943
Date: 2004-05-14
Date Submitted: 2004-05-05

Project: 03-1120-895

P.O. Number:
Matrix: Surfacewater

		LAB ID:	315971	315972				**GUIDELINE**		
		Sample Date:	2004-05-05	2004-05-05						
		Sample ID:	SA-K	SA-L-1						
PARAMETER	**UNITS**	**MDL**						**TYPE**	**LIMIT**	**UNITS**
Styrene	ug/L	0.5	<0.5	<0.5						
t-1,2-Dichloroethylene	ug/L	0.4	<0.4	<0.4						
t-1,3-Dichloropropylene	ug/L	0.2	<0.2	<0.2						
Tetrachloroethylene	ug/L	0.3	<0.3	<0.3						
Toluene	ug/L	0.5	<0.5	<0.5						
Trichloroethylene	ug/L	0.3	<0.3	<0.3						
Trichlorofluoromethane	ug/L	0.5	<0.5	<0.5						
Vinyl Chloride	ug/L	0.2	<0.2	<0.2						
VOC SURROGATES										
1,2-dichloroethane-d4	%		107	106						
4-bromofluorobenzene	%		95	96						
Toluene-d8	%		100	102						
Total Petroleum Hydrocarbons										
GRO (<C10)	mg/L	0.2	<0.2	<0.2						
DRO (C10-C24)	mg/L	0.2	<0.2	<0.2						
GRO + DRO	mg/L	0.2	<0.2	<0.2						
Oil & Grease										
Oil & Grease - Mineral	mg/L	1	4	19						

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL: ____________
Mina Nasirai
Organic Lab Supervisor

CHAIN OF CUSTODY RECORD

ACCUTEST LABORATORIES LTD.

☐ 146 Colonnade Rd., Unit 8
Ottawa, ON K2E 7Y1
Ph: (613) 727-5692 Fax: (613) 727-5222

☐ 608 Norris Court
Kingston, ON K7P 2R9
Ph: (613) 634-9307 Fax: (613) 634-9308

LAB USE ONLY
Report Number: 2407943

Company Name: Golder	Address:	☐ Fax Results to: Golder
Report Attention: Keith Holmes	City/Prov: Postal Code:	☒ E-mail Results to: kholmes@golder.com
Phone: 224-5874 Waterworks #:	Project # 03-1120-845 * Quotation # 240282	☐ Copy of Results to:

Invoice to:
(if different from above)

SAMPLE ANALYSIS REQUIRED

⇦ Indicate: F=Filtered or P=Preserved

Sample ID	Date/Time Collected	Sample Matrix	C=Comp. G=Grab	Number of Containers	Service Required ** R=Rush S=Standard	VOC	TPH gas+ho	TSS	Metals ICP 20 element						Laboratory Identification	CRITERIA REQUIRED * (i.e. MOE GUCSO, CCME, PWQO, ODWS, Québec) MOE Reg. #: PWQO Other: — MOE Reportable ?
SA-A	May 5/2004	SW		7	S	X	X	X	X						315961	Yes ☐ No ☑
SA-B															315962	Yes ☐ No ☑
SA-C															315963	Yes ☐ No ☑
SA-D															315964	Yes ☐ No ☑
SA-E															315965	Yes ☐ No ☑
SA-F															315966	Yes ☐ No ☑
SA-G															315967	Yes ☐ No ☑
SA-H															315968	Yes ☐ No ☑
SA-I										High Solids or Heavy					315969	Yes ☐ No ☑
SA-J										concentration.					315970	Yes ☐ No ☑
SA-K															315971	Yes ☐ No ☑
SA-L-1															315972	Yes ☐ No ☑

Sampled By: Keith Holmes	Date/Time: 5/may/04	Shipped Via:	Waybill #:	Comments: Filter one metals bottle for Al. May 6 - Rush for May 7 100% surcharge
Relinquished By: [signature]	Date/Time: 5/may/04	Received By: [signature]	Date/Time:	
Relinquished By:	Date/Time:	Received By Lab: [signature]	Date/Time: May 5/04 4:25pm	

* Indicates a required field. If not complete, analysis will proceed only on verification of missing information. ** There may be a surcharge applied to "Rush" service. Please check with lab.

Page ___ of ___

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ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

JUN - 3 2004
GOLDER ASSOCIATES RECEIVED OTTAWA

Client: **Golder Associates Ltd.**
1796 Courtwood Cr.
Ottawa, ON
K2C 2B5
Attention: **Mr. Keith Holmes**

Report Number: 2407944
Date: 2004-05-07
Date Submitted: 2004-05-05

Project: 03-1120-895

P.O. Number:
Matrix: Surfacewater

		LAB ID:	315973	315974	315975			**GUIDELINE**		
		Sample Date:	2004-05-05	2004-05-05	2004-05-05					
		Sample ID:	SA-L-2	SA-M	SA-N					
PARAMETER	**UNITS**	**MDL**						**TYPE**	**LIMIT**	**UNITS**
Total Suspended Solids	mg/L	2	43	566	798					
Aluminum	mg/L	0.01	0.01	<0.01	<0.01					
Barium	mg/L	0.01	0.08	0.09	0.10					
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001					
Boron	mg/L	0.01	0.08	0.04	0.08					
Cadmium	mg/L	0.0001	0.0005	0.0028	0.0034					
Chromium	mg/L	0.005	0.005	<0.01	<0.01					
Cobalt	mg/L	0.0002	0.0009	0.0039	0.0041					
Copper	mg/L	0.001	0.051	0.203	0.271					
Iron	mg/L	0.01	0.82	2.44	4.31					
Lead	mg/L	0.001	0.065	0.263	0.368					
Manganese	mg/L	0.01	0.06	0.46	0.47					
Molybdenum	mg/L	0.005	0.017	<0.005	0.005					
Nickel	mg/L	0.005	0.011	0.030	0.028					
Silicon	mg/L	0.1	2.2	3.2	3.3					
Silver	mg/L	0.0001	<0.0001	0.0001	0.0001					
Strontium	mg/L	0.001	0.410	0.739	0.982					
Thallium	mg/L	0.001	<0.001	<0.001	<0.001					
Titanium	mg/L	0.01	0.01	0.02	0.02					
Vanadium	mg/L	0.001	0.001	0.005	0.005					
Zinc	mg/L	0.01	0.22	1.05	1.29					

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:
315973: MDL increased for some Cr results due to interference.

APPROVAL: ____________
Ewan McRobbie
Inorganic Lab Supervisor

ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

Client: **Golder Associates Ltd.**
1796 Courtwood Cr.
Ottawa, ON
K2C 2B5
Attention: **Mr. Keith Holmes**

Report Number: 2407944
Date: 2004-05-18
Date Submitted: 2004-05-05

Project: 03-1120-895

P.O. Number:
Matrix: Surfacewater

		LAB ID:	315973	315974	315975			**GUIDELINE**		
		Sample Date:	2004-05-05	2004-05-05	2004-05-05					
		Sample ID:	SA-L-2	SA-M	SA-N					
PARAMETER	**UNITS**	**MDL**						**TYPE**	**LIMIT**	**UNITS**
VOLATILE ORGANIC COMPOUNDS - VOCs										
1,1,1,2-tetrachloroethane	ug/L	0.6	<0.6	<0.6	<0.6					
1,1,1-trichloroethane	ug/L	0.4	<0.4	<0.4	<0.4					
1,1,2,2-tetrachloroethane	ug/L	0.6	<0.6	<0.6	<0.6					
1,1,2-trichloroethane	ug/L	0.4	<0.4	<0.4	<0.4					
1,1-dichloroethane	ug/L	0.4	<0.4	<0.4	<0.4					
1,1-dichloroethylene	ug/L	0.5	<0.5	<0.5	<0.5					
1,2-dibromoethane	ug/L	1.0	<1.0	<1.0	<1.0					
1,2-dichlorobenzene	ug/L	0.4	<0.4	<0.4	<0.4					
1,2-dichloroethane	ug/L	0.5	<0.5	<0.5	<0.5					
1,2-dichloropropane	ug/L	0.7	<0.7	<0.7	<0.7					
1,3,5-trimethylbenzene	ug/L	0.3	<0.3	<0.3	<0.3					
1,3-dichlorobenzene	ug/L	0.4	<0.4	<0.4	<0.4					
1,4-dichlorobenzene	ug/L	0.4	<0.4	<0.4	<0.4					
Benzene	ug/L	0.5	<0.5	<0.5	<0.5					
Bromodichloromethane	ug/L	0.3	<0.3	<0.3	<0.3					
Bromoform	ug/L	0.4	<0.4	<0.4	<0.4					
Bromomethane	ug/L	0.5	<0.5	<0.5	<0.5					
c-1,2-Dichloroethylene	ug/L	0.4	<0.4	<0.4	0.5					
c-1,3-Dichloropropylene	ug/L	0.2	<0.2	<0.2	<0.2					
Carbon Tetrachloride	ug/L	0.5	<0.5	<0.5	<0.5					
Chloroethane	ug/L	1.0	<1.0	<1.0	<1.0					
Chloroform	ug/L	0.5	<0.5	<0.5	<0.5					
Chloromethane	ug/L	1.0	<1.0	<1.0	<1.0					
Dibromochloromethane	ug/L	0.3	<0.3	<0.3	<0.3					
Dichloromethane	ug/L	4.0	<4.0	<4.0	<4.0					
Ethylbenzene	ug/L	0.5	<0.5	<0.5	<0.5					
m/p-xylene	ug/L	1.0	<1.0	<1.0	<1.0					
Monochlorobenzene	ug/L	0.2	<0.2	<0.2	<0.2					
o-xylene	ug/L	0.5	<0.5	<0.5	<0.5					

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:

Mina Nasirai

Client: **Golder Associates Ltd.**
1796 Courtwood Cr.
Ottawa, ON
K2C 2B5
Attention: **Mr. Keith Holmes**

Report Number: 2407944
Date: 2004-05-18
Date Submitted: 2004-05-05

Project: 03-1120-895

P.O. Number:
Matrix: Surfacewater

		LAB ID:	315973	315974	315975			**GUIDELINE**		
		Sample Date:	2004-05-05	2004-05-05	2004-05-05					
		Sample ID:	SA-L-2	SA-M	SA-N					
PARAMETER	**UNITS**	**MDL**						**TYPE**	**LIMIT**	**UNITS**
Styrene	ug/L	0.5	<0.5	<0.5	<0.5					
t-1,2-Dichloroethylene	ug/L	0.4	<0.4	<0.4	<0.4					
t-1,3-Dichloropropylene	ug/L	0.2	<0.2	<0.2	<0.2					
Tetrachloroethylene	ug/L	0.3	<0.3	<0.3	<0.3					
Toluene	ug/L	0.5	<0.5	<0.5	0.5					
Trichloroethylene	ug/L	0.3	<0.3	<0.3	<0.3					
Trichlorofluoromethane	ug/L	0.5	<0.5	<0.5	<0.5					
Vinyl Chloride	ug/L	0.2	<0.2	<0.2	<0.2					
VOC SURROGATES										
1,2-dichloroethane-d4	%		105	104	106					
4-bromofluorobenzene	%		95	94	96					
Toluene-d8	%		102	102	102					
Total Petroleum Hydrocarbons										
GRO (<C10)	mg/L	0.2	<0.2	<0.2	<0.2					
DRO (C10-C24)	mg/L	0.2	<0.2	0.4	0.8					
GRO + DRO	mg/L	0.2	<0.2	0.4	0.8					
Oil & Grease										
Oil & Grease - Mineral	mg/L	1	2	10	8					

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL: [signature]
Mina Nasirai
Organic Lab Supervisor

CHAIN OF CUSTODY RECORD

ACCUTEST LABORATORIES LTD.

☐ 146 Colonnade Rd., Unit 8
Ottawa, ON K2E 7Y1
Ph: (613) 727-5692 Fax: (613) 727-5222

☐ 608 Norris Court
Kingston, ON K7P 2R9
Ph: (613) 634-9307 Fax: (613) 634-9308

LAB USE ONLY
Report Number: 2407944

Company Name: Golder	Address:	☒ Fax Results to: Golder
Report Attention: Keith Holmes	City/Prov: Postal Code:	☒ E-mail Results to: kholmes@golder.com
Phone: 224 5364 Waterworks #:	Project # 03-1120-875 * Quotation # 240282	☐ Copy of Results to:

Invoice to:
(if different from above)

SAMPLE ANALYSIS REQUIRED

⇦ Indicate: F=Filtered or P=Preserved

Sample ID	Date/Time Collected	Sample Matrix	C=Comp. G=Grab	Number of Containers	Service Required ** R=Rush S=Standard	VOCs	TPH 3/4 + n/o	TSS	metals ICP 200 ohms						Laboratory Identification	CRITERIA REQUIRED * (i.e. MOE GUCSO, CCME, PWQO, ODWS, Québec) MOE Reg. #: R-GW Other: MOE Reportable ?
SA-L-2	5 May 2004	SW		7	S	X	Y	Y	Y						315973	Yes ☐ No ☒
SA-M	↓	SW		↓	S	Y	Y	Y	Y						315974	Yes ☐ No ☒
SA-N	↓	SW		↓	S	Y	Y	Y	Y						315975	Yes ☐ No ☒
																Yes ☐ No ☐
																Yes ☐ No ☐
																Yes ☐ No ☐
																Yes ☐ No ☐
																Yes ☐ No ☐
																Yes ☐ No ☐
																Yes ☐ No ☐
																Yes ☐ No ☐
																Yes ☐ No ☐

Sampled By: Keith Holmes	Date/Time: 5/May/04	Shipped Via:	Waybill #:	Comments
Relinquished By: [illegible]	Date/Time: 5/May/04	Received By:	Date/Time:	Filter one metal bottle for Al analyses
Relinquished By:	Date/Time:	Received By Lab: [illegible]	Date/Time: May 5/04 4:25pm	Rush May 6 for May 7 100% surcharge

* Indicates a required field. If not complete, analysis will proceed only on verification of missing information. ** There may be a surcharge applied to "Rush" service. Please check with lab.

Page ____ of ____

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APPENDIX B

HISTORIC RAINFALL EVENT DISTRIBUTION

Table G-2: Summer rain event distribution for 6 hour interevent time

Year	Rain Events	RAINFALL EVENT DISTRIBUTION by depth in mm 0-5	5-10	10-20	20-30	30-40	40-50	50-75	>75
1960	41	26	8	6	1	0	0	0	0
1961	50	30	9	8	3	0	0	0	0
1962	45	25	7	7	5	1	0	0	0
1963	40	25	3	9	1	1	0	1	0
1964	38	20	8	6	4	0	0	0	0
1965	45	31	4	7	1	2	0	0	0
1966	39	22	9	5	3	0	0	0	0
1967	42	19	11	6	3	1	1	1	0
1968	40	26	4	3	2	3	2	0	0
1969	40	27	4	5	1	1	2	0	0
1970	42	24	9	5	0	3	1	0	0
1971	43	24	6	7	3	3	0	0	0
1972	54	27	12	8	2	2	1	2	0
1973	46	30	5	5	2	2	2	0	0
1974	51	38	7	5	0	1	0	0	0
1975	49	31	7	6	0	4	1	0	0
1976	47	29	7	9	1	1	0	0	0
1977	60	39	7	8	4	2	0	0	0
1978	51	33	7	8	2	1	0	0	0
1979	43	26	6	4	2	3	1	1	0
1980	60	38	9	8	5	0	0	0	0
1981	55	30	12	6	3	1	2	0	1
1982	40	19	8	10	2	0	1	0	0
1983	36	20	11	4	0	1	0	0	0
1984	41	27	1	8	3	2	0	0	0
1985	42	27	4	6	4	1	0	0	0
1986	53	27	8	9	6	1	1	0	1
1987	46	27	8	7	1	1	0	2	0
1988	36	19	7	3	4	2	1	0	0
MEAN	45	27	7	6	2	1	1	0	0

From analysis of the years 1961 to 1989, the arithmetic mean (μ) and standard deviation (σ) of summer total rainfall (using AES monthly totals) were found to be:

μ = 338.1 mm σ = 90.8 mm

Based on the arithmetic mean, 6 years of various magnitudes ($\mu \pm 10$ mm) were selected from the summer totals (1961-1989, see Table G-4). Year 1989 was included to determine the mean year because AES monthly data were available for the months of interest during this year and this additional piece of information would help to more accurately define the longterm mean volume of precipitation. However, 1989 data were not used for any other calculations because hourly rainfall data were unavailable for the complete summer period.

APPENDIX C

PRECIPITATION ANALYSIS

APPENDIX C

PRECIPITATION ANALYSIS

Use of the 4 hour Chicago Distribution 25 mm storm

The 4 h Chicago storm is referenced throughout the document for erosion control and the sizing of first flush pipes, forebays, etc. The 4 hour Chicago storm was used since it is one of the most widely accepted storm distributions across the province which is applicable for urban areas.

A 4 hour distribution was used instead of a 2 hour distribution since the 2 hour distribution produces unreasonably high peak flows (ie. similar to a 2 year storm). Given that stormwater quality measures are intended for the everyday event, the 2 hour distribution is excessive for design purposes. If for example, if the minor system is designed for a 2 year flow, a first flush pipe which accepted the 2 year peak flow would not be appropriate.

Figures C.1 and C.2 indicate that a 25 mm event occurs approximately 4 times per year and that a daily capture of 25 mm would result in an annual capture rate of 95% of the annual precipitation.

The timestep for simulation should be based on the representative time of concentration of the site being modelled. The peak flow from a site may not be modelled accurately if the simulation timestep is larger than the time of concentration since the peak flow could occur within a timestep and may be missed.

Previous work (Urban Drainage Design Guidelines, 1987) indicates that the discretization of a Chicago distributed hyetograph with a timestep less than 10 minutes results in unrealistically high peak flows. In situations where a timestep less than 10 minutes is required, the 10 minute intensities can be replicated based on the timestep required.

Use of a 20 mm capture

The 20 mm storm capture rate was used for rooftop leaders since this is equivalent to a 90% annual precipitation capture rate as shown on Figure C.2. Capturing more runoff than 20 mm for infiltration type SWMPs results in an excess expenditure of money for storage which, for the most part, will not be utilized.

Use of the 15 mm storm

The use of a 4 hour Chicago distribution of a 15 mm storm is proposed for the temperature impact assessment for wet ponds and wetlands in Chapter 4. An analysis of 20 years of the daily precipitation record from the Atmospheric Environment Service rainfall gauge at Yonge and Bloor Street indicated that there are approximately 14 days a year which have a daily precipitation depth greater than 15 mm (Figure C.1), whereas there are approximately 130 days a year which have a daily precipitation depth less than 15 mm (excluding days with no precipitation). Therefore the use of the 15 mm storm is more realistic in assessing a change to the overall thermal regime in the receiving waters.

This storm was also chosen as a reasonable compromise for SWMPs which would not be economically feasible, or would be adversely affected, if designed to accommodate the runoff from a 25 mm storm. These SWMPs include sand filters, infiltration trenches and basins, and pervious pipes and catch-basins.

Use of the 10 mm storm

An analysis of 20 years of the daily precipitation record from the Atmospheric Environment Service rainfall gauge at Yonge and Bloor Street indicated that a daily capture of 10 mm is equivalent to a annual capture rate of 70% (70% of the precipitation is treated).

This storm was chosen as a reasonable compromise for SWMPs which would not be economically feasible, or would be adversely affected, if designed to accommodate the runoff from a 25 mm storm.

These SWMPs include vegetated filter strips and oil / grit separators.

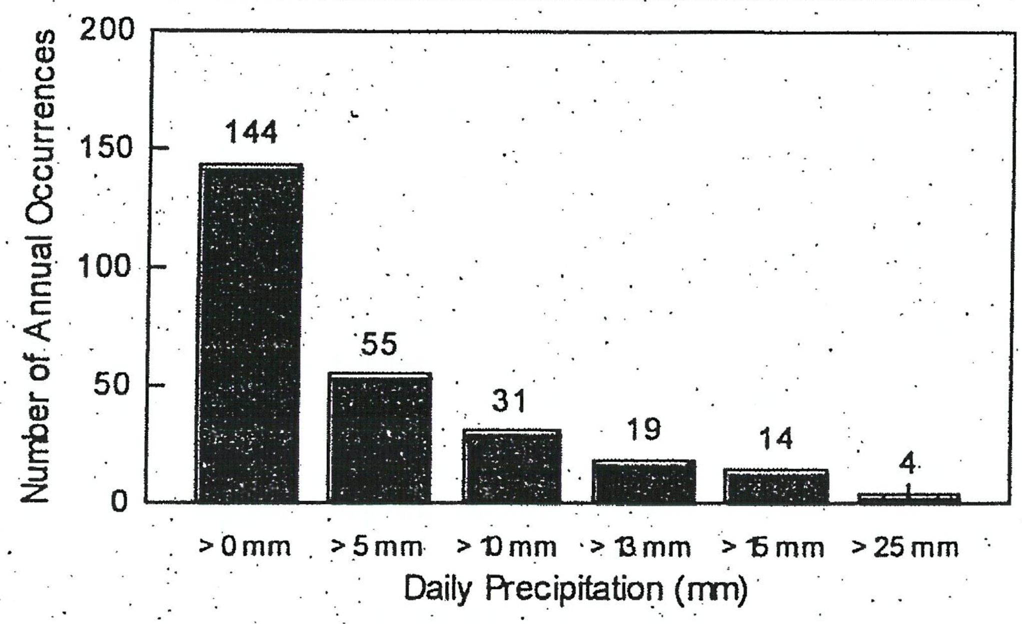


Figure C.1 Annual Precipitation Event Distribution

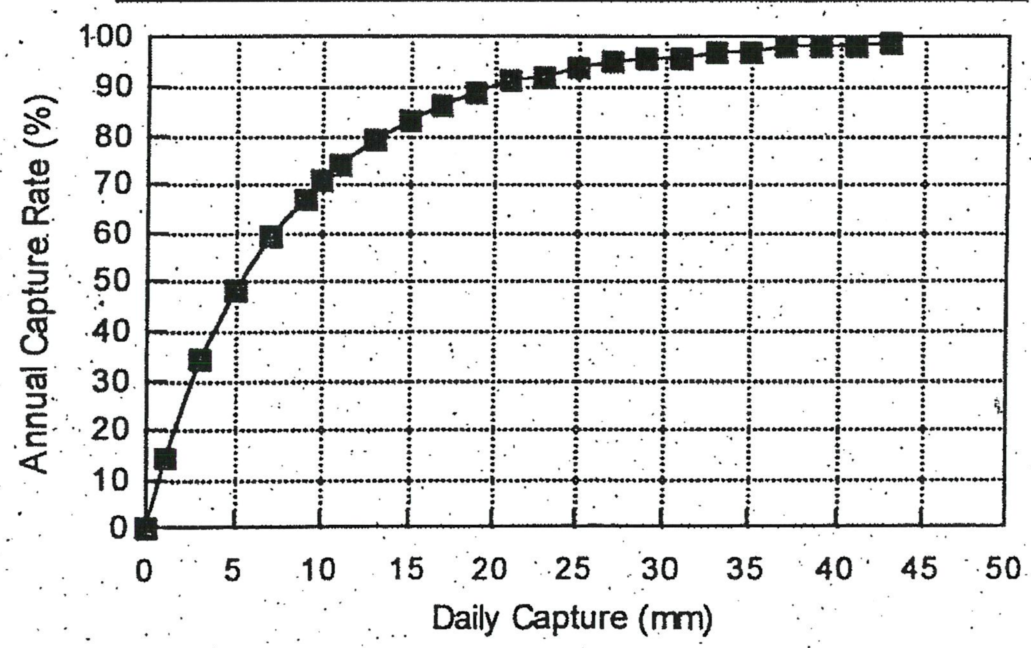


Figure C.2 Annual Capture Rate for Daily Capture Amounts

APPENDIX D

DISSOLVED SOLIDS POLLUTOGRAPHS

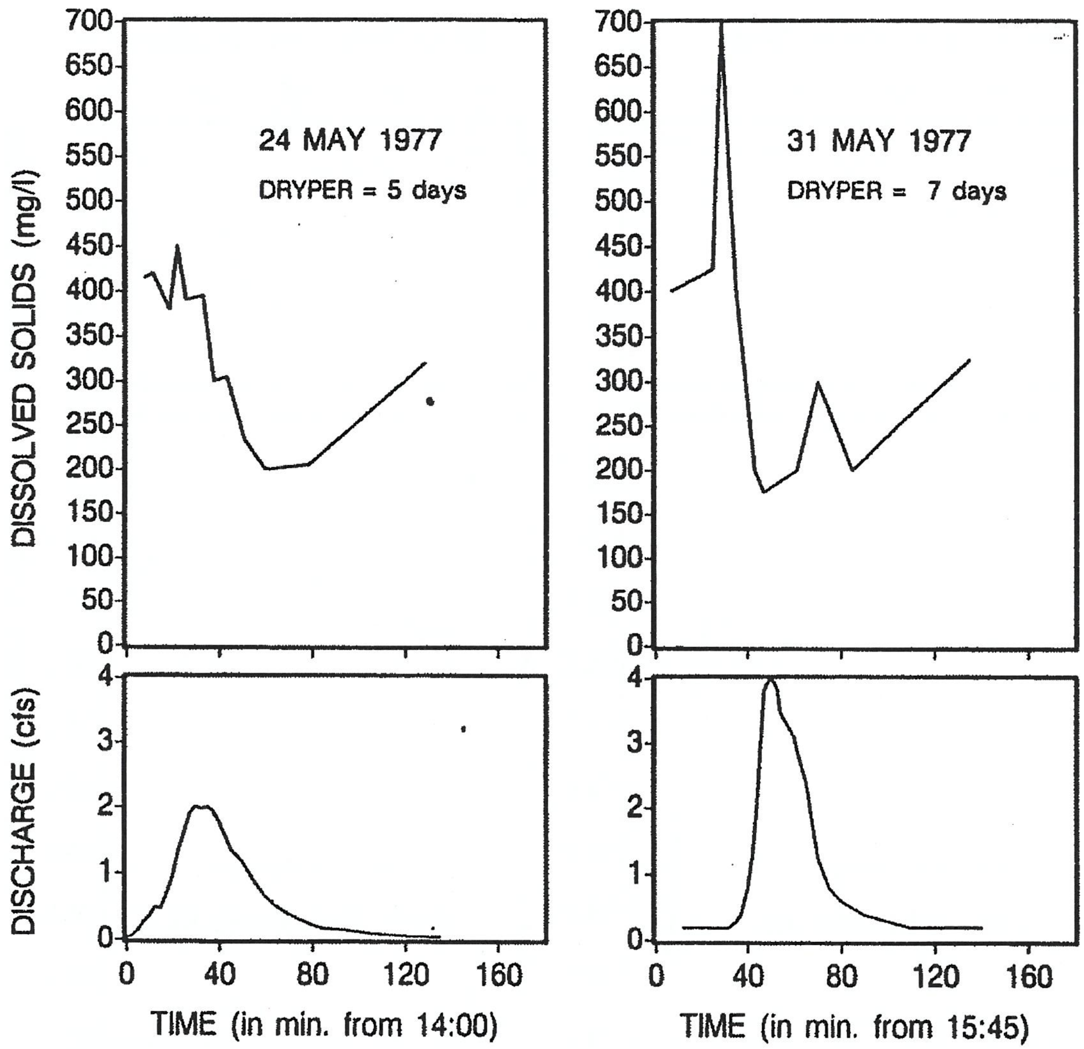


FIGURE 9.3 B DISSOLVED SOLIDS Pollutographs For Two Runoff Events (Carling Street Catchment, London, Ont.)

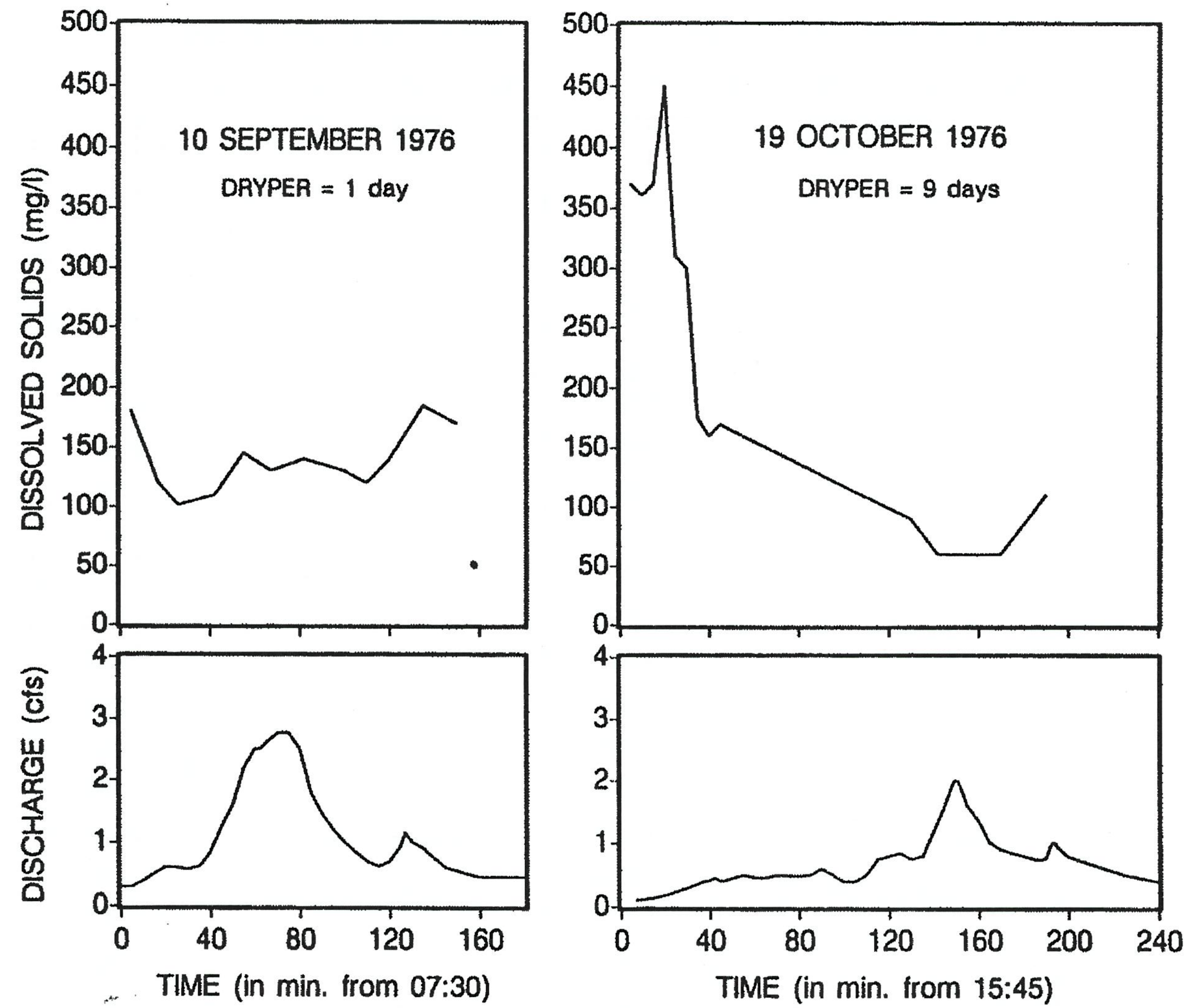


FIGURE 9.3 A DISSOLVED SOLIDS Pollutographs For Two Runoff Events (Carling Street Catchment, London, Ont.)

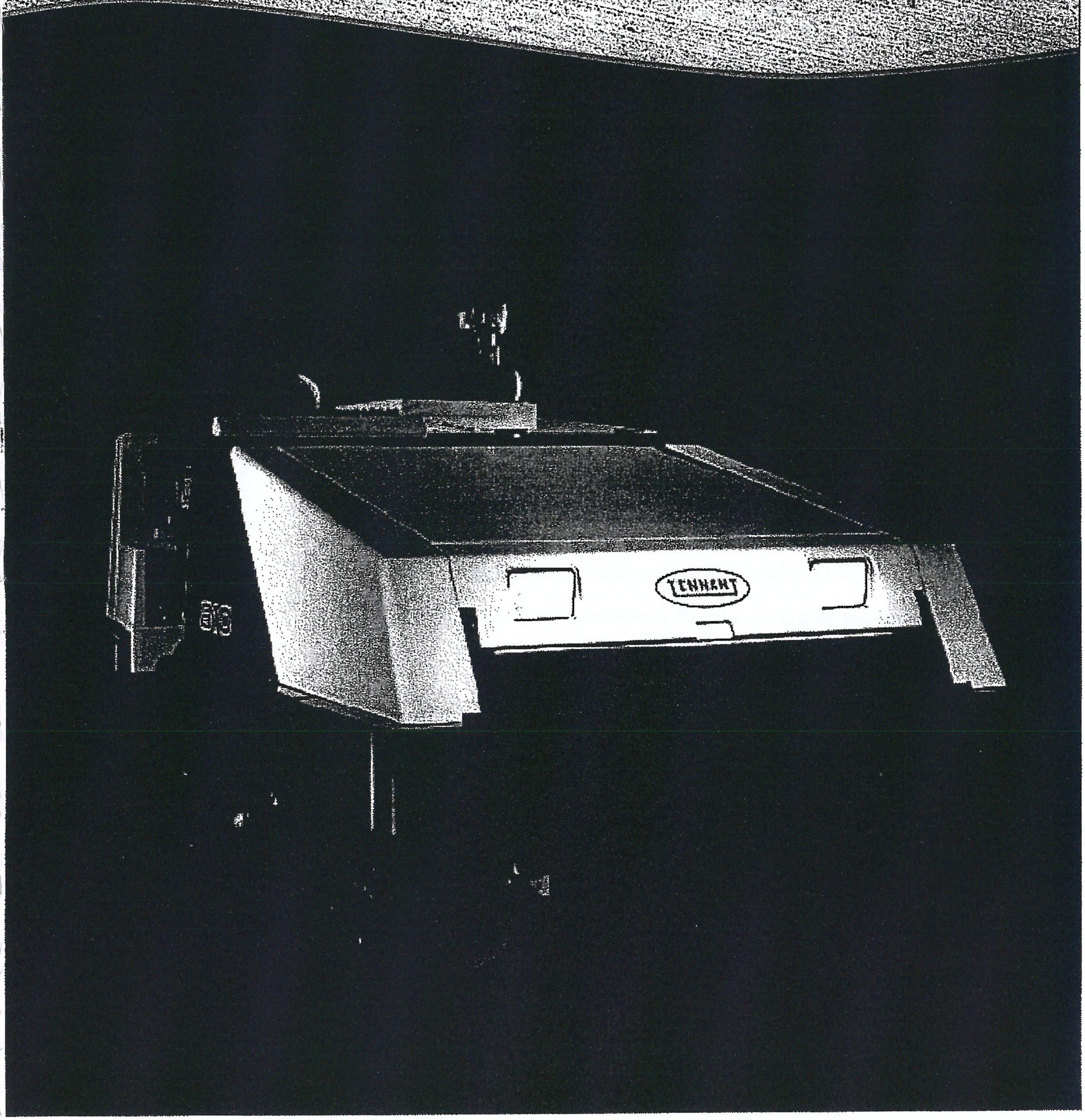
APPENDIX E

SWEEPER SPECIFICATIONS

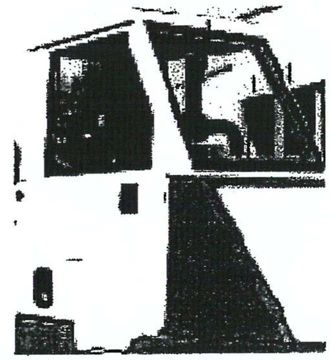
TENNANT

Working for a cleaner, safer world.™

800/810
Power Sweepers



Two Rugged Power Sweepers

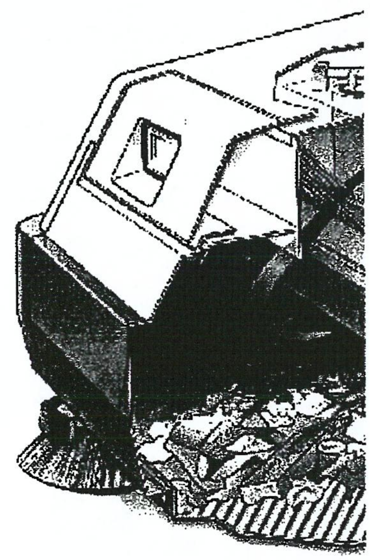


A deluxe cab is available with pressurizer, heater or air conditioner.

The Model 800 and Model 810 are built to withstand heavy use and abuse, year after year.

The 800 is ideal for tough indoor industrial applications. It features a massive steel frame and a rugged T-beam superstructure, along with huge steel bumpers that encircle and protect the machine.

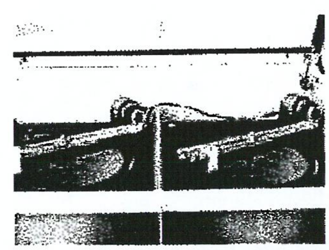
It cleans a 66" path and covers as much as 200,000 sq. ft. in a single hour. A large 30 cubic ft. hopper holds up to 2,000 lbs. of debris, so time spent traveling to dump sites is kept to a minimum. And with six inches of ground clearance, it easily navigates speed bumps and rough terrain.



The Model 800 is also extremely efficient at controlling dust. In addition, it's easy to operate and the main brush can be changed in one minute — without tools.

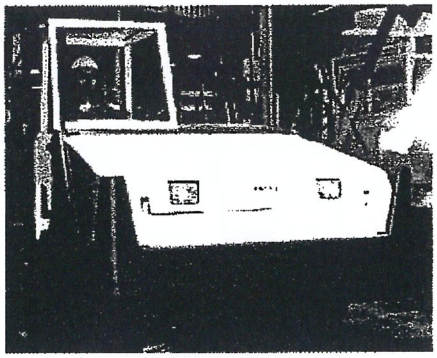
The Model 810 features everything the 800 offers, and more.

The 810 is specially designed to take-on your tough **outdoor** sweeping challenges. With a choice of direct-throw sweeping or the patented, Power-Throw cleaning system, it picks up nearly any debris from dust, sand and rocks — to broken glass and light, bulky paper litter.

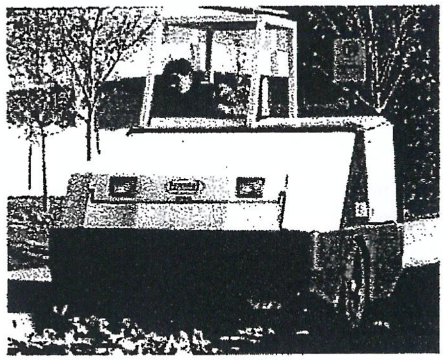


Productivity-Enhancing Options

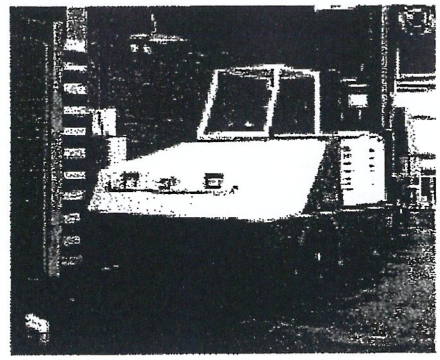
Both the Model 800 and 810 are available with Severe Environment (SE) options that offer special machine protection, heavy-duty tower bumpers, regenerative filter system, and a stainless steel hopper bottom that's ideal for aluminum reduction plants, foundries, steel mills or other extremely rugged environments.



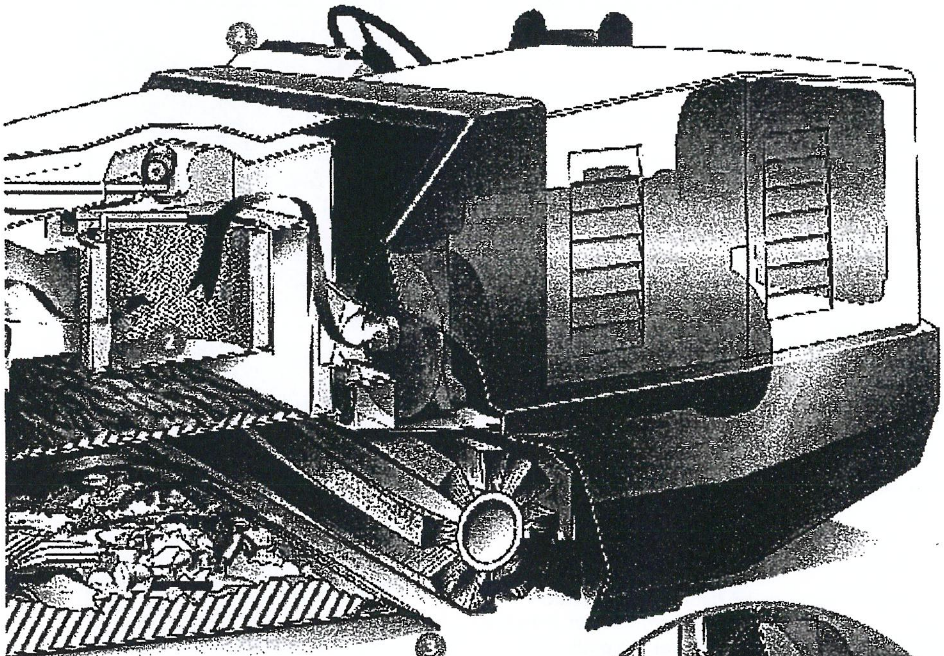
The 800 cleans a wide 66" path, and performs even under the toughest conditions.



The 810 makes light work of picking up rocks, leaves and other debris — and keeps kick-up dust to a minimum.

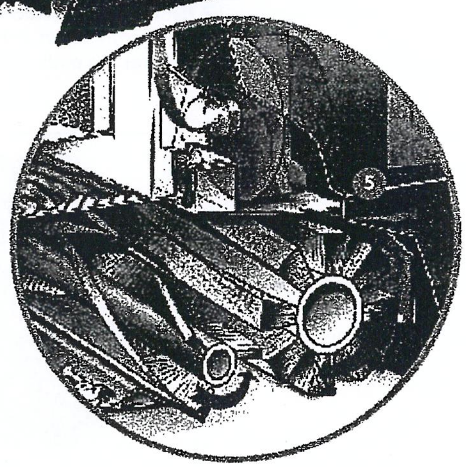


This rugged machine practically pampers its operators with an energy absorbing seat, tilt steering wheel, power steering, and an adjustable drive pedal.



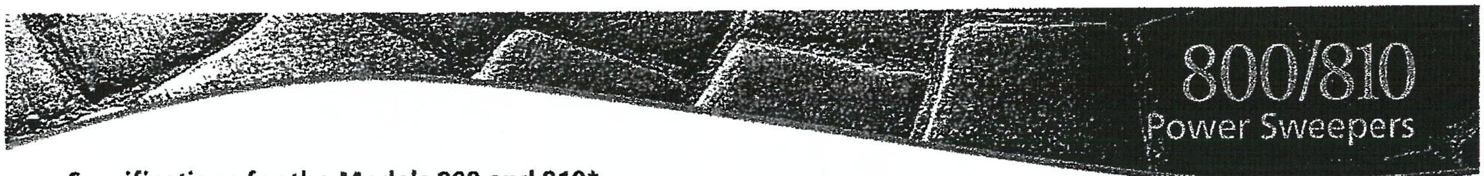
Model 800 and 810

1. To eliminate the need to handle debris twice, the standard 30 cubic ft. multi-level dump hopper empties on the ground or into dumpsters as high as 6 ft.
2. The Quad Filtering System uses four separate high-efficiency filters to trap particles.
3. Routine maintenance is fast and easy. The engine area, fittings, filters and battery have wide open, easy access.
4. Thermo-Sentry™, system monitoring lights, brush down-pressure indicator and a fuel gauge warn the operator of potential problems.
5. The 810 offers even greater cleaning quality with an extra sweeping brush.



Dust and moisture are checked by a unique Quad Filtering System that allows the 800 and 810 to operate nearly dust-free, long after others clog.

800/810 Power Sweepers



Specifications for the Models 800 and 810*

Sweeping System		
Cleaning path	66 in	1675 mm
Main brush length	50 in	1270 mm
Main brush lift	Hydraulic	
Side brush diameter	26 in	650 mm
Hopper volume capacity	30 ft³	850 L
Hopper dump height	72 in	1830 mm
Propelling System		
Engine		
Gas/LP Ford 2.3 liter (max)	63 hp	
Diesel Perkins 3.0 liter (max)	63 hp	
Gradeability		
Full hopper	8.5 deg/15%	
Ground clearance	6 in	150 mm
Propel speed		
Forward (variable to)	10.0 mph	16.1 km/h
Reverse (variable to)	4.5 mph	7.2 km/h
Machine Dimensions		
Length	120.0 in	3050 mm
Width	70.0 in	1780 mm
Turning radius (Left)	85 in	2160 mm
Minimum aisle turn (Left)	135 in	3430 mm

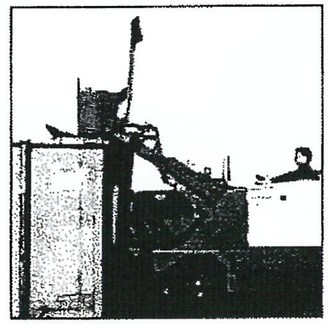
Tennant Value Added Equipment Includes:

II-Speed™ cleaning system	Industrial radiator/debris screen
Timed filter shaker	Triple, heavy duty accessory pumps
Thermo-sentry™	Retractable sidebrush
T-beam frame super-structure	Power steering
Steel-channel wraparound bumper	Servo-assist adjustable foot pedal

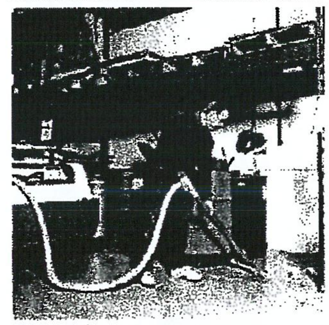
Optional Equipment

Severe environment version	Vacuum wand
Audio-visual backup alarm	Enclosed cab
Heavy-duty bumpers	Overhead guard
Stainless steel hopper bottom	Left-hand sidebrush

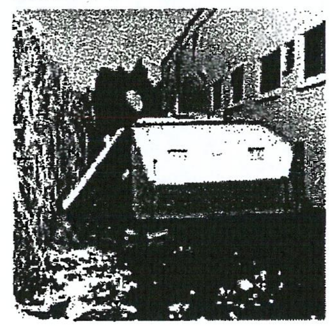
* Subject to change without notice.
Power Throw is a United States trademark of the Tennant Company.



Standard multi-level dump hopper empties its contents on the ground or into dumpsters or trucks as high as 6 feet.



With the optional vacuum wand, the 800/810 cleans tight spots and hard-to-reach areas.



A handy blower attachment conveniently blows light litter into the sweeper's path.

Working for a cleaner, safer world.™

Tennant Company and Castex, Inc. offer the most complete lines of floor and surface maintenance equipment, floor coatings, brushes, and cleaning detergents in the world. Our sales and service networks are able to provide you with integrated custom cleaning solutions to meet any floor care need.

The Tennant Total Solution Includes:

- •Factory-Direct Sales
- •Factory-Direct Service
- •Authorized Floor Coatings Contractors
- •Authorized Sales & Service Distributors

ISO 9001 Certified

TENNANT

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P.O. Box 1452
Minneapolis, MN U.S.A. 55440
Call toll-free: 800-553-8033
In Quebec call: 514-335-6061
Fax: 612-540-1437
Email: tennantco.com

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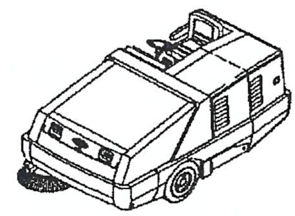
TENNANT
810
POWER SWEEPER
SPECIFICATIONS



Machine Dimensions		
Length	120.0 in	3050 mm
Width	70 in	1780 mm
Turning radius (left)	85 in	2160 mm
Minimum aisle turn (left)	135 in	3430 mm
Propelling System		
Engine		
Gasoline/LP GMC 3.0 liter	83 hp	61.9 kw
Diesel Caterpillar 3.3 liter	63 hp 47 kW	63 hp 47 kW
Gradeability		
Full hopper	8.5 deg/15%	8.5 deg/15%
Ground clearance	6 in	150 mm
Propel speed		
Forward (variable to)	10.0 mph	16.1 km/h
Reverse (variable to)	4.5 mph	7.2 km/h
Sweeping System		
Cleaning Path	66 in	1675 mm
Main brush length	50 in	1270 mm
Main brush lift	Hydraulic	Hydraulic
Power-Throw brush length	50 in	1270 mm
Side brush diameter	26 in	650 mm
Hopper volume capacity	30 ft^3	850 L
Hopper dump height	72 in	1830 mm

Tennant Value-Added Equipment Includes:

- Power-Throw cleaning system
- II-Speed™ cleaning system
- Timed filter shaker
- Thermo-sentry™
- T-beam frame super-structure
- Steel-channel wraparound bumper
- Industrial radiator/debris screen
- Triple, heavy duty accessory pumps
- Retractable sidebrush
- Power steering
- Servo-assist adjustable foot pedal

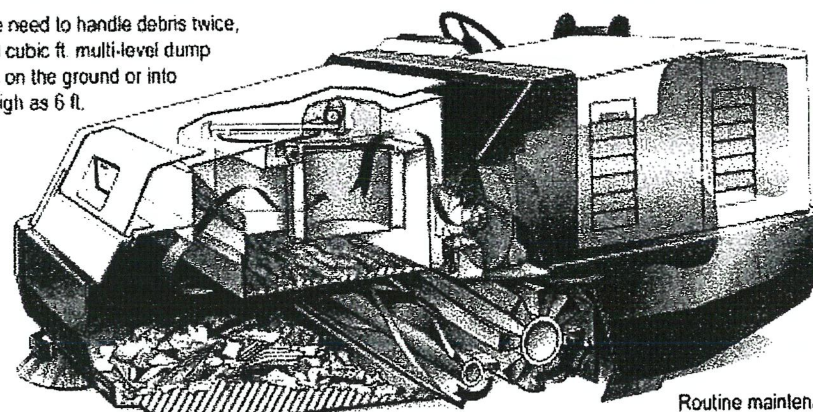
Optional Equipment

- Severe environment version
- Audio-visual backup alarm
- Heavy-duty bumpers
- Stainless steel hopper bottom
- Regenerative dust filter system
- Vacuum wand
- Enclosed cab
- Overhead guard
- Left-hand sidebrush

Tennant Company
P.O. Box 1452
Minneapolis, MN 55440
Tel: 763-540-1200; Fax: 763-540-1437
www.tennantco.com email: info@tennantco.com

(Specifications subject to change)
Some options may not be available in all countries.
Rev. 5/04

Tennant Model 810



APPENDIX F

U.S. DEPARTMENT OF TRANSPORTATION – STORMWATER MANAGEMENT BEST PRACTICES

Stormwater Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring

Monitoring Case Study-Streetsweeping BMP Evaluation, Port Of Seattle, Washington

This case study is based on a study evaluating streetsweeping technology by Kurahashi and Associates, Inc. (1997).

The Port of Seattle owns five cargo container yards, covering a total area of approximately 162 ha (400 ac), which serve its marine terminals. A major expansion effort currently under way at two of the five yards will result in a substantial increase in the container yard area. At the present time, the only stormwater treatment BMP that is technically feasible and approved for new marine facilities is the wet vault. In May 1996, the Port of Seattle contracted with Kurahashi and Associates to evaluate the effectiveness of new high-efficiency pavement sweepers in combination with conventional sediment-trapping catch basins to determine if the combination technology provided pollutant reduction benefits that were comparable to those of wet vaults. The evaluation was prompted by the results of recent studies conducted by Kurahashi and Associates that indicated significant reductions in pollutant loadings could be achieved through the use of high-efficiency sweepers. Older studies, dating back to the Nationwide Urban Runoff Program (NURP), had indicated that streetsweeping was of limited benefit in improving the quality of urban runoff. The use of high-efficiency pavement sweepers in combination with conventional sediment-trapping catch basins would result in substantial savings for the Port of Seattle compared to the use of wet vaults (estimated life cycle costs of $2 million for high-efficiency sweepers in combination with conventional sediment-trapping catch basins versus $18 million for wet vaults).

Study Objectives

- Calibrate a stormwater quality computer model using pollutant accumulation data from nine sites in various activity areas of a container storage yard in the Port of Seattle.
- Use the calibrated model to evaluate the stormwater pollutant removal effectiveness of new high-efficiency pavement sweepers used in combination with conventional sediment- trapping catch basins and determine if the removal effectiveness was equivalent to that obtained through wet vaults.

Modeling Approach, Data Collection, and Calibration

The Simplified Particulate Transport Model (SIMPTM) was used in the study. SIMPTM is a continuous stormwater quality model that has been shown to accurately simulate the accumulation and washoff of sediment and associated pollutants, and the load reductions expected through the implementation of BMPs. SIMPTM accounts for sediment deposition, armoring, and resuspension processes, and models scheduled cleaning of streets, parking lots, catch basins, and maintenance hatches. The model aggregates hourly precipitation data into rainfall events and provides continuous simulation of sediment and bound pollutant transport.

Data on pollutant accumulation was obtained over a 2-month period at nine sites within three areas in the container yard that were deemed to be representative of various ongoing activities. The activity areas selected were the alleyways between stored containers, the alleyways between parked trailers, and the area beneath the trailers. One site in each activity area was sampled every week; the second and third sites were sampled every two weeks and four weeks, respectively. Samples were collected on designated days by hand sweeping and mechanical vacuuming. A mechanical grain size analysis and chemical analysis for metals and total petroleum hydrocarbons was performed on each sample.

The SIMPTM model was calibrated using data on pollutant accumulation obtained over the 2-month sampling period and rainfall data for the same period collected at a nearby airport. Calibration essentially entailed adjusting the values of washoff and accumulation parameters until the best overall match was obtained between predicted and observed sediment accumulations for each of the activity areas during the two month sampling period. The best match was determined by visually comparing line graphs of predicted and actual sediment accumulation values for different parameter combinations.

The calibrated model for each activity area was used to simulate the average annual total suspended solids (TSS) loadings using an "average year" of rainfall events, synthesized from the analysis of a 29-year precipitation record at the airport. SIMPTM simulations included copper, lead, zinc, and phosphorus. Estimates of the particulate (suspended) fraction of each pollutant were based on the mean mass-fraction of the pollutant found in the analysis of samples collected from the container yard. These estimates were that 50 percent of the copper, phosphorus, and zinc washoff at any given time was assumed to be dissolved, while only 20 percent of the lead was assumed to be dissolved.

Alternative frequencies of sweeping (daily to monthly) and alternative sizes of catch basins (normal or enlarged)) were considered in the SIMPTM simulations. Since the model does not allow alteration of basic performance characteristics of the sweeper for a given model run, two sets of results were obtained to simulate performance characteristics of dry sweeping (high pickup efficiency) and damp pavement sweeping (reduced pickup efficiency).

Wet vaults are not explicitly modeled by the SIMPTM model. Sediment and associated pollutant removals for wet vaults were computed based on a modification of Stoke's Law for determining settling velocities for various grain sizes. SIMPTM model outputs (with no sweeping assumed) were used as inputs for these computations.

Results and Conclusions

The expected range of annual pollutant load reductions for various sweeping frequencies indicated by SIMPTM are summarized in Table 41. The table also provides the expected range of pollutant load reductions for wet vaults. The following conclusions were drawn from the simulation study:

- Pollutant removals obtained with high-efficiency sweeping at a weekly frequency in combination with normal catch basin inlets cleaned annually are comparable to removals obtained by wet vaults.
- High-efficiency sweeping appears more effective than wet vaults in the removal of highly dissolved pollutants (copper, zinc, and phosphorus).
- Wet vaults appear more effective than high-efficiency sweeping in the removal of TSS and sediment-bound pollutants such as lead.
- High-efficiency sweeping carried out on a weekly basis in combination with normal catch basin inlets is a viable, cost-effective BMP, with overall pollutant removals comparable to those obtained by wet vaults.

Table 41. Comparison of pollutant load reductions from various sweeping frequencies and wet vaults (%)[1]

Pollutant	Twice Weekly Sweeping	Weekly Sweeping	Biweekly Sweeping	Wet Vaults
TSS	45-70	45-65	40-60	75-90
TP	35-60	30-55	20-40	35-45
Total Lead	40-60	35-60	30-50	65-80
Total Zinc	30-55	25-50	20-40	35-45
Total Copper	35-60	30-55	20-40	35-45

[1] The low end of each range is obtained under the assumptions that none of the dissolved pollutants are captured by sweeping during damp pavement conditions and that parked trailers do not block the potential transport of material beneath trailers.

References

Kurahashi & Associates, Inc. 1997. *Port of Seattle - Stormwater Treatment BMP Evaluation.* Prepared for Port of Seattle, Pier 66. Prepared by Kurahashi & Associates, in association with AGI Technologies.

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APPENDIX G

WILKINSON WATER BOX SPECIFICATIONS

PRECAST CONCRETE PRODUCTS

WILKINSON HEAVY PRECAST LIMITED
5 km West of #6 Highway
588 #5 Highway, R.R.#2 Dundas
Ontario L9H 5E2
Tel: (905) 628-5611
Fax: (905) 628-9292
Toll Free: 1-800-263-8503

Wilkinson WaterBox

November 22/2000

Model	Max. Flow rate L/sec	Width m (external)	Length m (external)	Height m (external)	# inclined plates	Comments
Model 3	43 (tss) 19 (oil)	1.00	2.50	2.10	Standard 6	Downflow
Model 8	90 (tss) 40 (oil)	1.83	3.66	2.59	Standard 6	Downflow
Model 12	235 (tss) 103 (oil)	2.00	4.00	1.95	Standard 6	Downflow
Model 19	300 (tss) 130 (oil)	2.50	5.10	2.50	Standard 14	Upflow
Model 22	410 (tss) 180 (oil)	2.70	5.00	2.50	Standard 5	Upflow
Model 50	1430 (tss) 624 (oil)	3.00	7.31	3.00	6-18	Downflow/ Upflow

Is This Just Another Oil/Grit Separator?

Wilkinson Heavy Precast Limited is introducing the **WATERBOX SYSTEM** for storm runoff treatment. The **WATERBOX** is designed to provide a higher level of pollutant removal than can be expected of an oil/grit separator.

At Wilkinson Heavy Precast Limited our definition of an oil/grit separator is a relatively small underground container meant to trap dry weather spills and to separate free oil from water (i.e. runoff). As the name implies, it also removes grit and heavy solids. Small particles and suspended solids are removed incidentally rather than by design. The three compartment Oil/Grit Separator that we have manufactured for many years has always been recognized for its ability to trap floating solids and debris. Many OGS's on the market today are simply kitchen grease traps and floor wash water/oil interceptors made larger so as to accept much larger piping and hopefully treat greater flow. This multiplication of scale has not been without consequences. Scrutiny of the drawings will show that some oil/grit separator designs do not provide for safe access into all compartments of the structure. This is a departure from the normal requirements for underground infra structure. Perhaps the greatest weakness inherent with current OGS design is the inability to treat more than a very small portion of a given storm event. The OGS was designed to capture accidental oil spills, remove grit and sand and separate free oil from storm runoff.

Storm water treatment should consist of more than this. The **WATERBOX** is our answer to the requirement for better storm water treatment.

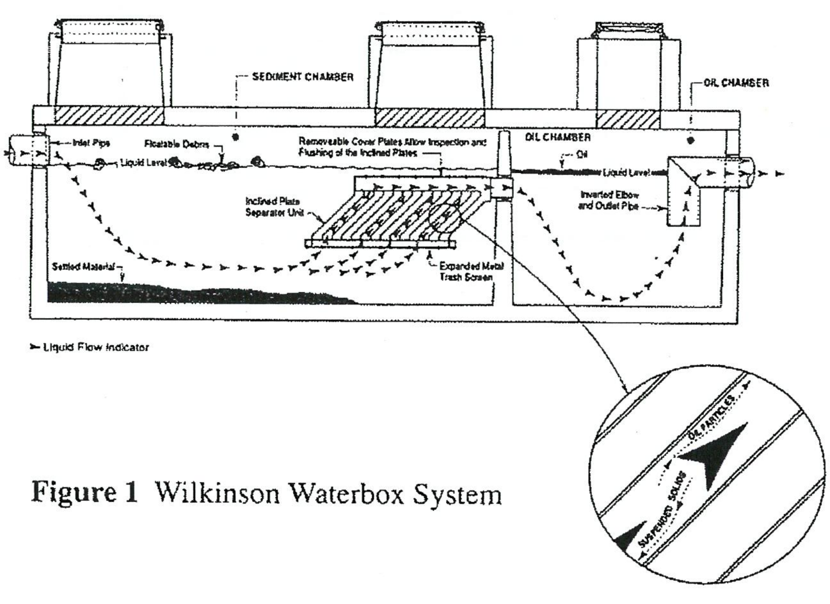


Figure 1 Wilkinson Waterbox System

To achieve the high level of treatment required for Level 1 Habitant, the Wilkinson Waterbox System combines the proven performance of coalescent plate settling technology and its own experience in the design and manufacture of precast concrete tanks, including the largest two piece precast concrete tank in the world. The Wilkinson Waterbox uses the coalescent plate (Lamella) separation principle. Conceived and designed from the ground up as a solution to storm water treatment the **WATERBOX** should be used when something more than an oil/grit separator is required. The absence of a by-pass allows it to trap and contain ALL floating debris and heavy grit. It can capture and contain large spills and separate oil entrained in storm runoff. The **WATERBOX** design also allows the entrapment of the much finer particles and associated pollutants than can be caught by other designs of oil/grit separators.

Theory

The coalescent plate settler consists of a series of plates inclined at an angle from the horizontal. Flow enters from the bottom (up flow) or sides (cross flow) and exits at the top. Solids which settle onto the plates slide by gravity to the bottom of the plates and then fall to the bottom of the containment tank. Laminar flow between the plates improves hydraulic stability and eliminates turbulance.

Figure 2 shows the equations associated with the calculation of lamella flows (*Source: Water Treatment - Principle and Design - James M. Montgomery, 1985*). As shown in the calculations, surface loading is directly proportional to the surface area available for settling. The greater the settling surface area the smaller the surface loadings become. The performance of the coalescent plate separator is affected by, the angle of the plates, available settling area, flow rate and the settling velocity of the particulate to be removed.

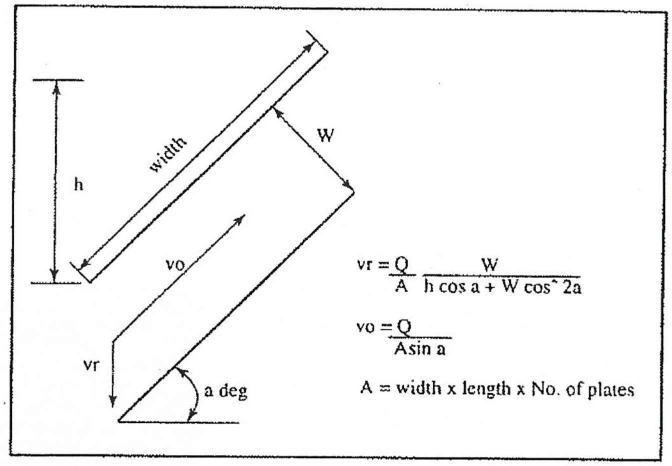


Figure 2 Basic Formula

Application

The use of coalescent plate settlers is common in Water and Waste Water Treatment. In Ontario, this technology can be found in Lake Huron W.T.P. Grand Bend, Lorne Park W.T.P. Mississauga, Windsor W.T.P. , Lakeview Waste Water Treatment Plant, Grimsby W.T.P. and in the Town of Huntsville (*Source: Ecodyne Limited*). Wilkinson Heavy Precast Limited is presently involved with at least seven Storm Water Management projects where the Waterbox has been specified. Table 2 shows the **WATERBOX** system for which shop drawings and design have been prepared.

Table 1 Various Waterbox Systems

Model/Volume	Lamella Unit	In/Out Pipe Diameter	Design Flow
18,900 Litres	G24-70-04-14	600mm/750mm	256 litres/sec.
50,000 Litres	G30-96-04-10	600mm	450 litres/sec.
57,000 Litres	G24-96-04-14	600mm	785 litres/sec.
14,000 Litres	G12-84-04-06	375mm	76 litres/sec.
10,000 Litres	G12-84-04-10	375mm	86 litres/sec.

Site Constraints

The **WATERBOX** is an end-of-pipe system. It has not been designed to replace infiltration, wet and extended ponds, sand filters, source controls, etc. It should be used only where the larger more natural treatments are not an option. The Waterbox is simply a better alternative than an OGS. The Waterbox is ideally suited to residential, commercial and industrial retrofit situations.
Site constraints are similar to those affecting any underground structure: conflict with other utilities, traffic loads, confined space entry, proximity of bedrock and the ground water table, sulfate soils, etc. etc.

Design

At present, Wilkinson Heavy Precast Limited is recommending that the **WATERBOX** be designed for the same peak flow as the minor system. In Ontario, it is common practice to design the minor system for storm return in the range of 2-10 years.
The Waterbox has the capacity to accommodate these high flows. There are several benefits in taking this approach. The cost associated with the increased flow rate from 25 mm to a 2 year storm return is minimum when compared to the cost of building an over flow or by-pass. Even at these high flow rates, the overall cost of the Waterbox is comparable to the low flow OGS. By using the peak flow when the velocity is at the highest, as the design criteria, the Waterbox will provide for greater efficiency before and after the peak when the velocity is slower. The Waterbox System provides for a greater overall performance than a system with a bypass or overflow resulting in greater protection of the downstream receiving waters.

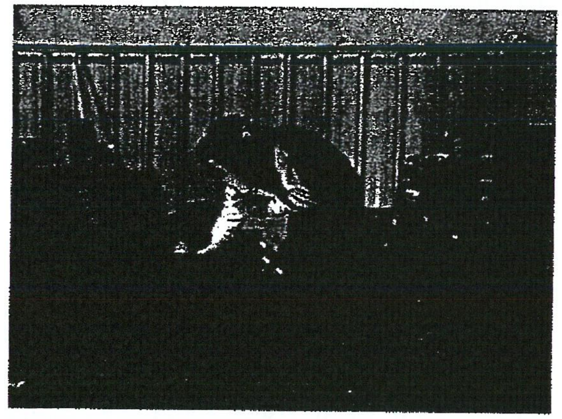


Figure 3 Welding The Plates

Construction

Wilkinson Heavy Precast Limited has been manfacturing and installing large precast concrete tanks and chambers for many years. Installation procedures for Waterbox Chambers are similar to those for our other water and waste water tanks.
The chamber is lifted from the delivery vehicle by an appropriately sized crane and placed into the excavation onto a prepared bed of granular material, connections are made and the whole is then backfilled. Where the on site assembly of two or more sections is required, complete installation instructions are provided and/or Wilkinson personnel will be on site to aid in the operation.

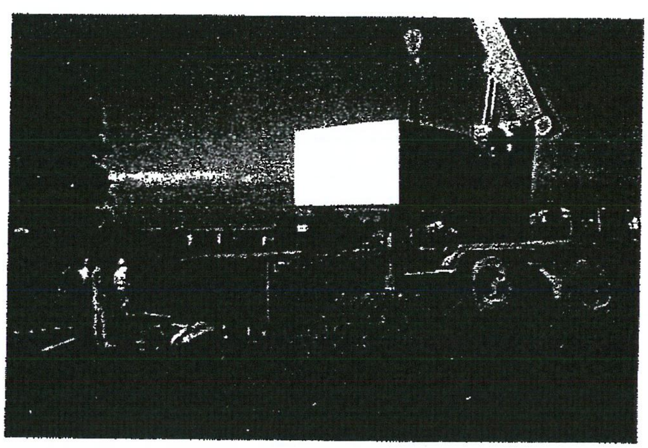


Figure 4 Installation

Wilkinson Heavy Precast Limited is intent upon maintaining its reputation as a manufacturer of strong water tight concrete products. Our design team would be glad to answer your questions regarding the construction of our product.

Maintenance

Any storm water control or treatment structure will receive considerable amounts of debris, typically foam cups, plastic and paper bags, branches, leaves, garbage bags etc.. As the diagram shows the Waterbox Treatment Unit has two separate compartments. Each of these compartments are accessible from above through large roof openings. Visual inspection from street level will show any accumulated trash, debris or oil. The **WATERBOX** does not have an inlet fitting that can be plugged with this material. The Lamella Unit is screened to prevent migration of this debris into the inclined plates. Doors in the top of the Lamella Unit can be opened for inspection and, if necessary, flushing with high pressure water.

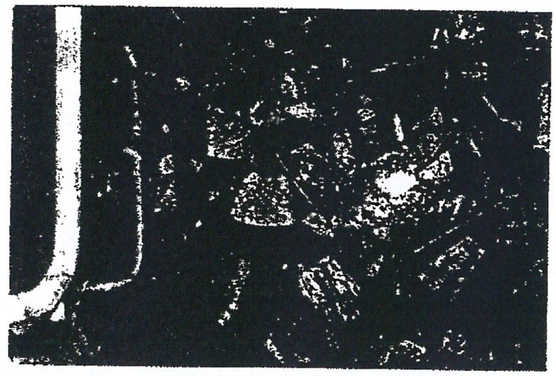


Figure 5 Debris found in Storm Water

Unless equipped with our optional Trash Basket System, large debris, paper cups, plastic bags, pop cans, etc. would normally require manual removal, while fines and oil can be removed with the same mobile vacuum equipment as used in catch basin maintenance.

Performance

As previously indicated, inclined plate settlers are commonly used in drinking and waste water treatment plants, both locally and internationally. The advantages of plated sedimentation tanks were compared with conventional sedimentation tanks both theoretically and experimentally by various investigators (Basturk et al., 1990; Fadel et al., 1990; Shamin et al., 1990; Tikje, 1974; Chen, 1970; etc...). Others have carried out both theoretical and experimental analysis of the best angle in inclined plate settlers. (Demir, 1995).

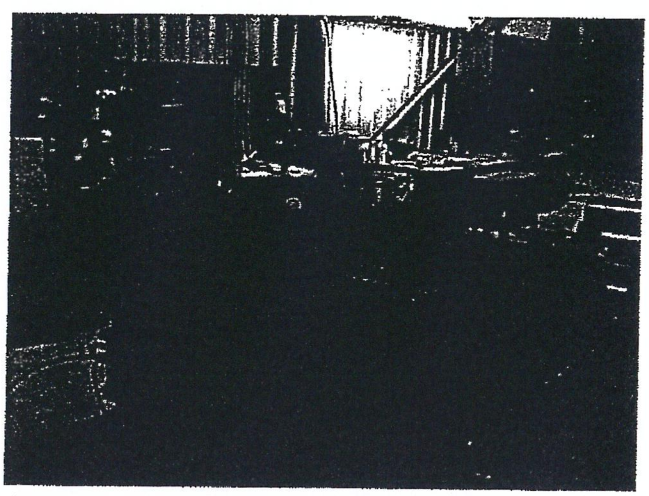


Figure 6 Lamella Unit Under Fabrication

A good reference is "Water Treatment - Principle and Design by James M. Montgomery - 1985", which provided information on the theory and performance of inclined plate sedimentation tanks.

In this textbook, basic design criteria are provided for both conventional and high rate settler basins as follows:

Table 2 Basic Design Criteria

Description	Conventional	High-Rate Settler
Surface Loading (Alum Floc) m3/m2.D	18-30	60-150
Detention Time,min.	120-240	6-25

As previously indicated, the coalescent plate settlers are commonly used in Ontario. The Approvals Branch of the Ontario Ministry of the Environment recognizes that inclined plate technology is not new and is comfortable with its proven track record, so much so that they did not see the need for a monitoring program to evacuate the performance of an inclined plate treatment unit recently installed in Sudbury. Wilkinson Heavy Precast Limited is cooperating with the Ministry and the municipalities in developing a monitoring program to evaluate the performance of the Waterbox System as a storm water quality control device. Works are underway to modify our design to accommodate sampling and monitoring equipment. The location is being kept confidential until the monitoring plan is approved by all parties.

So we let you be the judge. Is the **WATERBOX** just another Oil/Grit Separator?

Let us know at 1-800-263-8503 or stop by at the plant for a tour.

APPENDIX H

TABLES - PARTICLE SIZE DISTRIBUTION IN STORMWATER

Equations 1 and 4 were used to formulate a continuous model of settling rates for particles during quiescent and dynamic conditions respectively. The definition of Q_t implies that the separator is being treated as a completely mixed facility. The concentration of suspended solids in the separator was assumed homogeneous and was based on a simple accounting procedure of how much came in, how much settled out, and how much was discharged in the effluent.

The settling velocity is related to the size of particle. As such, the use of a single settling velocity would not be representative of suspended solids in stormwater since there is a distribution of particle sizes, each of which has different settling velocities. Research on particle size distribution in stormwater indicates that the distribution can be approximated by 5 different size classes. Table 5-1 indicates the standard size classes used by the US EPA methodology for detention basin analysis.

TABLE 5-1
Particle Size Distribution in Storm Water

Size Fraction	% of Particle Mass	Particle Size (micrometre)	Average v_s (m/s) ≤
1	0 - 20	20	0.00000254
2	20 - 40	60	0.00002540
3	40 - 60	130	0.00012700
4	60 - 80	400	0.00059267
5	80 - 100	4000	0.00550333

Table 5-1 was revised based on Canadian observations (Reference 3) regarding the distribution of particle sizes in storm water. The revised particle size distribution is presented in Table 5-2.

TABLE 5-2
Revised Particle Size Distribution in Storm Water

Size Fraction	% of Particle Mass	Particle Size (micrometre)	Average v_s (m/s) ≤
1	0 - 20	20	0.00000254
2	20 - 30	40	0.00001300
3	30 - 40	60	0.00002540
4	40 - 60	130	0.00012700
5	60 - 80	400	0.00059267
6	80 - 100	4000	0.00550333

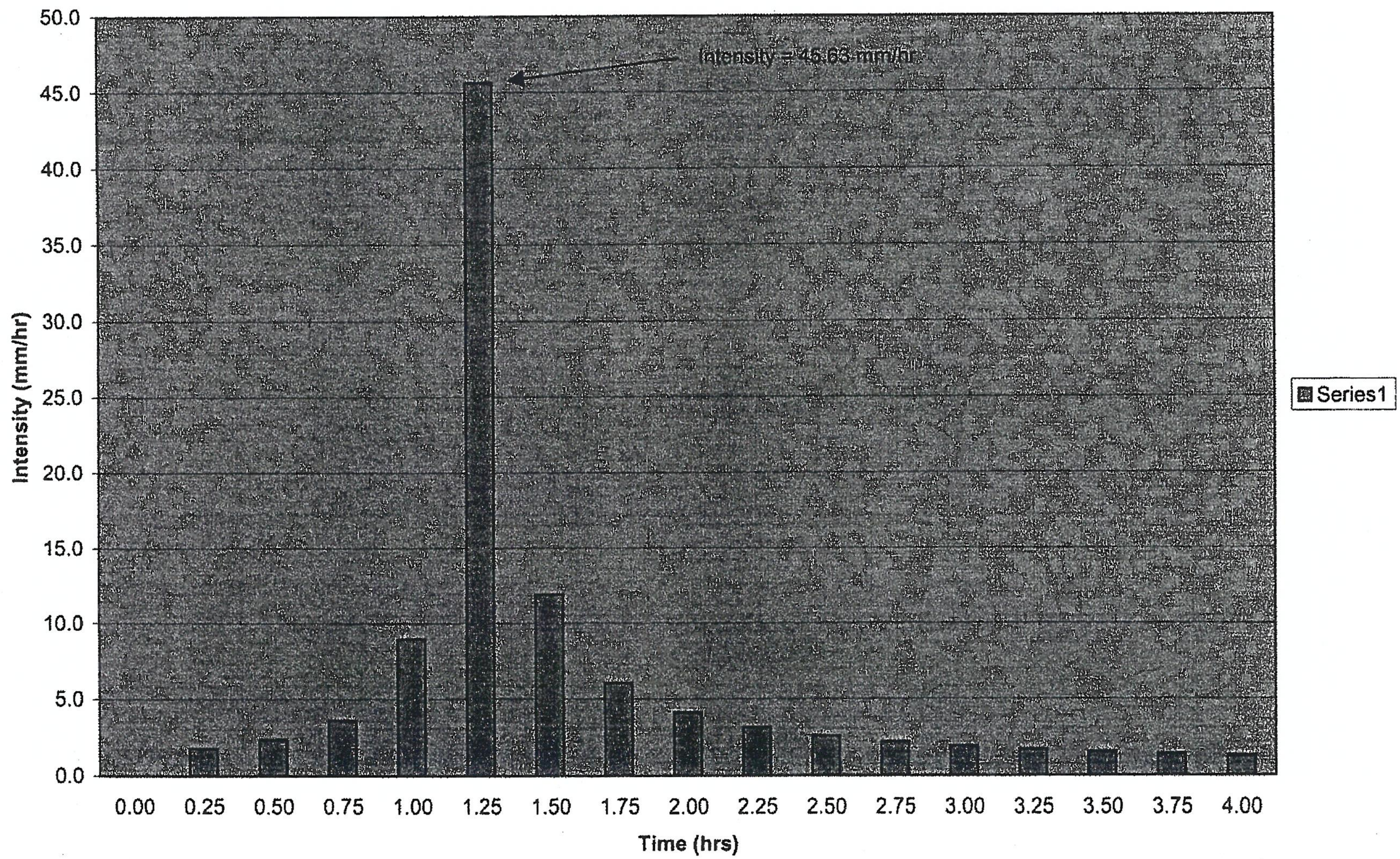
Table 5-2 indicates that 30 % of the suspended solids in storm water are smaller than the 40 μm size. The settling velocity associated with size fraction 1 translates to falling a depth of 1 m in about 110 hours.

It should be recognized that the actual distribution of particle sizes for the site will govern the operational removal efficiency of the facility.

APPENDIX I

4 HR – 25 MM CHICAGO DESIGN STORM

4 Hr - 25 mm Chicago Design Storm



APPENDIX J

STORMWATER MANAGEMENT HYDROLOGIC MODEL
(SWMHYMO, 1999)

```
2     Metric units
*#*************************************************************************
*#  Project Name: BAKERMET INC.- 2555 SHEFFIELD RD          Project Number: [196
*#  Date         : JUNE 14, 2004
*#  Modeller     : Guy Forget, P.Eng.
*#  Company      : J.L. Richards and Associates Limited
*#  License #    : 4418403
*#  Filename     : C:\OTTHYMO.OLD\19612REV.DAT
*#*************************************************************************
*%
*****************************************************************
*  STORAGE VOLUME REQUIREMENTS FOR 25 mm - 15 MIN STORM EVENT  *
*****************************************************************
*
*%-----------------|-------------------------------------------------------|
START               TZERO=[0.0],   METOUT=[2],   NSTORM=[0],   NRUN=[0]
*%
READ STORM          STORM_FILENAME=["4HR25-15.STM"],
*%-----------------|-------------------------------------------------------|
*%
*
*
* Sub-Area No. 1
*
DESIGN STANDHYD     ID=   1      NHYD= 0010  DT= 2.0 MIN  AREA= 2.37 HA
                    XIMP= 0.20   TIMP= 0.95  DWF= 0.0     LOSS= 2
                    CN*=75       SLOP= 3.00  END=  -1
*
* This command will compute the volume required to control the outflow to 0cms
*%
COMPUTE VOLUME      ID=[1], STRATE=[-100](cms), RELRATE=[0](cms)
*
ROUTE RESERVOIR      ID=2  NHYD= 0030  IDIN= 1 DT= 1.0
                      DISCH(CMS)  STORAGE (HA M)
                         0.0          0.0000
                         0.004        0.0010
                         0.005        0.0020
                         0.005        0.0500
*
*
ROUTE RESERVOIR      ID=3  NHYD= 0040  IDIN= 1 DT= 1.0
                      DISCH(CMS)  STORAGE (HA M)
                         0.0          0.0000
                         0.013        0.0010
                         0.015        0.0020
                         0.015        0.0500
*
*
ROUTE RESERVOIR      ID=4  NHYD= 0050  IDIN= 1 DT= 1.0
                      DISCH(CMS)  STORAGE (HA M)
                         0.0          0.0000
                         0.018        0.0010
                         0.020        0.0020
                         0.020        0.0500
*
*
ROUTE RESERVOIR      ID=5  NHYD= 0060  IDIN= 1 DT= 1.0
                      DISCH(CMS)  STORAGE (HA M)
                         0.0          0.0000
                         0.048        0.0010
                         0.050        0.0020
                         0.050        0.0500
*
* Sub-Area No. 1A
*
DESIGN STANDHYD     ID=   6      NHYD= 0010  DT= 2.0 MIN  AREA= 1.40 HA
                    XIMP= 0.20   TIMP= 0.95  DWF= 0.0     LOSS= 2
                    CN*=75       SLOP= 3.00  END=  -1
*
*
* Sub-Area No. 2
*
DESIGN STANDHYD     ID=   7      NHYD= 0050  DT= 2.0 MIN  AREA= 1.21 HA
                    XIMP= 0.20   TIMP= 0.95  DWF= 0.0     LOSS= 2
                    CN*=75       SLOP= 1.60  END=  -1
*
*# This command will compute the volume required to control the outflow to 0cms
*%
COMPUTE VOLUME      ID=[7], STRATE=[-100](cms), RELRATE=[0](cms)
*
ROUTE RESERVOIR      ID=8  NHYD= 0060  IDIN= 7 DT= 1.0
                      DISCH(CMS)  STORAGE (HA M)
                         0.0          0.0000
                         0.004        0.0010
                         0.005        0.0020
                         0.005        0.0225
*
*
ROUTE RESERVOIR      ID=8  NHYD= 0070  IDIN= 7 DT= 1.0
                      DISCH(CMS)  STORAGE (HA M)
                         0.0          0.0000
                         0.008        0.0010
                         0.010        0.0020
                         0.010        0.0200
*
*
ROUTE RESERVOIR      ID=8  NHYD= 0080  IDIN= 7 DT= 1.0
                      DISCH(CMS)  STORAGE (HA M)
                         0.0          0.0000
                         0.013        0.0010
                         0.015        0.0020
                         0.015        0.0175
*
*
ROUTE RESERVOIR      ID=8  NHYD= 0090  IDIN= 7 DT= 1.0
                      DISCH(CMS)  STORAGE (HA M)
                         0.0          0.0000
                         0.018        0.0010
                         0.020        0.0020
                         0.020        0.0145
*
*
ROUTE RESERVOIR      ID=8  NHYD= 0100  IDIN= 7 DT= 1.0
                      DISCH(CMS)  STORAGE (HA M)
                         0.0          0.0000
                         0.028        0.0010
                         0.030        0.0020
                         0.030        0.0135
*
*
FINISH
```

```
*****************************************************************************
 SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999    999  =========
 S      W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
 SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9 Ver. 4.02
     S   W W   M   M  H   H    Y    M   M  O   O       9999   9999 July 1999
 SSSSS   W W   M   M  H   H    Y    M   M   OOO           9      9 =========
                                                      9   9  9   9 # 4418403
      StormWater Management HYdrologic Model           999    999  =========

 *************************************************************************
 ************************* SWMHYMO-99 Ver/4.02 ***************************
 *******  A single event and continuous hydrologic simulation model  *******
 *******     based on the principles of HYMO and its successors     *******
 *******                OTTHYMO-83 and OTTHYMO-89.                   *******
 *************************************************************************
 ******* Distributed by:  J.F. Sabourin and Associates Inc.          *******
 *******                  Ottawa,  Ontario: (613) 727-5199           *******
 *******                  Gatineau, Quebec: (819) 243-6858           *******
 *******                  E-Mail: swmhymo@jfsa.Com                   *******
 *************************************************************************

 *************************************************************************
 ******* Licensed user: J.L. Richards & Associates Limited           *******
 *******               Ottawa                  SERIAL#:4418403       *******
 *************************************************************************

 *************************************************************************
 *******              ++++++ PROGRAM ARRAY DIMENSIONS ++++++         *******
 *******              Maximum value for ID numbers   :     10        *******
 *******              Max. number of rainfall points:  15000         *******
 *******              Max. number of flow points     :  15000        *******
 *************************************************************************


 ********************   D E T A I L E D   O U T P U T   *******************
 *************************************************************************
 *       DATE: 2004-06-16     TIME: 11:17:42     RUN COUNTER: 000208       *
 *************************************************************************
 * Input    filename: C:\OTTHYMO.OLD\19612REV.DAT                          *
 * Output   filename: C:\OTTHYMO.OLD\19612REV.out                          *
 * Summary filename: C:\OTTHYMO.OLD\19612REV.sum                           *
 * User comments:                                                          *
 * 1:______________________________________________________________________*
 * 2:______________________________________________________________________*
 * 3:______________________________________________________________________*
 *************************************************************************

-----------------------------------------------------------------------------
001:0001---------------------------------------------------------------------
*#****************************************************************************
*#  Project Name: BAKERMET INC.- 2555 SHEFFIELD RD         Project Number: [196
*#  Date         : JUNE 14, 2004
*#  Modeller     : Guy Forget, P.Eng.
*#  Company      : J.L. Richards and Associates Limited
*#  License #    : 4418403
*#  Filename     : C:\OTTHYMO.OLD\19612REV.DAT
*#****************************************************************************
*********************************************************************
*  STORAGE VOLUME REQUIREMENTS FOR 25 mm - 15 MIN STORM EVENT  *
*********************************************************************
*
---------------------
| START              |  Project  dir.: C:\OTTHYMO.OLD\
---------------------  Rainfall dir.: C:\OTTHYMO.OLD\
   TZERO =   .00 hrs on        0
   METOUT=   2 (output = METRIC)
   NRUN  = 001
   NSTORM=   0
-----------------------------------------------------------------------------
001:0002---------------------------------------------------------------------
---------------------
| READ STORM        |     Filename: C:\OTTHYMO.OLD\4HR25-15.STM
| Ptotal=  25.00 mm |     Comments: 4 HR - 25 mm storm - CHICAGO DESIGN STOR
---------------------
                  TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
                   hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
                   .25   1.777 |   1.25  45.631 |   2.25   3.138 |   3.25   1.675
                   .50   2.357 |   1.50  11.911 |   2.50   2.555 |   3.50   1.509
                   .75   3.618 |   1.75   6.061 |   2.75   2.165 |   3.75   1.376
                  1.00   6.975 |   2.00   4.106 |   3.00   1.885 |   4.00   1.266

-----------------------------------------------------------------------------
001:0003---------------------------------------------------------------------
*
*
* Sub-Area No. 1
*
-----------------------
| DESIGN STANDHYD      |   Area    (ha)=    2.37
| 01:000010 DT= 2.00   |   Total Imp(%)=   95.00   Dir. Conn.(%)=   20.00
-----------------------
                                  IMPERVIOUS    PERVIOUS (i)
     Surface Area        (ha)=        2.25          .12
     Dep. Storage        (mm)=         .80         1.50
     Average Slope       (%)=         3.00         3.00
     Length              (m)=       125.70        40.00
     Mannings n             =         .013         .250

     Max.eff.Inten.(mm/hr)=          45.63       668.24
               over (min)             2.14         6.43
     Storage Coeff.  (min)=           2.88 (ii)    5.81 (ii)
     Unit Hyd. Tpeak (min)=           2.14         6.43
     Unit Hyd. peak  (cms)=            .42          .19
                                                            *TOTALS*
     PEAK FLOW       (cms)=            .06          .19        .248 (iii)
     TIME TO PEAK    (hrs)=           1.25         1.25       1.250
     RUNOFF VOLUME   (mm)=           24.20        20.54      21.273
     TOTAL RAINFALL  (mm)=           25.00        25.00      24.999
     RUNOFF COEFFICIENT   =            .97          .82        .851

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------
001:0004---------------------------------------------------------------------
*
* This command will compute the volume required to control the outflow to 0cms
---------------------
| COMPUTE VOLUME     |
| ID:01  (000010)    |                 DISCHARGE      TIME
---------------------                   (cms)        (hrs)
           START CONTROLLING AT          .000          .036
           INFLOW HYD. PEAKS AT          .248         1.250
           STOP  CONTROLLING AT          .000         4.964

           REQUIRED STORAGE VOLUME (ha.m.)=         .0504
           TOTAL HYDROGRAPH VOLUME (ha.m.)=         .0504
           % OF HYDROGRAPH TO STORE        =      99.9996

           NOTE:  Storage was computed to reduce the inflow

-----------------------------------------------------------------------------
001:0005---------------------------------------------------------------------
*
----------------------
| ROUTE RESERVOIR     |     Requested routing time step =  1.0 min.
|  IN>01:(000010)     |
| OUT<02:(000030)     |     =========  OUTLFOW STORAGE TABLE  =========
----------------------      OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                             (cms)     (ha.m.)   |   (cms)     (ha.m.)
                              .000   .0000E+00   |    .005   .2000E-02
                              .004   .1000E-02   |    .005   .5000E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (000010)         2.37      .248     1.250     21.273
     OUTFLOW<02: (000030)         2.37      .005      .929     21.273

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=    2.016
                   TIME SHIFT OF PEAK FLOW          (min)=   -19.29
                   MAXIMUM  STORAGE   USED       (ha.m.)=.4412E-01

-----------------------------------------------------------------------------
001:0006---------------------------------------------------------------------
*
*
----------------------
| ROUTE RESERVOIR     |     Requested routing time step =  1.0 min.
|  IN>01:(000010)     |
| OUT<03:(000040)     |     =========  OUTLFOW STORAGE TABLE  =========
----------------------      OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                             (cms)     (ha.m.)   |   (cms)     (ha.m.)
                              .000   .0000E+00   |    .015   .2000E-02
                              .013   .1000E-02   |    .015   .5000E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (000010)         2.37      .248     1.250     21.273
     OUTFLOW<03: (000040)         2.37      .015     1.018     21.273

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=    6.049
                   TIME SHIFT OF PEAK FLOW          (min)=   -13.93
                   MAXIMUM  STORAGE   USED       (ha.m.)=.3442E-01

-----------------------------------------------------------------------------
001:0007---------------------------------------------------------------------
*
*
----------------------
| ROUTE RESERVOIR     |     Requested routing time step =  1.0 min.
|  IN>01:(000010)     |
| OUT<04:(000050)     |     =========  OUTLFOW STORAGE TABLE  =========
----------------------      OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                             (cms)     (ha.m.)   |   (cms)     (ha.m.)
                              .000   .0000E+00   |    .020   .2000E-02
                              .018   .1000E-02   |    .020   .5000E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (000010)         2.37      .248     1.250     21.273
     OUTFLOW<04: (000050)         2.37      .020     1.038     21.273

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=    8.065
                   TIME SHIFT OF PEAK FLOW          (min)=   -12.86
                   MAXIMUM  STORAGE   USED       (ha.m.)=.3151E-01

-----------------------------------------------------------------------------
001:0008---------------------------------------------------------------------
*
*
----------------------
| ROUTE RESERVOIR     |     Requested routing time step =  1.0 min.
|  IN>01:(000010)     |
| OUT<05:(000060)     |     =========  OUTLFOW STORAGE TABLE  =========
----------------------      OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                             (cms)     (ha.m.)   |   (cms)     (ha.m.)
                              .000   .0000E+00   |    .050   .2000E-02
                              .048   .1000E-02   |    .050   .5000E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (000010)         2.37      .248     1.250     21.273
     OUTFLOW<05: (000060)         2.37      .050     1.089     21.273

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   20.162
                   TIME SHIFT OF PEAK FLOW          (min)=    -9.64
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2136E-01

-----------------------------------------------------------------------------
001:0009---------------------------------------------------------------------
*
* Sub-Area No. 1A
*
-----------------------
| DESIGN STANDHYD      |   Area    (ha)=    1.40
| 06:000010 DT= 2.00   |   Total Imp(%)=   95.00   Dir. Conn.(%)=   20.00
-----------------------
                                  IMPERVIOUS    PERVIOUS (i)
     Surface Area        (ha)=        1.33          .07
     Dep. Storage        (mm)=         .80         1.50
     Average Slope       (%)=         3.00         3.00
     Length              (m)=        96.61        40.00
     Mannings n             =         .013         .250

     Max.eff.Inten.(mm/hr)=          45.63       668.24
               over (min)             2.14         6.43
     Storage Coeff.  (min)=           2.46 (ii)    5.39 (ii)
     Unit Hyd. Tpeak (min)=           2.14         6.43
     Unit Hyd. peak  (cms)=            .46          .20
                                                            *TOTALS*
     PEAK FLOW       (cms)=            .04          .11        .149 (iii)
     TIME TO PEAK    (hrs)=           1.25         1.25       1.250
     RUNOFF VOLUME   (mm)=           24.20        20.54      21.273
     TOTAL RAINFALL  (mm)=           25.00        25.00      24.999
     RUNOFF COEFFICIENT   =            .97          .82        .851

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------
001:0010---------------------------------------------------------------------
*
*
* Sub-Area No. 2
*
-----------------------
| DESIGN STANDHYD      |   Area    (ha)=    1.21
| 07:000050 DT= 2.00   |   Total Imp(%)=   95.00   Dir. Conn.(%)=   20.00
-----------------------
                                  IMPERVIOUS    PERVIOUS (i)
     Surface Area        (ha)=        1.15          .06
     Dep. Storage        (mm)=         .80         1.50
     Average Slope       (%)=         1.60         1.60
```

```
        Length              (m)=        89.81         40.00
        Mannings n             =         .013          .250

        Max.eff.Inten.(mm/hr)=          45.63        668.24
                   over (min)            2.14          6.43
        Storage Coeff.   (min)=          2.85 (ii)     5.38 (ii)
        Unit Hyd. Tpeak (min)=           2.14          6.43
        Unit Hyd. peak  (cms)=            .42           .18
                                                                  *TOTALS*
        PEAK FLOW        (cms)=           .03           .09         .124 (iii)
        TIME TO PEAK     (hrs)=          1.25          1.25        1.250
        RUNOFF VOLUME    (mm)=          24.20         20.54       21.273
        TOTAL RAINFALL   (mm)=          25.00         25.00       24.999
        RUNOFF COEFFICIENT   =            .97           .82         .851

           (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
               CN* =  75.0    Ia = Dep. Storage  (Above)
          (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
               THAN THE STORAGE COEFFICIENT.
         (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ----------------------------------------------------------------------------
 001:0011--------------------------------------------------------------------
 *
 *# This command will compute the volume required to control the outflow to 0cms
 ---------------------
 | COMPUTE VOLUME    |
 | ID:07  (000050)   |                   DISCHARGE      TIME
 ---------------------                     (cms)        (hrs)
             START CONTROLLING AT           .000         .036
             INFLOW HYD. PEAKS AT           .124        1.250
             STOP  CONTROLLING AT           .000        4.964

             REQUIRED STORAGE VOLUME (ha.m.)=     .0257
             TOTAL HYDROGRAPH VOLUME (ha.m.)=     .0257
             % OF HYDROGRAPH TO STORE       =   99.9997

             NOTE:  Storage was computed to reduce the Inflow

 ----------------------------------------------------------------------------
 001:0012--------------------------------------------------------------------
 *
 ---------------------
 | ROUTE RESERVOIR   |     Requested routing time step =  1.0 min.
 |   IN>07:(000050)  |
 | OUT<08:(000060)   |     ========= OUTLFOW STORAGE TABLE =========
 ---------------------     OUTFLOW   STORAGE  |  OUTFLOW   STORAGE
                            (cms)    (ha.m.)  |   (cms)    (ha.m.)
                             .000  .0000E+00  |    .005  .2000E-02
                             .004  .1000E-02  |    .005  .2250E-01

      ROUTING RESULTS              AREA      QPEAK      TPEAK       R.V.
      ---------------------        (ha)      (cms)      (hrs)       (mm)
      INFLOW >07: (000050)         1.21       .124      1.250     21.273
      OUTFLOW<08: (000060)         1.21       .005      1.071     21.272

                 PEAK   FLOW   REDUCTION [Qout/Qin](%)=    4.029
                 TIME SHIFT OF PEAK FLOW          (min)=  -10.71
                 MAXIMUM  STORAGE   USED        (ha.m.)=.1987E-01

 ----------------------------------------------------------------------------
 001:0013--------------------------------------------------------------------
 *
 *
 ---------------------
 | ROUTE RESERVOIR   |     Requested routing time step =  1.0 min.
 |   IN>07:(000050)  |
 | OUT<08:(000070)   |     ========= OUTLFOW STORAGE TABLE =========
 ---------------------     OUTFLOW   STORAGE  |  OUTFLOW   STORAGE
                            (cms)    (ha.m.)  |   (cms)    (ha.m.)
                             .000  .0000E+00  |    .010  .2000E-02
                             .008  .1000E-02  |    .010  .2000E-01

      ROUTING RESULTS              AREA      QPEAK      TPEAK       R.V.
      ---------------------        (ha)      (cms)      (hrs)       (mm)
      INFLOW >07: (000050)         1.21       .124      1.250     21.273
      OUTFLOW<08: (000070)         1.21       .010      1.089     21.273

                 PEAK   FLOW   REDUCTION [Qout/Qin](%)=    8.057
                 TIME SHIFT OF PEAK FLOW          (min)=   -9.64
                 MAXIMUM  STORAGE   USED        (ha.m.)=.1650E-01

 ----------------------------------------------------------------------------
 001:0014--------------------------------------------------------------------
 *
 *
 ---------------------
 | ROUTE RESERVOIR   |     Requested routing time step =  1.0 min.
 |   IN>07:(000050)  |
 | OUT<08:(000080)   |     ========= OUTLFOW STORAGE TABLE =========
 ---------------------     OUTFLOW   STORAGE  |  OUTFLOW   STORAGE
                            (cms)    (ha.m.)  |   (cms)    (ha.m.)
                             .000  .0000E+00  |    .015  .2000E-02
                             .013  .1000E-02  |    .015  .1750E-01

      ROUTING RESULTS              AREA      QPEAK      TPEAK       R.V.
      ---------------------        (ha)      (cms)      (hrs)       (mm)
      INFLOW >07: (000050)         1.21       .124      1.250     21.273
      OUTFLOW<08: (000080)         1.21       .015      1.107     21.273

                 PEAK   FLOW   REDUCTION [Qout/Qin](%)=   12.086
                 TIME SHIFT OF PEAK FLOW          (min)=   -8.57
                 MAXIMUM  STORAGE   USED        (ha.m.)=.1433E-01

 ----------------------------------------------------------------------------
 001:0015--------------------------------------------------------------------
 *
 *
 ---------------------
 | ROUTE RESERVOIR   |     Requested routing time step =  1.0 min.
 |   IN>07:(000050)  |
 | OUT<08:(000090)   |     ========= OUTLFOW STORAGE TABLE =========
 ---------------------     OUTFLOW   STORAGE  |  OUTFLOW   STORAGE
                            (cms)    (ha.m.)  |   (cms)    (ha.m.)
                             .000  .0000E+00  |    .020  .2000E-02
                             .018  .1000E-02  |    .020  .1450E-01

      ROUTING RESULTS              AREA      QPEAK      TPEAK       R.V.
      ---------------------        (ha)      (cms)      (hrs)       (mm)
      INFLOW >07: (000050)         1.21       .124      1.250     21.273
      OUTFLOW<08: (000090)         1.21       .020      1.125     21.273

                 PEAK   FLOW   REDUCTION [Qout/Qin](%)=   16.115
                 TIME SHIFT OF PEAK FLOW          (min)=   -7.50
                 MAXIMUM  STORAGE   USED        (ha.m.)=.1269E-01

 ----------------------------------------------------------------------------
 001:0016--------------------------------------------------------------------
 *
 *
 ---------------------
 | ROUTE RESERVOIR   |     Requested routing time step =  1.0 min.
 |   IN>07:(000050)  |
 | OUT<08:(000100)   |     ========= OUTLFOW STORAGE TABLE =========
 ---------------------     OUTFLOW   STORAGE  |  OUTFLOW   STORAGE
                            (cms)    (ha.m.)  |   (cms)    (ha.m.)
                             .000  .0000E+00  |    .030  .2000E-02
                             .026  .1000E-02  |    .030  .1250E-01

      ROUTING RESULTS              AREA      QPEAK      TPEAK       R.V.
      ---------------------        (ha)      (cms)      (hrs)       (mm)
      INFLOW >07: (000050)         1.21       .124      1.250     21.273
      OUTFLOW<08: (000100)         1.21       .030      1.143     21.273

                 PEAK   FLOW   REDUCTION [Qout/Qin](%)=   24.172
                 TIME SHIFT OF PEAK FLOW          (min)=   -6.43
                 MAXIMUM  STORAGE   USED        (ha.m.)=.1015E-01

 ----------------------------------------------------------------------------
 001:0017--------------------------------------------------------------------
 *
 *
     FINISH
 ----------------------------------------------------------------------------
 ****************************************************************************
      WARNINGS / ERRORS / NOTES
      -------------------------
    Simulation ended on 2004-06-16     at 13:17:43
 ============================================================================
```

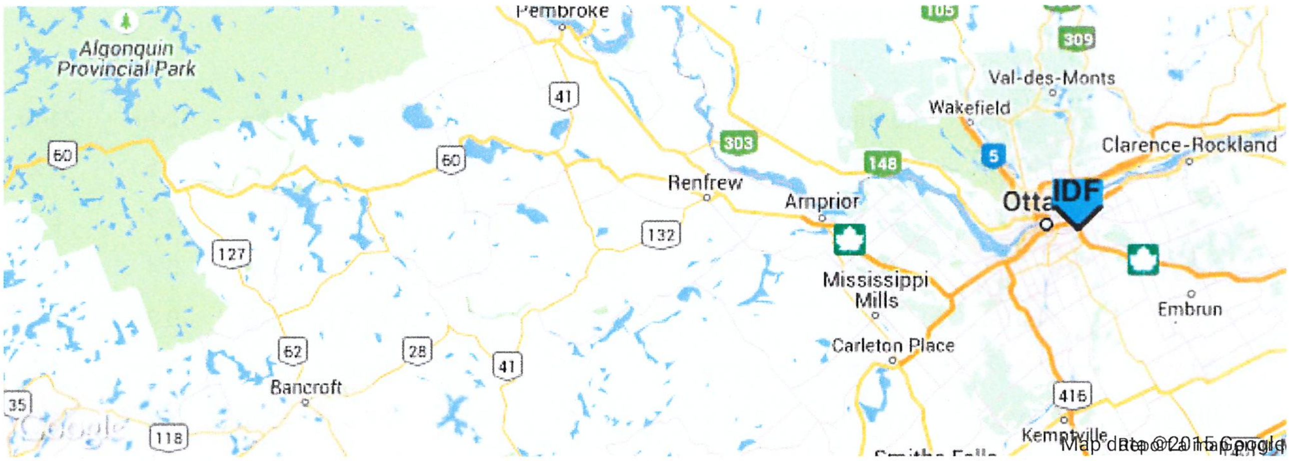
APPENDIX B

MTO IDF Curves

Active coordinate

45° 24' 15" N, 75° 36' 14" W (45.404167,-75.604167) Modify selection

Retrieved: Tue, 12 May 2015 15:44:25 UTC



Map options: Modify selection | Show/hide gauging stations | Re-center selection

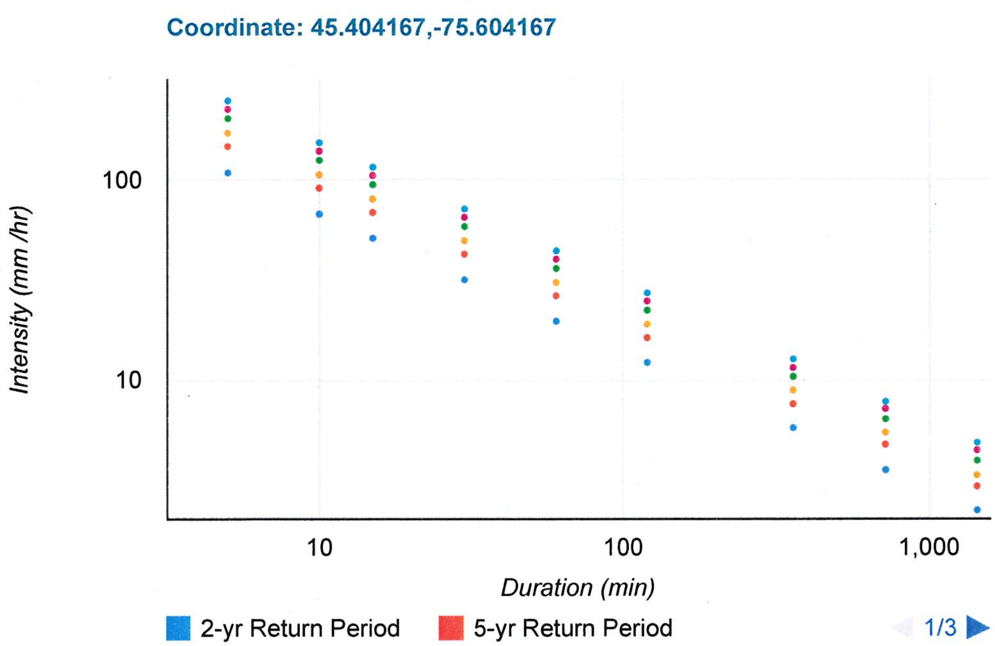
Coordinate summary

These are the coordinates in the selection.

IDF Curve: 45° 24' 15" N, 75° 36' 14" W (45.404167,-75.604167)

Results

An IDF curve was found for this set of coordinates.



Coefficient summary   Notes

Click a return period in the table header for more detail.

Return period	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
A	19.5	26.1	30.4	35.8	39.8	43.8
B	-0.689	-0.693	-0.694	-0.696	-0.696	-0.697

Statistics

Rainfall intensity (mm hr^{-1})

Duration	5-min	10-min	15-min	30-min	1-hr	2-hr	6-hr	12-hr	24-hr
2-yr	108.0	67.0	50.7	31.4	19.5	12.1	5.7	3.5	2.2
5-yr	146.1	90.3	68.2	42.2	26.1	16.1	7.5	4.7	2.9
10-yr	170.5	105.4	79.6	49.2	30.4	18.8	8.8	5.4	3.3
25-yr	201.8	124.6	94.0	58.0	35.8	22.1	10.3	6.3	3.9
50-yr	224.4	138.5	104.5	64.5	39.8	24.6	11.4	7.1	4.4
100-yr	247.6	152.7	115.1	71.0	43.8	27.0	12.6	7.7	4.8

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Exit

APPENDIX C

Visual Otthymo Existing Conditions Model

```
=====================================================================================
=======================

       V     V    I    SSSSS  U    U     A     L
       V     V    I    SS     U    U    A A    L
        V   V     I     SS    U    U   AAAAA   L
        V   V     I      SS   U    U   A   A   L
         VV       I    SSSSS  UUUUU    A   A   LLLLL

        OOO    TTTTT  TTTTT   H    H   Y    Y   M    M   OOO      TM
       O   O     T      T     H    H    Y Y     MM  MM  O   O
       O   O     T      T     H    H     Y      M    M  O   O    Company

        OOO      T      T     H    H     Y      M    M   OOO                  Serial
```

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```
                    *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual Otthymo 2.4\VO2\voin.dat

  Output  filename:
C:\Users\mknowles\AppData\Local\Temp\eda46f54-a1a4-498f-aefb-a77ea08251a7\Scenario.o
ut
  Summary filename:
C:\Users\mknowles\AppData\Local\Temp\eda46f54-a1a4-498f-aefb-a77ea08251a7\Scenario.s
um


DATE: 07/09/2015                              TIME: 03:35:38

USER:



COMMENTS: Pre-Development Visual Otthymo model using Nash Hydrograph. Simulation 1 =
25mm; Simulation 2 = 5yr;
Simulation 3 = 100yr.


-------------------------------------------------------------------------------------
-----------------------
  ****************************
  ** SIMULATION NUMBER:   1 **
  ****************************

--------------------
| CHICAGO STORM    |     IDF curve parameters: A= 434.000
| Ptotal= 25.01 mm |                           B=   6.000
--------------------                           C=   0.787
                         used in:   INTENSITY =  A / (t + B)^C

                         Duration of storm   =  6.00 hrs
                         Storm time step     = 10.00 min
                         Time to peak ratio =  0.33

                  TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                   hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
```

0.17	1.03	1.67	5.08	3.17	2.67	4.67	1.31
0.33	1.11	1.83	12.11	3.33	2.38	4.83	1.25
0.50	1.22	2.00	48.96	3.50	2.14	5.00	1.19
0.67	1.35	2.17	15.85	3.67	1.96	5.17	1.14
0.83	1.51	2.33	8.38	3.83	1.80	5.33	1.09
1.00	1.74	2.50	5.75	4.00	1.67	5.50	1.05
1.17	2.05	2.67	4.42	4.17	1.56	5.67	1.01
1.33	2.52	2.83	3.61	4.33	1.47	5.83	0.97
1.50	3.33	3.00	3.06	4.50	1.39	6.00	0.94

| CALIB |
| NASHYD (0100) |
|ID= 1 DT= 5.0 min |

Area (ha)= 1.79 Curve Number (CN)= 90.0
Ia (mm)= 5.00 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= 0.25

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.03	1.583	5.08	3.083	2.67	4.58	1.31
0.167	1.03	1.667	5.08	3.167	2.67	4.67	1.31
0.250	1.11	1.750	12.11	3.250	2.38	4.75	1.25
0.333	1.11	1.833	12.11	3.333	2.38	4.83	1.25
0.417	1.22	1.917	48.96	3.417	2.14	4.92	1.19
0.500	1.22	2.000	48.96	3.500	2.14	5.00	1.19
0.583	1.35	2.083	15.85	3.583	1.96	5.08	1.14
0.667	1.35	2.167	15.85	3.667	1.96	5.17	1.14
0.750	1.51	2.250	8.38	3.750	1.80	5.25	1.09
0.833	1.51	2.333	8.38	3.833	1.80	5.33	1.09
0.917	1.74	2.417	5.75	3.917	1.67	5.42	1.05
1.000	1.74	2.500	5.75	4.000	1.67	5.50	1.05
1.083	2.05	2.583	4.42	4.083	1.56	5.58	1.01
1.167	2.05	2.667	4.42	4.167	1.56	5.67	1.01
1.250	2.52	2.750	3.61	4.250	1.47	5.75	0.97
1.333	2.52	2.833	3.61	4.333	1.47	5.83	0.97
1.417	3.33	2.917	3.06	4.417	1.39	5.92	0.94
1.500	3.33	3.000	3.06	4.500	1.39	6.00	0.94

Unit Hyd Qpeak (cms)= 0.273

PEAK FLOW (cms)= 0.032 (i)
TIME TO PEAK (hrs)= 2.250
RUNOFF VOLUME (mm)= 8.295
TOTAL RAINFALL (mm)= 25.010
RUNOFF COEFFICIENT = 0.332

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| NASHYD (0200) |
|ID= 1 DT= 5.0 min |

Area (ha)= 2.37 Curve Number (CN)= 90.0
Ia (mm)= 5.00 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= 0.25

Unit Hyd Qpeak (cms)= 0.362

PEAK FLOW (cms)= 0.043 (i)

```
    TIME TO PEAK      (hrs)=    2.250
    RUNOFF VOLUME      (mm)=    8.295
    TOTAL RAINFALL     (mm)=   25.010
    RUNOFF COEFFICIENT    =     0.332

    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD    (0005) |
|   1 +  2 =  3     |          AREA     QPEAK     TPEAK      R.V.
--------------------           (ha)     (cms)     (hrs)      (mm)
          ID1= 1 (0100):       1.79    0.032      2.25      8.29
        + ID2= 2 (0200):       2.37    0.043      2.25      8.29
          ===============================================
          ID = 3 (0005):       4.16    0.075      2.25      8.29

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
  ****************************
  ** SIMULATION NUMBER:   2 **
  ****************************

--------------------
| CHICAGO STORM     |     IDF curve parameters: A= 521.096
| Ptotal= 40.54 mm  |                           B=    1.501
--------------------                            C=    0.718
                          used in:   INTENSITY =  A / (t + B)^C

                          Duration of storm   =  4.00 hrs
                          Storm time step     = 10.00 min
                          Time to peak ratio  =  0.33

                     The CORRELATION coefficient is = 0.9996

                       TIME        INPUT INT.          TAB. INT.
                       (min)       (mm/hr)             (mm/hr)
                          5.        146.10              135.89
                         10.         90.30               90.22
                         15.         68.20               69.62
                         30.         42.20               43.76
                         60.         26.10               27.07
                        120.         16.10               16.60
                        360.          7.50                7.59
                        720.          4.70                4.62
                       1440.          2.90                2.81

                   TIME     RAIN |  TIME     RAIN |'  TIME     RAIN |  TIME     RAIN
                    hrs    mm/hr |   hrs    mm/hr |'   hrs    mm/hr |   hrs    mm/hr
                   0.17     3.26 |  1.17    17.79 |  2.17     6.70 |  3.17     3.78
                   0.33     3.66 |  1.33    90.22 |  2.33     5.87 |  3.33     3.55
                   0.50     4.21 |  1.50    22.43 |  2.50     5.25 |  3.50     3.35
                   0.67     5.00 |  1.67    13.17 |  2.67     4.76 |  3.67     3.18
                   0.83     6.28 |  1.83     9.75 |  2.83     4.37 |  3.83     3.02
                   1.00     8.81 |  2.00     7.89 |  3.00     4.05 |  4.00     2.88

--------------------------------------------------------------------------------
--------------------
| CALIB             |
```

```
| NASHYD    (0100) |    Area     (ha)=    1.79   Curve Number   (CN)= 90.0
|ID= 1 DT= 5.0 min |    Ia       (mm)=    5.00   # of Linear Res.(N)= 3.00
--------------------    U.H. Tp(hrs)=    0.25

        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
                     0.083     3.26 | 1.083    17.79 | 2.083    6.70 |  3.08     3.78
                     0.167     3.26 | 1.167    17.79 | 2.167    6.70 |  3.17     3.78
                     0.250     3.66 | 1.250    90.22 | 2.250    5.87 |  3.25     3.55
                     0.333     3.66 | 1.333    90.22 | 2.333    5.87 |  3.33     3.55
                     0.417     4.21 | 1.417    22.43 | 2.417    5.25 |  3.42     3.35
                     0.500     4.21 | 1.500    22.43 | 2.500    5.25 |  3.50     3.35
                     0.583     5.00 | 1.583    13.17 | 2.583    4.76 |  3.58     3.18
                     0.667     5.00 | 1.667    13.17 | 2.667    4.76 |  3.67     3.18
                     0.750     6.28 | 1.750     9.75 | 2.750    4.37 |  3.75     3.02
                     0.833     6.28 | 1.833     9.75 | 2.833    4.37 |  3.83     3.02
                     0.917     8.81 | 1.917     7.89 | 2.917    4.05 |  3.92     2.88
                     1.000     8.81 | 2.000     7.89 | 3.000    4.05 |  4.00     2.88

    Unit Hyd Qpeak  (cms)=   0.273

    PEAK FLOW       (cms)=   0.092 (i)
    TIME TO PEAK    (hrs)=   1.583
    RUNOFF VOLUME    (mm)=  19.793
    TOTAL RAINFALL   (mm)=  40.540
    RUNOFF COEFFICIENT   =   0.488

    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD    (0200) |    Area     (ha)=    2.37   Curve Number   (CN)= 90.0
|ID= 1 DT= 5.0 min |    Ia       (mm)=    5.00   # of Linear Res.(N)= 3.00
--------------------    U.H. Tp(hrs)=    0.25

    Unit Hyd Qpeak  (cms)=   0.362

    PEAK FLOW       (cms)=   0.121 (i)
    TIME TO PEAK    (hrs)=   1.583
    RUNOFF VOLUME    (mm)=  19.793
    TOTAL RAINFALL   (mm)=  40.540
    RUNOFF COEFFICIENT   =   0.488

    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3     |          AREA     QPEAK     TPEAK      R.V.
--------------------          (ha)     (cms)     (hrs)      (mm)
          ID1= 1 (0100):      1.79    0.092      1.58     19.79
        + ID2= 2 (0200):      2.37    0.121      1.58     19.79
          ==================================================
          ID = 3 (0005):      4.16    0.213      1.58     19.79

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
```

```
------------------------------------------------------------------------------
  ****************************
  ** SIMULATION NUMBER:   3 **
  ****************************

--------------------
| CHICAGO STORM    |     IDF curve parameters: A= 892.151
| Ptotal= 67.53 mm |                           B=   1.501
--------------------                           C=   0.723
                         used in:   INTENSITY =  A / (t + B)^C

                         Duration of storm  =  4.00 hrs
                         Storm time step    = 10.00 min
                         Time to peak ratio =  0.33

                     The CORRELATION coefficient is = 0.9997

                      TIME        INPUT INT.           TAB. INT.
                     (min)         (mm/hr)              (mm/hr)
                        5.          247.60               230.49
                       10.          152.70               152.59
                       15.          115.10               117.54
                       30.           71.00                73.65
                       60.           43.80                45.40
                      120.           27.00                27.75
                      360.           12.60                12.62
                      720.            7.70                 7.65
                     1440.            4.80                 4.64

                  TIME     RAIN | TIME     RAIN |' TIME     RAIN | TIME     RAIN
                   hrs    mm/hr |  hrs    mm/hr |'  hrs    mm/hr |  hrs    mm/hr
                  0.17     5.34 | 1.17    29.57 | 2.17    11.04 | 3.17     6.20
                  0.33     6.00 | 1.33   152.59 | 2.33     9.66 | 3.33     5.82
                  0.50     6.91 | 1.50    37.36 | 2.50     8.63 | 3.50     5.49
                  0.67     8.22 | 1.67    21.82 | 2.67     7.82 | 3.67     5.20
                  0.83    10.34 | 1.83    16.11 | 2.83     7.18 | 3.83     4.95
                  1.00    14.55 | 2.00    13.01 | 3.00     6.65 | 4.00     4.72

------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0100) |   Area    (ha)=   1.79   Curve Number   (CN)= 90.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.25

           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
                 0.083     5.34 | 1.083   29.57 | 2.083   11.04 | 3.08     6.20
                 0.167     5.34 | 1.167   29.57 | 2.167   11.04 | 3.17     6.20
                 0.250     6.00 | 1.250  152.59 | 2.250    9.66 | 3.25     5.82
                 0.333     6.00 | 1.333  152.59 | 2.333    9.66 | 3.33     5.82
                 0.417     6.91 | 1.417   37.36 | 2.417    8.63 | 3.42     5.49
                 0.500     6.91 | 1.500   37.36 | 2.500    8.63 | 3.50     5.49
                 0.583     8.22 | 1.583   21.82 | 2.583    7.82 | 3.58     5.20
                 0.667     8.22 | 1.667   21.82 | 2.667    7.82 | 3.67     5.20
                 0.750    10.34 | 1.750   16.11 | 2.750    7.18 | 3.75     4.95
                 0.833    10.34 | 1.833   16.11 | 2.833    7.18 | 3.83     4.95
```

```
          0.917    14.55 | 1.917    13.01 | 2.917     6.65 |   3.92     4.72
          1.000    14.55 | 2.000    13.01 | 3.000     6.65 |   4.00     4.72

     Unit Hyd Qpeak  (cms)=   0.273

     PEAK FLOW       (cms)=   0.219 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  43.049
     TOTAL RAINFALL   (mm)=  67.529
     RUNOFF COEFFICIENT   =   0.637

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD    (0200) |    Area     (ha)=    2.37   Curve Number   (CN)= 90.0
|ID= 1 DT= 5.0 min |    Ia       (mm)=    5.00   # of Linear Res.(N)= 3.00
--------------------    U.H. Tp(hrs)=    0.25

     Unit Hyd Qpeak  (cms)=   0.362

     PEAK FLOW       (cms)=   0.290 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  43.049
     TOTAL RAINFALL   (mm)=  67.529
     RUNOFF COEFFICIENT   =   0.637

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |          AREA    QPEAK     TPEAK      R.V.
--------------------          (ha)    (cms)     (hrs)      (mm)
          ID1= 1 (0100):      1.79    0.219     1.50     43.05
        + ID2= 2 (0200):      2.37    0.290     1.50     43.05
          ==================================================
          ID = 3 (0005):      4.16    0.508     1.50     43.05

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

 FINISH
=====================================================================================
=======================
```

APPENDIX D

Visual Otthymo Proposed Conditions Model

```
===================================================================================
=======================

       V     V    I    SSSSS  U    U    A     L
       V     V    I    SS     U    U   A A    L
        V   V     I     SS    U    U  AAAAA   L
        V   V     I      SS   U    U  A    A  L
         VV       I    SSSSS  UUUUU   A    A  LLLLL

        OOO    TTTTT  TTTTT  H    H  Y    Y  M    M   OOO     TM
       O   O     T      T    H    H   Y Y    MM MM   O   O
       O   O     T      T    H    H    Y     M    M  O   O     Company

        OOO      T      T    H    H    Y     M    M   OOO                  Serial

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                   *****  D E T A I L E D   O U T P U T *****

  Input   filename: C:\Program Files (x86)\Visual Otthymo 2.4\VO2\voin.dat

  Output  filename:
C:\Users\bcripps\AppData\Local\Temp\b7d99655-818b-42d0-8dc8-0a2de078e360\Scenario.ou
t
  Summary filename:
C:\Users\bcripps\AppData\Local\Temp\b7d99655-818b-42d0-8dc8-0a2de078e360\Scenario.su
m

DATE: 12/11/2015                            TIME: 11:51:36

USER:

COMMENTS: Post-Development Visual Otthymo model using Nash Hydrograph. Simulation 1
= 25mm; Simulation 2 = 5yr;
Simulation 3 = 100yr.

-----------------------------------------------------------------------------------
-----------------------
  ****************************
  ** SIMULATION NUMBER:   1 **
  ****************************

--------------------
| CHICAGO STORM    |     IDF curve parameters: A= 434.000
| Ptotal= 25.01 mm |                           B=   6.000
--------------------                           C=   0.787
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm   =  6.00 hrs
                        Storm time step     = 10.00 min
                        Time to peak ratio =  0.33

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
```

0.17	1.03	1.67	5.08	3.17	2.67	4.67	1.31
0.33	1.11	1.83	12.11	3.33	2.38	4.83	1.25
0.50	1.22	2.00	48.96	3.50	2.14	5.00	1.19
0.67	1.35	2.17	15.85	3.67	1.96	5.17	1.14
0.83	1.51	2.33	8.38	3.83	1.80	5.33	1.09
1.00	1.74	2.50	5.75	4.00	1.67	5.50	1.05
1.17	2.05	2.67	4.42	4.17	1.56	5.67	1.01
1.33	2.52	2.83	3.61	4.33	1.47	5.83	0.97
1.50	3.33	3.00	3.06	4.50	1.39	6.00	0.94

```
------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD    (0003)   |   Area     (ha)=    1.36   Curve Number    (CN)= 98.0
|ID= 1 DT= 5.0 min   |   Ia       (mm)=    1.00   # of Linear Res.(N)= 3.00
--------------------    U.H. Tp(hrs)=     0.25
```

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.03	1.583	5.08	3.083	2.67	4.58	1.31
0.167	1.03	1.667	5.08	3.167	2.67	4.67	1.31
0.250	1.11	1.750	12.11	3.250	2.38	4.75	1.25
0.333	1.11	1.833	12.11	3.333	2.38	4.83	1.25
0.417	1.22	1.917	48.96	3.417	2.14	4.92	1.19
0.500	1.22	2.000	48.96	3.500	2.14	5.00	1.19
0.583	1.35	2.083	15.85	3.583	1.96	5.08	1.14
0.667	1.35	2.167	15.85	3.667	1.96	5.17	1.14
0.750	1.51	2.250	8.38	3.750	1.80	5.25	1.09
0.833	1.51	2.333	8.38	3.833	1.80	5.33	1.09
0.917	1.74	2.417	5.75	3.917	1.67	5.42	1.05
1.000	1.74	2.500	5.75	4.000	1.67	5.50	1.05
1.083	2.05	2.583	4.42	4.083	1.56	5.58	1.01
1.167	2.05	2.667	4.42	4.167	1.56	5.67	1.01
1.250	2.52	2.750	3.61	4.250	1.47	5.75	0.97
1.333	2.52	2.833	3.61	4.333	1.47	5.83	0.97
1.417	3.33	2.917	3.06	4.417	1.39	5.92	0.94
1.500	3.33	3.000	3.06	4.500	1.39	6.00	0.94

```
Unit Hyd Qpeak  (cms)=   0.207

PEAK FLOW       (cms)=   0.075 (i)
TIME TO PEAK    (hrs)=   2.167
RUNOFF VOLUME    (mm)=  19.731
TOTAL RAINFALL   (mm)=  25.010
RUNOFF COEFFICIENT   =   0.789

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```
------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD    (0004)   |   Area     (ha)=    1.32   Curve Number    (CN)= 90.0
|ID= 1 DT= 5.0 min   |   Ia       (mm)=    5.00   # of Linear Res.(N)= 3.00
--------------------    U.H. Tp(hrs)=     0.25

Unit Hyd Qpeak  (cms)=   0.202

PEAK FLOW       (cms)=   0.024 (i)
```

```
     TIME TO PEAK     (hrs)=   2.250
     RUNOFF VOLUME     (mm)=   8.295
     TOTAL RAINFALL    (mm)=  25.010
     RUNOFF COEFFICIENT    =   0.332

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------

--------------------
| ADD HYD    (0005) |
|  1 +  2 =  3      |         AREA     QPEAK     TPEAK      R.V.
--------------------          (ha)     (cms)     (hrs)      (mm)
          ID1= 1 (0003):      1.36    0.075      2.17     19.73
        + ID2= 2 (0004):      1.32    0.024      2.25      8.29
          ==================================================
          ID = 3 (0005):      2.68    0.097      2.25     14.10

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR (0002) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |        OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------          (cms)    (ha.m.)   |   (cms)    (ha.m.)
                             0.0000     0.0000   |  0.0388     0.0212
                             0.0327     0.0108   |  0.4150     0.0275

                                   AREA     QPEAK     TPEAK       R.V.
                                   (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)        2.677     0.097      2.25      14.10
     OUTFLOW: ID= 1 (0002)        2.677     0.035      2.83      14.07

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 36.12
                  TIME SHIFT OF PEAK FLOW        (min)= 35.00
                  MAXIMUM  STORAGE   USED      (ha.m.)=  0.0149

-------------------------------------------------------------------------------
--------------------
| CALIB             |
| NASHYD     (0006) |  Area     (ha)=   1.48   Curve Number    (CN)= 90.0
|ID= 1 DT= 5.0 min  |  Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.25

     Unit Hyd Qpeak  (cms)=   0.227

     PEAK FLOW       (cms)=   0.027 (i)
     TIME TO PEAK    (hrs)=   2.250
     RUNOFF VOLUME    (mm)=   8.295
     TOTAL RAINFALL   (mm)=  25.010
     RUNOFF COEFFICIENT   =   0.332

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------

--------------------
| ADD HYD    (0007) |
|  1 +  2 =  3      |         AREA     QPEAK     TPEAK      R.V.
--------------------          (ha)     (cms)     (hrs)      (mm)
          ID1= 1 (0002):      2.68    0.035      2.83     14.07
        + ID2= 2 (0006):      1.48    0.027      2.25      8.29
```

```
=================================================
ID = 3 (0007):      4.16   0.058     2.33    12.01

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
  ****************************
  ** SIMULATION NUMBER:   2 **
  ****************************

--------------------
| CHICAGO STORM    |        IDF curve parameters: A= 521.096
| Ptotal= 40.54 mm |                              B=   1.501
--------------------                              C=   0.718
                            used in:   INTENSITY =  A / (t + B)^C

                            Duration of storm  =  4.00 hrs
                            Storm time step    = 10.00 min
                            Time to peak ratio =  0.33

                        The CORRELATION coefficient is = 0.9996

                         TIME         INPUT INT.          TAB. INT.
                        (min)          (mm/hr)             (mm/hr)
                           5.          146.10              135.89
                          10.           90.30               90.22
                          15.           68.20               69.62
                          30.           42.20               43.76
                          60.           26.10               27.07
                         120.           16.10               16.60
                         360.            7.50                7.59
                         720.            4.70                4.62
                        1440.            2.90                2.81

                      TIME     RAIN |  TIME     RAIN |' TIME     RAIN |  TIME    RAIN
                       hrs    mm/hr |   hrs    mm/hr |'  hrs    mm/hr |   hrs   mm/hr
                      0.17     3.26 |  1.17    17.79 |  2.17     6.70 |  3.17    3.78
                      0.33     3.66 |  1.33    90.22 |  2.33     5.87 |  3.33    3.55
                      0.50     4.21 |  1.50    22.43 |  2.50     5.25 |  3.50    3.35
                      0.67     5.00 |  1.67    13.17 |  2.67     4.76 |  3.67    3.18
                      0.83     6.28 |  1.83     9.75 |  2.83     4.37 |  3.83    3.02
                      1.00     8.81 |  2.00     7.89 |  3.00     4.05 |  4.00    2.88

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0003) |     Area     (ha)=    1.36   Curve Number    (CN)= 98.0
|ID= 1 DT= 5.0 min |     Ia       (mm)=    1.00   # of Linear Res.(N)= 3.00
--------------------     U.H. Tp(hrs)=    0.25

         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
                     0.083     3.26 | 1.083    17.79 | 2.083     6.70 |  3.08    3.78
                     0.167     3.26 | 1.167    17.79 | 2.167     6.70 |  3.17    3.78
                     0.250     3.66 | 1.250    90.22 | 2.250     5.87 |  3.25    3.55
                     0.333     3.66 | 1.333    90.22 | 2.333     5.87 |  3.33    3.55
                     0.417     4.21 | 1.417    22.43 | 2.417     5.25 |  3.42    3.35
```

```
     0.500    4.21 | 1.500   22.43 | 2.500    5.25 |  3.50    3.35
     0.583    5.00 | 1.583   13.17 | 2.583    4.76 |  3.58    3.18
     0.667    5.00 | 1.667   13.17 | 2.667    4.76 |  3.67    3.18
     0.750    6.28 | 1.750    9.75 | 2.750    4.37 |  3.75    3.02
     0.833    6.28 | 1.833    9.75 | 2.833    4.37 |  3.83    3.02
     0.917    8.81 | 1.917    7.89 | 2.917    4.05 |  3.92    2.88
     1.000    8.81 | 2.000    7.89 | 3.000    4.05 |  4.00    2.88

     Unit Hyd Qpeak  (cms)=   0.207

     PEAK FLOW       (cms)=   0.142 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  34.929
     TOTAL RAINFALL   (mm)=  40.540
     RUNOFF COEFFICIENT   =   0.862

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD    (0004) |    Area     (ha)=    1.32   Curve Number   (CN)= 90.0
|ID= 1 DT= 5.0 min |    Ia       (mm)=    5.00   # of Linear Res.(N)= 3.00
--------------------    U.H. Tp(hrs)=    0.25

     Unit Hyd Qpeak  (cms)=   0.202

     PEAK FLOW       (cms)=   0.068 (i)
     TIME TO PEAK    (hrs)=   1.583
     RUNOFF VOLUME    (mm)=  19.793
     TOTAL RAINFALL   (mm)=  40.540
     RUNOFF COEFFICIENT   =   0.488

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD    (0005) |
|   1 +  2 =  3     |          AREA    QPEAK     TPEAK     R.V.
--------------------           (ha)    (cms)     (hrs)     (mm)
          ID1= 1 (0003):      1.36   0.142      1.50    34.93
        + ID2= 2 (0004):      1.32   0.068      1.58    19.79
          ===================================================
          ID = 3 (0005):      2.68   0.209      1.50    27.47

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0002) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |       OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------        (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           0.0000     0.0000    |  0.0388      0.0212
                           0.0327     0.0108    |  0.4150      0.0275

                                  AREA     QPEAK      TPEAK       R.V.
                                  (ha)     (cms)      (hrs)       (mm)
     INFLOW : ID= 2 (0005)       2.677     0.209       1.50       27.47
     OUTFLOW: ID= 1 (0002)       2.677     0.167       1.75       27.44

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 79.82
```

```
               TIME SHIFT OF PEAK FLOW          (min)= 15.00
               MAXIMUM  STORAGE   USED        (ha.m.)=  0.0235

-------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD    (0006)   |   Area     (ha)=    1.48   Curve Number   (CN)= 90.0
|ID= 1 DT= 5.0 min   |   Ia       (mm)=    5.00   # of Linear Res.(N)= 3.00
--------------------     U.H. Tp(hrs)=    0.25

     Unit Hyd Qpeak  (cms)=   0.227

     PEAK FLOW       (cms)=   0.076 (i)
     TIME TO PEAK    (hrs)=   1.583
     RUNOFF VOLUME    (mm)=  19.793
     TOTAL RAINFALL   (mm)=  40.540
     RUNOFF COEFFICIENT   =   0.488

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------

--------------------
| ADD HYD   (0007)   |
|   1 +  2 =  3      |          AREA    QPEAK      TPEAK      R.V.
--------------------            (ha)    (cms)      (hrs)      (mm)
          ID1= 1 (0002):        2.68   0.167       1.75     27.44
        + ID2= 2 (0006):        1.48   0.076       1.58     19.79
          ==================================================
          ID = 3 (0007):        4.16   0.230       1.75     24.72

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
  *****************************
  ** SIMULATION NUMBER:   3 **
  *****************************

--------------------
| CHICAGO STORM      |      IDF curve parameters: A= 892.151
| Ptotal= 67.53 mm   |                            B=   1.501
--------------------                              C=   0.723
                            used in:    INTENSITY =  A / (t + B)^C

                            Duration of storm   =  4.00 hrs
                            Storm time step     = 10.00 min
                            Time to peak ratio  =  0.33

                        The CORRELATION coefficient is = 0.9997

                         TIME         INPUT INT.            TAB. INT.
                        (min)          (mm/hr)               (mm/hr)
                           5.          247.60                230.49
                          10.          152.70                152.59
                          15.          115.10                117.54
                          30.           71.00                 73.65
                          60.           43.80                 45.40
                         120.           27.00                 27.75
                         360.           12.60                 12.62
                         720.            7.70                  7.65
                        1440.            4.80                  4.64
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.17	5.34	1.17	29.57	2.17	11.04	3.17	6.20
0.33	6.00	1.33	152.59	2.33	9.66	3.33	5.82
0.50	6.91	1.50	37.36	2.50	8.63	3.50	5.49
0.67	8.22	1.67	21.82	2.67	7.82	3.67	5.20
0.83	10.34	1.83	16.11	2.83	7.18	3.83	4.95
1.00	14.55	2.00	13.01	3.00	6.65	4.00	4.72

```
--------------------
| CALIB              |
| NASHYD    (0003)   |   Area     (ha)=    1.36   Curve Number    (CN)= 98.0
|ID= 1 DT= 5.0 min   |   Ia       (mm)=    1.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=     0.25
```

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	5.34	1.083	29.57	2.083	11.04	3.08	6.20
0.167	5.34	1.167	29.57	2.167	11.04	3.17	6.20
0.250	6.00	1.250	152.59	2.250	9.66	3.25	5.82
0.333	6.00	1.333	152.59	2.333	9.66	3.33	5.82
0.417	6.91	1.417	37.36	2.417	8.63	3.42	5.49
0.500	6.91	1.500	37.36	2.500	8.63	3.50	5.49
0.583	8.22	1.583	21.82	2.583	7.82	3.58	5.20
0.667	8.22	1.667	21.82	2.667	7.82	3.67	5.20
0.750	10.34	1.750	16.11	2.750	7.18	3.75	4.95
0.833	10.34	1.833	16.11	2.833	7.18	3.83	4.95
0.917	14.55	1.917	13.01	2.917	6.65	3.92	4.72
1.000	14.55	2.000	13.01	3.000	6.65	4.00	4.72

```
Unit Hyd Qpeak   (cms)=   0.207

PEAK FLOW        (cms)=   0.254 (i)
TIME TO PEAK     (hrs)=   1.500
RUNOFF VOLUME     (mm)=  61.671
TOTAL RAINFALL    (mm)=  67.529
RUNOFF COEFFICIENT   =    0.913

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```
--------------------
| CALIB              |
| NASHYD    (0004)   |   Area     (ha)=    1.32   Curve Number    (CN)= 90.0
|ID= 1 DT= 5.0 min   |   Ia       (mm)=    5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=     0.25

Unit Hyd Qpeak   (cms)=   0.202

PEAK FLOW        (cms)=   0.161 (i)
TIME TO PEAK     (hrs)=   1.500
RUNOFF VOLUME     (mm)=  43.049
TOTAL RAINFALL    (mm)=  67.529
RUNOFF COEFFICIENT   =    0.637

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```
--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |         AREA     QPEAK     TPEAK      R.V.
--------------------         (ha)     (cms)     (hrs)      (mm)
          ID1= 1 (0003):     1.36    0.254      1.50     61.67
        + ID2= 2 (0004):     1.32    0.161      1.50     43.05
          ==================================================
          ID = 3 (0005):     2.68    0.415      1.50     52.50

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0002) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW     STORAGE   |  OUTFLOW     STORAGE
--------------------      (cms)     (ha.m.)    |   (cms)     (ha.m.)
                          0.0000     0.0000    |  0.0388      0.0212
                          0.0327     0.0108    |  0.4150      0.0275

                                 AREA      QPEAK      TPEAK        R.V.
                                 (ha)      (cms)      (hrs)        (mm)
     INFLOW : ID= 2 (0005)      2.677       0.415       1.50        52.50
     OUTFLOW: ID= 1 (0002)      2.677       0.403       1.58        52.47

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 97.10
                  TIME SHIFT OF PEAK FLOW          (min)=  5.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.0274

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0006) |   Area     (ha)=    1.48   Curve Number   (CN)= 90.0
|ID= 1 DT= 5.0 min |   Ia       (mm)=    5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=     0.25

     Unit Hyd Qpeak  (cms)=    0.227

     PEAK FLOW       (cms)=    0.181 (i)
     TIME TO PEAK    (hrs)=    1.500
     RUNOFF VOLUME    (mm)=   43.049
     TOTAL RAINFALL   (mm)=   67.529
     RUNOFF COEFFICIENT   =    0.637

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0007) |
|   1 +  2 =  3    |         AREA     QPEAK     TPEAK      R.V.
--------------------         (ha)     (cms)     (hrs)      (mm)
          ID1= 1 (0002):     2.68    0.403      1.58     52.47
        + ID2= 2 (0006):     1.48    0.181      1.50     43.05
          ==================================================
          ID = 3 (0007):     4.16    0.581      1.58     49.11

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
```

FINISH
===

APPENDIX E

Storm Sewer Design Sheet

Storm Sewer Design Sheet

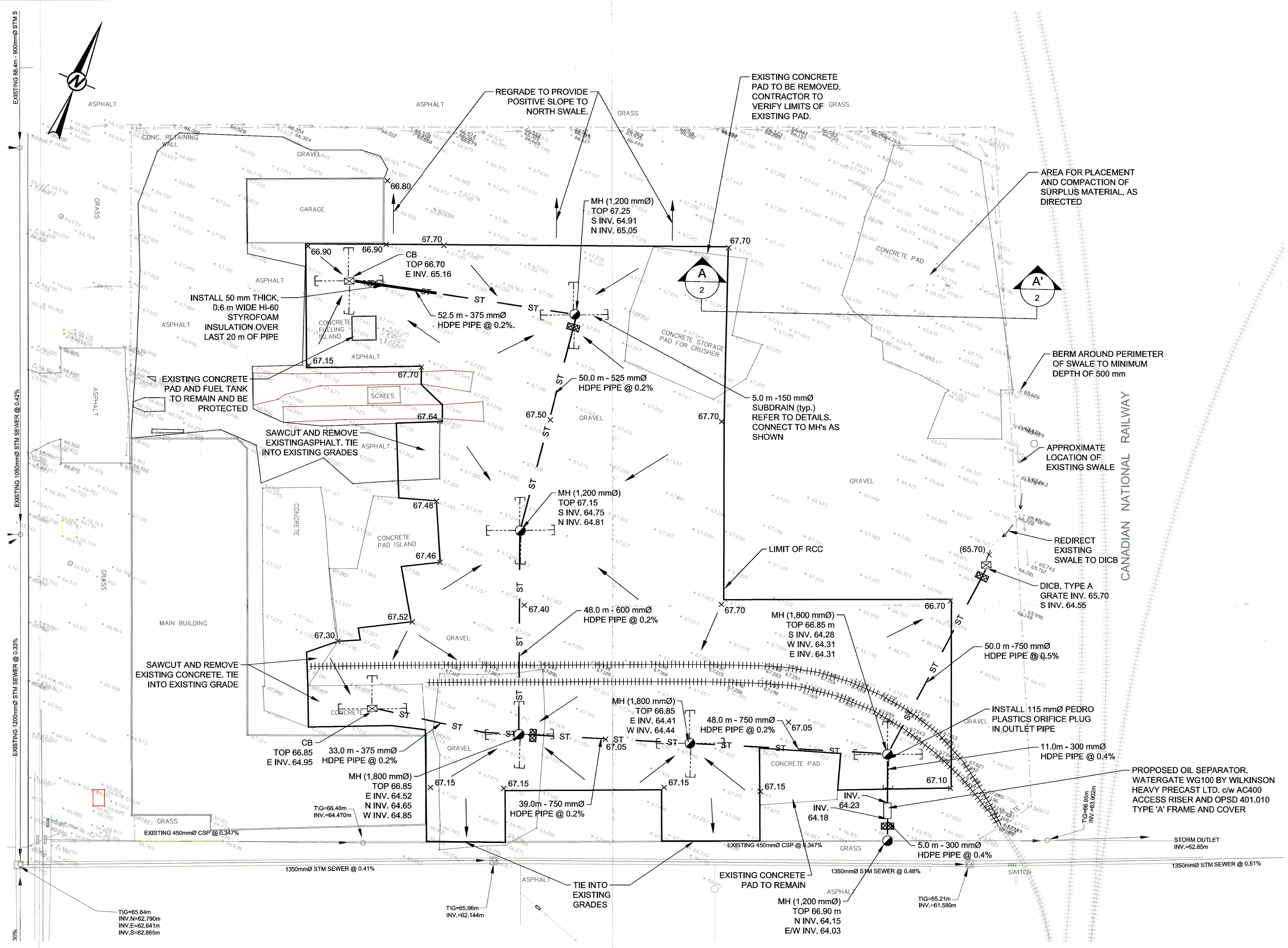
File No.: 1527275
Project: American Iron and Metal, 2555 Sheffield Road
Date: December 11, 2015

Pipe	Location				Drainage Area				Runoff				Pipe Selection							
	From		To		A	C	Cumul. A	Adjusted C	T_i	Cumul. Tc	I (Ottawa, 5yr)	Q	Dia.	So	Pipe Length	Rough Coeff.	Velocity (full)	Actual Capacity (full)	Time of Flow	Percent Full Flow
	CB/MH No.	CB No.	CB/MH No.	Pipe	ha		ha		min.	min.	mm/hr	m^3/s	m	m/m	m	n	m/s	m^3/s	min.	
	1		2		0.1570	0.90	0.1570	0.90	10	10.00	104.19	**0.0409**	**0.375**	**0.002**	52.5	0.013	**0.71**	**0.0784**	1.23	52%
	2		3		0.2890	0.90	0.4460	0.90		11.23	98.10	**0.1094**	**0.525**	**0.002**	55.0	0.013	**0.89**	**0.1923**	1.03	57%
	3		5		0.3190	0.90	0.7650	0.90		12.26	93.58	**0.1790**	**0.600**	**0.002**	48.0	0.013	**0.97**	**0.2746**	0.82	65%
	4		5		0.1370	0.90	0.1370	0.90	10	10.00	104.19	**0.0357**	**0.375**	**0.002**	33.0	0.013	**0.71**	**0.0784**	0.77	46%
	5		6		0.1830	0.90	1.0850	0.90		13.09	90.29	**0.2449**	**0.750**	**0.002**	39.0	0.013	**1.13**	**0.4979**	0.58	49%
	6		7		0.1840	0.90	1.2690	0.90		13.66	88.13	**0.2796**	**0.750**	**0.002**	48.0	0.013	**1.13**	**0.4979**	0.71	56%
	8		7		1.3190	0.60	1.3190	0.60	20	20.00	70.25	**0.1544**	**0.750**	**0.005**	50.0	0.013	**1.78**	**0.7872**	0.47	20%
	7		Outlet		0.0890	0.90	2.6770	0.75				**0.0460**	**0.300**	**0.004**	11.0	0.013	**0.87**	**0.0612**	0.21	75%

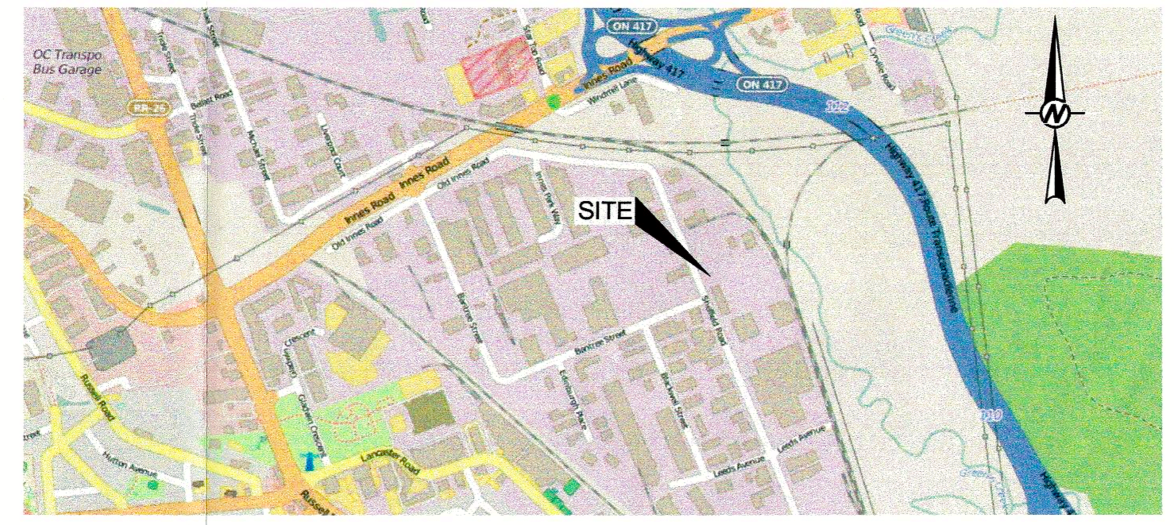
Prepared by: MHK
Checked by: SWT

APPENDIX F

Drawings:
Site Servicing Plan, Drawing 1
Details Sheet, Drawing 2
Drainage Area Plan, Drawing 3



KEY MAP



SCALE: 1:20,000

LEGEND

	EXISTING GRADE
	EXISTING SEWER AND MH
	EXISTING FENCE LINE
	EXISTING RAIL LINE
× 67.30	PROPOSED GRADE
× (65.60)	PROPOSED SWALE GRADE
- ST - ST	PROPOSED STORM SEWER AND MH
	PROPOSED SURFACE FLOW DIRECTION
	PROPOSED SEEPAGE BARRIER

REFERENCE

TOPOGRAPHIC INFORMATION PROVIDED IN A DIGITAL FORMAT BY COLAUTTI GROUP DATE RECEIVED APRIL 7, 2015.

NOTES

1. CONSTRUCTION SHALL BE IN ACCORDANCE WITH CITY STANDARDS AND SPECIFICATIONS AND ONTARIO PROVINCIAL STANDARD DRAWINGS AND SPECIFICATIONS WHERE APPLICABLE. ONTARIO PROVINCIAL STANDARDS SHALL APPLY WHERE NO CITY STANDARDS ARE AVAILABLE.
2. THE CONTRACTOR IS RESPONSIBLE FOR ALL REMOVALS NECESSARY TO SATISFY ENGINEERING WORKS. CONTRACTOR TO OBTAIN PERMIT FOR CONNECTING TO SEWERS. CONTRACTOR TO VISIT SITE PRIOR TO TENDERING AND CONFIRM SITE CONDITIONS. CONTRACTOR IS RESPONSIBLE FOR OBTAINING ALL PERMITS REQUIRED AND BEAR COST OF SAME.
3. LOCATION OF SERVICES ARE NOT ALL SHOWN. LOCATION OF UTILITIES AND UNDERGROUND WORKS THAT ARE SHOWN ARE APPROXIMATE. CONTRACTOR TO VERIFY LOCATION AND ELEVATION OF ALL SERVICES, UTILITIES AND UNDERGROUND STRUCTURES PRIOR TO ANY CONSTRUCTION. THE CONTRACTOR IS RESPONSIBLE FOR PROTECTION AND REINSTATEMENT.
4. THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES TO PROVIDE FOR PROTECTION OF THE RECEIVING STORM SEWER DURING CONSTRUCTION ACTIVITIES. THESE PRACTICE ARE REQUIRED TO ENSURE NO SEDIMENT AND/OR ASSOCIATED POLLUTANTS ARE RELEASED TO THE RECEIVING WATERCOURSE. THESE PRACTICES INCLUDE INSTALLATION OF SEDIMENT BARRIERS ON ALL CATCH BASIN AND MAINTENANCE HOLES AND A SILT FENCE BARRIER (AS PER OPSD 219.110 AND ASSOCIATED SPECIFICATIONS) ALONG ALL OTHER AREAS THAT SHEET DRAIN OFF SITE. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALTIES IMPOSED BY ANY APPLICABLE REGULATORY AGENCY.
5. ALL DISTURBED AREAS TO BE REINSTATED TO EQUAL OR BETTER CONDITION. ALL NEW WORK SHALL BLEND INTO EXISTING (TO BE APPROVED BY CONSULTANT).
6. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED. DRAWINGS SHOULD NOT BE SCALED BY THE CONTRACTOR. ANY MISSING OR QUESTIONABLE DIMENSIONS ARE TO BE CONFIRMED WITH THE CONSULTANT IN WRITING.
7. SIDE SLOPE OF EXCAVATIONS SHOULD BE SLOPED IN ACCORDANCE WITH THE REQUIREMENTS OF ONT. REG. 213/91 UNDER THE OCCUPATIONAL HEALTH AND SAFETY ACT.
8. NOTE THAT THE EXISTING GRADES AND WORKS SHOWN MAY NOT REFLECT ACTUAL SITE CONDITIONS. THE BIDDING CONTRACTORS ARE TO VERIFY ALL EXISTING UNDERGROUND AND ABOVE GROUND SITE CONDITIONS AND MAKE ALLOWANCE IN THE BID PRICE.
9. SEEPAGE BARRIERS TO BE PROVIDED AS INDICATED. SEEPAGE BARRIERS ARE TO CONSIST OF NATURAL CLAY MATERIAL EXTENDING THE ENTIRE WIDTH OF THE TRENCH, A LENGTH OF 1.5 m ALONG THE TRENCH AND THE FULL HEIGHT OF GRANULAR BEDDING AND BACKFILL MATERIAL FOR THE PIPE INSTALLATION.

0 20 40

1:500 METRES

Rev.	YYYY-MM-DD	DESCRIPTION	PREPARED	DESIGN	REVIEW	APPROVED
2	2015-06-19	ISSUED FOR CONSTRUCTION	MLF	SWT	DVK	DVK
1	2015-05-12	ISSUED FOR REVIEW	MLF	SWT	DVK	DVK

SEAL

LICENSED PROFESSIONAL ENGINEER S.A.W. TAYLOR 100078983 17 June 15 PROVINCE OF ONTARIO

CLIENT

AMERICAN IRON AND METAL S.E.C.

CONSULTANT

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www.golder.com

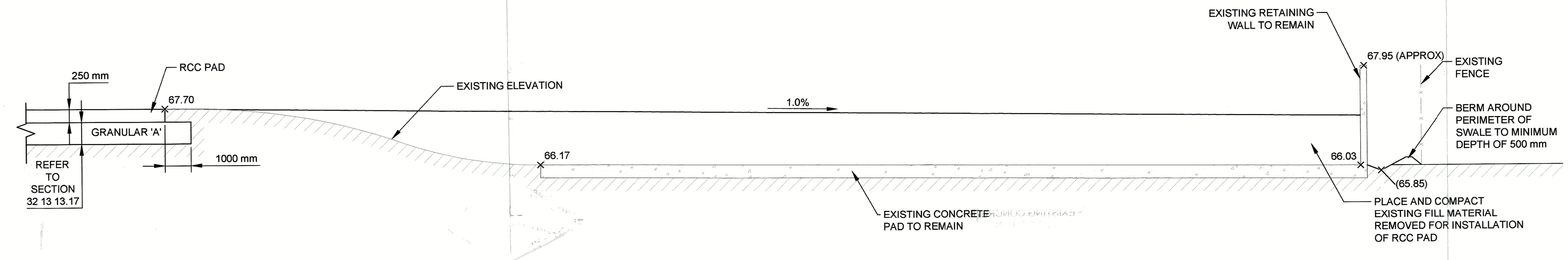
PROJECT

2555 SHEFFIELD

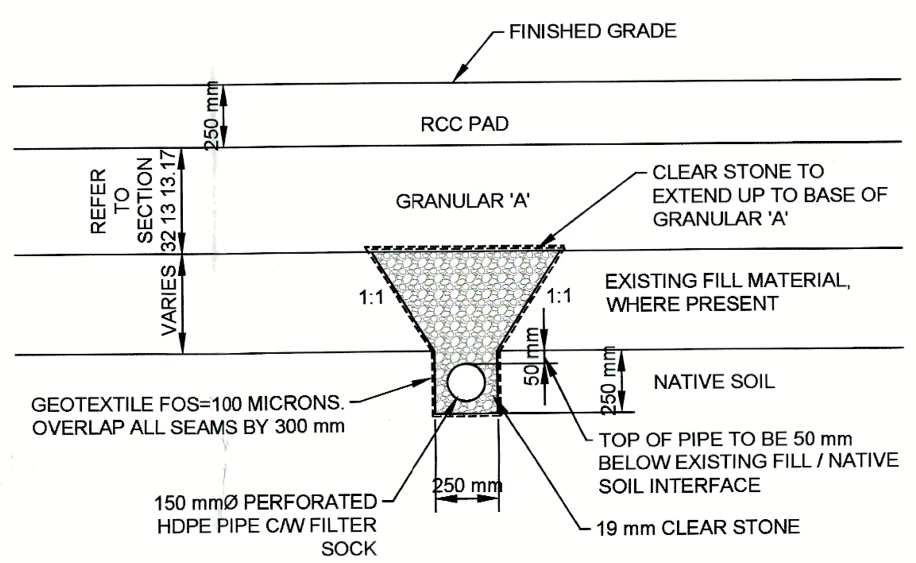
TITLE

SITE SERVICING PLAN

PROJECT No.	PHASE	Rev.		DRAWING
1527275	1000	2	1 of 2	1



SCALE: NTS (A-A' / 1) SECTION



SUBDRAIN DETAIL
SCALE N.T.S.

Rev.	YYYY-MM-DD	DESCRIPTION	PREPARED	DESIGN	REVIEW	APPROVED
2	2015-06-19	ISSUED FOR CONSTRUCTION	MLF	SWT	DVK	DVK
1	2015-05-12	ISSUED FOR REVIEW	MLF	SWT	DVK	DVK

SEAL
LICENSED PROFESSIONAL ENGINEER
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19 June 15
PROVINCE OF ONTARIO

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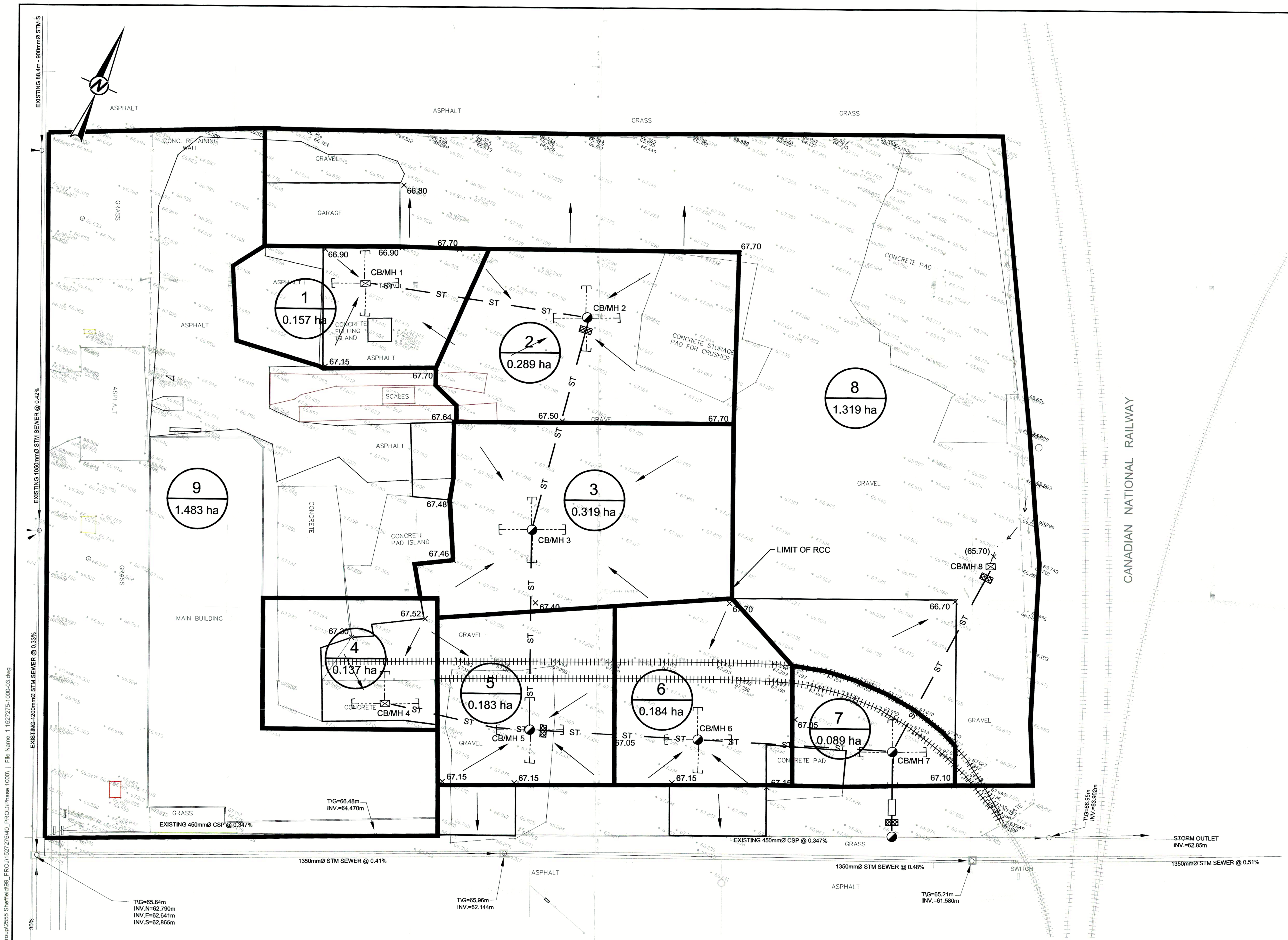
PROJECT
2555 SHEFFIELD

TITLE
DETAIL SHEET

PROJECT No.	PHASE	Rev.		DRAWING
1527275	1000	2	2 of 2	2

Path: \\golder.gds\gal\ottawa\Active\Spatial_IM\AIM Group\2555 Sheffield\99_PROJ\1527275\40_PROD\Phase 1000\ | File Name: 1527275-1000-02.dwg

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D
25 mm



KEY MAP

SCALE: 1:20,000

LEGEND

- EXISTING GRADE
- EXISTING SEWER AND MH
- EXISTING FENCE LINE
- EXISTING RAIL LINE
- ST — PROPOSED STORM SEWER AND MH
- PROPOSED SURFACE FLOW DIRECTION
- PROPOSED SEEPAGE BARRIER
- XXX / XXX — DRAINAGE AREA I.D. / DRAINAGE AREAS (ha.)

REFERENCE

TOPOGRAPHIC INFORMATION PROVIDED IN A DIGITAL FORMAT BY COLAUTTI GROUP DATE RECEIVED APRIL 7, 2015.

NOTES

1. CONSTRUCTION SHALL BE IN ACCORDANCE WITH CITY STANDARDS AND SPECIFICATIONS AND ONTARIO PROVINCIAL STANDARD DRAWINGS AND SPECIFICATIONS WHERE APPLICABLE. ONTARIO PROVINCIAL STANDARDS SHALL APPLY WHERE NO CITY STANDARDS ARE AVAILABLE.
2. THE CONTRACTOR IS RESPONSIBLE FOR ALL REMOVALS NECESSARY TO SATISFY ENGINEERING WORKS. CONTRACTOR TO OBTAIN PERMIT FOR CONNECTING TO SEWERS. CONTRACTOR TO VISIT SITE PRIOR TO TENDERING AND CONFIRM SITE CONDITIONS. CONTRACTOR IS RESPONSIBLE FOR OBTAINING ALL PERMITS REQUIRED AND BEAR COST OF SAME.
3. LOCATION OF SERVICES ARE NOT ALL SHOWN. LOCATION OF UTILITIES AND UNDERGROUND WORKS THAT ARE SHOWN ARE APPROXIMATE. CONTRACTOR TO VERIFY LOCATION AND ELEVATION OF ALL SERVICES, UTILITIES AND UNDERGROUND STRUCTURES PRIOR TO ANY CONSTRUCTION. THE CONTRACTOR IS RESPONSIBLE FOR PROTECTION AND REINSTATEMENT.
4. THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES TO PROVIDE FOR PROTECTION OF THE RECEIVING STORM SEWER DURING CONSTRUCTION ACTIVITIES. THESE PRACTICE ARE REQUIRED TO ENSURE NO SEDIMENT AND/OR ASSOCIATED POLLUTANTS ARE RELEASED TO THE RECEIVING WATERCOURSE. THESE PRACTICES INCLUDE INSTALLATION OF SEDIMENT BARRIERS ON ALL CATCH BASIN AND MAINTENANCE HOLES AND A SILT FENCE BARRIER (AS PER OPSD 219.110 AND ASSOCIATED SPECIFICATIONS) ALONG ALL OTHER AREAS THAT SHEET DRAIN OFF SITE. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALTIES IMPOSED BY ANY APPLICABLE REGULATORY AGENCY.
5. ALL DISTURBED AREAS TO BE REINSTATED TO EQUAL OR BETTER CONDITION. ALL NEW WORK SHALL BLEND INTO EXISTING (TO BE APPROVED BY CONSULTANT).
6. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED. DRAWINGS SHOULD NOT BE SCALED BY THE CONTRACTOR. ANY MISSING OR QUESTIONABLE DIMENSIONS ARE TO BE CONFIRMED WITH THE CONSULTANT IN WRITING.
7. SIDE SLOPE OF EXCAVATIONS SHOULD BE SLOPED IN ACCORDANCE WITH THE REQUIREMENTS OF ONT. REG. 213/91 UNDER THE OCCUPATIONAL HEALTH AND SAFETY ACT.
8. NOTE THAT THE EXISTING GRADES AND WORKS SHOWN MAY NOT REFLECT ACTUAL SITE CONDITIONS. THE BIDDING CONTRACTORS ARE TO VERIFY ALL EXISTING UNDERGROUND AND ABOVE GROUND SITE CONDITIONS AND MAKE ALLOWANCE IN THE BID PRICE.
9. SEEPAGE BARRIERS TO BE PROVIDED AS INDICATED. SEEPAGE BARRIERS ARE TO CONSIST OF NATURAL CLAY MATERIAL EXTENDING THE ENTIRE WIDTH OF THE TRENCH, A LENGTH OF 1.5 m ALONG THE TRENCH AND THE FULL HEIGHT OF GRANULAR BEDDING AND BACKFILL MATERIAL FOR THE PIPE INSTALLATION.

0 20 40
1:500 METRES

Rev.	YYYY-MM-DD	DESCRIPTION	PREPARED	DESIGN	REVIEW	APPROVED
1	2015-12-11	ISSUED FOR REVIEW	MLF	SWT	DVK	DVK

SEAL

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PROJECT
2555 SHEFFIELD

TITLE
DRAINAGE AREA PLAN

PROJECT No.	PHASE	Rev.	3 of 3	DRAWING
1527275	1000	1		3