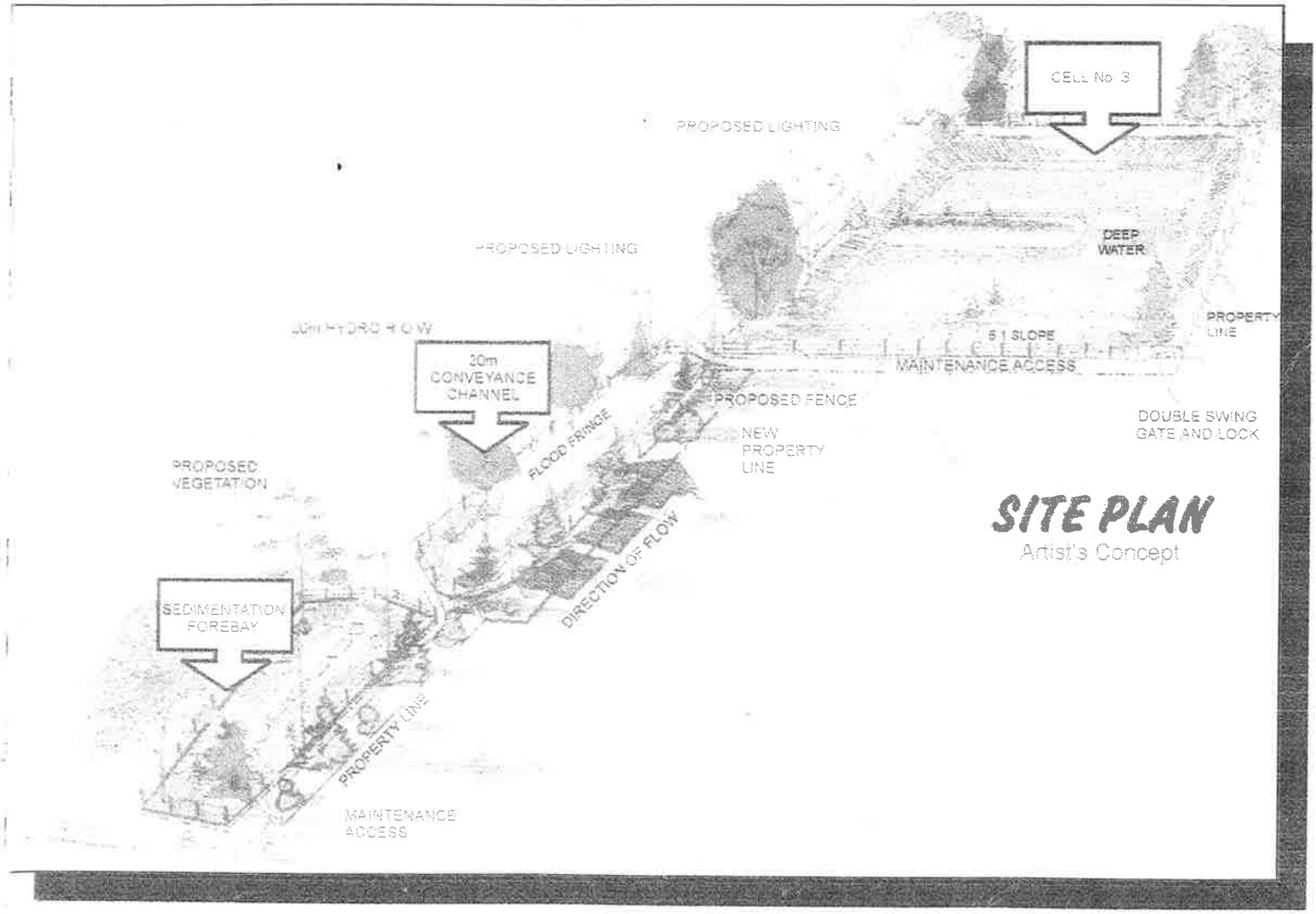
FINAL DRAINAGE REPORT
FOR
JPPER NO NAME CREEK/BELL BOULEVARD
STORMWATER MANAGEMENT SYSTEM
City of Belleville, Ontario
March 1998



Prepared in Compliance with the Drainage Act

WESLAKE INC.

WESLAKE INC.

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TRANSMITTAL

TO:	Quinte Conservation Authority Hwy 2 @ Wallbridge-Loyalist Road Belleville, Ontario K8N 5B3	**DATE:**	April 16, 1998
		PROJECT:	Upper No Name Creek
		PROJECT No.:	1333
ATTENTION:	Mr. Ernie Margetson	**VIA:**	Courier

RE: Upper No Name Creek - Drainage Act Works

WE ARE SENDING THE FOLLOWING:

☐ For Your Approval	☐ Approved as Noted
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Qty.	Reference	Description
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	Tai Bui, P.Eng.

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FOREWORD

This report is prepared as part of the requirements set out in the Drainage Act with respect to the Upper No Name Stormwater Management System in the City of Belleville, Ontario.

Weslake Inc. was retained by the City of Belleville to act as the Drainage Engineer with respect to the subject works (see By-laws 14236 and 14237).

To provide the reader with some background on the project, the following key events are summarized in chronological order.

- In September 1997 staff of the City of Belleville Public Works Department held several discussions with Weslake Inc. with respect to using the Drainage Act as the basis for the construction of the Bell Boulevard stormwater management system.
- Based on the City's request, Weslake Inc. prepared a letter (dated October 20, 1997) to the City Engineer summarizing several procedures available under the Drainage Act. It was recommended that the "Petition Drains" procedure was the appropriate mechanism for the project.
- A resolution was passed by City Council on December 15, 1997 appointing Weslake Inc. as the Drainage Engineer. This resolution also indicated the steps required under the Drainage Act. Following approval of the resolution. The Petition was submitted by Weslake Inc. on December 5, 1997 and, following Council approval of the resolution, was filed with the City Clerk.
- A summary report was prepared by Weslake Inc. in January 1998 outlining the drainage issues, proposed mitigating measures and methods of assessing the financial distribution. Copies of this report were sent to all affected landowners within the watershed. In addition, the "Notice of Appointment for Examination by Engineer" was included in the communication. Notification was sent out in mid-January, 1998 following submission to the City by Weslake on January 6, 1998.
- A site meeting was held on January 23, 1998, minutes of which are included in Appendix "A" of this report.

A summary of the steps required to complete the procedures under the Drainage Act is provided in Appendix "B".

Project Objectives and Recommendations

Several reports and studies have been completed to investigate feasible solutions for the study area. Important conclusions and recommendations contained in these reports include the following:

1. A stormwater management system is required to provide treatment of stormwater runoff resulting from the study area. This includes treatment in terms of both quality and quantity.
2. Quantity control is implemented to facilitate new developments, while quality control benefits both existing and future developments within the study area.
3. The costs associated with the proposed stormwater management system should be distributed equitably among the benefiting stakeholders.

In addition to meeting the Drainage Act requirements, this report is also prepared to provide the following information:

- The stormwater management system needs including area required for drainage and stormwater management objectives.
- The proposed stormwater management system and its function in terms of protecting and enhancing the surrounding environment and community. Supporting technical information and potential benefits are also evaluated.
- Discussion with respect to a cost/benefit analysis, financial constraints and economic implications.
- A detailed cost assessment and cost allowance.

Structure of this Report

The information is presented under the following main sections:

1. INTRODUCTION
2. DESCRIPTION OF THE WATERSHED
3. THE DRAINAGE PROBLEM
4. AREA REQUIRING DRAINAGE
5. DESIGN CONSTRAINTS
6. RECOMMENDATIONS AND ALTERNATIVES
7. PLANS, PROFILES AND SPECIFICATIONS

Acknowledgements

This report has been prepared with assistance from the following organizations:

- Quinte Conservation Authority
- City of Belleville
- Ministry of Natural Resources
- Ministry of Environment

Appendices

The report contains a number of Appendices.

1 INTRODUCTION

The Upper No Name Creek watershed comprises sections of three formerly distinct municipalities, namely the Township of Sidney, Township of Thurlow and the City of Belleville. Since January 1, 1998 the Township of Thurlow has been absorbed into the City of Belleville and the Township of Sidney has merged with other entities to form the municipality of Quinte West.

To allow these municipalities to plan developments at lower cost and with the full, pre-arranged support of all participant stakeholders, the Quinte Conservation Authority (formerly the Moira River Conservation Authority) initiated a watershed planning study for the watershed in 1994. A report "Upper No Name Creek Stormwater Management Facility Study (Final Report)" by Gore and Storrie Ltd. was submitted in March, 1995.

Figure 1 (overleaf) shows the drainage area within the City of Belleville which is located within the Upper No Name Creek watershed. Stormwater runoff resulting from the Upper No Name Creek Watershed discharges into a major trunk sewer at the Lemoine Street outlet.

A subsequent report entitled "Final Stormwater Management Implementation Study – Upper No Name Creek, Belleville, Ontario" was prepared by Weslake Inc. in 1995 to detail the implementation stage of the watershed plan. The conclusions and recommendations contained in that report included the following:

- A regional stormwater management facility, together with appropriate on-site control stormwater management for individual commercial developments, is required for the study area. The facility will provide both quantity and quality control for stormwater runoff resulting from the subject area.
- The cost of implementing a Regional stormwater management system should be shared among all benefiting parties.

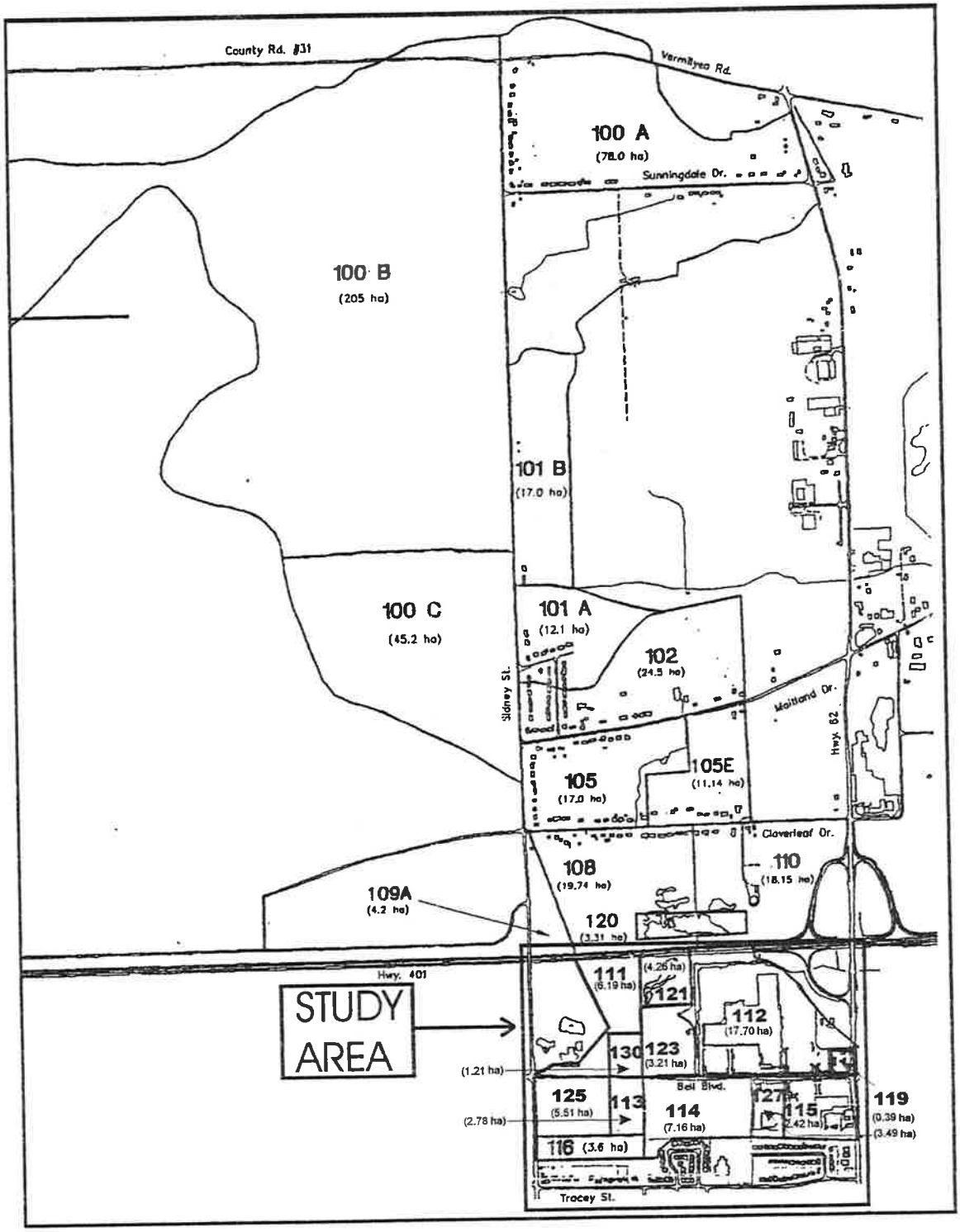
Furthermore, the City of Belleville Council passed certain by-laws and resolutions indicating that the Drainage Act should be used to provide the basis of the cost assessment and allowance for the project.

Based on the above, this report has been prepared to address and clarify the following issues related to the study area:

- Introduction
- Description of the Watershed
- Drainage Issues
- Design Parameters
- Available Mitigating Measures and Preferred Options

In addition, conclusions and recommendations contained in this report will enable both the municipality and other stakeholders to enter into a mutual harmonized working schedule and economic arrangement for the captioned project.

Figure 1 – Drainage Area



II DESCRIPTION OF THE WATERSHED

The Upper No Name Creek sub-watershed is located in the north end of the City of Belleville and the southwest corner of the Township of Thurlow. The sub-watershed represents the northern portion of the No Name Creek watershed which outlets to the Moira River near its mouth at the Bay of Quinte. Construction of the Tracey Street storm sewer in the City of Belleville resulted in the creek being subdivided into northern and southern sections, the former being drained by a 1.5m diameter trunk sewer along Tracey Street between Lemoine Street and the Moira River.

The study area consists of the areas that drain to the Upper No Name Creek either directly or indirectly through numerous storm sewer pipes and ditches. The watershed is roughly bounded by North Front Street to the east, Tracey Street to the south, Highway 401 to the north and Sidney Street to the west.

The limits of the study area are shown in Figure 1, and Figure 2 outlines the sub-catchment areas used in the study. The total drainage area is approximately 63.5 hectares.

In general, all sub-areas within the study area slope gently towards either Bell Boulevard or the unopened Lemoine Street. Slopes range from 0.5% to 2.0%.

With respect to soil characteristics, the study area can be described as underlying an average of 0.26m of topsoil. Its subsurface consists of a shallow deposit of sandy or clayey silt till underlain by weathered limestone bedrock. Up to 1.6m of fill materials may be encountered in some locations. Groundwater seepage was encountered during a geotechnical investigation conducted in June 1995 at depths ranging from 0.8m to 3.5m below existing ground. Extracts from the geotechnical report prepared by Golder & Associates are contained in Appendix "D".

A mixture of land uses exists in the study area. These include industrial, commercial, residential, vacant and open space uses. The vacant lands have the potential for both commercial and residential development.

The existing Upper No Name Creek located within the unopened Lemoine Street from Highway 401 to the existing sewer at Tracey Street is a man-made channel conveying flow from an area north of Highway 401 as well as from within the study area. The stream is considered a perennial watercourse.

Current land use zoning both north and south of Bell Blvd. is for commercial development. Significant areas are either already developed or are in the planning or construction stage. Consequently the percentage of impervious area is rapidly increasing and will average between 80% and 90% within a few years at the current rate of development. Even with the implementation of on-site controls the rate and volume of runoff will experience marked increase to an extent that flooding potential will be increased and the quality of runoff to the Moira River will suffer significant deterioration. Early implementation of a centralized stormwater management system is essential if the City is to benefit from the current high level of development activity.

III THE DRAINAGE PROBLEM

As mentioned in the previous Section, the construction of Tracey Street formed a barrier to the natural course of the No-Name Creek. Consequently a storm sewer was constructed along Tracey Street from the unopened Lemoine Street road allowance to the Moira River. This effectively divided the catchment of the No-Name Creek into Upper and Lower sub-catchments.

Previous studies have estimated the capacity of the existing 1.52 m (5 ft) diameter storm sewer as 3.5 cub.m/s. Earlier reports have also suggested that following ultimate development within the catchment of the Upper No-Name Creek for currently zoned land use the runoff would exceed the estimated capacity and would result in serious flooding of existing residential areas in the vicinity of Tracey Street.

One objective of the proposal is, therefore, to provide a stormwater management facility to control the peak flows resulting from a design storm with a return period of 100 years to a value which can be conveyed by the existing storm sewer. Such a facility is a necessary pre-requisite before development can proceed within the catchment of the upper No-Name Creek in both the City of Belleville and the (former) Township of Thurlow, north of Highway 401.

Concern over the potential degradation of water quality resulting from development arose in 1991 in parallel with the Bay of Quinte Remedial Action Plan (RAP). Around the same time, the South-Eastern region of the (then) Ontario Ministry of Environment set stringent conditions for the quality of stormwater discharged to the Moira River and thence to the bay of Quinte.

Specifically two criteria were identified:

(1) Not more than 25 milligrams of suspended solids per litre

(2) Not more than 100 E-Coli per decilitre of stormwater

These criteria were to be exceeded not more than 4 times during the body contact season – i.e. the period generally between May and September when recreational activities in the receiving waters and the Bay of Quinte are expected to be at a maximum.

A second objective of the proposed stormwater management project is therefore to ensure that the quality of stormwater will be improved for both existing developments and future developments within the catchment of the Upper No-Name Creek.

When the problem was initially considered the catchment area fell within the boundaries of two distinct municipalities, namely the City of Belleville and the Township of Thurlow. The identification of an acceptable solution was further complicated by the need to assign equitable proportions of the total cost to all benefiting parties, including specifically six separate developers.

This report therefore represents the culmination of a number of earlier studies and identifies a technically feasible and socially equitable solution to achieve the identified objectives and thus facilitate revenue generating commercial development in the consolidated municipalities of both Belleville and Thurlow.

IV AREA REQUIRING DRAINAGE

The catchment area of the Upper No-Name Creek includes a large, flat area north-west of Thurlow, extending from the Township of Sidney to an area within the City of Belleville north of Tracey Street and generally contained within Sidney Street on the west to North Front Street in the east limits of the catchment.

The area north of Highway 401 is 455.3 ha. This runoff flows south to a naturally occurring wetland area from which it passes under Highway 401 by way of an existing rectangular concrete culvert to a smaller wetland area immediately west of Quinte Mall in the City of Belleville.

The catchment area within Belleville is approximately 63.5 ha most of which is zoned for commercial development. Future development of the commercial lands in both Thurlow and Belleville will result in considerable increase in the peak runoff and in the total volume of runoff.

A fraction of the contributing area south of Highway 401 comprises existing roadways and unopened road allowances owned by the City of Belleville. The City of Belleville is therefore empowered to initiate a petition under the Drainage Act to facilitate construction and cost recovery for the stormwater management project necessary to achieve the objectives outlined in Section III of this report.

V DESIGN CONSTRAINTS

5.1 Cost factors

The factors affecting the capital cost to construct the required stormwater management facilities may be summarized as follows.

Land Cost

The works within the City of Belleville will be located generally within lands which are zoned for commercial development. Land values are therefore substantial and – as discussed below – have significantly influenced the selection of the preferred solution.

The City will make maximum use of unopened road allowances along Lemoine Street to allow reconstruction of a stable and aesthetically pleasing watercourse. In addition, areas of land suitable for the construction of the proposed sediment forebay and the extended detention pond have been acquired by the City the cost having been determined by independent land value assessment.

Geotechnical Features

The areas where major earth moving and excavation is anticipated has a relatively shallow overburden of soft material. It is expected therefore that significant removal of rock will be required. The design has been influenced by the need to keep rock blasting, excavation, crushing and removal to a minimum. Appendix "D" contains extracts of information from a geotechnical report prepared by Golder and Associates.

Watercourse Characteristics.

Much of the No-Name Creek within the City of Belleville has been artificially controlled to follow the lines of existing road allowances. The native material is quite erodable and the design has therefore included consideration of the factors which influence the formation of a stable channel cross-section and line.

The design therefore incorporates features to provide local hardening (e.g. rip-rap) and a drop structure to provide a more stable channel gradient and cross-section.

5.2 Technical Constraints

For the design currently proposed the following constraints have been identified and defined in order to achieve the benefits of flood prevention and stormwater quality improvement described in Section III *The Drainage Problem.*

5.2.1 Quantity Control (100-year storm):

To achieve the necessary level of quantity control, extended detention ponds will be constructed in Thurlow, immediately north of the culvert under Highway 401, and in Belleville slightly north of the intersection of Tracey Street and the unopened Lemoine Street road allowance. The following target flows have been identified for these two facilities.

The net result will be a significant reduction of the peak flow entering the existing storm sewer along Tracey Street thus effectively eliminating flooding hazard under ultimate land development conditions.

Peak outflow from Thurlow pond.	<=	1.2 c.m/s
Peak outflow from Main pond.	<=	3.5 c.m/s
Maximum water level in Main pond	<=	92.00 m

5.2.2 Quality Control (14 mm storm):

For both ponds a permanent storage volume should be provided which is based on the guidelines of the Ontario Ministry of Environment & Energy report "Storm Water Practices, Planning and Design Manual" (June 1994) for Level 1 protection. (Table 4.1 *Water Quality Storage Requirements Based on Receiving Waters* - page 173).

5.3 Construction Constraints

In the event that construction must proceed after winter freeze-up appropriate measures will be taken with respect to construction equipment and methods to be employed. These are shown in Appendix "I" *Construction Schedule and Methods.*

5.4 Environmental Constraints

Environmental constraints are considered under the topics of runoff quality, ground water and fish and wildlife concerns. Each is discussed briefly in the sub-sections which follow.

5.4.1 Stormwater Quality

As a result of the proposed stormwater management facility the quality of stormwater issuing to the Moira River and the Bay of Quinte will be substantially improved with the object of meeting the quality criteria set by the Ministry of Environment and Energy (South East Region), i.e.

- Not more than 25 milligrams of suspended solids per litre
- Not more than 100 E-Coli per decilitre of stormwater

to be exceeded not more than 4 times during the body contact season from June 1 to September 7 approximately.

5.4.2 Ground Water

It is not expected that the proposed works will have any measurable impact on ground water supply or quality. Measures will be taken when constructing the main detention pond to provide an effective sealing membrane to achieve the dual purposes of:

- maintaining the permanent storage level during dry weather, and
- eliminate the danger of elevating the water table in the vicinity of existing residential property on the north side of Tracey Street.

5.4.3 Fish and Wildlife

Information with respect to fish and wildlife in the study area is contained in an excerpt of the report prepared by Gore & Storrie. This excerpt can be found in Appendix "E".

5.5 Permission and Damage Constraints

Prior to construction and commissioning, a permit will be obtained from the Quinte Conservation Authority. Also, an application will be made to the Ministry of Environment and Energy for an amendment to the Certificate of Approval.

Staff of the Quinte Conservation Authority (formerly the Moira River Conservation Authority) have been closely involved with the development and design of the project since its inception. This liaison and cooperation has ensured that all concerns expressed by the Authority have been satisfied and , in general, has resulted in the identification of a superior design.

No agricultural land of any significance lies within the scope of the project and no issues concerning crop damage will be encountered.

VI RECOMMENDATIONS AND ALTERNATIVES

This section provides a description of the work proposed to provide a technically feasible and socially equitable solution to the storm water drainage problem described in previous sections of the report. Where appropriate, reference will be made to Appendices which describe in detail the assumptions on which the design is based and schedules relating to construction, costs, allowances and assessments. This section will present this information under the following sub-headings.

- Recommended Solution
- Alternatives Considered
- Design Criteria
- Cost Estimate
- Distribution of Cost

6.1 Recommended Solution

The measures proposed to achieve the objectives described in Section 3 – *Drainage Problem* are described in this sub-section. These may be generally grouped under two headings:

- Centralized facilities (see section 6.1.1)
- Distributed controls (see section 6.1.2)

6.1.1 Central Facilities

Centralized facilities will be constructed at the following locations

(a) at the downstream limit of the areas draining from or through the (former) township of Thurlow immediately upstream of the existing culvert under Highway 401, (see section 6.1.1.1), and
(b) immediately upstream of the inlet to the existing storm trunk along Tracey Street from the unopened Lemoine Street road allowance to the Moira River (see section 6.1.1.2).

In addition, the existing channel between the Highway 401 and Tracey Street will be modified to provide stability with acceptable maintenance costs under the action of increased volumes and rates of runoff resulting from ultimate land use development in both Thurlow and Belleville.

6.1.1.1 Thurlow Facility

An existing natural wetland is located immediately north of Highway 401 draining to the culvert approximately 500 m east of Sidney Street. This feature will be augmented by the construction of an extended detention pond comprising three cells and an outflow control structure. The cells will retain permanent storage in excess of 5,500 cubic metres with a proposed top water level of 94.6 m. The earth embankments separating the three cells will be overtopped during periods of significant runoff thus providing a single cell containing dynamic (or temporary) storage. For a storm with a recurrence interval of 100 years this proposed facility will perform as described by the following approximate estimates.

Peak inflow	=	4.94	c.m/s
Peak outflow	=	1.186	c.m/s
Maximum water level	=	95.63	m
Maximum dynamic storage volume	=	23,000	c.m

It is estimated that this level of performance can be achieved if distributed controls are implemented in areas of new development which are in compliance with guidelines described in the 1996 Weslake report.

This facility will achieve the desired control of both quantity and quality of runoff. A detailed analysis and design of the facility was provided in the November 1996 report by Ecos Garatech Consulting Engineers (EGA).

6.1.1.2 Belleville Facilities

Quantity and quality control facilities will be constructed south of Bell Blvd. and upstream of the existing outlet to the Tracey Street storm sewer. These will comprise:

b) A sediment forebay immediately south of the culvert at Bell Blvd., and

c) A large extended detention storage pond on the west side of the No-Name Creek and south of the 20 m wide Ontario Hydro easement.

In addition, the channel between the proposed sediment forebay and detention pond will be reconstructed to provide a stable watercourse. Special measures have been taken in the design of the channel to accommodate the existing sanitary sewer and associated manhole chambers which runs south within the unopened Lemoine Street road allowance.

The sediment forebay has been designed in accordance with the recommendations provided in the 1994 report *'Storm Water Practices, Planning and Design Manual'* by the Ontario Ministry of Environment and Energy. The outflow control from the forebay will comprise a segmented concrete weir which will retain a permanent storage volume of approximately 750 c.m with a top water elevation of 91.0 m. During a 100-year storm the sediment forebay will retain a dynamic volume of approximately 935 c.m with a top water level of 91.76 m.

The main detention pond will be constructed in an area of ground (approximately 1.5 hectares) which has been acquired by the City of Belleville and which is bounded by the following limits.

- On the east side by the unopened Lemoine Street road allowance
- On the north side by the property limit of the Loblaws (No Frills) development
- On the south side by the rear yard property line of existing residences fronting on Tracey Street
- On the west side by the property line of proposed residential property (Hawley Group)

For runoff resulting from the quality storm event (14 mm depth), the total flow in the No-Name Creek will be diverted into the main pond by a diversion weir with a crest elevation of approximately 91.4 m. For more severe storm events, a portion of the runoff will overtop the diversion weir thus bypassing the detention pond and proceed directly to the existing Tracey Street storm sewer through a proposed extension of the storm sewer.

The performance of the main detention pond under the action of the quantity storm (100 year recurrence interval) is estimated to be as described by the following peak flow values.

Peak inflow	=	3.354	c.m/s
Peak outflow	=	2.794	c.m/s
Maximum water level	=	91.74	m
Maximum dynamic storage volume	=	8,723	c.m

The existing Tracey Street storm sewer is estimated to have a capacity of 3.5 c.m/s. Thus the predicted peak outflow will occur with a depth of just over 1.0 m. This corresponds to a static water level (i.e. total energy level) of 91.64 m which is less than the expected maximum water surface elevation in the detention pond.

6.1.2 Distributed Controls

The 1995 report *'Upper No-Name Creek Stormwater Management Study'* by Gore and Storrie Ltd. included the important recommendation that the size and cost of the planned centralized facilities should be reduced by requiring that developers of commercial areas should make use of on-site storage to reduce the peak runoff which would otherwise result from the very large increase in the fraction of impervious area.

Subsequently, the 1996 report by Weslake Inc. 'Stormwater Management Implementation Study – Upper No-Name Creek' contained in Appendix "D" (of that report) some guidelines for the design of rooftop storage and parking lot storage.

These recommendations provide some flexibility depending on special circumstances which may affect a particular development. It is intended and assumed in this report that these guidelines apply to all commercial developments in both Thurlow and Belleville. A brief description of the guidelines for rooftop and parking lot storage is contained in the following two sub-section.

6.1.2.1 Rooftop Storage

Roof drains should be installed to provide one flow control device for each 450 – 500 sq. m of roof area. A typical flow rate for each weir control is 24 litres per minute for each 25 mm of depth at the roof drain.

In the absence of detailed site plan information the following should be assumed:

- The building footprint or total roof area is approximately 33% of the gross area of the development site.
- The roof area is 100% impervious and runoff from the total area is directed to the roof top storage area.
- To allow for roof top structures, the storage area should be assumed to be 75% of the total roof area.
- The storage area contributing to each roof drain should be assumed to be 450 sq.m.
- The available storage may be estimated as the depth multiplied by the storage area – i.e. a 'dead flat' roof may be assumed.

6.1.2.2 Parking Lot Storage

The area remaining after removal of the building footprint will comprise the following fractions:

- Parking area
- Circulation area
- Landscaping area

In the absence of detailed site plan information the following assumptions should be used.

Parking area is 67% of the remaining impervious surface (i.e. site area less building footprint less landscaping).

Catch basins will be installed with a density of 1 per 2500 sq.m.

Each catch basin will be fitted with an Inlet Control Device located with the centre of the orifice 1.0 m below the catch basin rim elevation.
The maximum depth of ponding above the catch basin rim should be not more than 0.3 m.

In general, the surface gradients in parking areas should be relatively flat (e.g. 1.0%) in order to maximize the potential storage around each catch basin. For example, if 2% gradients were to be used the maximum storage for a depth of 0.3 m would be only 90 cub.m which would have only a marginal effect in reducing the peak outflow.

6.1.3 Road Access for Maintenance

An important part of the design is the provision for access to the proposed works for the purpose of safety and maintenance. In general a continuous road access of 3.0 m minimum width will be provided from the furthest downstream limit of the works at Tracey Street and Lemoine Street to the existing wetlands located west of the Cambridge Properties extension of Quinte Mall and immediately south of the culvert under Highway 401.

The access route crosses the watercourse at various points as shown in various drawings. The following summarizes the location of the access and the special structures to provide crossings. The description proceeds north from the existing short spur of Lemoine Street on the north side of Tracey Street. Details are provided on the accompanying drawings.

- A short cul-de-sac section of Lemoine Street will be constructed north of Tracey Street to a point close to the south boundary of the Ontario Hydro lands and easement. This will be done by others but the subject contract will include extension of the existing 1.52 m (5 ft) diameter storm sewer.
- From the north extremity of the cul-de-sac a 3m access route will follow the west limit of the Lemoine road allowance for a distance of 50 m across the Ontario Hydro easement.
- From this access route two further accesses to the main pond area will be provided. These will run in a westerly direction and terminate in ramps to allow vehicular access to cells 2 and 3 of the main pond. Each of these will be controlled by swing gates.

- The 3 m access continues on the east bank of the re-constructed watercourse for a distance of approximately 115 m. This is also controlled by a swing gate at the south connection to the public road.
- The access road will follow a 'Con/Span' culvert system constructed over the segmented control weir at the downstream end of the sediment forebay, and follow the west limit of the forebay for a distance of 75 m. From the swing gated entrance on the south side of Bell Boulevard an inclined ramp 35 m in length provides vehicular access to the floor of the sediment forebay.
- The access on the west bank will be linked to a similar westerly access route along the unopened Mary Street road allowance which will be constructed by others.

6.1.4 Road Crossings and other Structures.

As mentioned in section 6.1.2 *Road Access for Maintenance* the 3 m wide access route will cross the re-constructed watercourse at various points. Some of these crossings are located at major structures in the facility. The following summarizes these structures moving upstream from the existing outlet at Tracey Street.

- Extension of the existing 1.52 m diameter storm sewer by approximately 50 m. to the proposed downstream limit of the reconstructed channel at the Ontario Hydro lands/easement.
- Construction of a diversion weir at entry to the storm sewer with a crest elevation of approximately 91.4 m and a length of 8.0 m.
- Construction of an extended detention pond to provide a permanent volume of not less than 9000 cub.m and dynamic storage of approximately 9000 cub.m, complete with a controlled outflow device to the storm sewer and an inlet pipe of 0.6 m diameter to carry flow from upstream of the proposed diversion weir.
- Construction of a sediment forebay of 75 m length and a length to width ratio of not less than 3:1 to provide permanent storage of approximately 750 cub.m. At the downstream end of the sediment forebay a segmented outflow control weir will maintain a permanent water level of 91.0 m. In the same location of the outflow control weir a culvert system and road crossing will be formed using a pre-cast 'Con/Span' arch complete with wing walls.
- At the upstream end of the sediment forebay the outflow from the existing culvert will be modified to provide improved entry flow characteristics by use of radius pipes or equivalent.
- Upstream of the existing culvert at Bell Blvd. a shallow pool will be formed in the reconstructed channel to improve the hydraulic conditions at the point where adjacent properties will contribute runoff immediately prior to entry to the culvert.
- At the point where flow enters the re-constructed channel from the existing wetlands a drop structure will provide a transition to flatten the slope of the channel and promote a stable cross-section in the moveable bed material while preventing drawdown of the existing wetlands.
- At various points along the length of the re-constructed channel outflow storm sewers and headwalls will be constructed to provide a stable and hydraulically efficient entry of runoff from the following properties to be constructed by others.
  - Cambridge Quinte Mall Extension
  - Undeveloped properties north of Bell Blvd and adjacent to the re-constructed channel.
  - Citation Phase 1 - Zellers. (to sediment forebay)

- Loblaws (No Frills).
- Undeveloped property west of Loblaws
- Undeveloped residential property south of Hydro easement. (to main pond))

6.1.5 Maintenance and Safety Issues

As mentioned in Section 6.1 the size and cost of the centralized facilities will be reduced by requiring individual developers to provide on-site storage in compliance with the stipulated guidelines. Assignment of cost will be conditional on the developer achieving the desired level of on-site control. Compliance will be verified at the stage of site plan approval.

Access for maintenance purposes will be provided by a 3 m access road along the entire length of the proposed works. As shown in various drawings, fencing complete with lockable swing gates and vehicular access control will be constructed as part of the project to ensure adequate safety precautions as and when each component of the work is completed and commissioned.

At the proposed diversion weir an inclined bar screen will be constructed to prevent accidental or deliberate access to the storm sewer system.

All disturbed ground will be restored by appropriate seeding or equivalent methods. Along the length of the re-constructed channel appropriate landscaping and planting will be provided in order to ensure an adequate vegetative buffer strip which will assist in quality and temperature control. All such landscaping areas will be constructed with gradients of 5H:1V or better to facilitate maintenance.

Around the main pond, an embankment slope of 7H:1V or flatter will be maintained for a distance of 3.0 m above and below the permanent water level of 91.0 m as recommended in the 1994 Ministry guidelines for safety reasons.

All of the planned facilities will be contained within standard 1.8 m high chain link, unclimbable fencing complete with swing gates with appropriate locks and/or padlocks to permit access for maintenance staff.

6.1.6 Abandoned Structures

One existing CSP culverts of approximately 1400 mm diameter located adjacent to an existing sanitary manhole just north of the Ontario Hydro easement will be removed during the re-construction of the channel.

6.1.7 Construction Issues

This section discussed, briefly, certain items relative to the construction of the planned facilities.

6.1.7.1 Benchmarks

Very top of hydrant on north side of Bell Boulevard just east of the unopened road allowance for Lemoine Street (proposed channel works). From City of Belleville Survey Crew:

Elevation = 94.998m

6.1.7.2 Disposal of Excess Materials

Where possible, and subject to approval of the Engineer, excavated rock and soft material shall be used as fill material where required. All surplus or unsuitable material will be removed from the site and disposed of in a fashion which is acceptable to the Engineer and the City of Belleville.

6.1.7.3 Working Space

All required working areas and accesses will be negotiated between the City of Belleville and the relevant landowners in order to facilitate construction within the Lemoine Street and Bell Boulevard road allowances and in the stormwater management block.

Working easements will be negotiated between the City of Belleville and relevant landowners as required.

Permanent easements have already been, or are currently, in the process of being negotiated where such easements are necessary for the continued maintenance of the facility.

6.2 Alternatives Considered

The 1995 report by Gore and Storrie Ltd. Proposed a centralized pond facility to be constructed between Bell Blvd. and the Ontario Hydro easement in the form of 3 cells in series formed in the Lemoine Street road allowance augmented by additional lands from adjacent developers.
This option was examined in detail but was found inadequate to provide the required degree of flood peak attenuation due to cascade effect of the distributed storage. Another factor was the relatively high assessed value of the commercial land required for this configuration.

6.3 Design Criteria

This section provides a summary of the criteria used in modelling the rainfall-runoff and in the design of the centralized and distributed storage facilities. Modelling was carried out using the MIDUSS98 program for the design of stormwater management systems. A more complete description is contained in Appendix "C" - *Design Brief.* Discussion here is presented under the following headings:

- Design Storms
- Rainfall Abstractions
- Modelling Catchments for Commercial Developments.

6.3.1 Design Storms

Two single event design storms are used in this design:

Quantity Storm:

- A storm with an average return period of 100-years to represent potential flooding risk. This is referred to as the 'Quantity' storm. A storm depth of 67.3 mm was adopted with a duration of 6 hours and a distribution corresponding to the Natural Resource Conservation Service's (formerly the Soil Conservation Service (SCS)) 6-hour mass rainfall distribution curve.

Quality Storm:

- A storm of a magnitude which is likely to be exceeded four time within the body-contact season (June 1 through September 7). This is referred to as the 'Quality' storm and is used to estimate the measures required for environmental protection of the watershed. A storm depth of 14 mm was adopted with a duration of 4 hours. The distribution of rainfall intensity is assumed to be represented by the same SCS 6-hour mass rainfall distribution curve. Appendix 'E' of the 1996 Weslake report provides information on how the magnitude of the Quality storm was determined from approximately 30 years of rainfall record at Belleville.

These storms are the same as used in the previous reports by Gore & Storrie and by Weslake Inc.

It should be noted that notwithstanding the selection of the Quality storm, estimates of the required permanent storage for quality control are based on the 1994 Ministry of Environment and Energy guidelines which assume a precipitation depth of 25 mm. This is discussed in the Design Brief of Appendix "C" (Section 8.1 of that report, *Estimation of Required permanent Storage Volume.*)
The two design storms are illustrated in Figures 2(a) and 2(b) of the Design Brief (Appendix "C")

6.3.2 Rainfall abstractions

Various models can be used to estimate the fraction of rainfall which results in runoff. This design employs the Horton equation in order to be consistent with previous studies by Gore & Storrie Ltd. (1989), Falcone Smith Assoc. (1991), Gore & Storrie Ltd. (1994) and Weslake Inc. (1996). The following parameters are used in the current design:

Parameter	Pervious	Impervious	units
Initial infiltration capacity	50.0	0.0	mm/hour
Final infiltration capacity	7.5	0.0	mm/hour
Lag time	0.5	0.5	hour
Surface depression storage	5.0	1.5	mm

6.3.3 Modelling sub-catchments for commercial land-use.

A standard procedure is used to model the runoff from a typical commercial development. The area is assumed to be broken down into three (or more) components representing rooftop, parking area(s) and the balance of the sub-area. The process of modelling each of these is described in detail in the Design Brief (Appendix "C")
The rooftop and parking area storage facilities are modeled by use of the MIDUSS98 Pond command which operates on the runoff generated for the appropriate catchment area. The outflow from each pseudo "pond" is accumulated at a hypothetical junction node from which the total runoff from the commercial sub-catchment is obtained.

6.4 Future Maintenance Considerations

Maintenance of the facility will involve at least four tasks related to (1) the wet pond, (2) vegetative buffer strips, (3) the sediment forebay and (4) on-site storage controls. The main points for inspection and maintenance for each of these tasks are summarized in point form below. Application of these maintenance items will be in accordance with the guidelines provided in Table 6.2 of the Ministry of Environment and Energy 1994 report *Stormwater Management Practices Planning and Design Manual.*

6.4.1 Wet pond maintenance

- Check permanent water level is not high (blocked outlet) or too low (blocked inlet and/or leakage).
- Check possible need for re-vegetation around the pond and/or in the shallows.
- Check sediment accumulation.

6.4.2 Vegetative buffer strips

- Annual removal of accumulated debris
- Annual check on vegetation and possible need for re-planting.
- Grass cutting (on the contour) no more than twice per growing season
- Manual removal of noxious weeds

6.4.3 Sediment removal

For the ultimate land-use in the area draining to the sediment forebay and main pond sediment accumulation of 4 cub.m/ha/year may be expected over the contributing area of approximately 47 ha allowing for rooftop surfaces, wetland and pond surfaces. This is equivalent to an annual accumulation of under 190 cub.m. Now, for Level 1 protection, a 5% reduction in removal efficiency corresponds to a reduction in permanent storage of approximately 20% or 1800 cub.m. On that basis an interval of 10 years between sediment removal operations may be acceptable.

Using a factor of safety of 2, a period of 5 years should be planned but annual estimates of sediment accumulation should be made using a suitable sounding rod at 2 or more pre-determined locations in the main pond. Similar observations should be made in the sediment forebay where the rate of accumulation may be dependent on particle size distribution of the total suspended solids.

The sediment forebay has no outlet below the permanent water level of 91.0 m and it will require to be pumped out to the downstream channel to allow accumulated material to thicken to a manageable consistency.

The 600mm diameter pipe leading from the diversion weir to the main pond will have stop boards fitted at the upstream end to facilitate dewatering of the channel downstream of the sediment forebay by pumping to the main pond.

6.4.4 Monitoring Requirement

At this time, an ultra violet treatment facility is no longer necessary. In addition, based on the additional storage volumes provided by both stormwater management facilities (north and south of Highway 401), it is expected that the stormwater runoff will be properly treated. Furthermore, since the treated stormwater will be discharged into the existing storm sewer on Lemoine Street, it is recommended that the monitoring requirement be deleted. All maintenance and sediment removal measures as outlined in the previous sections should, however, be carried out to ensure peak performance of the proposed stormwater management facility.

6.5 Cost Assessment and Allowances

This section presents the recommendations with respect to the estimates of total cost and the distribution of allowance and assessments between the benefiting parties. The detailed calculations on which these recommendations are based are provided in Appendix "F".

6.5.1 Summary of Cost Components

The calculations have been carried out with best efforts to be accurate, fair and impartial. However, it is recognized that contributing parties will wish to verify the calculation with reference to their respective cost assessments.

As much detail as possible has been included in the report in order to facilitate review and scrutiny by the contributing parties. The areas have been computed from a digital drawing which can be obtained from Weslake Inc. on request. The drawing file is compatible with AutoCAD release 12.0 or later.

The computer program used to analyze the rainfall-runoff from the individual sub-catchments is MIDUSS98 version 0.24. Information with respect to the MIDUSS98 program can be obtained by contacting Dr. Alan A. Smith at Weslake Inc.

The total cost is the sum of the following components. These are discussed briefly below and more detail is presented in the remainder of this Section and in Appendix "F".

1. Construction costs
2. Engineering fees and disbursements
3. Land costs
4. Allowances to contributors

(1) Construction cost has been estimated as $1,522,492.40. This includes an item for contingencies but does not include GST. This estimate is used to provide a preliminary distribution of costs and will be adjusted once the final cost of construction is known.

(2) Engineering fees are known to date and an estimate has been included for the cost of completion. However, for the purpose of this report the engineering fees and disbursements are assumed to be included in the 20% contingency allowance shown in Appendix "H". When the final construction cost is known the engineering fees and related expenses will be added to calculate the final cost assessment figures.

(3) Land costs are a significant component of the total cost. The land areas have been determined from a consolidated reference plan prepared by a qualified Land Surveyor. The land values used have been taken from the land value assessments made in 1996 for the preliminary cost distribution. These depend on the zoning condition for the land and as follows.

Commercial land	$320,000 per acre
Residential land	$180,000 per acre

Because land areas are measured in hectares the following conversion factor has been used.

1 hectare	=	2.471054 acres

This leads to the equivalent land values per hectare as follows.

Commercial land	$790,737.22	per hectare
Residential land	$444,789.69	per hectare

(4) Cost allowances represent compensation to parties to the agreement which have made a contribution in cash or in kind towards the implementation of the project. Many of these allowances relate to the provision of land. Examples of land contribution are the use of unopened road allowances or the use of land parcels which have been acquired by the City. Examples of cash contribution might be monies contributed by developers in order to compensate a landowner who has deeded to the City an area required for the project.

Allowances will be credited to the contributing parties and will offset the assessment of cost the respective parties.

The cash equivalent of all such allowances must therefore appear as an expense item in calculating the total cost of the project.

A preliminary estimate of the total cost of the facility is approximately $1,522,492.40. This has been divided into two components:

Cost for quantity control	$ 890,564.40
Cost for quality control	$ 631,928.00

Details of this estimate are provided in Appendix "H".

6.5.2 Cost Assessments

This section describes the method used to apportion the total cost between the benefiting parties. The following assumptions have been used in arriving at the percentage of cost to be assessed.

The total cost is divided into two fractions for quantity control and quality control. These are discussed separately in the following sections.

The cost of providing some fraction of the facilities for flow quantity control will be distributed between new developments which are:

- Under construction
- In the planning process
- Future developments

It follows that the balance of the total cost of the project will represent a cost for quality improvement. This cost will be distributed between all benefiting parties which are:

- New developments as defined above
- Existing developments which lie in whole or in part within the catchment of the Upper No Name Creek.
- Public authorities including the City of Belleville

6.5.3 Distribution of Costs for Quantity Control

The criterion for proportioning the cost of quantity control will be the product of the contributing area *A* multiplied by the peak flow runoff coefficient *C*. The contributing area is defined by the property lines of the registered plan if the property lies entirely within the sub-catchment representing the drainage area. If the property is only partially within the sub-catchment, the contributing area is defined by a composite plan comprising both property lines and drainage area boundaries.

The runoff coefficient C is defined by the rational equation for peak flow:

$$Q = C\,i\,A \qquad \text{or} \qquad C = \frac{Q}{i\,A}$$

where *A* total contributing area
Q peak runoff
i maximum rainfall intensity

For the 100-year Quantity design storm used and employing time steps of 15 minutes, the maximum rainfall intensity is 45.786 mm/hour.

Appendix "F" provides a detailed description of how these estimates have been made.

The process involves the following steps.

- Determine the total area of the sub-catchment or drainage area
- Determine the legal area representing the developable area
- Obtain the external areas such as a portion of Bell Blvd or Lemoine Street unopened road allowance.
- Carry out a computer simulation of the rainfall-runoff process to obtain the peak flow of runoff from the watershed.
- Using the same modelling parameters, obtain the peak runoff from each of the external areas which are tributary to the sub-catchment
- By subtraction obtain the peak runoff from the developable area
- Calculate the flow rate from the developable area for the peak rainfall intensity
- Calculate the runoff coefficient as the ratio of the two values described above.

The details of these calculations are contained in a number of spreadsheets and tables shown in Appendix "F". A summary table is provided in Table 1 below. The product of area and runoff coefficient is expressed as a percentage for those properties which will contribute to the cost of Quantity control. These percentages are used subsequently in estimating the cost assessments.

Table 1 - Estimation of Runoff Coefficients

Area	Owner	Area (ha)	Runoff coeff. C.	AxC	AxC as %
122	MTO	5.613			
121	Cambridge Leaseholds (Extension)	4.1005	0.4844	1.9683	15.2068%
123	Pronigo Distribution	2.9800	0.5690	1.6955	12.9802%
130	D.J.H. Development	1.1880	0.5469	0.6498	4.9744%
111	Cream of the Crop & 903717 Ontario	5.2997	0.4471	2.3641	18.0985%
119	Shell	0.3873			
112	Cambridge Properties (Quinte Mall)	17.0060			
115	151516 Ontario (Loebs Plaza)	2.0496			
127	Canadian Tire Corp. (Phase 1)	2.2105			
128	Canadian Tire Corp (Phase 2)	0.6366			
114	1133166 Ontario (Zellers Plaza)	5.9271	0.3319	1.9675	15.0623%
113	Loblaws (No Frills Plaza)	2.2493	0.5510	1.2393	9.4878%
125	Sopresata Holdings	4.8921	0.3982	1.9481	14.9142%
116	D.J.H Development	2.3774	0.5096	1.2116	9.2759%
129	Main pond	1.4650			
	TOTALS			13.0622	100.0001%

6.5.4 Distribution of Costs for Quality Control

The criterion for proportioning the cost of quality control is the volume of runoff. This volume is estimated for the 14mm quality storm using the modelling methods and design criteria described in the Design Brief of Appendix "C". The process is similar to that described in the previous section and involves the following steps:

- Determine the total area of the sub-catchment or drainage area
- Determine the legal area representing the developable area
- Obtain the external areas such as a portion of Bell Blvd or Lemoine Street unopened road allowance.
- Carry out a computer simulation of the rainfall-runoff process to obtain the volume of runoff from the watershed for the 14 mm Quality storm
- Using the same modelling parameters, obtain the volume of runoff from each of the external areas which are tributary to the sub-catchment
- By subtraction obtain the runoff volume from the developable area

Table 2 - Estimation of Runoff Volume

Area	Owner	Area (ha)	Volume (cub.m)	Volume (%)
1222	MTO	5.2829	147.33	2.3472
121	Cambridge Leaseholds	4.1005	371.77	5.9228
123	Pronigo Distribution	2.9800	353.81	5.6366
130	D.J.H. Development	1.1880	141.12	2.2482
111	Cream of the Crop & 903717 Ont.	5.2997	627.97	10.0044
119	Shell	0.3873	16.14	0.2571
112	Cambridge Properties (Quinte Mall)	17.0060	2045.72	32.5909
115	151516 Ontario (Loebs Plaza)	2.0496	243.37	3.8772
127	Canadian Tire Corp. Phase 1	2.2105	262.50	4.1820
128	Canadian Tire Corp. Phase 2	0.6366	75.62	1.2047
114	1133166 Ontario (Zellers Plaza	5.9271	702.72	11.1952
113	Loblaws (No Frills Plaza)	2.2493	267.04	4.2543
125	Sopresata Holdings	4.8921	581.42	9.2628
116	D.J.H Development	2.3774	74.39	1.1851
129	Main Pond	1.4650		
	City of Belleville		304.93	4.8579
	Belleville PUC		12.15	0.1936
	OPP		48.96	0.7800
	TOTALS		6276.96	100.000

Table 2 above shows the volume of runoff calculated for each benefiting party. More details are provided in the spreadsheets and tables in Appendix "F". The net runoff volume is expressed as a percentage for each of the contributing parties. The volume of runoff from external areas is used to calculate the volume contribution from public authorities which are included in the list of benefiting parties. The percentages are used later in calculating the cost assessments for Quality control.

6.5.5 Land Costs for Quantity and Quality Controls

The proposed stormwater management facilities will occupy a significant area. These lands are currently designated as Commercial, residential or open space. Using a fair and equitable distribution of costs, assessments and allowances, the owners of the required lands will receive appropriate compensation. This calculation has been done using the following assumptions:

- Open space lands will not be compensated
- The sediment forebay and stormwater management pond will be fully compensated at the appropriate value per hectare.
- Lands occupied by the proposed 3 metre wide maintenance access along the length of the channel and located north and south of Bell Blvd. Will be compensated at the commercial land value.
- All land values are based on the land appraisal prepared by Darrell L. Hume Ltd., Ontario Land Surveyors, in 1995. These values are shown in Section 6.5.1 above.

Table 3 shows the land areas required and the corresponding costs and totals. In order to separate the total land cost into separate components for Quantity and Quality components, the fraction of land area for the main pond required for Quality control has been estimated as 34.3%. The basis of this calculation is shown in the MathCAD spreadsheet in Appendix "F".

Table 3 - Land Costs for Quantity and Quality Control

Component	Area (ha)	Unit Land Cost ($/ha)	Land Cost ($)	(%)	($)
Stormwater Mgmt. Pond	1.4910	444,789.69	663,181.43	34.30	227,471.23
Sediment Forebay	0.2787	790,737.22	220,378.46	100.00	220,378.46
Maintenance Access:					
North of Bell Blvd.	0.0720	790,737.22	56,933.08	0.00	0.00
South of Bell Blvd.	0.0360	790,737.22	28,466.54	0.00	0.00
Totals:			**968,959.51**		**447,849.69**

The two columns on the right side of Table 3 show respectively the percentage and the value of each component cost which is associated with Quality control. The balance of the land cost will give the corresponding land value required for Quantity control, i.e.

Land Cost for Quality Control	$ 447,849.69
Land Cost for Quantity Control	$ 521,109.82

In the following Section these costs will be combined with the estimate of construction cost to provide a basis for distribution of cost assessments.

6.5.6 Summary of Cost Assessments

This section brings together the information presented in previous sections to calculate the total cost of the project, the division of cost for Quantity and Quality control and the distribution of these costs among the benefiting parties.

Table 4 shows the combination of estimated construction costs and land costs.

Table 4 - Combination of Construction and Land Costs

	Construction Cost	Land Cost	Sub-Totals
Quantity control	$ 890,564.40	$ 521,109.82	$ 1,411,674.22
Quality control	$ 631,928.00	$ 447,849.69	$ 1,079,777.69
TOTALS	$ 1,522,492.40	$ 968,959.51	$ 2,491,451.91

The total costs for Quantity control and Quality control can now be distributed among the benefiting parties using the percentages developed in Tables 1 and 2 of this Section.

6.5.7 Schedule of Allowances

As mentioned in Section 6.5.1 (para. (4)) Cost Allowances will be credited to parties to the agreement which have made prior contribution to the total cost of the project. These allowances relate mainly to land or land costs.

The City of Belleville has assembled the necessary parcels of land to construct and maintain the proposed facilities. The value of these lands has already been included in the total cost of the project and Quantity and Quality components of the total cost have been distributed among the benefiting parties. The City of Belleville therefore stands to be credited with an allowance equivalent to the following areas valued at the appropriate appraised land value, i.e.:

Main Pond	1.491 ha	Residential	$444,789.69/ha	$663,181.43
Sediment Forebay	0.2787 ha	Commercial	$790,737.22/ha	$220,378.46
		Total		$968,959.51

The land was deeded to the City of Belleville by a consortium of developers in 1996 as a result of a cost sharing agreement enacted by the benefiting parties at that time. The values contributed by individual developers and the total value is summarized in Table 5 below.

Table 5 - Land Cost Contribution
(Excerpt of the 1996 Cost Sharing Agreement)

Owner	Land Cost	Note
North		
Cream of the Crop Developments	$152,392.00	
Hawley-Ming II	$36,829.00	
Bradlaw Enterprises	$90,701.00	(1)
Cambridge Leaseholds	$109,058.00	
South		
Hawley-Ming-NALACO	$217,316.00	(2)
Hawley-Ming II	$30,915.00	
835309 Ontario Inc (A)	$180,793.00	(3)
835309 Ontario Inc. (B)	$28,496.00	(3)

The matter is complicated by the fact that the entities involved in the previous cost sharing agreement are not the same as the current developers. With reference to Table 5 above, the following notes offer additional comment:

Note (1) Bradlaw Enterprises property sold to Pronego Distribution Inc.

Note (2) The block west of Lemoine Street road allowance and between Bell Boulevard and the north line of the Ontario Hydro easement previously held by the consortium Hawley-Ming and North American Life Assurance Company (NALACO) has been split and sold to (i) Loblaws and (ii) Sopresata Holdings Inc.

Note (3) Ownership of the land presently forming the site of the future Zeller's Plaza has been transferred from two entities, 835309 Ontario Inc. (A) and (B) to the new company 1133166 Ontario Ltd.

It is not known if the credits listed in Table 5 were included in the sale or transfer of the property so that it is not possible at this time to combine cost assessment and allowances to show a net cost or benefit.

6.5.8 Reconciliation of Assessments and Allowances

In order to provide an overall and detailed picture of the Assessments and Allowances, two spreadsheets have been prepared which are displayed in Tables 6 and 7 respectively on the following pages.

Table 6 *Reconciliation of Assessments and Allowances* attempts to simplify the overall picture by grouping the developers into "New" and "Old" of which the former will be assessed for all of the Quantity related costs while Quality costs are distributed among all of the benefiting parties.

The estimated costs include both land cost and construction cost although the latter is for the moment approximate. Construction and land costs are shown distributed between the Quantity and Quality components. In each of these columns the assessments are shown against each of three participants being the City of Belleville, New Developers and Old Developers. The City is shown as a separate entity as it is the proponent of the petition under the Drainage Act and will serve as the purse-holder for financing the project.

The column headed "Allowances" shows the amount credited to the City for the total land provided for the project. This more than offsets the assessment of $52,454.79 to the City for Quality control yielding a net revenue of $916,504.72.

This sum will be used to compensate the developers who incurred an expense totaling $846,500.00 leaving a net revenue or "profit" to the city of $70,004.72.

A further complication arises because the block of land provided for the main pond has an area of 1.509675 ha whereas the present cost calculation assumes that only 1.491 ha will be required for the main pond. This yields the City of Belleville an additional value of $8,306.45 increasing the net revenue to $78,311.17.

The calculation in the lower left portion of Table 6 shows that this sum is approximately equivalent to the value of that fraction of the Lemoine Street unopened road allowance which is used for the sediment forebay. The fractional area deeded by Hawley-Ming/NALACO is approximate because this is only a portion of a significantly larger block provided over a length of almost 120m on the west side of the No Name Creek.

Table 7 *Schedule of Assessments* shows the distribution of the total costs between the benefiting parties and is more straightforward.

In conclusion, therefore, it is recommended that these tables be updated when the final cost of engineering and construction is known and used as the basis of Assessments and Allowances under the Drainage Act.

Table 6 - Reconciliation of Assessments and Allowances

	Assessments Charged			Allowances	Net Cost
	Quantity	Quality	Total		
Construction	$ 890,564.40	$ 631,928.00	$ 1,522,492.40		
Land	$ 521,109.82	$ 447,849.69	$ 968,959.51		
Totals	$ 1,411,674.22	$ 1,079,777.69	$ 2,491,451.91		
City	$ -	$ 52,454.79	$ 52,454.79	$ (968,959.51)	$ (916,504.72)
New developers	$ 1,411,674.22	$ 536,751.16	$ 1,948,425.38	$ (846,500.00)	$ 1,101,925.38
Old Developers	$ -	$ 490,571.74	$ 490,571.74		
Total paid	$ 1,411,674.22	$ 1,079,777.69	$ 2,491,451.91		

City profit (land value credit less assessment)	$	916,504.72
less refund to developers	$	846,500.00
Net profit	$	70,004.72
Over-valued amount from Main pond	$	8,306.45
Net net profit	$	78,311.17

Area used for sediment forebay	0.278700	ha
Area from 835309 Ontario	0.173490	ha
Area from HM/NALACO (estimated)	0.006174	ha
Total deeded	0.179664	ha
Area from Lemoine St road allowance	0.099036	ha

$ 78,311.45

Owner	Deeded land value
Cream of the Crop	$ 152,392.00
Hawley-Ming II (north)	$ 36,829.00
Bradlaw Enterprises	$ 90,701.00
Cambridge Leaseholds	$ 109,058.00
Hawley-Ming NALACO	$ 217,316.00
Hawley Ming II	$ 30,915.00
835309 Ontario (A)	$ 180,793.00
835309 Ontario (B)	$ 28,496.00
Total value:	**$ 846,500.00**

Appraised Land Value Zoning	$/hectare
Commercial	$ 790,737.22
Residential	$ 444,789.69

Discrepancy In Pond Land Area	
Pond area	1.491000
Deeded for pond	1.509675
Excess area deeded	0.018675
at commercial land value	$ 8,306.45

Table 7 - Schedule of Assessments

Area	Owner	Quantity percentage	Quantity cost	Quality percentage	Quality cost	Total Cost
	Total cost distribution		$ 1,411,674.22		$ 1,079,777.69	$ 2,491,451.91
122	MTO Hwy 401		$ -	2.3472%	$ 25,344.06	$ 25,344.06
121	Cambridge Leaseholds.	15.2068%	$ 214,669.99	5.9228%	$ 63,952.77	$ 278,622.76
123	Pronigo Distribution	12.9802%	$ 183,238.08	5.6366%	$ 60,863.24	$ 244,101.33
130	D.J.H. Development	4.9744%	$ 70,222.57	2.2482%	$ 24,275.80	$ 94,498.37
111	Cream of the Crop	18.0985%	$ 255,491.54	10.0044%	$ 108,024.90	$ 363,516.44
119	Shell		$ -	0.2571%	$ 2,776.44	$ 2,776.44
112	Cambridge Properties		$ -	32.5909%	$ 351,909.65	$ 351,909.65
115	151516 Ont. Loebs Plaza		$ -	3.8772%	$ 41,865.09	$ 41,865.09
127	C.T.C. Phase 1		$ -	4.1820%	$ 45,155.88	$ 45,155.88
128	C.T.C. Phase 2		$ -	1.2047%	$ 13,008.33	$ 13,008.33
114	1133166 Ont. Zellers Plaza	15.0623%	$ 212,630.61	11.1952%	$ 120,883.58	$ 333,514.19
113	Loblaws	9.4878%	$ 133,936.13	4.2543%	$ 45,936.86	$ 179,872.99
125	Sopresata Holdings	14.9142%	$ 210,540.25	9.2628%	$ 100,017.26	$ 310,557.51
116	D.J.H. Development	9.2759%	$ 130,945.04	1.1851%	$ 12,796.75	$ 143,741.79
129	Main Pond		$ -	0.0000%	$ -	$ -
	City of Belleville		$ -	4.8579%	$ 52,454.79	$ 52,454.79
	Belleville PUC		$ -	0.1936%	$ 2,090.07	$ 2,090.07
	OPP		$ -	0.7800%	$ 8,422.22	$ 8,422.22
						$ 2,491,451.91
	TOTALS	100.0000%	$ 1,411,674.22	100.0000%	$ 1,079,777.69	$ 2,491,451.91

APPENDIX "A"

Minutes of January 23, 1998 Site Meeting

UPPER NO NAME CREEK – DRAINAGE ACT
File No. 1333

MINUTES OF SITE MEETING
Intersection of Lemoine Street and Bell Boulevard

JANUARY 23, 1998 @ 1 PM

Those Present:

Joe Angelo	City Engineer, City of Belleville
Ray Ford	City of Belleville
Ernie Margetson	Quinte Conservation Authority
Ross Robinson	Residential Land South of Hydro Lands; East of Lemoine Street
Ruth Ferguson	RFA Planning Consultants (re Provigal – Old Bradlaw)
Tai Bui	Weslake Inc.

Points Discussed:

Tai Bui handed out the Preliminary Report prepared in accordance with the Drainage Act, and provided a discussion with respect to the following points:

1. The function of the stormwater management system.
2. The use of the petition drains procedure (i.e. conformity with the Drainage Act).
3. The method of assessment

Ruth Ferguson asked what will happen next.

Tai outlined the next step which will include the following:

- Finalize the design.
- Obtain additional information from all landowners (i.e. legal survey, grading and servicing plans, etc.).
- Prepare a cost assessment and report.

The meeting ended at approximately 1:45 p.m.

APPENDIX "B"

Summary of Drainage Act Procedure Steps

manner prescribed for a petition under section 4.

Duty of council

(14) Unless the requisition is withdrawn or a petition is filed with the council of the local municipality within the time limits prescribed by subsection (12), the council by by-law or resolution shall instruct the engineer to prepare a report.

Idem

(15) Despite any other provision of this Act, upon the filing of the report, unless the requisition is withdrawn, the council of the local municipality shall, subject to any appeal that may be taken, adopt the report and proceed to implement it in accordance with this Act.

Appeals

(16) Upon the filing of a report, an appeal lies therefrom to the Tribunal and as nearly as may be possible in the same manner and on the same grounds as in the case of a report for the construction of a drainage works commenced by petition under section 4.

Collection of expenses

(17) Where the requisition is withdrawn or the drainage works is not proceeded with under requisition as a result of an appeal, the owner who filed the requisition is chargeable with and liable to the municipality for the expenses incurred by the municipality in connection with the requisition, and the sum with which such owner is chargeable shall be entered upon the collector's roll for the municipality against the lands of the owner, and shall be collected in the same manner as real property taxes.

Existing ditches

(18) Every ditch constructed under *The Ditches and Watercourses Act*, being chapter 109 of the Revised Statutes of Ontario, 1960, shall be maintained in accordance with the award of the engineer providing for such maintenance until such ditch is brought under the provisions of this Act by requisition in the manner prescribed by subsection (1) or by petition as set out in section 4. R.S.O. 1990, c. D.17, s. 3.

PETITION DRAINS

Petition

4. (1) A petition for the drainage by means of a drainage works of an area requiring drainage as described in the petition may be filed with the clerk of the local municipality in which the area is situate by,

(a) the majority in number of the owners, as shown by the last revised assessment roll of lands in the area, including the owners of any roads in the area;

Obligation du conseil

(14) Sous réserve que dans le délai prescrit au paragraphe (12) une demande déposée auprès du conseil de la municipalité locale ne soit retirée ou qu'une pétition ne soit déposée auprès de celui-ci, le conseil, par règlement municipal ou par résolution, ordonne à l'ingénieur de préparer un rapport.

Idem

(15) Sur dépôt du rapport, à moins que la demande ne soit retirée et sous réserve d'un appel qui peut être interjeté, le conseil de la municipalité locale, malgré les autres dispositions de la présente loi, adopte le rapport et procède à son exécution conformément à la présente loi.

Appels

(16) L'appel d'un rapport déposé est interjeté devant la Commission et dans la mesure du possible de la même façon et en se fondant sur les mêmes moyens d'appel que dans le cas d'un rapport relatif à la construction d'installations de drainage entreprises à la suite de la pétition visée à l'article 4.

Recouvrement de dépenses

(17) En cas de retrait de la demande ou à défaut de construction des installations de drainage exigées dans celle-ci à la suite d'un appel interjeté au sujet de cette demande, le propriétaire qui a déposé la demande est redevable envers la municipalité des dépenses engagées par celle-ci à cet effet. Le montant de cette somme est inscrit au rôle de perception de la municipalité à l'égard des biens-fonds de ce propriétaire et il est recouvrable de la même façon que des impôts fonciers.

Fosses existants

(18) Les fossés exécutés en vertu de la loi intitulée *The Ditches and Watercourses Act*, qui constitue le chapitre 109 des Lois refondues de l'Ontario de 1960, sont entretenus conformément à la décision de l'ingénieur prévoyant leur entretien tant que ces fossés ne sont pas assujettis aux dispositions de la présente loi aux termes de la demande faite de la façon prescrite au paragraphe (1) ou de la pétition mentionnée à l'article 4. L.R.O. 1990, chap. D.17, art. 3.

TRAVAUX DE DRAINAGE EFFECTUÉS SUR PÉTITION

Pétition

4. (1) La pétition demandant des installations de drainage pour la zone nécessitant de telles installations décrite dans celle-ci, peut être déposée au bureau du secrétaire de la municipalité locale où est située cette zone :

a) par la majorité des propriétaires fonciers de la zone concernée, notamment ceux figurant au rôle d'évaluation révisé le plus récent, y compris les propriétaires de chemins de cette zone;

(b) the owner or owners, as shown by the last revised assessment roll, of lands in the area representing at least 60 per cent of the hectarage in the area;

b) par celui ou ceux des propriétaires fonciers de la zone concernée, dont les biens-fonds représentent au moins 60 pour cent de la superficie en hectares de la zone en question, figurant notamment au rôle d'évaluation révisé le plus récent;

(c) where a drainage works is required for a road or part thereof, the engineer, road superintendent or person having jurisdiction over such road or part, despite subsection 61 (5);

c) par l'ingénieur, le directeur de la voirie ou la personne ayant la compétence requise à l'égard du chemin ou de la section de celui-ci, si des installations de drainage sont requises pour ce chemin ou cette section de celui-ci, malgré le paragraphe 61 (5);

(d) where a drainage works is required for the drainage of lands used for agricultural purposes, the Director.

d) par le directeur, dans le cas où les installations de drainage sont requises afin d'assurer le drainage de biens-fonds utilisés à des fins agricoles.

Form of petition

(2) A petition under subsection (1) shall be in the form prescribed by the regulations and, where it is filed by an owner or owners under clause (1) (a) or (b), shall be signed by such owner or owners.

Formule relative à la pétition

(2) La pétition visée au paragraphe (1) est faite selon la formule prescrite par les règlements. Dans le cas où cette pétition est déposée par celui ou ceux des propriétaires visés à l'alinéa (1) a) ou b), elle doit être revêtue de leur signature.

Petition where area lies on each side of boundary line

(3) Where it is desired to construct a drainage works for the drainage of an area composed of lands or roads lying on each side of a boundary line between two or more local municipalities, the council of any of them may proceed upon a petition as required by this Act in all respects, including the sending of notices, as if such area were entirely within the limits of the municipality.

Pétition dans le cas où la zone est située de chaque côté d'une ligne de démarcation

(3) S'il est nécessaire de construire des installations de drainage destinées à drainer une zone qui comprend des biens-fonds ou des chemins situés de chaque côté d'une ligne de démarcation entre deux municipalités locales ou plus, le conseil de n'importe laquelle de ces municipalités peut procéder, sur pétition à cet effet, de la façon requise par la présente loi à tous égards, y compris en ce qui concerne l'envoi d'avis, comme si cette zone était entièrement située dans les limites de la municipalité en question.

Person deemed owner

(4) Where a person who is the owner of land, but does not appear by the last revised assessment roll of the municipality to be the owner, is a petitioner, the person shall be deemed an owner if the person's ownership is proved to the satisfaction of the clerk, and, if the person who appears by the assessment roll to be the owner is a petitioner, the person's name shall be disregarded in determining the sufficiency of the petition.

Personne réputée véritable propriétaire

(4) La personne qui est propriétaire d'un bien-fonds, mais qui n'est pas mentionnée à ce titre au rôle d'évaluation révisé le plus récent de la municipalité, et qui est au nombre des pétitionnaires, est réputée propriétaire si elle fournit la preuve suffisante de son droit de propriété au secrétaire. Dans ce cas, pour décider de la validité de la pétition, il n'est pas tenu compte du nom de la personne qui est mentionnée à titre de propriétaire au rôle d'évaluation révisé le plus récent et qui est l'un des pétitionnaires.

Persons jointly assessed

(5) Where two or more persons are jointly assessed for a property, in determining the sufficiency of a petition, they shall be deemed to be one owner. R.S.O. 1990, c. D.17, s. 4.

Personnes qui font l'objet d'une évaluation foncière commune

(5) Si deux personnes ou plus font l'objet d'une évaluation foncière commune au sujet d'un bien-fonds pour décider de la validité de la pétition, elles sont réputées un seul propriétaire. L.R.O. 1990, chap. D.17, art. 4.

Drainage works constructed on petition

5. (1) Where a petition in accordance with section 4 has been filed, the council shall forthwith consider the petition and shall, within thirty days after the filing of the petition,

Installations de drainage exécutées sur pétition

5. (1) Si une pétition est déposée conformément à l'article 4, le conseil l'examine sans délai et dans les trente jours à compter de la date de son dépôt :

(a) if it decides not to proceed with the drainage works, give written notice of its decision to each petitioner; or

(b) if it decides to proceed with the drainage works, give written notice of the petition and of its decision to each petitioner, the clerk of each local municipality that may be affected, and the conservation authority that has jurisdiction over any lands in the area or, if no such conservation authority exists, the Minister of Natural Resources.

Appeal to Tribunal

(2) Where a petitioner,

(a) receives notice under clause (1) (a) of a decision of the council not to proceed with the drainage works; or

(b) has not, within thirty days after the filing of the petition, received notice of a decision of the council,

the petitioner may appeal to the Tribunal or, where lands used for agricultural purposes are included in the area described in the petition, the Minister may refer the matter to the Tribunal, and the Tribunal may confirm the decision of the council or direct the council to make such decision and to take such action as the council is authorized to take under this Act and as the Tribunal considers proper. R.S.O. 1990, c. D.17, s. 5.

Notice that environmental appraisal is required

6. (1) Upon receipt of a notice from the initiating municipality under subsection 5 (1), a local municipality, conservation authority or the Minister of Natural Resources, as the case may be, may send to the council of the initiating municipality within thirty days a notice that an environmental appraisal of the effects of the drainage works on the area is required, and the cost thereof shall be paid by the party who requested it.

Authorization for environmental appraisal

(2) The council of the initiating municipality may obtain an environmental appraisal on its own initiative, the cost of which shall be paid by the municipality from its general funds.

Appeal

(3) The party requesting the environmental appraisal or the council of the initiating municipality, as the case may be, within forty days of receiving the account therefor, may appeal to the Tribunal, and the Tribunal may confirm or vary the account as it considers proper. R.S.O. 1990, c. D.17, s. 6.

a) s'il décide de ne pas construire les installations de drainage, en donne avis par écrit à chacun des pétitionnaires;

b) s'il décide de construire les installations de drainage, donne avis écrit de la pétition et de sa décision à chacun des pétitionnaires, au secrétaire de chaque municipalité locale qui peut être affectée, ainsi qu'à l'office de protection de la nature sous la compétence duquel se trouvent placés les biens-fonds situés dans la zone visée ou à défaut, au ministre des Richesses naturelles.

Appel à la Commission

(2) Si un pétitionnaire :

a) reçoit l'avis visé à l'alinéa (1) a) au sujet d'une décision du conseil de ne pas construire les installations de drainage;

b) n'a pas reçu d'avis d'une décision du conseil dans les trente jours à compter du dépôt de la pétition,

il peut interjeter appel auprès de la Commission ou, si des biens-fonds utilisés à des fins agricoles sont situés dans la zone décrite dans la pétition, le ministre peut renvoyer la question devant la Commission. La Commission peut confirmer la décision du conseil ou ordonner que celui-ci prenne la décision ainsi que les mesures qu'il est autorisé à prendre en vertu de la présente loi et que la Commission estime appropriées. L.R.O. 1990, chap. D.17, art. 5.

Avis imposant une évaluation des répercussions sur l'environnement

6. (1) La municipalité locale, l'office de protection de la nature ou le ministre des Richesses naturelles, selon le cas, dans les trente jours à compter de la date de réception de l'avis visé au paragraphe 5 (1) émanant de la municipalité initiatrice, peut envoyer au conseil de cette dernière un avis exigeant qu'une évaluation des répercussions des installations de drainage sur l'environnement soit faite au sujet de la zone concernée. Le coût de cette évaluation est imputé à la partie qui en fait la demande.

Autorisation relative à l'évaluation des répercussions sur l'environnement

(2) Le conseil de la municipalité initiatrice peut, de sa propre initiative, obtenir l'évaluation des répercussions sur l'environnement. Le coût d'une telle évaluation est dans ce cas imputé au fonds général de fonctionnement de cette municipalité.

Appel

(3) La partie qui fait la demande d'une évaluation des répercussions sur l'environnement ou le conseil de la municipalité initiatrice, selon le cas, peut, dans les quarante jours à compter de la date de réception du compte rendu sur cette question, interjeter appel auprès de la Commission. La Commission peut confirmer ou modifier le compte rendu, selon

ce qu'elle estime approprié. L.R.O. 1990, chap. D.17, art. 6.

Benefit cost statement

7. (1) The council of any local municipality to which notice was given under subsection 5 (1) or the Minister may send to the council of the initiating municipality within thirty days a notice that a benefit cost statement is required and the cost of preparing such statement shall be paid by the party who required it.

État coût-avantages

7. (1) Le conseil d'une municipalité locale auquel a été donné l'avis visé au paragraphe 5 (1) ou le ministre peut envoyer au conseil de la municipalité initiatrice, dans les trente jours à compter de la réception de cet avis, un avis de produire un état coût-avantages et le coût de la préparation de cet état est imputé à la partie qui l'exige.

Idem

(2) The council of the initiating municipality may obtain a benefit cost statement on its own initiative, the cost of which shall be paid by the municipality from its general funds. R.S.O. 1990, c. D.17, s. 7.

Idem

(2) Le conseil de la municipalité initiatrice peut, de sa propre initiative, obtenir l'état coût-avantages. Le coût d'un tel état est dans ce cas imputé au fonds général de fonctionnement de cette municipalité. L.R.O. 1990, chap. D.17, art. 7.

Appointment of engineer

8. (1) Where the council of the initiating municipality has decided to proceed with the drainage works described in a petition, the council shall by by-law or resolution appoint an engineer to make an examination of the area requiring drainage as described in the petition and to prepare a report which shall include,

Nomination d'un ingénieur

8. (1) Si le conseil de la municipalité initiatrice décide de procéder à la construction d'installations de drainage décrites dans une pétition, il nomme, par voie de règlement municipal ou de résolution, un ingénieur chargé d'examiner la zone qui requiert le drainage tel que décrit dans la pétition et de préparer un rapport qui comprend ce qui suit :

(a) plans, profiles and specifications of the drainage works, including a description of the area requiring drainage;

a) les plans, profils et devis descriptifs des installations de drainage, y compris une description de la zone qui requiert le drainage;

(b) an estimate of the total cost thereof;

b) un état estimatif du coût total;

(c) an assessment of the amount or proportion of the cost of the works to be assessed against every parcel of land and road for benefit, outlet liability and injuring liability;

c) une évaluation du montant ou de la fraction du coût des installations à évaluer à l'égard de chaque parcelle de terrain et de chemin en ce qui concerne les avantages, la responsabilité de la sortie et la responsabilité des dommages;

(d) allowances, if any, to be paid to the owners of land affected by the drainage works; and

d) le montant d'indemnités, s'il y a lieu, devant être versées aux propriétaires de biens-fonds qui sont affectés par les installations de drainage;

(e) such other matters as are provided for under this Act.

e) les autres indications ou documents qui sont prévus par la présente loi.

Where engineer is a corporation, etc.

(2) Where the engineer appointed under this Act is a corporation, association or partnership, the appointee shall, within ten days of the date of appointment, notify the council of the name of the individual engineer who will have charge of the project and who will remain in charge until the report is filed and if for any reason the designated engineer ceases to be employed by the appointee, the appointee shall within ten days of such time notify the council of the name of his or her replacement.

Cas où l'ingénieur désigné est une personne morale

(2) Si l'ingénieur nommé aux termes de la présente loi est une personne morale, une association de personnes ou une société en nom collectif, il doit, dans les dix jours à compter de la date de sa nomination, communiquer au conseil le nom de l'ingénieur qui sera chargé du projet jusqu'à ce que le rapport soit déposé. Si pour un motif quelconque l'ingénieur ainsi désigné cesse d'être employé par le titulaire du projet, ce dernier dans les dix jours d'une telle cessation d'emploi communique au conseil le nom de l'ingénieur qui le remplace.

Appeal or referral to Tribunal

(3) Where the council fails to appoint an engineer within sixty days after giving notice of its decision to proceed, any petitioner may appeal to the Tribunal or, where the petition was signed by the Director or where lands

Appel ou renvoi devant la Commission

(3) Si le conseil fait défaut de nommer un ingénieur dans un délai de soixante jours à compter de la date à laquelle il a donné l'avis de sa décision de construire les installations, les auteurs de la pétition peuvent interjeter

used for agricultural purposes are included in the area to be drained, the Minister may refer the matter to the Tribunal, and the Tribunal may direct the council to take such action as the council is authorized to take under this Act and as the Tribunal considers proper.

appel auprès de la Commission ou, si la pétition était signée par le directeur ou si des biens-fonds utilisés à des fins agricoles se trouvent dans la zone destinée à être drainée, le ministre peut renvoyer la question devant la Commission. La Commission peut alors ordonner au conseil de prendre les mesures qu'il est autorisé à prendre en vertu de la présente loi et que la Commission estime appropriées.

One report on two or more petitions

(4) The council of the initiating municipality may instruct the engineer to make one report with respect to two or more petitions requiring drainage in two or more adjoining areas that require drainage. R.S.O. 1990, c. D.17, s. 8.

Un seul rapport portant sur deux pétitions ou plus

(4) Le conseil de la municipalité initiatrice peut indiquer à l'ingénieur d'établir un seul rapport en ce qui concerne deux pétitions ou plus portant sur le drainage dans deux zones contiguës ou plus qui requièrent le drainage. L.R.O. 1990, chap. D.17, art. 8.

Notice

9. (1) The engineer shall, before making an examination and report, cause the clerk of the local municipality to send at least seven days written notice in the form prescribed by the regulations to each owner of lands within the area requiring drainage as described in the petition and to each public utility that may be affected by the petition setting out the time and place of an on-site meeting with the engineer to examine the area.

Avis

9. (1) L'ingénieur, avant d'effectuer l'examen des biens-fonds et d'établir son rapport, en fait envoyer par le secrétaire de la municipalité locale un avis écrit dans un délai imparti d'au moins sept jours, selon la formule prescrite par les règlements, à chaque propriétaire de biens-fonds situés dans la zone qui requiert le drainage dont la description figure sur la pétition ainsi qu'à chaque service public pouvant être affecté par cette pétition en y précisant les date, heure et lieu de la tenue de la réunion sur les lieux avec l'ingénieur afin d'examiner la zone en question.

Duty of engineer

(2) At the on-site meeting, the engineer shall,

(a) determine the area requiring drainage;

(b) determine whether the petition complies with section 4 for the area requiring drainage; and

(c) where the engineer is of opinion that the petition fails to so comply, establish the requirements for a petition to comply with section 4.

Obligations de l'ingénieur

(2) Lors de la réunion sur les lieux, l'ingénieur :

a) décide de la zone qui requiert le drainage;

b) décide si la pétition est conforme à l'article 4 en ce qui concerne la zone qui requiert le drainage;

c) s'il est d'avis que la pétition n'est pas conforme à l'article 4, fixe les conditions requises afin qu'elle soit conforme à celles-ci.

Idem

(3) Where the engineer is of opinion that the petition complies with section 4, the engineer shall proceed to prepare a report or a preliminary report, as the case may be.

Idem

(3) L'ingénieur, s'il est d'avis que la pétition est conforme à l'article 4, prépare le rapport ou le rapport préliminaire, selon le cas.

Report of engineer

(4) Where the engineer is of opinion that the petition does not comply with section 4, the engineer shall so report to the council of the initiating municipality stating wherein the petition is deficient, the amount of the engineer's fees and by whom they shall be paid, and the council shall forthwith send a copy of such opinion to each petitioner.

Rapport de l'ingenieur

(4) L'ingénieur, s'il est d'avis que la pétition n'est pas conforme à l'article 4, en fait le rapport au conseil de la municipalité initiatrice en déclarant dans celui-ci ce qui n'est pas conforme dans la pétition et en y précisant le montant de ses honoraires et à qui il incombe de les acquitter. Le conseil envoie alors, sans délai, une copie de cette opinion qui fait état de l'avis de l'ingénieur à chaque pétitionnaire.

Fees to form part of costs

(5) Where, within sixty days of the engineer's reporting to council under subsection (4), a petition that complies with the requirements of section 4 is filed with the clerk of the council,

Honoraires inclus dans les coûts

(5) Si dans les soixante jours à compter de la date du dépôt du rapport visé au paragraphe (4) auprès du conseil par l'ingénieur, une pétition conforme aux dispositions de l'article 4 est déposée auprès du secrétaire du conseil :

(a) the council shall instruct the engineer to prepare a report, or a preliminary report, as the case may be; and

(b) the fees mentioned in subsection (4) shall form part of the cost of the drainage works. R.S.O. 1990, c. D.17, s. 9.

a) le conseil indique à l'ingénieur de préparer un rapport, ou un rapport préliminaire, selon le cas;

b) les honoraires mentionnés au paragraphe (4) sont inclus dans le coût des installations de drainage. L.R.O. 1990, chap. D.17, art. 9.

Preliminary report

10. (1) Where the council of the initiating municipality deems it expedient, it may, or if it has received notice under section 6 that an environmental appraisal is required, it shall instruct the engineer to prepare a preliminary report containing a sketched plan of the drainage works and an estimate of the cost thereof in so far as it is practicable to do so, and which shall include the environmental appraisal, if any, and the benefit cost statement, if any, and the engineer shall forthwith prepare and file such a preliminary report with the council.

Rapport préliminaire

10. (1) Le conseil de la municipalité initiatrice, s'il l'estime pertinent, peut, ou s'il a reçu l'avis visé à l'article 6 qui exige qu'une évaluation de l'environnement soit effectuée, doit indiquer à l'ingénieur qu'il prépare un rapport préliminaire sur les installations de drainage comportant obligatoirement un plan schématique de celles-ci et, si possible, un état estimatif de leur coût. Sont également inclus dans ce rapport préliminaire, le cas échéant, l'évaluation de l'environnement et l'état coût-avantages. L'ingénieur prépare ce rapport préliminaire et il le dépose, sans délai, auprès du conseil.

Consideration of report

(2) Upon the filing of the preliminary report, the council of the initiating municipality shall cause the clerk to send a copy of the preliminary report and a notice of the date of the council meeting at which the preliminary report will be considered, to,

Examen du rapport

(2) Le conseil de la municipalité initiatrice, dès que le rapport préliminaire est déposé, en fait envoyer par le secrétaire une copie accompagnée d'un avis précisant la date de la tenue de la réunion lors de laquelle il prévoit de l'examiner. Le secrétaire est chargé de faire parvenir cette copie du rapport préliminaire et l'avis en question aux parties intéressées suivantes :

(a) every owner of land within the area requiring drainage as determined by the engineer or described in the petition, as the case may be;

(b) any public utility or road authority that may be affected by the drainage works;

(c) any local municipality and conservation authority entitled to notice under section 5 or, if no authority is entitled to notice, to the Minister of Natural Resources; and

(d) the Minister.

a) chaque propriétaire foncier de la zone qui requiert le drainage en fonction de la décision de l'ingénieur ou de la description de celle-ci qui figure dans la pétition, selon le cas;

b) le service public ou l'office de la voirie qui peuvent être affectés par les installations de drainage;

c) la municipalité locale et l'office de protection de la nature ayant droit de recevoir l'avis visé à l'article 5 ou, à défaut de l'office ayant droit à cet avis, le ministre des Richesses naturelles;

d) le ministre.

Withdrawal from and additions to petition

(3) At the meeting referred to in subsection (2), the council shall consider the preliminary report and shall give to any person who signed the petition an opportunity to withdraw from it by putting a withdrawal in writing, signing it and filing it with the clerk, and to any person present who owns land in the area requiring drainage and has not signed the petition an opportunity to do so.

Désistement de la pétition et ajouts

(3) Le conseil, lors de la réunion mentionnée au paragraphe (2), examine le rapport préliminaire et donne l'occasion aux signataires de la pétition de se désister de celle-ci. Quiconque se désiste le fait par écrit, signe sa déclaration de désistement et la dépose auprès du secrétaire. Le conseil donne également l'occasion aux propriétaires fonciers de la zone présents à cette réunion et dont les biens-fonds requièrent le drainage de signer la pétition s'ils ne l'ont pas encore fait.

Cost of petition and preliminary report

(4) If at the end of the meeting the petition does not contain a sufficient number of names to comply with section 4, the original peti-

Coûts relatifs à la pétition et au rapport préliminaire

(4) Les pétitionnaires initiaux de la pétition, qui à la fin de la réunion ne contient pas le nombre suffisant de noms pour être con-

tioners are chargeable in equal shares with and liable to the municipality for the expenses incurred by the municipality in connection with the petition and preliminary report, excluding the amount of any grants and the costs of any environmental appraisal or benefit cost statement, and the sum with which each of such petitioners is chargeable shall be entered upon the collector's roll for the municipality against the lands of the person liable and shall be collected in the same manner as real property taxes.

forme à l'article 4, sont tenus responsables à parts égales et sont redevables envers la municipalité des dépenses que celle-ci a faites relativement à la pétition et au rapport préliminaire, à l'exclusion toutefois du montant de subventions et du coût d'une évaluation des répercussions sur l'environnement ou de celui d'un état de coût-avantages. Le montant de la somme dont chacun des pétitionnaires est redevable est inscrit au rôle de perception de la municipalité à l'égard des biens-fonds de la personne qui en est redevable et il est perçu de la même façon que les impôts fonciers.

Instruction to engineer

(5) If at the end of the meeting, the petition contains a sufficient number of names to comply with section 4, the council may instruct the engineer to proceed with the preparation of a report.

Ordre donné à l'ingénieur

(5) Si à la fin de la réunion la pétition contient le nombre suffisant de noms pour être conforme à l'article 4, le conseil peut ordonner à l'ingénieur de procéder à la préparation d'un rapport.

Appeal to Tribunal

(6) Where the council of the initiating municipality fails to instruct the engineer to proceed with the preparation of a report, any petitioner may appeal to the Tribunal or, where lands used for agricultural purposes are included in the area to be drained, the Minister may refer the matter to the Tribunal and the Tribunal may direct the council to take such action as the council is authorized to take under this Act and as the Tribunal considers proper.

Appel à la Commission

(6) Si le conseil de la municipalité initiatrice fait défaut d'ordonner à l'ingénieur de procéder à la préparation d'un rapport, un pétitionnaire peut interjeter appel devant la Commission. Toutefois, dans le cas de biens-fonds utilisés à des fins agricoles qui sont situés dans la zone sujette au drainage, le ministre peut renvoyer la question devant la Commission et celle-ci peut ordonner au conseil de prendre les mesures que ce dernier est autorisé à prendre en vertu de la présente loi et que la Commission estime appropriées.

Idem

(7) Where any party mentioned in clause (2) (a), (b) or (c) is dissatisfied with the environmental appraisal, an appeal lies to the Tribunal.

Idem

(7) Les parties visées à l'alinéa (2) a), b) ou c) qui ne sont pas satisfaites de l'évaluation des répercussions sur l'environnement peuvent interjeter appel devant la Commission.

Referral to Tribunal

(8) Where,

Renvoi devant la Commission

(8) Le renvoi de l'évaluation des répercussions sur l'environnement devant la Commission peut être ordonné, selon le cas, par :

(a) lands used for agricultural purposes are included in the area to be drained, the Minister; or

a) le ministre, dans le cas de biens-fonds utilisés à des fins agricoles situés dans la zone sujette au drainage;

(b) a conservation authority or regional office of the Ministry of Natural Resources reports to the Minister of Natural Resources that the environmental appraisal is unsatisfactory, the Minister of Natural Resources,

b) le ministre des Richesses naturelles, dans le cas où un office de protection de la nature ou un bureau régional du ministère des Richesses naturelles fait valoir auprès du ministre des Richesses naturelles que l'évaluation des répercussions sur l'environnement n'est pas satisfaisante.

may refer the environmental appraisal to the Tribunal.

Powers of Tribunal

(9) An appeal under subsection (7) or a reference under subsection (8) shall be made within forty days after the meeting referred to in subsection (2), and the Tribunal may confirm the environmental appraisal or direct that it be reconsidered in such respects as the Tribunal considers proper. R.S.O. 1990, c. D.17, s. 10.

Pouvoirs de la Commission

(9) L'appel visé au paragraphe (7) ou le renvoi visé au paragraphe (8) sont interjetés ou ordonnés dans un délai de quarante jours à la suite de la réunion mentionnée au paragraphe (2). La Commission peut confirmer l'évaluation des répercussions sur l'environnement ou ordonner qu'elle fasse l'objet d'un nouvel examen en ce qui concerne les aspects de celle-ci que la Commission estime appropriés. L.R.O. 1990, chap. D.17, art. 10.

ENGINEER'S REPORT

RAPPORT DE L'INGÉNIEUR

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11. The engineer shall, to the best of the engineer's skill, knowledge, judgment and ability, honestly and faithfully, and without fear of, favour to or prejudice against any person, perform the duty assigned to the engineer in connection with any drainage works and make a true report thereon. R.S.O. 1990, c. D.17, s. 11.

Fonctions de l'ingénieur

11. L'ingénieur exerce les fonctions qui lui sont confiées relativement aux installations de drainage et fait un rapport exact au sujet de celles-ci. Il exerce ses fonctions au mieux de sa qualification, de ses connaissances, de son jugement et de ses compétences, honnêtement et loyalement. À cet effet, il agit sans crainte et sans partialité à l'égard de quiconque. L.R.O. 1990, chap. D.17, art. 11.

Power to enter on lands

12. (1) The engineer or any of the engineer's assistants when engaged in the performance of their duties during or after the examination of the locality may enter, measure along, ascertain the bearings of any line, plant the stakes that they consider necessary for the performance of the work and take levels on the land of any person.

Pouvoir d'entrer sur les biens-fonds

12. (1) L'ingénieur ou l'un de ses adjoints agissant dans l'exercice de leurs fonctions pendant ou après l'examen de la localité peuvent entrer sur les biens-fonds de quiconque en vue d'y prendre les mesures, d'y vérifier les coordonnées des lignes de bornage, d'y planter les jalons qu'ils estiment nécessaires pour effectuer les travaux, notamment pour y mesurer les cotes de niveau.

Offence, obstruction of engineer

(2) Every person who wilfully interferes with or obstructs the engineer or any of the engineer's assistants in the exercise of the powers conferred by this section is guilty of an offence and on conviction is liable to a fine of not more than $1,000. R.S.O. 1990, c. D.17, s. 12.

Infraction pour entrave à l'action de l'ingénieur

(2) Quiconque gêne ou entrave sciemment l'action de l'ingénieur ou d'un de ses adjoints dans l'exercice des pouvoirs qui leur sont conférés en vertu du présent article est coupable d'une infraction et passible, sur déclaration de culpabilité, d'une amende d'au plus 1 000 $. L.R.O. 1990, chap. D.17, art. 12.

Duties re survey

13. (1) The engineer in making a survey shall establish sufficient bench marks or permanent levels by which a drainage works may be governed, and shall in the report record the description, location and elevation of every bench mark or permanent level.

Fonctions relatives au levé

13. (1) L'ingénieur, en effectuant un levé, met en place assez de bornes repères ou de cotes de niveau permanentes pour assurer un bon régime d'écoulement des installations de drainage. Il indique en outre dans le rapport la description, l'emplacement et l'altitude de chaque borne repère ou cote de niveau permanente.

Offence, interference with bench marks

(2) Every person who interferes with, removes or destroys any bench mark or permanent level established under this section is guilty of an offence and on conviction is liable to a fine of not more than $1,000. R.S.O. 1990, c. D.17, s. 13.

Infraction en cas de dérangement de borne repère

(2) Quiconque dérange, enlève ou détruit une borne repère ou une cote de niveau permanente mise en place en vertu du présent article est coupable d'une infraction et passible, sur déclaration de culpabilité, d'une amende d'au plus 1 000 $. L.R.O. 1990, chap. D.17, art. 13.

Providing capacity for covered drainage works

14. (1) Subject to subsection (2), the construction of a drainage works by means of the improvement of a natural watercourse shall not include a covered drainage works, unless the part of the drainage works in which the covered drainage works is included provides capacity for all the surface water from the lands and roads draining naturally towards and into it and for all the waters from all the lands and roads assessed for the drainage works.

Capacité suffisante des installations de drainage couvertes

14. (1) Sous réserve du paragraphe (2), la construction d'installations de drainage qui consiste à améliorer un cours d'eau naturel ne comprend pas des installations de drainage couvertes, sauf si la partie de ces installations de drainage qui comprend les installations de drainage couvertes assure une capacité de drainage suffisante pour drainer la totalité des eaux de surface qui s'écoulent naturellement des biens-fonds et des chemins en direction et dans ce cours d'eau, ainsi que pour drainer la totalité des eaux provenant de l'ensemble des biens-fonds et des chemins qui ont fait l'objet d'une évaluation pour des installations de drainage.

Covered drainage works may be employed

(2) A covered drainage works may be employed in conjunction with an open drain provided that the total capacity of the system

Installations de drainage couvertes utilisées

(2) Des installations de drainage couvertes peuvent être utilisées conjointement à un drain découvert pourvu que la capacité totale du

is sufficient for the purposes of subsection (1). R.S.O. 1990, c. D.17, s. 14.

réseau soit suffisante aux fins énoncées au paragraphe (1). L.R.O. 1990, chap. D.17, art. 14.

Sufficient outlet

15. Subject to section 32, every drainage works constructed under this Act shall be continued to a sufficient outlet. R.S.O. 1990, c. D.17, s. 15.

Sortie appropriée

15. Sous réserve de l'article 32, les installations de drainage construites en vertu de la présente loi sont prolongées jusqu'à une sortie appropriée. L.R.O. 1990, chap. D.17, art. 15.

Report re disposal of material taken from drainage works

16. The engineer in the report shall determine in what manner the material taken from any drainage works in the construction, improvement, repair or maintenance thereof shall be disposed of. R.S.O. 1990, c. D.17, s. 16.

Rapport concernant l'élimination des matériaux provenant des installations de drainage

16. L'ingénieur précise dans le rapport la façon prévue pour l'élimination des matériaux provenant d'installations de drainage et notamment de la construction, l'amélioration, la réparation ou de l'entretien de celles-ci. L.R.O. 1990, chap. D.17, art. 16.

Bridges and culverts on roads

17. The engineer in the report shall provide for the construction, enlargement or other improvement of any bridges or culverts throughout the course of the drainage works rendered necessary by the drainage works crossing any public road or part thereof. R.S.O. 1990, c. D.17, s. 17.

Ponts et ponceaux sur des chemins

17. L'ingénieur prévoit dans le rapport, la construction, l'élargissement ou autre amélioration d'un pont ou d'un ponceau se trouvant sur l'ensemble du tracé des installations de drainage, rendus nécessaires par le fait que celles-ci croisent un chemin public ou une section de celui-ci. L.R.O. 1990, chap. D.17, art. 17.

Construction of bridges, etc.

18. Subject to section 33, the engineer in the report shall provide for the construction or the replacement, enlargement or other improvement of bridges, culverts, pumping stations and water gates rendered necessary by the drainage works including the cost of the construction or the replacement, enlargement or other improvement of the bridges, pumping stations, water gates and culverts, in the assessment for the construction, improvement, maintenance or repair of the drainage works, and they shall, for the purposes of maintenance or repair, be deemed part of the drainage works. R.S.O. 1990, c. D.17, s. 18.

Construction de ponts

18. Sous réserve de l'article 33, l'ingénieur prévoit dans le rapport la construction ou le remplacement, l'élargissement ou autre amélioration d'un pont, ponceau, poste de pompage et de vannes dont la nécessité découle de la construction des installations de drainage. En outre, il inclut le coût de la construction ou du remplacement, de l'élargissement ou autre amélioration de ces ouvrages, dans l'évaluation relative à la construction, l'amélioration, l'entretien ou la réparation des installations de drainage. Ces ouvrages sont réputés faire partie des installations de drainage aux fins de leur entretien ou de leur réparation. L.R.O. 1990, chap. D.17, art. 18.

Engineer may recommend abandonment of drain

19. The engineer in the report may recommend the abandonment of any drain or part thereof that is no longer useful or that is being supplanted by a new drainage works. R.S.O. 1990, c. D.17, s. 19.

L'ingénieur peut recommander d'abandonner l'utilisation d'un drain

19. L'ingénieur peut recommander dans le rapport de cesser d'utiliser un drain ou une partie de celui-ci dont l'utilisation n'est plus nécessaire ou qui a été remplacé par un nouveau réseau d'installations de drainage. L.R.O. 1990, chap. D.17, art. 19.

Continuing drainage works beyond limits of municipality

20. (1) Where it is considered necessary to continue a drainage works beyond the limits of the initiating municipality, the engineer employed by the council of the municipality may continue the drainage works on or along or across any road allowance or other boundary between any two or more municipalities, and from any such road allowance or other boundary into or through any municipality until the engineer reaches a sufficient outlet.

Extension des installations de drainage au-delà des limites de la municipalité

20. (1) Lorsque l'extension des installations de drainage au-delà des limites de la municipalité initiatrice s'avère nécessaire, l'ingénieur qui est au service du conseil de la municipalité peut procéder à l'extension des installations de drainage sur ou à travers un emplacement affecté à la construction d'une route ou une autre limite entre deux municipalités ou plus ou en bordure de ceux-ci. Il peut en outre, procéder aux installations de drainage à partir de cet emplacement affecté à la construction d'une route ou autre limite sur ou à travers le territoire d'une municipalité jusqu'à une sortie appropriée.

Where drainage works not deemed outside initiating municipality

(2) A drainage works shall not be deemed to be continued into a municipality other than the initiating municipality merely by reason of such drainage works or some part thereof being constructed on a road allowance form-

Les installations de drainage ne sont pas réputées être hors des limites de la municipalité initiatrice

(2) Les installations de drainage ne sont pas réputées se prolonger sur le territoire d'une municipalité autre que la municipalité initiatrice pour le seul motif que ces installations de drainage ou une partie de celles-ci ont

APPENDIX "C"

Stormwater Management Design Brief

DRAFT

City of Belleville
Upper No-Name Creek
Storm Water Management – Design Brief

1. Objective

This report is intended to serve as a supporting document for an application to amend the existing Certificate of Approval (No. 3-1647-95-966) for construction of a storm water management facility which was obtained following submission of the Weslake Inc. report of January 1996.

The No-Name Creek drains over 450 ha north of Highway 401 (Thurlow) and flows south and east through north-west Belleville discharging to the Moira River. Construction of Tracy Street in Belleville resulted in the creek being split into northern and southern sections, the former being drained by a major storm trunk sewer flowing east along Tracy St. to the Moira River. This sub-watershed is known as the Upper No-Name Creek.

Development within this area will result in significant increase in the volume and peak flow of runoff. Previous reports by Gore & Storrie Ltd. (1995) and by Weslake Inc. (1996) have studied the potential for effective and feasible methods to control increased runoff resulting from ultimate development within the catchment.

This document summarizes the criteria and methods used to finalize the design of the infrastructure required to implement the storm water management plan.

2 Areas included

The total drainage area must be divided into smaller sub-catchments both to facilitate hydrological modelling and also to assist in estimating the contribution of runoff from different landowners. Previous studies used areas estimated from existing mapping supplemented by ground observations.

The sub-areas used in this design are based on more detailed measurements. In Thurlow, this was done by EGA Ltd. for the design of the proposed pond immediately north of the culvert under Highway 401. For the City of Belleville, the areas have been measured from detailed surveys and site-plans (where these exist) along with on-site observations.

In undeveloped areas where site plans are not yet available the analysis has been based on the guidelines provided in Appendix 'D' of the 1996 Weslake report.

Significant differences in the areas can be seen as summarized in the spreadsheet of Figure 1 (*Comparison of 1998 and 1995 Runoff Analyses*). The total area in Thurlow increased by less than 1% whereas the area within the City of Belleville is reduced by

almost 13%. The Notes column provides some explanation for these changes. Figure 1 also shows flow peaks and volumes obtained for the scenarios examined.

3 Design Storms

Two single event design storms are used in this design:

(a) A storm with an average return period of 100-years to represent potential flooding risk. This is referred to as the 'Quantity' storm. A storm depth of 67.3 mm was adopted.

(b) A storm of a magnitude which is likely to be exceeded four time within the body-contact season (June 1 through September 7). This is referred to as the 'Quality' storm and is used to estimate the measures required for environmental protection of the watershed. A storm depth of 14 mm was adopted. Appendix 'E' of the 1996 Weslake report provides information on how the magnitude of the Quality storm was determined from approximately 30 years of rainfall record at Belleville.

These storms are the same as used in the previous reports by Gore & Storrie and by Weslake Inc.

4 Stormwater Management

The 1995 report by Gore & Storrie Ltd. included two important recommendations. These are:

(a) The cost of implementing a storm water management system should be shared between the benefiting parties.

(b) To reduce the total cost of the centralized management system, control of runoff should include on-site storage where this is appropriate.

On-site storage has been used in many commercial developments within the City of Belleville portion of the Upper No-Name catchment. A notable instance is at Quinte Mall.

4.1 On-Site Control

For a commercial development, on-site storage can be achieved in various ways some of which are described briefly below.

4.1.1 Rooftop storage on flat-roofed commercial buildings using flow restricters which causes a modest degree of ponding (e.g. less than 10 cm) on the roof. This occurs for all but very modest storm events (e.g. > 3.5 mm/hour). Runoff from rooftops is generally considered to be of good quality – i.e. relatively free of suspended sediments.

4.1.2 Storage on parking lots can be achieved by throttling of the discharge from catchbasins. This produces ponding on the surface during relatively extreme storm events – e.g. more than 5 year return interval. Ponding must be limited in depth to allow access for emergency vehicles. In this study, a maximum depth of 0.3 m above rim elevation has been used. For a given depth of ponding, storage volume can be maximized only by using grading of less than 1%.

4.1.3 Underground storage may be used in cases where no other means are available or where it is desired to reduce the frequency of surface ponding around catchbasins. Within the study area only one site has made use of this type of management (Canadian Tire Corp. expansion).

In the Weslake Inc. report (1996), Appendix 'D' provides guidelines on the design and use of rooftop and parking lot storage. These recommendations provide an opportunity for flexibility depending on special circumstances affecting the development.

4.2 Central Facilities

Some form of centralized storage facility is necessary to provide both Quantity and Quality treatment of runoff. The earlier reports proposed major extended detention pond facilities at two locations in the catchment area.

These ponds are designed as 'wet' ponds, meaning that during dry weather there will be a finite volume of water in the facility. This is referred to as permanent or 'dead' storage. This serves to dilute the 'first foul flush' which results from a rain storm and provides a delay period during which suspended sediment can settle and high concentrations of bacteria can be reduced by natural decay processes. One potentially negative effect of ponding is an increase in water temperature during summer periods. This can be countered by proper landscaping of shade canopy.

During periods of significant runoff these ponds provide additional storage by restricting the capacity of the outflow control device. This is referred to as dynamic or 'live' storage and has the effect of reducing the peak flow of the downstream hydrograph. The duration of the reduced outflow is increased because of the inevitable increase in runoff volume.

4.2.1 Pond at Hwy 401 (Thurlow pond)

The location of this proposed pond is at the existing wetland immediately north of the inlet to the culvert under Highway 401.

Earlier reports proposed permanent storage of 5,500 c.m and a maximum dynamic storage of 20,000 c.m. More detailed analysis and design was undertaken for the then Township of Thurlow by Ecos Garatech Associates (EGA) in 1997. A re-analysis of the pond performance has been done in the present design based on the detailed design of the pond proposed by EGA.

4.2.2 Pond at Tracy St/Lemoine St. (Main pond)

A report by Gore & Storrie Ltd. in 1989 (approx.) suggested that the capacity of the Tracy St. storm sewer was not more than 3.5 c.m/s and that this flow would be exceeded for ultimate land-use conditions for the 100-year storm. That report recommended that a centralized detention pond facility be constructed immediately south of the Ontario Hydro easement on the west side of the unopened Lemoine Street road allowance.

An appropriate area of land (approximately 1 ha) was deeded to the City of Belleville by an adjacent developer around 1990. At that time no provision for quality control was proposed.

5 Design Constraints

For the design currently proposed the following constraints have been identified and defined.

5.1 Quantity Control (100-year storm):

Peak outflow from Thurlow pond.	<=	1.2 c.m/s
Peak outflow from Main pond.	<=	3.5 c.m/s
Maximum water level in Main pond	<=	92.00 m

5.2 Quality Control (14 mm storm):

For both ponds a permanent storage volume should be provided which is based on the guidelines of the Ontario Ministry of Environment & Energy report "Storm Water Practices, Planning and Design Manual" (June 1994) for Level 1 protection. The relevant data is contained in Table 4.1 *Water Quality Storage Requirements Based on Receiving Waters* (page 173).

6 Hydrological Modelling

Prediction of the runoff resulting from specified rainfall was carried out using the computer program MIDUSS98. This is a recent update of the Miduss program for use under Windows 95 or Windows NT (v. 4.0).

The steps in hydrologic modelling involve the following:

- divide the total watershed into a series of discrete sub-catchments (discretization) each of which represent a reasonably homogeneous area either in terms of physical characteristics or ownership.
- define the time steps and design storm to be used
- select a method to represent infiltration and rainfall abstractions
- working in a downstream direction define each of the series of sub-catchment areas and compute the direct runoff hydrograph which contributes to the flow in one tributary of the drainage network
- design the element of the drainage network as a pipe, channel, detention pond, exfiltration trench, diversion structure or other facility

The remainder of this section describes briefly the hydrological processes involved. The design aspects are discussed in the following section.

6.1 Discretization

Weslake drawing 1333STM "Storm Drainage Plan" shows the main subdivision of the watershed south of the Thurlow pond. Each sub-catchment is identified by a node number and shows the total area in hectares and runoff coefficient for the runoff resulting from a 100-year storm. The main criterion for this level of discretization is ownership but some adjustment will be required for the purpose of cost sharing.

Most of these areas are subdivided still further into smaller sub-catchments to represent rooftop area, parking lot areas and other areas to make up the total.

A major difference between the present design and previous studies concerns the modelling of the area 119 which is located in the vicinity of the intersection of Bell Blvd. and North Front Street. Previously, it was assumed that this sub-catchment had a total area of 8.3 ha and that the runoff was split between a portion which flows south along North Front Street and the balance which flows west along Bell Blvd.

From careful study of the area it was concluded in the present design that the area is in fact only 0.39 ha (the Shell station on the north-west quadrant). Further, only the major flow component plus flow captured by one of three catchbasins contributes to Quinte Mall and thus to the Upper No-Name Creek.

Further it was noted that a portion of area 115 (East end of Loeb's Plaza) flows east to North Front Street and does not contribute to the Upper No-Name Creek.

6.2 Time parameters

For consistency with previous studies and for convenience of modelling the following time parameters were used.

Maximum storm duration	=	360	minutes
Maximum hydrograph duration	=	1500	minutes
Time step	=	15	minutes

The 15 minute time step is used for representing the design storm and for reporting and plotting flow hydrographs, but in many processes a smaller sub-multiple is used by MIDUSS98 in order to ensure numerical stability. This is transparent to the user and is not generally reported in the output from the program.

6.3 Design storms

6.3.1 Quantity storm

The 100-year design storm is represented by a total rainfall depth of 67.3 mm over a storm duration of 6 hours. The distribution of intensity within the 6 hour duration is represented by the Soil Conservation Service (SCS) 6-hour mass rainfall distribution curve.

6.3.2 Quality storm

From a previous analysis of the Belleville rainfall record (1960-1991) it was concluded that this event can be represented by a total rainfall depth of 14 mm. A storm duration of 4 hours is used. The distribution of rainfall intensity is assumed to be represented by the same SCS 6-hour mass rainfall distribution curve.

It should be noted that notwithstanding the selection of the Quality storm, estimates of the required permanent storage for quality control are based on the 1994 M.of E&E guidelines which assume a precipitation depth of 25 mm. This is discussed in Section 8.1 of this report, *Estimation of Required permanent Storage Volume*.

Figures 2(a) and 2(b) show the pattern of the storm together with the effective rainfall on impervious and pervious surfaces for the Quantity and Quality storms respectively.

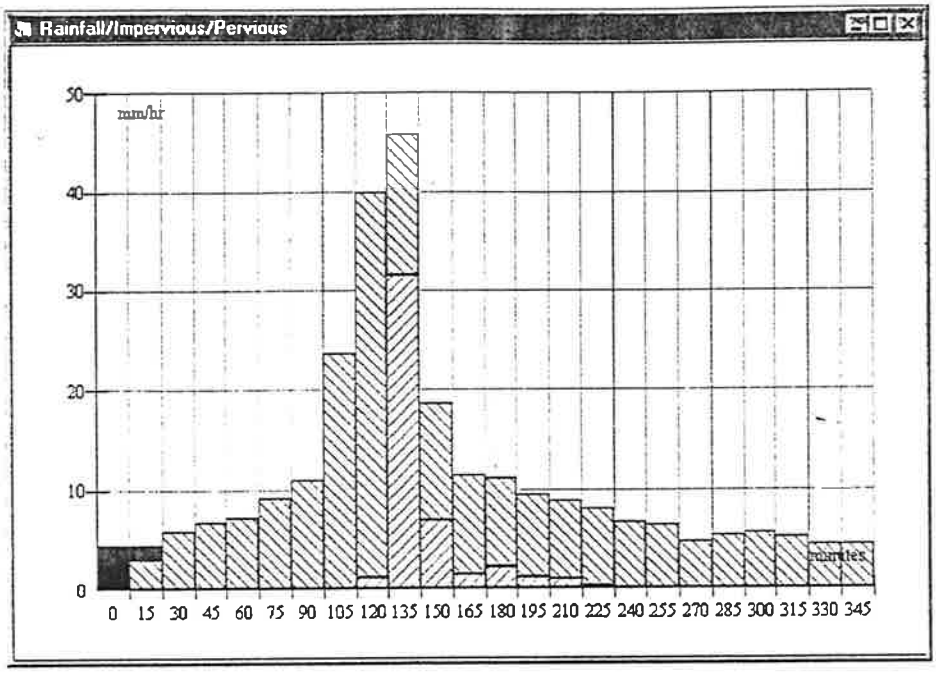

Figure 2(a) Storm, impervious effective and pervious effective rainfall hyetographs for the Quantity storm (67.3 mm over 6 hours)

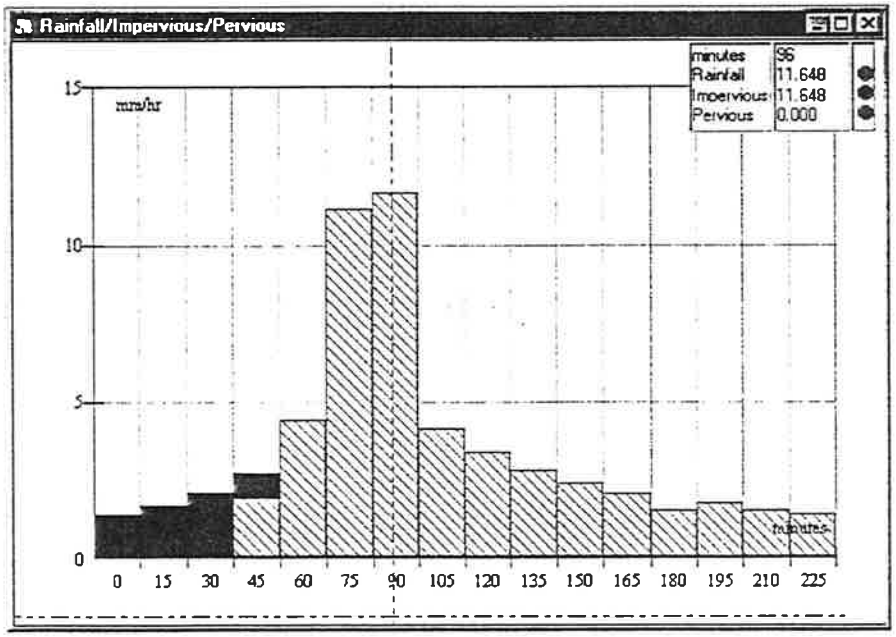

Figure 2(b) Storm and impervious effective rainfall hyetographs for the Quality storm (14 mm over 4 hours). No effective rainfall is produced from the pervious areas.

6.4 Rainfall abstractions

Various models can be used to estimate the fraction of rainfall which results in runoff. This design employs the Horton equation in order to be consistent with previous studies by Gore & Storrie Ltd. (1989), Falcone Smith Assoc. (1991), Gore & Storrie Ltd. (1994) and Weslake Inc. (1996).

The following parameters are used in the current design:

Parameter	Pervious	Impervious	units
Initial infiltration capacity	50.0	0.0	mm/hour
Final infiltration capacity	7.5	0.0	mm/hour
Lag time	0.5	0.5	hour
Surface depression storage	5.0	1.5	mm

6.5 Modelling sub-catchments for commercial land-use.

A standard procedure is used to model the runoff from a typical commercial development. The area is assumed to be broken down into three (or more) components representing rooftop, parking area(s) and the balance of the sub-area. Each of these is described below.

The rooftop and parking area storage facilities are modelled by use of the MIDUSS98 Pond command which operates on the runoff generated for the appropriate catchment area. The outflow from each pseudo "pond" is accumulated at a hypothetical junction node from which the total runoff from the commercial sub-catchment is obtained.

6.5.1 Rooftop Storage

The rooftop area is typically about 30% - 33% of the gross area or the actual building footprint if this is available. This is assumed to be 100% impervious and contributes runoff to a rooftop storage area which is smaller than the total area to allow for rooftop structures. A typical value is 75% of the building footprint.

This runoff discharges through a number of roof drains which is either known explicitly or is estimated at approximately 1 roof drain for each 450 sq.m. of roof storage area. The discharge capacity of each roof drain is a function of depth of storage at the drain. The discharge to depth relationship is assumed to be linear. This is either known from 'as-built' drawings or estimated as 24 litres/minute for each 25 mm (1 inch approx.) of depth.

6.5.2 Parking Lot Storage

Parking lot storage can be estimated either by direct measurement from the grading plan or estimated as 67% of the balance of the impervious area in the sub-catchment. If a digitized drawing of the grading plan is available the contour around each catchbasin with an elevation of 0.3 m above the rim elevation is drawn and the area obtained from the drawing. In some cases a depth of less than 0.3 m must be used if a low point in the grading plan is within the 0.3 m contour.

The available volume which can be stored at the catchbasin is approximated as an inverted cone the base of which is either a circle or ellipse. The gradient on the parking surface is estimated for the major and minor axes of the ellipse. Estimation of these parameters is done using a simple spreadsheet. A typical example for Quinte Mall is shown in Figure 3 (*Estimation of Grade Parameters for Modelling of Parking Lot Storage*).

The capture capacity of the catchbasin depends on the size of the Inflow Control Device (ICD) and the depth of the ICD below rim elevation. The depth is either known from the grading plan or is estimated as approximately 1.0 m. This approximation is on the low side and therefore tends to under-estimate the discharge capacity and therefore give a conservative estimate of the required on-site storage.

The computer program provides an initial estimate of the design which can be modified if information is available or if the user chooses to exercise engineering judgement.

6.5.3 Balance of the Catchment

The remaining fraction of the commercial sub-catchment will comprise impervious surface for circulation and the pervious area resulting from landscaping or setbacks. This is modelled in the normal way and the runoff is copied directly to the junction node where the outflows from the other component areas have been accumulated.

6.6 Estimating the runoff coefficient

In order to obtain a measure of the effectiveness of on-site controls a peak flow runoff coefficient is calculated. The runoff coefficient C is defined by the equation for runoff in terms of rainfall intensity and area, thus:

$$Q = C\,i\,A \qquad \text{or} \qquad C = \frac{Q}{i\,A}$$

Figure 4 (*Estimation of Runoff Coefficient*) shows the calculation of the theoretical instantaneous runoff for an impervious area of the same size subject to the peak rainfall intensity for the Quantity storm. Using 15 minute time steps, the 100-year storm has a peak rainfall intensity of 45.786 mm/hour which is equivalent to 0.12718 cub.m/sec/ha. The actual runoff from an area is moderated by factors such as the percent of pervious ground, on-site storage, diversion etc. This is available directly from the MIDUSS98 results.

The results of the calculation are shown in Table 1 for convenience of reference.

Table 1 - Estimation of Runoff Coefficients

Area	Owner	Area (ha)	Imperv. %	Q (c.m/s)	i x A (c.m/s)	Runoff coeff..
122	MTO	5.613	21.0	0.355	0.714	0.497
121	Cambridge	4.262	68.4	0.269	0.542	0.496
123	Bradlaw	3.213	90.0	0.224	0.409	0.548
111	Quickert+	7.404	90.1	0.527	0.942	0.560
119	Shell	0.390	100.0	0.022	0.050	0.444
112	Quinte	17.698	96.3	0.685	2.251	0.304
115	Loebs	2.423	90.0	0.141	0.308	0.458
127	CTC 1	3.4730	88.0	0.252	0.442	0.570
114	Citation	7.160	90.6	0.373	0.911	0.410
113	Loblaws	2.780	84.2	0.202	0.354	0.571
125	Hawley	5.510	90.0	0.300	0.701	0.428
116	Hawley (res)	2.162	25.0	0.140	0.275	0.509
129	Main pond	1.452	62.0	0.141	0.185	0.764

Some refinement of this table will be required for the purpose of cost-sharing calculations because many of the areas include a half-width of roadway or other area (i.e. the sediment forebay) which is outside of the legal boundary of the property and which is therefore the responsibility of the City of Belleville.

7 Analysis of Proposed Thurlow Pond

The design for this proposed facility was developed by EGA for the (then) Municipality of Town of Thurlow. ("*Township of Thurlow: Storm water management - Wetland Facility Implementation Plan, Upper No-name Creek*", EGA, November 1996).

As part of the present analysis the total runoff entering the proposed pond was modelled for both the Quantity and Quality storms. Some differences were noted in the calculation of the total hydrograph entering the proposed pond. These are shown and discussed briefly in the spreadsheet of Figure 5 (*Thurlow wetland facility - Comparison of EGA and*

Weslake Analysis). The net result of the re-analysis was an increase in the peak 100-year hydrograph entering the facility from 4.688 to 4.938 c.m/s.

Using the geometry and controls as developed by EGA the 100-year quantity inflow hydrograph was routed through the pond in order to determine the outflow hydrograph which represents an upstream boundary condition for the City of Belleville portion of the Upper No-Name catchment.

The proposed pond in Thurlow will have three cells which will merge into a single cell for water levels above the permanent storage level. To facilitate modelling in the MIDUSS98 program the equivalent aspect ratio and side slope were determined as shown in Figure 6 (*Calculation of Proposed Thurlow Pond Volume*). In preparing the data for this calculation it was noted that the permanent pool surface area used by EGA was conservative compared to a carefully scaled measured area of just under 20,000 sq.m. From the pond routing calculation the peak outflow was found to lower than that used by EGA (1.186 c.m/s compared to 1.366 c.m/s). The former was used as the external area inflow to the area within the City of Belleville.

8. Design of the City of Belleville Main Pond

This section describes the steps taken to develop and refine the design of the proposed Belleville facility. It is considered below under the separate headings of the Quality storm and the Quantity event.

An important feature of the design is the location of the permanent pond storage "off-line" to minimize the potential impact of extreme storm events which might otherwise result in re-suspension of the settled material accumulated during preceding storms of modest intensity.

This will be done by constructing a diversion weir at the downstream end of the Upper No-Name Creek where it will enter the pond. The crest elevation of this weir will be above the permanent pond water level by an amount that will capture the 14mm Quality storm. For more extreme storms, the first foul flush will be captured and detained in the pond.

Once the weir crest is overtopped, a fraction of the excess flow will be transmitted downstream to the Tracy Street storm sewer without passing through the pond. However, by virtue of the increased head generated upstream of the diversion weir, the water level in the pond will increase further thereby increasing the amount of dynamic storage and thus providing a significant measure of peak flow attenuation for the downstream transmitted hydrograph.

This arrangement will maximize the dual purpose nature of the facility for both quantity and quality control.

8.1 Estimation of Required Permanent Storage Volume

Figure 7 (*Estimate Volume of Permanent Storage for Quality Treatment*) shows the assumptions and detailed calculations made to determine the necessary storage volume. These may be summarized as follows:

- The area to be treated includes every contributing area downstream of the proposed Thurlow pond, including the tributary portion of Highway 401. The total area amounts to 63.54 ha.
- For each area the percent of impervious surface is known and from this the average impervious ratio is found to be 81.1%
- For commercial areas in which rooftop storage is employed, the rooftop area is deducted from the total impervious surface since the quality of runoff from rooftops is considered to be good enough to make further treatment unnecessary. The net area is thus found to be 49.473 ha.
- This area is further reduced by the area of the existing wetland (immediately downstream of the 401 culvert) and also the actual water surface areas of the proposed sediment forebay and the main pond. The water surface in the creek is ignored. This results in a net area of 47.181 ha.
- For Level 1 treatment the suggested volume per hectare is 210 cub.m which includes an allowance of 40 cub.m for extended detention. The total required volume is thus calculated as 170 cub.m per hectare for a net area of 47.181 ha or 8,021 cub.m.

8.2 Estimation of Revised Pond Invert Level

In order to avoid backwater effects at the existing culvert under Bell Blvd. the permanent pond water level was set at 90.9m. The previous design used an invert level of 89.0 m with a side slope of 2H:1V up to an elevation of 90.3m and 5H:1V above that. This provides a distance of 3.0 m both below and above the permanent water level for reasons of safety as recommended in the 1994 M.of E&E guidelines.

For the revised design it was decided to maintain the same plan area and layout at the level of 90.9 and raise the pond invert in order to achieve maximum economy in construction cost by minimizing the amount of rock excavation and removal.

The detailed calculation is shown in the spread sheet of Figure 8 (*Estimate Permanent Storage in Main Pond*). The following comments explain the procedure used.

- The four main columns show calculations for the three individual cells of the proposed facility plus a column showing an equivalent single cell pond. The agreement between the two estimates is very acceptable.
- The calculation starts from the original invert elevation of 89.0 m in order to establish the increased plan area available at an elevated invert.
- The calculation is done for depth increments of 0.05 m and the side slope is set as 2H:1V or 5H:1V depending on whether the level is below or above 90.6.
- It is found that using an invert level of 89.75 results in a permanent storage volume of 8875.9 c.m. To this can be added a permanent storage in the sediment forebay which provides a margin over the estimated required volume of 8,021 c.m which is judged to be adequate.

8.3 Determination of Diversion Weir Crest Level

As mentioned above, the diversion weir must retain the quality storm runoff while releasing a modest outflow to the Tracy Street storm sewer. This outflow control was represented by an orifice of 150 mm diameter with an invert level of 90.5 m - i.e. 0.4 m below the permanent pond water level. An outflow control device will be installed upstream of this orifice in order to retain the desired permanent pond level of 90.9 m.

Modelling of the Thurlow and Belleville catchments for the 14 mm Quality storm provides an estimate of the total inflow hydrograph to the main pond. This analysis takes account of the modest attenuation through the sediment forebay and the direct inflow to the main pond from the proposed residential area south of the Ontario Hydro easement.

The peak inflow to the Main Pond for the Quality storm is 1.170 c.m/s. With the proposed pond geometry and orifice flow control the maximum water level in the pond is 91.4 m. The crest of the diversion weir is therefore set at 91.4 m. These estimates may be subject to very minor change when final legal survey data is obtained to fine tune the modelling.

The peak inflow to the Main pond is found to be 3.373 c.m/s which is significantly lower than the 1995 estimate of 4.246 c.m/s and also less than the estimated capacity of the Tracy Street storm sewer of 3.5 c.m/s.

The result of routing the 100-year Quantity storm hydrograph through the Main pond is illustrated in Figure 9. The peak flow is reduced to 2.805 c.m/s with a top water level of 91.769 m and a total dynamic storage of just over 9000 c.m. The outflow can be carried by the Tracy Street sewer with a total energy level at inlet of 91.7 m so that no backwater from the sewer will affect the pond level. To achieve this a weir crest length of 8.0 m is required assuming a discharge coefficient of 0.9 which is probably slightly conservative.

9. Channel Design

This section considers the design of the channel between the wetlands (south of the 401 culvert) and entry to the Main pond.

To look at the system in an overall perspective, i.e. connectivity of the watershed, the channel between Thurlow pond and the Bell Blvd storm water management system was carefully analyzed. The channel is designed to provide adequate capacities both in terms of hydraulics and sediment transport.

Aspects considered in the design include:

- The discharge and flow resistance relationship, and
- The power expenditure vs energy relationship.

In addition to the above, the regime concept is also used to describe the quasi-equilibrium state of the stream as well as to determine the "stable conditions" of the channel.

In short, the channel was designed based on four relationships or equations, i.e.-

- Flow resistance equation
- Continuity equations (water and sediment)
- Shear stress distribution, and
- Transport equation

Furthermore, given the state of the channel, i.e. coarse material and a man-made channel, the following assumptions were made:
Bray's logarithmic velocity distribution is appropriate, and
The Chang's approach for stable channel design adequately addresses the objective of the design. The approach assumes low shear stress and uniform flow, which is consistent with a man-made channel.

The results of the stable channel design and analysis are included in an Appendix to this report.

10 Conclusions and Recommendations

10.1 Reduced Runoff

The projected runoff peaks and volumes are found to be smaller than originally estimated in previous reports. This is due primarily to three factors:

- The effectiveness of the proposed wetland facility in Thurlow can be predicted with much greater accuracy now that specific engineering proposals are available from EGA.
- Careful scrutiny of the available mapping and site plans supplemented by on-site survey where necessary has shown the areas tributary to the No-Name Creek to be smaller than originally estimated or assumed in earlier reports.
- A detailed assessment of the existing and proposed on-site storage measures has also been made.

The peak flows for the Quality and Quantity storm events are summarized in Table 2 below.

Table 2 - Peak Flows at Key Locations

Location within the Upper No-Name Creek		Storm Event	
		Quality 14 mm	Quantity 67.3 mm
		(c.m/s)	(c.m/s)
Thurlow pond	Inflow	0.848	4.939
	Outflow	0.016	1.186
Sediment forebay	Inflow	1.202	3.208
	Outflow	1.124	3.092
Main pond	Inflow	1.170	3.373
	Outflow	0.054	2.797

10.2 Quality Control

An argument has been proposed which suggests that quality control to Level 1 standards can provided with a total volume of permanent storage of 8021 c.m. Using the proposed geometry for the Sediment Forebay and the Main Pond a total volume of more than 9340 c.m will be provided representing a margin of over 16%. This volume is made up from:

Sediment forebay	470 c.m
Main pond	8876 c.m
Total	9345 c.m

This represents a significant reduction in the cost of constructing the permanent pool storage as the change to the geometry has been made to minimize the rock excavation and removal. Approximately 4,800 c.m of mostly rock excavation has been eliminated which will result in cost reduction which will largely offset the loss of the financial contribution from the Town of Thurlow.

10.3 Quantity Control

The peak outflow from the main pond will be well below the estimated carrying capacity of 3.5 c.m/s in the Tracy Street storm sewer. The 100-yr storm hydrograph is estimated to have a peak flow of 2.797 c.m/s with a top water level of 91.686 m. This water surface elevation is below the target limit of 92.0 m by more than0.3 m.

For this outflow rate the existing storm sewer will be flow with a normal (i.e. uniform) depth of just over 1.0 m or roughly 2/3 full. The corresponding energy level at the entrance to the storm sewer will be 91.645 m. This represents a drop of 41 mm from the predicted pond water level which will ensure that the pond will not experience any backwater effect from the storm sewer.

It should be noted that the safety grill should therefore be constructed upstream of the proposed diversion weir to limit the effect of backwater from trash accumulation to the upstream reach of the creek.

10.4 Cost Sharing

The analysis has been carried out in a way which will provide the necessary data on which the cost sharing criterion of (Area x Runoff Coefficient) can be accurately assessed. However, additional calculations will be required to calculate and demonstrate the proportion of the total cost which should be assigned to the City of Belleville

Some refinement of these calculations may also be required once the requested legal surveys have been made available.

10.5 Data Files

The Input and Output files for the MIDUSS98 analyses are appended to this report in the form of text files on the accompanying computer disk. Hardcopy of any of these files can be provided on request.

SUMMARY OF FIGURES

City of Belleville: **Upper No-Name Creek** **Jan-98**
Comparison of 1998 and 1995 Runoff Analysis

This file: \\aas\d:\Miduss Projects\Belleville\Comparison1.xls

Flows and Volumes for: **100-yr storm:** **67.3 mm SCS-6hr distribution**

Township of Thurlow

Area #	AREA 1995 ha	AREA 1998 ha	FLOW PEAK 1995 c.m/s	FLOW PEAK 1998 c.m/s	VOLUME 1995 c.m	VOLUME 1998 c.m	NOTES
100A/B	283.0	283.0	0.644	0.638			All areas in Thurlow
100C	45.2	45.2	0.122	0.121			modified by EGA for
101A	12.1	12.1	0.502	0.509			design of Thurlow
101B	17.0	17.0	0.659	0.656			detention pond.
102	20.4	24.5	0.882	1.073			
105	26.0	17.0	1.183	0.816			
108	19.3		0.600				
108+109A		23.9		0.925			
105E		11.1		0.541			
110	28.6	18.2	0.880	0.721			
120		3.3		0.369			
Total area	451.6	455.3					
Pond Inflow			4.327	4.939	53478	57923	
Pond storage					15706	23001	
Pond Outflow			1.445	1.186			
City of Belleville							
122N		2.816		0.177			Not included previously
122S		2.797		0.178			Previously part of 112
121		4.262		0.269			Previously part of 111
111	17.25	7.404	0.625	0.527			With 121 & 123 = 16.46
123	0.00	3.213	0.000	0.224			Previously part of 111
119	8.30	0.390	0.356	0.022			Drains to N.Front St.
112	20.40	17.698	1.035	0.685			Previously included 122S
115	8.10	5.896	0.859	0.528			Part flows east to N.Front
114	9.10	7.160	0.331	0.373			
125	0.00	5.510	0.000	0.300			Previously part of 113
113	7.90	2.780	0.286	0.202			
Total to forebay			4.069	3.208			
Forebay storage						890	
Forebay outflow				3.092			
116	3.60	2.162	0.177	0.140			Length reduced from 75m to 20m
Main pond		1.452		0.141			
Total to Main pond			4.246	3.373			
Pond storage					7390	8092	Preliminary design in 1998
Outflow to Tracy St.			3.63	2.797			
Total area	74.65	63.540					

Figure 1: Comparison of 1988 and 1995 Runoff Analysis

City of Belleville **Upper No-Name Creek** **Feb. 10 - 1998**

Estimation of Grade Parameters for Modelling of Parking Lot Storage
Area 112 Quinte Mall

This file: **\\aas\C:\MidussProj\Quinte\ParkVols1.xls**

This spreadsheet shows a typical example of estimation of the major and minor grades describing the available storage at an existing or planned catch basin.
For each CB the digital grading plan provides the area of the maximum water surface defined by either a maximum depth of 0.3 m or as dictated by the adjacent low point.
From an approximate aspect ratio of the ponded surface area, the major and minor radius of an equivalent ellipse is calculated.
From these radii the corresponding major and minor surface gradients are obtained which are used as input to the MIDUSS 98 model.

CB Pond #	C.B.No.	Rim Elev. m	Depth m	Top Elev. m	Ponding Area hectare	Aspect ratio #	Major radius R1 m	Minor radius R2 m	Grade g1H:1V %	Grade g2H:1V %
1	DCB1	96.19	0.30	96.49	0.07	2	21	11	70	35
2	DCB2	94.12	0.30	94.42	0.08	1.4	19	13	63	45
3	DCB27	94.20	0.30	94.50	0.17	1.4	28	20	92	66
4	DCB23	94.09	0.30	94.39	0.13	1	20	20	68	68
5	CB24	94.14	0.30	94.44	0.12	1.5	24	16	80	53
6	CB22	93.90	0.15	94.05	0.08	1.5	20	13	130	87
7	DCB27	93.91	0.10	94.01	0.09	1.3	19	15	193	148
8	DCB21	93.95	0.15	94.10	0.22	1	26	26	176	176
9	DCB20	93.82	0.20	94.02	0.22	1.3	30	23	151	116
10	DCB28	93.56	0.20	93.76	0.07	1.5	18	12	91	61
11	DCB5	94.22	0.20	94.42	0.05	1.6	16	10	80	50
12	DCB8	93.62	0.30	93.92	0.05	1.5	15	10	52	34
13	DCB9	93.59	0.30	93.89	0.09	1.6	21	13	71	45
14	DCB12	93.59	0.30	93.89	0.16	1.1	24	22	79	72
15	DCB15	93.81	0.30	94.11	0.22	1.3	30	23	101	77
16	DCB14	93.45	0.30	93.75	0.06	1.1	14	13	48	44

Figure 3: Estimation of Grade Parameters for Modelling of Parking Lot Storage

City of Belleville **Feb-12-1998**

No-Name Creek

Estimation of Runoff Coefficient **File:** **\\alan\c:\MidussProjects\Belleville\RunoffC7.xls**

This spreadsheet estimates the runoff coefficient in terms of peak runoff compared to the maximum possible runoff for an impervious area of the same size subject to the peak rainfall intensity for the storm.

The 100-yr storm used is 67.3 mm over 6 hours using the SCS-6 hour distribution using time steps of 15 minutes. For this event the peak intensity is 45.786 mm/hr.

The peak outflow from a sub-catchment is based on the runoff from rooftop, parking area and the balance of the subcatchment attenuated by the on-site control measures. These peak runoff values are obtained from the MIDUSS 98 modelling of each sub-area.

Peak rainfall 45.786 mm/h 0.012718 mm/sec 0.12718 c.m/s/ha

Area	Owner/ Occupier	Area (ha)	Impervious (%)	Peak Outflow Actual (c.m/s)	Peak Outflow Theoretical (c.m/s)	Runoff Coeff.
122	MTO	5.613	21.0%	0.355	0.714	0.497
121	Cambridge	4.262	68.4%	0.269	0.542	0.496
119	Shell	0.39	100.0%	0.022	0.050	0.444
112	Quinte	17.698	96.3%	0.685	2.251	0.304
115	Loebs	2.423	90.0%	0.141	0.308	0.458
127	CTC(1)	2.46	88.0%	0.181	0.313	0.579
128	CTC(2)	1.013	88.0%	0.071	0.129	0.551
114	Zellers	7.16	90.6%	0.373	0.911	0.410
123	Bradlaw	3.213	90.0%	0.224	0.409	0.548
111	Quickert et al	7.404	90.1%	0.527	0.942	0.560
113	Loblaws	2.78	84.2%	0.202	0.354	0.571
125	Hawley	5.51	90.0%	0.300	0.701	0.428
116	Hawley (res)	2.162	25.0%	0.140	0.275	0.509
129	Pond	1.452	62.0%	0.141	0.185	0.764

Figure 4: Estimation of Peak Runoff Coefficients

City of Belleville **Upper No-Name Creek**
Calculation of Proposed Thurlow Pond Volume

Oct. 30 1997

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Areas and perimeters scaled from EGA drawing 1077-17-02

This spreadsheet is used to estimate the available dynamic volume in the proposed Thurlow pond based on the design prepared by EGA.
The calculation also determines the aspect ratio parameter R and equivalent side slope which is used in the MIDUSS98 Pond command to represent the pond as an equivalent single-cell rectangular pond . The aspect ratio R is related to the area A and perimeter P of a rectangle by the relation:

$$f(R) = 4R + 4/R + 8 = P^2/A$$

The spreadsheet also compares the results of treating the pond as three separate cells (as proposed) or as an equivalent single cell for simplicity of modelling.
It is assumed that for elevations above the permanent storage the levels in all three cells are equal at any time during the period of runoff.

Aspect ratio R f(R) = 4R + 4/R + 8 = P^2/A

Measured quantities:

Pond	Area (94.6)	Perim (94.6)	P^2/A	R	f(R)
West	6873.38	344.3	17.247	1.737	17.251
Centre	9851.38	475.6	22.961	3.450	22.959
East	3274.43	238.5	17.372	1.781	17.370
Total	19999.19	1058.4	56.013	11.9193	56.013

Treat as Single pond

Sslope	Elev	dX, dY	Area	R	X	Y	Volume	EGA vol
1.79	94.6		19999.19	11.919	488.238	40.962		
	95.1	1.79	20949.66		490.028	42.752		
	95.6	3.58	21906.54		491.818	44.542	**20950.73**	**21111**

Treat as three separate ponds

Sslope	Elev	dX, dY	Area	R	X	Y	Volume	EGA vol
West pond								
2.069	94.6		6873.38	1.737	109.266	62.905		
	95.1	2.069	7233.88		111.335	64.974		
	95.6	4.138	7602.95		113.404	67.043	7235.31	
Centre pond								
2.069	94.6		9851.38	3.45	184.356	53.437		
	95.1	2.069	10347.65		186.425	55.506		
	95.6	4.138	10852.49		188.494	57.575	10349.08	
East pond								
2.069	94.6		3274.43	1.781	76.366	42.878		
	95.1	2.069	3525.43		78.435	44.947		
	95.6	4.138	3784.99		80.504	47.016	3526.85	
					Total volume		**21111.24**	**21111**

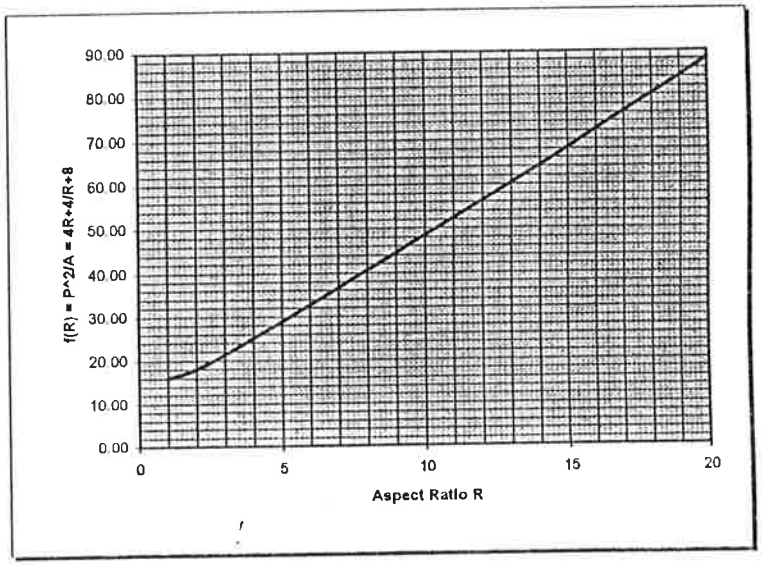

Figure 5: Calculation of Available Dynamic Storage in Proposed Thurlow Pond

City of Belleville **Upper No-Name Creek** **Nov-10-1997**

Thurlow Wetland Facility
Comparison of EGA and Weslake Analysis

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ID no.	Area	Imperv		Total imperv	Total area	EGA Analysis Local Qp	EGA Analysis Total Qp	EGA Analysis Vol	On-site storage	Weslake Analysis Local Qp	Weslake Analysis Total Qp	Weslake Analysis Vol	On-site storage	Note
	ha	%	ha	ha	ha	c.m/s	c.m/s	cub.m	cub.m	c.m/s	c.m/s	cub.m	cub.m	
100C	45.2	2%	0.904	0.904	45.20	0.122				0.121				
100A,B	283	3%	8.490	9.394	328.20	0.488	0.488	4215		0.638	0.657	30350		1
101A	12.1	28%	3.388	12.782	340.30	0.502				0.509				
101B	17	9%	1.530	14.312	357.30	0.659	1.142	9842		0.656	1.134	35884		
102	24.5	28%	6.860	21.172	381.80	1.060	1.970	11804		1.073	1.957			
105	17	28%	4.760	25.932	398.80	0.808	2.664	15905		0.816	2.653	33857		
Commercial area 108														
1081	7.9	100%	7.900			0.94			3187	0.993			3579	2
						0.111				0.129				
1082	10.97	70%	7.679			0.979			905	0.990			585	3
						0.44				0.557				
1083	5.07	35%	1.775			0.284				0.287				
108	23.94		17.354	43.286	442.09	0.782	3.425	24752		0.925	3.552	45250		
New tributary														
105E	11.14	28%	3.119	46.405	453.23	0.536				0.541				
Commercial area 110														
1101	5.993	100%	5.993			0.713			2415	0.753			2717	2
						0.085				0.098				
1102	8.32	70%	5.824			0.742			684	0.751			402	3
						0.334				0.444				
1103	3.84	35%	1.344			0.215				0.218				
110	18.15		13.161	59.566	471.38	0.594	4.493			0.721	4.738			
Pond area														
120	3.31	90%	2.979	62.545	474.69	0.365	4.688			0.369	4.938	58374		
									22199				23000	4
Wetland							1.366					1.186		

Note 1: Main difference in estimate of hydrograph volume is because EGA outflow hydrograph base has not been extended to allow for the very slow runoff from areas 100A and B. This was first estimated in the 1995 G&S report and subsequently in the Weslake report. The delayed flow makes little difference to the peak flows or to the performance of the pond at the 401.

Note 2: For rooftop storage the roofs were assumed to be dead flat. In the current analysis a very slight difference in roofslope was used and also the number of roofdrains may be slightly different than used by EGA.

Note 3: The estimate of parking lot storage used by EGA assumes a concentrated storage area. The current analysis assumes a number of separate catchbasins with distributed storage around each CB.

Note 4: The Head-Discharge-Volume Table 2.3 in the EGA report (page 10) implies a surface area at 94.6 of less than 16,950 sq.m. Scaling of the drawing shows the actual surface area at 94.6 to be very close to 20,000 sq.m. This gives greater reduction of the flood peak from the EGA estimate.

Figure 6: Thurlow Wetland Facility - Comparison of EGA and Weslake Analyses

Belleville **Job 1333** **Feb-10-1998**

Estimate volume of permanent storage for quality treatment

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Area #	Owner	Area (ha)	Imperv. (%)	Imperv (ha)	Rooftop (ha)	Net (ha)
1221	MTO (401)	2.816	20.3%	0.572		2.816
1222	MTO(401)	2.797	21.7%	0.607		2.797
121	Cambridge	4.262	68.4%	2.915	0.328	3.934
119	N.Front	0.39	100.0%	0.390		0.390
112	Quinte	17.698	96.3%	17.043	4.582	13.116
115	Loebs	2.423	90.0%	2.181	0.454	1.969
127	Can.Tire	3.473	88.0%	3.056	0.769	2.704
114	Zellers	7.16	90.6%	6.487	2.6	4.560
123	Bradlaw	3.213	90.0%	2.892	1.06	2.153
111	Quickart	7.404	90.1%	6.671	2.221	5.183
113	Loblaws	2.78	84.2%	2.341	0.4	2.380
125	Hawley	5.51	90.0%	4.959	1.653	3.857
116	Hawley(res)	2.162	25.0%	0.541		2.162
129	Pond	1.452	62.0%	0.900		1.452
		63.54	81.1%	51.554	14.067	49.473

Total pervious & impervious area for quality		**49.473**	**ha**
Exceptions:			
Wetland	1.302		ha
Sediment forebay	0.090		ha
Main pond	0.900		ha
		2.292	ha
Net area for quality treatment		**47.181**	**ha**
For %imperv > 80%			
Volume per hectare	210		
Extended detention allowance	40		
Net vol./ha		170	c.m/ha
Volume of permanent storage		**8021**	**c.m**

Figure 7: Estimation of Required Quality Storage for Belleville Facility

Belleville Job: 1333

Upper No-Name Creek

Feb-11-1998

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Estimate permanent storage in Main Pond.

The proposed Main pond will contain three cells formed by submerged berms with 2H:1V side slopes and formed with a top elevation of approximately 90.6m - eg 0.3 m below the proposed permanent water elevation of 90.9m.
This spread-sheet estimates the stage-storage values for the permanent storage.
Side slope will be 2H:1V from the pond invert to 90.3m above which the slope will flatten to 5H:1V which provides a horizontal distance of 3.0 m above and below the permanent WL for safety.

The Table below shows a calculation of volume for each of the three cells plus the total of these three cells and a "lumped" calculation for an equivalent single cell.
The latter has a high aspect ratio to reflect the relatively high perimeter when the surface area is divided into three discrete cells.
The aspect ratio R is computed from the equation:
f(R) = 4.R + 4/R + 8 = P^2/A (source AAS)
The sideslope below 90.3 is 2H:1V and above 90.3 it flattens to 5H:1V.
The calculation starts from 89.0 merely to establish the areas and perimeters at the proposed new bottom elevation at which level the volume is set to zero and accumulated from that level.
Extra volume above the top of the berms (assumed to be 90.6) is ignored.

Pond invert level 89.75 m dy= 0.05 m

	1	2	3	Sum	
Cell					
Base area A	1450	3698	850	5998	Area scaled
Base perimeter P	160	260	117	537	Perimeter scaled
P^2/A	17.66	18.28	16.10	48.08	
Aspect ratio R	1.883	2.092	1.175	9.919	Length/Width
f(R)=4R+4/R+8	17.66	18.28	16.10	48.08	

Elev	Area	X	Y	R	Vol	Area	X	Y	R	Vol	Area	X	Y	R	Vol	Tot.Vol	Area	X	Y	R	Vol	
89.00	1450.0	52.25	27.75	1.883	0.0	3698.0	87.96	42.04	2.092	0.0	850.0	31.60	26.90	1.175	0.0	0.0	5998.0	243.91	24.59	9.919	0.0	Start 2H:1V sideslope
89.05	1466.0	52.45	27.95	1.877	72.9	3724.0	88.16	42.24	2.087	185.6	861.7	31.80	27.10	1.174	42.8	301.2	6051.7	244.11	24.79	9.847	301.2	
89.10	1482.2	52.65	28.15	1.870	146.6	3750.2	88.36	42.44	2.082	372.4	873.6	32.00	27.30	1.172	86.2	605.2	6105.6	244.31	24.99	9.776	605.2	
89.15	1498.4	52.85	28.35	1.864	221.1	3776.4	88.56	42.64	2.077	560.6	885.5	32.20	27.50	1.171	130.2	911.8	6159.5	244.51	25.19	9.707	911.8	
89.20	1514.6	53.05	28.55	1.858	296.4	3802.6	88.76	42.84	2.072	750.0	897.4	32.40	27.70	1.170	174.7	1221.2	6213.4	244.71	25.39	9.638	1221.1	
89.25	1531.0	53.25	28.75	1.852	372.6	3829.0	88.96	43.04	2.067	940.8	909.5	32.60	27.90	1.169	219.9	1533.3	6267.5	244.91	25.59	9.570	1533.1	
89.30	1547.4	53.45	28.95	1.846	449.5	3855.4	89.16	43.24	2.062	1132.9	921.6	32.80	28.10	1.168	265.7	1848.2	6321.6	245.11	25.79	9.504	1847.9	
89.35	1564.0	53.65	29.15	1.841	527.3	3882.0	89.36	43.44	2.057	1326.4	933.9	33.00	28.30	1.166	312.1	2165.8	6375.9	245.31	25.99	9.439	2165.3	
89.40	1580.6	53.85	29.35	1.835	605.9	3908.6	89.56	43.64	2.052	1521.1	946.2	33.20	28.50	1.165	359.1	2486.2	6430.2	245.51	26.19	9.374	2485.5	
89.45	1597.2	54.05	29.55	1.829	685.4	3935.2	89.76	43.84	2.047	1717.2	958.5	33.40	28.70	1.164	406.7	2809.3	6484.5	245.71	26.39	9.311	2808.3	
89.50	1614.0	54.25	29.75	1.824	765.7	3962.0	89.96	44.04	2.042	1914.7	971.0	33.60	28.90	1.163	454.9	3135.3	6539.0	245.91	26.59	9.248	3133.9	
89.55	1630.8	54.45	29.95	1.818	846.8	3988.8	90.16	44.24	2.038	2113.4	983.5	33.80	29.10	1.162	503.8	3464.0	6593.6	246.11	26.79	9.187	3462.2	
89.60	1647.8	54.65	30.15	1.813	928.8	4015.8	90.36	44.44	2.033	2313.6	996.2	34.00	29.30	1.161	553.3	3795.6	6648.2	246.31	26.99	9.126	3793.3	
89.65	1664.8	54.85	30.35	1.807	1011.6	4042.8	90.56	44.64	2.028	2515.0	1008.9	34.20	29.50	1.160	603.4	4130.0	6702.9	246.51	27.19	9.066	4127.1	
89.70	1681.8	55.05	30.55	1.802	1095.2	4069.8	90.76	44.84	2.024	2717.8	1021.6	34.40	29.70	1.158	654.2	4467.2	6757.7	246.71	27.39	9.007	4463.6	
89.75	1699.0	55.25	30.75	1.797	1179.8	4097.0	90.96	45.04	2.019	2922.0	1034.5	34.6	29.9	1.157	705.6	4807.3	6812.5	246.91	27.59	8.949	4802.8	Volume saved
89.75	1699.0	55.25	30.75	1.797	0.0	4097.0	90.96	45.04	2.019	0.0	1034.5	34.60	29.90	1.157	0.0	0.0	6812.5	246.91	27.59	8.949	0.0	Restart volume
89.80	1716.2	55.45	30.95	1.792	85.4	4124.2	91.16	45.24	2.015	205.5	1047.4	34.80	30.10	1.156	52.0	343.0	6867.5	247.11	27.79	8.892	342.0	calculation
89.85	1733.6	55.65	31.15	1.787	171.6	4151.6	91.36	45.44	2.010	412.4	1060.5	35.00	30.30	1.155	104.7	688.8	6922.5	247.31	27.99	8.836	686.7	
89.90	1751.0	55.85	31.35	1.782	258.7	4179.0	91.56	45.64	2.006	620.7	1073.6	35.20	30.50	1.154	158.1	1037.5	6977.6	247.51	28.19	8.780	1034.2	
89.95	1768.4	56.05	31.55	1.777	346.7	4206.4	91.76	45.84	2.001	830.3	1086.7	35.40	30.70	1.153	212.1	1389.2	7032.8	247.71	28.39	8.725	1384.5	
90.00	1786.0	56.25	31.75	1.772	435.6	4234.0	91.96	46.04	1.997	1041.3	1100.0	35.60	30.90	1.152	266.8	1743.7	7088.0	247.91	28.59	8.671	1737.5	
90.05	1803.7	56.45	31.95	1.767	525.3	4261.6	92.16	46.24	1.993	1253.7	1113.3	35.80	31.10	1.151	322.1	2101.2	7143.4	248.11	28.79	8.618	2093.3	
90.10	1821.4	56.65	32.15	1.762	616.0	4289.4	92.36	46.44	1.989	1467.5	1126.8	36.00	31.30	1.150	378.1	2461.6	7198.8	248.31	28.99	8.565	2451.9	
90.15	1839.2	56.85	32.35	1.757	707.5	4317.2	92.56	46.64	1.984	1682.7	1140.3	36.20	31.50	1.149	434.8	2824.9	7254.3	248.51	29.19	8.514	2813.2	
90.20	1857.1	57.05	32.55	1.753	799.9	4345.0	92.76	46.84	1.980	1899.2	1153.8	36.40	31.70	1.148	492.1	3191.2	7309.9	248.71	29.39	8.462	3177.3	
90.25	1875.0	57.25	32.75	1.748	893.2	4373.0	92.96	47.04	1.976	2117.2	1167.5	36.60	31.90	1.148	550.2	3560.5	7365.5	248.91	29.59	8.412	3544.2	
90.30	1893.1	57.45	32.95	1.744	987.4	4401.0	93.16	47.24	1.972	2336.5	1181.2	36.80	32.10	1.147	608.9	3932.8	7421.3	249.11	29.79	8.362	3913.8	End 2H:1V sideslope
90.35	1938.5	57.95	33.45	1.733	1083.2	4471.5	93.66	47.74	1.962	2558.3	1215.9	37.30	32.60	1.144	668.8	4310.3	7561.0	249.61	30.29	8.241	4288.4	Start 5H:1V sideslope
90.40	1984.5	58.45	33.95	1.722	1181.2	4542.4	94.16	48.24	1.952	2783.7	1251.1	37.80	33.10	1.142	730.5	4695.4	7701.2	250.11	30.79	8.123	4670.0	
90.45	2030.9	58.95	34.45	1.711	1281.6	4613.9	94.66	48.74	1.942	3012.6	1286.8	38.30	33.60	1.140	793.9	5088.2	7841.9	250.61	31.29	8.009	5058.5	
90.50	2077.9	59.45	34.95	1.701	1384.3	4685.8	95.16	49.24	1.932	3245.1	1323.0	38.80	34.10	1.138	859.2	5488.6	7983.1	251.11	31.79	7.899	5454.2	
90.55	2125.3	59.95	35.45	1.691	1489.4	4758.3	95.66	49.74	1.923	3481.2	1359.7	39.30	34.60	1.136	926.3	5896.9	8124.8	251.61	32.29	7.792	5856.9	
90.60	2173.3	60.45	35.95	1.682	1596.9	4831.2	96.16	50.24	1.914	3720.9	1396.9	39.80	35.10	1.134	995.2	6313.0	8267.0	252.11	32.79	7.689	6266.6	
90.65	2221.7	60.95	36.45	1.672	1706.8	4904.7	96.66	50.74	1.905	3964.3	1434.6	40.30	35.60	1.132	1066.0	6737.0	8409.7	252.61	33.29	7.588	6683.6	
90.70	2270.7	61.45	36.95	1.663	1819.1	4978.6	97.16	51.24	1.896	4211.4	1472.8	40.80	36.10	1.130	1138.7	7169.1	8552.9	253.11	33.79	7.491	7107.6	
90.75	2320.1	61.95	37.45	1.654	1933.8	5053.1	97.66	51.74	1.887	4462.2	1511.5	41.30	36.60	1.129	1213.3	7609.3	8696.6	253.61	34.29	7.396	7538.9	
90.80	2370.1	62.45	37.95	1.646	2051.1	5128.0	98.16	52.24	1.879	4716.7	1550.7	41.80	37.10	1.127	1289.8	8057.6	8840.8	254.11	34.79	7.304	7977.3	
90.85	2420.5	62.95	38.45	1.637	2170.9	5203.5	98.66	52.74	1.870	4975.0	1590.4	42.30	37.60	1.125	1368.3	8514.2	8985.5	254.61	35.29	7.215	8423.0	
90.90	2471.5	63.45	38.95	1.629	2293.2	5279.4	99.16	53.24	1.862	5237.1	1630.6	42.80	38.10	1.124	1448.9	8979.1	9130.7	255.11	35.79	7.128	8875.9	

Figure 8: Estimate Permanent Storage in Main Pond

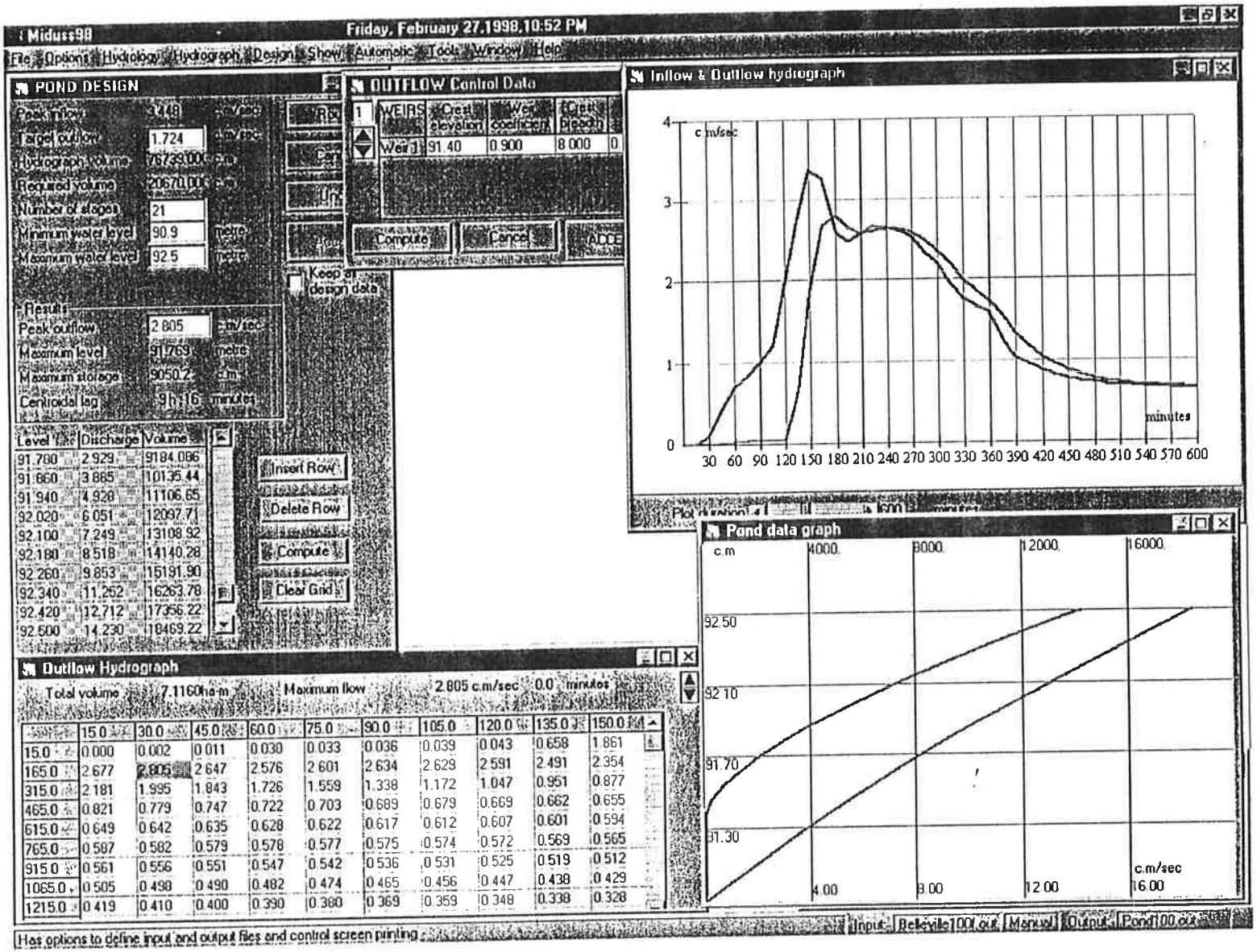

Figure 9 **Routing the Quantity storm hydrograph through the Main Pond.**

City of Belleville: Upper No-Name Creek Feb-7-98

Stage-Discharge for Tracy St. Storm Sewer

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Assume:	Diameter	1.524	m	(5 ft)
	Slope	0.237	%	average from Lemoine to North Front
	Manning	0.013		
	M	1		Manning eq. coefficient
	gravity	9.81	m/s/s	
	IL	90.4	m	at existing entrance

This spreadsheet is intended to provide a link between the top water level in and the discharge from the Main Pond (at Tracy & Lemoine) and the stage discharge relationship of the tracy St. storm trunk sewer.

For any depth of flow in the storm sewer the normal (uniform flow) discharge and the corresponding energy level in the pipe are shown. The pond design and specifically the sil elevation of the diversion weir at the main pond should be such that the top water level in the pond should be not less than the energy level in the pipe otherwise backwater effects will drown out the level in the pond.

dy= 0.05

Depth y	WL	phi rad.	Area sq.m	Perimeter m	Hyd.Rad. m	Q0 c.m/s	Vel m/s	v2/2g m	E m
0.05	90.45	0.72854	0.01822	0.55515	0.03282	0.00699	0.3839	0.007511	90.458
0.10	90.50	1.03618	0.05101	0.78957	0.06461	0.03076	0.6030	0.018531	90.519
0.15	90.55	1.27647	0.09275	0.97267	0.09536	0.07249	0.7816	0.031138	90.581
0.20	90.60	1.48277	0.14128	1.12987	0.12504	0.13230	0.9364	0.044694	90.645
0.25	90.65	1.66801	0.19531	1.27102	0.15366	0.20983	1.0743	0.058828	90.709
0.30	90.70	1.83880	0.25388	1.40116	0.18120	0.30444	1.1991	0.073287	90.773
0.35	90.75	1.99910	0.31628	1.52331	0.20763	0.41530	1.3131	0.087878	90.838
0.40	90.80	2.15152	0.38190	1.63945	0.23295	0.54144	1.4178	0.102447	90.902
0.45	90.85	2.29789	0.45023	1.75099	0.25713	0.68175	1.5142	0.116867	90.967
0.50	90.90	2.43960	0.52080	1.85898	0.28015	0.83502	1.6033	0.131026	91.031
0.55	90.95	2.57772	0.59320	1.96422	0.30200	0.99994	1.6857	0.144826	91.095
0.60	91.00	2.71313	0.66706	2.06740	0.32266	1.17513	1.7617	0.158179	91.158
0.65	91.05	2.84656	0.74200	2.16908	0.34208	1.35911	1.8317	0.171002	91.221
0.70	91.10	2.97868	0.81769	2.26976	0.36025	1.55034	1.8960	0.183221	91.283
0.75	91.15	3.11010	0.89379	2.36989	0.37714	1.74717	1.9548	0.194761	91.345
0.80	91.20	3.24137	0.96996	2.46993	0.39271	1.94790	2.0082	0.205553	91.406
0.85	91.25	3.37308	1.04589	2.57029	0.40691	2.15072	2.0564	0.215526	91.466
0.90	91.30	3.50581	1.12123	2.67143	0.41971	2.35375	2.0993	0.224611	91.525
0.95	91.35	3.64018	1.19565	2.77382	0.43105	2.55498	2.1369	0.232737	91.583
1.00	91.40	3.77689	1.26880	2.87799	0.44086	2.75228	2.1692	0.239828	91.640
1.05	91.45	3.91676	1.34030	2.98457	0.44908	2.94338	2.1961	0.245804	91.696
1.10	91.50	4.06075	1.40976	3.09429	0.45560	3.12582	2.2173	0.250576	91.751
1.15	91.55	4.21007	1.47673	3.20807	0.46032	3.29690	2.2326	0.254043	91.804
1.20	91.60	4.36632	1.54075	3.32714	0.46309	3.45358	2.2415	0.256081	91.856
1.25	91.65	4.53168	1.60124	3.45314	0.46371	3.59238	2.2435	0.256539	91.907
1.30	91.70	4.70936	1.65755	3.58854	0.46190	3.70907	2.2377	0.255209	91.955
1.35	91.75	4.90447	1.70886	3.73720	0.45726	3.79818	2.2226	0.251792	92.002
1.40	91.80	5.12614	1.75405	3.90612	0.44905	3.85188	2.1960	0.245788	92.046
1.45	91.85	5.39447	1.79150	4.11059	0.43583	3.85647	2.1526	0.236182	92.086
1.50	91.90	5.77989	1.81806	4.40428	0.41279	3.77450	2.0761	0.219688	92.120

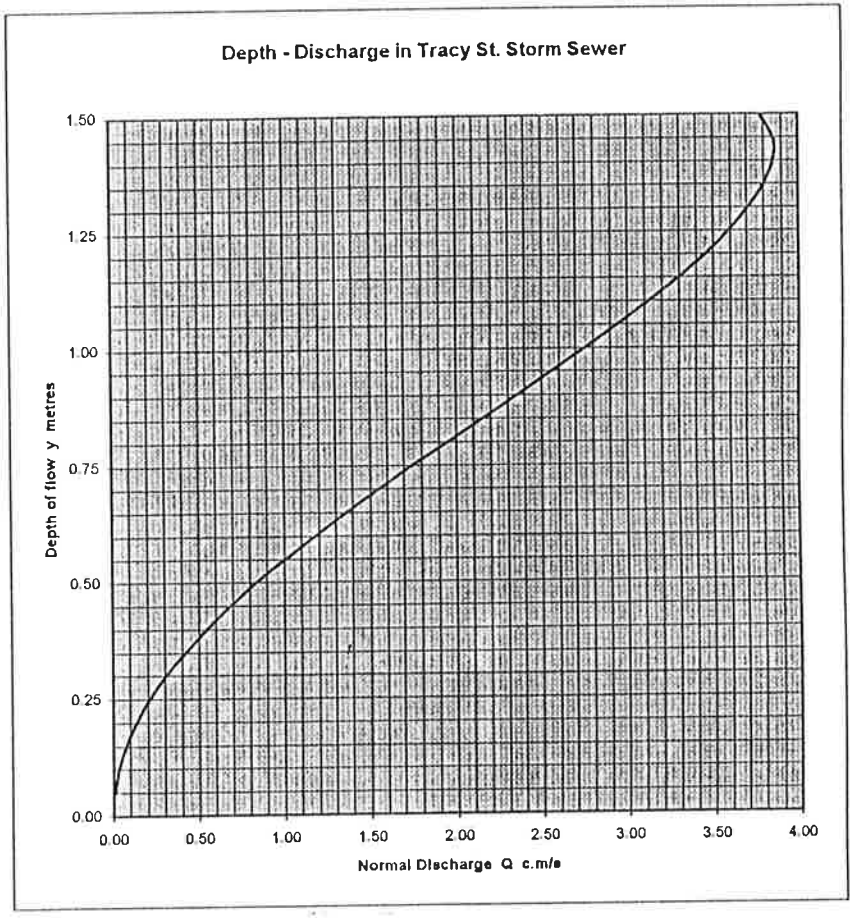

Figure 10: Stage-Discharge for Tracy St. Storm Sewer

APPENDIX "D"

Extract from Geotechnical Report
(Golder Associates – June, 1995)

APPENDIX "D"

This appendix contains brief excerpts from the report "Stormwater Management Facility Study and Best Management Practices" prepared by Golder Associates Ltd. in June 1995.

Golder Associates Ltd.

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REPORT ON

STORMWATER MANAGEMENT FACILITY STUDY AND BEST MANAGEMENT PRACTICES IMPLEMENTATION IN CONNECTION WITH PROPOSED ZELLER'S STORE BELL BOULEVARD BELLEVILLE, ONTARIO

Submitted to:

Weslake Inc.
10-120 Lancing Drive
Hamilton, Ontario
L8W 3A1

Distribution:

4 copies	-	Weslake Inc.
2 copies	-	Golder Associates Ltd.

June, 1995

951-8014A

Golder Associates Ltd.

100 Scotia Court
Whitby, Ontario, Canada L1N 8Y6
Telephone (905) 723-2727
Fax (905) 723-2182

Golder Associates

June 28, 1995

951-8014A

Weslake Inc.
10-120 Lancing Drive
Hamilton, Ontario
L8W 3A1

Attention: Mr. Tai Bui,P.Eng.

RE: STORMWATER MANAGEMENT FACILITY STUDY
AND BEST MANAGEMENT PRACTICES IMPLEMENTATION IN CONNECTION WITH PROPOSED ZELLER'S STORE
BELL BOULEVARD
BELLEVILLE, ONTARIO

Dear Sirs:

This report presents the results of the above referenced studies carried out along and in the vicinity of Upper No Name Creek and Lemoine Street in the City of Belleville as shown on the Key Plan, Figure 1. The purpose of the investigation was to determine the subsurface soil, bedrock and shallow groundwater conditions at the site by means of a limited number of shallow test pits, and based on our interpretation of the subsurface data, to address the issues described as Tasks 1 and 2 in the March 13, 1995 request for proposal from Weslake Inc. (Ref: File No. 1231) relating to the proposed Stormwater Management Facility and the feasibility of Best Management Practices Implementation in connection with the overall development of a Zeller's Store and related developments. Authorization to proceed with these studies was received by us in a fax transmittal from Weslake Inc. on May 4, 1995 with attached authorization forms signed on behalf of The Citation Group and The Hawley-Ming Group.

This report presents the studies described as Tasks 1 and 2 and was issued in draft for comment on June 16, 1995. The results of Task 3, relating to the geotechnical design aspects of the proposed development were presented in a separate report (Golder Associates Ltd. report No. 951-8014) dated June 5, 1995.

TABLE OF CONTENTS

The factual data, interpretations and recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location or elevation, or if the project is not initiated within eighteen months of the date of the report, Golder Associates Ltd. should be given an opportunity to confirm that the recommendations are still valid.

SITE DESCRIPTION AND GEOLOGY

The site under investigation comprises essentially three parcels of land which are shown on the Location Plan, Figure 2. These are described as follows:

Storm Water Management Channel

The main storm sewer management channel easement which corresponds to the Lemoine Street right-of-way, extends for some 570 m from 140 m south of Hwy 401, as shown on Figure 2. This easement currently has a drainage channel, typically 2 m deep, running most of its length. At the time of the investigation (May 1995) the channel contained about 0.3 m of water. Sewer manholes were noted on the west side of the channel. A 450 mm diameter sanitary sewer which is located along this alignment is to be relocated. The area is vegetated with low scrub brush and grasses

White Rose Property

The second area which was included in the investigation comprised a parcel of land on the north side of Bell Boulevard and on the west side of the Lemoine Street R.O.W. (see Figure 2). This site some 200 by 100 m in area is covered with dense mixed conifer and deciduous bush interspersed with scrub brush. It is understood that this site is proposed for commercial development.

Cell #3

An area some 100 m by 90 m and located on the south side of the hydro easement and west of the Lemoine Street R.O.W., is proposed for development as Cell #3 as part of the overall storm water management scheme. This site is relatively flat and is grass covered.

The sites lie in the physiographic region of Southern Ontario known as the Napanee Plain. Physiographic mapping in the immediate vicinity of the site indicates a limestone plain (Map 2226, Chapman & Putnam, 1984), overlain by a shallow glacial till sheet. The limestone bedrock is of the Trenton Black River Group.

INVESTIGATION PROCEDURE

The field work for this investigation was carried out on May 11, 1995, when 13 test pits (numbered 101 to 113) were excavated at the approximate locations indicated on the Location Plan, Figure 2. The test pits were excavated using a Case 888 track mounted backhoe supplied and operated by a local contractor.

Chunk samples were taken from the major strata exposed in the test pits and groundwater seepage conditions were noted. The test pits were loosely backfilled upon completion of sampling. All of the soil samples obtained were brought to our Whitby laboratory for further examination and representative classification testing. During the excavation of the test pits, percolation tests were undertaken in representative sandy, gravelly materials, and Guelph Permeameter testing was undertaken in selected finer grained materials. Groundwater levels were measured in three monitoring wells installed as part of the geotechnical investigation undertaken on the adjacent property, and reported under separate cover. Groundwater levels were also noted several test pit locations.

The field work for this investigation was directed by a member of our engineering staff who also logged the test pits and cared for the samples obtained. Approximate ground surface elevations at the test pit locations were obtained by interpolation from undated 1:500 and 1:2000 scale site topographic plans supplied by Weslake Inc. This mapping did not extend to the proposed Cell #3 location, thus elevations of test pits in this area were assumed based on nearby topography. It is understood that these elevations are referred to geodetic datum.

TASK 2: STORMWATER MANAGEMENT FACILITIES

This section of the report provides engineering information for the geotechnical and hydrogeotechnical design aspects of the project based on our interpretation of the test pit information and on our understanding of the project requirements. The information in this portion of the report is provided for the guidance of the design engineers. Where comments are made on construction, they are provided only in order to highlight aspects of construction which could affect the design of the project. Contractors bidding on or undertaking any work at the site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing and the like. Of particular importance is the confirmation of groundwater elevations across the site, prior to final design and construction. The groundwater elevations determined during this investigation were established in mid May, at a time when near maximum groundwater elevations are expected to occur. However, slightly higher elevations may occur during the peak of spring runoff during April each year, and lower elevations are expected in late summer, early fall, and mid winter. Further, the elevations were estimated based on small scale topographic mapping.

Our professional services for this assignment address only the geotechnical (physical) aspects of the subsurface conditions at the site. The geo-environmental (chemical) aspects, including the consequences of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this report and have not been investigated or addressed.

PROJECT DESCRIPTION

It is understood that the existing storm water drainage channel running north to south just outside the west limit of the Zeller's site is to be upgraded. The upgrading will involve increasing its capacity by increasing its cross section and incorporating a sediment settling pond (Cell #2) near its south end and by providing a storm water storage pond at the south end.

Since the new channel invert will be deeper, the existing 450 mm diameter sanitary sewer line will have to be relocated to the east.

Conveyance Channel

It would appear that the proposed conveyance channel, which extends from the north boundary of the Bradlaw Property to Bell Boulevard, is at approximately the same invert as the existing drainage channel. Assuming the invert in this section does not fall below about elevation 92.00 m, bedrock should not be encountered. The base and sides of the channel are likely to be in clayey silt till or sandy silt till. Occasional sand layers may be encountered. Above the permanent water table side slopes of 3 horizontal to 1 vertical should be used. Below the permanent water table side slopes of 4 horizontal to 1 vertical are recommended. Where a rock filled gabion basket is used to protect the bank, needle-punched, non-woven geotextile fabric should be used as a separation medium between the native fine grained soils and the gabion basket, both below and behind the basket.

To reduce the potential for migration of fines and for erosion, protection should be placed on the exposed faces and base of the open channel. Where the channel will only have to accommodate occasional storm water flows, grass and vegetation should be adequate. Where faster and more continuous flows are anticipated proper filters and rip rap or gabion mats or other proprietary system should be provided. Where water bearing fine sand or silt seams are intersected, the side slopes may need to be flattened locally, and a geotextile and granular protective blanket installed to prevent ongoing washouts and loss of fines.

Cell # 2

The storm water channel is to incorporate a two-stage sediment settling pond, designated as Cell #2. On the upstream side is a sediment forebay with a design base elevation at 90.00 m. Downstream is a permanent pool with a design base elevation of 89.00 m.

Based on the limited test pit information in the area of the proposed sediment forebay, bedrock surface elevations are likely to be in the range of 89 to 90 m. However it slopes upwards towards

the south and thus some provision for rock removal should be made towards the south end of the sediment pond.

In the proposed area for the permanent pool, bedrock is likely to be above the design elevation of 89.0 m throughout the entire length. Based on the information from Borehole 11, bedrock near the south end of the permanent pool may be at elevation 92 m or higher. Thus provision for significant rock removal by blasting should be made to complete the permanent pool to the design base level. Groundwater levels in this area are relatively high and probably close to elevation 91 m. A detailed description of the implications of the facilities on groundwater resources appears below.

For the portions of these ponds which are in bedrock, essentially vertical sides can be used. Within the tills and below the water table, side slopes of 4 horizontal to 1 vertical are recommended. Above the permanent water table, side slopes of 3 horizontal to 1 vertical should be adequate.

Where rock filled gabion baskets are used on the side slopes, the long term stability of the gabion system against overturning should be confirmed. The limestone bedrock and undisturbed native till will provide suitable foundation support for a gabion protective wall. As noted above, to prevent loss of fines from the native soils, a geotextile separation layer should be provided directly behind and below the gabion baskets. To reduce the potential for instability as a result of rapid drawdown conditions, the gabion wall should be backfilled (directly against the geotextile) with a free draining material such as a clean Granular B. The free draining backfill should extend for at least a width of 0.5 m.

Cell # 3

It is understood that a stormwater pond is proposed to be constructed at the south end of the site (south side of the hydro easement). Test Pits 112 and 113 were completed in this area. Based on the results of these test pits, the subsurface soil conditions consist of a thin layer of clayey silt till or sandy silt till underlying the topsoil. Bedrock was encountered at between 0.8 and 1.3 m below the existing ground surface. While we do not have accurate topographic information for this area of the site, based on nearby contours we estimate the bedrock surface elevations to be in the range of 91 to 92 m. While the design base elevation for the stormwater pond is not indicated, it is likely

that rock removal will be needed to complete it. As noted in Test Pit 113, almost 0.4 m of rock was penetrated with a conventional backhoe. Beyond this depth, controlled blasting would be needed. The excavated clayey silt tills and sandy silt tills excavated from above the water table at the site will be suitable for reuse as berm construction material. Where these materials are removed from below the water table, some drying prior to placement and compaction may be required. Rock removed by conventional excavation or blasting may be reused on site as general fill. Since it will be relatively permeable, it would not be suitable for the construction of berms where some water confining capability will be needed. Selected portions of it may be suitable for filling gabion baskets.

The following information is provided for the geotechnical design aspects of the stormwater pond (Cell #3).

- Pond side slopes above the permanent water level should be no steeper than 3 horizontal to 1 vertical (3:1); side slopes below the water level should be 4:1 or flatter. In bedrock, vertical side slopes may be used.

- Berms around the pond should have a top width of at least 3 m to allow access by maintenance vehicles. The top of the berms should be at least 1 m above the maximum anticipated water level.

- Since the pond invert is likely to be below the local water table indicated during the field investigation, it is expected that there could be some net infiltration into the pond. This should be taken into account in sizing the pond.

- Because of the variability of the rock quality at the site, it may be prudent to arrange for a "public digging" prior to tendering to allow prospective bidders to assess their method of construction for rock removal and to assess groundwater seepage conditions at the time of the work.

- The cut side slopes of the pond should be inspected by the geotechnical engineer during construction. Where erodible seams (eg. sand or silt seams) are encountered, some form of

blanketing, flattening of the slope angles or the like would be required. The need for and design of any blanketing or other remedial measures should be determined during construction by the geotechnical engineer.

- The pond must be equipped with an emergency spillway or similar structure(s), designed to eliminate the possibility of over-topping of the berms and maintain at least 0.5 m of free board.

- Where pipes enter or exit the pond, they should be encased in concrete and the backfill over the pipe, which forms the pond face, should consist of relatively impermeable material (ie. clayey material) to minimize preferential flow through the pipe bedding and backfill and possible loss of ground. Pipes entering or exiting the pond should be sized and designed to allow for cleaning. Any exposed ends should be provided with a protective wire mesh or the like to prevent unauthorized access (eg. by children).

- Regular inspection by the geotechnical engineer should be carried out during the pond construction. The final pond side slopes should be sodded or otherwise treated to reduce erosion. Maintenance will be required over the first several years until the vegetative mat has taken root.

POTENTIAL IMPACT ON SURFACE WATER AND GROUNDWATER RESOURCES

Groundwater

The water table in the site vicinity was encountered in the boreholes and test pits installed as part of the site investigation. The stabilized water table elevations as measured in mid May, 1995 appear to decline from a high of about 92.9 m immediately south of Highway 401, to approximately 90.5 m at the location of proposed Cell #3 of the stormwater management facility. These elevations are likely to represent near seasonal maxima, although it is possible that slightly higher water table elevations could be encountered during the peak of spring runoff conditions in April of each year.

Based upon a review of Weslake Inc. Drawing No. 4, entitled "Overall Profile Plan, Option No. 2", the following observations are made regarding the potential impacts of the proposed facilities on the existing groundwater resources.

- No significant impact on groundwater resources is anticipated to occur within the portion of the proposed stormwater management facility which lies to the north of Cell #2, north of Bell Boulevard. No significant alteration to the existing gradient or invert elevations within the Upper No Name Creek bed are proposed.

- Within the vicinity of Cell #2, from Bell Boulevard to the Hydro right-of-way, the groundwater elevation declines from about 91.0 metres in the north to about 90.5 m in the south. The invert of the proposed Cell #2 structure is indicated on Weslake Inc. Figure 4 to be 90.0 m in the north and 89.0 m in the south. Therefore, the natural groundwater elevation in this area lies at an elevation between 1 and 1.5 metres above the proposed inverts of the cell. Based upon the proposed invert of the south outlet storm sewer section of approximately 91.3 m, it is unlikely, except for short periods during the peak of spring runoff, that natural groundwater will be discharged directly to the storm sewer. However, in the absence of a liner for Cell #2, it is probable that groundwater will infiltrate into Cell #2 to an elevation of between 90.5 and 91.0 m. The presence of groundwater within the Cell secondary forebay and permanent pool will significantly reduce the stormwater storage capacity of the proposed facility.

  In the event that water elevations within the Cell #2 structure are allowed to rise above an elevation of 90.5 to 92.3 m, a portion of the ponded water will infiltrate into the subsurface through the floor and sides of the forebay and permanent pool areas, unless a liner is provided. The radius away from the structure within which groundwater elevations would be raised depends primarily upon the permeability of the saturated soils. In the case of the sediment forebay, the saturated soils in contact with the base and sides are expected to be comprised of clayey silt glacial till. In the permanent pool area, the saturated material in contact with the base and sides is expected to be fractured limestone.

The maximum proposed water elevation in Cell #2 is 92.3 m, which could result in an imposed head of at least 1.3 to 1.8 metres above the local water table elevation. Therefore, retained surface water will recharge the saturated zone, causing a localized groundwater mounding effect. In the sediment forebay area, the saturated soils are clayey silt tills, with a permeability on the order of 10^{-7} cm/sec. As such, the mounding impact will only affect a lateral distance of less than 1 metre away from the limits of the forebay. The saturated permeability in that pond is likely less than the permeability of the sediment cake which may ultimately accumulate in the sediment forebay.

In the permanent pool area, the saturated material is likely to be weathered and fractured limestone, with a permeability on the order of 10^{-3} cm/sec. In this area, the mounding impact could have an affect on the water table for a lateral distance of up to 30 metres away from the limits of the pool.

- In the vicinity of Cell #3, although no cross-sections were provided, it is inferred based upon the identified storage capacity, that the cell will have to be on the order of 2 metres deep. It is also indicated on Weslake Inc. Drawing No. 3 that the maximum water elevation in Cell #3 would be on the order of 92.3 m. The natural water table elevation in mid May, 1995 in this area is interpreted to be approximately 90.5 m. Therefore, about 1.8 m of available storage exists above the natural water table or dead water storage level. This will constrain the available storage volume during the spring of the year. The seasonal low water table elevation has not been determined to date in this area, and it is therefore not possible to predict the maximum available storage above the water table in the proposed cell.

- In the vicinity of Cell #3, the saturated material which will form the base and sides of the proposed facility is expected to be weathered and fractured limestone, exhibiting a permeability on the order of 10^{-3} cm/sec. When the operating pond elevation is above the natural water table elevation, groundwater recharge and groundwater mounding will occur. The lateral distance of mounding effect beyond the limits of the cell is predicted to be on the order of 30 m.

- Given that groundwater recharge from the surface water management facility is predicted to occur when the operating level of the system is above the local groundwater elevation, the potential exists for groundwater quality impacts to occur. During the spring runoff period, when operating levels are expected to be maximized, the collected surface water may contain dissolved road salt components, and other contaminants. During the later spring and summer periods, fertilizers, herbicides and other commonly applied agricultural or gardening products may be present in the surface water runoff which reaches the system. There is always the potential for other released chemical products (gasoline, oil) to reach the system.

- Some existing houses are located just south of the site for Cell #3. Depending on the proximity of the completed pond to these houses, there is the potential for the locally raised water level to impact these houses. As a guide, if the houses are greater then 50 m from the outer perimeter of the pond than no noticeable impacts on groundwater levels should occur. However, this should be assessed following final design. It would also be prudent to carry out a preconstruction survey of all nearby residential and commercial buildings so that the validity of any subsequent claims (relating to groundwater or blasting damage) can be assessed.

Surface Water

It would appear that the Upper No Name Creek is the only existing active water course within the hydraulic area of influence (up to about 30 m) of the proposed surface water management facility. There are three identified minor wetland areas located in the upstream reaches of the Upper No Name Creek. The most significant wetland area south of Highway 401 flanks the banks of the natural watercourse which flows into the channelized portion of the creek. The other two identified minor wetlands lie to the east and west of the channelized section of the creek north of Bell Boulevard (see Figure 8). All of these wetland areas are located at a distance of greater than 30 m from the limits of the significant proposed structures, and therefore, no impact on these wetland areas is predicted to occur as a result of construction of the proposed facilities.

Within the upper reaches of the creek, above Bell Boulevard, no impact on water elevation or water quality is predicted to occur as a result of the proposed facilities, due to the fact that the maximum

proposed elevation of water in the sediment forebay section is 92.3 m, which is approximately 0.7 m lower than the existing creek bed invert, upstream of Bell Boulevard.

Sanitary Sewer Relocation

It is understood that the 450 mm diameter sanitary sewer may be relocated to the east. The proposed new alignment is not known at this time. Assuming it will be relocated to between its current location and Boreholes 1, 6 and 11 and assuming the inverts will be about the same as those of the existing sanitary sewer (about elevation 88.0 m), bedrock removal will definitely be required, with the amount of rock removal increasing towards the south. Based on the results of this investigation, the founding conditions for the sewer will generally consist of competent glacial till soils, or bedrock, both of which are considered suitable for the support of the sewer provided the integrity of the base can be maintained during construction. Some difficulty may be encountered excavating the very dense/hard glacial till and bedrock at some locations. Controlled blasting techniques will be required where inverts extend more than about 0.3 m into bedrock. Cobbles and boulders will be encountered throughout the tills. Groundwater control during excavation within the tills can probably be achieved by pumping from properly constructed and filtered sumps located within the excavations, if inflow is encountered.

It is anticipated that the sewer trench excavations will consist of conventional temporary open cuts with side slopes not steeper than 1 horizontal to 1 vertical. However, near vertical slopes are possible in sound bedrock, provided that the excavations are inspected by an engineer.

The bedding for the sewer should be compatible with the type and class of pipe, the surrounding subsoil and anticipated loading conditions. If granular bedding is deemed to be acceptable, then OPS Granular A material or 19 mm crusher run limestone should be used from at least 150 mm below invert to springline. From springline to 300 mm above the obvert of the pipe, sand cover could be used. All bedding and cover materials should be placed in maximum 150 mm loose lifts and uniformly compacted to at least 98 per cent of standard Proctor maximum dry density.

It is understood that to avoid the need to relocate the existing sanitary sewer, the capacity f the channel may be expanded by widening the cross-section rather than deepening it and by relocating Cell #2 away from the sewer line.

ASSESSMENT OF POTENTIAL IMPACTS ON SEWERS

Existing Storm Sewers

As discussed above, there is a likelihood that groundwater recharge, and localized groundwater mounding will occur within about 30 m of the permanent pool portion of Cell #2, and all of Cell #3. It is also probable that any existing storm sewers south of Bell Boulevard are located below the natural water table at least part of the year. Within 30 m of the two structures, the effect of localized groundwater mounding could increase the pressure head of groundwater above the storm sewers. Therefore, if the storm sewers are currently leaking (accepting additional flow due to infiltrating groundwater), the volume of infiltration will increase in proportion to the increase in groundwater head. However, if the sewers are not currently leaking, the increase in groundwater head is unlikely to cause structural damage to the sewer pipes resulting in failure or seepage.

Sanitary Sewer Relocation

We understand that the existing sanitary sewer may be relocated to some point to the east of the stormwater management facility. The invert of the sewer is to be on the order of 6 m below grade. As such, it is likely to be constructed entirely below the water table. Under these conditions, groundwater may infiltrate into the sewer pipe unless adequate joint sealing is undertaken, and the granular bedding which typically surrounds the pipe can create a preferred migration pathway for the natural groundwater flow pattern. Steps to prevent "short-circuiting" of groundwater should be considered. These are discussed later in this report.

Redesigning the storm water management system to avoid the need to relocate the existing sanitary sewer would be preferable.

Mitigating Measures

It is understood that the invert or base elevation of the proposed sediment forebay and permanent pool structures in Cell #2, and in all of Cell #3 have been designed to be below the permanent water table so that a permanent dead storage with dilution capability is achieved. Clearly, the effective capacity of these facilities will be the difference between the high water table and the design maximum water level. Groundwater mounding within 30 m of the permanent pool and Cell #3 is predicted to occur at least during the peak groundwater elevation periods in the spring and perhaps in the late fall of the year.

As noted above, relocation of the sanitary sewer should be avoided if possible. The construction of a sanitary sewer below the natural water table could cause the development of a preferred groundwater migration pathway along the permeable sewer bedding. This could cause groundwater depression within the radius of influence, which at a depth of 6 m is expected to be 30 m or less, depending upon the permeability of the surrounding saturated materials.

Because the sewer is expected to be entirely below the water table, appropriate seals and waterstops should be incorporated into the design.

Since groundwater recharge will be allowed to occur from the stormwater management facility, periodic samples should be collected from the recharging ponds and tested for organic and inorganic constituents commonly detected within municipal stormwater effluent streams, such as sodium, calcium, phosphorus, nitrogen, potassium and herbicides.

Inspection and Testing

Prior to construction, the geotechnical aspects of the final design drawings and specifications should be reviewed by this office to confirm that the intent of this report has been met. In particular, it should be noted that the bedrock/till interface is somewhat variable. Therefore, depending upon

the proposed depths of excavation for footings, utilities and the like, it may be necessary to excavate several test pits on site to investigate the depth and nature of the bedrock/till interface in greater detail prior to tendering and construction.

During construction sufficient inspections, in situ density tests and materials testing should be carried out to confirm that the conditions exposed are consistent with those encountered during the investigation and to monitor conformance to the pertinent project specifications.

TASK 3: BEST MANAGEMENT PRACTICES FEASIBILITY

We understand that the proposed developments at the Zeller's and White Rose sites are to incorporate the application of Best Management Practices (BMP) with respect to the reinfiltration of stormwater into the subsurface. Based upon the discussion included with the Request For Proposal for this assignment, the practices under consideration include the use of porous asphalt, pervious catchbasins and soak away pits.

In order to assess the feasibility of the proposed BMP alternatives, the nature of the saturated and unsaturated soils beneath the two sites was assessed, in terms of the hydraulic conductivity (permeability), the depth to water table, and the soil moisture conditions above the water table.

Enhanced infiltration techniques, such as those proposed, are most severely constrained by the permeability of the receiving soils. The soil moisture content above the water table controls the ability to infiltrate water if moisture contents above field capacity are present. The infiltration of surface water below the water table, within the saturated zone comprises a groundwater recharge scheme. Generally, the detailed design of a groundwater recharge scheme requires assessment of the receiving saturated zone by means of pumping or injection tests carried out over a period of about six hours. No such testing has been carried out in the preparation of this report. Nevertheless, preliminary design recommendations can be provided based upon the observation of site conditions across the site.

The soil types encountered beneath the proposed Zeller's and White Rose properties are described in detail on Page 6 of this report, and in the geotechnical design report for the Zeller's property,

provided under separate cover. Representative grain size distribution curves are provided on Figures 3 to 7 inclusive. An interpretation of shallow groundwater (water table) elevation contours, based on water level measurements and inferences from mid May, 1995, appears on Figure 8. Table 1 summarizes the soil moisture content information for soil samples collected from test pits and boreholes on the White Rose and Zeller's properties. Note that the reported moisture contents differ from those reported on the Record of Test Pit and Record of Borehole sheets for these samples. This is due to the fact that geotechnical analyses depend upon moisture contents reported as mass of water divided by the total dry sample mass, while moisture content data required for infiltration analyses are based upon volume of water divided by the total soil volume. Thus a correction factor must be applied to the reported geotechnical moisture contents, based upon the density of the soil.

A graphic depiction of the relationship between soil type and soil moisture factors is presented for reference on Figure 9. Table 2 provides cross referencing guide to soil moisture factors based upon soil type, as described under the Unified Soil Classification System.

At four locations within the finer grained silt tills (1 on the White Rose and 2 on the Zeller's properties, 1 in Cell #3), Guelph permeameter testing was undertaken. At all four locations within the till, no decrease in water level in the permeameter was achieved in the testing period of up to one hour. The hydraulic conductivity of the clayey silt till was estimated based upon the grain size curves shown on Figures 3 and 6, to average about 2.4×10^{-7}. These soils would not be expected to infiltrate more than about 100 to 150 mm of water per year, according to guidance advice provided by the Ontario Ministry of Environment and Energy.

In addition, a percolation test was carried out within the sand and gravel at Test Pit 109 on the White Rose property. A percolation rate on the order of about 4 minutes per cm was determined at that location. The grain size distribution curve for the sand and gravel soil type indicates a hydraulic conductivity on the order of about 2×10^{-1} cm/sec in this material.

While no pump testing of the shallow fractured bedrock has been undertaken, our experience in this area indicates that the permeability of the fractured rock may lie in the range of 10^{-3} cm/sec.

We trust that this report provides sufficient geotechnical and hydrogeological information for you to proceed with the design of this project. If you have any questions regarding the contents of this report, please do not hesitate to contact this office.

Yours truly,

GOLDER ASSOCIATES LTD.

Michael L.J. Maher, P.Eng.
Principal

Thomas A. McIelwain,P.Eng.
Principal

MLJM:TAM:sb

Attachments:

Abbreviations and Symbols
Records of Test Pits 101 to 113
Figures 1 to 9

Table 1
VOLUMETRE MOISTURE CONTENTS
WHITE ROSE PROPERTY

	Soil Texture	Moisture Content (%)
TP 109 Sa 1	Sand and Gravel (SW)	16.7
TP 109 Sa 2	Clayey Silt (ML)	26.1
TP 109 Sa 3	Clayey Silt (ML)	34.7
TP 109 Sa 4	Clayey Silt (ML)	33.8
TP 110 Sa 1	Clayey Silt (ML)	28.8
TP 110 Sa 2	Bedrock	-
TP 111 Sa 1	Sand and Gravel (SW)	16.2
TP 111 Sa 2	Sand and Gravel (SW)	29.7
TP 111 Sa 3	Sandy Silt (ML)	19.2

Table 2

Moisture Retention Parameters

Soil Texture Class			Total Porosity vol/vol	Field Capacity vol/vol	Wilting Point vol/vol	Saturated Hydraulic Conductivity cm/sec
HELP	USDA	USCS				
1	CoS	SP	0.417	0.045	0.018	1.0×10^{-2}
2	S	SW	0.437	0.062	0.024	5.8×10^{-3}
3	FS	SW	0.457	0.083	0.033	3.1×10^{-3}
4	LS	SM	0.437	0.105	0.047	1.7×10^{-3}
5	LFS	SM	0.457	0.131	0.058	1.0×10^{-3}
6	SL	SM	0.453	0.190	0.085	7.2×10^{-4}
7	FSL	SM	0.473	0.222	0.104	5.2×10^{-4}
8	L	ML	0.463	0.232	0.116	3.7×10^{-4}
9	SiL	ML	0.501	0.284	0.135	1.9×10^{-4}
10	SCL	SC	0.398	0.244	0.136	1.2×10^{-4}
11	CL	CL	0.464	0.310	0.187	6.4×10^{-5}
12	SiCL	CL	0.471	0.342	0.210	4.2×10^{-5}
13	SC	SC	0.430	0.321	0.221	3.3×10^{-5}
14	SiC	CH	0.479	0.371	0.251	2.5×10^{-5}
15	C	CH	0.475	0.378	0.251	2.5×10^{-5}
21	G	GP	0.397	0.032	0.013	3.0×10^{-1}

Unified Soil Classification System	Definition
G	Gravel
S	Sand
M	Silt
C	Clay
P	Poorly Graded
W	Well Graded
H	High Plasticity or Compressibility
L	Low Plasticity or Compressibility

APPENDIX "E"

Natural Features

APPENDIX "E"

A field survey of the natural features of the area was carried out and reported by Gore & Storrie in 1996. Portions of three pages and a diagram relevant to the area of the current study are reproduced here with due acknowledgement to Gore & Storrie.

2.4.1 *Physiography*

The Upper No Name Creek watershed lies in the Napanee Plain physiographic region of Ontario. The Napanee Plain is a flat-to-undulating plain of limestone from which the glacier stripped most of the overburden (Chapman and Putnam, 1984). The land was nearly completely occupied by farms, but farming was relatively unproductive on the shallow soils (Chapman and Putnam, 1984) and much of the No Name Creek watershed is urbanized or consists of abandoned farmland or pasture.

The original vegetation in the area was forest, with sugar maple the dominant tree. White elm, silver and red maple and cedar likely occupied the low ground. At present, white cedar occurs in fairly pure stands where it is invading old pastures (Chapman and Putnam, 1984).

2.4.2 *Vegetation Communities*

Field visits were made on November 9 and 10, 1994 to describe and map vegetation communities and make a list of plants (those identifiable at this time of year) within the watershed. Casual observations were made of wildlife seen during the field visits, as the time of year was not suitable for breeding bird surveys or for intensive surveys of reptile and amphibian distribution. Plants found are noted in Appendix B. Scientific names of all species mentioned can be found in this appendix.

In general, the creek runs through fields in an advanced state of succession, at the edge of a highly urbanized area of Belleville. Two areas of the western part of the watershed, north of Highway 401, are dominated by mature lowland deciduous forest. South of Highway 401, where the watershed is relatively more urbanized, two small patches of mature mesic cedar forest comprise the only mature vegetation. Most of the creek channel was dry at the time of the field visit. Water was noted flowing in the channel south of Highway 401, but was seen only in sloughs and ponds north of the highway. All channels north of the beaver impoundment area were dry at the time of the field visit.

Vegetation communities discussed in this text are shown in Figure 2-2. This map categorizes the vegetation communities into Environmental Constraint Zones, from 1 to 5. Zone 1 represents a Water Dominant or Related area. According to the Bay of Quinte RAP, the objective is to achieve no net loss of Zone 1 areas within the study

area. The other four Zones are: Special Wooded Areas (Zone 2), Wooded Areas (Zone 3), Old Field Regeneration (Zone 4) and Modified Areas (Zone 5).

2.4.2.1 *Tracey Street to Highway 401*

Agricultural Field

A hay field occupies the southwest side of the watershed in this section.

Buckthorn Dominated Old Field

These areas consist of agricultural fields in the process of succession by the invasive woody shrubs common buckthorn and grey dogwood. Other dominant species were herbs such as Canada goldenrod, wild carrot, orchard grass, and wild strawberry. There are also scattered pioneering trees such as poplar, cottonwood, Manitoba maple and red cedar.

Red Cedar Dominated Old Field

In some areas young to medium-aged red cedar grows in dense stands, with a sparse understorey of buckthorn saplings, raspberries and avens.

White Cedar Forest

Two areas, one immediately south of Highway 401 and one south of Bell Boulevard, are dominated by dense, and relatively large (between approximately 20 to 40 cm diameter at breast height [dbh]) eastern white cedars.

The area south of Highway 401 contains an admixture of white spruce, balsam fir and white birch. Balsam fir and small buckthorn saplings are also very common in the understorey. This appears to be a mesic cedar forest community: there were few wetland species noted in the understorey. The ground was mainly covered with moss, with a few scattered herbaceous species such as helleborine orchid. There is a small log cabin in an advanced state of disrepair in this forest. This area was classed as Zone 2, a Special Wooded Area, due to the mature and diverse nature of the forest.

The cedar forest south of Bell Boulevard contains a high proportion of red cedar, which is invading old fields around the forest. The understorey is mainly of scattered old field shrubs and herbs, but is also very sparse. Again, this appears to be a mesic cedar forest community. This forest was classed as Zone 3 due to the higher degree of disturbance in this area.

Cattail Reed Canary-grass Marsh

A wide, wet slough apparently draining a culvert from beaver ponds immediately north of Highway 401 is dominated by common cattail and reed canary-grass, with other wetland species such as bugleweed, sedges, willows and balsam poplar. This slough drains into a small drainage ditch from the commercial area to the east, just

before it enters No Name Creek. Water levels were high and the water was flowing in both the slough and the drainage ditch during the field visit, probably because the visit was conducted immediately after heavy rains in the area. The creek itself was approximately 0.5 m deep, but the water was not moving.

Another small patch is found west of the creek channel north of Tracey Street.

These marshes fall into Zone 1, Water Dominated or Related areas.

Elm/Buckthorn Woods

A small patch of woods contains American elm, with buckthorn in the understorey. Other trees found here (generally young to intermediate-aged) include red ash, white oak, red maple and Manitoba maple. These woods may contain wet pockets at certain times of the year, but generally have an understorey of old field species.

Creek Banks

The banks of the creek are steep and mainly open, with reed canary-grass and other scattered wetland species only in wetter soil near the bottom of the channel.

APPENDIX "F"

Schedule of Assessments - Calculations

APPENDIX "F"

This appendix provides more detailed information on the methods used to determine the Cost Assessments and Allowances described in Section 6.5. The information is provided in a series of Tables most of which show spreadsheets prepared using Microsoft Excel 97. Each Table is preceded by a short descriptive preamble to clarify assumptions which may not be self-evident from the spreadsheet.

The intent is to allow interested parties to verify information presented in this report in order to accelerate the process of reaching agreement.

Basic topographic data was obtained from Weslake Drawing #2 Ownership Plan (Project No. 1333). This drawing has file reference number F:\1333\1333STM2.DWG which may be obtained on request from Weslake Inc. as an e-mail transmission. The file can be read using AutoCAD release 12 or later.

The hydrology and hydraulic modelling was carried out using version 0.24 of MIDUSS98. This program runs under the Windows 95 operating system. MIDUSS98 can be downloaded from the web site www.alanasmith.com and may be used at no cost for a period of 30 days from the date of installation. Hardware requirements are described in the web site.

The sequence of displays is as follows:

- Schedule of Drainage Areas.
- Discretization of Drainage Areas for Modelling
- Adjustment of Peak Flows and Runoff Volumes for External Areas
- Calculation of Runoff Coefficients and Distribution of Quantity Costs.
- Calculation of Net Runoff Volumes and Distribution of Quality costs.
- Total Cost Distribution (Schedule of Assessments)
- Estimate of Land Requirements for Quantity and Quality Components of the Main Pond.

1. Schedule of Drainage Areas

This table shows the drainage area and the Legal Ownership area for each of the sub-catchments used in the modelling of the area under study. The area numbers are shown in Figure 2.

In almost every case the drainage area includes the Legal area plus adjacent fractions of roads or road allowances. These additional fractions are referred to as 'External Areas'. In a few cases the drainage area includes the property of more than one owner and these are listed in the Description under 'Owner'.

In modelling the runoff, the total drainage area was used and then adjustments were computed for the External Areas. Adjustments have been calculated for peak flow in the case of the Quantity (100-year) storm and runoff volume in the case of the Quality (14 mm) storm.

Area No.	Drainage Area (ha)	Legal Area (ha)	Owner
1221	2.8160	2.4859	MTO Highway 401 Westbound
1222	2.7979	2.7979	MTO Highway 401 Eastbound
121	4.220	4.1005	Cambridge Leaseholds (excluding portion to be deeded to the City). Lemoine Street remainder
123	3.455	2.9800	Pronigo DistributionInc. Bell Boulevard remainder Lemoine Street remainder
130	1.530	1.1880	D.J.H. Hawley Development Ltd., Hawley-Ming Partnership
111	5.874	5.2997	Cream of the Crop Developments Ltd. 5.1870 903717 Ontario Ltd. 0.1127
119	0.535	0.3873	Shell Canada Bell Boulevard remainder North Front Street remainder
112	18.343	17.5097	Cambridge Leaseholds 17.0060 OPP .4123 Belleville Public Works .0913 Bell Boulevard, North Front Street, MTO remainder
115	2.4182	2.0496	151516 Ontario Ltd. Ontario Hydro lands Bell Boulevard remainder
127	2.6022	2.2105	Canadian Tire Corporation Ontario Hydro, Bell Boulevard remainder
128	1.0732	0.6366	Canadian Tire Corporation Belleville Utilities, City of Belleville, Ontario Hydro, Bell Boulevard remainder
114	7.2755	5.9271	1133166 Ontario Ltd. Lemoine. Bell Boulevard, Ontario Hydro remainder
113	2.598	2.2493	Loblaw's Bell Boulevard, Lemoine Street remainder
125	5.323	4.8921	Sopresata Holdings Inc. Bell Boulevard, Sidney Street remainder
129	1.4902	1.4650	City of Belleville Lemoine Street remainder
116	2.454	2.3774	D.J.H. Developments Hawley-Ming Partnership II
		0.5476	Unopened Lemoine Street Road Allowance North of Bell Boulevard (City of Belleville)
		0.4847	Unopened Lemoine Street Road Allowance South of Bell Boulevard (City of Belleville) Sediment Forebay 0.2787 Channel 0.2060
		3.0006	Bell Boulevard (City of Belleville)

2. Discretization of Drainage Areas for Modelling

Most of the sub-catchments are or will be developed as commercial properties. To allow a proper measure to be made of the effectiveness of on-site storage controls, the areas are divided into three parts as follows:

- Total building footprint to allow design of rooftop storage (100% impervious).
- Parking areas on which grading is arranged to produce ponding around catchbasins (100% impervious).
- An area representing the balance of the total drainage area with a finite fraction of pervious surface.

In the absence of reliable data, the sub-catchment area with the exception of the building rooftop is assumed to have 95% impervious surface. The pervious fraction is combined with any other pervious surface in the external areas.

The tables cover 6 pages and show the calculation of the relevant areas and parameters for the different drainage areas. For existing developments for which information is available more specific data has been obtained from site plans, grading plans supplemented by field survey where applicable.

Special cases include:

- Area 121 includes a significant area of existing wetland. Runoff volume from the wetland has been excluded from the volume of runoff used to compute the assessment for Quality control.
- Area 112 contains many catchbasins. These have been modeled in two separate groups so that a total of four sub-catchments are used for modelling.

The results of the modelling using this discretization can be found in the MIDUSS98 output files contained in Appendix "G".

City of Belleville April 1, 1996
Upper No Name Creek
Final Report

Owner: Cambridge Properties **121**

	area	%Imp	pervious
Drainage area	4.2200		
Legal area	4.1005		
Wetland	0.9700	10.0%	0.8730
Developable area	3.1305	95.0%	0.1565
External area	0.1195		
Bell Blvd	0.0000	0.0%	0.0000
Lemoine St.	0.1195	0.0%	0.1195
Landscape	0.1565	0.0%	0.1565
Total pervious area			0.2760
Rooftop	0.3280	100.0%	
Parking	2.4200	100.0%	
Balance	0.5020	45.0%	
Wetland	0.9700	10.0%	
TOTAL	4.2200	72.8%	

Owner: Pronigo Distribution Inc **123**

	area	%Imp	pervious
Drainage area	3.4710		
Legal area	2.9800	95.0%	0.1490
External area	0.4910		
Bell Blvd	0.3630	65.0%	0.1271
Lemoine St.	0.1280	0.0%	0.1280
Landscape	0.1490	0.0%	0.149
Total pervious area			0.4041
Rooftop	1.0600	100.0%	
Parking	1.2210	100.0%	
Balance	1.1900	66.0%	
TOTAL	3.4710	88.4%	

Owner: D.J.H. Development **130**

	area	%Imp	pervious
Drainage area	1.5140		
Legal area	1.1880	95.0%	0.0594
External area	0.3260		
Bell Blvd	0.2380	58.0%	0.1000
Lemoine St.	0.0880	37.5%	0.0550
Landscape	0.0594	0.0%	0.0594
Total pervious area			0.2144
Rooftop	0.3630	100.0%	
Parking	0.4840	100.0%	
Balance	0.6670	67.9%	
TOTAL	1.5140	85.8%	

Owner: Cream of the Crop **111**

	area	%Imp	pervious
Drainage area	5.8660		
Legal area	5.2880	95.0%	0.2644
External area	0.5780		
Bell Blvd	0.3700	44.0%	0.2072
Lemoine St.	0.2080	17.3%	0.1720
Landscape	0.2644	0.0%	0.2644
Total pervious area			0.6436
Rooftop	1.7600	100.0%	
Parking	2.7370	100.0%	
Balance	1.3690	53.0%	
TOTAL	5.8660	89.0%	

Owner: Cambridge Quinte Mall 112

			area	%Imp	pervious
Drainage area			18.3430		
Legal area			17.5097	95.0%	0.8755
Cambridge		17.0060			
OPP, Pub.Wks		0.5037			
External area			0.8333		
Bell Blvd			0.7190	63.0%	0.2660
MTO ramp			0.1143	0.0%	0.1143
Landscape	5%	17.0060	0.8503	0.0%	0.8503
Total pervious area					1.2306
Rooftop			4.5820	100.0%	
Parking	East	to MH 'G'	6.9900	100.0%	
Parking	West	to MH 'L'	5.3100	100.0%	
Balance			1.4610	15.8%	
TOTAL			18.3430	93.3%	

Owner: 1511516 Ontario Ltd. (part of Loebs Plaza) 115

	area	%Imp	pervious
Drainage area	2.4180		
Legal area	2.0496	95.0%	0.1025
External area	0.3684		
Bell Blvd	0.1710	82.2%	0.0304
Hydro lands	0.1974	0.0%	0.1974
Landscape	0.1025	0.0%	0.1025
Total pervious area			0.3303
Rooftop	0.4540	100.0%	
Parking	0.9000	100.0%	
Balance	1.0640	69.0%	
TOTAL	2.4180	86.3%	

Owner: Canadian Tire Corp. - Phase 1 127

	area	%Imp	pervious
Drainage area	2.6020		
Legal area	2.2105	95.0%	0.1105
External area	0.3915		
Bell Blvd	0.1845	79.0%	0.0387
Hydro lands	0.2070	0.0%	0.2070
Landscape	0.1105	0.0%	0.1105
Total pervious area			0.3563
Rooftop	0.6440	100.0%	
Parking	0.7600	100.0%	
Balance	1.1980	70.3%	
TOTAL	2.6020	86.3%	

Owner: Canadian Tire Corp. - Phase 2 128

	area	%Imp	pervious
Drainage area	1.0732		
Legal area	0.6366	95.0%	0.0318
External area	0.4366		
Bell Blvd	0.0807	62.0%	0.0307
Hydro lands	0.0867	0.0%	0.0867
PUC	0.0972	100.0%	0.0000
City of Belleville	0.1720	50.0%	0.0860
Landscape	0.0318	0.0%	0.0318
Total pervious area			0.2352
Rooftop	0.1250	100.0%	
Parking	0.3250	100.0%	
Balance	0.6232	62.3%	
TOTAL	1.0732	78.1%	

Owner: 1133166 Ontario Ltd (Zellers Plaza) **114**

	area	%Imp	pervious
Drainage area	7.2755		
Legal area	5.9271	95.0%	0.2964
External area	1.3484		
Bell Blvd	0.4360	77.0%	0.1003
Hydro lands	0.6354	0.0%	0.6354
Lemoine	0.2770	9.5%	0.2507
Landscape	0.2964	0.0%	0.2964
Total pervious area			1.2827
Rooftop	2.6000	100.0%	
Parking	2.9000	100.0%	
Balance	1.7755	27.8%	
TOTAL	7.2755	82.4%	

Owner: Loblaws **113**

	area	%Imp	pervious
Drainage area	2.5980		
Legal area	2.2493	95.0%	0.1125
External area	0.3487		
Bell Blvd	0.1410	90.0%	0.0141
Lemoine	0.2080	24.0%	0.1581
Landscape	0.1125	0.0%	0.1125
Total pervious area			0.2846
Rooftop	0.4000	100.0%	
Parking	1.1920	100.0%	
Balance	1.0060	71.7%	
TOTAL	2.5980	89.0%	

Owner: Sopresata **125**

	area	%Imp	pervious
Drainage area	5.3230		
Legal area	4.8921	95.0%	0.2446
External area	0.4309		
Bell Blvd	0.2209	67.0%	0.0729
Sidney St.	0.2100	50.0%	0.1050
Landscape	0.2446	0.0%	0.2446
Total pervious area			0.4225
Rooftop	1.6530	100.0%	
Parking	2.2040	100.0%	
Balance	1.4660	71.2%	
TOTAL	5.3230	92.1%	

Owner: D.J.H. Developments **116**

	area	%Imp	pervious
Drainage area	2.4540		
Legal area	2.3774	25.0%	1.7831
External area	0.0766		
Sidney St	0.0766	40.0%	0.0460
Lemoine	0.0000	0.0%	0.0000
Landscape	1.7831	0.0%	1.7831
Total pervious area			1.8290
Rooftop	0.0000	100.0%	
Parking	0.0000	100.0%	
Balance	2.4540	25.5%	
TOTAL	2.4540	25.5%	

3. Adjustment of Peak Flows and Runoff Volumes for External Areas

This foldout shows two Tables describing Peak Flow and Runoff Volume for the drainage areas. For each area the contribution of the different external areas is shown in a column which is specific to the road or road allowance. Responsibility for each external area is indicated in the column header. Totals for each responsible public authority are shown at the bottom of each column. These are used, where appropriate, in order to calculate an assessment amount. This is of use only for costs associated with Quality control.

4. Calculation of Runoff Coefficients and Distribution of Quantity Costs

This spreadsheet uses the adjusted peak flows to compute a peak flow runoff coefficient for each drainage area. The ratio of peak flow rates is required as opposed to a volumetric runoff coefficient in order to obtain a measure of the effectiveness of the on-site controls. This is obtained by comparing the adjusted peak flow for the Legal area with the flow which would result from the peak rainfall intensity over the subject area with a 100% impervious surface. The runoff coefficient is therefore sensitive to both the amount of pervious surface and the volumes of temporary storage provided on rooftops and parking lots.

The distribution of assessments for Quantity control is based on the product of Legal area and runoff coefficient.

City of Belleville **Feb-12-1998**

No-Name Creek

Estimation of Runoff Coefficient **File:** **\\AS\c:\MidussProjects\Belleville\FinalRunoffC7.xls**

This spreadsheet estimates the runoff coefficient in terms of peak runoff compared to the maximum possible runoff for an impervious area of the same size subject to the peak rainfall intensity for the storm.
The 100-yr storm used is 67.3 mm over 6 hours using the SCS-6 hour distribution using time steps of 15 minutes. For this event the peak intensity is 45.786 mm/hr.
The peak outflow from a sub-catchment is based on the runoff from rooftop, parking area and the balance of the subcatchment attenuated by the on-site control measures. These peak runoff values are obtained from the MIDUSS 98 modelling of each sub-area.
The peaks are corrected by subtracting the peak flow from the external areas to each property so that the net peak is attribtable to the legal property area.
Only new developments are included in quantity cost sharing.

Peak rainfall 45.786 mm/h 0.012718 mm/sec 0.12718 c.m/s/ha

Area	Owner/ Occupier	Legal Area (ha)	Peak flow Actual (c.m/s)	Reduction of peak flow due to external areas: Bell (c.m/s)	Lemoine	Sidney	Hydro	MTO	PUC	City	Net peak flow (c.m/s)	Theoretica (c.m/s)	Runoff coeff R	AxR	AxR as %
1221	Hwy 401 West	2 8160	0.177									0.35815	0.0000		
1222	Hwy 401 East	2.7970	0.178												
121	Cambridge Prop.	4.1005	0.25812		0.00549						0.25263	0.52152	0.4844	1.9863	15.2068%
123	Pronigo Distribution	2.9800	0.25677	0.03525	0.00588						0.21564	0.37901	0.5690	1.6955	12.9802%
130	D.J.H. Development	1.1880	0.11078	0.02168	0.00646						0.08264	0.15109	0.5469	0.6498	4.9744%
111	Cream of the Crop	5.2880	0.34159	0.02925	0.01167						0.30067	0.67255	0.4471	2.3641	18.0985%
119	Shell	0.3900	0.03982												
112	Quinte Mall	17.0060	0.75308	0.06858				0.00525	0.0619						
115	151516 Ont. Loebs Plaza	2 0496	0.1621	0.01913			0.00907								
127	C.T.C. Phase 1	2.2105	0.19138	0.02014			0.00951								
128	C.T.C. Phase 2	0.6366	0.06756	0.00763			0.00398		0.01236	0.01448					
114	1133166 Ont. Zellers Plaza	5.9271	0.33762	0.04683	0.01137		0.02919				0.25023	0.75383	0.3319	1.9675	15.0623%
113	Loblaws	2.2493	0.18721	0.01672	0.01287						0.15762	0.28607	0.5510	1.2393	9.4878%
125	Sopresata Holdings	4.8921	0.28728	0.02183		0.01768					0.24777	0.62219	0.3982	1.9481	14.9142%
116	D.J.H. Development	2.3774	0.15989			0.00579					0.15410	0.30237	0.5096	1.2116	9.2759%
129	Main Pond	1.4650	0.14254								0.14254	0.18632	0.7650		
														13.0622	100 0000%

300 L/s

5.244

= 56.9 L/s

Figure 4: Estimation of Peak Runoff Coefficients

5. Calculation of Net Runoff Volumes and Distribution of Quality Costs

This spreadsheet uses the adjusted results from the modelling of the 14 mm Quality storm. This provides an assessment of the volume of water generated by the development and which therefore contributes to the cost of Quality control.

For areas such as Bell Blvd which are not modeled explicitly the contributed volumes are taken from Exhibit 3 *Adjustment of Peak Flows and Runoff Volumes for External Areas.*

Expressing each volume contribution as a percentage of the total runoff volume provides a basis for distributing the cost assessments for Quality control.

The following points, specific to certain drainage areas should be noted.

- Area 121 Runoff volume from the existing wetlands is assumed to be natural and is therefore excluded from the volume attributed to the development.

- Area 119 For the 14 mm storm all runoff is captured by the three catchbasins and no surface or major flow is assumed to occur. Of the three catchbasins, two connect to the storm sewer in North Front Street so only one third of the captured volume is used in computing the assessment.

- Area 128 This drainage area includes an underground storage facility which captures the runoff from the rooftop and the parking lot catchbasin. The total volume is therefore calculated as the outflow volume from the underground detention facility plus the total runoff volume from the balance of the catchment (i.e. sub-area 1286)

- Area 129 Volume generated on the area of the main pond is assumed to be natural and therefore does not contribute to the total volume requiring Quality control.

City of Belleville
No-Name Creek
Estimation of Volumes for Quality Cost Distributio File:

Feb-12-1998

\\AS\c:\MidussProjects\Belleville\FinalVolumes.xls

This spreadsheet estimates the runoff volume from each of the contributing areas to provide a basis for distribution of costs for quality control. Runoff is computed using the Quality storm. The Quality storm used is 14 mm over 4 hours (240 minutes) using the SCS-6 hour distribution using time steps of 15 minutes.
The volumes are corrected by subtracting the volumes from the external areas to each property so that the net volume is attributable to the legal property area. These fractional volumes are taken from spreadsheet ExternalArea.xls.
Both new and existing developments are included in Quality cost sharing.

Area	Owner/ Occupier	Legal Area (ha)	Runoff Volume (cub.m)	Reduction of volumes due to external areas: Bell (cub.m)	Lemoine (cub.m)	Sidney (cub.m)	Hydro (cub.m)	MTO (cub.m)	PUC	OPP (cub.m)	City (cub.m)	Net volume (cub.m)	Volume percent (%)
1221	Hwy 401 West	2.4859	71.46					71.46					
1222	Hwy 401 East	2.7970	75.87					75.87					
121	Cambridge Leaseholds.	4.1005	371.77		0.00							371.77	5.9228%
123	Pronigo Distribution	2.9800	383.30	29.49	0.00							353.81	5.6366%
130	D.J.H. Development	1.1880	162.50	17.25	4.13							141.12	2.2482%
111	Cream of the Crop	5.2880	652.82	20.35	4.50							627.97	10.0044%
119	Shell	0.3900	22.29	6.15								16.14	0.2571%
112	Cambridge Properties	17.0060	2162.14	56.62				0.00		48.96	10.84	2045.72	32.5909%
115	151516 Ont. Loebs Plaza	2.0496	260.94	17.57			0.00					243.37	3.8772%
127	C.T.C. Phase 1	2.2105	280.72	18.22			0.00					262.5	4.1820%
128	C.T.C. Phase 2	0.6366	104.77	6.25			0.00		12.15		10.75	75.62	1.2047%
114	1133166 Ont. Zellers Plaza	5.9271	747.98	41.97	3.29		0.00					702.72	11.1952%
113	Loblaws	2.2493	289.14	15.86	6.24							267.04	4.2543%
125	Sopresata Holdings	4.8921	613.04	18.50		13.12						581.42	9.2628%
116	D.J.H. Development	2.3774	78.22			3.83						74.39	1.1851%
129	Main Pond	1.4650	111.83									0.00	
	City of Belleville			248.23	18.16	16.95					21.59	304.93	4.8579%
	MTO							147.33				147.33	2.3472%
	Belleville PUC								12.15			12.15	0.1936%
	OPP									48.96		48.96	0.7800%
												6276.96	100.0000%

Figure 5: Estimation of Quality Volume Contributions

6. Total Cost Distribution (Schedule of Assessments)

This spreadsheet represents a combination of all costs (i.e. land cost plus construction cost) multiplied by the appropriate distribution percentage for either Quantity or Quality and assessed to each drainage area.

It should be noted that the percentages shown have only 5 or 6 significant figures and will not yield the exact costs shown if multiplied by the total cost. The percentage fractions have been obtained by linkage to the other spreadsheets (Exhibits 4 and 5) and are correct to 18 significant figures. Subtotals are computed and compared in order to demonstrate a proper reconciliation of the costs.

Belleville
Upper No Name Creek
Distribution of Costs.

Apr-6-1998

File: **\\AS\C:\MidussProjects\Belleville\TotalCostDistrib.xls**

Area	Owner	Quantity percentage	Quantity cost	Quality percentage	Quality cost	Total Cost
	Total cost distribution		$ 1,411,674.22		$ 1,079,777.69	$ 2,491,451.91
122	MTO Hwy 401		$ -	2.3472%	$ 25,344.06	$ 25,344.06
121	Cambridge Leaseholds.	15.2068%	$ 214,669.99	5.9228%	$ 63,952.77	$ 278,622.76
123	Pronigo Distribution	12.9802%	$ 183,238.08	5.6366%	$ 60,863.24	$ 244,101.33
130	D.J.H. Development	4.9744%	$ 70,222.57	2.2482%	$ 24,275.80	$ 94,498.37
111	Cream of the Crop	18.0985%	$ 255,491.54	10.0044%	$ 108,024.90	$ 363,516.44
119	Shell		$ -	0.2571%	$ 2,776.44	$ 2,776.44
112	Cambridge Properties		$ -	32.5909%	$ 351,909.65	$ 351,909.65
115	151516 Ont. Loebs Plaza		$ -	3.8772%	$ 41,865.09	$ 41,865.09
127	C.T.C. Phase 1		$ -	4.1820%	$ 45,155.88	$ 45,155.88
128	C.T.C. Phase 2		$ -	1.2047%	$ 13,008.33	$ 13,008.33
114	1133166 Ont. Zellers Plaza	15.0623%	$ 212,630.61	11.1952%	$ 120,883.58	$ 333,514.19
113	Loblaws	9.4878%	$ 133,936.13	4.2543%	$ 45,936.86	$ 179,872.99
125	Sopresata Holdings	14.9142%	$ 210,540.25	9.2628%	$ 100,017.26	$ 310,557.51
116	D.J.H. Development	9.2759%	$ 130,945.04	1.1851%	$ 12,796.75	$ 143,741.79
129	Main Pond		$ -	0.0000%	$ -	$ -
	City of Belleville		$ -	4.8579%	$ 52,454.79	$ 52,454.79
	Belleville PUC		$ -	0.1936%	$ 2,090.07	$ 2,090.07
	OPP		$ -	0.7800%	$ 8,422.22	$ 8,422.22
						$ 2,491,451.91
	TOTALS	100.0000%	$ 1,411,674.22	100.0000%	$ 1,079,777.69	$ 2,491,451.91

7. Estimate of Land Requirements for Quantity and Quality Components of the Main Pond

This Exhibit is a MathCAD spreadsheet and is developed to demonstrate how the total land requirement for the main pond is divided into Quantity and Quality components.

Upper No Name Storm water management system

Lands required for the 'active' storage.

Assumptions:
1. Length to width ratio of 2:1,
2. Depth = 1.1m

$D := 1.1 \cdot m$

$V := 8500 \cdot m^3$ $\quad z := 4$

Guess values: $L := 1000 \cdot m$

$W := 500 \cdot m$

Given

$V = ((L \cdot W) + (L + 2 \cdot z \cdot D) \cdot (W + 2 \cdot z \cdot D)) \cdot .5 \cdot D$

$L = 2 \cdot W$

$\begin{bmatrix} L \\ W \end{bmatrix} := \text{find}(L, W)$

$L = 117.58 \cdot m$

$W = 58.79 \cdot m$

$(L + 2 \cdot z \cdot D) \cdot (W + 2 \cdot z \cdot D) = 8.542 \cdot 10^3 \cdot m^2$ **Land required for active storage**

Estimated ratio between quantity and quality requirements (re: Land).

$T := 1.3 \cdot 10^4 \cdot m^2$ Total pond surface

$Quan := 8.542 \cdot 10^3 \cdot m^2$ Surface area required for active storage

$Rquan := \frac{Quan}{T}$ $\quad Rquan = 0.657$ **Quantity portion**

$Rqual := 1 - Rquan$ $\quad Rqual = 0.343$ **Quality portion**

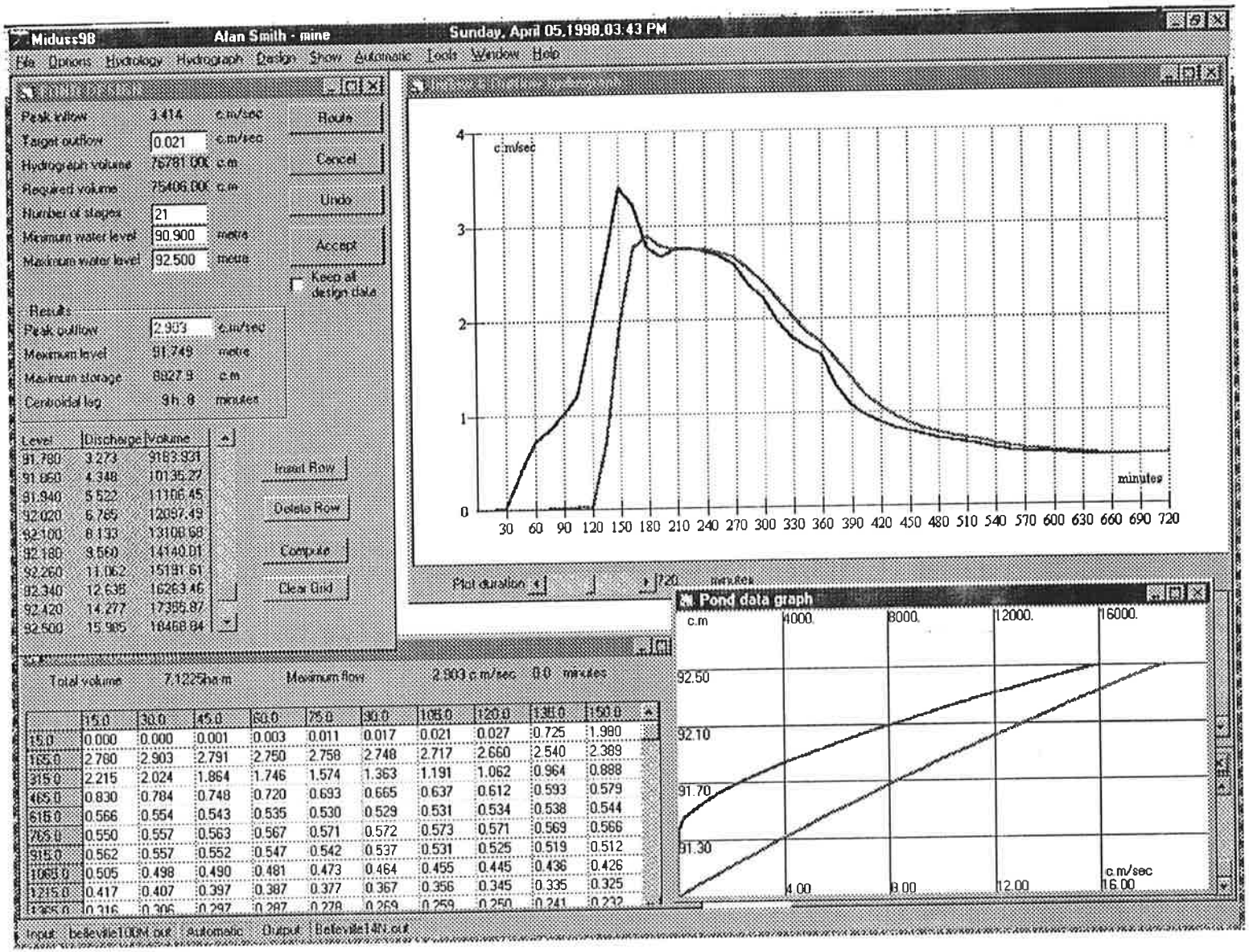
APPENDIX "G"

MIDUSS98 Output Files

APPENDIX "G"

This Appendix contains listings of the MIDUSS98 output files for the two storm events considered:

1. Quantity Storm 67.3mm over 360 minutes – File Name *BELLEVILLE14N.OUT*
2. Quality Storm 14mm over 260 minutes – File Name *BELLEVILLE100N.OUT*


Midus98
Alan Smith - mine
Sunday, April 05,1998,03:43 PM
File Options Hydrology Hydrograph Design Show Automatic Tools Window Help
Peak inflow 3.414 c.m/sec
Target outflow 0.021 c.m/sec
Hydrograph volume 76781.00 c.m
Required volume 75406.00 c.m
Number of stages 21
Minimum water level 90.900 metre
Maximum water level 92.500 metre
Route
Cancel
Undo
Accept
Keep all design data
Results
Peak outflow 2.903 c.m/sec
Maximum level 91.749 metre
Maximum storage 8827.9 c.m
Centroidal lag 9h 8 minutes
Level Discharge Volume
91.780 3.273 9183.931
91.860 4.348 10135.27
91.940 5.522 11106.45
92.020 6.765 12097.49
92.100 8.133 13108.68
92.180 9.560 14140.01
92.260 11.062 15191.61
92.340 12.636 16263.46
92.420 14.277 17355.87
92.500 15.985 18468.84
Insert Row
Delete Row
Compute
Clear Grid
c.m/sec
minutes
Plot duration
720 minutes
Total volume 7.1225ha.m
Maximum flow 2.903 c.m/sec 0.0 minutes
15.0 30.0 45.0 60.0 75.0 90.0 105.0 120.0 135.0 150.0
15.0 0.000 0.000 0.001 0.003 0.011 0.017 0.021 0.027 0.725 1.980
165.0 2.760 2.903 2.791 2.750 2.758 2.748 2.717 2.660 2.540 2.389
315.0 2.215 2.024 1.864 1.746 1.574 1.363 1.191 1.062 0.964 0.888
465.0 0.830 0.784 0.748 0.720 0.693 0.665 0.637 0.612 0.593 0.579
615.0 0.566 0.554 0.543 0.535 0.530 0.529 0.531 0.534 0.538 0.544
765.0 0.550 0.557 0.563 0.567 0.571 0.572 0.573 0.571 0.569 0.566
915.0 0.562 0.557 0.552 0.547 0.542 0.537 0.531 0.525 0.519 0.512
1065.0 0.505 0.498 0.490 0.481 0.473 0.464 0.455 0.445 0.436 0.426
1215.0 0.417 0.407 0.397 0.387 0.377 0.367 0.356 0.345 0.335 0.325
Pond data graph
c.m
92.50
92.10
91.70
91.30
4.00
8.00
12.00
16.00
c.m/sec
Input bellevile100M.out Automatic Output Bellevile140.out

100 YR


```
"                MIDUSS 98 Output------------------------------------------------>"
"                MIDUSS 98 version number                                    0.23"
"                MIDUSS 98 created                        Saturday, April 04, 1998"
"           10   Units used:                                              ie METRIC"
"                Project filename:                  C:\MidussProjects\Belleville\"
"                Output filename:                                Belleville100N.out"
"                Licensee name:                                          Alan Smith"
"                Company                                                     mine"
"                Date & Time last used:                        4/5/98 at 4:30:53 PM"
" 31           TIME PARAMETERS"
"       15.000   Time Step"
"      360.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32           STORM Mass Curve"
"           3   Mass Curve"
"      67.300   Rainfall depth"
"      360.000  Duration"
"          11   scs_6hr.mrd   SCS 6 hour distribution"
"               Maximum intensity              45.786    mm/hr"
"               Total depth                    67.300    mm"
"           6   100hyd   Hydrograph extension used in this file"
" 37           START/RE-START TOTALS "
"           1   Runoff Totals turned ON"
" 81           ADD COMMENT=============================================="
"          15   Lines of comment"
"               This file <Belleville100L.out> created 1998-04-3."
"               Storm is 67.3 mm over 6 hours (360 min) using SCS-6hr mass"
"               rainfall distribution file (i.e. 100-year storm)."
"               External Inflow to City of Belleville part of Upper"
"               No-Name catchment is outflow from Thurlow pond, file"
"               <PondOutflow.100hyd>"
"                    "
"               Areas are modified from previous runs to be consistent"
"               with legal survey & Weslake survey and review of as-built"
"               drawings (Dec.1997 and Jan. 1998) and differ significantly"
"               from areas used in previous studies (e.g. Gore & Storrie,"
"               Weslake and EGA)"
"                    "
"               Area parameters represent ultimate development.  On-site"
"               quantity controls are in use."
" 81           ADD COMMENT=============================================="
"          20   Lines of comment"
"               Areas used in this analysis compared with previous studies "
"               ID#   Description          Present          Previous    "
"                                          (ha)   (%I)      (ha)   (%I) "
"               1221  Hwy 401 (Westbound)  2.816  20.3%    0.000        "
"               1222  Hwy 401 (Eastbound   2.797  21.7%    0.000        "
"               121   Cambridge expn.      4.220  71.0%    part of 111  "
"               123   Pronigo              3.213  90.0%    part of 111  "
"               130   D.J.H.Development    1.530  85.5%    part of 111  "
"               111   Cream of the Crop    5.866  90.0%   17.250  80.0%"
"               119   N.Front St. (major)  0.535 100.0%    8.300  91.0%"
"               112   Quinte Mall & OPP   18.343  96.8%   20.400  93.0%"
"               115   Loebs (west)         2.418  91.0%    8.100  91.0%"
"               127   Canadian Tire Ph.1   2.602  90.6%    part of 115  "
"               128   Canadian Tire Ph.2   1.073  81.0%    part of 115  "
"               114   1133166 Ontario      7.275  86.0%    9.100  80.0%"
"               113   Loblaws              2.598  91.0%    part of 113  "
"               113   Sopresata Holdings   5.323  92.0%    7.900  80.0%"
"               116   D.J.H.Developments   2.454  25.0%    2.162  25.0%"
"               129   Main Pond            1.490  60.0%    0.000        "
"                     Totals              64.553  81.16%                "
" 81           ADD COMMENT=============================================="
"           6   Lines of comment"
"               Import outflow from Thurlow pond in file: "
"               <pondoutflow.100hyd> "
```



```
"               Peak inflow     =   4.939 c.m/s "
"               Hyd.volume      =   57923 c.m "
"               Peak outflow    =   1.186 c.m/s "
"                    "
" 47           FILEI_O Read/Open pondoutflow.100hyd"
"           1   1=read/open; 2=write/save"
"           2   1=rainfall; 2=hydrograph"
"           2   1=runoff; 2=inflow; 3=outflow; 4=junction"
"               pondoutflow.100hyd"
"               Outflow from Thurlow pond for 100-yr storm"
"                    0.000     1.186     0.000     0.000 c.m/sec"
" 81           ADD COMMENT=============================================="
"           6   Lines of comment"
"               Add MTO contribution from Hwy 401 from stn. 10+915 to "
"               11+550m. (east of Sidney St.) "
"               Area 1221   West bound (north) 2.381 h @ 30% imperv. "
"               Area 1222   East bound (south) 1.472 h @ 30% imperv. "
"               Assume flow lengths of 10 m on imperv., 25 m on pervious "
"                    "
" 33           CATCHMENT 1221"
"           4   Linear reservoir"
"           3   Specify values"
"           2   Horton equation"
"        1221   ID number"
"      20.300   % Impervious"
"       2.816   Total Area"
"      25.000   Flow length"
"       2.000   Overland Slope"
"       2.244   Pervious Area"
"      25.000   Pervious length"
"       2.000   Pervious slope"
"       0.572   Impervious Area"
"       0.000   Impervious length"
"       2.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      50.000   Pervious Max.infiltration"
"       7.500   Pervious Min.infiltration"
"       0.500   Pervious Lag constant (hours)"
"       5.000   Pervious Depression storage"
"       0.015   Impervious Manning 'n'"
"       0.000   Impervious Max.infiltration"
"       0.000   Impervious Min.infiltration"
"       0.500   Impervious Lag constant (hours)"
"       1.500   Impervious Depression storage"
"                    0.177     1.186     0.000     0.000 c.m/sec"
"               Catchment 1221          Pervious   Impervious Total Area "
"               Surface Area            2.244      0.572      2.816      hectare"
"               Time of concentration   17.083     0.000      6.892      minutes"
"               Time to Centroid        166.904    169.846    168.659    minutes"
"               Rainfall depth          67.300     67.300     67.300     mm"
"               Rainfall volume         0.00       0.00       0.00       c.m"
"               Rainfall losses         67.300     67.300     67.300     mm"
"               Runoff depth            0.000      0.000      0.000      mm"
"               Runoff volume           254.35     376.14     630.49     c.m"
"               Maximum flow            0.104      0.073      0.177      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                    0.177     1.203     0.000     0.000"
" 81           ADD COMMENT=============================================="
"           3   Lines of comment"
"               Route flow through culvert 1.20 m wide with 0.12% slope"
"               Use Manning n=0.015 over length of 52.8m"
"                    "
" 52           CHANNEL DESIGN"
"       1.203   Current peak flow    c.m/sec"
"       0.015   Manning 'n'"
```

```
"          0.   Cross-section type: 0=trapezoidal; 1=general"
"       1.200   Basewidth    metre"
"       0.000   Left bank slope"
"       0.000   Right bank slope"
"       0.940   Channel depth    metre"
"       0.120   Gradient   %"
"            Depth of flow                  0.866    metre"
"            Velocity                       1.157    m/sec"
"            Channel capacity               1.333    c.m/sec"
"            Critical depth                 0.468    metre"
" 53         ROUTE    Channel Route"
"      52.80      Channel Route Reach length   ( metre)"
"       0.000   X-factor <= 0.5"
"      34.234   K-lag   ( seconds)"
"       0.000   Default(0) or user spec.(1) values used"
"       0.000   X-factor <= 0.5"
"     324.000   K-lag   ( seconds)"
"       1.056   Beta weighting factor"
"     300.000   Routing time step   ( seconds)"
"           1   No. of sub-reaches"
"            Peak outflow                   1.199    c.m/sec"
"                   0.177     1.203     1.199     0.000 c.m/sec"
" 40         HYDROGRAPH   Combine    1222"
"           6   Combine "
"        1222   Node #"
"               South end of 401 culvert"
"            Maximum flow                   1.199    c.m/sec"
"            Hydrograph volume          42690.470    c.m"
"                   0.177     1.203     1.199     1.199"
" 81         ADD COMMENT============================================="
"           1  Lines of comment"
"           Now add runoff from south (Eastbound) lanes.      "
" 40         HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                   0.177     0.000     1.199     1.199"
" 33         CATCHMENT 1222"
"           4   Linear reservoir"
"           3   Specify values"
"           2   Horton equation"
"        1222   ID number"
"      21.700   % Impervious"
"       2.797   Total Area"
"      25.000   Flow length"
"       2.000   Overland Slope"
"       2.190   Pervious Area"
"      25.000   Pervious length"
"       2.000   Pervious slope"
"       0.607   Impervious Area"
"      10.000   Impervious length"
"       2.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      50.000   Pervious Max.infiltration"
"       7.500   Pervious Min.infiltration"
"       0.500   Pervious Lag constant (hours)"
"       5.000   Pervious Depression storage"
"       0.015   Impervious Manning 'n'"
"       0.000   Impervious Max.infiltration"
"       0.000   Impervious Min.infiltration"
"       0.500   Impervious Lag constant (hours)"
"       1.500   Impervious Depression storage"
"                   0.178     0.000     1.199     1.199 c.m/sec"
"            Catchment 1222          Pervious   Impervious Total Area "
"            Surface Area            2.190      0.607      2.797      hectare"
"            Time of concentration   17.083     1.568      7.515      minutes"
"            Time to Centroid        166.904    170.630    169.202    minutes"
"            Rainfall depth          67.300     67.300     67.300     mm"
```



```
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         67.300     67.300     67.300     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           248.20     399.37     647.57     c.m"
"            Maximum flow            0.102      0.076      0.178      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                   0.178     0.178     1.199     1.199"
" 40         HYDROGRAPH Copy to Outflow"
"           8   Copy to Outflow"
"                   0.178     0.178     0.178     1.199"
" 40         HYDROGRAPH   Combine    1222"
"           6   Combine "
"        1222   Node #"
"               South end of 401 culvert"
"            Maximum flow                   1.216    c.m/sec"
"            Hydrograph volume          43338.030    c.m"
"                   0.178     0.178     0.178     1.216"
" 37         START/RE-START TOTALS 1222"
"           2   Runoff Totals reset to ZERO"
"            Catchment area to node 1222                5.613    hectare"
"            Impervious area to node 1222               1.179    hectare"
"            % impervious to node 1222                 20.998"
"            Peak runoff to node 1222                   0.355    c.m/sec"
"            Total volume to node 1222                  1278.1   c.m"
" 40         HYDROGRAPH   Confluence    1222"
"           7   Confluence "
"        1222   Node #"
"               South end of 401 culvert"
"            Maximum flow                   1.216    c.m/sec"
"            Hydrograph volume          43338.030    c.m"
"                   0.178     1.216     0.178     0.000"
" 81         ADD COMMENT============================================="
"           9  Lines of comment"
"           Design channel representing watercourse through wetlands "
"           and route flow over 150 m reach to a point close to the "
"           proposed drop structure where runoff from Cambridge "
"           expansion (Area 121) will enter."
"                "
"           Channel will have nominally flat side slopes and grade of "
"           1.0% being the drop in IL of approximately 1.5 m "
"           (93.5 - 92.0) over a reach of 150 m length."
"                "
" 52         CHANNEL DESIGN"
"       1.216   Current peak flow    c.m/sec"
"       0.050   Manning 'n'"
"          0.   Cross-section type: 0=trapezoidal; 1=general"
"       0.600   Basewidth    metre"
"       5.000   Left bank slope"
"       5.000   Right bank slope"
"       1.100   Channel depth    metre"
"       1.000   Gradient   %"
"            Depth of flow                  0.486    metre"
"            Velocity                       0.825    m/sec"
"            Channel capacity               9.202    c.m/sec"
"            Critical depth                 0.358    metre"
" 53         ROUTE    Channel Route"
"     150.00      Channel Route Reach length   ( metre)"
"       0.433   X-factor <= 0.5"
"     136.302   K-lag   ( seconds)"
"       0.000   Default(0) or user spec.(1) values used"
"       0.480   X-factor <= 0.5"
"     456.900   K-lag   ( seconds)"
"       0.500   Beta weighting factor"
"     150.000   Routing time step   ( seconds)"
"           1   No. of sub-reaches"
```

```
"            Peak outflow                    1.208    c.m/sec"
"                 0.178     1.216     1.208     0.000 c.m/sec"
" 81          ADD COMMENT==================================================="
"           4  Lines of comment"
"              Store routed outflow at junction 1219 to allow design of"
"              Area 121 which is Cambridge extension for theatre and"
"              possible future bookstore"
"                 "
" 40          HYDROGRAPH   Combine    1219"
"             6   Combine "
"          1219   Node #"
"              South of wetlands at Cambridge extension"
"              Maximum flow                    1.208    c.m/sec"
"              Hydrograph volume           43309.950    c.m"
"                   0.178     1.216     1.208     1.208"
" 81          ADD COMMENT==================================================="
"            21  Lines of comment"
"              Model Cambridge extension for cinema & bookstore located "
"              south of 401 and east of No-Name Creek wetlands. "
"              Add wetland area of 0.97 ha north-west of expansion. "
"              Store at internal junction node 121"
"                 "
"              Drainage area              4.2200 ha "
"              Legal area                 4.1005 ha "
"              Wetland                    0.9700 ha "
"              Developable 4.1005-0.97    3.1305 ha "
"              External areas             0.1205 ha comprising: "
"                 Lemoine St.             0.1205 ha    0.0% "
"                 Landscape 5%x3.1305     0.1565 ha    0.0% "
"                 Total pervious          0.2770 ha "
"              Use: "
"              Rooftop area   1211        0.328 ha  100.0% imperv "
"              Roof storage area    0.246 "
"              Parking area   1212        2.420 ha  100.0% imperv "
"              Balance        1213        0.502 ha   45.0% imperv "
"              Wetland        1214        0.970 ha   10.0% imperv "
"              TOTAL          121         4.220 ha   72.7% imperv."
"                 "
" 33          CATCHMENT 1211"
"             4   Linear reservoir"
"             1   Equal length"
"             2   Horton equation"
"          1211   ID number"
"       100.000   % Impervious"
"         0.328   Total Area"
"        10.000   Flow length"
"         0.250   Overland Slope"
"         0.000   Pervious Area"
"        10.000   Pervious length"
"         0.250   Pervious slope"
"         0.328   Impervious Area"
"        10.000   Impervious length"
"         0.250   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        50.000   Pervious Max.infiltration"
"         7.500   Pervious Min.infiltration"
"         0.500   Pervious Lag constant (hours)"
"         5.000   Pervious Depression storage"
"         0.013   Impervious Manning 'n'"
"         0.000   Impervious Max.infiltration"
"         0.000   Impervious Min.infiltration"
"         0.500   Impervious Lag constant (hours)"
"         1.500   Impervious Depression storage"
"                   0.041     1.216     1.208     1.208 c.m/sec"
"              Catchment 1211          Pervious   Impervious Total Area "
"              Surface Area            0.000      0.328      0.328      hectare"
```



```
"              Time of concentration  18.397     2.686     2.686     minutes"
"              Time to Centroid       167.561    171.189   171.189   minutes"
"              Rainfall depth         67.300     67.300    67.300    mm"
"              Rainfall volume        0.00       0.00      0.00      c.m"
"              Rainfall losses        67.300     67.300    67.300    mm"
"              Runoff depth           0.000      0.000     0.000     mm"
"              Runoff volume          0.00       215.82    215.82    c.m"
"              Maximum flow           0.000      0.041     0.041     c.m/sec"
" 40          HYDROGRAPH Start - New Tributary"
"             2   Start - New Tributary"
"                   0.041     0.000     1.208     1.208"
" 40          HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                   0.041     0.041     1.208     1.208"
" 54          POND DESIGN"
"         0.041   Current peak flow    c.m/sec"
"         220.0   Hydrograph volume    c.m/sec"
"           11.   Number of stages"
"         0.000   Minimum water level    c.m/sec"
"         0.150   Maximum water level    c.m/sec"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                   0.000     0.000      0.0"
"                   0.015     0.001      3.9"
"                   0.030     0.002     30.3"
"                   0.045     0.004     67.2"
"                   0.060     0.005    104.1"
"                   0.075     0.006    141.0"
"                   0.090     0.007    177.9"
"                   0.105     0.008    214.8"
"                   0.120     0.010    251.7"
"                   0.135     0.011    288.6"
"                   0.150     0.012    325.5"
"            1.   ROOFTOP"
"                 Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                   hectare     hectare    sq.metre  L/min/25mm      g H:1V"
"                     0.328       0.246     450.000      24.000     400.000"
"              Using 5 roofdrains on roofstorage area of 2460. square metre"
"              Peak outflow                    0.006    c.m/sec"
"              Maximum level                   0.072    metre"
"              Maximum storage               134.253    c.m"
"              Centroidal lag                  7.984    hours"
"                   0.041     0.041     0.006     1.208 c.m/sec"
" 40          HYDROGRAPH   Combine    121"
"             6   Combine "
"           121   Node #"
"              Cambridge cinema & bookstore"
"              Maximum flow                    0.006    c.m/sec"
"              Hydrograph volume             215.858    c.m"
"                   0.041     0.041     0.006     0.006"
" 40          HYDROGRAPH Start - New Tributary"
"             2   Start - New Tributary"
"                   0.041     0.000     0.006     0.006"
" 81          ADD COMMENT==================================================="
"           3  Lines of comment"
"              Add runoff from parking area for ultimate development."
"              Area = 2.0 h with 4 catchbasins"
"                 "
" 33          CATCHMENT 1212"
"             4   Linear reservoir"
"             1   Equal length"
"             2   Horton equation"
"          1212   ID number"
"       100.000   % Impervious"
"         2.420   Total Area"
"        30.000   Flow length"
```

```
"        1.500   Overland Slope"
"        0.000   Pervious Area"
"       30.000   Pervious length"
"        1.500   Pervious slope"
"        2.420   Impervious Area"
"       30.000   Impervious length"
"        1.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.303     0.000     0.006     0.006 c.m/sec"
"            Catchment 1212          Pervious   Impervious Total Area "
"            Surface Area            0.000      2.420      2.420      hectare"
"            Time of concentration   20.776     3.033      3.033      minutes"
"            Time to Centroid        168.750    171.362    171.362    minutes"
"            Rainfall depth          67.300     67.300     67.300     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         67.300     67.300     67.300     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           0.00       1592.36    1592.36    c.m"
"            Maximum flow            0.000      0.303      0.303      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.303     0.303     0.006     0.006"
" 54         POND DESIGN"
"      0.303   Current peak flow    c.m/sec"
"     1600.0   Hydrograph volume    c.m/sec"
"       21.    Number of stages"
"     92.700   Minimum water level    c.m/sec"
"     94.500   Maximum water level    c.m/sec"
"          0   Keep Design Data: 1 = True; 0 = False"
"              Level Discharge    Volume"
"             92.700     0.000       0.0"
"             92.790     0.014       0.0"
"             92.880     0.050       0.0"
"             92.970     0.069       0.0"
"             93.060     0.083       0.0"
"             93.150     0.096       0.0"
"             93.240     0.107       0.0"
"             93.330     0.117       0.0"
"             93.420     0.126       0.0"
"             93.510     0.135       0.0"
"             93.600     0.143       0.0"
"             93.690     0.150       0.0"
"             93.780     0.158      16.1"
"             93.870     0.165     154.4"
"             93.960     0.171     552.2"
"             94.050     0.178    1347.0"
"             94.140     0.184    2676.2"
"             94.230     0.190    4677.3"
"             94.320     0.196    7487.4"
"             94.410     0.201   11244.4"
"             94.500     0.207   16085.1"
"        1.   ORIFICES"
"             Orifice   Orifice   Orifice Number of"
"              invert coefficie  diameter  orifices"
"             92.700     0.630     0.120     5.000"
"        1.   WEDGES"
"              Wedge   Grade 1   Grade 2     Angle    Number"
```



```
"              invert    g1H:1V    g2H:1V subtended of wedges"
"              93.700    50.000   120.000    90.000    20.000"
"           Peak outflow                    0.166     c.m/sec"
"           Maximum level                  93.881     metre"
"           Maximum storage               201.956     c.m"
"           Centroidal lag                  2.971     hours"
"              0.303     0.303     0.166     0.006 c.m/sec"
" 40         HYDROGRAPH   Combine    121"
"          6   Combine "
"        121   Node #"
"              Cambridge cinema & bookstore"
"           Maximum flow                    0.171     c.m/sec"
"           Hydrograph volume            1843.839     c.m"
"                 0.303     0.303     0.166     0.171"
" 81         ADD COMMENT================================================="
"          2  Lines of comment"
"             Add balance of area = 0.632 h at 72% imperv."
"              "
" 40         HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                0.303     0.000     0.166     0.171"
" 33         CATCHMENT 1213"
"          4   Linear reservoir"
"          1   Equal length"
"          2   Horton equation"
"       1213   ID number"
"     45.000   % Impervious"
"      0.502   Total Area"
"     30.000   Flow length"
"      1.000   Overland Slope"
"      0.276   Pervious Area"
"     30.000   Pervious length"
"      1.000   Pervious slope"
"      0.226   Impervious Area"
"     30.000   Impervious length"
"      1.000   Impervious slope"
"      0.250   Pervious Manning 'n'"
"     50.000   Pervious Max.infiltration"
"      7.500   Pervious Min.infiltration"
"      0.500   Pervious Lag constant (hours)"
"      5.000   Pervious Depression storage"
"      0.013   Impervious Manning 'n'"
"      0.000   Impervious Max.infiltration"
"      0.000   Impervious Min.infiltration"
"      0.500   Impervious Lag constant (hours)"
"      1.500   Impervious Depression storage"
"                0.039     0.000     0.166     0.171 c.m/sec"
"            Catchment 1213          Pervious   Impervious Total Area "
"            Surface Area            0.276      0.226      0.502      hectare"
"            Time of concentration   23.463     3.426      6.910      minutes"
"            Time to Centroid        170.094    171.559    171.304    minutes"
"            Rainfall depth          67.300     67.300     67.300     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         67.300     67.300     67.300     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           31.29      148.64     179.93     c.m"
"            Maximum flow            0.013      0.028      0.039      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.039     0.039     0.166     0.171"
" 40         HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                0.039     0.039     0.039     0.171"
" 40         HYDROGRAPH   Combine    121"
"          6   Combine "
"        121   Node #"
```

```
"              Cambridge cinema & bookstore"
"            Maximum flow                    0.208    c.m/sec"
"            Hydrograph volume            2023.772    c.m"
"                  0.039     0.039     0.039     0.208"
" 81         ADD COMMENT==========================================="
"          3  Lines of comment"
"             Add runoff from triangular area north-west wetlands with "
"             nominal 10% of impervious to account for ponded surface "
"                 "
" 33         CATCHMENT 1214"
"            4   Linear reservoir"
"            1   Equal length"
"            2   Horton equation"
"         1214   ID number"
"       10.000   % Impervious"
"        0.970   Total Area"
"       30.000   Flow length"
"        1.000   Overland Slope"
"        0.873   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        0.097   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.050     0.039     0.039     0.208 c.m/sec"
"             Catchment 1214          Pervious   Impervious Total Area "
"             Surface Area            0.873      0.097      0.970      hectare"
"             Time of concentration   19.058     2.783      12.676     minutes"
"             Time to Centroid        167.891    171.237    169.203    minutes"
"             Rainfall depth          67.300     67.300     67.300     mm"
"             Rainfall volume         0.00       0.00       0.00       c.m"
"             Rainfall losses         67.300     67.300     67.300     mm"
"             Runoff depth            0.000      0.000      0.000      mm"
"             Runoff volume           98.94      63.83      162.76     c.m"
"             Maximum flow            0.040      0.012      0.050      c.m/sec"
" 40         HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                  0.050     0.000     0.039     0.208"
" 40         HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                  0.050     0.050     0.039     0.208"
" 40         HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                  0.050     0.050     0.050     0.208"
" 40         HYDROGRAPH   Combine    121"
"            6   Combine "
"          121   Node #"
"              Cambridge cinema & bookstore"
"             Maximum flow                    0.258    c.m/sec"
"             Hydrograph volume            2186.534    c.m"
"                  0.050     0.050     0.050     0.258"
" 37         START/RE-START TOTALS 1214"
"            2   Runoff Totals reset to ZERO"
"             Catchment area to node 121                 4.220    hectare"
"             Impervious area to node 121                3.071    hectare"
"             % impervious to node 121                  72.770"
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"             Peak runoff to node 121                    0.433    c.m/sec"
"             Total volume to node 121                2150.9      c.m"
" 81         ADD COMMENT==========================================="
"          4  Lines of comment"
"             Recover total flow from junction 121 and re-design channel "
"             down Lemoine Street road allowance to upstream end of "
"             culvert under Bell Blvd."
"                 "
" 40         HYDROGRAPH   Confluence    121"
"            7   Confluence "
"          121   Node #"
"              Cambridge cinema & bookstore"
"             Maximum flow                    0.258    c.m/sec"
"             Hydrograph volume            2186.534    c.m"
"                  0.050     0.258     0.050     0.000"
" 40         HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                  0.050     0.258     0.258     0.000"
" 40         HYDROGRAPH   Combine    1219"
"            6   Combine "
"         1219   Node #"
"              South of wetlands at Cambridge extension"
"             Maximum flow                    1.271    c.m/sec"
"             Hydrograph volume           45496.480    c.m"
"                  0.050     0.258     0.258     1.271"
" 40         HYDROGRAPH   Confluence    1219"
"            7   Confluence "
"         1219   Node #"
"              South of wetlands at Cambridge extension"
"             Maximum flow                    1.271    c.m/sec"
"             Hydrograph volume           45496.480    c.m"
"                  0.050     1.271     0.258     0.000"
" 81         ADD COMMENT==========================================="
"          5  Lines of comment"
"             Route flow through 200m of re-constructed channel"
"             down Lemoine St. road allowance to north intake of"
"             of culvert under bell Blvd.  Channel cross section"
"             has 2m base width and side slopes at 2H:1V and"
"             grade of 0.3%."
" 52         CHANNEL DESIGN"
"         1.271   Current peak flow    c.m/sec"
"         0.040   Manning 'n'"
"            0.   Cross-section type: 0=trapezoidal; 1=general"
"         2.000   Basewidth    metre"
"         2.000   Left bank slope"
"         2.000   Right bank slope"
"         1.100   Channel depth    metre"
"         0.300   Gradient   %"
"              Depth of flow                  0.560    metre"
"              Velocity                       0.728    m/sec"
"              Channel capacity               4.833    c.m/sec"
"              Critical depth                 0.310    metre"
" 53         ROUTE    Channel Route"
"       200.00      Channel Route Reach length   ( metre)"
"         0.254   X-factor <= 0.5"
"       206.016   K-lag   ( seconds)"
"         0.000   Default(0) or user spec.(1) values used"
"         0.480   X-factor <= 0.5"
"       456.900   K-lag   ( seconds)"
"         0.500   Beta weighting factor"
"       300.000   Routing time step   ( seconds)"
"             1   No. of sub-reaches"
"              Peak outflow                   1.268    c.m/sec"
"                   0.050     1.271     1.268     0.000 c.m/sec"
" 81         ADD COMMENT==========================================="
"          7  Lines of comment"
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"            Store total outflow from channel at junction node 111 at "
"            north side of culvert at lemoine Street road allowance and "
"            Bell Blvd."
"            This will allow processing of runoff from areas:  "
"            123 (Pronigo) "
"            111 (Cream of the Crop, and "
"            130  (D.J.H. Development) "
" 40          HYDROGRAPH   Combine    111"
"           6   Combine "
"         111   Node #"
"               Lemoine and Bell Blvd (North side)"
"            Maximum flow                    1.268    c.m/sec"
"            Hydrograph volume           45453.750    c.m"
"                  0.050     1.271     1.268     1.268"
" 81          ADD COMMENT================================================="
"          14  Lines of comment"
"            Pronego property: (area 123)"
"            Drainage area                3.471 ha "
"            Legal area                   2.980 ha "
"            External areas               0.491 ha comprising: "
"               Bell Blvd                 0.363 ha   65.0 imperv% "
"               Lemoine St.               0.128 ha    0.0% "
"               Landscape 5%x2.98         0.149 ha    0.0% "
"               Total pervious            0.404 ha "
"            Use:"
"            Rooftop area   1231          1.060 ha  100.0% imperv "
"            Parking area   1232          1.221 ha  100.0% imperv "
"            Balance        1233          1.190 ha   66.0% imperv "
"            TOTAL          123           3.471 ha   88.3% imperv."
"              "
" 33          CATCHMENT 1231"
"             4   Linear reservoir"
"             1   Equal length"
"             2   Horton equation"
"          1231   ID number"
"       100.000   % Impervious"
"         1.060   Total Area"
"        10.000   Flow length"
"         1.000   Overland Slope"
"         0.000   Pervious Area"
"        10.000   Pervious length"
"         1.000   Pervious slope"
"         1.060   Impervious Area"
"        10.000   Impervious length"
"         1.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        50.000   Pervious Max.infiltration"
"         7.500   Pervious Min.infiltration"
"         0.500   Pervious Lag constant (hours)"
"         5.000   Pervious Depression storage"
"         0.013   Impervious Manning 'n'"
"         0.000   Impervious Max.infiltration"
"         0.000   Impervious Min.infiltration"
"         0.500   Impervious Lag constant (hours)"
"         1.500   Impervious Depression storage"
"                   0.133     1.271     1.268     1.268 c.m/sec"
"                Catchment 1231          Pervious   Impervious Total Area "
"                Surface Area            0.000      1.060      1.060      hectare"
"                Time of concentration   12.137     1.772      1.772      minutes"
"                Time to Centroid        164.431    170.732    170.732    minutes"
"                Rainfall depth          67.300     67.300     67.300     mm"
"                Rainfall volume         0.00       0.00       0.00       c.m"
"                Rainfall losses         67.300     67.300     67.300     mm"
"                Runoff depth            0.000      0.000      0.000      mm"
"                Runoff volume           0.00       697.48     697.48     c.m"
"                Maximum flow            0.000      0.133      0.133      c.m/sec"
```



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" 40          HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                 0.133     0.000     1.268     1.268"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                 0.133     0.133     1.268     1.268"
" 54          POND DESIGN"
"         0.133   Current peak flow     c.m/sec"
"         698.0   Hydrograph volume     c.m/sec"
"           11.   Number of stages"
"         0.000   Minimum water level     c.m/sec"
"         0.200   Maximum water level     c.m/sec"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                   0.000     0.000      0.0"
"                   0.020     0.006      1.9"
"                   0.040     0.012     15.1"
"                   0.060     0.017     50.9"
"                   0.080     0.023    120.6"
"                   0.100     0.029    235.6"
"                   0.120     0.035    391.9"
"                   0.140     0.040    550.9"
"                   0.160     0.046    709.9"
"                   0.180     0.052    868.9"
"                   0.200     0.058   1027.9"
"           1.   ROOFTOP"
"                Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                  hectare     hectare    sq.metre  L/min/25mm       g H:1V"
"                    1.060       0.795     450.000      24.000     100.000"
"              Using 18 roofdrains on roofstorage area of 7950. square metre"
"              Peak outflow                    0.031    c.m/sec"
"              Maximum level                   0.108    metre"
"              Maximum storage               301.333    c.m"
"              Centroidal lag                  4.722    hours"
"                 0.133     0.133     0.031     1.268 c.m/sec"
" 40          HYDROGRAPH   Combine    123"
"           6   Combine "
"         123   Node #"
"               Bradlaw property"
"              Maximum flow                    0.031    c.m/sec"
"              Hydrograph volume             697.671    c.m"
"                    0.133     0.133     0.031     0.031"
" 40          HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                 0.133     0.000     0.031     0.031"
" 33          CATCHMENT 1232"
"             4   Linear reservoir"
"             1   Equal length"
"             2   Horton equation"
"          1232   ID number"
"       100.000   % Impervious"
"         1.221   Total Area"
"        30.000   Flow length"
"         1.000   Overland Slope"
"         0.000   Pervious Area"
"        30.000   Pervious length"
"         1.000   Pervious slope"
"         1.221   Impervious Area"
"        30.000   Impervious length"
"         1.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        50.000   Pervious Max.infiltration"
"         7.500   Pervious Min.infiltration"
"         0.500   Pervious Lag constant (hours)"
"         5.000   Pervious Depression storage"
"         0.013   Impervious Manning 'n'"
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"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.152     0.000     0.031     0.031 c.m/sec"
"             Catchment 1232          Pervious   Impervious Total Area "
"             Surface Area            0.000      1.221      1.221      hectare"
"             Time of concentration   23.463     3.426      3.426      minutes"
"             Time to Centroid        170.094    171.559    171.559    minutes"
"             Rainfall depth          67.300     67.300     67.300     mm"
"             Rainfall volume         0.00       0.00       0.00       c.m"
"             Rainfall losses         67.300     67.300     67.300     mm"
"             Runoff depth            0.000      0.000      0.000      mm"
"             Runoff volume           0.00       803.42     803.42     c.m"
"             Maximum flow            0.000      0.152      0.152      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                    0.152     0.152     0.031     0.031"
" 54          POND DESIGN"
"         0.152   Current peak flow    c.m/sec"
"         804.0   Hydrograph volume    c.m/sec"
"           21.   Number of stages"
"        90.900   Minimum water level    c.m/sec"
"        92.200   Maximum water level    c.m/sec"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                   90.900     0.000      0.0"
"                   90.965     0.007      0.0"
"                   91.030     0.028      0.0"
"                   91.095     0.041      0.0"
"                   91.160     0.050      0.0"
"                   91.225     0.058      0.0"
"                   91.290     0.065      0.0"
"                   91.355     0.071      0.0"
"                   91.420     0.077      0.0"
"                   91.485     0.082      0.0"
"                   91.550     0.087      0.0"
"                   91.615     0.092      0.0"
"                   91.680     0.096      0.0"
"                   91.745     0.101      0.0"
"                   91.810     0.105      0.0"
"                   91.875     0.109      0.0"
"                   91.940     0.112      1.7"
"                   92.005     0.116     30.3"
"                   92.070     0.120    128.6"
"                   92.135     0.123    339.8"
"                   92.200     0.126    706.8"
"             1.    ORIFICES"
"                   Orifice   Orifice   Orifice Number of"
"                    invert coefficie  diameter  orifices"
"                    90.900     0.630     0.102     5.000"
"             1.    WEDGES"
"                     Wedge   Grade 1   Grade 2     Angle    Number"
"                    invert    g1H:1V    g2H:1V subtended of wedges"
"                    91.900    50.000   100.000    90.000    20.000"
"                  Peak outflow                    0.116    c.m/sec"
"                  Maximum level                  92.000    metre"
"                  Maximum storage                27.923    c.m"
"                  Centroidal lag                  2.880    hours"
"                       0.152     0.152     0.116     0.031 c.m/sec"
" 40              HYDROGRAPH   Combine    123"
"               6   Combine "
"             123   Node #"
"                   Bradlaw property"
"                  Maximum flow                    0.146    c.m/sec"
"                  Hydrograph volume            1492.199    c.m"
```



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"                       0.152     0.152     0.116     0.146"
" 40              HYDROGRAPH Start - New Tributary"
"               2   Start - New Tributary"
"                       0.152     0.000     0.116     0.146"
" 33              CATCHMENT 1233"
"               4   Linear reservoir"
"               1   Equal length"
"               2   Horton equation"
"            1233   ID number"
"          66.000   % Impervious"
"           1.190   Total Area"
"          35.000   Flow length"
"           1.000   Overland Slope"
"           0.405   Pervious Area"
"          35.000   Pervious length"
"           1.000   Pervious slope"
"           0.785   Impervious Area"
"          35.000   Impervious length"
"           1.000   Impervious slope"
"           0.250   Pervious Manning 'n'"
"          50.000   Pervious Max.infiltration"
"           7.500   Pervious Min.infiltration"
"           0.500   Pervious Lag constant (hours)"
"           5.000   Pervious Depression storage"
"           0.013   Impervious Manning 'n'"
"           0.000   Impervious Max.infiltration"
"           0.000   Impervious Min.infiltration"
"           0.500   Impervious Lag constant (hours)"
"           1.500   Impervious Depression storage"
"                       0.113     0.000     0.116     0.146 c.m/sec"
"                Catchment 1233          Pervious   Impervious Total Area "
"                Surface Area            0.405      0.785      1.190      hectare"
"                Time of concentration   25.737     3.758      5.549      minutes"
"                Time to Centroid        171.231    171.725    171.684    minutes"
"                Rainfall depth          67.300     67.300     67.300     mm"
"                Rainfall volume         0.00       0.00       0.00       c.m"
"                Rainfall losses         67.300     67.300     67.300     mm"
"                Runoff depth            0.000      0.000      0.000      mm"
"                Runoff volume           45.85      516.79     562.65     c.m"
"                Maximum flow            0.018      0.098      0.113      c.m/sec"
" 40              HYDROGRAPH Add Runoff "
"               4   Add Runoff "
"                       0.113     0.113     0.116     0.146"
" 40              HYDROGRAPH Copy to Outflow"
"               8   Copy to Outflow"
"                       0.113     0.113     0.113     0.146"
" 40              HYDROGRAPH   Combine    123"
"               6   Combine "
"             123   Node #"
"                   Bradlaw property"
"                  Maximum flow                    0.257    c.m/sec"
"                  Hydrograph volume            2054.844    c.m"
"                       0.113     0.113     0.113     0.257"
" 37              START/RE-START TOTALS 1233"
"               2   Runoff Totals reset to ZERO"
"                  Catchment area to node 123                 3.471    hectare"
"                  Impervious area to node 123                3.066    hectare"
"                  % impervious to node 123                  88.343"
"                  Peak runoff to node 123                    0.398    c.m/sec"
"                  Total volume to node 123                2063.5      c.m"
" 81              ADD COMMENT================================================="
"               2   Lines of comment"
"                   Add Pronego runoff to junction node 111 on north end of"
"                   culvert under Bell Blvd."
" 40              HYDROGRAPH   Confluence    123"
"               7   Confluence "
```

```
"          123   Node #"
"                Bradlaw property"
"             Maximum flow                    0.257    c.m/sec"
"             Hydrograph volume            2054.844    c.m"
"                   0.113     0.257     0.113     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"              8   Copy to Outflow"
"                   0.113     0.257     0.257     0.000"
" 40          HYDROGRAPH   Combine    111"
"              6   Combine "
"          111   Node #"
"                Lemoine and Bell Blvd (North side)"
"             Maximum flow                    1.337    c.m/sec"
"             Hydrograph volume            47508.600    c.m"
"                   0.113     0.257     0.257     1.337"
" 81          ADD COMMENT================================================="
"           17  Lines of comment"
"             D.J.H. Development property: (area 130)  "
"             Assume this enters creek at upstream end of culvert "
"             under Bell Blvd. "
"             Drainage area                 1.514 ha "
"             Legal area                    1.188 ha "
"             External areas                0.326 ha comprising: "
"                Bell Blvd                  0.238 ha   58.0 imperv% "
"                Lemoine St.                0.088 ha   37.5% "
"                Landscape 5%x1.188         0.059 ha    0.0% "
"                Total pervious             0.214 ha "
"             Use: "
"                  "
"               1301        0.363 ha  100.0% imperv ""
"             Parking area   1302         0.484 ha  100.0% imperv "
"             Balance        1303         0.667 ha   67.9% imperv "
"             TOTAL          130          1.514 ha   85.9% imperv."
"                  "
" 33          CATCHMENT 1301"
"             4   Linear reservoir"
"             1   Equal length"
"             2   Horton equation"
"          1301   ID number"
"       100.000   % Impervious"
"         0.363   Total Area"
"        10.000   Flow length"
"         0.750   Overland Slope"
"         0.000   Pervious Area"
"        10.000   Pervious length"
"         0.750   Pervious slope"
"         0.363   Impervious Area"
"        10.000   Impervious length"
"         0.750   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        50.000   Pervious Max.infiltration"
"         7.500   Pervious Min.infiltration"
"         0.500   Pervious Lag constant (hours)"
"         5.000   Pervious Depression storage"
"         0.013   Impervious Manning 'n'"
"         0.000   Impervious Max.infiltration"
"         0.000   Impervious Min.infiltration"
"         0.500   Impervious Lag constant (hours)"
"         1.500   Impervious Depression storage"
"                   0.046     0.257     0.257     1.337 c.m/sec"
"             Catchment 1301          Pervious   Impervious Total Area "
"             Surface Area            0.000      0.363      0.363      hectare"
"             Time of concentration   13.231     1.932      1.932      minutes"
"             Time to Centroid        164.978    170.812    170.812    minutes"
"             Rainfall depth          67.300     67.300     67.300     mm"
"             Rainfall volume         0.00       0.00       0.00       c.m"
```



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"             Rainfall losses         67.300     67.300     67.300     mm"
"             Runoff depth            0.000      0.000      0.000      mm"
"             Runoff volume           0.00       238.85     238.85     c.m"
"             Maximum flow            0.000      0.046      0.046      c.m/sec"
" 40          HYDROGRAPH Start - New Tributary"
"              2   Start - New Tributary"
"                   0.046     0.000     0.257     1.337"
" 40          HYDROGRAPH Add Runoff "
"              4   Add Runoff "
"                   0.046     0.046     0.257     1.337"
" 54          POND DESIGN"
"         0.046   Current peak flow    c.m/sec"
"         240.0   Hydrograph volume    c.m/sec"
"           11.   Number of stages"
"         0.000   Minimum water level    c.m/sec"
"         0.175   Maximum water level    c.m/sec"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                   0.000     0.000      0.0"
"                   0.018     0.002      0.8"
"                   0.035     0.003      6.1"
"                   0.053     0.005     21.4"
"                   0.070     0.007     49.2"
"                   0.087     0.008     92.5"
"                   0.105     0.010    141.5"
"                   0.123     0.012    190.5"
"                   0.140     0.013    236.8"
"                   0.157     0.015    283.1"
"                   0.175     0.017    332.1"
"            1.   ROOFTOP"
"                 Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                   hectare     hectare    sq.metre  L/min/25mm      g H:1V"
"                     0.363       0.272     450.000      24.000    133.333"
"                 Using 6 roofdrains on roofstorage area of 2723. square metre"
"                 Peak outflow                    0.009    c.m/sec"
"                 Maximum level                   0.095    metre"
"                 Maximum storage               115.294    c.m"
"                 Centroidal lag                  5.346    hours"
"                   0.046     0.046     0.009     1.337 c.m/sec"
" 40          HYDROGRAPH   Combine    130"
"              6   Combine "
"          130   Node #"
"                Hawley-Ming N of Bell"
"             Maximum flow                    0.009    c.m/sec"
"             Hydrograph volume             238.871    c.m"
"                   0.046     0.046     0.009     0.009"
" 40          HYDROGRAPH Start - New Tributary"
"              2   Start - New Tributary"
"                   0.046     0.000     0.009     0.009"
" 33          CATCHMENT 1302"
"             4   Linear reservoir"
"             1   Equal length"
"             2   Horton equation"
"          1302   ID number"
"       100.000   % Impervious"
"         0.484   Total Area"
"        25.000   Flow length"
"         1.000   Overland Slope"
"         0.000   Pervious Area"
"        25.000   Pervious length"
"         1.000   Pervious slope"
"         0.484   Impervious Area"
"        25.000   Impervious length"
"         1.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        50.000   Pervious Max.infiltration"
```

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"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.061     0.000     0.009     0.009 c.m/sec"
"              Catchment 1302          Pervious   Impervious Total Area "
"              Surface Area            0.000      0.484      0.484      hectare"
"              Time of concentration   21.032     3.071      3.071      minutes"
"              Time to Centroid        168.878    171.381    171.381    minutes"
"              Rainfall depth          67.300     67.300     67.300     mm"
"              Rainfall volume         0.00       0.00       0.00       c.m"
"              Rainfall losses         67.300     67.300     67.300     mm"
"              Runoff depth            0.000      0.000      0.000      mm"
"              Runoff volume           0.00       318.47     318.47     c.m"
"              Maximum flow            0.000      0.061      0.061      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                 0.061     0.061     0.009     0.009"
" 54          POND DESIGN"
"        0.061   Current peak flow    c.m/sec"
"        319.0   Hydrograph volume    c.m/sec"
"          21.   Number of stages"
"       90.900   Minimum water level    c.m/sec"
"       92.200   Maximum water level    c.m/sec"
"           0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge    Volume"
"                 90.900     0.000      0.0"
"                 90.965     0.003      0.0"
"                 91.030     0.009      0.0"
"                 91.095     0.013      0.0"
"                 91.160     0.016      0.0"
"                 91.225     0.018      0.0"
"                 91.290     0.020      0.0"
"                 91.355     0.022      0.0"
"                 91.420     0.024      0.0"
"                 91.485     0.026      0.0"
"                 91.550     0.027      0.0"
"                 91.615     0.029      0.0"
"                 91.680     0.030      0.0"
"                 91.745     0.031      0.0"
"                 91.810     0.033      0.0"
"                 91.875     0.034      0.0"
"                 91.940     0.035      0.8"
"                 92.005     0.036     14.7"
"                 92.070     0.037     62.3"
"                 92.135     0.038    164.4"
"                 92.200     0.040    342.1"
"           1.   ORIFICES"
"                Orifice   Orifice   Orifice Number of"
"                 invert coefficie  diameter  orifices"
"                 90.900     0.630     0.090     2.000"
"           1.   WEDGES"
"                  Wedge   Grade 1   Grade 2     Angle    Number"
"                 invert    g1H:1V    g2H:1V subtended of wedges"
"                 91.900    55.000   110.000    90.000     8.000"
"              Peak outflow                    0.037    c.m/sec"
"              Maximum level                  92.027    metre"
"              Maximum storage                30.933    c.m"
"              Centroidal lag                  2.933   hours"
"                 0.061     0.061     0.037     0.009 c.m/sec"
" 40          HYDROGRAPH   Combine    130"
"           6   Combine "
```



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"         130   Node #"
"               Hawley-Ming N of Bell"
"             Maximum flow                  0.045    c.m/sec"
"             Hydrograph volume           564.323    c.m"
"                   0.061     0.061     0.037     0.045"
" 40          HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                   0.061     0.000     0.037     0.045"
" 33          CATCHMENT 1303"
"           4   Linear reservoir"
"           1   Equal length"
"           2   Horton equation"
"        1303   ID number"
"      67.900   % Impervious"
"       0.667   Total Area"
"      20.000   Flow length"
"       1.000   Overland Slope"
"       0.214   Pervious Area"
"      20.000   Pervious length"
"       1.000   Pervious slope"
"       0.453   Impervious Area"
"      20.000   Impervious length"
"       1.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      50.000   Pervious Max.infiltration"
"       7.500   Pervious Min.infiltration"
"       0.500   Pervious Lag constant (hours)"
"       5.000   Pervious Depression storage"
"       0.013   Impervious Manning 'n'"
"       0.000   Impervious Max.infiltration"
"       0.000   Impervious Min.infiltration"
"       0.500   Impervious Lag constant (hours)"
"       1.500   Impervious Depression storage"
"                 0.066     0.000     0.037     0.045 c.m/sec"
"              Catchment 1303          Pervious   Impervious Total Area "
"              Surface Area            0.214      0.453      0.667      hectare"
"              Time of concentration   18.397     2.686      3.869      minutes"
"              Time to Centroid        167.561    171.189    170.915    minutes"
"              Rainfall depth          67.300     67.300     67.300     mm"
"              Rainfall volume         0.00       0.00       0.00       c.m"
"              Rainfall losses         67.300     67.300     67.300     mm"
"              Runoff depth            0.000      0.000      0.000      mm"
"              Runoff volume           24.26      298.00     322.27     c.m"
"              Maximum flow            0.010      0.057      0.066      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                 0.066     0.066     0.037     0.045"
" 40          HYDROGRAPH Copy to Outflow"
"           8   Copy to Outflow"
"                 0.066     0.066     0.066     0.045"
" 40          HYDROGRAPH   Combine    130"
"           6   Combine "
"         130   Node #"
"               Hawley-Ming N of Bell"
"             Maximum flow                  0.111    c.m/sec"
"             Hydrograph volume           886.592    c.m"
"                   0.066     0.066     0.066     0.111"
" 37          START/RE-START TOTALS 1303"
"           2   Runoff Totals reset to ZERO"
"              Catchment area to node 130                 1.514    hectare"
"              Impervious area to node 130                1.300    hectare"
"              % impervious to node 130                  85.858"
"              Peak runoff to node 130                    0.172    c.m/sec"
"              Total volume to node 130                 879.6      c.m"
" 81          ADD COMMENT================================================="
"           2   Lines of comment"
```

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"          Recover flow from junction node 130 and add to total flow "
"          at junction 111"
" 40       HYDROGRAPH   Confluence    130"
"        7   Confluence "
"      130   Node #"
"            Hawley-Ming N of Bell"
"          Maximum flow                  0.111    c.m/sec"
"          Hydrograph volume           886.592    c.m"
"                0.066     0.111     0.066     0.000"
" 40       HYDROGRAPH Copy to Outflow"
"        8   Copy to Outflow"
"                0.066     0.111     0.111     0.000"
" 40       HYDROGRAPH   Combine    111"
"        6   Combine "
"      111   Node #"
"            Lemoine and Bell Blvd (North side)"
"          Maximum flow                  1.364    c.m/sec"
"          Hydrograph volume         48395.200    c.m"
"                0.066     0.111     0.111     1.364"
" 81       ADD COMMENT==========================================================="
"        1  Lines of comment"
"           Now route through culvert under Bell Blvd."
" 40       HYDROGRAPH   Confluence    111"
"        7   Confluence "
"      111   Node #"
"            Lemoine and Bell Blvd (North side)"
"          Maximum flow                  1.364    c.m/sec"
"          Hydrograph volume         48395.190    c.m"
"                0.066     1.364     0.111     0.000"
" 51       PIPE DESIGN"
"      1.364   Current peak flow    c.m/sec"
"      0.013   Manning 'n'"
"      1.500   Diameter    metre"
"      1.000   Gradient   %"
"          Depth of flow                 0.447    metre"
"          Velocity                      3.092    m/sec"
"          Pipe capacity                 7.069    c.m/sec"
"          Critical depth                0.595    metre"
" 53       ROUTE    Pipe Route"
"     25.00       Pipe Route Reach length   ( metre)"
"      0.020   X-factor <= 0.5"
"      6.064   K-lag   ( seconds)"
"      0.000   Default(0) or user spec.(1) values used"
"      0.480   X-factor <= 0.5"
"    456.900   K-lag   ( seconds)"
"      0.500   Beta weighting factor"
"     11.842   Routing time step   ( seconds)"
"          1   No. of sub-reaches"
"          Peak outflow                  1.364    c.m/sec"
"                0.066     1.364     1.364     0.000 c.m/sec"
" 40       HYDROGRAPH   Combine    114"
"        6   Combine "
"      114   Node #"
"            Upstream of sediment forebay"
"          Maximum flow                  1.364    c.m/sec"
"          Hydrograph volume         48393.930    c.m"
"                0.066     1.364     1.364     1.364"
" 81       ADD COMMENT==========================================================="
"        7  Lines of comment"
"           Process area 111.  This comprises Cream of the Crop on "
"           north side of Bell Blvd. and generally west of No-Name "
"           creek. All runoff assumed to go to Bell Blvd."
"           Runoff from West of culvert enters through a 450 mm storm"
"           on south side of Bell Blvd. entering No-Name Creek at"
"           Lemoine St. at south (downstream) side of culvert."
"                "
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" 81       ADD COMMENT==========================================================="
"       19  Lines of comment"
"           Cream of the Crop property: (area 111)"
"           Area 111 comprises part of Cream-of-the-Crop only"
"           Total area 5.866 ha drains to 450 mm storm"
"           on south side of Bell Blvd. flowing east to Lemoine St "
"           culvert (downstream). "
"                "
"           Drainage area                 5.866 ha "
"           Legal area                    5.288 ha "
"           External areas                0.578 ha comprising: "
"              Bell Blvd                  0.370 ha   44.0 imperv% "
"              Lemoine St.                0.208 ha   17.3% "
"              Landscape 5%x5.288         0.264 ha    0.0% "
"              Total pervious             0.643 ha "
"           Use: "
"           Rooftop area   1111          1.760 ha  100.0% imperv "
"           Parking area   1112          2.737 ha  100.0% imperv "
"           Balance        1113          1.369 ha   53.0% imperv "
"           TOTAL          111           5.866 ha   89.0% imperv."
"                "
" 40       HYDROGRAPH Start - New Tributary"
"        2   Start - New Tributary"
"                0.066     0.000     1.364     1.364"
" 33       CATCHMENT 1111"
"        4   Linear reservoir"
"        1   Equal length"
"        2   Horton equation"
"     1111   ID number"
"  100.000   % Impervious"
"    1.760   Total Area"
"   10.000   Flow length"
"    0.750   Overland Slope"
"    0.000   Pervious Area"
"   10.000   Pervious length"
"    0.750   Pervious slope"
"    1.760   Impervious Area"
"   10.000   Impervious length"
"    0.750   Impervious slope"
"    0.250   Pervious Manning 'n'"
"   50.000   Pervious Max.infiltration"
"    7.500   Pervious Min.infiltration"
"    0.500   Pervious Lag constant (hours)"
"    5.000   Pervious Depression storage"
"    0.013   Impervious Manning 'n'"
"    0.000   Impervious Max.infiltration"
"    0.000   Impervious Min.infiltration"
"    0.500   Impervious Lag constant (hours)"
"    1.500   Impervious Depression storage"
"                0.221     0.000     1.364     1.364 c.m/sec"
"            Catchment 1111          Pervious  Impervious Total Area "
"            Surface Area            0.000     1.760     1.760     hectare"
"            Time of concentration   13.231    1.932     1.932     minutes"
"            Time to Centroid        164.978   170.812   170.812   minutes"
"            Rainfall depth          67.300    67.300    67.300    mm"
"            Rainfall volume         0.00      0.00      0.00      c.m"
"            Rainfall losses         67.300    67.300    67.300    mm"
"            Runoff depth            0.000     0.000     0.000     mm"
"            Runoff volume           0.00      1158.08   1158.08   c.m"
"            Maximum flow            0.000     0.221     0.221     c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"        4   Add Runoff "
"                0.221     0.221     1.364     1.364"
" 54       POND DESIGN"
"      0.221   Current peak flow    c.m/sec"
"     1160.0   Hydrograph volume    c.m/sec"
```

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"          11.   Number of stages"
"       0.000    Minimum water level    c.m/sec"
"       0.175    Maximum water level    c.m/sec"
"           0    Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                  0.000     0.000      0.0"
"                  0.018     0.008      4.1"
"                  0.035     0.016     29.8"
"                  0.053     0.025    103.5"
"                  0.070     0.032    238.5"
"                  0.087     0.040    448.4"
"                  0.105     0.049    686.0"
"                  0.123     0.057    923.6"
"                  0.140     0.065   1148.0"
"                  0.157     0.073   1372.4"
"                  0.175     0.081   1610.0"
"         1.   ROOFTOP"
"              Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                hectare     hectare   sq.metre   L/min/25mm      g H:1V"
"                  1.760       1.320     450.000      24.000     133.333"
"            Using 29 roofdrains on roofstorage area of 13200. square metre"
"            Peak outflow                   0.044    c.m/sec"
"            Maximum level                  0.095    metre"
"            Maximum storage              559.900    c.m"
"            Centroidal lag                 5.357    hours"
"                  0.221     0.221     0.044     1.364 c.m/sec"
" 40       HYDROGRAPH   Combine    1114"
"          6   Combine "
"       1114   Node #"
"              Quickert property"
"            Maximum flow                   0.044    c.m/sec"
"            Hydrograph volume           1158.136    c.m"
"                  0.221     0.221     0.044     0.044"
" 40       HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                  0.221     0.000     0.044     0.044"
" 33       CATCHMENT 1112"
"          4   Linear reservoir"
"          1   Equal length"
"          2   Horton equation"
"       1112   ID number"
"    100.000   % Impervious"
"      2.737   Total Area"
"     25.000   Flow length"
"      1.000   Overland Slope"
"      0.000   Pervious Area"
"     25.000   Pervious length"
"      1.000   Pervious slope"
"      2.737   Impervious Area"
"     25.000   Impervious length"
"      1.000   Impervious slope"
"      0.250   Pervious Manning 'n'"
"     50.000   Pervious Max.infiltration"
"      7.500   Pervious Min.infiltration"
"      0.500   Pervious Lag constant (hours)"
"      5.000   Pervious Depression storage"
"      0.013   Impervious Manning 'n'"
"      0.000   Impervious Max.infiltration"
"      0.000   Impervious Min.infiltration"
"      0.500   Impervious Lag constant (hours)"
"      1.500   Impervious Depression storage"
"                0.342     0.000     0.044     0.044 c.m/sec"
"            Catchment 1112          Pervious   Impervious Total Area "
"            Surface Area            0.000      2.737      2.737      hectare"
"            Time of concentration  21.032      3.071      3.071      minutes"
"            Time to Centroid      168.878    171.381    171.381      minutes"
```



```
"            Rainfall depth         67.300     67.300     67.300     mm"
"            Rainfall volume         0.00       0.00       0.00      c.m"
"            Rainfall losses        67.300     67.300     67.300     mm"
"            Runoff depth            0.000      0.000      0.000     mm"
"            Runoff volume           0.00    1800.94    1800.94      c.m"
"            Maximum flow            0.000      0.342      0.342     c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.342     0.342     0.044     0.044"
" 54       POND DESIGN"
"       0.342    Current peak flow    c.m/sec"
"      1810.0    Hydrograph volume    c.m/sec"
"          11.   Number of stages"
"      93.900    Minimum water level    c.m/sec"
"      95.200    Maximum water level    c.m/sec"
"           0    Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                 93.900     0.000      0.0"
"                 94.030     0.047      0.0"
"                 94.160     0.079      0.0"
"                 94.290     0.102      0.0"
"                 94.420     0.120      0.0"
"                 94.550     0.136      0.0"
"                 94.680     0.151      0.0"
"                 94.810     0.164      0.0"
"                 94.940     0.176      3.4"
"                 95.070     0.187    257.2"
"                 95.200     0.198   1413.7"
"          1.   ORIFICES"
"               Orifice   Orifice   Orifice Number of"
"                invert coefficie  diameter  orifices"
"                93.900     0.630     0.090    10.000"
"          1.   WEDGES"
"                Wedge   Grade 1   Grade 2     Angle    Number"
"                invert    g1H:1V    g2H:1V subtended of wedges"
"                94.900    50.000   100.000    90.000    40.000"
"            Peak outflow                   0.186    c.m/sec"
"            Maximum level                 95.058    metre"
"            Maximum storage              234.050    c.m"
"            Centroidal lag                 2.975    hours"
"                0.342     0.342     0.186     0.044 c.m/sec"
" 40       HYDROGRAPH   Combine    1114"
"          6   Combine "
"       1114   Node #"
"              Quickert property"
"            Maximum flow                   0.228    c.m/sec"
"            Hydrograph volume           2991.510    c.m"
"                0.342     0.342     0.186     0.228"
" 40       HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                0.342     0.000     0.186     0.228"
" 33       CATCHMENT 1113"
"          4   Linear reservoir"
"          1   Equal length"
"          2   Horton equation"
"       1113   ID number"
"     53.000   % Impervious"
"      1.369   Total Area"
"     20.000   Flow length"
"      1.000   Overland Slope"
"      0.643   Pervious Area"
"     20.000   Pervious length"
"      1.000   Pervious slope"
"      0.726   Impervious Area"
"     20.000   Impervious length"
"      1.000   Impervious slope"
```

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"       0.250   Pervious Manning 'n'"
"      50.000   Pervious Max.infiltration"
"       7.500   Pervious Min.infiltration"
"       0.500   Pervious Lag constant (hours)"
"       5.000   Pervious Depression storage"
"       0.013   Impervious Manning 'n'"
"       0.000   Impervious Max.infiltration"
"       0.000   Impervious Min.infiltration"
"       0.500   Impervious Lag constant (hours)"
"       1.500   Impervious Depression storage"
"                 0.120     0.000     0.186     0.228 c.m/sec"
"            Catchment 1113          Pervious   Impervious Total Area "
"            Surface Area            0.643      0.726      1.369      hectare"
"            Time of concentration   18.397     2.686      4.768      minutes"
"            Time to Centroid        167.561    171.189    170.708    minutes"
"            Rainfall depth          67.300     67.300     67.300     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         67.300     67.300     67.300     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           72.92      477.43     550.34     c.m"
"            Maximum flow            0.030      0.091      0.120      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                 0.120     0.120     0.186     0.228"
" 40         HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                 0.120     0.120     0.120     0.228"
" 40         HYDROGRAPH   Combine    1114"
"          6   Combine "
"       1114   Node #"
"              Quickert property"
"            Maximum flow                  0.342    c.m/sec"
"            Hydrograph volume          3541.854    c.m"
"                 0.120     0.120     0.120     0.342"
" 37         START/RE-START TOTALS 1113"
"          2   Runoff Totals reset to ZERO"
"            Catchment area to node 1114                 5.866    hectare"
"            Impervious area to node 1114                5.223    hectare"
"            % impervious to node 1114                  89.031"
"            Peak runoff to node 1114                    0.683    c.m/sec"
"            Total volume to node 1114                  3509.4    c.m"
" 37         START/RE-START TOTALS 1113"
"          2   Runoff Totals reset to ZERO"
"            Catchment area to node 1114                 0.000    hectare"
"            Impervious area to node 1114                0.000    hectare"
"            % impervious to node 1114                   0.000"
"            Peak runoff to node 1114                    0.000    c.m/sec"
"            Total volume to node 1114                     0.0    c.m"
" 40         HYDROGRAPH   Confluence    1114"
"          7   Confluence "
"       1114   Node #"
"              Quickert property"
"            Maximum flow                  0.342    c.m/sec"
"            Hydrograph volume          3541.855    c.m"
"                 0.120     0.342     0.120     0.000"
" 81         ADD COMMENT================================================="
"          3  Lines of comment"
"             Assume total runoff flows through the major and minor"
"             system to junction 114 at south end of culvert under"
"             Bell Blvd."
" 51         PIPE DESIGN"
"       0.342   Current peak flow    c.m/sec"
"       0.013   Manning 'n'"
"       0.450   Diameter    metre"
"       0.500   Gradient   %"
"            Surcharged HGL                1.436    %"
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"            Velocity                      2.148    m/sec"
"            Pipe capacity                 0.202    c.m/sec"
"            Critical depth                0.000    metre"
" 53         ROUTE    Pipe Route"
"       200.00      Pipe Route Reach length   ( metre)"
"        0.000   X-factor <= 0.5"
"       45.279   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.480   X-factor <= 0.5"
"      456.900   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"       11.842   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"            Peak outflow                  0.342    c.m/sec"
"                 0.120     0.342     0.342     0.000 c.m/sec"
" 40         HYDROGRAPH   Combine    114"
"          6   Combine "
"        114   Node #"
"              Upstream of sediment forebay"
"            Maximum flow                  1.478    c.m/sec"
"            Hydrograph volume         51935.780    c.m"
"                 0.120     0.342     0.342     1.478"
" 81         ADD COMMENT================================================="
"         11  Lines of comment"
"             Now move east to Bell Blvd. at N.Front Street."
"             Add area 119 at Bell Blvd. and N.Front St."
"             This area is very much smaller than in previous report as "
"             most runoff is directed south on N.Front. St."
"                 "
"             Area comprises:"
"             Shell station less minor flow captured by 2 CBs which is "
"             directed East to N.Front St."
"             CB #3 flows to Quinte Mall drainage network."
"             Area is 0.535 ha at 100% imperv."
"                 "
" 33         CATCHMENT 119"
"            4   Linear reservoir"
"            1   Equal length"
"            2   Horton equation"
"          119   ID number"
"      100.000   % Impervious"
"        0.535   Total Area"
"       30.000   Flow length"
"        1.000   Overland Slope"
"        0.000   Pervious Area"
"       30.000   Pervious length"
"        1.000   Pervious slope"
"        0.535   Impervious Area"
"       30.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.067     0.342     0.342     1.478 c.m/sec"
"             Catchment 119           Pervious   Impervious Total Area "
"             Surface Area            0.000      0.535      0.535      hectare"
"             Time of concentration   23.463     3.426      3.426      minutes"
"             Time to Centroid        170.094    171.559    171.559    minutes"
"             Rainfall depth          67.300     67.300     67.300     mm"
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"            Rainfall volume          0.00        0.00        0.00      c.m"
"            Rainfall losses          67.300      67.300      67.300    mm"
"            Runoff depth             0.000       0.000       0.000     mm"
"            Runoff volume            0.00        352.03      352.03    c.m"
"            Maximum flow             0.000       0.067       0.067     c.m/sec"
" 40         HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                0.067     0.000     0.342     1.478"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.067     0.067     0.342     1.478"
" 81         ADD COMMENT==================================================="
"          4 Lines of comment"
"            Subtract equivalent of 2 x 0.5 cfs or 0.027 c.m/s for "
"            2 CBs using Diversion command."
"            3rd CB flows west to Quinte Mall."
"              "
" 56         DIVERSION"
"        119   Node number"
"      0.027   Overflow threshold"
"     1.0000   Required diverted fraction"
"            Peak of diverted flow          0.040    c.m/sec"
"            Volume of diverted flow       72.359    c.m"
"            DIV00119.100hyd"
"            Excess major runoff to Bell Blvd"
"                0.067     0.067     0.027     1.478 c.m/sec"
" 37         START/RE-START TOTALS 119"
"          2   Runoff Totals reset to ZERO"
"            Catchment area to node 0                    0.535    hectare"
"            Impervious area to node 0                   0.535    hectare"
"            % impervious to node 0                    100.000"
"            Peak runoff to node 0                       0.067    c.m/sec"
"            Total volume to node 0                      352.0    c.m"
" 81         ADD COMMENT==================================================="
"          28  Lines of comment"
"            Cambridge Quinte Mall, OPP, Pub.Wks (112)  "
"            Add runoff from Quinte Mall plus portion from O.P.P lands."
"            On site controls include roof top storage and two groups of"
"            CBs for parking lot storage.  "
"              "
"            Drainage area                 18.3430 ha  "
"            Legal area                    17.5097 ha  "
"              Cambridge          17.0060 "
"              OPP, Pub.Wks.       0.5037 "
"            External areas                 0.8333 ha comprising: "
"               Bell Blvd                   0.7190 ha   63.0 imperv% "
"               MTO ramp                    0.1143 ha    0.0% "
"               Landscape 5%x17.006         0.8503 ha    0.0% "
"               Total pervious              1.2306 ha "
"            Use: "
"            Rooftop area   1121          4.582 ha  100.0% imperv MH 'G' "
"              410 sq.m/RD"
"               "
"              1122         6.990 ha  100.0% imperv MH 'L' ""
"            Parking west    1123         5.310 ha  100.0% imperv "
"            Balance         1124         1.461 ha   15.8% imperv "
"            TOTAL           112         18.343 ha   93.3% imperv."
"              "
"            (See spreadsheet ParkVols.xls for details of available "
"            volumes at 16 CBs.  "
"            East parking   (CBs 1 - 6 & 11 - 13)    Rim.El. 93.07"
"            West parking   (CBs 7 - 10 & 14 - 16)   Rim.El. 91.90"
"              "
" 33         CATCHMENT 1121"
"          4   Linear reservoir"
"          1   Equal length"
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"            2   Horton equation"
"         1121   ID number"
"      100.000   % Impervious"
"        4.582   Total Area"
"       10.000   Flow length"
"        1.000   Overland Slope"
"        0.000   Pervious Area"
"       10.000   Pervious length"
"        1.000   Pervious slope"
"        4.582   Impervious Area"
"       10.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.000   Impervious Depression storage"
"                  0.576     0.067     0.027     1.478 c.m/sec"
"              Catchment 1121          Pervious   Impervious Total Area "
"              Surface Area            0.000      4.582      4.582      hectare"
"              Time of concentration   12.137     1.772      1.772      minutes"
"              Time to Centroid        164.431    169.649    169.650    minutes"
"              Rainfall depth          67.300     67.300     67.300     mm"
"              Rainfall volume         0.00       0.00       0.00       c.m"
"              Rainfall losses         67.300     67.300     67.300     mm"
"              Runoff depth            0.000      0.000      0.000      mm"
"              Runoff volume           0.00       3037.86    3037.86    c.m"
"              Maximum flow            0.000      0.576      0.576      c.m/sec"
" 40         HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                0.576     0.000     0.027     1.478"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.576     0.576     0.027     1.478"
" 81         ADD COMMENT==================================================="
"          2 Lines of comment"
"            Model roof top storage assuming R.D. density of 410 sq.m "
"              "
" 54         POND DESIGN"
"      0.576   Current peak flow    c.m/sec"
"     3040.0   Hydrograph volume    c.m/sec"
"         11.  Number of stages"
"      0.000   Minimum water level    c.m/sec"
"      0.200   Maximum water level    c.m/sec"
"          0   Keep Design Data: 1 = True; 0 = False"
"                Level Discharge    Volume"
"                0.000     0.000      0.0"
"                0.020     0.027      8.9"
"                0.040     0.054     71.5"
"                0.060     0.081    241.4"
"                0.080     0.108    572.2"
"                0.100     0.134   1117.6"
"                0.120     0.161   1804.3"
"                0.140     0.188   2491.6"
"                0.160     0.215   3178.9"
"                0.180     0.242   3866.2"
"                0.200     0.269   4553.5"
"            1.   ROOFTOP"
"                 Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                   hectare     hectare    sq.metre  L/min/25mm       g H:1V"
"                     4.582       3.436     410.000      24.000     100.000"
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"            Using 84 roofdrains on roofstorage area of 34365. square metre"
"            Peak outflow                    0.141    c.m/sec"
"            Maximum level                   0.105    metre"
"            Maximum storage              1274.711    c.m"
"            Centroidal lag                  4.586    hours"
"                0.576     0.576     0.141     1.478 c.m/sec"
" 40         HYDROGRAPH   Combine    112"
"          6   Combine "
"        112   Node #"
"              Quinte Mall on Bell Blvd."
"            Maximum flow                    0.141    c.m/sec"
"            Hydrograph volume            3039.232    c.m"
"                0.576     0.576     0.141     0.141"
" 40         HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                0.576     0.000     0.141     0.141"
" 81         ADD COMMENT================================================="
"          4  Lines of comment"
"             Add East parking area with on-site controls.  Assume "
"             average Rim.El. = 93.07m with catchbasin IL at 92.07m "
"             with ICD diameter of 120 mm"
"                "
" 33         CATCHMENT 1122"
"            4   Linear reservoir"
"            1   Equal length"
"            2   Horton equation"
"         1122   ID number"
"      100.000   % Impervious"
"        6.990   Total Area"
"       30.000   Flow length"
"        1.000   Overland Slope"
"        0.000   Pervious Area"
"       30.000   Pervious length"
"        1.000   Pervious slope"
"        6.990   Impervious Area"
"       30.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                0.873     0.000     0.141     0.141 c.m/sec"
"             Catchment 1122          Pervious   Impervious Total Area "
"             Surface Area            0.000      6.990      6.990      hectare"
"             Time of concentration   23.463     3.426      3.426      minutes"
"             Time to Centroid        170.094    171.559    171.559    minutes"
"             Rainfall depth          67.300     67.300     67.300     mm"
"             Rainfall volume         0.00       0.00       0.00       c.m"
"             Rainfall losses         67.300     67.300     67.300     mm"
"             Runoff depth            0.000      0.000      0.000      mm"
"             Runoff volume           0.00       4599.42    4599.42    c.m"
"             Maximum flow            0.000      0.873      0.873      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                0.873     0.873     0.141     0.141"
" 54         POND DESIGN"
"       0.873   Current peak flow    c.m/sec"
"      4600.0   Hydrograph volume    c.m/sec"
"         21.   Number of stages"
"      92.070   Minimum water level    c.m/sec"
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"      93.470   Maximum water level    c.m/sec"
"           0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge    Volume"
"                92.070     0.000       0.0"
"                92.140     0.016       0.0"
"                92.210     0.070       0.0"
"                92.280     0.102       0.0"
"                92.350     0.127       0.0"
"                92.420     0.148       0.0"
"                92.490     0.166       0.0"
"                92.560     0.182       0.0"
"                92.630     0.197       0.0"
"                92.700     0.211       0.0"
"                92.770     0.224       0.0"
"                92.840     0.236       0.0"
"                92.910     0.248       0.0"
"                92.980     0.259       0.0"
"                93.050     0.269       0.0"
"                93.120     0.280       5.3"
"                93.190     0.290      73.3"
"                93.260     0.299     290.9"
"                93.330     0.309     745.3"
"                93.400     0.318    1523.9"
"                93.470     0.326    2714.0"
"           1.   ORIFICES"
"                Orifice   Orifice   Orifice Number of"
"                 invert coefficie  diameter  orifices"
"                92.070     0.630     0.120     9.000"
"           9.   WEDGES"
"                  Wedge   Grade 1   Grade 2     Angle    Number"
"                  invert    g1H:1V    g2H:1V subtended of wedges"
"                93.070    70.000    35.000    90.000     4.000"
"                93.070    63.000    45.000    90.000     4.000"
"                93.070    92.000    66.000    90.000     4.000"
"                93.070    68.000    68.000    90.000     4.000"
"                93.070    80.000    53.000    90.000     4.000"
"                93.070   130.000    87.000    90.000     4.000"
"                93.070    80.000    50.000    90.000     4.000"
"                93.070    52.000    34.000    90.000     4.000"
"                93.070    71.000    45.000    90.000     4.000"
"              Peak outflow                    0.312    c.m/sec"
"              Maximum level                  93.360    metre"
"              Maximum storage              1081.973    c.m"
"              Centroidal lag                  3.308    hours"
"                  0.873     0.873     0.312     0.141 c.m/sec"
" 40           HYDROGRAPH   Combine    112"
"            6   Combine "
"          112   Node #"
"                Quinte Mall on Bell Blvd."
"              Maximum flow                    0.453    c.m/sec"
"              Hydrograph volume            7671.866    c.m"
"                  0.873     0.873     0.312     0.453"
" 81           ADD COMMENT================================================="
"            2  Lines of comment"
"               Add runoff from area draining to west group of "
"               catch basins."
" 33           CATCHMENT 1123"
"              4   Linear reservoir"
"              1   Equal length"
"              2   Horton equation"
"           1123   ID number"
"        100.000   % Impervious"
"          5.310   Total Area"
"         30.000   Flow length"
"          1.000   Overland Slope"
"          0.000   Pervious Area"
```

```
"       30.000   Pervious length"
"        1.000   Pervious slope"
"        5.310   Impervious Area"
"       30.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.663     0.873     0.312     0.453 c.m/sec"
"            Catchment 1123          Pervious   Impervious Total Area "
"            Surface Area            0.000      5.310      5.310      hectare"
"            Time of concentration   23.463     3.426      3.426      minutes"
"            Time to Centroid        170.094    171.559    171.559    minutes"
"            Rainfall depth          67.300     67.300     67.300     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         67.300     67.300     67.300     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           0.00       3493.98    3493.98    c.m"
"            Maximum flow            0.000      0.663      0.663      c.m/sec"
" 40         HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                  0.663     0.000     0.312     0.453"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                  0.663     0.663     0.312     0.453"
" 54         POND DESIGN"
"        0.663   Current peak flow    c.m/sec"
"       3494.0   Hydrograph volume    c.m/sec"
"          21.   Number of stages"
"       90.900   Minimum water level    c.m/sec"
"       92.200   Maximum water level    c.m/sec"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                 90.900     0.000       0.0"
"                 90.965     0.011       0.0"
"                 91.030     0.049       0.0"
"                 91.095     0.075       0.0"
"                 91.160     0.094       0.0"
"                 91.225     0.109       0.0"
"                 91.290     0.123       0.0"
"                 91.355     0.135       0.0"
"                 91.420     0.147       0.0"
"                 91.485     0.157       0.0"
"                 91.550     0.167       0.0"
"                 91.615     0.176       0.0"
"                 91.680     0.185       0.0"
"                 91.745     0.193       0.0"
"                 91.810     0.201       0.0"
"                 91.875     0.209       0.0"
"                 91.940     0.216       6.6"
"                 92.005     0.224     119.0"
"                 92.070     0.231     505.1"
"                 92.135     0.237    1334.4"
"                 92.200     0.244    2776.0"
"            1.   ORIFICES"
"                 Orifice   Orifice   Orifice Number of"
"                  invert coefficie  diameter  orifices"
"                 90.900     0.630     0.120     7.000"
"            7.   WEDGES"
```



```
"                  Wedge   Grade 1   Grade 2     Angle    Number"
"                  invert    g1H:1V    g2H:1V subtended of wedges"
"                 91.900   193.000   148.000     90.000     4.000"
"                 91.900   176.000   176.000     90.000     4.000"
"                 91.900   151.000   116.000     90.000     4.000"
"                 91.900    91.000    61.000     90.000     4.000"
"                 91.900    79.000    72.000     90.000     4.000"
"                 91.900   101.000    77.000     90.000     4.000"
"                 91.900    48.000    44.000     90.000     4.000"
"            Peak outflow                        0.233    c.m/sec"
"            Maximum level                      92.095    metre"
"            Maximum storage                   829.647    c.m"
"            Centroidal lag                      3.310    hours"
"                 0.663     0.663     0.233     0.453 c.m/sec"
" 40         HYDROGRAPH   Combine    112"
"          6   Combine "
"        112   Node #"
"              Quinte Mall on Bell Blvd."
"            Maximum flow                        0.686    c.m/sec"
"            Hydrograph volume                11168.040    c.m"
"                 0.663     0.663     0.233     0.686"
" 81         ADD COMMENT================================================="
"          2   Lines of comment"
"              Add runoff from balance of area.  This is 0.814 ha with"
"              nominal 20% imperv."
" 33         CATCHMENT 1124"
"            4   Linear reservoir"
"            1   Equal length"
"            2   Horton equation"
"         1124   ID number"
"       15.800   % Impervious"
"        1.461   Total Area"
"       30.000   Flow length"
"        1.000   Overland Slope"
"        1.230   Pervious Area"
"       30.000   Pervious length"
"        1.000   Pervious slope"
"        0.231   Impervious Area"
"       30.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.076     0.663     0.233     0.686 c.m/sec"
"            Catchment 1124          Pervious   Impervious Total Area "
"            Surface Area            1.230      0.231      1.461      hectare"
"            Time of concentration   23.463     3.426      13.015     minutes"
"            Time to Centroid        170.094    171.559    170.858    minutes"
"            Rainfall depth          67.300     67.300     67.300     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         67.300     67.300     67.300     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           139.41     151.89     291.30     c.m"
"            Maximum flow            0.056      0.029      0.076      c.m/sec"
" 40         HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                  0.076     0.000     0.233     0.686"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
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"                0.076     0.076     0.233     0.686"
" 40         HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                0.076     0.076     0.076     0.686"
" 40         HYDROGRAPH   Combine    112"
"          6   Combine "
"        112   Node #"
"              Quinte Mall on Bell Blvd."
"            Maximum flow                  0.753    c.m/sec"
"            Hydrograph volume         11459.340    c.m"
"                0.076     0.076     0.076     0.753"
" 37         START/RE-START TOTALS 1124"
"          2   Runoff Totals reset to ZERO"
"            Catchment area to node 112                 18.343    hectare"
"            Impervious area to node 112                17.113    hectare"
"            % impervious to node 112                   93.293"
"            Peak runoff to node 112                     2.189    c.m/sec"
"            Total volume to node 112                11422.6      c.m"
" 81         ADD COMMENT==================================================="
"          3  Lines of comment"
"            Recover diverted hydrograph from area 119 (Shell station) "
"            and add to total runoff from area 112 (Quinte Mall)"
"                "
" 47         FILE1_O Read/Open div00119.100hyd"
"          1   1=read/open; 2=write/save"
"          2   1=rainfall; 2=hydrograph"
"          3   1=runoff; 2=inflow; 3=outflow; 4=junction"
"            div00119.100hyd"
"            Excess major runoff to Bell Blvd"
"                0.076     0.076     0.040     0.753 c.m/sec"
" 40         HYDROGRAPH   Combine    112"
"          6   Combine "
"        112   Node #"
"              Quinte Mall on Bell Blvd."
"            Maximum flow                  0.783    c.m/sec"
"            Hydrograph volume         11531.700    c.m"
"                0.076     0.076     0.040     0.783"
" 81         ADD COMMENT==================================================="
"         18  Lines of comment"
"            151516 Ontario Ltd. (Loebs Plaza) (115) "
"            Now add Loebs Plaza on South side of Bell Blvd."
"            Only west portion contributes   "
"                "
"            Drainage area                 2.4180 ha "
"            Legal area                    2.0496 ha "
"            External areas                0.3684 ha comprising: "
"               Bell Blvd                  0.1710 ha   82.2 imperv% "
"               Hydro lands                0.1974 ha    0.0% "
"               Landscape 5%x2.0496        0.1025 ha    0.0% "
"               Total pervious             0.3303 ha "
"            Use: "
"            Rooftop area    1151          0.454 ha  100.0% imperv "
"            Parking area    1152          0.900 ha  100.0% imperv "
"            Balance         1153          1.064 ha   69.0% imperv "
"            TOTAL           115           2.418 ha   86.3% imperv."
"                "
"            Padded text"
" 40         HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                0.076     0.000     0.040     0.783"
" 33         CATCHMENT 1151"
"          4   Linear reservoir"
"          1   Equal length"
"          2   Horton equation"
"       1151   ID number"
"    100.000   % Impervious"
```



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"      0.454   Total Area"
"     10.000   Flow length"
"      1.000   Overland Slope"
"      0.000   Pervious Area"
"     10.000   Pervious length"
"      1.000   Pervious slope"
"      0.454   Impervious Area"
"     10.000   Impervious length"
"      1.000   Impervious slope"
"      0.250   Pervious Manning 'n'"
"     50.000   Pervious Max.infiltration"
"      7.500   Pervious Min.infiltration"
"      0.500   Pervious Lag constant (hours)"
"      5.000   Pervious Depression storage"
"      0.013   Impervious Manning 'n'"
"      0.000   Impervious Max.infiltration"
"      0.000   Impervious Min.infiltration"
"      0.500   Impervious Lag constant (hours)"
"      1.500   Impervious Depression storage"
"                0.057     0.000     0.040     0.783 c.m/sec"
"            Catchment 1151          Pervious   Impervious Total Area "
"            Surface Area            0.000      0.454      0.454      hectare"
"            Time of concentration   12.137     1.772      1.772      minutes"
"            Time to Centroid        164.431    170.732    170.732    minutes"
"            Rainfall depth          67.300     67.300     67.300     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         67.300     67.300     67.300     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           0.00       298.73     298.73     c.m"
"            Maximum flow            0.000      0.057      0.057      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.057     0.057     0.040     0.783"
" 54         POND DESIGN"
"        0.057   Current peak flow     c.m/sec"
"        300.0   Hydrograph volume     c.m/sec"
"          11.   Number of stages"
"        0.000   Minimum water level     c.m/sec"
"        0.250   Maximum water level     c.m/sec"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge     Volume"
"                  0.000     0.000       0.0"
"                  0.025     0.002       1.2"
"                  0.050     0.005       9.9"
"                  0.075     0.007      33.3"
"                  0.100     0.010      79.0"
"                  0.125     0.012     153.5"
"                  0.150     0.014     238.6"
"                  0.175     0.017     323.7"
"                  0.200     0.019     408.8"
"                  0.225     0.022     494.0"
"                  0.250     0.024     579.1"
"              1.   ROOFTOP"
"                  Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                    hectare     hectare    sq.metre  L/min/25mm      g H:1V"
"                      0.454       0.340     575.000      24.000     100.000"
"                  Using 6 roofdrains on roofstorage area of 3405. square metre"
"                  Peak outflow                  0.012    c.m/sec"
"                  Maximum level                 0.121    metre"
"                  Maximum storage             141.775    c.m"
"                  Centroidal lag                5.243    hours"
"                    0.057     0.057     0.012     0.783 c.m/sec"
" 40         HYDROGRAPH   Combine    115"
"          6   Combine "
"        115   Node #"
"              Loebs Plaza (West part)"
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"                Maximum flow                  0.012    c.m/sec"
"                Hydrograph volume           298.852    c.m"
"                     0.057     0.057       0.012     0.012"
" 33             CATCHMENT 1152"
"              4   Linear reservoir"
"              1   Equal length"
"              2   Horton equation"
"           1152   ID number"
"        100.000   % Impervious"
"          0.900   Total Area"
"         25.000   Flow length"
"          1.000   Overland Slope"
"          0.000   Pervious Area"
"         25.000   Pervious length"
"          1.000   Pervious slope"
"          0.900   Impervious Area"
"         25.000   Impervious length"
"          1.000   Impervious slope"
"          0.250   Pervious Manning 'n'"
"         50.000   Pervious Max.infiltration"
"          7.500   Pervious Min.infiltration"
"          0.500   Pervious Lag constant (hours)"
"          5.000   Pervious Depression storage"
"          0.013   Impervious Manning 'n'"
"          0.000   Impervious Max.infiltration"
"          0.000   Impervious Min.infiltration"
"          0.500   Impervious Lag constant (hours)"
"          1.500   Impervious Depression storage"
"                      0.113     0.057     0.012     0.012 c.m/sec"
"                Catchment 1152          Pervious   Impervious Total Area "
"                Surface Area            0.000      0.900      0.900      hectare"
"                Time of concentration   21.032     3.071      3.071      minutes"
"                Time to Centroid        168.878    171.381    171.381    minutes"
"                Rainfall depth          67.300     67.300     67.300     mm"
"                Rainfall volume         0.00       0.00       0.00       c.m"
"                Rainfall losses         67.300     67.300     67.300     mm"
"                Runoff depth            0.000      0.000      0.000      mm"
"                Runoff volume           0.00       592.20     592.20     c.m"
"                Maximum flow            0.000      0.113      0.113      c.m/sec"
" 40             HYDROGRAPH Start - New Tributary"
"              2   Start - New Tributary"
"                      0.113     0.000     0.012     0.012"
" 40             HYDROGRAPH Add Runoff "
"              4   Add Runoff "
"                      0.113     0.113     0.012     0.012"
" 54             POND DESIGN"
"          0.113   Current peak flow    c.m/sec"
"          593.0   Hydrograph volume    c.m/sec"
"            21.   Number of stages"
"         90.900   Minimum water level    c.m/sec"
"         92.200   Maximum water level    c.m/sec"
"              0   Keep Design Data: 1 = True; 0 = False"
"                    Level Discharge    Volume"
"                   90.900     0.000      0.0"
"                   90.965     0.003      0.0"
"                   91.030     0.011      0.0"
"                   91.095     0.016      0.0"
"                   91.160     0.019      0.0"
"                   91.225     0.022      0.0"
"                   91.290     0.025      0.0"
"                   91.355     0.027      0.0"
"                   91.420     0.030      0.0"
"                   91.485     0.032      0.0"
"                   91.550     0.033      0.0"
"                   91.615     0.035      0.0"
"                   91.680     0.037      0.0"
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"                   91.745     0.039      0.0"
"                   91.810     0.040      0.0"
"                   91.875     0.042      0.0"
"                   91.940     0.043      0.8"
"                   92.005     0.045     14.7"
"                   92.070     0.046     62.3"
"                   92.135     0.047    164.4"
"                   92.200     0.049    342.1"
"              1.   ORIFICES"
"                   Orifice   Orifice   Orifice Number of"
"                    invert coefficie  diameter  orifices"
"                   90.900     0.630     0.100     2.000"
"              1.   WEDGES"
"                     Wedge   Grade 1   Grade 2     Angle    Number"
"                    invert    g1H:1V    g2H:1V subtended of wedges"
"                   91.900    55.000   110.000    90.000     8.000"
"                Peak outflow                      0.047    c.m/sec"
"                Maximum level                    92.104    metre"
"                Maximum storage                 116.308    c.m"
"                Centroidal lag                    3.127    hours"
"                     0.113     0.113     0.047     0.012 c.m/sec"
" 40             HYDROGRAPH   Combine    115"
"              6   Combine "
"            115   Node #"
"                  Loebs Plaza (West part)"
"                Maximum flow                      0.058    c.m/sec"
"                Hydrograph volume               887.454    c.m"
"                     0.113     0.113     0.047     0.058"
" 40             HYDROGRAPH Start - New Tributary"
"              2   Start - New Tributary"
"                     0.113     0.000     0.047     0.058"
" 33             CATCHMENT 1153"
"              4   Linear reservoir"
"              1   Equal length"
"              2   Horton equation"
"           1153   ID number"
"         69.000   % Impervious"
"          1.064   Total Area"
"         25.000   Flow length"
"          1.000   Overland Slope"
"          0.330   Pervious Area"
"         25.000   Pervious length"
"          1.000   Pervious slope"
"          0.734   Impervious Area"
"         25.000   Impervious length"
"          1.000   Impervious slope"
"          0.250   Pervious Manning 'n'"
"         50.000   Pervious Max.infiltration"
"          7.500   Pervious Min.infiltration"
"          0.500   Pervious Lag constant (hours)"
"          5.000   Pervious Depression storage"
"          0.013   Impervious Manning 'n'"
"          0.000   Impervious Max.infiltration"
"          0.000   Impervious Min.infiltration"
"          0.500   Impervious Lag constant (hours)"
"          1.500   Impervious Depression storage"
"                      0.105     0.000     0.047     0.058 c.m/sec"
"                Catchment 1153          Pervious   Impervious Total Area "
"                Surface Area            0.330      0.734      1.064      hectare"
"                Time of concentration   21.032     3.071      4.361      minutes"
"                Time to Centroid        168.878    171.381    171.201    minutes"
"                Rainfall depth          67.300     67.300     67.300     mm"
"                Rainfall volume         0.00       0.00       0.00       c.m"
"                Rainfall losses         67.300     67.300     67.300     mm"
"                Runoff depth            0.000      0.000      0.000      mm"
"                Runoff volume           37.38      483.08     520.46     c.m"
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"            Maximum flow            0.015       0.092       0.105       c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.105       0.105       0.047       0.058"
" 40         HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                0.105       0.105       0.105       0.058"
" 40         HYDROGRAPH   Combine    115"
"          6   Combine "
"        115   Node #"
"              Loebs Plaza (West part)"
"            Maximum flow                  0.162     c.m/sec"
"            Hydrograph volume          1407.911     c.m"
"                0.105       0.105       0.105       0.162"
" 37         START/RE-START TOTALS 1153"
"          2   Runoff Totals reset to ZERO"
"            Catchment area to node 115                  2.418     hectare"
"            Impervious area to node 115                 2.088     hectare"
"            % impervious to node 115                   86.359"
"            Peak runoff to node 115                     0.275     c.m/sec"
"            Total volume to node 115                   1411.4     c.m"
" 40         HYDROGRAPH   Confluence    115"
"          7   Confluence "
"        115   Node #"
"              Loebs Plaza (West part)"
"            Maximum flow                  0.162     c.m/sec"
"            Hydrograph volume          1407.912     c.m"
"                0.105       0.162       0.105       0.000"
" 81         ADD COMMENT================================================="
"          3  Lines of comment"
"            Outflow from area 115 is now added to total inflow to Bell "
"            Blvd. storm at junction 112."
"                "
" 40         HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                0.105       0.162       0.162       0.000"
" 40         HYDROGRAPH   Combine    112"
"          6   Combine "
"        112   Node #"
"              Quinte Mall on Bell Blvd."
"            Maximum flow                  0.945     c.m/sec"
"            Hydrograph volume         12939.610     c.m"
"                0.105       0.162       0.162       0.945"
" 81         ADD COMMENT================================================="
"         37  Lines of comment"
"            Treat Canadian Tire as Area 127 with internal node "
"            128 to model Phase 2 rooftop and parking area"
"            includes half width of Bell Blvd. and half of Hydro strip"
"            as well as PUC station"
"                "
"            Phase 1 (127)  "
"            Drainage area                 2.6020 ha "
"            Legal area                    2.2105 ha "
"            External areas                0.3915 ha comprising: "
"               Bell Blvd                  0.1710 ha   79.0 imperv% "
"               Hydro lands                0.2070 ha    0.0% "
"               Landscape 5%x2.2105        0.1105 ha    0.0% "
"               Total pervious             0.5020 ha "
"            Use: "
"            Rooftop area    1271          0.644 ha  100.0% imperv "
"            Parking area    1272          0.760 ha  100.0% imperv "
"            Balance         1273          1.198 ha   70.3% imperv "
"            TOTAL           127           2.602 ha   86.3% imperv."
"                "
"            Phase 2 (128)"
"                "
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"                        1.0732 ha ""
"            Legal area                    0.6366 ha "
"            External areas                0.4366 ha comprising: "
"               Bell Blvd                  0.0807 ha   62.0 imperv% "
"               Hydro lands                0.0867 ha    0.0% "
"               City of Belleville         0.1720 ha   50.0% imperv "
"               Landscape 5%x0.6366        0.0318 ha    0.0% "
"               Total pervious             0.2352 ha "
"            Use: "
"            Rooftop area    1271          0.125  ha  100.0% imperv "
"            Parking area    1272          0.325  ha  100.0% imperv "
"            Balance         1273          0.6232 ha   62.3% imperv "
"            TOTAL           127           1.0732 ha   78.1% imperv."
"                "
"            Storage is 60m x 2.4m x 1.83m high with 0.067m orifice"
"                "
" 33         CATCHMENT 1271"
"          4   Linear reservoir"
"          1   Equal length"
"          2   Horton equation"
"       1271   ID number"
"    100.000   % Impervious"
"      0.644   Total Area"
"     10.000   Flow length"
"      0.750   Overland Slope"
"      0.000   Pervious Area"
"     10.000   Pervious length"
"      0.750   Pervious slope"
"      0.644   Impervious Area"
"     10.000   Impervious length"
"      0.750   Impervious slope"
"      0.250   Pervious Manning 'n'"
"     50.000   Pervious Max.infiltration"
"      7.500   Pervious Min.infiltration"
"      0.500   Pervious Lag constant (hours)"
"      5.000   Pervious Depression storage"
"      0.013   Impervious Manning 'n'"
"      0.000   Impervious Max.infiltration"
"      0.000   Impervious Min.infiltration"
"      0.500   Impervious Lag constant (hours)"
"      1.500   Impervious Depression storage"
"                  0.081       0.162       0.162       0.945 c.m/sec"
"               Catchment 1271          Pervious    Impervious  Total Area "
"               Surface Area            0.000       0.644       0.644       hectare"
"               Time of concentration   13.231      1.932       1.932       minutes"
"               Time to Centroid        164.978     170.812     170.812     minutes"
"               Rainfall depth          67.300      67.300      67.300      mm"
"               Rainfall volume         0.00        0.00        0.00        c.m"
"               Rainfall losses         67.300      67.300      67.300      mm"
"               Runoff depth            0.000       0.000       0.000       mm"
"               Runoff volume           0.00        423.75      423.75      c.m"
"               Maximum flow            0.000       0.081       0.081       c.m/sec"
" 40         HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                  0.081       0.000       0.162       0.945"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                  0.081       0.081       0.162       0.945"
" 54         POND DESIGN"
"       0.081   Current peak flow     c.m/sec"
"       424.0   Hydrograph volume     c.m/sec"
"         11.   Number of stages"
"       0.000   Minimum water level     c.m/sec"
"       0.175   Maximum water level     c.m/sec"
"           0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge     Volume"
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"                0.000     0.000      0.0"
"                0.018     0.003      1.2"
"                0.035     0.005      8.9"
"                0.053     0.008     31.0"
"                0.070     0.010     71.4"
"                0.087     0.013    137.1"
"                0.105     0.015    224.0"
"                0.123     0.018    310.9"
"                0.140     0.020    393.0"
"                0.157     0.023    475.1"
"                0.175     0.025    562.1"
"          1.   ROOFTOP"
"               Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                 hectare     hectare    sq.metre  L/min/25mm       g H:1V"
"                   0.644       0.483      550.000      24.000      133.333"
"             Using 9 roofdrains on roofstorage area of 4830. square metre"
"             Peak outflow                    0.015    c.m/sec"
"             Maximum level                   0.103    metre"
"             Maximum storage               215.765    c.m"
"             Centroidal lag                  5.715    hours"
"                 0.081     0.081     0.015     0.945 c.m/sec"
" 40          HYDROGRAPH   Combine    127"
"           6   Combine "
"         127   Node #"
"               Can.Tire Phase 1"
"             Maximum flow                    0.015    c.m/sec"
"             Hydrograph volume             423.992    c.m"
"                   0.081     0.081     0.015     0.015"
" 40          HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                 0.081     0.000     0.015     0.015"
" 33          CATCHMENT 1272"
"           4   Linear reservoir"
"           1   Equal length"
"           2   Horton equation"
"        1272   ID number"
"     100.000   % Impervious"
"       0.760   Total Area"
"      25.000   Flow length"
"       1.250   Overland Slope"
"       0.000   Pervious Area"
"      25.000   Pervious length"
"       1.250   Pervious slope"
"       0.760   Impervious Area"
"      25.000   Impervious length"
"       1.250   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      50.000   Pervious Max.infiltration"
"       7.500   Pervious Min.infiltration"
"       0.500   Pervious Lag constant (hours)"
"       5.000   Pervious Depression storage"
"       0.013   Impervious Manning 'n'"
"       0.000   Impervious Max.infiltration"
"       0.000   Impervious Min.infiltration"
"       0.500   Impervious Lag constant (hours)"
"       1.500   Impervious Depression storage"
"                 0.095     0.000     0.015     0.015 c.m/sec"
"             Catchment 1272          Pervious   Impervious Total Area "
"             Surface Area            0.000      0.760      0.760      hectare"
"             Time of concentration   19.670     2.872      2.872      minutes"
"             Time to Centroid        168.197    171.282    171.282    minutes"
"             Rainfall depth          67.300     67.300     67.300     mm"
"             Rainfall volume         0.00       0.00       0.00       c.m"
"             Rainfall losses         67.300     67.300     67.300     mm"
"             Runoff depth            0.000      0.000      0.000      mm"
"             Runoff volume           0.00       500.08     500.08     c.m"
```



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"             Maximum flow            0.000      0.095      0.095 -    c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                 0.095     0.095     0.015     0.015"
" 54          POND DESIGN"
"       0.095   Current peak flow    c.m/sec"
"       501.0   Hydrograph volume    c.m/sec"
"         21.   Number of stages"
"      90.900   Minimum water level    c.m/sec"
"      92.200   Maximum water level    c.m/sec"
"           0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge    Volume"
"                90.900     0.000       0.0"
"                90.965     0.004       0.0"
"                91.030     0.016       0.0"
"                91.095     0.022       0.0"
"                91.160     0.027       0.0"
"                91.225     0.031       0.0"
"                91.290     0.035       0.0"
"                91.355     0.038       0.0"
"                91.420     0.041       0.0"
"                91.485     0.044       0.0"
"                91.550     0.046       0.0"
"                91.615     0.049       0.0"
"                91.680     0.051       0.0"
"                91.745     0.054       0.0"
"                91.810     0.056       0.0"
"                91.875     0.058       5.4"
"                91.940     0.060      47.5"
"                92.005     0.062     165.6"
"                92.070     0.064     398.7"
"                92.135     0.066     786.0"
"                92.200     0.067    1366.7"
"          1.   ORIFICES"
"               Orifice   Orifice   Orifice Number of"
"                invert coefficie  diameter  orifices"
"                90.900     0.630     0.096     3.000"
"          1.   WEDGES"
"                 Wedge   Grade 1   Grade 2     Angle    Number"
"                invert    g1H:1V    g2H:1V subtended of wedges"
"                91.814    61.500   123.000    90.000    12.000"
"             Peak outflow                    0.060    c.m/sec"
"             Maximum level                  91.935    metre"
"             Maximum storage                44.151    c.m"
"             Centroidal lag                  2.909    hours"
"                 0.095     0.095     0.060     0.015 c.m/sec"
" 40          HYDROGRAPH   Combine    127"
"           6   Combine "
"         127   Node #"
"               Can.Tire Phase 1"
"             Maximum flow                    0.074    c.m/sec"
"             Hydrograph volume             914.882    c.m"
"                   0.095     0.095     0.060     0.074"
" 40          HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                 0.095     0.000     0.060     0.074"
" 33          CATCHMENT 1273"
"           4   Linear reservoir"
"           1   Equal length"
"           2   Horton equation"
"        1273   ID number"
"      70.300   % Impervious"
"       1.198   Total Area"
"      25.000   Flow length"
"       1.250   Overland Slope"
"       0.356   Pervious Area"
```

```
"       25.000   Pervious length"
"        0.750   Pervious slope"
"        0.842   Impervious Area"
"       25.000   Impervious length"
"        0.750   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.119     0.000     0.060     0.074 c.m/sec"
"             Catchment 1273          Pervious   Impervious Total Area "
"             Surface Area            0.356      0.842      1.198      hectare"
"             Time of concentration   22.928     3.348      4.676      minutes"
"             Time to Centroid        169.826    171.519    171.405    minutes"
"             Rainfall depth          67.300     67.300     67.300     mm"
"             Rainfall volume         0.00       0.00       0.00       c.m"
"             Rainfall losses         67.300     67.300     67.300     mm"
"             Runoff depth            0.000      0.000      0.000      mm"
"             Runoff volume           40.32      554.16     594.49     c.m"
"             Maximum flow            0.016      0.105      0.119      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.119     0.119     0.060     0.074"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.119     0.119     0.119     0.074"
" 40          HYDROGRAPH   Combine    127"
"            6   Combine "
"          127   Node #"
"                Can.Tire Phase 1"
"             Maximum flow                    0.191    c.m/sec"
"             Hydrograph volume            1509.369    c.m"
"                    0.119     0.119     0.119     0.191"
" 37          START/RE-START TOTALS 1273"
"            2   Runoff Totals reset to ZERO"
"             Catchment area to node 127                  2.602    hectare"
"             Impervious area to node 127                 2.246    hectare"
"             % impervious to node 127                   86.326"
"             Peak runoff to node 127                     0.295    c.m/sec"
"             Total volume to node 127                 1518.3      c.m"
" 33          CATCHMENT 1274"
"            4   Linear reservoir"
"            1   Equal length"
"            2   Horton equation"
"         1274   ID number"
"      100.000   % Impervious"
"        0.125   Total Area"
"       10.000   Flow length"
"        0.750   Overland Slope"
"        0.000   Pervious Area"
"       10.000   Pervious length"
"        0.750   Pervious slope"
"        0.125   Impervious Area"
"       10.000   Impervious length"
"        0.750   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
```



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"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.016     0.119     0.119     0.191 c.m/sec"
"             Catchment 1274          Pervious   Impervious Total Area "
"             Surface Area            0.000      0.125      0.125      hectare"
"             Time of concentration   13.231     1.932      1.932      minutes"
"             Time to Centroid        164.978    170.812    170.812    minutes"
"             Rainfall depth          67.300     67.300     67.300     mm"
"             Rainfall volume         0.00       0.00       0.00       c.m"
"             Rainfall losses         67.300     67.300     67.300     mm"
"             Runoff depth            0.000      0.000      0.000      mm"
"             Runoff volume           0.00       82.25      82.25      c.m"
"             Maximum flow            0.000      0.016      0.016      c.m/sec"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.016     0.000     0.119     0.191"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.016     0.016     0.119     0.191"
" 54          POND DESIGN"
"        0.016   Current peak flow    c.m/sec"
"         83.0   Hydrograph volume    c.m/sec"
"          11.   Number of stages"
"        0.000   Minimum water level    c.m/sec"
"        0.175   Maximum water level    c.m/sec"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                  0.000     0.000      0.0"
"                  0.018     0.001      0.3"
"                  0.035     0.001      2.3"
"                  0.053     0.002      7.9"
"                  0.070     0.002     18.1"
"                  0.087     0.003     33.5"
"                  0.105     0.003     50.4"
"                  0.123     0.004     67.3"
"                  0.140     0.004     83.2"
"                  0.157     0.005     99.2"
"                  0.175     0.006    116.0"
"             1.   ROOFTOP"
"                  Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                    hectare    hectare    sq.metre  L/min/25mm      g H:1V"
"                      0.125      0.094      420.000      24.000     133.333"
"             Using 2 roofdrains on roofstorage area of 938. square metre"
"             Peak outflow                    0.003    c.m/sec"
"             Maximum level                   0.095    metre"
"             Maximum storage                40.774    c.m"
"             Centroidal lag                  5.527    hours"
"                    0.016     0.016     0.003     0.191 c.m/sec"
" 40          HYDROGRAPH   Combine    128"
"            6   Combine "
"          128   Node #"
"                Can.Tire Phase 2"
"             Maximum flow                    0.003    c.m/sec"
"             Hydrograph volume              82.279    c.m"
"                    0.016     0.016     0.003     0.003"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.016     0.000     0.003     0.003"
" 33          CATCHMENT 1275"
"            4   Linear reservoir"
"            1   Equal length"
"            2   Horton equation"
"         1275   ID number"
```

```
"      100.000   % Impervious"
"        0.325   Total Area"
"       25.000   Flow length"
"        1.250   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        1.250   Pervious slope"
"        0.325   Impervious Area"
"       25.000   Impervious length"
"        1.250   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.041     0.000     0.003     0.003 c.m/sec"
"             Catchment 1275          Pervious   Impervious Total Area "
"             Surface Area            0.000      0.325      0.325      hectare"
"             Time of concentration   19.670     2.872      2.872      minutes"
"             Time to Centroid        168.197    171.282    171.282    minutes"
"             Rainfall depth          67.300     67.300     67.300     mm"
"             Rainfall volume         0.00       0.00       0.00       c.m"
"             Rainfall losses         67.300     67.300     67.300     mm"
"             Runoff depth            0.000      0.000      0.000      mm"
"             Runoff volume           0.00       213.85     213.85     c.m"
"             Maximum flow            0.000      0.041      0.041      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                 0.041     0.041     0.003     0.003"
" 54          POND DESIGN"
"       0.041   Current peak flow    c.m/sec"
"       220.0   Hydrograph volume    c.m/sec"
"         21.   Number of stages"
"      90.900   Minimum water level    c.m/sec"
"      92.200   Maximum water level    c.m/sec"
"           0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge    Volume"
"                90.900     0.000       0.0"
"                90.965     0.001       0.0"
"                91.030     0.005       0.0"
"                91.095     0.007       0.0"
"                91.160     0.009       0.0"
"                91.225     0.010       0.0"
"                91.290     0.012       0.0"
"                91.355     0.013       0.0"
"                91.420     0.014       0.0"
"                91.485     0.015       0.0"
"                91.550     0.015       0.0"
"                91.615     0.016       0.0"
"                91.680     0.017       0.0"
"                91.745     0.018       0.0"
"                91.810     0.019       0.0"
"                91.875     0.019       1.0"
"                91.940     0.020       9.2"
"                92.005     0.021      32.0"
"                92.070     0.021      77.0"
"                92.135     0.022     151.7"
"                92.200     0.022     263.8"
"           1.   ORIFICES"
"                Orifice   Orifice   Orifice Number of"
"                 invert coefficie  diameter  orifices"
```



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"                90.900     0.630     0.096     1.000"
"           1.   WEDGES"
"                 Wedge   Grade 1   Grade 2     Angle    Number"
"                 invert    g1H:1V    g2H:1V subtended of wedges"
"                91.814    46.800    93.600    90.000     4.000"
"              Peak outflow                    0.021    c.m/sec"
"              Maximum level                  92.005    metre"
"              Maximum storage                31.832    c.m"
"              Centroidal lag                  2.983    hours"
"                   0.041     0.041     0.021     0.003 c.m/sec"
" 40          HYDROGRAPH   Combine    128"
"           6   Combine "
"         128   Node #"
"               Can.Tire Phase 2"
"              Maximum flow                    0.023    c.m/sec"
"              Hydrograph volume             292.136    c.m"
"                   0.041     0.041     0.021     0.023"
" 81          ADD COMMENT================================================="
"           5   Lines of comment"
"               Get runoff from node 128 and route this through a pond "
"               with a base area of 144 sq.m and vertical sides controlled "
"               by an orifice 0.067m diameter (67mm) at IL 92.76m."
"               This is underground box culvert."
"                 "
" 40          HYDROGRAPH   Confluence    128"
"           7   Confluence "
"         128   Node #"
"               Can.Tire Phase 2"
"              Maximum flow                    0.023    c.m/sec"
"              Hydrograph volume             292.136    c.m"
"                   0.041     0.023     0.021     0.000"
" 54          POND DESIGN"
"       0.023   Current peak flow    c.m/sec"
"       300.0   Hydrograph volume    c.m/sec"
"         21.   Number of stages"
"      92.760   Minimum water level    c.m/sec"
"      94.800   Maximum water level    c.m/sec"
"           0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge    Volume"
"                92.760     0.000       0.0"
"                92.862     0.002      14.7"
"                92.964     0.004      29.4"
"                93.066     0.005      44.1"
"                93.168     0.006      58.8"
"                93.270     0.007      73.4"
"                93.372     0.007      88.1"
"                93.474     0.008     102.8"
"                93.576     0.009     117.5"
"                93.678     0.009     132.2"
"                93.780     0.010     146.9"
"                93.882     0.010     161.6"
"                93.984     0.011     176.3"
"                94.086     0.011     190.9"
"                94.188     0.012     205.6"
"                94.290     0.012     220.3"
"                94.392     0.012     235.0"
"                94.494     0.013     249.7"
"                94.596     0.013     264.4"
"                94.698     0.014     279.1"
"                94.800     0.014     293.8"
"           1.   ORIFICES"
"                Orifice   Orifice   Orifice Number of"
"                 invert coefficie  diameter  orifices"
"                92.760     0.630     0.067     1.000"
"           1.   LAYERS"
"                 Bottom    Aspect    Bottom       Top   Average"
```

```
"                  area     ratio elevation elevation sideslope"
"               144.000    25.000    92.760    94.800     0.000"
"            Peak outflow                    0.009    c.m/sec"
"            Maximum level                  93.677    metre"
"            Maximum storage               132.039    c.m"
"            Centroidal lag                  6.887    hours"
"                 0.041     0.023     0.009     0.000 c.m/sec"
" 40         HYDROGRAPH Next link "
"          5   Next link "
"                 0.041     0.009     0.009     0.000"
" 33         CATCHMENT 1276"
"          4   Linear reservoir"
"          1   Equal length"
"          2   Horton equation"
"       1276   ID number"
"     62.300   % Impervious"
"      0.623   Total Area"
"     10.000   Flow length"
"      0.750   Overland Slope"
"      0.235   Pervious Area"
"     10.000   Pervious length"
"      0.750   Pervious slope"
"      0.388   Impervious Area"
"     10.000   Impervious length"
"      0.750   Impervious slope"
"      0.250   Pervious Manning 'n'"
"     50.000   Pervious Max.infiltration"
"      7.500   Pervious Min.infiltration"
"      0.500   Pervious Lag constant (hours)"
"      5.000   Pervious Depression storage"
"      0.013   Impervious Manning 'n'"
"      0.000   Impervious Max.infiltration"
"      0.000   Impervious Min.infiltration"
"      0.500   Impervious Lag constant (hours)"
"      1.500   Impervious Depression storage"
"                 0.061     0.009     0.009     0.000 c.m/sec"
"            Catchment 1276          Pervious   Impervious Total Area "
"            Surface Area            0.235      0.388      0.623      hectare"
"            Time of concentration   13.231     1.932      2.998      minutes"
"            Time to Centroid        164.978    170.812    170.261    minutes"
"            Rainfall depth          67.300     67.300     67.300     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         67.300     67.300     67.300     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           26.62      255.39     282.01     c.m"
"            Maximum flow            0.012      0.049      0.061      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                 0.061     0.068     0.009     0.000"
" 37         START/RE-START TOTALS 1276"
"          2   Runoff Totals reset to ZERO"
"            Catchment area to node 128                1.073    hectare"
"            Impervious area to node 128               0.838    hectare"
"            % impervious to node 128                 78.111"
"            Peak runoff to node 128                   0.118    c.m/sec"
"            Total volume to node 128                  578.1    c.m"
" 81         ADD COMMENT==================================================="
"          3  Lines of comment"
"             Recover total flow in Inflow hydrograph and add this to "
"             junction node 127"
"                "
" 40         HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                 0.061     0.068     0.068     0.000"
" 40         HYDROGRAPH   Combine    127"
"          6   Combine "
```



```
"        127   Node #"
"              Can.Tire Phase 1"
"            Maximum flow                    0.259    c.m/sec"
"            Hydrograph volume            2083.468    c.m"
"                  0.061     0.068     0.068     0.259"
" 40         HYDROGRAPH   Confluence    127"
"          7   Confluence "
"        127   Node #"
"              Can.Tire Phase 1"
"            Maximum flow                    0.259    c.m/sec"
"            Hydrograph volume            2083.467    c.m"
"                  0.061     0.259     0.068     0.000"
" 40         HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                  0.061     0.259     0.259     0.000"
" 40         HYDROGRAPH   Combine    112"
"          6   Combine "
"        112   Node #"
"              Quinte Mall on Bell Blvd."
"            Maximum flow                    1.204    c.m/sec"
"            Hydrograph volume           15023.080    c.m"
"                  0.061     0.259     0.259     1.204"
" 81         ADD COMMENT==================================================="
"          5  Lines of comment"
"             Route this flow along Bell Blvd. storm sewer to Lemoine "
"             St. culvert (south end) and store it at this point - "
"             junction node 114.  Then process area 114 (Zellers Plaza) "
"             which goes directly to the sediment forebay "
"                "
" 40         HYDROGRAPH   Confluence    112"
"          7   Confluence "
"        112   Node #"
"              Quinte Mall on Bell Blvd."
"            Maximum flow                    1.204    c.m/sec"
"            Hydrograph volume           15023.080    c.m"
"                  0.061     1.204     0.259     0.000"
" 51         PIPE DESIGN"
"        1.204   Current peak flow    c.m/sec"
"        0.013   Manning 'n'"
"        1.200   Diameter    metre"
"        0.200   Gradient    %"
"            Depth of flow                   0.733    metre"
"            Velocity                        1.663    m/sec"
"            Pipe capacity                   1.744    c.m/sec"
"            Critical depth                  0.597    metre"
" 53         ROUTE    Pipe Route"
"      400.00      Pipe Route Reach length   ( metre)"
"        0.195   X-factor <= 0.5"
"      180.377   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.480   X-factor <= 0.5"
"      456.900   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      225.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"            Peak outflow                    1.169    c.m/sec"
"                  0.061     1.204     1.169     0.000 c.m/sec"
" 40         HYDROGRAPH   Combine    114"
"          6   Combine "
"        114   Node #"
"              Upstream of sediment forebay"
"            Maximum flow                    2.438    c.m/sec"
"            Hydrograph volume           66959.560    c.m"
"                  0.061     1.204     1.169     2.438"
" 81         ADD COMMENT==================================================="
"         16  Lines of comment"
```

```
"            1133166 Ontario Ltd. (Zellers Plaza 114)   "
"                "
"            Drainage area                7.2755 ha "
"            Legal area                   5.9271 ha "
"            External areas               1.3484 ha comprising: "
"               Bell Blvd                 0.4360 ha   77.0 imperv% "
"               Hydro lands               0.6354 ha    0.0% "
"               Landscape 5%x5.9271       0.2964 ha    0.0% "
"               Lemoine St. (forebay)     0.2770 ha    9.5% Path=264 sq.m "
"               Total pervious            1.2828 ha "
"            Use: "
"            Rooftop area   1141          2.600  ha  100.0% imperv "
"            Parking area   1142          2.900  ha  100.0% imperv "
"            Balance        1143          1.7755 ha   27.8% imperv "
"            TOTAL          114           7.2755 ha   82.4% imperv."
"                "
" 40         HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                  0.061     0.000     1.169     2.438"
" 33         CATCHMENT 1141"
"           4   Linear reservoir"
"           1   Equal length"
"           2   Horton equation"
"        1141   ID number"
"     100.000   % Impervious"
"       2.600   Total Area"
"      10.000   Flow length"
"       0.750   Overland Slope"
"       0.000   Pervious Area"
"      10.000   Pervious length"
"       0.750   Pervious slope"
"       2.600   Impervious Area"
"      10.000   Impervious length"
"       0.750   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      50.000   Pervious Max.infiltration"
"       7.500   Pervious Min.infiltration"
"       0.500   Pervious Lag constant (hours)"
"       5.000   Pervious Depression storage"
"       0.013   Impervious Manning 'n'"
"       0.000   Impervious Max.infiltration"
"       0.000   Impervious Min.infiltration"
"       0.500   Impervious Lag constant (hours)"
"       1.500   Impervious Depression storage"
"                  0.327     0.000     1.169     2.438 c.m/sec"
"            Catchment 1141          Pervious   Impervious Total Area "
"            Surface Area            0.000      2.600      2.600      hectare"
"            Time of concentration   13.231     1.932      1.932      minutes"
"            Time to Centroid        164.978    170.812    170.812    minutes"
"            Rainfall depth          67.300     67.300     67.300     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         67.300     67.300     67.300     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           0.00       1710.80    1710.80    c.m"
"            Maximum flow            0.000      0.327      0.327      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                  0.327     0.327     1.169     2.438"
" 54         POND DESIGN"
"         0.327   Current peak flow    c.m/sec"
"        1720.0   Hydrograph volume    c.m/sec"
"           11.   Number of stages"
"         0.000   Minimum water level    c.m/sec"
"         0.175   Maximum water level    c.m/sec"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
```



```
"                  0.000     0.000      0.0"
"                  0.018     0.014      6.6"
"                  0.035     0.027     48.3"
"                  0.053     0.041    167.8"
"                  0.070     0.054    386.7"
"                  0.087     0.067    709.4"
"                  0.105     0.081   1060.4"
"                  0.123     0.094   1411.4"
"                  0.140     0.108   1742.9"
"                  0.157     0.121   2074.4"
"                  0.175     0.134   2425.4"
"           1.   ROOFTOP"
"                Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                  hectare     hectare     sq.metre  L/min/25mm      g H:1V"
"                    2.600       1.950       410.000      24.000     133.333"
"              Using 48 roofdrains on roofstorage area of 19500. square metre"
"              Peak outflow                      0.070    c.m/sec"
"              Maximum level                     0.091    metre"
"              Maximum storage                 792.506    c.m"
"              Centroidal lag                    5.096    hours"
"                  0.327     0.327     0.070     2.438 c.m/sec"
" 81         ADD COMMENT================================================="
"           1  Lines of comment"
"              Accumulate runoff from area 114 at junction node 1144   "
" 40          HYDROGRAPH   Combine    1144"
"            6   Combine "
"         1144   Node #"
"                Zellers Plaza"
"              Maximum flow                    0.070    c.m/sec"
"              Hydrograph volume            1711.426    c.m"
"                  0.327     0.327     0.070     0.070"
" 40         HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                  0.327     0.000     0.070     0.070"
" 33         CATCHMENT 1142"
"           4   Linear reservoir"
"           1   Equal length"
"           2   Horton equation"
"        1142   ID number"
"     100.000   % Impervious"
"       2.900   Total Area"
"      35.000   Flow length"
"       1.000   Overland Slope"
"       0.000   Pervious Area"
"      35.000   Pervious length"
"       1.000   Pervious slope"
"       2.900   Impervious Area"
"      35.000   Impervious length"
"       1.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      50.000   Pervious Max.infiltration"
"       7.500   Pervious Min.infiltration"
"       0.500   Pervious Lag constant (hours)"
"       5.000   Pervious Depression storage"
"       0.013   Impervious Manning 'n'"
"       0.000   Impervious Max.infiltration"
"       0.000   Impervious Min.infiltration"
"       0.500   Impervious Lag constant (hours)"
"       1.500   Impervious Depression storage"
"                  0.362     0.000     0.070     0.070 c.m/sec"
"            Catchment 1142          Pervious   Impervious Total Area "
"            Surface Area            0.000      2.900      2.900      hectare"
"            Time of concentration   25.737     3.758      3.758      minutes"
"            Time to Centroid        171.231    171.725    171.725    minutes"
"            Rainfall depth          67.300     67.300     67.300     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
```

```
"            Rainfall losses          67.300      67.300      67.300     mm"
"            Runoff depth             0.000       0.000       0.000      mm"
"            Runoff volume            0.00        1908.20     1908.20    c.m"
"            Maximum flow             0.000       0.362       0.362      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.362     0.362     0.070     0.070"
" 54         POND DESIGN"
"      0.362   Current peak flow    c.m/sec"
"     1910.0   Hydrograph volume    c.m/sec"
"        21.   Number of stages"
"     93.200   Minimum water level    c.m/sec"
"     94.500   Maximum water level    c.m/sec"
"          0   Keep Design Data: 1 = True; 0 = False"
"               Level Discharge    Volume"
"              93.200     0.000      0.0"
"              93.265     0.010      0.0"
"              93.330     0.040      0.0"
"              93.395     0.057      0.0"
"              93.460     0.070      0.0"
"              93.525     0.081      0.0"
"              93.590     0.091      0.0"
"              93.655     0.099      0.0"
"              93.720     0.107      0.0"
"              93.785     0.115      0.0"
"              93.850     0.122      0.0"
"              93.915     0.128      0.0"
"              93.980     0.135      0.0"
"              94.045     0.141      0.0"
"              94.110     0.147      0.0"
"              94.175     0.152      0.0"
"              94.240     0.157      2.7"
"              94.305     0.162     48.9"
"              94.370     0.168    207.7"
"              94.435     0.172    548.6"
"              94.500     0.177   1141.4"
"          1.  ORIFICES"
"              Orifice   Orifice   Orifice Number of"
"               invert coefficie  diameter  orifices"
"              93.200     0.630     0.102     7.000"
"          6.  WEDGES"
"               Wedge   Grade 1   Grade 2     Angle    Number"
"              invert    g1H:1V    g2H:1V subtended of wedges"
"              94.200   108.000    72.000    90.000     4.000"
"              94.200    89.000    64.000    90.000     4.000"
"              94.200    94.000    79.000    90.000     4.000"
"              94.200    75.000    38.000    90.000     4.000"
"              94.200   110.000    74.000    90.000     4.000"
"              94.200    80.000    53.000    90.000     8.000"
"            Peak outflow                  0.169    c.m/sec"
"            Maximum level                94.391    metre"
"            Maximum storage             319.499    c.m"
"            Centroidal lag                3.031    hours"
"                0.362     0.362     0.169     0.070 c.m/sec"
" 40         HYDROGRAPH   Combine    1144"
"          6   Combine "
"       1144   Node #"
"              Zellers Plaza"
"            Maximum flow                  0.238    c.m/sec"
"            Hydrograph volume          3583.286    c.m"
"                0.362     0.362     0.169     0.238"
" 33         CATCHMENT 1143"
"          4   Linear reservoir"
"          1   Equal length"
"          2   Horton equation"
"       1143   ID number"
```



```
"     27.800   % Impervious"
"      1.775   Total Area"
"     35.000   Flow length"
"      1.000   Overland Slope"
"      1.282   Pervious Area"
"     35.000   Pervious length"
"      1.000   Pervious slope"
"      0.493   Impervious Area"
"     35.000   Impervious length"
"      1.000   Impervious slope"
"      0.250   Pervious Manning 'n'"
"     50.000   Pervious Max.infiltration"
"      7.500   Pervious Min.infiltration"
"      0.500   Pervious Lag constant (hours)"
"      5.000   Pervious Depression storage"
"      0.013   Impervious Manning 'n'"
"      0.000   Impervious Max.infiltration"
"      0.000   Impervious Min.infiltration"
"      0.500   Impervious Lag constant (hours)"
"      1.500   Impervious Depression storage"
"                0.108     0.362     0.169     0.238 c.m/sec"
"            Catchment 1143          Pervious   Impervious Total Area "
"            Surface Area            1.282      0.493      1.775      hectare"
"            Time of concentration   25.737     3.758      10.551     minutes"
"            Time to Centroid        171.231    171.725    171.572    minutes"
"            Rainfall depth          67.300     67.300     67.300     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         67.300     67.300     67.300     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           145.24     324.69     469.93     c.m"
"            Maximum flow            0.057      0.062      0.108      c.m/sec"
" 40         HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                0.108     0.000     0.169     0.238"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.108     0.108     0.169     0.238"
" 40         HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                0.108     0.108     0.108     0.238"
" 40         HYDROGRAPH   Combine    1144"
"          6   Combine "
"       1144   Node #"
"              Zellers Plaza"
"            Maximum flow                  0.338    c.m/sec"
"            Hydrograph volume          4053.211    c.m"
"                0.108     0.108     0.108     0.338"
" 37         START/RE-START TOTALS 1143"
"          2   Runoff Totals reset to ZERO"
"            Catchment area to node 1144                 7.275    hectare"
"            Impervious area to node 1144                5.993    hectare"
"            % impervious to node 1144                  82.384"
"            Peak runoff to node 1144                    0.797    c.m/sec"
"            Total volume to node 1144                  4088.9    c.m"
" 81         ADD COMMENT================================================="
"          3   Lines of comment"
"              Get total flow from area 114 (accumulated at internal "
"              junction node 1144) and add to junction node 114 "
"                  "
" 40          HYDROGRAPH   Confluence    1144"
"          7   Confluence "
"       1144   Node #"
"              Zellers Plaza"
"            Maximum flow                  0.338    c.m/sec"
"            Hydrograph volume          4053.211    c.m"
"                0.108     0.338     0.108     0.000"
```

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" 40          HYDROGRAPH Copy to Outflow"
"           8   Copy to Outflow"
"                 0.108     0.338     0.338     0.000"
" 40          HYDROGRAPH   Combine    114"
"           6   Combine "
"         114   Node #"
"               Upstream of sediment forebay"
"             Maximum flow                  2.776    c.m/sec"
"             Hydrograph volume         71012.760    c.m"
"                   0.108     0.338     0.338     2.776"
" 81          ADD COMMENT==================================================="
"           5  Lines of comment"
"             Model old area 113 but split it into:"
"             Area 113 - Loblaws     - area 2.598 ha"
"             Area 125 - Sopresata   - area 5.323 ha"
"             Store Loblaws at junction node 113"
"                "
" 81          ADD COMMENT==================================================="
"           16  Lines of comment"
"             Loblaws Plaza (113) "
"                "
"             Drainage area                2.5980 ha "
"             Legal area                   2.2493 ha "
"             External areas               0.3487 ha comprising: "
"                Bell Blvd                 0.1410 ha   90.0% imperv "
"                Lemoine                   0.2080 ha   24.0% imperv "
"               (Path = 360 sq.m)  "
"                Landscape 5%x2.2493       0.1125 ha    0.0% "
"                Total pervious            0.2847 ha "
"             Use: "
"             Rooftop area   1131          0.400 ha  100.0% imperv "
"             Parking area   1132          1.192 ha  100.0% imperv "
"             Balance        1133          1.006 ha   71.7% imperv "
"             TOTAL          113           2.598 ha   89.0% imperv."
"                "
" 40          HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                 0.108     0.000     0.338     2.776"
" 33          CATCHMENT 1131"
"           4   Linear reservoir"
"           1   Equal length"
"           2   Horton equation"
"        1131   ID number"
"      100.000  % Impervious"
"        0.400  Total Area"
"       10.000  Flow length"
"        0.750  Overland Slope"
"        0.000  Pervious Area"
"       10.000  Pervious length"
"        0.750  Pervious slope"
"        0.400  Impervious Area"
"       10.000  Impervious length"
"        0.750  Impervious slope"
"        0.250  Pervious Manning 'n'"
"       50.000  Pervious Max.infiltration"
"        7.500  Pervious Min.infiltration"
"        0.500  Pervious Lag constant (hours)"
"        5.000  Pervious Depression storage"
"        0.013  Impervious Manning 'n'"
"        0.000  Impervious Max.infiltration"
"        0.000  Impervious Min.infiltration"
"        0.500  Impervious Lag constant (hours)"
"        1.500  Impervious Depression storage"
"                 0.050     0.000     0.338     2.776 c.m/sec"
"             Catchment 1131          Pervious   Impervious Total Area "
"             Surface Area            0.000      0.400      0.400      hectare"
```



```
"             Time of concentration  13.231     1.932      1.932      minutes"
"             Time to Centroid       164.978    170.812    170.812    minutes"
"             Rainfall depth         67.300     67.300     67.300     mm"
"             Rainfall volume        0.00       0.00       0.00       c.m"
"             Rainfall losses        67.300     67.300     67.300     mm"
"             Runoff depth           0.000      0.000      0.000      mm"
"             Runoff volume          0.00       263.20     263.20     c.m"
"             Maximum flow           0.000      0.050      0.050      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                 0.050     0.050     0.338     2.776"
" 54          POND DESIGN"
"         0.050   Current peak flow    c.m/sec"
"         270.0   Hydrograph volume    c.m/sec"
"           11.   Number of stages"
"         0.000   Minimum water level    c.m/sec"
"         0.175   Maximum water level    c.m/sec"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                   0.000     0.000      0.0"
"                   0.018     0.002      0.9"
"                   0.035     0.004      6.8"
"                   0.053     0.006     23.5"
"                   0.070     0.008     54.2"
"                   0.087     0.010    101.9"
"                   0.105     0.012    155.9"
"                   0.123     0.014    209.9"
"                   0.140     0.016    260.9"
"                   0.157     0.018    311.9"
"                   0.175     0.020    365.9"
"               1.   ROOFTOP"
"                   Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                     hectare     hectare     sq.metre  L/min/25mm       g H:1V"
"                       0.400       0.300      450.000      24.000     133.333"
"                 Using 7 roofdrains on roofstorage area of 3000. square metre"
"                 Peak outflow                    0.011    c.m/sec"
"                 Maximum level                   0.094    metre"
"                 Maximum storage               123.396    c.m"
"                 Centroidal lag                  5.166    hours"
"                       0.050     0.050     0.011     2.776 c.m/sec"
" 40          HYDROGRAPH   Combine    113"
"           6   Combine "
"         113   Node #"
"               Loblaws plus future Sopresata"
"             Maximum flow                    0.011    c.m/sec"
"             Hydrograph volume             263.173    c.m"
"                   0.050     0.050     0.011     0.011"
" 40          HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                 0.050     0.000     0.011     0.011"
" 33          CATCHMENT 1132"
"           4   Linear reservoir"
"           1   Equal length"
"           2   Horton equation"
"        1132   ID number"
"      100.000  % Impervious"
"        1.192  Total Area"
"       30.000  Flow length"
"        1.300  Overland Slope"
"        0.000  Pervious Area"
"       30.000  Pervious length"
"        1.300  Pervious slope"
"        1.192  Impervious Area"
"       30.000  Impervious length"
"        1.300  Impervious slope"
"        0.250  Pervious Manning 'n'"
```

```
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.149     0.000     0.011     0.011 c.m/sec"
"             Catchment 1132          Pervious   Impervious Total Area "
"             Surface Area            0.000      1.192      1.192      hectare"
"             Time of concentration   21.687     3.166      3.166      minutes"
"             Time to Centroid        169.206    171.429    171.429    minutes"
"             Rainfall depth          67.300     67.300     67.300     mm"
"             Rainfall volume         0.00       0.00       0.00       c.m"
"             Rainfall losses         67.300     67.300     67.300     mm"
"             Runoff depth            0.000      0.000      0.000      mm"
"             Runoff volume           0.00       784.34     784.34     c.m"
"             Maximum flow            0.000      0.149      0.149      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                 0.149     0.149     0.011     0.011"
" 54          POND DESIGN"
"       0.149   Current peak flow    c.m/sec"
"       785.0   Hydrograph volume    c.m/sec"
"         21.   Number of stages"
"      92.000   Minimum water level    c.m/sec"
"      93.300   Maximum water level    c.m/sec"
"           0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge    Volume"
"                92.000     0.000       0.0"
"                92.065     0.007       0.0"
"                92.130     0.021       0.0"
"                92.195     0.028       0.0"
"                92.260     0.034       0.0"
"                92.325     0.039       0.0"
"                92.390     0.043       0.0"
"                92.455     0.047       0.0"
"                92.520     0.051       0.0"
"                92.585     0.054       0.0"
"                92.650     0.057       0.0"
"                92.715     0.060       0.0"
"                92.780     0.063       0.0"
"                92.845     0.066       0.0"
"                92.910     0.069       0.0"
"                92.975     0.071       0.0"
"                93.040     0.074       2.0"
"                93.105     0.076      35.4"
"                93.170     0.078     150.2"
"                93.235     0.081     396.8"
"                93.300     0.083     825.6"
"           1.   ORIFICES"
"                Orifice   Orifice   Orifice Number of"
"                 invert coefficie  diameter  orifices"
"                92.000     0.630     0.075     6.000"
"           3.   WEDGES"
"                  Wedge   Grade 1   Grade 2     Angle    Number"
"                 invert    g1H:1V    g2H:1V subtended of wedges"
"                93.000    55.000   100.000    90.000     8.000"
"                93.000    75.000   100.000    90.000     8.000"
"                93.000    40.000    40.000    90.000     8.000"
"             Peak outflow                    0.077    c.m/sec"
"             Maximum level                  93.147    metre"
"             Maximum storage               109.200    c.m"
"             Centroidal lag                  2.980    hours"
```



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"                 0.149     0.149     0.077     0.011 c.m/sec"
" 40          HYDROGRAPH   Combine    113"
"           6   Combine "
"         113   Node #"
"               Loblaws plus future Sopresata"
"             Maximum flow                  0.088    c.m/sec"
"             Hydrograph volume          1046.755    c.m"
"                   0.149     0.149     0.077     0.088"
" 40          HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                 0.149     0.000     0.077     0.088"
" 33          CATCHMENT 1133"
"           4   Linear reservoir"
"           1   Equal length"
"           2   Horton equation"
"        1133   ID number"
"      71.700   % Impervious"
"       1.006   Total Area"
"      30.000   Flow length"
"       1.000   Overland Slope"
"       0.285   Pervious Area"
"      30.000   Pervious length"
"       1.000   Pervious slope"
"       0.721   Impervious Area"
"      30.000   Impervious length"
"       1.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      50.000   Pervious Max.infiltration"
"       7.500   Pervious Min.infiltration"
"       0.500   Pervious Lag constant (hours)"
"       5.000   Pervious Depression storage"
"       0.013   Impervious Manning 'n'"
"       0.000   Impervious Max.infiltration"
"       0.000   Impervious Min.infiltration"
"       0.500   Impervious Lag constant (hours)"
"       1.500   Impervious Depression storage"
"                 0.101     0.000     0.077     0.088 c.m/sec"
"             Catchment 1133          Pervious   Impervious Total Area "
"             Surface Area            0.285      0.721      1.006      hectare"
"             Time of concentration   23.463     3.426      4.701      minutes"
"             Time to Centroid        170.094    171.559    171.465    minutes"
"             Rainfall depth          67.300     67.300     67.300     mm"
"             Rainfall volume         0.00       0.00       0.00       c.m"
"             Rainfall losses         67.300     67.300     67.300     mm"
"             Runoff depth            0.000      0.000      0.000      mm"
"             Runoff volume           32.26      474.62     506.88     c.m"
"             Maximum flow            0.013      0.090      0.101      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                 0.101     0.101     0.077     0.088"
" 40          HYDROGRAPH Copy to Outflow"
"           8   Copy to Outflow"
"                 0.101     0.101     0.101     0.088"
" 40          HYDROGRAPH   Combine    113"
"           6   Combine "
"         113   Node #"
"               Loblaws plus future Sopresata"
"             Maximum flow                  0.187    c.m/sec"
"             Hydrograph volume          1553.636    c.m"
"                   0.101     0.101     0.101     0.187"
" 37          START/RE-START TOTALS 1133"
"           2   Runoff Totals reset to ZERO"
"             Catchment area to node 113                2.598    hectare"
"             Impervious area to node 113               2.313    hectare"
"             % impervious to node 113                 89.042"
"             Peak runoff to node 113                   0.300    c.m/sec"
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"            Total volume to node 113                    1554.4   c.m"
" 81        ADD COMMENT=================================================="
"          15  Lines of comment"
"            Area 125 - Sopresata =  5.323 ha    "
"                 "
"            Drainage area                5.3230 ha "
"            Legal area                   4.8921 ha "
"            External areas               0.4309 ha comprising: "
"               Bell Blvd                 0.2209 ha   67.0 imperv% "
"               Sidney St.s               0.2100 ha   50.0% "
"               Landscape 5%x4.8921       0.2446 ha    0.0% "
"               Total pervious            0.4976 ha "
"            Use: "
"            Rooftop area    1251         1.653 ha  100.0% imperv "
"            Parking area    1252         2.204 ha  100.0% imperv "
"            Balance         1253         1.466 ha   71.2% imperv "
"            TOTAL           125          5.323 ha   92.1% imperv."
"                 "
" 40         HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                 0.101     0.000     0.101     0.187"
" 33         CATCHMENT 1251"
"          4   Linear reservoir"
"          1   Equal length"
"          2   Horton equation"
"       1251   ID number"
"    100.000   % Impervious"
"      1.653   Total Area"
"     10.000   Flow length"
"      0.750   Overland Slope"
"      0.000   Pervious Area"
"     10.000   Pervious length"
"      0.750   Pervious slope"
"      1.653   Impervious Area"
"     10.000   Impervious length"
"      0.750   Impervious slope"
"      0.250   Pervious Manning 'n'"
"     50.000   Pervious Max.infiltration"
"      7.500   Pervious Min.infiltration"
"      0.500   Pervious Lag constant (hours)"
"      5.000   Pervious Depression storage"
"      0.013   Impervious Manning 'n'"
"      0.000   Impervious Max.infiltration"
"      0.000   Impervious Min.infiltration"
"      0.500   Impervious Lag constant (hours)"
"      1.500   Impervious Depression storage"
"                 0.208     0.000     0.101     0.187 c.m/sec"
"            Catchment 1251          Pervious   Impervious Total Area "
"            Surface Area            0.000      1.653      1.653      hectare"
"            Time of concentration   13.231     1.932      1.932      minutes"
"            Time to Centroid        164.978    170.812    170.812    minutes"
"            Rainfall depth          67.300     67.300     67.300     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         67.300     67.300     67.300     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           0.00       1087.67    1087.67    c.m"
"            Maximum flow            0.000      0.208      0.208      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                 0.208     0.208     0.101     0.187"
" 54         POND DESIGN"
"        0.208   Current peak flow    c.m/sec"
"       1090.0   Hydrograph volume    c.m/sec"
"          11.   Number of stages"
"        0.000   Minimum water level    c.m/sec"
"        0.175   Maximum water level    c.m/sec"
```



```
"           0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge    Volume"
"                 0.000     0.000      0.0"
"                 0.018     0.008      3.8"
"                 0.035     0.016     28.0"
"                 0.053     0.024     97.2"
"                 0.070     0.031    224.0"
"                 0.087     0.039    421.1"
"                 0.105     0.047    644.3"
"                 0.123     0.055    867.4"
"                 0.140     0.063   1078.2"
"                 0.157     0.070   1288.9"
"                 0.175     0.078   1512.1"
"          1.   ROOFTOP"
"               Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                 hectare     hectare    sq.metre  L/min/25mm      g H:1V"
"                   1.653       1.240     450.000      24.000     133.333"
"               Using 28 roofdrains on roofstorage area of 12398. square metre"
"               Peak outflow                   0.042    c.m/sec"
"               Maximum level                  0.095    metre"
"               Maximum storage              518.331    c.m"
"               Centroidal lag                 5.268    hours"
"                 0.208     0.208     0.042     0.187 c.m/sec"
" 40         HYDROGRAPH   Combine    125"
"          6   Combine "
"        125   Node #"
"              Hawley land"
"               Maximum flow                   0.042    c.m/sec"
"               Hydrograph volume           1087.782    c.m"
"                 0.208     0.208     0.042     0.042"
" 40         HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                 0.208     0.000     0.042     0.042"
" 33         CATCHMENT 1252"
"          4   Linear reservoir"
"          1   Equal length"
"          2   Horton equation"
"       1252   ID number"
"    100.000   % Impervious"
"      2.204   Total Area"
"     35.000   Flow length"
"      1.300   Overland Slope"
"      0.000   Pervious Area"
"     35.000   Pervious length"
"      1.300   Pervious slope"
"      2.204   Impervious Area"
"     35.000   Impervious length"
"      1.300   Impervious slope"
"      0.250   Pervious Manning 'n'"
"     50.000   Pervious Max.infiltration"
"      7.500   Pervious Min.infiltration"
"      0.500   Pervious Lag constant (hours)"
"      5.000   Pervious Depression storage"
"      0.013   Impervious Manning 'n'"
"      0.000   Impervious Max.infiltration"
"      0.000   Impervious Min.infiltration"
"      0.500   Impervious Lag constant (hours)"
"      1.500   Impervious Depression storage"
"                 0.275     0.000     0.042     0.042 c.m/sec"
"            Catchment 1252          Pervious   Impervious Total Area "
"            Surface Area            0.000      2.204      2.204      hectare"
"            Time of concentration   23.789     3.473      3.473      minutes"
"            Time to Centroid        170.257    171.582    171.582    minutes"
"            Rainfall depth          67.300     67.300     67.300     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         67.300     67.300     67.300     mm"
```

Roof. OUTFLOW max

```
"                Runoff depth                0.000       0.000       0.000     mm"
"                Runoff volume               0.00        1450.23     1450.23   c.m"
"                Maximum flow                0.000       0.275       0.275     c.m/sec"
" 40             HYDROGRAPH Add Runoff "
"              4   Add Runoff "
"                      0.275     0.275     0.042     0.042"
" 54             POND DESIGN"
"          0.275   Current peak flow    c.m/sec"
"         1460.0   Hydrograph volume    c.m/sec"
"            21.   Number of stages"
"         92.000   Minimum water level    c.m/sec"
"         93.300   Maximum water level    c.m/sec"
"              0   Keep Design Data: 1 = True; 0 = False"
"                    Level Discharge    Volume"
"                   92.000     0.000      0.0"
"                   92.065     0.009      0.0"
"                   92.130     0.028      0.0"
"                   92.195     0.038      0.0"
"                   92.260     0.045      0.0"
"                   92.325     0.052      0.0"
"                   92.390     0.058      0.0"
"                   92.455     0.063      0.0"
"                   92.520     0.068      0.0"
"                   92.585     0.072      0.0"
"                   92.650     0.076      0.0"
"                   92.715     0.080      0.0"
"                   92.780     0.084      0.0"
"                   92.845     0.088      0.0"
"                   92.910     0.091      0.0"
"                   92.975     0.095      0.0"
"                   93.040     0.098      3.9"
"                   93.105     0.101     69.8"
"                   93.170     0.104    296.3"
"                   93.235     0.107    782.8"
"                   93.300     0.110   1628.7"
"              1.   ORIFICES"
"                   Orifice   Orifice  Orifice Number of"
"                    invert coefficie diameter  orifices"
"                   92.000     0.630     0.075     8.000"
"              1.   WEDGES"
"                     Wedge   Grade 1   Grade 2     Angle    Number"
"                     invert    g1H:1V    g2H:1V subtended of wedges"
"                   93.000    60.000   120.000    90.000    32.000"
"                Peak outflow                        0.105    c.m/sec"
"                Maximum level                      93.172    metre"
"                Maximum storage                   313.627    c.m"
"                Centroidal lag                      3.184    hours"
"                     0.275     0.275     0.105     0.042 c.m/sec"
" 40             HYDROGRAPH   Combine    125"
"              6   Combine "
"            125   Node #"
"                  Hawley land"
"                Maximum flow                        0.147    c.m/sec"
"                Hydrograph volume                2502.047    c.m"
"                      0.275     0.275     0.105     0.147"
" 40             HYDROGRAPH Start - New Tributary"
"              2   Start - New Tributary"
"                      0.275     0.000     0.105     0.147"
" 33             CATCHMENT 1253"
"              4   Linear reservoir"
"              1   Equal length"
"              2   Horton equation"
"           1253   ID number"
"         71.200   % Impervious"
"          1.466   Total Area"
"         30.000   Flow length"
```



```
"          1.000   Overland Slope"
"          0.422   Pervious Area"
"         30.000   Pervious length"
"          1.000   Pervious slope"
"          1.044   Impervious Area"
"         30.000   Impervious length"
"          1.000   Impervious slope"
"          0.250   Pervious Manning 'n'"
"         50.000   Pervious Max.infiltration"
"          7.500   Pervious Min.infiltration"
"          0.500   Pervious Lag constant (hours)"
"          5.000   Pervious Depression storage"
"          0.013   Impervious Manning 'n'"
"          0.000   Impervious Max.infiltration"
"          0.000   Impervious Min.infiltration"
"          0.500   Impervious Lag constant (hours)"
"          1.500   Impervious Depression storage"
"                      0.147     0.000     0.105     0.147 c.m/sec"
"                Catchment 1253          Pervious  Impervious Total Area "
"                Surface Area            0.422     1.044     1.466     hectare"
"                Time of concentration   23.463    3.426     4.731     minutes"
"                Time to Centroid        170.094   171.559   171.463   minutes"
"                Rainfall depth          67.300    67.300    67.300    mm"
"                Rainfall volume         0.00      0.00      0.00      c.m"
"                Rainfall losses         67.300    67.300    67.300    mm"
"                Runoff depth            0.000     0.000     0.000     mm"
"                Runoff volume           47.85     686.82    734.66    c.m"
"                Maximum flow            0.019     0.130     0.147     c.m/sec"
" 40             HYDROGRAPH Add Runoff "
"              4   Add Runoff "
"                      0.147     0.105     0.147"
" 40             HYDROGRAPH Copy to Outflow"
"              8   Copy to Outflow"
"                      0.147     0.147     0.147     0.147"
" 40             HYDROGRAPH   Combine    125"
"              6   Combine "
"            125   Node #"
"                  Hawley land"
"                Maximum flow                        0.287    c.m/sec"
"                Hydrograph volume                3236.710    c.m"
"                      0.147     0.147     0.147     0.287"
" 37             START/RE-START TOTALS 1253"
"              2   Runoff Totals reset to ZERO"
"                Catchment area to node 125                    5.323    hectare"
"                Impervious area to node 125                   4.901    hectare"
"                % impervious to node 125                     92.068"
"                Peak runoff to node 125                       0.630    c.m/sec"
"                Total volume to node 125                   3272.6      c.m"
" 81             ADD COMMENT================================================="
"              5   Lines of comment"
"                  Recover total flow from area 125 and route it through "
"                  storm sewer to junction node 113, then add it to junction "
"                  node 113 to combine with Loblaws before adding to sediment "
"                  forebay at node 114"
"                  "
" 40             HYDROGRAPH   Confluence    125"
"              7   Confluence "
"            125   Node #"
"                  Hawley land"
"                Maximum flow                        0.287    c.m/sec"
"                Hydrograph volume                3236.710    c.m"
"                      0.147     0.287     0.147     0.000"
" 51             PIPE DESIGN"
"          0.287   Current peak flow    c.m/sec"
"          0.013   Manning 'n'"
"          0.535   Diameter    metre"
```

```
"       0.500   Gradient   %"
"            Depth of flow                    0.396    metre"
"            Velocity                         1.610    m/sec"
"            Pipe capacity                    0.320    c.m/sec"
"            Critical depth                   0.361    metre"
" 53         ROUTE    Pipe Route"
"       350.00      Pipe Route Reach length   ( metre)"
"         0.406   X-factor <= 0.5"
"       163.093   K-lag   ( seconds)"
"         0.000   Default(0) or user spec.(1) values used"
"         0.480   X-factor <= 0.5"
"       456.900   K-lag   ( seconds)"
"         0.500   Beta weighting factor"
"       180.000   Routing time step   ( seconds)"
"             1   No. of sub-reaches"
"            Peak outflow                     0.280    c.m/sec"
"                   0.147     0.287     0.280     0.000 c.m/sec"
" 40         HYDROGRAPH   Combine    113"
"           6   Combine "
"         113   Node #"
"               Loblaws plus future Sopresata"
"            Maximum flow                     0.467    c.m/sec"
"            Hydrograph volume             4790.347    c.m"
"                   0.147     0.287     0.280     0.467"
" 81         ADD COMMENT=================================================="
"          3  Lines of comment"
"             Recover runoff from junction 113 and add to junction node "
"             114 at entry to sediment forebay"
"                "
" 40         HYDROGRAPH   Confluence    113"
"           7   Confluence "
"         113   Node #"
"               Loblaws plus future Sopresata"
"            Maximum flow                     0.467    c.m/sec"
"            Hydrograph volume             4790.347    c.m"
"                   0.147     0.467     0.280     0.000"
" 40         HYDROGRAPH Copy to Outflow"
"           8   Copy to Outflow"
"                   0.147     0.467     0.467     0.000"
" 40         HYDROGRAPH   Combine    114"
"           6   Combine "
"         114   Node #"
"               Upstream of sediment forebay"
"            Maximum flow                     3.243    c.m/sec"
"            Hydrograph volume            75803.080    c.m"
"                   0.147     0.467     0.467     3.243"
" 81         ADD COMMENT=================================================="
"          3  Lines of comment"
"             Recover runoff from junction 114, save it as a file and "
"             route it through the sediment forebay"
"                "
" 40         HYDROGRAPH   Confluence    114"
"           7   Confluence "
"         114   Node #"
"               Upstream of sediment forebay"
"            Maximum flow                     3.243    c.m/sec"
"            Hydrograph volume            75803.080    c.m"
"                   0.147     3.243     0.467     0.000"
" 47         FILEI_O Write/Save forebayin.100hyd"
"          2   1=read/open; 2=write/save"
"          2   1=rainfall; 2=hydrograph"
"          2   1=runoff; 2=inflow; 3=outflow; 4=junction"
"           forebayin.100hyd"
"           100-yr inflow to sediment forebay"
"                0.147     3.243     0.467     0.000 c.m/sec"
" 81         ADD COMMENT=================================================="
```



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"          10  Lines of comment"
"              Sediment forebay has a surface area of 897 sq.m at "
"              elevation of 90.9 m with 3H:1V sideslopes.  Downstream "
"              outflow control comprises a compound weir with following "
"              geometry:"
"              Width 1.400 m at elev. 91.000"
"              Width 1.440 m at elev. 91.150"
"              Width 1.440 m at elev. 91.350"
"              Use reduced coeff.of discharge for lowest segment to  "
"              all for backwater at 90.9 m elevation "
"                "
" 54           POND DESIGN"
"         3.243   Current peak flow    c.m/sec"
"       75804.0   Hydrograph volume    c.m/sec"
"           21.   Number of stages"
"        90.900   Minimum water level    c.m/sec"
"        92.500   Maximum water level    c.m/sec"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge     Volume"
"                  90.900     0.000        0.0"
"                  90.980     0.000       73.1"
"                  91.060     0.025      148.9"
"                  91.140     0.088      227.4"
"                  91.220     0.213      308.7"
"                  91.300     0.403      392.8"
"                  91.380     0.647      479.7"
"                  91.460     0.983      569.5"
"                  91.540     1.384      662.2"
"                  91.620     1.838      757.9"
"                  91.700     2.337      856.5"
"                  91.780     2.879      958.2"
"                  91.860     3.459     1063.0"
"                  91.940     4.076     1170.8"
"                  92.020     4.726     1281.8"
"                  92.100     5.409     1395.9"
"                  92.180     6.122     1513.3"
"                  92.260     6.865     1633.9"
"                  92.340     7.636     1757.8"
"                  92.420     8.435     1885.0"
"                  92.500     9.260     2015.6"
"           3.   WEIRS"
"                  Crest      Weir      Crest      Left      Right"
"              elevation coefficie    breadth sideslope sideslope"
"                 91.000     0.700      1.400     0.000     0.000"
"                 91.150     0.900      1.440     0.000     0.000"
"                 91.350     0.900      1.440     0.000     0.000"
"           2.   LAYERS"
"                  Bottom    Aspect    Bottom       Top   Average"
"                    area     ratio elevation elevation sideslope"
"                 897.000     3.000    90.900    92.000     3.000"
"                1397.058     2.448    92.000    92.500     3.000"
"               Peak outflow                   3.111    c.m/sec"
"               Maximum level                 91.812    metre"
"               Maximum storage             1000.142    c.m"
"               Centroidal lag                 8.412    hours"
"                   0.147     3.243     3.111     0.000 c.m/sec"
" 81           ADD COMMENT=================================================="
"          3  Lines of comment"
"             Save outflow as a file and then add runoff from area 116 "
"             (residential south of Hydro easement) to give total inflow "
"                "
" 47           FILEI_O Write/Save forebayout.100hyd"
"          2   1=read/open; 2=write/save"
"          2   1=rainfall; 2=hydrograph"
"          3   1=runoff; 2=inflow; 3=outflow; 4=junction"
"           forebayout.100hyd"
```

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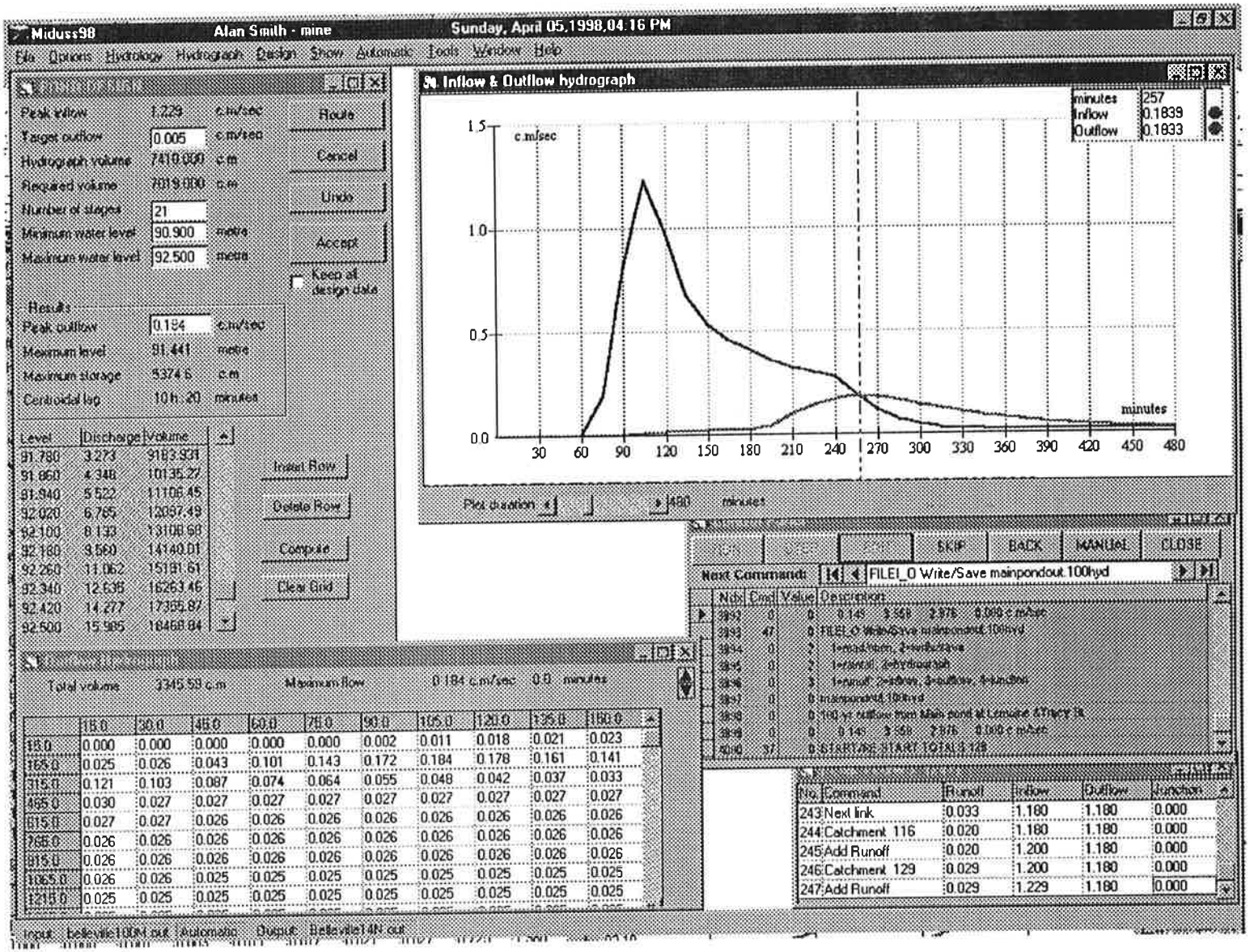
"            100-yr outflow from sediment forebay"
"                 0.147     3.243     3.111     0.000 c.m/sec"
" 81         ADD COMMENT==========================================================="
"          2  Lines of comment"
"             Recover outflow from sediment forebay as Inflow to Main "
"             pond. "
" 40         HYDROGRAPH Next link "
"           5   Next link "
"                 0.147     3.111     3.111     0.000"
" 81         ADD COMMENT==========================================================="
"         13  Lines of comment"
"             D.J.H Development (residential) south of Hydro easement "
"                 "
"             Drainage area              2.4540 ha "
"             Legal area                 2.3774 ha "
"             External areas             0.0766 ha comprising: "
"                Sidney St.              0.0766 ha   40.0 imperv% "
"                Landscaping 75%x2.3774  1.7831"
"                  "
"             s          1.8290 ha ""
"             Use: "
"             TOTAL          116         2.4540 ha   25.5% imperv."
"                 "
"             Padded text"
" 33         CATCHMENT 116"
"            4   Linear reservoir"
"            1   Equal length"
"            2   Horton equation"
"          116   ID number"
"       25.500   % Impervious"
"        2.454   Total Area"
"       20.000   Flow length"
"        1.000   Overland Slope"
"        1.828   Pervious Area"
"       20.000   Pervious length"
"        1.000   Pervious slope"
"        0.626   Impervious Area"
"       20.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.160     3.111     3.111     0.000 c.m/sec"
"             Catchment 116          Pervious   Impervious Total Area "
"             Surface Area           1.828      0.626      2.454      hectare"
"             Time of concentration  18.397     2.686      7.945      minutes"
"             Time to Centroid       167.561    171.189    169.974    minutes"
"             Rainfall depth         67.300     67.300     67.300     mm"
"             Rainfall volume        0.00       0.00       0.00       c.m"
"             Rainfall losses        67.300     67.300     67.300     mm"
"             Runoff depth           0.000      0.000      0.000      mm"
"             Runoff volume          207.19     411.76     618.95     c.m"
"             Maximum flow           0.084      0.078      0.160      c.m/sec"
" 37         START/RE-START TOTALS 116"
"            2   Runoff Totals reset to ZERO"
"             Catchment area to node 114                    2.454    hectare"
"             Impervious area to node 114                   0.626    hectare"
"             % impervious to node 114                     25.500"
"             Peak runoff to node 114                       0.160    c.m/sec"
```



```
"             Total volume to node 114                    618.9     c.m"
" 40         HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                 0.160     3.271     3.111     0.000"
" 81         ADD COMMENT==========================================================="
"          4  Lines of comment"
"             Allow for main pond with permanent water surface area of "
"             approx.  8950 sqare metre, i.e.  "
"             Total area                 1.491 ha  60.0% imperv. "
"                 "
" 33         CATCHMENT 129"
"            4   Linear reservoir"
"            1   Equal length"
"            2   Horton equation"
"          129   ID number"
"       60.000   % Impervious"
"        1.491   Total Area"
"       30.000   Flow length"
"        5.000   Overland Slope"
"        0.596   Pervious Area"
"       30.000   Pervious length"
"        5.000   Pervious slope"
"        0.895   Impervious Area"
"       30.000   Impervious length"
"        5.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.143     3.271     3.111     0.000 c.m/sec"
"             Catchment 129          Pervious   Impervious Total Area "
"             Surface Area           0.596      0.895      1.491      hectare"
"             Time of concentration  14.478     2.114      3.387      minutes"
"             Time to Centroid       165.601    170.903    170.357    minutes"
"             Rainfall depth         67.300     67.300     67.300     mm"
"             Rainfall volume        0.00       0.00       0.00       c.m"
"             Rainfall losses        67.300     67.300     67.300     mm"
"             Runoff depth           0.000      0.000      0.000      mm"
"             Runoff volume          67.59      588.65     656.24     c.m"
"             Maximum flow           0.030      0.112      0.143      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                 0.143     3.414     3.111     0.000"
" 47         FILE1_O Write/Save MainPondIn.100hyd"
"            2   1=read/open; 2=write/save"
"            2   1=rainfall; 2=hydrograph"
"            2   1=runoff; 2=inflow; 3=outflow; 4=junction"
"             MainPondIn.100hyd"
"             100-yr inflow to main pond at Lemoine and Tracy St"
"                  0.143     3.414     3.111     0.000 c.m/sec"
" 54         POND DESIGN"
"        3.414   Current peak flow    c.m/sec"
"     76781.0    Hydrograph volume    c.m/sec"
"         21.    Number of stages"
"       90.900   Minimum water level    c.m/sec"
"       92.500   Maximum water level    c.m/sec"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                 90.900     0.000      0.0"
"                 90.980     0.003    739.8"
```

```
"                91.060     0.012    1498.2"
"                91.140     0.017    2275.6"
"                91.220     0.021    3071.8"
"                91.300     0.024    3887.1"
"                91.380     0.027    4721.4"
"                91.460     0.232    5575.1"
"                91.540     0.755    6448.1"
"                91.620     1.459    7340.5"
"                91.700     2.305    8252.3"
"                91.780     3.273    9183.9"
"                91.860     4.348   10135.3"
"                91.940     5.522   11106.5"
"                92.020     6.785   12097.5"
"                92.100     8.133   13108.7"
"                92.180     9.560   14140.0"
"                92.260    11.062   15191.6"
"                92.340    12.635   16263.5"
"                92.420    14.277   17355.9"
"                92.500    15.985   18468.8"
"           1.   WEIRS"
"                 Crest      Weir     Crest      Left     Right"
"             elevation coefficie   breadth sideslope sideslope"
"                91.400     0.900     9.000     0.000     0.000"
"           1.   ORIFICES"
"                Orifice   Orifice   Orifice Number of"
"                 invert coefficie  diameter  orifices"
"                90.900     0.750     0.128     1.000"
"           3.   LAYERS"
"                 Bottom    Aspect    Bottom       Top   Average"
"                   area     ratio elevation elevation sideslope"
"              9130.600     7.127    90.900    91.400     5.000"
"             10610.040     6.376    91.400    92.300     5.000"
"             13399.040     5.404    92.300    92.500     5.000"
"              Peak outflow                    2.903    c.m/sec"
"              Maximum level                  91.749    metre"
"              Maximum storage              8827.913    c.m"
"              Centroidal lag                  9.136    hours"
"                 0.143     3.414     2.903     0.000 c.m/sec"
" 47           FILE1_0 Write/Save mainpondout.100hyd"
"             2   1=read/open; 2=write/save"
"             2   1=rainfall; 2=hydrograph"
"             3   1=runoff; 2=inflow; 3=outflow; 4=junction"
"              mainpondout.100hyd"
"              100-yr outflow from Main pond at Lemojne &Tracy St."
"                 0.143     3.414     2.903     0.000 c.m/sec"
" 37           START/RE-START TOTALS 129"
"             3   Runoff Totals on EXIT"
"              Total Catchment area                    64.796    hectare"
"              Total Impervious area                   51.387    hectare"
"              Total % impervious                      79.305"
" 37           START/RE-START TOTALS 129"
"             3   Runoff Totals on EXIT"
"              Total Catchment area                    64.796    hectare"
"              Total Impervious area                   51.387    hectare"
"              Total % impervious                      79.305"
" 37           START/RE-START TOTALS 129"
"             3   Runoff Totals on EXIT"
"              Total Catchment area                    64.796    hectare"
"              Total Impervious area                   51.387    hectare"
"              Total % impervious                      79.305"
" 19           EXIT"
```


Midus98
Alan Smith - mine
Sunday, April 05,1998,04:16 PM
File Options Hydrology Hydrograph Design Show Automatic Tools Window Help
Peak inflow 1.229 c.m/sec
Target outflow 0.005 c.m/sec
Hydrograph volume 7410.000 c.m
Required volume 7019.000 c.m
Number of stages 21
Minimum water level 90.900 metre
Maximum water level 92.500 metre
Route
Cancel
Undo
Accept
Keep all design data
Results
Peak outflow 0.184 c.m/sec
Maximum level 91.441 metre
Maximum storage 5374.6 c.m
Centroidal lag 10 h 20 minutes
Level Discharge Volume
91.780 3.273 9183.931
91.860 4.348 10135.27
91.940 5.522 11106.45
92.020 6.765 12097.49
92.100 8.133 13108.68
92.180 9.560 14140.01
92.260 11.062 15191.61
92.340 12.636 16263.46
92.420 14.277 17355.87
92.500 15.985 18468.84
Insert Row
Delete Row
Compute
Clear Grid
90. Inflow & Outflow hydrograph
minutes 257
Inflow 0.1839
Outflow 0.1833
c.m/sec
minutes
Plot duration 480 minutes
Total volume 3345.59 c.m
Maximum flow 0.184 c.m/sec 0.0 minutes
Next Commands: FILE1_0 Write/Save mainpondout100hyd
No. Command Runoff Inflow Outflow Junction
243 Next link 0.033 1.180 1.180 0.000
244 Catchment 116 0.020 1.180 1.180 0.000
245 Add Runoff 0.020 1.200 1.180 0.000
246 Catchment 129 0.029 1.200 1.180 0.000
247 Add Runoff 0.029 1.229 1.180 0.000
Input: Belleville100N.out Automatic Output: Belleville14N.out

QUALITY


```
"              MIDUSS 98 Output------------------------------------------------>"
"              MIDUSS 98 version number                                    0.23"
"              MIDUSS 98 created                          Saturday, April 04, 1998"
"          10  Units used:                                             ie METRIC"
"              Project filename:                  C:\MidussProjects\Belleville\"
"              Output filename:                                  Belleville14N.out"
"              Licensee name:                                          Alan Smith"
"              Company                                                      mine"
"              Date & Time last used:                          4/5/98 at 4:11:29 PM"
" 31         TIME PARAMETERS"
"      15.000   Time Step"
"     360.000   Max. Storm length"
"    1500.000   Max. Hydrograph"
" 32         STORM Mass Curve"
"           3   Mass Curve"
"      14.000   Rainfall depth"
"     240.000   Duration"
"          11   scs_6hr.mrd   SCS 6 hour distribution"
"             Maximum intensity            11.648     mm/hr"
"             Total depth                  14.000     mm"
"           5   14hyd   Hydrograph extension used in this file"
" 37         START/RE-START TOTALS "
"           1   Runoff Totals turned ON"
" 81         ADD COMMENT==================================================="
"          15  Lines of comment"
"             This file <Belleville14N.out> created 1998-04-4."
"             Storm is 14 mm over 4 hours (240 min) using SCS-6hr mass"
"             rainfall distribution file (i.e. the Quality storm)."
"             External Inflow to City of Belleville part of Upper"
"             No-Name catchment is outflow from Thurlow pond, file"
"             <PondOutflow.14hyd>"
"                 "
"             Areas are modified from previous runs to be consistent"
"             with legal survey & Weslake survey and review of as-built"
"             drawings (Dec.1997 and Jan. 1998) and differ significantly"
"             from areas used in previous studies (e.g. Gore & Storrie,"
"             Weslake and EGA)"
"                 "
"             Area parameters represent ultimate development.  On-site"
"             quantity controls are in use."
" 81         ADD COMMENT==================================================="
"          20  Lines of comment"
"             Areas used in this analysis compared with previous studies "
"             ID#   Description          Present          Previous     "
"                                        (ha)   (%I)      (ha)   (%I) "
"             1221  Hwy 401 (Westbound)  2.816  20.3%    0.000        "
"             1222  Hwy 401 (Eastbound   2.797  21.7%    0.000        "
"             121   Cambridge expn.      4.220  71.0%    part of 111 "
"             123   Pronigo              3.213  90.0%    part of 111 "
"             130   D.J.H.Development    1.530  85.5%    part of 111 "
"             111   Cream of the Crop    5.866  90.0%   17.250  80.0%"
"             119   N.Front St. (major)  0.535 100.0%    8.300  91.0%"
"             112   Quinte Mall & OPP   18.343  96.8%   20.400  93.0%"
"             115   Loebs (west)         2.418  91.0%    8.100  91.0%"
"             127   Canadian Tire Ph.1   2.602  90.6%    part of 115 "
"             128   Canadian Tire Ph.2   1.073  81.0%    part of 115 "
"             114   1133166 Ontario      7.275  86.0%    9.100  80.0%"
"             113   Loblaws              2.598  91.0%    part of 113 "
"             113   Sopresata Holdings   5.323  92.0%    7.900  80.0%"
"             116   D.J.H.Developments   2.454  25.0%    2.162  25.0%"
"             129   Main Pond            1.490  60.0%    0.000        "
"                   Totals              64.553  81.16%                "
" 81         ADD COMMENT==================================================="
"           6  Lines of comment"
"             Import outflow from Thurlow pond in file: "
"             <pondoutflow.100hyd> "
```



```
"             Peak inflow     =   4.939 c.m/s "
"             Hyd.volume      =   57923 c.m "
"             Peak outflow    =   1.186 c.m/s "
"                 "
" 47         FILEI_O Read/Open pondoutflow.14hyd"
"           1   1=read/open; 2=write/save"
"           2   1=rainfall; 2=hydrograph"
"           2   1=runoff; 2=inflow; 3=outflow; 4=junction"
"           pondoutflow.14hyd"
"           Outflow from Thurlow pond for 100-yr storm"
"                0.000     0.016     0.000     0.000 c.m/sec"
" 81         ADD COMMENT==================================================="
"           6  Lines of comment"
"             Add MTO contribution from Hwy 401 from stn. 10+915 to "
"             11+550m. (east of Sidney St.) "
"             Area 1221   West bound (north) 2.381 h @ 30% imperv. "
"             Area 1222   East bound (south) 1.472 h @ 30% imperv. "
"             Assume flow lengths of 10 m on imperv., 25 m on pervious "
"                 "
" 33         CATCHMENT 1221"
"           4   Linear reservoir"
"           3   Specify values"
"           2   Horton equation"
"        1221   ID number"
"      20.300   % Impervious"
"       2.816   Total Area"
"      25.000   Flow length"
"       2.000   Overland Slope"
"       2.244   Pervious Area"
"      25.000   Pervious length"
"       2.000   Pervious slope"
"       0.572   Impervious Area"
"       0.000   Impervious length"
"       2.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      50.000   Pervious Max.infiltration"
"       7.500   Pervious Min.infiltration"
"       0.500   Pervious Lag constant (hours)"
"       5.000   Pervious Depression storage"
"       0.015   Impervious Manning 'n'"
"       0.000   Impervious Max.infiltration"
"       0.000   Impervious Min.infiltration"
"       0.500   Impervious Lag constant (hours)"
"       1.500   Impervious Depression storage"
"                0.018     0.016     0.000     0.000 c.m/sec"
"             Catchment 1221          Pervious   Impervious Total Area "
"             Surface Area            2.244      0.572      2.816       hectare"
"             Time of concentration   999999.000 0.000      0.000       minutes"
"             Time to Centroid        0.000      122.903    122.903     minutes"
"             Rainfall depth          14.000     14.000     14.000      mm"
"             Rainfall volume         0.00       0.00       0.00        c.m"
"             Rainfall losses         14.000     14.000     14.000      mm"
"             Runoff depth            0.000      0.000      0.000       mm"
"             Runoff volume           0.00       71.46      71.46       c.m"
"             Maximum flow            0.000      0.018      0.018       c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                0.018     0.020     0.000     0.000"
" 81         ADD COMMENT==================================================="
"           3  Lines of comment"
"             Route flow through culvert 1.20 m wide with 0.12% slope"
"             Use Manning n=0.015 over length of 52.8m"
"                 "
" 52         CHANNEL DESIGN"
"       0.020   Current peak flow    c.m/sec"
"       0.015   Manning 'n'"
```

```
"          0.   Cross-section type: 0=trapezoidal; 1=general"
"       1.200   Basewidth    metre"
"       0.000   Left bank slope"
"       0.000   Right bank slope"
"       0.940   Channel depth    metre"
"       0.120   Gradient   %"
"            Depth of flow                    0.054    metre"
"            Velocity                         0.313    m/sec"
"            Channel capacity                 1.333    c.m/sec"
"            Critical depth                   0.031    metre"
" 53         ROUTE    Channel Route"
"      52.80       Channel Route Reach length   ( metre)"
"       0.233   X-factor <= 0.5"
"     126.431   K-lag   ( seconds)"
"       0.000   Default(0) or user spec.(1) values used"
"       0.000   X-factor <= 0.5"
"     324.000   K-lag   ( seconds)"
"       0.500   Beta weighting factor"
"     180.000   Routing time step   ( seconds)"
"           1   No. of sub-reaches"
"            Peak outflow                     0.020    c.m/sec"
"                  0.018     0.020     0.020     0.000 c.m/sec"
" 40         HYDROGRAPH   Combine    1222"
"           6   Combine "
"        1222   Node #"
"            South end of 401 culvert"
"            Maximum flow                     0.020    c.m/sec"
"            Hydrograph volume             1226.015    c.m"
"                  0.018     0.020     0.020     0.020"
" 81         ADD COMMENT================================================="
"           1  Lines of comment"
"            Now add runoff from south (Eastbound) lanes.      "
" 40         HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                  0.018     0.000     0.020     0.020"
" 33         CATCHMENT 1222"
"           4   Linear reservoir"
"           3   Specify values"
"           2   Horton equation"
"        1222   ID number"
"      21.700   % Impervious"
"       2.797   Total Area"
"      25.000   Flow length"
"       2.000   Overland Slope"
"       2.190   Pervious Area"
"      25.000   Pervious length"
"       2.000   Pervious slope"
"       0.607   Impervious Area"
"      10.000   Impervious length"
"       2.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      50.000   Pervious Max.infiltration"
"       7.500   Pervious Min.infiltration"
"       0.500   Pervious Lag constant (hours)"
"       5.000   Pervious Depression storage"
"       0.015   Impervious Manning 'n'"
"       0.000   Impervious Max.infiltration"
"       0.000   Impervious Min.infiltration"
"       0.500   Impervious Lag constant (hours)"
"       1.500   Impervious Depression storage"
"                  0.019     0.000     0.020     0.020 c.m/sec"
"            Catchment 1222          Pervious   Impervious Total Area "
"            Surface Area            2.190      0.607      2.797      hectare"
"            Time of concentration   999999.000 2.712      2.712      minutes"
"            Time to Centroid        0.000      124.259    124.259    minutes"
"            Rainfall depth          14.000     14.000     14.000     mm"
```



```
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         14.000     14.000     14.000     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           0.00       75.87      75.87      c.m"
"            Maximum flow            0.000      0.019      0.019      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                  0.019     0.019     0.020     0.020"
" 40         HYDROGRAPH Copy to Outflow"
"           8   Copy to Outflow"
"                  0.019     0.019     0.019     0.020"
" 40         HYDROGRAPH   Combine    1222"
"           6   Combine "
"        1222   Node #"
"            South end of 401 culvert"
"            Maximum flow                     0.040    c.m/sec"
"            Hydrograph volume             1301.884    c.m"
"                  0.019     0.019     0.019     0.040"
" 37         START/RE-START TOTALS 1222"
"           2   Runoff Totals reset to ZERO"
"            Catchment area to node 1222                5.613    hectare"
"            Impervious area to node 1222               1.179    hectare"
"            % impervious to node 1222                 20.998"
"            Peak runoff to node 1222                   0.038    c.m/sec"
"            Total volume to node 1222                  147.3    c.m"
" 40         HYDROGRAPH   Confluence    1222"
"           7   Confluence "
"        1222   Node #"
"            South end of 401 culvert"
"            Maximum flow                     0.040    c.m/sec"
"            Hydrograph volume             1301.884    c.m"
"                  0.019     0.040     0.019     0.000"
" 81         ADD COMMENT================================================="
"           9  Lines of comment"
"            Design channel representing watercourse through wetlands "
"            and route flow over 150 m reach to a point close to the "
"            proposed drop structure where runoff from Cambridge "
"            expansion (Area 121) will enter."
"                "
"            Channel will have nominally flat side slopes and grade of "
"            1.0% being the drop in IL of approximately 1.5 m "
"            (93.5 - 92.0) over a reach of 150 m length."
"                "
" 52         CHANNEL DESIGN"
"       0.040   Current peak flow    c.m/sec"
"       0.050   Manning 'n'"
"          0.   Cross-section type: 0=trapezoidal; 1=general"
"       0.600   Basewidth    metre"
"       5.000   Left bank slope"
"       5.000   Right bank slope"
"       1.100   Channel depth    metre"
"       1.000   Gradient   %"
"            Depth of flow                    0.104    metre"
"            Velocity                         0.340    m/sec"
"            Channel capacity                 9.202    c.m/sec"
"            Critical depth                   0.063    metre"
" 53         ROUTE    Channel Route"
"     150.00       Channel Route Reach length   ( metre)"
"       0.483   X-factor <= 0.5"
"     330.917   K-lag   ( seconds)"
"       0.000   Default(0) or user spec.(1) values used"
"       0.480   X-factor <= 0.5"
"     456.900   K-lag   ( seconds)"
"       0.500   Beta weighting factor"
"     300.000   Routing time step   ( seconds)"
"           1   No. of sub-reaches"
```

```
"              Peak outflow                    0.038     c.m/sec"
"                    0.019     0.040     0.038     0.000 c.m/sec"
" 81          ADD COMMENT================================================="
"           4  Lines of comment"
"              Store routed outflow at junction 1219 to allow design of"
"              Area 121 which is Cambridge extension for theatre and"
"              possible future bookstore"
"                   "
" 40          HYDROGRAPH   Combine    1219"
"             6   Combine "
"          1219   Node #"
"                 South of wetlands at Cambridge extension"
"              Maximum flow                    0.038     c.m/sec"
"              Hydrograph volume            1297.530     c.m"
"                    0.019     0.040     0.038     0.038"
" 81          ADD COMMENT================================================="
"           21  Lines of comment"
"              Model Cambridge extension for cinema & bookstore located "
"              south of 401 and east of No-Name Creek wetlands. "
"              Add wetland area of 0.97 ha north-west of expansion. "
"              Store at internal junction node 121"
"                   "
"              Drainage area                4.2200 ha "
"              Legal area                   4.1005 ha "
"              Wetland                      0.9700 ha "
"              Developable 4.1005-0.97      3.1305 ha "
"              External areas               0.1205 ha comprising: "
"                 Lemoine St.               0.1205 ha    0.0% "
"                 Landscape 5%x3.1305       0.1565 ha    0.0% "
"                 Total pervious            0.2770 ha "
"              Use: "
"              Rooftop area   1211          0.328 ha  100.0% imperv "
"              Roof storage area    0.246 "
"              Parking area   1212          2.420 ha  100.0% imperv "
"              Balance        1213          0.502 ha   45.0% imperv "
"              Wetland        1214          0.970 ha   10.0% imperv "
"              TOTAL          121           4.220 ha   72.7% imperv."
"                   "
" 33          CATCHMENT 1211"
"             4   Linear reservoir"
"             1   Equal length"
"             2   Horton equation"
"          1211   ID number"
"       100.000   % Impervious"
"         0.328   Total Area"
"        10.000   Flow length"
"         0.250   Overland Slope"
"         0.000   Pervious Area"
"        10.000   Pervious length"
"         0.250   Pervious slope"
"         0.328   Impervious Area"
"        10.000   Impervious length"
"         0.250   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        50.000   Pervious Max.infiltration"
"         7.500   Pervious Min.infiltration"
"         0.500   Pervious Lag constant (hours)"
"         5.000   Pervious Depression storage"
"         0.013   Impervious Manning 'n'"
"         0.000   Impervious Max.infiltration"
"         0.000   Impervious Min.infiltration"
"         0.500   Impervious Lag constant (hours)"
"         1.500   Impervious Depression storage"
"                       0.010     0.040     0.038     0.038 c.m/sec"
"                 Catchment 1211          Pervious   Impervious Total Area "
"                 Surface Area            0.000      0.328      0.328      hectare"
```



```
"                 Time of concentration  999999.000 4.644      4.644      minutes"
"                 Time to Centroid       0.000      125.225    125.225    minutes"
"                 Rainfall depth         14.000     14.000     14.000     mm"
"                 Rainfall volume        0.00       0.00       0.00       c.m"
"                 Rainfall losses        14.000     14.000     14.000     mm"
"                 Runoff depth           0.000      0.000      0.000      mm"
"                 Runoff volume          0.00       41.00      41.00      c.m"
"                 Maximum flow           0.000      0.010      0.010      c.m/sec"
" 40          HYDROGRAPH Start - New Tributary"
"             2   Start - New Tributary"
"                       0.010     0.000     0.038     0.038"
" 40          HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                       0.010     0.010     0.038     0.038"
" 54          POND DESIGN"
"         0.010   Current peak flow    c.m/sec"
"          41.0   Hydrograph volume    c.m/sec"
"           11.   Number of stages"
"         0.000   Minimum water level    c.m/sec"
"         0.150   Maximum water level    c.m/sec"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                   0.000     0.000      0.0"
"                   0.015     0.001      3.9"
"                   0.030     0.002     30.3"
"                   0.045     0.004     67.2"
"                   0.060     0.005    104.1"
"                   0.075     0.006    141.0"
"                   0.090     0.007    177.9"
"                   0.105     0.008    214.8"
"                   0.120     0.010    251.7"
"                   0.135     0.011    288.6"
"                   0.150     0.012    325.5"
"              1.   ROOFTOP"
"                   Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                     hectare     hectare    sq.metre  L/min/25mm       g H:1V"
"                       0.328       0.246     450.000      24.000     400.000"
"                 Using 5 roofdrains on roofstorage area of 2460. square metre"
"                 Peak outflow                    0.002     c.m/sec"
"                 Maximum level                   0.026     metre"
"                 Maximum storage                22.956     c.m"
"                 Centroidal lag                  4.410     hours"
"                       0.010     0.010     0.002     0.038 c.m/sec"
" 40          HYDROGRAPH   Combine    121"
"             6   Combine "
"           121   Node #"
"                 Cambridge cinema & bookstore"
"              Maximum flow                    0.002     c.m/sec"
"              Hydrograph volume              40.951     c.m"
"                       0.010     0.010     0.002     0.002"
" 40          HYDROGRAPH Start - New Tributary"
"             2   Start - New Tributary"
"                       0.010     0.000     0.002     0.002"
" 81          ADD COMMENT================================================="
"           3  Lines of comment"
"              Add runoff from parking area for ultimate development."
"              Area = 2.0 h with 4 catchbasins"
"                   "
" 33          CATCHMENT 1212"
"             4   Linear reservoir"
"             1   Equal length"
"             2   Horton equation"
"          1212   ID number"
"       100.000   % Impervious"
"         2.420   Total Area"
"        30.000   Flow length"
```

```
"       1.500   Overland Slope"
"       0.000   Pervious Area"
"      30.000   Pervious length"
"       1.500   Pervious slope"
"       2.420   Impervious Area"
"      30.000   Impervious length"
"       1.500   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      50.000   Pervious Max.infiltration"
"       7.500   Pervious Min.infiltration"
"       0.500   Pervious Lag constant (hours)"
"       5.000   Pervious Depression storage"
"       0.013   Impervious Manning 'n'"
"       0.000   Impervious Max.infiltration"
"       0.000   Impervious Min.infiltration"
"       0.500   Impervious Lag constant (hours)"
"       1.500   Impervious Depression storage"
"                 0.077     0.000     0.002     0.002 c.m/sec"
"            Catchment 1212          Pervious   Impervious Total Area "
"            Surface Area            0.000      2.420      2.420      hectare"
"            Time of concentration   999999.000 5.245      5.245      minutes"
"            Time to Centroid        0.000      125.526    125.526    minutes"
"            Rainfall depth          14.000     14.000     14.000     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         14.000     14.000     14.000     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           0.00       302.50     302.50     c.m"
"            Maximum flow            0.000      0.077      0.077      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                 0.077     0.077     0.002     0.002"
" 54       POND DESIGN"
"       0.077   Current peak flow    c.m/sec"
"       310.0   Hydrograph volume    c.m/sec"
"         21.   Number of stages"
"      92.700   Minimum water level    c.m/sec"
"      94.500   Maximum water level    c.m/sec"
"           0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge    Volume"
"                92.700     0.000       0.0"
"                92.790     0.014       0.0"
"                92.880     0.050       0.0"
"                92.970     0.069       0.0"
"                93.060     0.083       0.0"
"                93.150     0.096       0.0"
"                93.240     0.107       0.0"
"                93.330     0.117       0.0"
"                93.420     0.126       0.0"
"                93.510     0.135       0.0"
"                93.600     0.143       0.0"
"                93.690     0.150       0.0"
"                93.780     0.158      16.1"
"                93.870     0.165     154.4"
"                93.960     0.171     552.2"
"                94.050     0.178    1347.0"
"                94.140     0.184    2676.2"
"                94.230     0.190    4677.3"
"                94.320     0.196    7487.4"
"                94.410     0.201   11244.4"
"                94.500     0.207   16085.1"
"           1.   ORIFICES"
"                Orifice   Orifice   Orifice Number of"
"                 invert coefficie  diameter  orifices"
"                92.700     0.630     0.120     5.000"
"           1.   WEDGES"
"                  Wedge   Grade 1   Grade 2     Angle    Number"
```



```
"                 invert    g1H:1V    g2H:1V subtended of wedges"
"                 93.700    50.000   120.000    90.000    20.000"
"              Peak outflow                      0.077    c.m/sec"
"              Maximum level                    93.023    metre"
"              Maximum storage                   0.000    c.m"
"              Centroidal lag                    2.092    hours"
"                 0.077     0.077     0.077     0.002 c.m/sec"
" 40           HYDROGRAPH   Combine    121"
"            6   Combine "
"          121   Node #"
"                Cambridge cinema & bookstore"
"              Maximum flow                      0.079    c.m/sec"
"              Hydrograph volume               343.451    c.m"
"                 0.077     0.077     0.077     0.079"
" 81           ADD COMMENT================================================="
"          2   Lines of comment"
"              Add balance of area = 0.632 h at 72% imperv."
"                "
" 40           HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                 0.077     0.000     0.077     0.079"
" 33           CATCHMENT 1213"
"            4   Linear reservoir"
"            1   Equal length"
"            2   Horton equation"
"         1213   ID number"
"       45.000   % Impervious"
"        0.502   Total Area"
"       30.000   Flow length"
"        1.000   Overland Slope"
"        0.276   Pervious Area"
"       30.000   Pervious length"
"        1.000   Pervious slope"
"        0.226   Impervious Area"
"       30.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.007     0.000     0.077     0.079 c.m/sec"
"             Catchment 1213          Pervious   Impervious Total Area "
"             Surface Area            0.276      0.226      0.502      hectare"
"             Time of concentration   999999.000 5.923      5.923      minutes"
"             Time to Centroid        0.000      125.865    125.865    minutes"
"             Rainfall depth          14.000     14.000     14.000     mm"
"             Rainfall volume         0.00       0.00       0.00       c.m"
"             Rainfall losses         14.000     14.000     14.000     mm"
"             Runoff depth            0.000      0.000      0.000      mm"
"             Runoff volume           0.00       28.24      28.24      c.m"
"             Maximum flow            0.000      0.007      0.007      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                  0.007     0.007     0.077     0.079"
" 40          HYDROGRAPH Copy to Outflow"
"           8   Copy to Outflow"
"                  0.007     0.007     0.007     0.079"
" 40          HYDROGRAPH   Combine    121"
"           6   Combine "
"         121   Node #"
```

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"              Cambridge cinema & bookstore"
"           Maximum flow                    0.086    c.m/sec"
"           Hydrograph volume             371.688    c.m"
"                 0.007     0.007     0.007     0.086"
" 81        ADD COMMENT================================================="
"         3 Lines of comment"
"           Add runoff from triangular area north-west wetlands with "
"           nominal 10% of impervious to account for ponded surface "
"             "
" 33        CATCHMENT 1214"
"          4   Linear reservoir"
"          1   Equal length"
"          2   Horton equation"
"       1214   ID number"
"     10.000   % Impervious"
"      0.970   Total Area"
"     30.000   Flow length"
"      1.000   Overland Slope"
"      0.873   Pervious Area"
"     30.000   Pervious length"
"      2.000   Pervious slope"
"      0.097   Impervious Area"
"     30.000   Impervious length"
"      2.000   Impervious slope"
"      0.250   Pervious Manning 'n'"
"     50.000   Pervious Max.infiltration"
"      7.500   Pervious Min.infiltration"
"      0.500   Pervious Lag constant (hours)"
"      5.000   Pervious Depression storage"
"      0.013   Impervious Manning 'n'"
"      0.000   Impervious Max.infiltration"
"      0.000   Impervious Min.infiltration"
"      0.500   Impervious Lag constant (hours)"
"      1.500   Impervious Depression storage"
"                0.003     0.007     0.007     0.086 c.m/sec"
"           Catchment 1214          Pervious   Impervious Total Area "
"           Surface Area            0.873      0.097      0.970      hectare"
"           Time of concentration   999999.000 4.811      4.811      minutes"
"           Time to Centroid        0.000      125.309    125.309    minutes"
"           Rainfall depth          14.000     14.000     14.000     mm"
"           Rainfall volume         0.00       0.00       0.00       c.m"
"           Rainfall losses         14.000     14.000     14.000     mm"
"           Runoff depth            0.000      0.000      0.000      mm"
"           Runoff volume           0.00       12.13      12.13      c.m"
"           Maximum flow            0.000      0.003      0.003      c.m/sec"
" 40        HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                0.003     0.000     0.007     0.086"
" 40        HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.003     0.003     0.007     0.086"
" 40        HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                0.003     0.003     0.003     0.086"
" 40        HYDROGRAPH   Combine    121"
"          6   Combine "
"        121   Node #"
"           Cambridge cinema & bookstore"
"           Maximum flow                    0.089    c.m/sec"
"           Hydrograph volume             383.813    c.m"
"                 0.003     0.003     0.003     0.089"
" 37        START/RE-START TOTALS 1214"
"          2   Runoff Totals reset to ZERO"
"           Catchment area to node 121                  4.220    hectare"
"           Impervious area to node 121                 3.071    hectare"
"           % impervious to node 121                   72.770"
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"           Peak runoff to node 121                     0.098    c.m/sec"
"           Total volume to node 121                  383.9      c.m"
" 81        ADD COMMENT================================================="
"         4 Lines of comment"
"           Recover total flow from junction 121 and re-design channel "
"           down Lemoine Street road allowance to upstream end of "
"           culvert under Bell Blvd."
"             "
" 40        HYDROGRAPH   Confluence    121"
"          7   Confluence "
"        121   Node #"
"           Cambridge cinema & bookstore"
"           Maximum flow                    0.089    c.m/sec"
"           Hydrograph volume             383.813    c.m"
"                 0.003     0.089     0.003     0.000"
" 40        HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                0.003     0.089     0.089     0.000"
" 40        HYDROGRAPH   Combine    1219"
"          6   Combine "
"       1219   Node #"
"           South of wetlands at Cambridge extension"
"           Maximum flow                    0.127    c.m/sec"
"           Hydrograph volume            1681.343    c.m"
"                 0.003     0.089     0.089     0.127"
" 40        HYDROGRAPH   Confluence    1219"
"          7   Confluence "
"       1219   Node #"
"           South of wetlands at Cambridge extension"
"           Maximum flow                    0.127    c.m/sec"
"           Hydrograph volume            1681.343    c.m"
"                 0.003     0.127     0.089     0.000"
" 81        ADD COMMENT================================================="
"         5 Lines of comment"
"           Route flow through 200m of re-constructed channel"
"           down Lemoine St. road allowance to north intake of"
"           of culvert under bell Blvd.  Channel cross section"
"           has 2m base width and side slopes at 2H:1V and"
"           grade of 0.3%."
" 52        CHANNEL DESIGN"
"       0.127   Current peak flow    c.m/sec"
"       0.040   Manning 'n'"
"          0.   Cross-section type: 0=trapezoidal; 1=general"
"       2.000   Basewidth    metre"
"       2.000   Left bank slope"
"       2.000   Right bank slope"
"       1.100   Channel depth    metre"
"       0.300   Gradient   %"
"           Depth of flow                   0.155    metre"
"           Velocity                        0.356    m/sec"
"           Channel capacity                4.833    c.m/sec"
"           Critical depth                  0.073    metre"
" 53        ROUTE    Channel Route"
"     200.00      Channel Route Reach length   ( metre)"
"       0.425   X-factor <= 0.5"
"     421.183   K-lag   ( seconds)"
"       0.000   Default(0) or user spec.(1) values used"
"       0.480   X-factor <= 0.5"
"     456.900   K-lag   ( seconds)"
"       0.500   Beta weighting factor"
"     450.000   Routing time step   ( seconds)"
"           1   No. of sub-reaches"
"            Peak outflow                   0.116    c.m/sec"
"                 0.003     0.127     0.116     0.000 c.m/sec"
" 81        ADD COMMENT================================================="
"         7 Lines of comment"
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"          Store total outflow from channel at junction node 111 at "
"          north side of culvert at lemoine Street road allowance and "
"          Bell Blvd."
"          This will allow processing of runoff from areas:  "
"          123 (Pronigo) "
"          111 (Cream of the Crop, and "
"          130  (D.J.H. Development) "
" 40       HYDROGRAPH   Combine    111"
"        6   Combine "
"      111   Node #"
"          Lemoine and Bell Blvd (North side)"
"          Maximum flow                  0.116    c.m/sec"
"          Hydrograph volume          1675.791    c.m"
"                0.003     0.127     0.116     0.116"
" 81       ADD COMMENT================================================="
"       14  Lines of comment"
"          Pronego property: (area 123)"
"          Drainage area              3.471 ha "
"          Legal area                 2.980 ha "
"          External areas             0.491 ha comprising: "
"             Bell Blvd               0.363 ha   65.0 imperv% "
"             Lemoine St.             0.128 ha    0.0% "
"             Landscape 5%x2.98       0.149 ha    0.0% "
"             Total pervious          0.404 ha "
"          Use:"
"          Rooftop area   1231        1.060 ha  100.0% imperv "
"          Parking area   1232        1.221 ha  100.0% imperv "
"          Balance        1233        1.190 ha   66.0% imperv "
"          TOTAL          123         3.471 ha   88.3% imperv."
"                "
" 33       CATCHMENT 1231"
"        4   Linear reservoir"
"        1   Equal length"
"        2   Horton equation"
"     1231   ID number"
"  100.000   % Impervious"
"    1.060   Total Area"
"   10.000   Flow length"
"    1.000   Overland Slope"
"    0.000   Pervious Area"
"   10.000   Pervious length"
"    1.000   Pervious slope"
"    1.060   Impervious Area"
"   10.000   Impervious length"
"    1.000   Impervious slope"
"    0.250   Pervious Manning 'n'"
"   50.000   Pervious Max.infiltration"
"    7.500   Pervious Min.infiltration"
"    0.500   Pervious Lag constant (hours)"
"    5.000   Pervious Depression storage"
"    0.013   Impervious Manning 'n'"
"    0.000   Impervious Max.infiltration"
"    0.000   Impervious Min.infiltration"
"    0.500   Impervious Lag constant (hours)"
"    1.500   Impervious Depression storage"
"          0.034     0.127     0.116     0.116 c.m/sec"
"          Catchment 1231          Pervious   Impervious Total Area "
"          Surface Area            0.000      1.060      1.060      hectare"
"          Time of concentration   999999.000 3.064      3.064      minutes"
"          Time to Centroid        0.000      124.435    124.435    minutes"
"          Rainfall depth          14.000     14.000     14.000     mm"
"          Rainfall volume         0.00       0.00       0.00       c.m"
"          Rainfall losses         14.000     14.000     14.000     mm"
"          Runoff depth            0.000      0.000      0.000      mm"
"          Runoff volume           0.00       132.50     132.50     c.m"
"          Maximum flow            0.000      0.034      0.034      c.m/sec"
```



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" 40       HYDROGRAPH Start - New Tributary"
"        2   Start - New Tributary"
"                0.034     0.000     0.116     0.116"
" 40       HYDROGRAPH Add Runoff "
"        4   Add Runoff "
"                0.034     0.034     0.116     0.116"
" 54       POND DESIGN"
"      0.034   Current peak flow    c.m/sec"
"      140.0   Hydrograph volume    c.m/sec"
"        11.   Number of stages"
"      0.000   Minimum water level    c.m/sec"
"      0.200   Maximum water level    c.m/sec"
"          0   Keep Design Data: 1 = True; 0 = False"
"                Level Discharge    Volume"
"                0.000     0.000      0.0"
"                0.020     0.006      1.9"
"                0.040     0.012     15.1"
"                0.060     0.017     50.9"
"                0.080     0.023    120.6"
"                0.100     0.029    235.6"
"                0.120     0.035    391.9"
"                0.140     0.040    550.9"
"                0.160     0.046    709.9"
"                0.180     0.052    868.9"
"                0.200     0.058   1027.9"
"          1.   ROOFTOP"
"               Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                 hectare     hectare    sq.metre  L/min/25mm       g H:1V"
"                   1.060       0.795     450.000      24.000      100.000"
"          Using 18 roofdrains on roofstorage area of 7950. square metre"
"          Peak outflow                    0.016    c.m/sec"
"          Maximum level                   0.054    metre"
"          Maximum storage                40.785    c.m"
"          Centroidal lag                  2.554    hours"
"               0.034     0.034     0.016     0.116 c.m/sec"
" 40       HYDROGRAPH   Combine    123"
"        6   Combine "
"      123   Node #"
"          Bradlaw property"
"          Maximum flow                    0.016    c.m/sec"
"          Hydrograph volume             132.612    c.m"
"                0.034     0.034     0.016     0.016"
" 40       HYDROGRAPH Start - New Tributary"
"        2   Start - New Tributary"
"                0.034     0.000     0.016     0.016"
" 33       CATCHMENT 1232"
"        4   Linear reservoir"
"        1   Equal length"
"        2   Horton equation"
"     1232   ID number"
"  100.000   % Impervious"
"    1.221   Total Area"
"   30.000   Flow length"
"    1.000   Overland Slope"
"    0.000   Pervious Area"
"   30.000   Pervious length"
"    1.000   Pervious slope"
"    1.221   Impervious Area"
"   30.000   Impervious length"
"    1.000   Impervious slope"
"    0.250   Pervious Manning 'n'"
"   50.000   Pervious Max.infiltration"
"    7.500   Pervious Min.infiltration"
"    0.500   Pervious Lag constant (hours)"
"    5.000   Pervious Depression storage"
"    0.013   Impervious Manning 'n'"
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"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.039     0.000     0.016     0.016 c.m/sec"
"             Catchment 1232          Pervious   Impervious Total Area "
"             Surface Area            0.000      1.221      1.221      hectare"
"             Time of concentration   999999.000 5.923      5.923      minutes"
"             Time to Centroid        0.000      125.865    125.865    minutes"
"             Rainfall depth          14.000     14.000     14.000     mm"
"             Rainfall volume         0.00       0.00       0.00       c.m"
"             Rainfall losses         14.000     14.000     14.000     mm"
"             Runoff depth            0.000      0.000      0.000      mm"
"             Runoff volume           0.00       152.62     152.62     c.m"
"             Maximum flow            0.000      0.039      0.039      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                   0.039     0.039     0.016     0.016"
" 54          POND DESIGN"
"        0.039   Current peak flow    c.m/sec"
"        160.0   Hydrograph volume    c.m/sec"
"          21.   Number of stages"
"       90.900   Minimum water level    c.m/sec"
"       92.200   Maximum water level    c.m/sec"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                 90.900     0.000       0.0"
"                 90.965     0.007       0.0"
"                 91.030     0.028       0.0"
"                 91.095     0.041       0.0"
"                 91.160     0.050       0.0"
"                 91.225     0.058       0.0"
"                 91.290     0.065       0.0"
"                 91.355     0.071       0.0"
"                 91.420     0.077       0.0"
"                 91.485     0.082       0.0"
"                 91.550     0.087       0.0"
"                 91.615     0.092       0.0"
"                 91.680     0.096       0.0"
"                 91.745     0.101       0.0"
"                 91.810     0.105       0.0"
"                 91.875     0.109       0.0"
"                 91.940     0.112       1.7"
"                 92.005     0.116      30.3"
"                 92.070     0.120     128.6"
"                 92.135     0.123     339.8"
"                 92.200     0.126     706.8"
"            1.   ORIFICES"
"                 Orifice   Orifice   Orifice Number of"
"                  invert coefficie  diameter  orifices"
"                  90.900     0.630     0.102     5.000"
"            1.   WEDGES"
"                   Wedge   Grade 1   Grade 2     Angle     Number"
"                  invert    g1H:1V    g2H:1V subtended of wedges"
"                  91.900    50.000   100.000    90.000    20.000"
"               Peak outflow                    0.039    c.m/sec"
"               Maximum level                  91.087    metre"
"               Maximum storage                 0.000    c.m"
"               Centroidal lag                  2.098    hours"
"                    0.039     0.039     0.039     0.016 c.m/sec"
" 40          HYDROGRAPH   Combine    123"
"           6   Combine "
"         123   Node #"
"               Bradlaw property"
"               Maximum flow                    0.053    c.m/sec"
"               Hydrograph volume             285.237    c.m"
```



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"                    0.039     0.039     0.039     0.053"
" 40          HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                    0.039     0.000     0.039     0.053"
" 33          CATCHMENT 1233"
"           4   Linear reservoir"
"           1   Equal length"
"           2   Horton equation"
"        1233   ID number"
"      66.000   % Impervious"
"       1.190   Total Area"
"      35.000   Flow length"
"       1.000   Overland Slope"
"       0.405   Pervious Area"
"      35.000   Pervious length"
"       1.000   Pervious slope"
"       0.785   Impervious Area"
"      35.000   Impervious length"
"       1.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      50.000   Pervious Max.infiltration"
"       7.500   Pervious Min.infiltration"
"       0.500   Pervious Lag constant (hours)"
"       5.000   Pervious Depression storage"
"       0.013   Impervious Manning 'n'"
"       0.000   Impervious Max.infiltration"
"       0.000   Impervious Min.infiltration"
"       0.500   Impervious Lag constant (hours)"
"       1.500   Impervious Depression storage"
"                    0.025     0.000     0.039     0.053 c.m/sec"
"             Catchment 1233          Pervious   Impervious Total Area "
"             Surface Area            0.405      0.785      1.190      hectare"
"             Time of concentration   999999.000 6.497      6.497      minutes"
"             Time to Centroid        0.000      126.152    126.152    minutes"
"             Rainfall depth          14.000     14.000     14.000     mm"
"             Rainfall volume         0.00       0.00       0.00       c.m"
"             Rainfall losses         14.000     14.000     14.000     mm"
"             Runoff depth            0.000      0.000      0.000      mm"
"             Runoff volume           0.00       98.17      98.17      c.m"
"             Maximum flow            0.000      0.025      0.025      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                    0.025     0.025     0.039     0.053"
" 40          HYDROGRAPH Copy to Outflow"
"           8   Copy to Outflow"
"                    0.025     0.025     0.025     0.053"
" 40          HYDROGRAPH   Combine    123"
"           6   Combine "
"         123   Node #"
"               Bradlaw property"
"               Maximum flow                    0.079    c.m/sec"
"               Hydrograph volume             383.412    c.m"
"                    0.025     0.025     0.025     0.079"
" 37          START/RE-START TOTALS 1233"
"           2   Runoff Totals reset to ZERO"
"               Catchment area to node 123                  3.471    hectare"
"               Impervious area to node 123                 3.066    hectare"
"               % impervious to node 123                   88.343"
"               Peak runoff to node 123                     0.098    c.m/sec"
"               Total volume to node 123                    383.3    c.m"
" 81          ADD COMMENT================================================="
"           2   Lines of comment"
"               Add Pronego runoff to junction node 111 on north end of"
"               culvert under Bell Blvd."
" 40          HYDROGRAPH   Confluence    123"
"           7   Confluence "
```

```
"          123   Node #"
"                Bradlaw property"
"             Maximum flow                    0.079    c.m/sec"
"             Hydrograph volume             383.412    c.m"
"                   0.025     0.079     0.025     0.000"
" 40        HYDROGRAPH Copy to Outflow"
"           8   Copy to Outflow"
"                   0.025     0.079     0.079     0.000"
" 40        HYDROGRAPH   Combine    111"
"           6   Combine "
"         111   Node #"
"                Lemoine and Bell Blvd (North side)"
"             Maximum flow                    0.195    c.m/sec"
"             Hydrograph volume            2059.202    c.m"
"                   0.025     0.079     0.079     0.195"
" 81        ADD COMMENT================================================="
"          17  Lines of comment"
"             D.J.H. Development property: (area 130)  "
"             Assume this enters creek at upstream end of culvert "
"             under Bell Blvd. "
"             Drainage area                 1.514 ha "
"             Legal area                    1.188 ha "
"             External areas                0.326 ha comprising: "
"                Bell Blvd                  0.238 ha   58.0 imperv% "
"                Lemoine St.                0.088 ha   37.5% "
"                Landscape 5%x1.188         0.059 ha    0.0% "
"                Total pervious             0.214 ha "
"             Use: "
"                "
"               1301        0.363 ha  100.0% imperv ""
"             Parking area   1302         0.484 ha  100.0% imperv "
"             Balance        1303         0.667 ha   67.9% imperv "
"             TOTAL          130          1.514 ha   85.9% imperv."
"                "
" 33         CATCHMENT 1301"
"           4   Linear reservoir"
"           1   Equal length"
"           2   Horton equation"
"        1301   ID number"
"      100.000  % Impervious"
"       0.363   Total Area"
"      10.000   Flow length"
"       0.750   Overland Slope"
"       0.000   Pervious Area"
"      10.000   Pervious length"
"       0.750   Pervious slope"
"       0.363   Impervious Area"
"      10.000   Impervious length"
"       0.750   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      50.000   Pervious Max.infiltration"
"       7.500   Pervious Min.infiltration"
"       0.500   Pervious Lag constant (hours)"
"       5.000   Pervious Depression storage"
"       0.013   Impervious Manning 'n'"
"       0.000   Impervious Max.infiltration"
"       0.000   Impervious Min.infiltration"
"       0.500   Impervious Lag constant (hours)"
"       1.500   Impervious Depression storage"
"                   0.012     0.079     0.079     0.195 c.m/sec"
"            Catchment 1301          Pervious   Impervious Total Area "
"            Surface Area            0.000      0.363      0.363      hectare"
"            Time of concentration   999999.000 3.340      3.340      minutes"
"            Time to Centroid        0.000      124.573    124.573    minutes"
"            Rainfall depth          14.000     14.000     14.000     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
```



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"            Rainfall losses         14.000     14.000     14.000     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           0.00       45.37      45.37      c.m"
"            Maximum flow            0.000      0.012      0.012      c.m/sec"
" 40         HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                   0.012     0.000     0.079     0.195"
" 40         HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                   0.012     0.012     0.079     0.195"
" 54         POND DESIGN"
"       0.012   Current peak flow    c.m/sec"
"        46.0   Hydrograph volume    c.m/sec"
"         11.   Number of stages"
"       0.000   Minimum water level    c.m/sec"
"       0.175   Maximum water level    c.m/sec"
"           0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge    Volume"
"                 0.000     0.000      0.0"
"                 0.018     0.002      0.8"
"                 0.035     0.003      6.1"
"                 0.053     0.005     21.4"
"                 0.070     0.007     49.2"
"                 0.087     0.008     92.5"
"                 0.105     0.010    141.5"
"                 0.123     0.012    190.5"
"                 0.140     0.013    236.8"
"                 0.157     0.015    283.1"
"                 0.175     0.017    332.1"
"            1.   ROOFTOP"
"                 Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                   hectare     hectare    sq.metre  L/min/25mm       g H:1V"
"                     0.363       0.272     450.000      24.000     133.333"
"              Using 6 roofdrains on roofstorage area of 2723. square metre"
"              Peak outflow                    0.004    c.m/sec"
"              Maximum level                   0.047    metre"
"              Maximum storage                16.098    c.m"
"              Centroidal lag                  2.774    hours"
"                   0.012     0.012     0.004     0.195 c.m/sec"
" 40         HYDROGRAPH   Combine    130"
"           6   Combine "
"         130   Node #"
"                Hawley-Ming N of Bell"
"             Maximum flow                    0.004    c.m/sec"
"             Hydrograph volume              45.341    c.m"
"                   0.012     0.012     0.004     0.004"
" 40         HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                   0.012     0.000     0.004     0.004"
" 33         CATCHMENT 1302"
"           4   Linear reservoir"
"           1   Equal length"
"           2   Horton equation"
"        1302   ID number"
"      100.000  % Impervious"
"       0.484   Total Area"
"      25.000   Flow length"
"       1.000   Overland Slope"
"       0.000   Pervious Area"
"      25.000   Pervious length"
"       1.000   Pervious slope"
"       0.484   Impervious Area"
"      25.000   Impervious length"
"       1.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      50.000   Pervious Max.infiltration"
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"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.015     0.000     0.004     0.004 c.m/sec"
"             Catchment 1302          Pervious   Impervious Total Area "
"             Surface Area            0.000      0.484      0.484      hectare"
"             Time of concentration   999999.000 5.309      5.309      minutes"
"             Time to Centroid        0.000      125.558    125.558    minutes"
"             Rainfall depth          14.000     14.000     14.000     mm"
"             Rainfall volume         0.00       0.00       0.00       c.m"
"             Rainfall losses         14.000     14.000     14.000     mm"
"             Runoff depth            0.000      0.000      0.000      mm"
"             Runoff volume           0.00       60.50      60.50      c.m"
"             Maximum flow            0.000      0.015      0.015      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                 0.015     0.015     0.004     0.004"
" 54          POND DESIGN"
"       0.015   Current peak flow    c.m/sec"
"        61.0   Hydrograph volume    c.m/sec"
"         21.   Number of stages"
"      90.900   Minimum water level    c.m/sec"
"      92.200   Maximum water level    c.m/sec"
"           0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge    Volume"
"                 90.900     0.000      0.0"
"                 90.965     0.003      0.0"
"                 91.030     0.009      0.0"
"                 91.095     0.013      0.0"
"                 91.160     0.016      0.0"
"                 91.225     0.018      0.0"
"                 91.290     0.020      0.0"
"                 91.355     0.022      0.0"
"                 91.420     0.024      0.0"
"                 91.485     0.026      0.0"
"                 91.550     0.027      0.0"
"                 91.615     0.029      0.0"
"                 91.680     0.030      0.0"
"                 91.745     0.031      0.0"
"                 91.810     0.033      0.0"
"                 91.875     0.034      0.0"
"                 91.940     0.035      0.8"
"                 92.005     0.036     14.7"
"                 92.070     0.037     62.3"
"                 92.135     0.038    164.4"
"                 92.200     0.040    342.1"
"           1.    ORIFICES"
"                 Orifice   Orifice   Orifice Number of"
"                  invert coefficie  diameter  orifices"
"                  90.900     0.630     0.090     2.000"
"           1.    WEDGES"
"                   Wedge   Grade 1   Grade 2     Angle     Number"
"                  invert    g1H:1V    g2H:1V subtended of wedges"
"                  91.900    55.000   110.000    90.000     8.000"
"               Peak outflow                    0.015    c.m/sec"
"               Maximum level                  91.151    metre"
"               Maximum storage                 0.000    c.m"
"               Centroidal lag                  2.093    hours"
"                   0.015     0.015     0.015     0.004 c.m/sec"
" 40          HYDROGRAPH   Combine    130"
"           6   Combine "
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"         130   Node #"
"               Hawley-Ming N of Bell"
"             Maximum flow                  0.020    c.m/sec"
"             Hydrograph volume           105.841    c.m"
"                   0.015     0.015     0.015     0.020"
" 40          HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                   0.015     0.000     0.015     0.020"
" 33          CATCHMENT 1303"
"           4   Linear reservoir"
"           1   Equal length"
"           2   Horton equation"
"        1303   ID number"
"      67.900   % Impervious"
"       0.667   Total Area"
"      20.000   Flow length"
"       1.000   Overland Slope"
"       0.214   Pervious Area"
"      20.000   Pervious length"
"       1.000   Pervious slope"
"       0.453   Impervious Area"
"      20.000   Impervious length"
"       1.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      50.000   Pervious Max.infiltration"
"       7.500   Pervious Min.infiltration"
"       0.500   Pervious Lag constant (hours)"
"       5.000   Pervious Depression storage"
"       0.013   Impervious Manning 'n'"
"       0.000   Impervious Max.infiltration"
"       0.000   Impervious Min.infiltration"
"       0.500   Impervious Lag constant (hours)"
"       1.500   Impervious Depression storage"
"                 0.014     0.000     0.015     0.020 c.m/sec"
"            Catchment 1303          Pervious   Impervious Total Area "
"            Surface Area            0.214      0.453      0.667      hectare"
"            Time of concentration   999999.000 4.644      4.644      minutes"
"            Time to Centroid        0.000      125.225    125.225    minutes"
"            Rainfall depth          14.000     14.000     14.000     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         14.000     14.000     14.000     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           0.00       56.61      56.61      c.m"
"            Maximum flow            0.000      0.014      0.014      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                 0.014     0.014     0.015     0.020"
" 40          HYDROGRAPH Copy to Outflow"
"           8   Copy to Outflow"
"                 0.014     0.014     0.014     0.020"
" 40          HYDROGRAPH   Combine    130"
"           6   Combine "
"         130   Node #"
"               Hawley-Ming N of Bell"
"             Maximum flow                  0.034    c.m/sec"
"             Hydrograph volume           162.453    c.m"
"                   0.014     0.014     0.014     0.034"
" 37          START/RE-START TOTALS 1303"
"           2   Runoff Totals reset to ZERO"
"             Catchment area to node 130                1.514    hectare"
"             Impervious area to node 130               1.300    hectare"
"             % impervious to node 130                 85.858"
"             Peak runoff to node 130                   0.042    c.m/sec"
"             Total volume to node 130                  162.5    c.m"
" 81          ADD COMMENT================================================="
"           2  Lines of comment"
```

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"            Recover flow from junction node 130 and add to total flow "
"            at junction 111"
" 40         HYDROGRAPH   Confluence    130"
"          7   Confluence "
"        130   Node #"
"              Hawley-Ming N of Bell"
"            Maximum flow                  0.034    c.m/sec"
"            Hydrograph volume           162.453    c.m"
"                  0.014     0.034     0.014     0.000"
" 40         HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                  0.014     0.034     0.034     0.000"
" 40         HYDROGRAPH   Combine    111"
"          6   Combine "
"        111   Node #"
"              Lemoine and Bell Blvd (North side)"
"            Maximum flow                  0.229    c.m/sec"
"            Hydrograph volume          2221.655    c.m"
"                  0.014     0.034     0.034     0.229"
" 81         ADD COMMENT==================================================="
"          1  Lines of comment"
"             Now route through culvert under Bell Blvd."
" 40         HYDROGRAPH   Confluence    111"
"          7   Confluence "
"        111   Node #"
"              Lemoine and Bell Blvd (North side)"
"            Maximum flow                  0.229    c.m/sec"
"            Hydrograph volume          2221.655    c.m"
"                  0.014     0.229     0.034     0.000"
" 51         PIPE DESIGN"
"        0.229   Current peak flow    c.m/sec"
"        0.013   Manning 'n'"
"        1.500   Diameter    metre"
"        1.000   Gradient   %"
"            Depth of flow                 0.185    metre"
"            Velocity                      1.831    m/sec"
"            Pipe capacity                 7.069    c.m/sec"
"            Critical depth                0.238    metre"
" 53         ROUTE    Pipe Route"
"       25.00      Pipe Route Reach length   ( metre)"
"        0.318   X-factor <= 0.5"
"       10.240   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.480   X-factor <= 0.5"
"      456.900   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"       13.846   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"            Peak outflow                  0.228    c.m/sec"
"                  0.014     0.229     0.228     0.000 c.m/sec"
" 40         HYDROGRAPH   Combine    114"
"          6   Combine "
"        114   Node #"
"              Upstream of sediment forebay"
"            Maximum flow                  0.228    c.m/sec"
"            Hydrograph volume          2221.520    c.m"
"                  0.014     0.229     0.228     0.228"
" 81         ADD COMMENT==================================================="
"          7  Lines of comment"
"             Process area 111.  This comprises Cream of the Crop on "
"             north side of Bell Blvd. and generally west of No-Name "
"             creek. All runoff assumed to go to Bell Blvd."
"             Runoff from West of culvert enters through a 450 mm storm"
"             on south side of Bell Blvd. entering No-Name Creek at"
"             Lemoine St. at south (downstream) side of culvert."
"                 "
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" 81         ADD COMMENT==================================================="
"         19  Lines of comment"
"             Cream of the Crop property: (area 111)"
"             Area 111 comprises part of Cream-of-the-Crop only"
"             Total area 5.866 ha drains to 450 mm storm"
"             on south side of Bell Blvd. flowing east to Lemoine St "
"             culvert (downstream). "
"                 "
"             Drainage area                 5.866 ha "
"             Legal area                    5.288 ha "
"             External areas                0.578 ha comprising: "
"                Bell Blvd                  0.370 ha   44.0 imperv% "
"                Lemoine St.                0.208 ha   17.3% "
"                Landscape 5%x5.288         0.264 ha    0.0% "
"                Total pervious             0.643 ha "
"             Use: "
"             Rooftop area   1111          1.760 ha  100.0% imperv "
"             Parking area   1112          2.737 ha  100.0% imperv "
"             Balance        1113          1.369 ha   53.0% imperv "
"             TOTAL          111           5.866 ha   89.0% imperv."
"                 "
" 40         HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                  0.014     0.000     0.228     0.228"
" 33         CATCHMENT 1111"
"          4   Linear reservoir"
"          1   Equal length"
"          2   Horton equation"
"       1111   ID number"
"    100.000   % Impervious"
"      1.760   Total Area"
"     10.000   Flow length"
"      0.750   Overland Slope"
"      0.000   Pervious Area"
"     10.000   Pervious length"
"      0.750   Pervious slope"
"      1.760   Impervious Area"
"     10.000   Impervious length"
"      0.750   Impervious slope"
"      0.250   Pervious Manning 'n'"
"     50.000   Pervious Max.infiltration"
"      7.500   Pervious Min.infiltration"
"      0.500   Pervious Lag constant (hours)"
"      5.000   Pervious Depression storage"
"      0.013   Impervious Manning 'n'"
"      0.000   Impervious Max.infiltration"
"      0.000   Impervious Min.infiltration"
"      0.500   Impervious Lag constant (hours)"
"      1.500   Impervious Depression storage"
"                  0.056     0.000     0.228     0.228 c.m/sec"
"                Catchment 1111          Pervious   Impervious Total Area "
"                Surface Area            0.000      1.760      1.760      hectare"
"                Time of concentration   999999.000 3.340      3.340      minutes"
"                Time to Centroid        0.000      124.573    124.573    minutes"
"                Rainfall depth          14.000     14.000     14.000     mm"
"                Rainfall volume         0.00       0.00       0.00       c.m"
"                Rainfall losses         14.000     14.000     14.000     mm"
"                Runoff depth            0.000      0.000      0.000      mm"
"                Runoff volume           0.00       220.00     220.00     c.m"
"                Maximum flow            0.000      0.056      0.056      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                  0.056     0.056     0.228     0.228"
" 54         POND DESIGN"
"        0.056   Current peak flow    c.m/sec"
"       .220.0   Hydrograph volume    c.m/sec"
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"          11.   Number of stages"
"       0.000    Minimum water level    c.m/sec"
"       0.175    Maximum water level    c.m/sec"
"           0    Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                  0.000     0.000      0.0"
"                  0.018     0.008      4.1"
"                  0.035     0.016     29.8"
"                  0.053     0.025    103.5"
"                  0.070     0.032    238.5"
"                  0.087     0.040    448.4"
"                  0.105     0.049    686.0"
"                  0.123     0.057    923.6"
"                  0.140     0.065   1148.0"
"                  0.157     0.073   1372.4"
"                  0.175     0.081   1610.0"
"         1.   ROOFTOP"
"              Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                hectare     hectare    sq.metre  L/min/25mm      g H:1V"
"                  1.760       1.320     450.000      24.000     133.333"
"            Using 29 roofdrains on roofstorage area of 13200. square metre"
"            Peak outflow                  0.022    c.m/sec"
"            Maximum level                 0.047    metre"
"            Maximum storage              78.186    c.m"
"            Centroidal lag                2.777    hours"
"                 0.056     0.056     0.022     0.228 c.m/sec"
" 40       HYDROGRAPH   Combine    1114"
"          6   Combine "
"       1114   Node #"
"              Quickert property"
"            Maximum flow                  0.022    c.m/sec"
"            Hydrograph volume           219.740    c.m"
"                   0.056     0.056     0.022     0.022"
" 40       HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                 0.056     0.000     0.022     0.022"
" 33       CATCHMENT 1112"
"          4   Linear reservoir"
"          1   Equal length"
"          2   Horton equation"
"       1112   ID number"
"    100.000   % Impervious"
"      2.737   Total Area"
"     25.000   Flow length"
"      1.000   Overland Slope"
"      0.000   Pervious Area"
"     25.000   Pervious length"
"      1.000   Pervious slope"
"      2.737   Impervious Area"
"     25.000   Impervious length"
"      1.000   Impervious slope"
"      0.250   Pervious Manning 'n'"
"     50.000   Pervious Max.infiltration"
"      7.500   Pervious Min.infiltration"
"      0.500   Pervious Lag constant (hours)"
"      5.000   Pervious Depression storage"
"      0.013   Impervious Manning 'n'"
"      0.000   Impervious Max.infiltration"
"      0.000   Impervious Min.infiltration"
"      0.500   Impervious Lag constant (hours)"
"      1.500   Impervious Depression storage"
"                 0.088     0.000     0.022     0.022 c.m/sec"
"            Catchment 1112          Pervious   Impervious Total Area "
"            Surface Area            0.000      2.737      2.737      hectare"
"            Time of concentration   999999.000 5.309      5.309      minutes"
"            Time to Centroid        0.000      125.558    125.558    minutes"
```



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"            Rainfall depth          14.000     14.000     14.000     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         14.000     14.000     14.000     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           0.00       342.12     342.12     c.m"
"            Maximum flow            0.000      0.088      0.088      c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                 0.088     0.088     0.022     0.022"
" 54       POND DESIGN"
"       0.088    Current peak flow    c.m/sec"
"       343.0    Hydrograph volume    c.m/sec"
"          11.   Number of stages"
"      93.900    Minimum water level    c.m/sec"
"      95.200    Maximum water level    c.m/sec"
"           0    Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                  93.900     0.000      0.0"
"                  94.030     0.047      0.0"
"                  94.160     0.079      0.0"
"                  94.290     0.102      0.0"
"                  94.420     0.120      0.0"
"                  94.550     0.136      0.0"
"                  94.680     0.151      0.0"
"                  94.810     0.164      0.0"
"                  94.940     0.176      3.4"
"                  95.070     0.187    257.2"
"                  95.200     0.198   1413.7"
"          1.   ORIFICES"
"               Orifice   Orifice   Orifice Number of"
"                invert coefficie  diameter  orifices"
"                93.900     0.630     0.090    10.000"
"          1.   WEDGES"
"                 Wedge   Grade 1   Grade 2     Angle    Number"
"                invert     g1H:1V    g2H:1V subtended of wedges"
"                94.900     50.000   100.000    90.000    40.000"
"            Peak outflow                  0.088    c.m/sec"
"            Maximum level                94.207    metre"
"            Maximum storage               0.000    c.m"
"            Centroidal lag                2.093    hours"
"                 0.088     0.088     0.088     0.022 c.m/sec"
" 40       HYDROGRAPH   Combine    1114"
"          6   Combine "
"       1114   Node #"
"              Quickert property"
"            Maximum flow                  0.107    c.m/sec"
"            Hydrograph volume           561.865    c.m"
"                   0.088     0.088     0.088     0.107"
" 40       HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                 0.088     0.000     0.088     0.107"
" 33       CATCHMENT 1113"
"          4   Linear reservoir"
"          1   Equal length"
"          2   Horton equation"
"       1113   ID number"
"     53.000   % Impervious"
"      1.369   Total Area"
"     20.000   Flow length"
"      1.000   Overland Slope"
"      0.643   Pervious Area"
"     20.000   Pervious length"
"      1.000   Pervious slope"
"      0.726   Impervious Area"
"     20.000   Impervious length"
"      1.000   Impervious slope"
```

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"       0.250   Pervious Manning 'n'"
"      50.000   Pervious Max.infiltration"
"       7.500   Pervious Min.infiltration"
"       0.500   Pervious Lag constant (hours)"
"       5.000   Pervious Depression storage"
"       0.013   Impervious Manning 'n'"
"       0.000   Impervious Max.infiltration"
"       0.000   Impervious Min.infiltration"
"       0.500   Impervious Lag constant (hours)"
"       1.500   Impervious Depression storage"
"                 0.023     0.000     0.088     0.107 c.m/sec"
"            Catchment 1113          Pervious   Impervious Total Area "
"            Surface Area            0.643      0.726      1.369      hectare"
"            Time of concentration   999999.000 4.644      4.644      minutes"
"            Time to Centroid        0.000      125.225    125.225    minutes"
"            Rainfall depth          14.000     14.000     14.000     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         14.000     14.000     14.000     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           0.00       90.70      90.70      c.m"
"            Maximum flow            0.000      0.023      0.023      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                 0.023     0.023     0.088     0.107"
" 40         HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                 0.023     0.023     0.023     0.107"
" 40         HYDROGRAPH   Combine    1114"
"          6   Combine "
"       1114   Node #"
"            Quickert property"
"            Maximum flow                  0.131    c.m/sec"
"            Hydrograph volume           652.561    c.m"
"                 0.023     0.023     0.023     0.131"
" 37         START/RE-START TOTALS 1113"
"          2   Runoff Totals reset to ZERO"
"            Catchment area to node 1114                 5.866    hectare"
"            Impervious area to node 1114                5.223    hectare"
"            % impervious to node 1114                  89.031"
"            Peak runoff to node 1114                    0.167    c.m/sec"
"            Total volume to node 1114                   652.8    c.m"
" 37         START/RE-START TOTALS 1113"
"          2   Runoff Totals reset to ZERO"
"            Catchment area to node 1114                 0.000    hectare"
"            Impervious area to node 1114                0.000    hectare"
"            % impervious to node 1114                   0.000"
"            Peak runoff to node 1114                    0.000    c.m/sec"
"            Total volume to node 1114                     0.0    c.m"
" 40         HYDROGRAPH   Confluence    1114"
"          7   Confluence "
"       1114   Node #"
"            Quickert property"
"            Maximum flow                  0.131    c.m/sec"
"            Hydrograph volume           652.561    c.m"
"                 0.023     0.131     0.023     0.000"
" 81         ADD COMMENT==================================================="
"          3  Lines of comment"
"            Assume total runoff flows through the major and minor"
"            system to junction 114 at south end of culvert under"
"            Bell Blvd."
" 51         PIPE DESIGN"
"       0.131   Current peak flow    c.m/sec"
"       0.013   Manning 'n'"
"       0.450   Diameter    metre"
"       0.500   Gradient   %"
"            Depth of flow                 0.264    metre"
```



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"            Velocity                      1.348    m/sec"
"            Pipe capacity                 0.202    c.m/sec"
"            Critical depth                0.253    metre"
" 53         ROUTE    Pipe Route"
"       200.00      Pipe Route Reach length   ( metre)"
"        0.415   X-factor <= 0.5"
"      111.243   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.480   X-factor <= 0.5"
"      456.900   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      128.571   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"            Peak outflow                  0.128    c.m/sec"
"                 0.023     0.131     0.128     0.000 c.m/sec"
" 40         HYDROGRAPH   Combine    114"
"          6   Combine "
"        114   Node #"
"            Upstream of sediment forebay"
"            Maximum flow                  0.357    c.m/sec"
"            Hydrograph volume          2874.081    c.m"
"                 0.023     0.131     0.128     0.357"
" 81         ADD COMMENT==================================================="
"         11  Lines of comment"
"            Now move east to Bell Blvd. at N.Front Street."
"            Add area 119 at Bell Blvd. and N.Front St."
"            This area is very much smaller than in previous report as "
"            most runoff is directed south on N.Front. St."
"                "
"            Area comprises:"
"            Shell station less minor flow captured by 2 CBs which is "
"            directed East to N.Front St."
"            CB #3 flows to Quinte Mall drainage network."
"            Area is 0.535 ha at 100% imperv."
"                "
" 33         CATCHMENT 119"
"          4   Linear reservoir"
"          1   Equal length"
"          2   Horton equation"
"        119   ID number"
"      100.000   % Impervious"
"        0.535   Total Area"
"       30.000   Flow length"
"        1.000   Overland Slope"
"        0.000   Pervious Area"
"       30.000   Pervious length"
"        1.000   Pervious slope"
"        0.535   Impervious Area"
"       30.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.017     0.131     0.128     0.357 c.m/sec"
"             Catchment 119          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.535      0.535      hectare"
"             Time of concentration  999999.000 5.923      5.923      minutes"
"             Time to Centroid       0.000      125.865    125.865    minutes"
"             Rainfall depth         14.000     14.000     14.000     mm"
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"            Rainfall volume          0.00       0.00       0.00      c.m"
"            Rainfall losses          14.000     14.000     14.000    mm"
"            Runoff depth             0.000      0.000      0.000     mm"
"            Runoff volume            0.00       66.87      66.87     c.m"
"            Maximum flow             0.000      0.017      0.017     c.m/sec"
" 40         HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                0.017     0.000     0.128     0.357"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.017     0.017     0.128     0.357"
" 81         ADD COMMENT==========================================================="
"          4  Lines of comment"
"            Subtract equivalent of 2 x 0.5 cfs or 0.027 c.m/s for "
"            2 CBs using Diversion command."
"            3rd CB flows west to Quinte Mall."
"               "
" 56         DIVERSION"
"        119   Node number"
"      0.027   Overflow threshold"
"     1.0000   Required diverted fraction"
"            Peak of diverted flow          0.000     c.m/sec"
"            Volume of diverted flow        0.000     c.m"
"            DIV00119.14hyd"
"            Excess major runoff to Bell Blvd"
"                0.017     0.017     0.017     0.357 c.m/sec"
" 37         START/RE-START TOTALS 119"
"          2   Runoff Totals reset to ZERO"
"            Catchment area to node 0                    0.535    hectare"
"            Impervious area to node 0                   0.535    hectare"
"            % impervious to node 0                    100.000"
"            Peak runoff to node 0                       0.017    c.m/sec"
"            Total volume to node 0                      66.9     c.m"
" 81         ADD COMMENT==========================================================="
"         28  Lines of comment"
"            Cambridge Quinte Mall, OPP, Pub.Wks (112)  "
"            Add runoff from Quinte Mall plus portion from O.P.P lands."
"            On site controls include roof top storage and two groups of"
"            CBs for parking lot storage.  "
"               "
"            Drainage area              18.3430 ha  "
"            Legal area                 17.5097 ha  "
"              Cambridge       17.0060 "
"              OPP, Pub.Wks.    0.5037 "
"            External areas              0.8333 ha comprising: "
"               Bell Blvd                0.7190 ha   63.0 imperv% "
"               MTO ramp                 0.1143 ha    0.0% "
"               Landscape 5%x17.006      0.8503 ha    0.0% "
"               Total pervious           1.2306 ha "
"            Use: "
"            Rooftop area   1121         4.582 ha  100.0% imperv MH 'G' "
"              410 sq.m/RD"
"               "
"              1122        6.990 ha  100.0% imperv MH 'L' ""
"            Parking west   1123         5.310 ha  100.0% imperv "
"            Balance        1124         1.461 ha   15.8% imperv "
"            TOTAL          112         18.343 ha   93.3% imperv."
"               "
"            (See spreadsheet ParkVols.xls for details of available "
"            volumes at 16 CBs.  "
"            East parking   (CBs 1 - 6 & 11 - 13)    Rim.El. 93.07"
"            West parking   (CBs 7 - 10 & 14 - 16)   Rim.El. 91.90"
"               "
" 33         CATCHMENT 1121"
"          4   Linear reservoir"
"          1   Equal length"
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"          2   Horton equation"
"       1121   ID number"
"    100.000   % Impervious"
"      4.582   Total Area"
"     10.000   Flow length"
"      1.000   Overland Slope"
"      0.000   Pervious Area"
"     10.000   Pervious length"
"      1.000   Pervious slope"
"      4.582   Impervious Area"
"     10.000   Impervious length"
"      1.000   Impervious slope"
"      0.250   Pervious Manning 'n'"
"     50.000   Pervious Max.infiltration"
"      7.500   Pervious Min.infiltration"
"      0.500   Pervious Lag constant (hours)"
"      5.000   Pervious Depression storage"
"      0.013   Impervious Manning 'n'"
"      0.000   Impervious Max.infiltration"
"      0.000   Impervious Min.infiltration"
"      0.500   Impervious Lag constant (hours)"
"      1.000   Impervious Depression storage"
"                0.146     0.017     0.017     0.357 c.m/sec"
"            Catchment 1121          Pervious   Impervious Total Area "
"            Surface Area            0.000      4.582      4.582      hectare"
"            Time of concentration   999999.000 3.064      3.064      minutes"
"            Time to Centroid        0.000      121.676    121.676    minutes"
"            Rainfall depth          14.000     14.000     14.000     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         14.000     14.000     14.000     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           0.00       595.66     595.66     c.m"
"            Maximum flow            0.000      0.146      0.146      c.m/sec"
" 40         HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                0.146     0.000     0.017     0.357"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.146     0.146     0.017     0.357"
" 81         ADD COMMENT==========================================================="
"          2  Lines of comment"
"            Model roof top storage assuming R.D. density of 410 sq.m "
"               "
" 54         POND DESIGN"
"      0.146   Current peak flow    c.m/sec"
"      596.0   Hydrograph volume    c.m/sec"
"        11.   Number of stages"
"      0.000   Minimum water level    c.m/sec"
"      0.200   Maximum water level    c.m/sec"
"          0   Keep Design Data: 1 = True; 0 = False"
"                Level Discharge    Volume"
"                0.000     0.000      0.0"
"                0.020     0.027      8.9"
"                0.040     0.054     71.5"
"                0.060     0.081    241.4"
"                0.080     0.108    572.2"
"                0.100     0.134   1117.6"
"                0.120     0.161   1804.3"
"                0.140     0.188   2491.6"
"                0.160     0.215   3178.9"
"                0.180     0.242   3866.2"
"                0.200     0.269   4553.5"
"            1.   ROOFTOP"
"                Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                  hectare     hectare    sq.metre  L/min/25mm      g H:1V"
"                    4.582       3.436     410.000      24.000     100.000"
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"            Using 84 roofdrains on roofstorage area of 34365. square metre"
"            Peak outflow                    0.070    c.m/sec"
"            Maximum level                   0.052    metre"
"            Maximum storage               173.698    c.m"
"            Centroidal lag                  2.460   hours"
"                 0.146     0.146     0.070     0.357 c.m/sec"
" 40         HYDROGRAPH   Combine    112"
"          6   Combine "
"        112   Node #"
"              Quinte Mall on Bell Blvd."
"            Maximum flow                    0.070    c.m/sec"
"            Hydrograph volume             595.784    c.m"
"                 0.146     0.146     0.070     0.070"
" 40         HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                 0.146     0.000     0.070     0.070"
"                                                   ================================================="
" 81         ADD COMMENT
"          4  Lines of comment"
"             Add East parking area with on-site controls.  Assume "
"             average Rim.El. = 93.07m with catchbasin IL at 92.07m "
"             with ICD diameter of 120 mm"
"                 "
" 33         CATCHMENT 1122"
"            4   Linear reservoir"
"            1   Equal length"
"            2   Horton equation"
"         1122   ID number"
"      100.000   % Impervious"
"        6.990   Total Area"
"       30.000   Flow length"
"        1.000   Overland Slope"
"        0.000   Pervious Area"
"       30.000   Pervious length"
"        1.000   Pervious slope"
"        6.990   Impervious Area"
"       30.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.224     0.000     0.070     0.070 c.m/sec"
"             Catchment 1122          Pervious   Impervious Total Area "
"             Surface Area            0.000      6.990      6.990      hectare"
"             Time of concentration   999999.000 5.923      5.923      minutes"
"             Time to Centroid        0.000      125.865    125.865    minutes"
"             Rainfall depth          14.000     14.000     14.000     mm"
"             Rainfall volume         0.00       0.00       0.00       c.m"
"             Rainfall losses         14.000     14.000     14.000     mm"
"             Runoff depth            0.000      0.000      0.000      mm"
"             Runoff volume           0.00       873.75     873.75     c.m"
"             Maximum flow            0.000      0.224      0.224      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                  0.224     0.224     0.070     0.070"
" 54         POND DESIGN"
"         0.224   Current peak flow    c.m/sec"
"         874.0   Hydrograph volume    c.m/sec"
"           21.   Number of stages"
"        92.070   Minimum water level    c.m/sec"
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"        93.470   Maximum water level    c.m/sec"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                  92.070     0.000       0.0"
"                  92.140     0.016       0.0"
"                  92.210     0.070       0.0"
"                  92.280     0.102       0.0"
"                  92.350     0.127       0.0"
"                  92.420     0.148       0.0"
"                  92.490     0.166       0.0"
"                  92.560     0.182       0.0"
"                  92.630     0.197       0.0"
"                  92.700     0.211       0.0"
"                  92.770     0.224       0.0"
"                  92.840     0.236       0.0"
"                  92.910     0.248       0.0"
"                  92.980     0.259       0.0"
"                  93.050     0.269       0.0"
"                  93.120     0.280       5.3"
"                  93.190     0.290      73.3"
"                  93.260     0.299     290.9"
"                  93.330     0.309     745.3"
"                  93.400     0.318    1523.9"
"                  93.470     0.326    2714.0"
"             1.   ORIFICES"
"                  Orifice   Orifice   Orifice Number of"
"                   invert coefficie  diameter  orifices"
"                  92.070     0.630     0.120     9.000"
"             9.   WEDGES"
"                    Wedge   Grade 1   Grade 2     Angle    Number"
"                   invert    g1H:1V    g2H:1V subtended of wedges"
"                  93.070    70.000    35.000    90.000     4.000"
"                  93.070    63.000    45.000    90.000     4.000"
"                  93.070    92.000    66.000    90.000     4.000"
"                  93.070    68.000    68.000    90.000     4.000"
"                  93.070    80.000    53.000    90.000     4.000"
"                  93.070   130.000    87.000    90.000     4.000"
"                  93.070    80.000    50.000    90.000     4.000"
"                  93.070    52.000    34.000    90.000     4.000"
"                  93.070    71.000    45.000    90.000     4.000"
"               Peak outflow                    0.224    c.m/sec"
"               Maximum level                  92.770    metre"
"               Maximum storage                 0.000    c.m"
"               Centroidal lag                  2.098   hours"
"                    0.224     0.224     0.224     0.070 c.m/sec"
" 40            HYDROGRAPH   Combine    112"
"             6   Combine "
"           112   Node #"
"                 Quinte Mall on Bell Blvd."
"               Maximum flow                    0.289    c.m/sec"
"               Hydrograph volume            1469.533    c.m"
"                    0.224     0.224     0.224     0.289"
" 81            ADD COMMENT
"             2  Lines of comment"
"                Add runoff from area draining to west group of "
"                catch basins."
" 33            CATCHMENT 1123"
"               4   Linear reservoir"
"               1   Equal length"
"               2   Horton equation"
"            1123   ID number"
"         100.000   % Impervious"
"           5.310   Total Area"
"          30.000   Flow length"
"           1.000   Overland Slope"
"           0.000   Pervious Area"
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"       30.000   Pervious length"
"        1.000   Pervious slope"
"        5.310   Impervious Area"
"       30.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.170     0.224     0.224     0.289 c.m/sec"
"            Catchment 1123          Pervious   Impervious Total Area "
"            Surface Area            0.000      5.310      5.310      hectare"
"            Time of concentration   999999.000 5.923      5.923      minutes"
"            Time to Centroid        0.000      125.865    125.865    minutes"
"            Rainfall depth          14.000     14.000     14.000     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         14.000     14.000     14.000     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           0.00       663.75     663.75     c.m"
"            Maximum flow            0.000      0.170      0.170      c.m/sec"
" 40          HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                 0.170     0.000     0.224     0.289"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                 0.170     0.170     0.224     0.289"
" 54          POND DESIGN"
"         0.170   Current peak flow    c.m/sec"
"         664.0   Hydrograph volume    c.m/sec"
"           21.   Number of stages"
"        90.900   Minimum water level    c.m/sec"
"        92.200   Maximum water level    c.m/sec"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                  90.900     0.000       0.0"
"                  90.965     0.011       0.0"
"                  91.030     0.049       0.0"
"                  91.095     0.075       0.0"
"                  91.160     0.094       0.0"
"                  91.225     0.109       0.0"
"                  91.290     0.123       0.0"
"                  91.355     0.135       0.0"
"                  91.420     0.147       0.0"
"                  91.485     0.157       0.0"
"                  91.550     0.167       0.0"
"                  91.615     0.176       0.0"
"                  91.680     0.185       0.0"
"                  91.745     0.193       0.0"
"                  91.810     0.201       0.0"
"                  91.875     0.209       0.0"
"                  91.940     0.216       6.6"
"                  92.005     0.224     119.0"
"                  92.070     0.231     505.1"
"                  92.135     0.237    1334.4"
"                  92.200     0.244    2776.0"
"             1.   ORIFICES"
"                  Orifice   Orifice   Orifice Number of"
"                   invert coefficie  diameter  orifices"
"                  90.900     0.630     0.120     7.000"
"             7.   WEDGES"
```



```
"                   Wedge   Grade 1   Grade 2     Angle    Number"
"                  invert    g1H:1V    g2H:1V subtended of wedges"
"                  91.900   193.000   148.000     90.000     4.000"
"                  91.900   176.000   176.000     90.000     4.000"
"                  91.900   151.000   116.000     90.000     4.000"
"                  91.900    91.000    61.000     90.000     4.000"
"                  91.900    79.000    72.000     90.000     4.000"
"                  91.900   101.000    77.000     90.000     4.000"
"                  91.900    48.000    44.000     90.000     4.000"
"              Peak outflow                  0.170    c.m/sec"
"              Maximum level                91.572    metre"
"              Maximum storage               0.000    c.m"
"              Centroidal lag                2.098    hours"
"                   0.170     0.170     0.170     0.289 c.m/sec"
" 40          HYDROGRAPH   Combine    112"
"           6   Combine "
"         112   Node #"
"               Quinte Mall on Bell Blvd."
"              Maximum flow                  0.459    c.m/sec"
"              Hydrograph volume          2133.282    c.m"
"                   0.170     0.170     0.170     0.459"
" 81          ADD COMMENT================================================="
"           2   Lines of comment"
"               Add runoff from balance of area.  This is 0.814 ha with"
"               nominal 20% imperv."
" 33          CATCHMENT 1124"
"             4   Linear reservoir"
"             1   Equal length"
"             2   Horton equation"
"          1124   ID number"
"        15.800   % Impervious"
"         1.461   Total Area"
"        30.000   Flow length"
"         1.000   Overland Slope"
"         1.230   Pervious Area"
"        30.000   Pervious length"
"         1.000   Pervious slope"
"         0.231   Impervious Area"
"        30.000   Impervious length"
"         1.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        50.000   Pervious Max.infiltration"
"         7.500   Pervious Min.infiltration"
"         0.500   Pervious Lag constant (hours)"
"         5.000   Pervious Depression storage"
"         0.013   Impervious Manning 'n'"
"         0.000   Impervious Max.infiltration"
"         0.000   Impervious Min.infiltration"
"         0.500   Impervious Lag constant (hours)"
"         1.500   Impervious Depression storage"
"                   0.007     0.170     0.170     0.459 c.m/sec"
"               Catchment 1124          Pervious   Impervious Total Area "
"               Surface Area            1.230      0.231      1.461      hectare"
"               Time of concentration   999999.000 5.923      5.923      minutes"
"               Time to Centroid        0.000      125.865    125.865    minutes"
"               Rainfall depth          14.000     14.000     14.000     mm"
"               Rainfall volume         0.00       0.00       0.00       c.m"
"               Rainfall losses         14.000     14.000     14.000     mm"
"               Runoff depth            0.000      0.000      0.000      mm"
"               Runoff volume           0.00       28.85      28.85      c.m"
"               Maximum flow            0.000      0.007      0.007      c.m/sec"
" 40          HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                 0.007     0.000     0.170     0.459"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
```

```
"                0.007     0.007     0.170     0.459"
" 40          HYDROGRAPH Copy to Outflow"
"              8   Copy to Outflow"
"                0.007     0.007     0.007     0.459"
" 40          HYDROGRAPH   Combine    112"
"              6   Combine "
"            112   Node #"
"                Quinte Mall on Bell Blvd."
"              Maximum flow                  0.466    c.m/sec"
"              Hydrograph volume          2162.136    c.m"
"                0.007     0.007     0.007     0.466"
" 37          START/RE-START TOTALS 1124"
"              2   Runoff Totals reset to ZERO"
"              Catchment area to node 112                18.343    hectare"
"              Impervious area to node 112               17.113    hectare"
"              % impervious to node 112                  93.293"
"              Peak runoff to node 112                    0.547    c.m/sec"
"              Total volume to node 112                2162.0      c.m"
" 81          ADD COMMENT================================================="
"            3  Lines of comment"
"              Recover diverted hydrograph from area 119 (Shell station) "
"              and add to total runoff from area 112 (Quinte Mall)"
"                 "
" 47          FILE1_O Read/Open div00119.14hyd"
"             1   1=read/open; 2=write/save"
"             2   1=rainfall; 2=hydrograph"
"             3   1=runoff; 2=inflow; 3=outflow; 4=junction"
"              div00119.14hyd"
"              Excess major runoff to Bell Blvd"
"                0.007     0.007     0.000     0.466 c.m/sec"
" 40          HYDROGRAPH   Combine    112"
"              6   Combine "
"            112   Node #"
"                Quinte Mall on Bell Blvd."
"              Maximum flow                  0.466    c.m/sec"
"              Hydrograph volume          2162.136    c.m"
"                0.007     0.007     0.000     0.466"
" 81          ADD COMMENT================================================="
"            18  Lines of comment"
"              151516 Ontario Ltd. (Loebs Plaza) (115) "
"              Now add Loebs Plaza on South side of Bell Blvd."
"              Only west portion contributes   "
"                 "
"              Drainage area                 2.4180 ha "
"              Legal area                    2.0496 ha "
"              External areas                0.3684 ha comprising: "
"                 Bell Blvd                  0.1710 ha   82.2 imperv% "
"                 Hydro lands                0.1974 ha    0.0% "
"                 Landscape 5%x2.0496        0.1025 ha    0.0% "
"                 Total pervious             0.3303 ha "
"              Use: "
"              Rooftop area    1151          0.454 ha  100.0% imperv "
"              Parking area    1152          0.900 ha  100.0% imperv "
"              Balance         1153          1.064 ha   69.0% imperv "
"              TOTAL           115           2.418 ha   86.3% imperv."
"                 "
"              Padded text"
" 40          HYDROGRAPH Start - New Tributary"
"             2   Start - New Tributary"
"                0.007     0.000     0.000     0.466"
" 33          CATCHMENT 1151"
"             4   Linear reservoir"
"             1   Equal length"
"             2   Horton equation"
"          1151   ID number"
"       100.000   % Impervious"
```



```
"         0.454   Total Area"
"        10.000   Flow length"
"         1.000   Overland Slope"
"         0.000   Pervious Area"
"        10.000   Pervious length"
"         1.000   Pervious slope"
"         0.454   Impervious Area"
"        10.000   Impervious length"
"         1.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        50.000   Pervious Max.infiltration"
"         7.500   Pervious Min.infiltration"
"         0.500   Pervious Lag constant (hours)"
"         5.000   Pervious Depression storage"
"         0.013   Impervious Manning 'n'"
"         0.000   Impervious Max.infiltration"
"         0.000   Impervious Min.infiltration"
"         0.500   Impervious Lag constant (hours)"
"         1.500   Impervious Depression storage"
"                   0.014     0.000     0.000     0.466 c.m/sec"
"              Catchment 1151          Pervious   Impervious Total Area "
"              Surface Area            0.000      0.454      0.454      hectare"
"              Time of concentration   999999.000 3.064      3.064      minutes"
"              Time to Centroid        0.000      124.435    124.435    minutes"
"              Rainfall depth          14.000     14.000     14.000     mm"
"              Rainfall volume         0.00       0.00       0.00       c.m"
"              Rainfall losses         14.000     14.000     14.000     mm"
"              Runoff depth            0.000      0.000      0.000      mm"
"              Runoff volume           0.00       56.75      56.75      c.m"
"              Maximum flow            0.000      0.014      0.014      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                   0.014     0.014     0.000     0.466"
" 54          POND DESIGN"
"          0.014   Current peak flow    c.m/sec"
"           57.0   Hydrograph volume    c.m/sec"
"            11.   Number of stages"
"          0.000   Minimum water level    c.m/sec"
"          0.250   Maximum water level    c.m/sec"
"              0   Keep Design Data: 1 = True; 0 = False"
"                    Level Discharge    Volume"
"                    0.000     0.000      0.0"
"                    0.025     0.002      1.2"
"                    0.050     0.005      9.9"
"                    0.075     0.007     33.3"
"                    0.100     0.010     79.0"
"                    0.125     0.012    153.5"
"                    0.150     0.014    238.6"
"                    0.175     0.017    323.7"
"                    0.200     0.019    408.8"
"                    0.225     0.022    494.0"
"                    0.250     0.024    579.1"
"              1.   ROOFTOP"
"                   Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                     hectare     hectare    sq.metre  L/min/25mm      g H:1V"
"                       0.454       0.340     575.000      24.000    100.000"
"                   Using 6 roofdrains on roofstorage area of 3405. square metre"
"                   Peak outflow                  0.006    c.m/sec"
"                   Maximum level                 0.060    metre"
"                   Maximum storage              19.695    c.m"
"                   Centroidal lag                2.728    hours"
"                        0.014     0.014     0.006     0.466 c.m/sec"
" 40          HYDROGRAPH   Combine    115"
"              6   Combine "
"            115   Node #"
"                Loebs Plaza (West part)"
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"              Maximum flow                    0.006    c.m/sec"
"              Hydrograph volume              56.665    c.m"
"                    0.014     0.014      0.006     0.006"
" 33          CATCHMENT 1152"
"            4   Linear reservoir"
"            1   Equal length"
"            2   Horton equation"
"         1152   ID number"
"      100.000   % Impervious"
"        0.900   Total Area"
"       25.000   Flow length"
"        1.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        1.000   Pervious slope"
"        0.900   Impervious Area"
"       25.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.029     0.014      0.006     0.006 c.m/sec"
"              Catchment 1152          Pervious   Impervious Total Area "
"              Surface Area            0.000      0.900      0.900      hectare"
"              Time of concentration   999999.000 5.309      5.309      minutes"
"              Time to Centroid        0.000      125.558    125.558    minutes"
"              Rainfall depth          14.000     14.000     14.000     mm"
"              Rainfall volume         0.00       0.00       0.00       c.m"
"              Rainfall losses         14.000     14.000     14.000     mm"
"              Runoff depth            0.000      0.000      0.000      mm"
"              Runoff volume           0.00       112.50     112.50     c.m"
"              Maximum flow            0.000      0.029      0.029      c.m/sec"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.029     0.000      0.006     0.006"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.029     0.029      0.006     0.006"
" 54          POND DESIGN"
"         0.029   Current peak flow     c.m/sec"
"         120.0   Hydrograph volume     c.m/sec"
"           21.   Number of stages"
"        90.900   Minimum water level     c.m/sec"
"        92.200   Maximum water level     c.m/sec"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                   90.900     0.000      0.0"
"                   90.965     0.003      0.0"
"                   91.030     0.011      0.0"
"                   91.095     0.016      0.0"
"                   91.160     0.019      0.0"
"                   91.225     0.022      0.0"
"                   91.290     0.025      0.0"
"                   91.355     0.027      0.0"
"                   91.420     0.030      0.0"
"                   91.485     0.032      0.0"
"                   91.550     0.033      0.0"
"                   91.615     0.035      0.0"
"                   91.680     0.037      0.0"
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"                   91.745     0.039      0.0"
"                   91.810     0.040      0.0"
"                   91.875     0.042      0.0"
"                   91.940     0.043      0.8"
"                   92.005     0.045     14.7"
"                   92.070     0.046     62.3"
"                   92.135     0.047    164.4"
"                   92.200     0.049    342.1"
"            1.   ORIFICES"
"                 Orifice   Orifice   Orifice Number of"
"                  invert coefficie  diameter  orifices"
"                  90.900     0.630     0.100     2.000"
"            1.   WEDGES"
"                   Wedge   Grade 1   Grade 2     Angle    Number"
"                  invert    g1H:1V    g2H:1V subtended of wedges"
"                  91.900    55.000   110.000    90.000     8.000"
"              Peak outflow                    0.029    c.m/sec"
"              Maximum level                  91.399    metre"
"              Maximum storage                 0.000    c.m"
"              Centroidal lag                  2.093    hours"
"                    0.029     0.029      0.029     0.006 c.m/sec"
" 40          HYDROGRAPH   Combine    115"
"            6   Combine "
"          115   Node #"
"              Loebs Plaza (West part)"
"              Maximum flow                    0.034    c.m/sec"
"              Hydrograph volume             169.165    c.m"
"                    0.029     0.029      0.029     0.034"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.029     0.000      0.029     0.034"
" 33          CATCHMENT 1153"
"            4   Linear reservoir"
"            1   Equal length"
"            2   Horton equation"
"         1153   ID number"
"       69.000   % Impervious"
"        1.064   Total Area"
"       25.000   Flow length"
"        1.000   Overland Slope"
"        0.330   Pervious Area"
"       25.000   Pervious length"
"        1.000   Pervious slope"
"        0.734   Impervious Area"
"       25.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.023     0.000      0.029     0.034 c.m/sec"
"              Catchment 1153          Pervious   Impervious Total Area "
"              Surface Area            0.330      0.734      1.064      hectare"
"              Time of concentration   999999.000 5.309      5.309      minutes"
"              Time to Centroid        0.000      125.558    125.558    minutes"
"              Rainfall depth          14.000     14.000     14.000     mm"
"              Rainfall volume         0.00       0.00       0.00       c.m"
"              Rainfall losses         14.000     14.000     14.000     mm"
"              Runoff depth            0.000      0.000      0.000      mm"
"              Runoff volume           0.00       91.77      91.77      c.m"
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                Maximum flow              0.000       0.023       0.023       c.m/sec"
" 40            HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                   0.023       0.023       0.029       0.034"
" 40            HYDROGRAPH Copy to Outflow"
"             8   Copy to Outflow"
"                   0.023       0.023       0.023       0.034"
" 40            HYDROGRAPH    Combine     115"
"             6   Combine "
"           115   Node #"
"                 Loebs Plaza (West part)"
"                Maximum flow                    0.058     c.m/sec"
"                Hydrograph volume             260.935     c.m"
"                   0.023       0.023       0.023       0.058"
" 37            START/RE-START TOTALS 1153"
"             2   Runoff Totals reset to ZERO"
"                Catchment area to node 115                    2.418     hectare"
"                Impervious area to node 115                   2.088     hectare"
"                % impervious to node 115                     86.359"
"                Peak runoff to node 115                       0.067     c.m/sec"
"                Total volume to node 115                      261.0     c.m"
" 40            HYDROGRAPH    Confluence     115"
"             7   Confluence "
"           115   Node #"
"                 Loebs Plaza (West part)"
"                Maximum flow                    0.058     c.m/sec"
"                Hydrograph volume             260.935     c.m"
"                   0.023       0.058       0.023       0.000"
" 81            ADD COMMENT==================================================="
"           3   Lines of comment"
"               Outflow from area 115 is now added to total inflow to Bell "
"               Blvd. storm at junction 112."
"                 "
" 40            HYDROGRAPH Copy to Outflow"
"             8   Copy to Outflow"
"                   0.023       0.058       0.058       0.000"
" 40            HYDROGRAPH    Combine     112"
"             6   Combine "
"           112   Node #"
"                 Quinte Mall on Bell Blvd."
"                Maximum flow                    0.524     c.m/sec"
"                Hydrograph volume            2423.071     c.m"
"                   0.023       0.058       0.058       0.524"
" 81            ADD COMMENT==================================================="
"           37  Lines of comment"
"               Treat Canadian Tire as Area 127 with internal node "
"               128 to model Phase 2 rooftop and parking area"
"               includes half width of Bell Blvd. and half of Hydro strip"
"               as well as PUC station"
"                 "
"               Phase 1 (127)  "
"               Drainage area                 2.6020 ha "
"               Legal area                    2.2105 ha "
"               External areas                0.3915 ha comprising: "
"                  Bell Blvd                  0.1710 ha   79.0 imperv% "
"                  Hydro lands                0.2070 ha    0.0% "
"                  Landscape 5%x2.2105        0.1105 ha    0.0% "
"                  Total pervious             0.5020 ha "
"               Use: "
"               Rooftop area    1271          0.644 ha  100.0% imperv "
"               Parking area    1272          0.760 ha  100.0% imperv "
"               Balance         1273          1.198 ha   70.3% imperv "
"               TOTAL           127           2.602 ha   86.3% imperv."
"                 "
"               Phase 2 (128)"
"                 "
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"                         1.0732 ha ""
"               Legal area                    0.6366 ha "
"               External areas                0.4366 ha comprising: "
"                  Bell Blvd                  0.0807 ha   62.0 imperv% "
"                  Hydro lands                0.0867 ha    0.0% "
"                  City of Belleville         0.1720 ha   50.0% imperv "
"                  Landscape 5%x0.6366        0.0318 ha    0.0% "
"                  Total pervious             0.2352 ha "
"               Use: "
"               Rooftop area    1271          0.125  ha  100.0% imperv "
"               Parking area    1272          0.325  ha  100.0% imperv "
"               Balance         1273          0.6232 ha   62.3% imperv "
"               TOTAL           127           1.0732 ha   78.1% imperv."
"                 "
"               Storage is 60m x 2.4m x 1.83m high with 0.067m orifice"
"                 "
" 33            CATCHMENT 1271"
"             4   Linear reservoir"
"             1   Equal length"
"             2   Horton equation"
"          1271   ID number"
"       100.000   % Impervious"
"         0.644   Total Area"
"        10.000   Flow length"
"         0.750   Overland Slope"
"         0.000   Pervious Area"
"        10.000   Pervious length"
"         0.750   Pervious slope"
"         0.644   Impervious Area"
"        10.000   Impervious length"
"         0.750   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        50.000   Pervious Max.infiltration"
"         7.500   Pervious Min.infiltration"
"         0.500   Pervious Lag constant (hours)"
"         5.000   Pervious Depression storage"
"         0.013   Impervious Manning 'n'"
"         0.000   Impervious Max.infiltration"
"         0.000   Impervious Min.infiltration"
"         0.500   Impervious Lag constant (hours)"
"         1.500   Impervious Depression storage"
"                    0.021       0.058       0.058       0.524 c.m/sec"
"                 Catchment 1271          Pervious    Impervious  Total Area "
"                 Surface Area            0.000       0.644       0.644       hectare"
"                 Time of concentration   999999.000  3.340       3.340       minutes"
"                 Time to Centroid        0.000       124.573     124.573     minutes"
"                 Rainfall depth          14.000      14.000      14.000      mm"
"                 Rainfall volume         0.00        0.00        0.00        c.m"
"                 Rainfall losses         14.000      14.000      14.000      mm"
"                 Runoff depth            0.000       0.000       0.000       mm"
"                 Runoff volume           0.00        80.50       80.50       c.m"
"                 Maximum flow            0.000       0.021       0.021       c.m/sec"
" 40            HYDROGRAPH Start - New Tributary"
"             2   Start - New Tributary"
"                    0.021       0.000       0.058       0.524"
" 40            HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                    0.021       0.021       0.058       0.524"
" 54            POND DESIGN"
"          0.021   Current peak flow     c.m/sec"
"           81.0   Hydrograph volume     c.m/sec"
"            11.   Number of stages"
"          0.000   Minimum water level     c.m/sec"
"          0.175   Maximum water level     c.m/sec"
"              0   Keep Design Data: 1 = True; 0 = False"
"                    Level Discharge     Volume"
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"                0.000     0.000      0.0"
"                0.018     0.003      1.2"
"                0.035     0.005      8.9"
"                0.053     0.008     31.0"
"                0.070     0.010     71.4"
"                0.087     0.013    137.1"
"                0.105     0.015    224.0"
"                0.123     0.018    310.9"
"                0.140     0.020    393.0"
"                0.157     0.023    475.1"
"                0.175     0.025    562.1"
"          1.   ROOFTOP"
"               Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                 hectare     hectare    sq.metre  L/min/25mm       g H:1V"
"                   0.644       0.483     550.000      24.000      133.333"
"           Using 9 roofdrains on roofstorage area of 4830. square metre"
"           Peak outflow                    0.008    c.m/sec"
"           Maximum level                   0.052    metre"
"           Maximum storage                30.019    c.m"
"           Centroidal lag                  2.879   hours"
"                0.021     0.021     0.008     0.524 c.m/sec"
" 40       HYDROGRAPH   Combine    127"
"          6   Combine "
"        127   Node #"
"              Can.Tire Phase 1"
"           Maximum flow                    0.008    c.m/sec"
"           Hydrograph volume              80.440    c.m"
"                0.021     0.021     0.008     0.008"
" 40       HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                0.021     0.000     0.008     0.008"
" 33       CATCHMENT 1272"
"          4   Linear reservoir"
"          1   Equal length"
"          2   Horton equation"
"       1272   ID number"
"    100.000   % Impervious"
"      0.760   Total Area"
"     25.000   Flow length"
"      1.250   Overland Slope"
"      0.000   Pervious Area"
"     25.000   Pervious length"
"      1.250   Pervious slope"
"      0.760   Impervious Area"
"     25.000   Impervious length"
"      1.250   Impervious slope"
"      0.250   Pervious Manning 'n'"
"     50.000   Pervious Max.infiltration"
"      7.500   Pervious Min.infiltration"
"      0.500   Pervious Lag constant (hours)"
"      5.000   Pervious Depression storage"
"      0.013   Impervious Manning 'n'"
"      0.000   Impervious Max.infiltration"
"      0.000   Impervious Min.infiltration"
"      0.500   Impervious Lag constant (hours)"
"      1.500   Impervious Depression storage"
"                0.024     0.000     0.008     0.008 c.m/sec"
"           Catchment 1272          Pervious   Impervious Total Area "
"           Surface Area            0.000      0.760      0.760      hectare"
"           Time of concentration   999999.000 4.966      4.966      minutes"
"           Time to Centroid        0.000      125.386    125.386    minutes"
"           Rainfall depth          14.000     14.000     14.000     mm"
"           Rainfall volume         0.00       0.00       0.00       c.m"
"           Rainfall losses         14.000     14.000     14.000     mm"
"           Runoff depth            0.000      0.000      0.000      mm"
"           Runoff volume           0.00       95.00      95.00      c.m"
```



```
"           Maximum flow            0.000      0.024      0.024      c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.024     0.024     0.008     0.008"
" 54       POND DESIGN"
"       0.024   Current peak flow    c.m/sec"
"        95.0   Hydrograph volume    c.m/sec"
"         21.   Number of stages"
"      90.900   Minimum water level    c.m/sec"
"      92.200   Maximum water level    c.m/sec"
"           0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge    Volume"
"                90.900     0.000       0.0"
"                90.965     0.004       0.0"
"                91.030     0.016       0.0"
"                91.095     0.022       0.0"
"                91.160     0.027       0.0"
"                91.225     0.031       0.0"
"                91.290     0.035       0.0"
"                91.355     0.038       0.0"
"                91.420     0.041       0.0"
"                91.485     0.044       0.0"
"                91.550     0.046       0.0"
"                91.615     0.049       0.0"
"                91.680     0.051       0.0"
"                91.745     0.054       0.0"
"                91.810     0.056       0.0"
"                91.875     0.058       5.4"
"                91.940     0.060      47.5"
"                92.005     0.062     165.6"
"                92.070     0.064     398.7"
"                92.135     0.066     786.0"
"                92.200     0.067    1366.7"
"          1.   ORIFICES"
"               Orifice   Orifice  Orifice Number of"
"                invert coefficie diameter  orifices"
"                90.900     0.630     0.096     3.000"
"          1.   WEDGES"
"                 Wedge   Grade 1   Grade 2     Angle    Number"
"                invert    g1H:1V    g2H:1V subtended of wedges"
"                91.814    61.500   123.000    90.000    12.000"
"           Peak outflow                    0.024    c.m/sec"
"           Maximum level                  91.127    metre"
"           Maximum storage                 0.000    c.m"
"           Centroidal lag                  2.090   hours"
"                0.024     0.024     0.024     0.008 c.m/sec"
" 40       HYDROGRAPH   Combine    127"
"          6   Combine "
"        127   Node #"
"              Can.Tire Phase 1"
"           Maximum flow                    0.031    c.m/sec"
"           Hydrograph volume             175.440    c.m"
"                0.024     0.024     0.024     0.031"
" 40       HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                0.024     0.000     0.024     0.031"
" 33       CATCHMENT 1273"
"          4   Linear reservoir"
"          1   Equal length"
"          2   Horton equation"
"       1273   ID number"
"     70.300   % Impervious"
"      1.198   Total Area"
"     25.000   Flow length"
"      1.250   Overland Slope"
"      0.356   Pervious Area"
```

```
"       25.000   Pervious length"
"        0.750   Pervious slope"
"        0.842   Impervious Area"
"       25.000   Impervious length"
"        0.750   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.027     0.000     0.024     0.031 c.m/sec"
"            Catchment 1273          Pervious   Impervious Total Area "
"            Surface Area            0.356      0.842      1.198      hectare"
"            Time of concentration   999999.000 5.788      5.788      minutes"
"            Time to Centroid        0.000      125.797    125.797    minutes"
"            Rainfall depth          14.000     14.000     14.000     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         14.000     14.000     14.000     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           0.00       105.27     105.27     c.m"
"            Maximum flow            0.000      0.027      0.027      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                  0.027     0.027     0.024     0.031"
" 40         HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                  0.027     0.027     0.027     0.031"
" 40         HYDROGRAPH   Combine    127"
"          6   Combine "
"        127   Node #"
"            Can.Tire Phase 1"
"            Maximum flow                    0.058    c.m/sec"
"            Hydrograph volume             280.715    c.m"
"                  0.027     0.027     0.027     0.058"
" 37         START/RE-START TOTALS 1273"
"          2   Runoff Totals reset to ZERO"
"            Catchment area to node 127                 2.602    hectare"
"            Impervious area to node 127                2.246    hectare"
"            % impervious to node 127                  86.326"
"            Peak runoff to node 127                    0.072    c.m/sec"
"            Total volume to node 127                   280.8    c.m"
" 33         CATCHMENT 1274"
"          4   Linear reservoir"
"          1   Equal length"
"          2   Horton equation"
"       1274   ID number"
"     100.000   % Impervious"
"        0.125   Total Area"
"       10.000   Flow length"
"        0.750   Overland Slope"
"        0.000   Pervious Area"
"       10.000   Pervious length"
"        0.750   Pervious slope"
"        0.125   Impervious Area"
"       10.000   Impervious length"
"        0.750   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
```



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"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.004     0.027     0.027     0.058 c.m/sec"
"            Catchment 1274          Pervious   Impervious Total Area "
"            Surface Area            0.000      0.125      0.125      hectare"
"            Time of concentration   999999.000 3.340      3.340      minutes"
"            Time to Centroid        0.000      124.573    124.573    minutes"
"            Rainfall depth          14.000     14.000     14.000     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         14.000     14.000     14.000     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           0.00       15.62      15.62      c.m"
"            Maximum flow            0.000      0.004      0.004      c.m/sec"
" 40         HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                  0.004     0.000     0.027     0.058"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                  0.004     0.004     0.027     0.058"
" 54         POND DESIGN"
"        0.004   Current peak flow    c.m/sec"
"         20.0   Hydrograph volume    c.m/sec"
"          11.   Number of stages"
"        0.000   Minimum water level    c.m/sec"
"        0.175   Maximum water level    c.m/sec"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                  0.000     0.000      0.0"
"                  0.018     0.001      0.3"
"                  0.035     0.001      2.3"
"                  0.053     0.002      7.9"
"                  0.070     0.002     18.1"
"                  0.087     0.003     33.5"
"                  0.105     0.003     50.4"
"                  0.123     0.004     67.3"
"                  0.140     0.004     83.2"
"                  0.157     0.005     99.2"
"                  0.175     0.006    116.0"
"             1.   ROOFTOP"
"                  Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                    hectare     hectare    sq.metre  L/min/25mm      g H:1V"
"                      0.125       0.094     420.000      24.000    133.333"
"                  Using 2 roofdrains on roofstorage area of 938. square metre"
"                  Peak outflow                   0.001    c.m/sec"
"                  Maximum level                  0.046    metre"
"                  Maximum storage                5.722    c.m"
"                  Centroidal lag                 2.844    hours"
"                        0.004     0.004     0.001     0.058 c.m/sec"
" 40               HYDROGRAPH   Combine    128"
"                6   Combine "
"              128   Node #"
"                  Can.Tire Phase 2"
"                  Maximum flow                   0.001    c.m/sec"
"                  Hydrograph volume             15.620    c.m"
"                        0.004     0.004     0.001     0.001"
" 40               HYDROGRAPH Start - New Tributary"
"                2   Start - New Tributary"
"                        0.004     0.000     0.001     0.001"
" 33               CATCHMENT 1275"
"                4   Linear reservoir"
"                1   Equal length"
"                2   Horton equation"
"             1275   ID number"
```

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"      100.000   % Impervious"
"        0.325   Total Area"
"       25.000   Flow length"
"        1.250   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        1.250   Pervious slope"
"        0.325   Impervious Area"
"       25.000   Impervious length"
"        1.250   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.010     0.000     0.001     0.001 c.m/sec"
"             Catchment 1275          Pervious   Impervious Total Area "
"             Surface Area            0.000      0.325      0.325      hectare"
"             Time of concentration   999999.000 4.966      4.966      minutes"
"             Time to Centroid        0.000      125.386    125.386    minutes"
"             Rainfall depth          14.000     14.000     14.000     mm"
"             Rainfall volume         0.00       0.00       0.00       c.m"
"             Rainfall losses         14.000     14.000     14.000     mm"
"             Runoff depth            0.000      0.000      0.000      mm"
"             Runoff volume           0.00       40.62      40.62      c.m"
"             Maximum flow            0.000      0.010      0.010      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                 0.010     0.010     0.001     0.001"
" 54          POND DESIGN"
"       0.010   Current peak flow    c.m/sec"
"        41.0   Hydrograph volume    c.m/sec"
"         21.   Number of stages"
"      90.900   Minimum water level    c.m/sec"
"      92.200   Maximum water level    c.m/sec"
"           0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge    Volume"
"                90.900     0.000       0.0"
"                90.965     0.001       0.0"
"                91.030     0.005       0.0"
"                91.095     0.007       0.0"
"                91.160     0.009       0.0"
"                91.225     0.010       0.0"
"                91.290     0.012       0.0"
"                91.355     0.013       0.0"
"                91.420     0.014       0.0"
"                91.485     0.015       0.0"
"                91.550     0.015       0.0"
"                91.615     0.016       0.0"
"                91.680     0.017       0.0"
"                91.745     0.018       0.0"
"                91.810     0.019       0.0"
"                91.875     0.019       1.0"
"                91.940     0.020       9.2"
"                92.005     0.021      32.0"
"                92.070     0.021      77.0"
"                92.135     0.022     151.7"
"                92.200     0.022     263.8"
"             1.   ORIFICES"
"                  Orifice   Orifice   Orifice Number of"
"                   invert coefficie  diameter  orifices"
```



```
"                  90.900     0.630     0.096     1.000"
"             1.   WEDGES"
"                   Wedge   Grade 1   Grade 2     Angle    Number"
"                   invert    g1H:1V    g2H:1V subtended of wedges"
"                   91.814    46.800    93.600    90.000     4.000"
"               Peak outflow                        0.010    c.m/sec"
"               Maximum level                      91.229    metre"
"               Maximum storage                     0.000    c.m"
"               Centroidal lag                      2.090    hours"
"                   0.010     0.010     0.010     0.001 c.m/sec"
" 40          HYDROGRAPH   Combine    128"
"           6   Combine "
"         128   Node #"
"               Can.Tire Phase 2"
"               Maximum flow                        0.012    c.m/sec"
"               Hydrograph volume                  56.245    c.m"
"                   0.010     0.010     0.010     0.012"
" 81          ADD COMMENT================================================="
"           5   Lines of comment"
"               Get runoff from node 128 and route this through a pond "
"               with a base area of 144 sq.m and vertical sides controlled "
"               by an orifice 0.067m diameter (67mm) at IL 92.76m."
"               This is underground box culvert."
"                 "
" 40          HYDROGRAPH   Confluence    128"
"           7   Confluence "
"         128   Node #"
"               Can.Tire Phase 2"
"               Maximum flow                        0.012    c.m/sec"
"               Hydrograph volume                  56.245    c.m"
"                   0.010     0.012     0.010     0.000"
" 54          POND DESIGN"
"       0.012   Current peak flow    c.m/sec"
"        57.0   Hydrograph volume    c.m/sec"
"         21.   Number of stages"
"      92.760   Minimum water level    c.m/sec"
"      94.800   Maximum water level    c.m/sec"
"           0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge    Volume"
"                92.760     0.000       0.0"
"                92.862     0.002      14.7"
"                92.964     0.004      29.4"
"                93.066     0.005      44.1"
"                93.168     0.006      58.8"
"                93.270     0.007      73.4"
"                93.372     0.007      88.1"
"                93.474     0.008     102.8"
"                93.576     0.009     117.5"
"                93.678     0.009     132.2"
"                93.780     0.010     146.9"
"                93.882     0.010     161.6"
"                93.984     0.011     176.3"
"                94.086     0.011     190.9"
"                94.188     0.012     205.6"
"                94.290     0.012     220.3"
"                94.392     0.012     235.0"
"                94.494     0.013     249.7"
"                94.596     0.013     264.4"
"                94.698     0.014     279.1"
"                94.800     0.014     293.8"
"             1.   ORIFICES"
"                  Orifice   Orifice   Orifice Number of"
"                   invert coefficie  diameter  orifices"
"                  92.760     0.630     0.067     1.000"
"             1.   LAYERS"
"                   Bottom    Aspect    Bottom       Top   Average"
```

```
"                area     ratio elevation elevation sideslope"
"             144.000    25.000    92.760    94.800     0.000"
"          Peak outflow                    0.004    c.m/sec"
"          Maximum level                  92.937    metre"
"          Maximum storage                25.423    c.m"
"          Centroidal lag                  4.183    hours"
"               0.010     0.012     0.004     0.000 c.m/sec"
" 40        HYDROGRAPH Next link "
"         5   Next link "
"               0.010     0.004     0.004     0.000"
" 33        CATCHMENT 1276"
"         4   Linear reservoir"
"         1   Equal length"
"         2   Horton equation"
"      1276   ID number"
"    62.300   % Impervious"
"     0.623   Total Area"
"    10.000   Flow length"
"     0.750   Overland Slope"
"     0.235   Pervious Area"
"    10.000   Pervious length"
"     0.750   Pervious slope"
"     0.388   Impervious Area"
"    10.000   Impervious length"
"     0.750   Impervious slope"
"     0.250   Pervious Manning 'n'"
"    50.000   Pervious Max.infiltration"
"     7.500   Pervious Min.infiltration"
"     0.500   Pervious Lag constant (hours)"
"     5.000   Pervious Depression storage"
"     0.013   Impervious Manning 'n'"
"     0.000   Impervious Max.infiltration"
"     0.000   Impervious Min.infiltration"
"     0.500   Impervious Lag constant (hours)"
"     1.500   Impervious Depression storage"
"               0.012     0.004     0.004     0.000 c.m/sec"
"          Catchment 1276          Pervious   Impervious Total Area "
"          Surface Area            0.235      0.388      0.623      hectare"
"          Time of concentration   999999.000 3.340      3.340      minutes"
"          Time to Centroid        0.000      124.573    124.573    minutes"
"          Rainfall depth          14.000     14.000     14.000     mm"
"          Rainfall volume         0.00       0.00       0.00       c.m"
"          Rainfall losses         14.000     14.000     14.000     mm"
"          Runoff depth            0.000      0.000      0.000      mm"
"          Runoff volume           0.00       48.52      48.52      c.m"
"          Maximum flow            0.000      0.012      0.012      c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"         4   Add Runoff "
"               0.012     0.015     0.004     0.000"
" 37        START/RE-START TOTALS 1276"
"         2   Runoff Totals reset to ZERO"
"          Catchment area to node 128                  1.073    hectare"
"          Impervious area to node 128                 0.838    hectare"
"          % impervious to node 128                   78.111"
"          Peak runoff to node 128                     0.027    c.m/sec"
"          Total volume to node 128                    104.8    c.m"
" 81        ADD COMMENT================================================="
"         3  Lines of comment"
"            Recover total flow in Inflow hydrograph and add this to "
"            junction node 127"
"               "
" 40        HYDROGRAPH Copy to Outflow"
"         8   Copy to Outflow"
"               0.012     0.015     0.015     0.000"
" 40        HYDROGRAPH   Combine    127"
"         6   Combine "
```



```
"       127   Node #"
"             Can.Tire Phase 1"
"          Maximum flow                    0.073    c.m/sec"
"          Hydrograph volume             385.468    c.m"
"               0.012     0.015     0.015     0.073"
" 40        HYDROGRAPH   Confluence    127"
"         7   Confluence "
"       127   Node #"
"             Can.Tire Phase 1"
"          Maximum flow                    0.073    c.m/sec"
"          Hydrograph volume             385.468    c.m"
"               0.012     0.073     0.015     0.000"
" 40        HYDROGRAPH Copy to Outflow"
"         8   Copy to Outflow"
"               0.012     0.073     0.073     0.000"
" 40        HYDROGRAPH   Combine    112"
"         6   Combine "
"       112   Node #"
"             Quinte Mall on Bell Blvd."
"          Maximum flow                    0.597    c.m/sec"
"          Hydrograph volume            2808.540    c.m"
"               0.012     0.073     0.073     0.597"
" 81        ADD COMMENT================================================="
"         5  Lines of comment"
"            Route this flow along Bell Blvd. storm sewer to Lemoine "
"            St. culvert (south end) and store it at this point - "
"            junction node 114.  Then process area 114 (Zellers Plaza) "
"            which goes directly to the sediment forebay "
"               "
" 40        HYDROGRAPH   Confluence    112"
"         7   Confluence "
"       112   Node #"
"             Quinte Mall on Bell Blvd."
"          Maximum flow                    0.597    c.m/sec"
"          Hydrograph volume            2808.540    c.m"
"               0.012     0.597     0.073     0.000"
" 51        PIPE DESIGN"
"     0.597   Current peak flow    c.m/sec"
"     0.013   Manning 'n'"
"     1.200   Diameter    metre"
"     0.200   Gradient    %"
"          Depth of flow                   0.484    metre"
"          Velocity                        1.397    m/sec"
"          Pipe capacity                   1.744    c.m/sec"
"          Critical depth                  0.414    metre"
" 53        ROUTE    Pipe Route"
"   400.00      Pipe Route Reach length   ( metre)"
"     0.330   X-factor <= 0.5"
"   214.803   K-lag   ( seconds)"
"     0.000   Default(0) or user spec.(1) values used"
"     0.480   X-factor <= 0.5"
"   456.900   K-lag   ( seconds)"
"     0.500   Beta weighting factor"
"   225.000   Routing time step   ( seconds)"
"         1   No. of sub-reaches"
"          Peak outflow                    0.575    c.m/sec"
"               0.012     0.597     0.575     0.000 c.m/sec"
" 40        HYDROGRAPH   Combine    114"
"         6   Combine "
"       114   Node #"
"             Upstream of sediment forebay"
"          Maximum flow                    0.931    c.m/sec"
"          Hydrograph volume            5682.619    c.m"
"               0.012     0.597     0.575     0.931"
" 81        ADD COMMENT================================================="
"        16  Lines of comment"
```

```
"            1133166 Ontario Ltd. (Zellers Plaza 114)   "
"                "
"            Drainage area                 7.2755 ha "
"            Legal area                    5.9271 ha "
"            External areas                1.3484 ha comprising: "
"               Bell Blvd                  0.4360 ha   77.0 imperv% "
"               Hydro lands                0.6354 ha    0.0% "
"               Landscape 5%x5.9271        0.2964 ha    0.0% "
"               Lemoine St. (forebay)      0.2770 ha    9.5% Path=264 sq.m "
"               Total pervious             1.2828 ha "
"            Use: "
"            Rooftop area   1141          2.600  ha  100.0% imperv "
"            Parking area   1142          2.900  ha  100.0% imperv "
"            Balance        1143          1.7755 ha   27.8% imperv "
"            TOTAL          114           7.2755 ha   82.4% imperv."
"                "
" 40         HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                0.012     0.000     0.575     0.931"
" 33         CATCHMENT 1141"
"          4   Linear reservoir"
"          1   Equal length"
"          2   Horton equation"
"       1141   ID number"
"    100.000   % Impervious"
"      2.600   Total Area"
"     10.000   Flow length"
"      0.750   Overland Slope"
"      0.000   Pervious Area"
"     10.000   Pervious length"
"      0.750   Pervious slope"
"      2.600   Impervious Area"
"     10.000   Impervious length"
"      0.750   Impervious slope"
"      0.250   Pervious Manning 'n'"
"     50.000   Pervious Max.infiltration"
"      7.500   Pervious Min.infiltration"
"      0.500   Pervious Lag constant (hours)"
"      5.000   Pervious Depression storage"
"      0.013   Impervious Manning 'n'"
"      0.000   Impervious Max.infiltration"
"      0.000   Impervious Min.infiltration"
"      0.500   Impervious Lag constant (hours)"
"      1.500   Impervious Depression storage"
"                0.083     0.000     0.575     0.931 c.m/sec"
"            Catchment 1141          Pervious   Impervious Total Area "
"            Surface Area            0.000      2.600      2.600      hectare"
"            Time of concentration   999999.000 3.340      3.340      minutes"
"            Time to Centroid        0.000      124.573    124.573    minutes"
"            Rainfall depth          14.000     14.000     14.000     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         14.000     14.000     14.000     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           0.00       325.00     325.00     c.m"
"            Maximum flow            0.000      0.083      0.083      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.083     0.083     0.575     0.931"
" 54         POND DESIGN"
"       0.083   Current peak flow    c.m/sec"
"       325.0   Hydrograph volume    c.m/sec"
"         11.   Number of stages"
"       0.000   Minimum water level    c.m/sec"
"       0.175   Maximum water level    c.m/sec"
"           0   Keep Design Data: 1 = True; 0 = False"
"               Level Discharge    Volume"
```



```
"                0.000     0.000      0.0"
"                0.018     0.014      6.6"
"                0.035     0.027     48.3"
"                0.053     0.041    167.8"
"                0.070     0.054    386.7"
"                0.087     0.067    709.4"
"                0.105     0.081   1060.4"
"                0.123     0.094   1411.4"
"                0.140     0.108   1742.9"
"                0.157     0.121   2074.4"
"                0.175     0.134   2425.4"
"          1.   ROOFTOP"
"               Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                 hectare     hectare    sq.metre  L/min/25mm      g H:1V"
"                   2.600       1.950     410.000      24.000     133.333"
"            Using 48 roofdrains on roofstorage area of 19500. square metre"
"            Peak outflow                    0.034    c.m/sec"
"            Maximum level                   0.044    metre"
"            Maximum storage               110.375    c.m"
"            Centroidal lag                  2.691    hours"
"                0.083     0.083     0.034     0.931 c.m/sec"
" 81         ADD COMMENT=================================================="
"          1  Lines of comment"
"             Accumulate runoff from area 114 at junction node 1144  "
" 40          HYDROGRAPH   Combine    1144"
"            6   Combine "
"         1144   Node #"
"                Zellers Plaza"
"             Maximum flow                  0.034    c.m/sec"
"             Hydrograph volume           323.799    c.m"
"                   0.083     0.083     0.034     0.034"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                  0.083     0.000     0.034     0.034"
" 33          CATCHMENT 1142"
"            4   Linear reservoir"
"            1   Equal length"
"            2   Horton equation"
"         1142   ID number"
"      100.000   % Impervious"
"        2.900   Total Area"
"       35.000   Flow length"
"        1.000   Overland Slope"
"        0.000   Pervious Area"
"       35.000   Pervious length"
"        1.000   Pervious slope"
"        2.900   Impervious Area"
"       35.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.093     0.000     0.034     0.034 c.m/sec"
"             Catchment 1142          Pervious   Impervious Total Area "
"             Surface Area            0.000      2.900      2.900      hectare"
"             Time of concentration   999999.000 6.497      6.497      minutes"
"             Time to Centroid        0.000      126.152    126.152    minutes"
"             Rainfall depth          14.000     14.000     14.000     mm"
"             Rainfall volume         0.00       0.00       0.00       c.m"
```

```
"          Rainfall losses          14.000      14.000      14.000      mm"
"          Runoff depth             0.000       0.000       0.000       mm"
"          Runoff volume            0.00        362.50      362.50      c.m"
"          Maximum flow             0.000       0.093       0.093       c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"        4   Add Runoff "
"                0.093     0.093     0.034     0.034"
" 54       POND DESIGN"
"      0.093   Current peak flow    c.m/sec"
"      363.0   Hydrograph volume    c.m/sec"
"        21.   Number of stages"
"     93.200   Minimum water level    c.m/sec"
"     94.500   Maximum water level    c.m/sec"
"          0   Keep Design Data: 1 = True; 0 = False"
"                Level Discharge    Volume"
"               93.200     0.000      0.0"
"               93.265     0.010      0.0"
"               93.330     0.040      0.0"
"               93.395     0.057      0.0"
"               93.460     0.070      0.0"
"               93.525     0.081      0.0"
"               93.590     0.091      0.0"
"               93.655     0.099      0.0"
"               93.720     0.107      0.0"
"               93.785     0.115      0.0"
"               93.850     0.122      0.0"
"               93.915     0.128      0.0"
"               93.980     0.135      0.0"
"               94.045     0.141      0.0"
"               94.110     0.147      0.0"
"               94.175     0.152      0.0"
"               94.240     0.157      2.7"
"               94.305     0.162     48.9"
"               94.370     0.168    207.7"
"               94.435     0.172    548.6"
"               94.500     0.177   1141.4"
"        1.   ORIFICES"
"             Orifice   Orifice   Orifice Number of"
"              invert coefficie  diameter  orifices"
"              93.200     0.630     0.102     7.000"
"        6.   WEDGES"
"              Wedge   Grade 1   Grade 2     Angle    Number"
"              invert    g1H:1V    g2H:1V subtended of wedges"
"              94.200   108.000    72.000    90.000     4.000"
"              94.200    89.000    64.000    90.000     4.000"
"              94.200    94.000    79.000    90.000     4.000"
"              94.200    75.000    38.000    90.000     4.000"
"              94.200   110.000    74.000    90.000     4.000"
"              94.200    80.000    53.000    90.000     8.000"
"            Peak outflow                  0.093    c.m/sec"
"            Maximum level                93.607    metre"
"            Maximum storage               0.000    c.m"
"            Centroidal lag                2.103    hours"
"               0.093     0.093     0.093     0.034 c.m/sec"
" 40       HYDROGRAPH   Combine    1144"
"        6   Combine "
"     1144   Node #"
"            Zellers Plaza"
"            Maximum flow                  0.124    c.m/sec"
"            Hydrograph volume           686.298    c.m"
"                  0.093     0.093     0.093     0.124"
" 33       CATCHMENT 1143"
"        4   Linear reservoir"
"        1   Equal length"
"        2   Horton equation"
"     1143   ID number"
```



```
"       27.800   % Impervious"
"        1.775   Total Area"
"       35.000   Flow length"
"        1.000   Overland Slope"
"        1.282   Pervious Area"
"       35.000   Pervious length"
"        1.000   Pervious slope"
"        0.493   Impervious Area"
"       35.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.016     0.093     0.093     0.124 c.m/sec"
"             Catchment 1143          Pervious   Impervious Total Area "
"             Surface Area            1.282      0.493      1.775       hectare"
"             Time of concentration   999999.000 6.497      6.497       minutes"
"             Time to Centroid        0.000      126.152    126.152     minutes"
"             Rainfall depth          14.000     14.000     14.000      mm"
"             Rainfall volume         0.00       0.00       0.00        c.m"
"             Rainfall losses         14.000     14.000     14.000      mm"
"             Runoff depth            0.000      0.000      0.000       mm"
"             Runoff volume           0.00       61.68      61.68       c.m"
"             Maximum flow            0.000      0.016      0.016       c.m/sec"
" 40          HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                 0.016     0.000     0.093     0.124"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                 0.016     0.016     0.093     0.124"
" 40          HYDROGRAPH Copy to Outflow"
"           8   Copy to Outflow"
"                 0.016     0.016     0.016     0.124"
" 40          HYDROGRAPH   Combine    1144"
"           6   Combine "
"        1144   Node #"
"               Zellers Plaza"
"               Maximum flow                  0.140    c.m/sec"
"               Hydrograph volume           747.980    c.m"
"                     0.016     0.016     0.016     0.140"
" 37          START/RE-START TOTALS 1143"
"           2   Runoff Totals reset to ZERO"
"               Catchment area to node 1144                 7.275    hectare"
"               Impervious area to node 1144                5.993    hectare"
"               % impervious to node 1144                  82.384"
"               Peak runoff to node 1144                    0.192    c.m/sec"
"               Total volume to node 1144                   749.2    c.m"
" 81          ADD COMMENT================================================="
"           3   Lines of comment"
"               Get total flow from area 114 (accumulated at internal "
"               junction node 1144) and add to junction node 114 "
"                   "
" 40          HYDROGRAPH   Confluence    1144"
"           7   Confluence "
"        1144   Node #"
"               Zellers Plaza"
"               Maximum flow                  0.140    c.m/sec"
"               Hydrograph volume           747.980    c.m"
"                     0.016     0.140     0.016     0.000"
```

```
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                   0.016     0.140     0.140     0.000"
" 40          HYDROGRAPH   Combine    114"
"            6   Combine "
"          114   Node #"
"                Upstream of sediment forebay"
"               Maximum flow                 1.071    c.m/sec"
"               Hydrograph volume         6430.597    c.m"
"                     0.016     0.140     0.140     1.071"
" 81          ADD COMMENT==================================================="
"           5  Lines of comment"
"               Model old area 113 but split it into:"
"               Area 113 - Loblaws    - area 2.598 ha"
"               Area 125 - Sopresata  - area 5.323 ha"
"               Store Loblaws at junction node 113"
"                  "
" 81          ADD COMMENT==================================================="
"           16  Lines of comment"
"               Loblaws Plaza (113) "
"                  "
"               Drainage area                2.5980 ha "
"               Legal area                   2.2493 ha "
"               External areas               0.3487 ha comprising: "
"                  Bell Blvd                 0.1410 ha   90.0% imperv "
"                  Lemoine                   0.2080 ha   24.0% imperv "
"                 (Path = 360 sq.m)  "
"                  Landscape 5%x2.2493       0.1125 ha    0.0% "
"                  Total pervious            0.2847 ha "
"               Use: "
"               Rooftop area   1131         0.400 ha  100.0% imperv "
"               Parking area   1132         1.192 ha  100.0% imperv "
"               Balance        1133         1.006 ha   71.7% imperv "
"               TOTAL          113          2.598 ha   89.0% imperv."
"                  "
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                   0.016     0.000     0.140     1.071"
" 33          CATCHMENT 1131"
"            4   Linear reservoir"
"            1   Equal length"
"            2   Horton equation"
"         1131   ID number"
"      100.000   % Impervious"
"        0.400   Total Area"
"       10.000   Flow length"
"        0.750   Overland Slope"
"        0.000   Pervious Area"
"       10.000   Pervious length"
"        0.750   Pervious slope"
"        0.400   Impervious Area"
"       10.000   Impervious length"
"        0.750   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                   0.013     0.000     0.140     1.071 c.m/sec"
"               Catchment 1131          Pervious   Impervious Total Area "
"               Surface Area            0.000      0.400      0.400      hectare"
```



```
"               Time of concentration  999999.000 3.340      3.340      minutes"
"               Time to Centroid       0.000      124.573    124.573    minutes"
"               Rainfall depth         14.000     14.000     14.000     mm"
"               Rainfall volume        0.00       0.00       0.00       c.m"
"               Rainfall losses        14.000     14.000     14.000     mm"
"               Runoff depth           0.000      0.000      0.000      mm"
"               Runoff volume          0.00       50.00      50.00      c.m"
"               Maximum flow           0.000      0.013      0.013      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                   0.013     0.013     0.140     1.071"
" 54          POND DESIGN"
"          0.013   Current peak flow    c.m/sec"
"           50.0   Hydrograph volume    c.m/sec"
"            11.   Number of stages"
"          0.000   Minimum water level    c.m/sec"
"          0.175   Maximum water level    c.m/sec"
"              0   Keep Design Data: 1 = True; 0 = False"
"                    Level Discharge    Volume"
"                    0.000     0.000      0.0"
"                    0.018     0.002      0.9"
"                    0.035     0.004      6.8"
"                    0.053     0.006     23.5"
"                    0.070     0.008     54.2"
"                    0.087     0.010    101.9"
"                    0.105     0.012    155.9"
"                    0.123     0.014    209.9"
"                    0.140     0.016    260.9"
"                    0.157     0.018    311.9"
"                    0.175     0.020    365.9"
"                1.   ROOFTOP"
"                    Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                      hectare     hectare    sq.metre  L/min/25mm       g H:1V"
"                       0.400       0.300     450.000      24.000     133.333"
"                  Using 7 roofdrains on roofstorage area of 3000. square metre"
"                  Peak outflow                    0.005    c.m/sec"
"                  Maximum level                   0.046    metre"
"                  Maximum storage                17.165    c.m"
"                  Centroidal lag                  2.715    hours"
"                       0.013     0.013     0.005     1.071 c.m/sec"
" 40          HYDROGRAPH   Combine    113"
"            6   Combine "
"          113   Node #"
"                Loblaws plus future Sopresata"
"               Maximum flow                    0.005    c.m/sec"
"               Hydrograph volume              49.975    c.m"
"                     0.013     0.013     0.005     0.005"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                   0.013     0.000     0.005     0.005"
" 33          CATCHMENT 1132"
"            4   Linear reservoir"
"            1   Equal length"
"            2   Horton equation"
"         1132   ID number"
"      100.000   % Impervious"
"        1.192   Total Area"
"       30.000   Flow length"
"        1.300   Overland Slope"
"        0.000   Pervious Area"
"       30.000   Pervious length"
"        1.300   Pervious slope"
"        1.192   Impervious Area"
"       30.000   Impervious length"
"        1.300   Impervious slope"
"        0.250   Pervious Manning 'n'"
```

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"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.038     0.000     0.005     0.005 c.m/sec"
"            Catchment 1132          Pervious   Impervious Total Area "
"            Surface Area            0.000      1.192      1.192      hectare"
"            Time of concentration   999999.000 5.475      5.475      minutes"
"            Time to Centroid        0.000      125.641    125.641    minutes"
"            Rainfall depth          14.000     14.000     14.000     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         14.000     14.000     14.000     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           0.00       149.00     149.00     c.m"
"            Maximum flow            0.000      0.038      0.038      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.038     0.038     0.005     0.005"
" 54         POND DESIGN"
"       0.038   Current peak flow    c.m/sec"
"       150.0   Hydrograph volume    c.m/sec"
"         21.   Number of stages"
"      92.000   Minimum water level    c.m/sec"
"      93.300   Maximum water level    c.m/sec"
"          0   Keep Design Data: 1 = True; 0 = False"
"                Level Discharge    Volume"
"               92.000     0.000       0.0"
"               92.065     0.007       0.0"
"               92.130     0.021       0.0"
"               92.195     0.028       0.0"
"               92.260     0.034       0.0"
"               92.325     0.039       0.0"
"               92.390     0.043       0.0"
"               92.455     0.047       0.0"
"               92.520     0.051       0.0"
"               92.585     0.054       0.0"
"               92.650     0.057       0.0"
"               92.715     0.060       0.0"
"               92.780     0.063       0.0"
"               92.845     0.066       0.0"
"               92.910     0.069       0.0"
"               92.975     0.071       0.0"
"               93.040     0.074       2.0"
"               93.105     0.076      35.4"
"               93.170     0.078     150.2"
"               93.235     0.081     396.8"
"               93.300     0.083     825.6"
"          1.   ORIFICES"
"               Orifice   Orifice   Orifice Number of"
"                invert coefficie  diameter  orifices"
"               92.000     0.630     0.075     6.000"
"          3.   WEDGES"
"                 Wedge   Grade 1   Grade 2     Angle    Number"
"                invert    g1H:1V    g2H:1V subtended of wedges"
"               93.000    55.000   100.000    90.000     8.000"
"               93.000    75.000   100.000    90.000     8.000"
"               93.000    40.000    40.000    90.000     8.000"
"            Peak outflow                    0.038    c.m/sec"
"            Maximum level                  92.316    metre"
"            Maximum storage                 0.000    c.m"
"            Centroidal lag                  2.094    hours"
```



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"                  0.038     0.038     0.038     0.005 c.m/sec"
" 40         HYDROGRAPH   Combine    113"
"          6   Combine "
"        113   Node #"
"              Loblaws plus future Sopresata"
"            Maximum flow                  0.043    c.m/sec"
"            Hydrograph volume           198.975    c.m"
"                  0.038     0.038     0.038     0.043"
" 40         HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                  0.038     0.000     0.038     0.043"
" 33         CATCHMENT 1133"
"          4   Linear reservoir"
"          1   Equal length"
"          2   Horton equation"
"       1133   ID number"
"     71.700   % Impervious"
"      1.006   Total Area"
"     30.000   Flow length"
"      1.000   Overland Slope"
"      0.285   Pervious Area"
"     30.000   Pervious length"
"      1.000   Pervious slope"
"      0.721   Impervious Area"
"     30.000   Impervious length"
"      1.000   Impervious slope"
"      0.250   Pervious Manning 'n'"
"     50.000   Pervious Max.infiltration"
"      7.500   Pervious Min.infiltration"
"      0.500   Pervious Lag constant (hours)"
"      5.000   Pervious Depression storage"
"      0.013   Impervious Manning 'n'"
"      0.000   Impervious Max.infiltration"
"      0.000   Impervious Min.infiltration"
"      0.500   Impervious Lag constant (hours)"
"      1.500   Impervious Depression storage"
"                  0.023     0.000     0.038     0.043 c.m/sec"
"            Catchment 1133          Pervious   Impervious Total Area "
"            Surface Area            0.285      0.721      1.006      hectare"
"            Time of concentration   999999.000 5.923      5.923      minutes"
"            Time to Centroid        0.000      125.865    125.865    minutes"
"            Rainfall depth          14.000     14.000     14.000     mm"
"            Rainfall volume         0.00       0.00       0.00       c.m"
"            Rainfall losses         14.000     14.000     14.000     mm"
"            Runoff depth            0.000      0.000      0.000      mm"
"            Runoff volume           0.00       90.16      90.16      c.m"
"            Maximum flow            0.000      0.023      0.023      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.023     0.023     0.038     0.043"
" 40         HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                0.023     0.023     0.023     0.043"
" 40         HYDROGRAPH   Combine    113"
"          6   Combine "
"        113   Node #"
"              Loblaws plus future Sopresata"
"            Maximum flow                  0.066    c.m/sec"
"            Hydrograph volume           289.137    c.m"
"                  0.023     0.023     0.023     0.066"
" 37         START/RE-START TOTALS 1133"
"          2   Runoff Totals reset to ZERO"
"            Catchment area to node 113                2.598    hectare"
"            Impervious area to node 113               2.313    hectare"
"            % impervious to node 113                 89.042"
"            Peak runoff to node 113                   0.074    c.m/sec"
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"            Total volume to node 113                    289.2    c.m"
" 81         ADD COMMENT==========================================="
"          15  Lines of comment"
"              Area 125 - Sopresata =  5.323 ha   "
"                   "
"              Drainage area                5.3230 ha "
"              Legal area                   4.8921 ha "
"              External areas               0.4309 ha comprising: "
"                 Bell Blvd                 0.2209 ha   67.0 imperv% "
"                 Sidney St.s               0.2100 ha   50.0% "
"                 Landscape 5%x4.8921       0.2446 ha    0.0% "
"                 Total pervious            0.4976 ha "
"              Use: "
"              Rooftop area   1251          1.653 ha  100.0% imperv "
"              Parking area   1252          2.204 ha  100.0% imperv "
"              Balance        1253          1.466 ha   71.2% imperv "
"              TOTAL          125           5.323 ha   92.1% imperv."
"                   "
" 40           HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.023     0.000     0.023     0.066"
" 33           CATCHMENT 1251"
"            4   Linear reservoir"
"            1   Equal length"
"            2   Horton equation"
"         1251   ID number"
"      100.000   % Impervious"
"        1.653   Total Area"
"       10.000   Flow length"
"        0.750   Overland Slope"
"        0.000   Pervious Area"
"       10.000   Pervious length"
"        0.750   Pervious slope"
"        1.653   Impervious Area"
"       10.000   Impervious length"
"        0.750   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.053     0.000     0.023     0.066 c.m/sec"
"              Catchment 1251          Pervious   Impervious Total Area "
"              Surface Area            0.000      1.653      1.653      hectare"
"              Time of concentration   999999.000 3.340      3.340      minutes"
"              Time to Centroid        0.000      124.573    124.573    minutes"
"              Rainfall depth          14.000     14.000     14.000     mm"
"              Rainfall volume         0.00       0.00       0.00       c.m"
"              Rainfall losses         14.000     14.000     14.000     mm"
"              Runoff depth            0.000      0.000      0.000      mm"
"              Runoff volume           0.00       206.62     206.62     c.m"
"              Maximum flow            0.000      0.053      0.053      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.053     0.053     0.023     0.066"
" 54           POND DESIGN"
"         0.053   Current peak flow     c.m/sec"
"         210.0   Hydrograph volume     c.m/sec"
"           11.   Number of stages"
"         0.000   Minimum water level     c.m/sec"
"         0.175   Maximum water level     c.m/sec"
```



```
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                  0.000     0.000      0.0"
"                  0.018     0.008      3.8"
"                  0.035     0.016     28.0"
"                  0.053     0.024     97.2"
"                  0.070     0.031    224.0"
"                  0.087     0.039    421.1"
"                  0.105     0.047    644.3"
"                  0.123     0.055    867.4"
"                  0.140     0.063   1078.2"
"                  0.157     0.070   1288.9"
"                  0.175     0.078   1512.1"
"          1.   ROOFTOP"
"               Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                 hectare     hectare    sq.metre  L/min/25mm      g H:1V"
"                   1.653       1.240     450.000      24.000     133.333"
"             Using 28 roofdrains on roofstorage area of 12398. square metre"
"             Peak outflow                          0.021    c.m/sec"
"             Maximum level                         0.047    metre"
"             Maximum storage                      72.297    c.m"
"             Centroidal lag                        2.753    hours"
"                   0.053     0.053     0.021     0.066 c.m/sec"
" 40           HYDROGRAPH   Combine    125"
"            6   Combine "
"          125   Node #"
"                Hawley land"
"             Maximum flow                          0.021    c.m/sec"
"             Hydrograph volume                   207.068    c.m"
"                   0.053     0.053     0.021     0.021"
" 40           HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.053     0.000     0.021     0.021"
" 33           CATCHMENT 1252"
"            4   Linear reservoir"
"            1   Equal length"
"            2   Horton equation"
"         1252   ID number"
"      100.000   % Impervious"
"        2.204   Total Area"
"       35.000   Flow length"
"        1.300   Overland Slope"
"        0.000   Pervious Area"
"       35.000   Pervious length"
"        1.300   Pervious slope"
"        2.204   Impervious Area"
"       35.000   Impervious length"
"        1.300   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.071     0.000     0.021     0.021 c.m/sec"
"              Catchment 1252          Pervious   Impervious Total Area "
"              Surface Area            0.000      2.204      2.204      hectare"
"              Time of concentration   999999.000 6.005      6.005      minutes"
"              Time to Centroid        0.000      125.906    125.906    minutes"
"              Rainfall depth          14.000     14.000     14.000     mm"
"              Rainfall volume         0.00       0.00       0.00       c.m"
"              Rainfall losses         14.000     14.000     14.000     mm"
```

```
"          Runoff depth . .        0.000     0.000     0.000     mm"
"          Runoff volume           0.00      275.50    275.50    c.m"
"          Maximum flow            0.000     0.071     0.071     c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"        4   Add Runoff "
"              0.071     0.071     0.021     0.021"
" 54       POND DESIGN"
"     0.071   Current peak flow    c.m/sec"
"     280.0   Hydrograph volume    c.m/sec"
"       21.   Number of stages"
"    92.000   Minimum water level    c.m/sec"
"    93.300   Maximum water level    c.m/sec"
"         0   Keep Design Data: 1 = True; 0 = False"
"               Level Discharge    Volume"
"              92.000     0.000      0.0"
"              92.065     0.009      0.0"
"              92.130     0.028      0.0"
"              92.195     0.038      0.0"
"              92.260     0.045      0.0"
"              92.325     0.052      0.0"
"              92.390     0.058      0.0"
"              92.455     0.063      0.0"
"              92.520     0.068      0.0"
"              92.585     0.072      0.0"
"              92.650     0.076      0.0"
"              92.715     0.080      0.0"
"              92.780     0.084      0.0"
"              92.845     0.088      0.0"
"              92.910     0.091      0.0"
"              92.975     0.095      0.0"
"              93.040     0.098      3.9"
"              93.105     0.101     69.8"
"              93.170     0.104    296.3"
"              93.235     0.107    782.8"
"              93.300     0.110   1628.7"
"       1.   ORIFICES"
"            Orifice   Orifice   Orifice Number of"
"             invert coefficie  diameter  orifices"
"             92.000     0.630     0.075     8.000"
"       1.   WEDGES"
"             Wedge   Grade 1   Grade 2     Angle    Number"
"            invert    g1H:1V    g2H:1V subtended of wedges"
"            93.000    60.000   120.000    90.000    32.000"
"          Peak outflow                    0.071    c.m/sec"
"          Maximum level                  92.562    metre"
"          Maximum storage                 0.000    c.m"
"          Centroidal lag                  2.098    hours"
"              0.071     0.071     0.071     0.021 c.m/sec"
" 40       HYDROGRAPH   Combine    125"
"        6   Combine "
"      125   Node #"
"            Hawley land"
"          Maximum flow                    0.090    c.m/sec"
"          Hydrograph volume             482.567    c.m"
"              0.071     0.071     0.071     0.090"
" 40       HYDROGRAPH Start - New Tributary"
"        2   Start - New Tributary"
"              0.071     0.000     0.071     0.090"
" 33       CATCHMENT 1253"
"        4   Linear reservoir"
"        1   Equal length"
"        2   Horton equation"
"     1253   ID number"
"   71.200   % Impervious"
"    1.466   Total Area"
"   30.000   Flow length"
```



```
"    1.000   Overland Slope"
"    0.422   Pervious Area"
"   30.000   Pervious length"
"    1.000   Pervious slope"
"    1.044   Impervious Area"
"   30.000   Impervious length"
"    1.000   Impervious slope"
"    0.250   Pervious Manning 'n'"
"   50.000   Pervious Max.infiltration"
"    7.500   Pervious Min.infiltration"
"    0.500   Pervious Lag constant (hours)"
"    5.000   Pervious Depression storage"
"    0.013   Impervious Manning 'n'"
"    0.000   Impervious Max.infiltration"
"    0.000   Impervious Min.infiltration"
"    0.500   Impervious Lag constant (hours)"
"    1.500   Impervious Depression storage"
"              0.033     0.000     0.071     0.090 c.m/sec"
"          Catchment 1253          Pervious   Impervious Total Area "
"          Surface Area            0.422      1.044      1.466      hectare"
"          Time of concentration   999999.000 5.923      5.923      minutes"
"          Time to Centroid        0.000      125.865    125.865    minutes"
"          Rainfall depth          14.000     14.000     14.000     mm"
"          Rainfall volume         0.00       0.00       0.00       c.m"
"          Rainfall losses         14.000     14.000     14.000     mm"
"          Runoff depth            0.000      0.000      0.000      mm"
"          Runoff volume           0.00       130.47     130.47     c.m"
"          Maximum flow            0.000      0.033      0.033      c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"        4   Add Runoff "
"              0.033     0.033     0.071     0.090"
" 40       HYDROGRAPH Copy to Outflow"
"        8   Copy to Outflow"
"              0.033     0.033     0.033     0.090"
" 40       HYDROGRAPH   Combine    125"
"        6   Combine "
"      125   Node #"
"            Hawley land"
"          Maximum flow                    0.123    c.m/sec"
"          Hydrograph volume             613.041    c.m"
"              0.033     0.033     0.033     0.123"
" 37       START/RE-START TOTALS 1253"
"        2   Runoff Totals reset to ZERO"
"          Catchment area to node 125                  5.323    hectare"
"          Impervious area to node 125                 4.901    hectare"
"          % impervious to node 125                   92.068"
"          Peak runoff to node 125                     0.157    c.m/sec"
"          Total volume to node 125                    612.6    c.m"
" 81       ADD COMMENT================================================="
"        5   Lines of comment"
"            Recover total flow from area 125 and route it through "
"            storm sewer to junction node 113, then add it to junction "
"            node 113 to combine with Loblaws before adding to sediment "
"            forebay at node 114"
"            "
" 40         HYDROGRAPH   Confluence    125"
"          7   Confluence "
"        125   Node #"
"              Hawley land"
"            Maximum flow                    0.123    c.m/sec"
"            Hydrograph volume             613.041    c.m"
"                0.033     0.123     0.033     0.000"
" 51         PIPE DESIGN"
"       0.123   Current peak flow    c.m/sec"
"       0.013   Manning 'n'"
"       0.535   Diameter    metre"
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"       0.500   Gradient   %"
"            Depth of flow                  0.230    metre"
"            Velocity                       1.329    m/sec"
"            Pipe capacity                  0.320    c.m/sec"
"            Critical depth                 0.232    metre"
" 53         ROUTE    Pipe Route"
"      350.00       Pipe Route Reach length    ( metre)"
"       0.463   X-factor <= 0.5"
"     197.444   K-lag   ( seconds)"
"       0.000   Default(0) or user spec.(1) values used"
"       0.480   X-factor <= 0.5"
"     456.900   K-lag   ( seconds)"
"       0.500   Beta weighting factor"
"     180.000   Routing time step   ( seconds)"
"           1   No. of sub-reaches"
"            Peak outflow                   0.119    c.m/sec"
"                   0.033     0.123     0.119     0.000 c.m/sec"
" 40         HYDROGRAPH   Combine    113"
"          6   Combine "
"        113   Node #"
"            Loblaws plus future Sopresata"
"            Maximum flow                   0.185    c.m/sec"
"            Hydrograph volume            902.178    c.m"
"                   0.033     0.123     0.119     0.185"
" 81         ADD COMMENT================================================="
"          3  Lines of comment"
"            Recover runoff from junction 113 and add to junction node "
"            114 at entry to sediment forebay"
"               "
" 40         HYDROGRAPH   Confluence    113"
"          7   Confluence "
"        113   Node #"
"            Loblaws plus future Sopresata"
"            Maximum flow                   0.185    c.m/sec"
"            Hydrograph volume            902.179    c.m"
"                   0.033     0.185     0.119     0.000"
" 40         HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                   0.033     0.185     0.185     0.000"
" 40         HYDROGRAPH   Combine    114"
"          6   Combine "
"        114   Node #"
"            Upstream of sediment forebay"
"            Maximum flow                   1.256    c.m/sec"
"            Hydrograph volume            7332.777   c.m"
"                   0.033     0.185     0.185     1.256"
" 81         ADD COMMENT================================================="
"          3  Lines of comment"
"            Recover runoff from junction 114, save it as a file and "
"            route it through the sediment forebay"
"               "
" 40         HYDROGRAPH   Confluence    114"
"          7   Confluence "
"        114   Node #"
"            Upstream of sediment forebay"
"            Maximum flow                   1.256    c.m/sec"
"            Hydrograph volume            7332.777   c.m"
"                   0.033     1.256     0.185     0.000"
" 47         FILEI_O Write/Save forebayin.14hyd"
"          2   1=read/open; 2=write/save"
"          2   1=rainfall; 2=hydrograph"
"          2   1=runoff; 2=inflow; 3=outflow; 4=junction"
"           forebayin.14hyd"
"           100-yr inflow to sediment forebay"
"                   0.033     1.256     0.185     0.000 c.m/sec"
" 81         ADD COMMENT================================================="
```



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"          10  Lines of comment"
"            Sediment forebay has a surface area of 897 sq.m at "
"            elevation of 90.9 m with 3H:1V sideslopes.  Downstream "
"            outflow control comprises a compound weir with following "
"            geometry:"
"            Width 1.400 m at elev. 91.000"
"            Width 1.440 m at elev. 91.150"
"            Width 1.440 m at elev. 91.350"
"            Use reduced coeff.of discharge for lowest segment to  "
"            all for backwater at 90.9 m elevation "
"               "
" 54         POND DESIGN"
"       1.256   Current peak flow     c.m/sec"
"      7333.0   Hydrograph volume     c.m/sec"
"        21.    Number of stages"
"      90.900   Minimum water level    c.m/sec"
"      92.500   Maximum water level    c.m/sec"
"           0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge     Volume"
"                90.900     0.000       0.0"
"                90.980     0.000      73.1"
"                91.060     0.025     148.9"
"                91.140     0.088     227.4"
"                91.220     0.213     308.7"
"                91.300     0.403     392.8"
"                91.380     0.647     479.7"
"                91.460     0.983     569.5"
"                91.540     1.384     662.2"
"                91.620     1.838     757.9"
"                91.700     2.337     856.5"
"                91.780     2.879     958.2"
"                91.860     3.459    1063.0"
"                91.940     4.076    1170.8"
"                92.020     4.726    1281.8"
"                92.100     5.409    1395.9"
"                92.180     6.122    1513.3"
"                92.260     6.865    1633.9"
"                92.340     7.636    1757.8"
"                92.420     8.435    1885.0"
"                92.500     9.260    2015.6"
"             3.   WEIRS"
"                  Crest      Weir      Crest      Left      Right"
"              elevation coefficie   breadth sideslope sideslope"
"                 91.000     0.700     1.400     0.000     0.000"
"                 91.150     0.900     1.440     0.000     0.000"
"                 91.350     0.900     1.440     0.000     0.000"
"             2.   LAYERS"
"                  Bottom    Aspect    Bottom       Top   Average"
"                    area     ratio elevation elevation sideslope"
"                 897.000     3.000    90.900    92.000     3.000"
"                1397.058     2.448    92.000    92.500     3.000"
"               Peak outflow                  1.180    c.m/sec"
"               Maximum level                91.499    metre"
"               Maximum storage             615.024    c.m"
"               Centroidal lag                4.396   hours"
"                   0.033     1.256     1.180     0.000 c.m/sec"
" 81         ADD COMMENT================================================="
"          3  Lines of comment"
"            Save outflow as a file and then add runoff from area 116 "
"            (residential south of Hydro easement) to give total inflow "
"               "
" 47         FILEI_O Write/Save forebayout.14hyd"
"          2   1=read/open; 2=write/save"
"          2   1=rainfall; 2=hydrograph"
"          3   1=runoff; 2=inflow; 3=outflow; 4=junction"
"           forebayout.14hyd"
```

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"            100-yr outflow from sediment forebay"
"                 0.033     1.256     1.180     0.000 c.m/sec"
" 81          ADD COMMENT==========================================================="
"           2  Lines of comment"
"              Recover outflow from sediment forebay as Inflow to Main "
"              pond. "
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                  0.033     1.180     1.180     0.000"
" 81          ADD COMMENT==========================================================="
"           13  Lines of comment"
"              D.J.H Development (residential) south of Hydro easement "
"                 "
"              Drainage area              2.4540 ha "
"              Legal area                 2.3774 ha "
"              External areas             0.0766 ha comprising: "
"                 Sidney St.              0.0766 ha   40.0 imperv% "
"                 Landscaping 75%x2.3774  1.7831"
"                 "
"              s          1.8290 ha ""
"              Use: "
"              TOTAL          116         2.4540 ha   25.5% imperv."
"                 "
"              Padded text"
" 33          CATCHMENT 116"
"            4   Linear reservoir"
"            1   Equal length"
"            2   Horton equation"
"          116   ID number"
"       25.500   % Impervious"
"        2.454   Total Area"
"       20.000   Flow length"
"        1.000   Overland Slope"
"        1.828   Pervious Area"
"       20.000   Pervious length"
"        1.000   Pervious slope"
"        0.626   Impervious Area"
"       20.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.020     1.180     1.180     0.000 c.m/sec"
"              Catchment 116          Pervious   Impervious Total Area "
"              Surface Area           1.828      0.626      2.454      hectare"
"              Time of concentration  999999.000 4.644      4.644      minutes"
"              Time to Centroid       0.000      125.225    125.225    minutes"
"              Rainfall depth         14.000     14.000     14.000     mm"
"              Rainfall volume        0.00       0.00       0.00       c.m"
"              Rainfall losses        14.000     14.000     14.000     mm"
"              Runoff depth           0.000      0.000      0.000      mm"
"              Runoff volume          0.00       78.22      78.22      c.m"
"              Maximum flow           0.000      0.020      0.020      c.m/sec"
" 37          START/RE-START TOTALS 116"
"            2   Runoff Totals reset to ZERO"
"              Catchment area to node 114                    2.454    hectare"
"              Impervious area to node 114                   0.626    hectare"
"              % impervious to node 114                     25.500"
"              Peak runoff to node 114                       0.020    c.m/sec"
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"              Total volume to node 114                     78.2     c.m"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                  0.020     1.200     1.180     0.000"
" 81          ADD COMMENT==========================================================="
"           4  Lines of comment"
"              Allow for main pond with permanent water surface area of "
"              approx.  8950 sqare metre, i.e.  "
"              Total area                 1.491 ha  60.0% imperv. "
"                 "
" 33          CATCHMENT 129"
"            4   Linear reservoir"
"            1   Equal length"
"            2   Horton equation"
"          129   ID number"
"       60.000   % Impervious"
"        1.491   Total Area"
"       30.000   Flow length"
"        5.000   Overland Slope"
"        0.596   Pervious Area"
"       30.000   Pervious length"
"        5.000   Pervious slope"
"        0.895   Impervious Area"
"       30.000   Impervious length"
"        5.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       50.000   Pervious Max.infiltration"
"        7.500   Pervious Min.infiltration"
"        0.500   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.500   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                  0.029     1.200     1.180     0.000 c.m/sec"
"              Catchment 129          Pervious   Impervious Total Area "
"              Surface Area           0.596      0.895      1.491      hectare"
"              Time of concentration  999999.000 3.655      3.655      minutes"
"              Time to Centroid       0.000      124.731    124.731    minutes"
"              Rainfall depth         14.000     14.000     14.000     mm"
"              Rainfall volume        0.00       0.00       0.00       c.m"
"              Rainfall losses        14.000     14.000     14.000     mm"
"              Runoff depth           0.000      0.000      0.000      mm"
"              Runoff volume          0.00       111.83     111.83     c.m"
"              Maximum flow           0.000      0.029      0.029      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                  0.029     1.229     1.180     0.000"
" 47          FILE1_O Write/Save MainPondIn.14hyd"
"            2   1=read/open; 2=write/save"
"            2   1=rainfall; 2=hydrograph"
"            2   1=runoff; 2=inflow; 3=outflow; 4=junction"
"             MainPondIn.14hyd"
"             100-yr inflow to main pond at Lemoine and Tracy St"
"                  0.029     1.229     1.180     0.000 c.m/sec"
" 54          POND DESIGN"
"         1.229   Current peak flow    c.m/sec"
"       7410.0    Hydrograph volume    c.m/sec"
"          21.    Number of stages"
"       90.900    Minimum water level    c.m/sec"
"       92.500    Maximum water level    c.m/sec"
"            0    Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                  90.900     0.000      0.0"
"                  90.980     0.003    739.8"
```

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"              91.060     0.012    1498.2"
"              91.140     0.017    2275.6"
"              91.220     0.021    3071.8"
"              91.300     0.024    3887.1"
"              91.380     0.027    4721.4"
"              91.460     0.232    5575.1"
"              91.540     0.755    6448.1"
"              91.620     1.459    7340.5"
"              91.700     2.305    8252.3"
"              91.780     3.273    9183.9"
"              91.860     4.348   10135.3"
"              91.940     5.522   11106.5"
"              92.020     6.785   12097.5"
"              92.100     8.133   13108.7"
"              92.180     9.560   14140.0"
"              92.260    11.062   15191.6"
"              92.340    12.635   16263.5"
"              92.420    14.277   17355.9"
"              92.500    15.985   18468.8"
"        1.   WEIRS"
"             Crest      Weir     Crest      Left     Right"
"         elevation coefficie   breadth sideslope sideslope"
"              91.400     0.900     9.000     0.000     0.000"
"        1.   ORIFICES"
"             Orifice   Orifice   Orifice Number of"
"              invert coefficie  diameter  orifices"
"              90.900     0.750     0.128     1.000"
"        3.   LAYERS"
"              Bottom    Aspect    Bottom       Top   Average"
"                area     ratio elevation elevation sideslope"
"           9130.600     7.127    90.900    91.400     5.000"
"          10610.040     6.376    91.400    92.300     5.000"
"          13399.040     5.404    92.300    92.500     5.000"
"         Peak outflow                  0.184    c.m/sec"
"         Maximum level                91.441    metre"
"         Maximum storage            5374.615    c.m"
"         Centroidal lag               10.332   hours"
"              0.029     1.229     0.184     0.000 c.m/sec"
" 47     FILEI_O Write/Save mainpondout.14hyd"
"        2   1=read/open; 2=write/save"
"        2   1=rainfall; 2=hydrograph"
"        3   1=runoff; 2=inflow; 3=outflow; 4=junction"
"         mainpondout.14hyd"
"         100-yr outflow from Main pond at Lemojne &Tracy St."
"              0.029     1.229     0.184     0.000 c.m/sec"
" 37     START/RE-START TOTALS 129"
"        3   Runoff Totals on EXIT"
"         Total Catchment area                    64.796    hectare"
"         Total Impervious area                   51.387    hectare"
"         Total % impervious                      79.305"
" 37     START/RE-START TOTALS 129"
"        3   Runoff Totals on EXIT"
"         Total Catchment area                    64.796    hectare"
"         Total Impervious area                   51.387    hectare"
"         Total % impervious                      79.305"
" 37     START/RE-START TOTALS 129"
"        3   Runoff Totals on EXIT"
"         Total Catchment area                    64.796    hectare"
"         Total Impervious area                   51.387    hectare"
"         Total % impervious                      79.305"
" 19     EXIT"
```

APPENDIX "H"

Cost Estimates

APPENDIX "H1" – COST ESTIMATE FOR THE STORMWATER MANAGEMENT SYSTEM

Schedule of Unit Prices Attached to

And Forming Part of the Tender For

CONTRACT NO. 98-

UPPER NO NAME CREEK/BELL BOULEVARD STORMWATER MANAGEMENT SYSTEM
(Bell Boulevard/Lemoine Street)

S.P. stands for Special Provisions
M.S. stands for Municipal Specifications

ITEM NO.	SPEC NO.	DESCRIPTION	EST. QUAN.	UNIT	UNIT PRICE	AMOUNT
1.0		Topsoil stripping and disposal at a site approved by the City of Belleville.	7,850.00	CM	$ 5.00	$ 39,250.00
1.1		15m wide channel north of Bell Boulevard.	235.00	LM	$ 120.00	$ 28,200.00
1.2		20m wide channel south of Bell Boulevard.	115.00	LM	$ 150.00	$ 17,250.00
1.3		Stormwater management pond blasting (approx. 1.5m over burden)	14,000.00	CM	$ 33.00	$ 462,000.00
1.4		Stormwater management pond excavation. a) Earth b) Rock	 7,500.00 14,000.00	 CM CM	 $ 5.00 $ 6.00	 $ 37,500.00 $ 84,000.00
1.5		Pregrading of sediment forebay.	1.00	LS	$ 10,000.00	$ 10,000.00
1.6		Cast in place concrete headwall/diversion structure.	1.00	LS	$ 17,000.00	$ 17,000.00
1.7		1500mm dia. storm.	39.50	LM	$ 650.00	$ 25,675.00
1.8		1500mm dia. radius pipe.	16.00	LM	$ 800.00	$ 12,800.00
1.9		Concast culvert system and wing walls.	1.00	LS	$ 48,000.00	$ 48,000.00
1.10		Cast in place weir wall.	1.00	LS	$ 10,000.00	$ 10,000.00

ITEM NO.	SPEC NO.	DESCRIPTION	EST. QUAN.	UNIT	UNIT PRICE	AMOUNT
1.11		Stormwater management pond inlet/outlet.				
		a) 600mm dia. pipe	30.00	LM	$ 150.00	$ 4,500.00
		b) 400mm dia. drain	26.50	LM	$ 90.00	$ 2,385.00
		c) 200mm dia. Hickenbottom complete with 1200mm dia. Armtec CSP riser and cap and 50mm dia. clear stone as specified.	1.00	EA	$ 15,000.00	$ 15,000.00
1.12		Headwall, complete with grating (OPSD 804.04, 804.05).	2.00	EA	$ 13,500.00	$ 27,000.00
1.13		Armour stone retaining wall.				
		a) 1.0m height	105.00	LM	$ 100.00	$ 10,500.00
		b) 2.0m height	105.00	LM	$ 200.00	$ 21,000.00
1.14		Riprap – 0.3m in depth.	400.00	SM	$ 10.50	$ 4,200.00
1.15		Martek Grasspave^2 for sediment forebay.	500.00	SM	$ 34.50	$ 17,250.00
1.16		Bentofix geosynthetic clay liners in stormwater management pond.	10,350.00	SM	$ 13.00	$ 134,550.00
1.17		Seeding of channels and stormwater management pond.	28,000.00	SM	$ 1.35	$ 37,800.00
1.18		3.0m maintenance access complete with 40mm of HL-8 and 450mm of Granular "A".	630.00	LM	$ 50.40	$ 31,752.00
1.19		6.0m maintenance access complete with 40mm of HL-8 and 450mm of Granular "A".	175.00	LM	$ 100.80	$ 17,640.00
1.20		Sedimentation control.	1.00	LS	$ 10,000.00	$ 10,000.00
1.21		Supply and install 1.8m chainlink fence as per OPSD 900.01.	910.00	LM	$ 39.00	$ 35,490.00
1.22		Supply and install single swing gate as per OPSD 900.03.	1.00	EA	$ 4,100.00	$ 4,100.00

ITEM NO.	SPEC NO.	DESCRIPTION	EST. QUAN.	UNIT	UNIT PRICE	AMOUNT
1.23		Supply and install double swing gate as per OPSD 900.03.	3.00	EA	$ 7,900.00	$ 23,700.00
1.24		Light standard "Nitetorch 1" (NRG-G211 SP2).	12.00	EA	$ 2,500.00	$ 30,000.00
1.25		Adjust sanitary manhole complete with watertight frame cover.	2.00	EA	$ 100.00	$ 200.00
1.26		Landscaping.	1.00	LS	$ 50,000.00	$ 50,000.00
					SUBTOTAL	$ 1,268,742.00
		Contingency allowance for Drainage Act procedures (20% of estimated cost).				$ 253,750.40
					SUBTOTAL	$ 1,522,492.40
					7% G.S.T.	$ 106,574.47
					TOTAL	$ 1,629,066.87

APPENDIX "H2" – COST ESTIMATE QUALITY COMPONENT

Component	Estimated Cost
Sediment forebay (Items 1.5, 1.9, 1.10 and 1.15)	$85,250.00
Stormwater management pond (4/7 of Items 1.3, 1.4b, 1.11c and 1.16)	$397,457.00
Miscellaneous, filter strip, vegetation (1/2 of Items 1.17 and 1.26)	$43,900.00
Subtotal	**$526,607.00**
Contingency allowance for Drainage Act Procedures (20% of estimate)	$105,321.00
Subtotal	**$631,928.00**
7% GST	$44,234.96
Total	**$676,162.96**

The balance of the total cost is assigned to quantity control.

i.e.:

Quantity Control =	$ 890,564.40
Quality Control =	$ 631,928.00
Total	$ 1,522,492.40

APPENDIX "I"

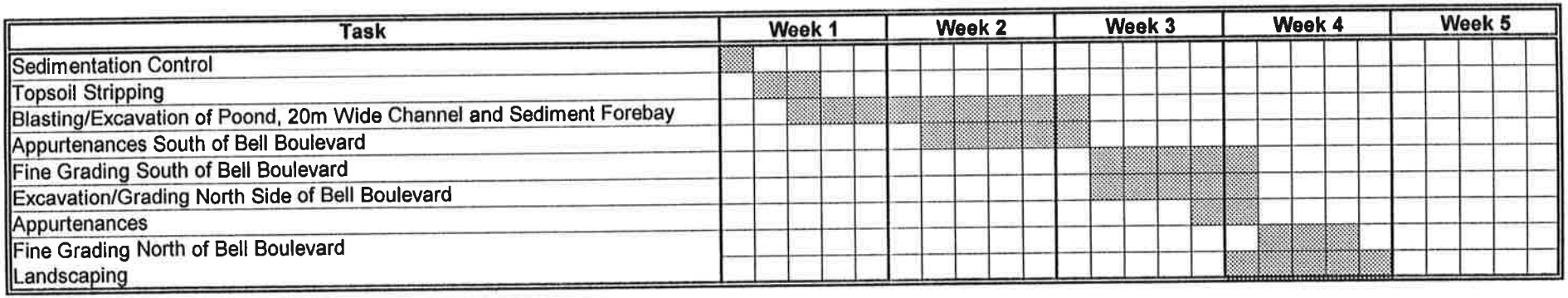
Construction Schedule and Methods

UPPER NO NAME CREEK/BELLBOULEVARD STORMWATER MANAGEMENT SYSTEM

EQUIPMENT EXAMPLES:

Caterpillar 235 Excavator
Caterpillar 963 Loader
Dresser TD15 Dozer
John Deere 450 Loader/Backhoe
Super Pac 840 Sheepsfoot Roller

PROPOSED CONSTRUCTION SCHEDULE



APPENDIX "J"

Specifications

Special Provisions With Respect to Tendered Items

UPPER NO NAME CREEK/BELL BOULEVARD STORMWATER MANAGEMENT SYSTEM (Bell Boulevard/Lemoine Street)

1.0 Topsoil Stripping

The unit price bid, per cubic metre, shall be all inclusive and shall include all labour and equipment necessary to remove topsoil. Topsoil shall be removed from the original surface of the entire extents of the project as directed by the Engineer and/or Geotechnical Consultant and stockpiled in an area designated by the Engineer. The Contractor shall ensure that all siltation and/or sedimentation control devices are in place prior to any construction activities proceeding.

1.1 15m Wide Channel North of Bell Boulevard

The unit price bid per lineal metre shall be all inclusive and shall include all material, labour and equipment necessary to construct the 15m wide conveyance channel as detailed on the engineering drawings. The work shall include, but not be limited to the following:

- any excavation, dewatering, grading and disposal of surplus material;
- removal from site of any unsuitable material;
- clearing and grubbing as required per the engineering drawings;
- pregrading for a future 3.0m wide maintenance access;
- any fine grading of slopes;
- reinstatement of surrounding conditions as directed by the Engineer and to the satisfaction of the City of Belleville.

Measurement for payment shall be on a lineal metre basis, measured along the proposed centreline of the stream.

Restorations of the streambed, due to the Contractor's access along the constructed streambed is the sole responsibility of the Contractor.

1.2 20m Wide Channel South of Bell Boulevard

The unit price bid per lineal metre shall be all inclusive and shall include all material, labour and equipment necessary to construct the 20m wide conveyance channel as detailed on the engineering drawings. The work shall include, but not be limited to the following:

- any excavation, dewatering, grading and disposal of surplus material;
- removal from site of any unsuitable material;
- clearing and grubbing as required per the engineering drawings;
- pregrading for a future 3.0m wide maintenance access;
- any fine grading of slopes;
- reinstatement of surrounding conditions as directed by the Engineer and to the satisfaction of the City of Belleville.

Measurement for payment shall be on a lineal metre basis, measured along the proposed centreline of the stream.

Restorations of the streambed, due to the Contractor's access along the constructed streambed is the sole responsibility of the Contractor.

1.3 Stormwater Management Pond Blasting

The unit price bid per cubic metre shall be all inclusive and shall include the supply of all materials, labour and equipment necessary to blast the rock for the stormwater management pond.

Included in this item, the Contractor must be responsible for:

a) General

Prior to the start of any blasting operations, a preblast survey shall be carried out.

All blasting shall be performed between 0700 and 1900 hours.

Any department or agency of government, person, partnership or corporation affected shall be notified prior to blasting.

A Blasting Control Specialist shall be employed by the Contractor to determine and control intensity of ground vibrations resulting from blasting.

All blasting, when completed, is intended to be excavated and used as fill in future parking areas in an adjacent site. Since this material is intended for fill, it is the Contractor's responsibility to ensure that the blast material is no larger than 500mm measured in any direction.

b) Blasting

The intensity of ground vibrations generated by blasting shall be controlled to a maximum peak particle velocity when measured in any of three mutually perpendicular directions; 50mm per second in ground adjacent to buildings, structures and services and 10mm per second in ground adjacent to concrete or grout in place less than 60 hours.

Blasting shall not be performed closer than 30m to fresh concrete within 70 hours after completion of the concrete pour for concrete curing at 4°C and 24 hours after completion of the concrete pour for concrete during at 20°C except on the recommendation of the Blasting Control Specialist and with the permission of the Engineer.

All blasting operations shall be conducted in strict accordance with existing ordinances and regulations relative to rock blasting and the storage and use of explosives.

Where it is necessary to use explosives, the supply, transportation, handling and storage of all explosives and

accessories shall be carried out in accordance with the regulations of the Explosives Division of the Department of Mines. The Contractor shall notify the nearest Federal Inspector of the location of the sits and names of the streets in which he intends to use explosives.

Before any blasting operation is carried out, the Contractor shall submit to the Engineer, for his approval, the method of blasting proposed to be used, the quantity of explosives involved, and the proposed safety precautions. The Engineer's approval must be obtained in writing before any detonation takes place, but this approval or authorization shall in no way relieve the Contractor of full responsibility for all claims arising from or pertaining to the use of explosives in this Contract.

The Contractor shall take every precaution to ensure that no damage is caused to any structure or pipeline during blasting operations and shall also take the necessary steps to prevent rock and stones from flying. A responsible member of the Contractor's staff shall notify all householders in the immediate vicinity daily before blasting operations take place.

The Contractor shall observe the Safety Code issued by the Ontario Highway Construction Safety Association and the Provincial Mining Act.

The site of the blast shall be covered with heavy timbers, blasting mats, or other devices to prevent damage by flying rock. The time of blasting and the number and sizes of charges shall be approved by the Engineer. The blasting shall be done only by experienced men. Where, in the opinion of the Engineer the sewers, watermains, gas mains or any other public utility or privately owned structure, blasting will not be permitted or may be limited to such an extent as to ensure the safety of such structures.

The blasting operation shall follow OPSS Section 515.04 to 515.10.01.

c) Submission and Design Requirements

All necessary permits and reports shall be submitted to the Engineer a minimum of one week before the start of blasting operations.

A report by a Blasting Control Specialist retained by the Contractor on the methods and controls required during blasting shall be submitted to the Engineer for review.

Seismic recordings shall be submitted to the Engineer as soon as possible after each blast.

d) Safety Precautions

The blast area shall be cleared of all residents, vehicular and pedestrian traffic prior to blasting. Flagmen shall be posted on

each road entering the blasting area to control traffic during blasting operations. Blasting mats or other approved methods shall be used to control flying rock.

e) Method of Measurement for Payment

Measurement will be in cubic metres.

The volume of rock blasting and excavation for trenches or open pits shall be determined by the product of the following dimensions measured in place or determined from the plans:

Height: The vertical distance from the rock surface to the bottom of the designed trench or pit.

Width: The minimum width shown on the plans.

Length: Measured horizontally along the centreline of the trench.

1.4 Stormwater Management Pond Excavation

The unit price bid per cubic metre for this item shall be all inclusive and shall include the supply of all material, labour and equipment necessary to excavate both overburden and blast rock and haul to adjacent sites to be used as fill.

Included in this item, the Contractor is responsible for:

- All excavation, dewatering and hauling of excavated material.
- Placing all blast rock first in fill areas and consolidating blast rock to the satisfaction of the Engineer.
- Placing all excavated overburden over consolidated blast rock and compacting fill material to 98% SPD and to the satisfaction of the Engineer.
- Stripping and stockpiling topsoil from areas on adjacent sites to receive fill.
- Reinstatement of surrounding conditions as directed by the Engineer and to the satisfaction of the City of Belleville.
- Preparing subgrade for Bentofix clay liner and seeding as per Special Provision Item 1.10.
- Supply and installation of warning signs as per engineering drawings.

Any material deemed unsuitable by the Geotechnical Engineer shall be removed from the site.

1.5 Pregrading of Sediment Forebay

The lump sum bid for this item shall be all inclusive and shall include the supply of all materials, labour, and equipment necessary to pregrade the sediment forebay. Included in this item shall be:

- Clearing and grubbing.
- Grading of the temporary channel from existing gabion

headwall to start of future lined sediment forebay.

- Pregrading of sediment forebay for future installation of interlocking brick and bedding.
- Pregrading of all lands as per engineering drawings from Bell Boulevard to future Con/Span culvert system and from future chainlink fence on the east side to 5m west of maintenance access.
- Pregrading of proposed 3.0m maintenance access along east side and 3.0m wide pond access.
- All excavation and dewatering
- Reinstatement of surrounding conditions as directed by the engineer.
- Supply and installation of warning signs as per engineering drawings.

1.6 Cast In Place Concrete Headwall/Diversion Structure

The lump sum bid for this item shall be all inclusive and shall include the supply of all materials, labour, and equipment necessary to construct the cast in place headwall and diversion structure as per the engineering drawings.

Included in this item the contractor is responsible for:

- Excavation, disposal of excess material, dewatering, and base preparation.
- Installation of grating as per engineering drawings.

Reinstatement of existing conditions as directed by the engineer.

1.7 1500mm Dia. Storm Sewer

The unit price, per lineal metre for this item measured horizontally from end of pipe to end of pipe shall be all inclusive and shall include:

- All excavation, dewatering, and disposal of surplus material.
- Supply and installation of specified bedding and pipe.
- Backfilling, compaction, and surface grading as detailed on the drawings.
- Connection to proposed headwalls.
- Reinstatement of surrounding existing features as directed by the engineer.

1.8 1500mm Dia. Radius Pipe

The unit price bid per lineal metre for the item measure from centre of manhole to end pipe shall be all inclusive and shall include:

- All excavation, dewatering, and disposal of surplus material.
- Connection to existing manhole including all bricking and benching.
- Removal and disposal of existing Gabion headwall.
- Supply and install specified pipe and bedding.
- Backfilling, compacting and any surface grading as detailed

on the drawing.

- Reinstatement of existing features as directed by the engineer.

1.9 Concast Culvert System and Wing Walls

The lump sum bid for this item shall be all inclusive and shall include the supply of all materials, labour, and equipment necessary to install the Con-Cast culvert system, attached wingwalls and parapet walls. Included under this item shall be:

- Excavation, disposal of excess excavated material, dewatering, and base preparation.
- Installation per manufacturer's details.
- Connection of wingwalls to culverts as per manufacturer's details.
- Backfill culvert and wing walls with Granular "A" and compact to 98% SPD.
- Reinstatement of surrounding existing features as directed by the engineer.

Reinstatement of rip-rap downstream of culvert previously placed under a separate item.

1.10 Cast In Place Weir Wall

The lump sum bid for this item shall be all inclusive and shall include the supply of all materials, labour, and equipment necessary to install the cast in place weir as detailed on the engineering drawings. Included under this item shall be:

- Excavation, disposal of excess excavated material, dewatering, and base preparation.
- Installation per engineering drawings.
- Connection of weir wall to wing walls.
- Backfill on downstream side of weir with material as detailed by the engineering drawings.
- Reinstatement of surrounding existing features as directed by the engineer.
- Shop drawings showing weir wall tie in to wing walls shall be submitted to engineer for approval.

1.11 Stormwater Management Pond Inlet/Outlet

The unit price bid shall be all inclusive and shall include the supply of all equipment, material and labour necessary to construct the stormwater management pond inlet/outlet.

As per the engineering drawings, the above shall include a 1200mm dia. Armtec CSP riser and cap, 200mm Hickenbottom polyethylene drain inlet, 400mm dia. drain and clean out cap, anti-seepage collar and gravel jacket and 600mm dia. storm., The above shall also include:

- All necessary dewatering and disposal of surplus material.
- Supply and install specified bedding and pipe.

- Backfilling, compaction and surface grading all as detailed on the drawings.
- Connection to headwall.

1.12 Headwall

The lump sum bid for this item shall be all inclusive and shall include the supply of all materials, labour, and equipment necessary to construct the proposed headwall as per engineering drawings and OPSD 804.04.

Included in this item the contractor is responsible for:

- Excavation, disposal of excess excavated material, dewatering, and base preparation.
- Backfill with Granular "B" compacted to 95% SPD.
- Installation of grating (OPSD 804.05)
- Connection to existing pipes
- Reinstatement of existing conditions as directed by the engineer.

1.13 Armour Stone Retaining Wall

The unit price per square metre measured along he face of the retaining walls shall include the supply of all materials, labour and equipment necessary to place the armour stone retaining walls as shown on the engineering drawings.

This item shall also include the following:

- Excavations, cutting and filling;
- Any dewatering or temporary diversions of the stream to facilitate the construction;
- supply and placement of 0.3m Granular "B" under structure, as directed by the Engineer;
- Supply and placement of armour stone as shown on the drawings;
- Supply and place geotextile material;
- Supply and place 40 - 200mm filter stone;

all as required to complete the construction of the armour stone retaining walls.

Armour stone shall be quarried stone of sound rock. The armour stone shall be "hand picked" by the Engineer and the Contractor on site. The stones will be selected on the basis of their rectangular shape to facilitate assembly in the desired shape, soundness and size. The stone shall have the approximate dimensions of 1.0m in height, 1.0 metre in width and 1.2 to 1.5metres in length. Each armour stone shall weigh a minimum of two (2) tonnes to a maximum of four (4) tonnes.

The armour stones shall be individually placed using equipment large enough to lift and adjust the stones.

Payment shall constitute full compensation for all labour, material and equipment, filter stone, backfill, filter cloth, grading etc. required to complete this work including the selection of the armour stone.

Geotextile shall be placed in a manner so that it is free of any folds, tears and wrinkles and all seams shall be overlapped a minimum of 500mm and pinned to prevent sliding during installation. On slopes, the upper portion of the geotextile shall be fixed to a depth of 0.30m to prevent sliding during installation. The geotextile should be a nonwoven, polyester, Class II product with the filtration opening of 20 - 100 microns, meeting OPSS 1860 requirements.

The filter stone shall be graded with stone ranging from 40 to 200mm in size with sufficient larger stones to block the voids in the armour stone. The larger voids are to be blocked with stones that are hand placed and the remaining stone shall be placed by machine when the larger voids are blocked.

1.14 Rip-Rap – 0.3m in Depth

The price per square metre for this item shall be all inclusive and shall include all labour and material necessary to hand place the rip-rap as directed on the engineering drawings.

Included in this item shall be a geotextile material where the Bentofix geosynthetic clay liner is not being used. The geotextile material shall be placed in a manner as to be free of any folds, tears and wrinkles and all seams shall be overlapped a minimum of 500mm and pinned to prevent any sliding.

The geotextile should be a nonwoven, polyester, Class II produce with the filtration opening of 20 - 100 microns meeting OPSS 1860 requirements.

1.15 Martek Grasspave^2 for Sediment Forebay

The unit price bid per square metre shall be all inclusive and shall include the supply of all materials, labour, and equipment necessary to place the Martek Grasspave^2 as detailed on the engineering drawings. Under the previous contract the sediment forebay was pregraded in preparation for the Martek Grasspave^2. Prior to the installation the contractor is responsible for the following:

- Fine grading of sediment forebay and removal of vegetation.
- Place and compact 200mm of Granular "A".
- Install Martek Grasspave^2 as per manufacturer's specifications.
- Fill voids in Martek Grasspave^2 with native topsoil material approved by engineer.
- Reinstatement of existing features as directed by the engineer.

1.16 Bentofix Geosytnthetic Clay Liners

The unit price bid per square metre for this item shall be all inclusive and shall include the supply of all materials, labour, and equipment necessary to install the geosynthetic clay liner as shown on the engineering drawings.

Prior to the installation, the Contractor shall prepare the subgrade prior to the Bentofix clay liner being deployed. The subgrade should consist of a minimum of 200mm of native soil, free of rock, roots and debris larger than 50mm in size. The subgrade shall also be compacted to 95% Standard Proctor Density. In no case shall the Bentofix geosynthetic clay liner be placed directly on bedrock. Prior to installation of the clay liner, the subgrade shall be inspected and accepted by the Engineer.

Once the Bentofix geosynthetic clay liner has been deployed, it shall be covered with a minimum of 6" of native soils and rolled leaving a smooth consistent surface.

Under no circumstances shall the Bentofix clay liner be left exposed to the weather. All clay liner installed shall be covered with proposed overlying soils prior to the end of the working day.

1.17 Seeding of Channels and Stormwater Management Pond

The Contractor shall prepare the sub-base including placement of 80mm of topsoil, seed and fertilize and maintain the surface. Seed shall be spread by means of a mechanical seeder and at the rate of 20kg per hectare. The seed shall be spread in two intersecting directions and shall be worked into the top 25mm of topsoil by raking or harrowing and compacting so that the surface is smooth and firm.

After seeding, the topsoil shall be watered to ensure germination. The seed mix shall be as follows:

- 50% barren Kentucky Bluegrass;
- 30% turf type fescue;
- 20% turf type perennial rye.

1.18 3.0m and 1.19 6.0m Maintenance Accesses

The unit price bid per square metre for the 3.0m wide and 6.0m wide maintenance accesses shall be all inclusive and shall include the supply of all labour and materials and equipment necessary to construct the accesses Under the previous contract the walkways were pregraded. Under this item the contractor is responsible to remove any vegetation from these areas and fine grade and compact the subgrade in preparation of the granular material. Once graded, 450mm of Granular "A" will be placed, graded, and compacted to 100% SPD. Included under this item will be 40mm of HL-8 asphalt.

1.20 Sedimentation Control

The lump sum bid for this item shall be all inclusive and shall include all sedimentation control as shown on the engineering drawings. The Contractor, under this item, shall maintain all the

sedimentation devices to the satisfaction of the Engineer. It is intended that these devices be in place prior to any work taking place.

1.21 1.8m Chainlink Fence

The per metre price for this item shall be all inclusive and shall include the supply of all labour, material and equipment necessary to construct a chainlink fence according to OPSD 900.01 and the engineering drawings.

1.22 Single Swing Gate

The unit price bid for each of these items shall be all inclusive and shall include the supply of all labour, material and equipment necessary to install a single swing gate per OPSD 900.02 as shown on the engineering drawings. The Contractor is also responsible for installing locks on each gate and delivering the keys to the local authority as directed by the Engineer.

1.23 Double Swing Gate

The unit price bid for each of these items shall be all inclusive and shall include the supply of all labour, material and equipment necessary to install a double swing gate per OPSD 900.03 as shown on the engineering drawings. The Contractor is also responsible for installing locks on each gate and delivering the keys to the local authority as directed by the Engineer.

1.24 Light Standard "Nitetorch 1"

The unit price bid, each, for this item shall be all inclusive and shall include the supply of all labour, material and equipment necessary to install pole bases, poles and Nitetorch1 NRG-G21SP2 luminaries according to the manufacturer's specifications and the engineering drawings.

1.25 Adjust Sanitary Manhole

The unit price, each, for this item shall include the supply of all labour, material and equipment to adjust manholes according to the engineering drawings and place a watertight frame and cover per OPSD 401.03.

1.26 Landscaping

The plantings shown on the drawings required for the deep water area, shallow water areas, flood fringe areas and upland areas will be reviewed and itemized upon completion of the construction of the detention ponds in consultation with the Quinte Conservation Authority and the City of Belleville. An allowance has been made in the Contract, however, this shall be considered a "provisional" item and shall not be used unless directed by the Engineer in writing. It is the intention to obtain separate quotes for this portion of the work once the extents have been more clearly itemized and defined.

APPENDIX "K"

Drawings