Functional Servicing Report Manning Road Secondary Plan Area Town of Tecumseh

Revised April 2015

"Minor Revisions Were Made Subsequent to May 26, 2015 (Date of the Statutory Public Meeting for the Area Specific Development Charge By-Law) to Reflect the Watson & Associates Economists Ltd. Office Consolidation, MRSPA Area-Specific Development Charge Background Report, October 13, 2015"

Corporation of the Town of Tecumseh

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1.0 INTRODUCTION

1.1 General

The Town of Tecumseh has been undertaking various studies that support their ongoing efforts to complete a Secondary Plan that will establish a framework for development of the Manning Road Secondary Plan Area (MRSPA). This area is approximately 100 hectares in size, and is bounded by Essex County Road 22 to the north, Manning Road (Essex County Road 19) to the east, Canadian Pacific Railway to the south, and existing residential development to the west, as shown in ***Figure 1.0 - Study Area***.

This report outlines the functional design for the following municipal infrastructure required to service the development of the MRSPA:

1. The sanitary sewage collection system, including pumping station;
2. The storm sewer collection system;
3. Overland drainage and site grading;
4. Stormwater management facility, including pumping station; and
5. Watermain network.

This report is expected to serve as a guideline for the Town, regulatory agencies, and land owners and developers to facilitate the orderly servicing of this area. Factors affecting the servicing of these lands include:

- Market conditions;
- Ability of land owners and developers to assemble lands of appropriate size to finance the needed infrastructure and enter into land owner agreements;
- Servicing costs;
- Proximity to sanitary and storm outlets;
- The Town's implementation of improvements to the existing sanitary sewer system to create the additional capacity necessary to fully accommodate the sanitary drainage requirements of the MRSPA under wet weather conditions;
- Proximity to a suitable potable water supply system; and
- Feasibility and approval of any interim measures for stormwater management.

Based on the functional servicing strategy developed in this report, estimates of probable construction costs were identified for the oversizing portion of the noted municipal infrastructure. These oversizing costs are intended to form the basis for area-specific development charges that will be applicable to all developments that take place within the Manning Road Secondary Plan Area (MRSPA).

1.2 Summary of Updates Reflected in the MRSPA Functional Servicing Report

Since the completion of the initial draft report (dated November 2012) that was presented at a public meeting that was held on December 11, 2012, various activities have taken place that resulted in additional time being required to update and finalize this Functional Servicing Report, including:

- Meetings were held with several of the local developers to review various development and site servicing proposals;
- Alternative servicing and grading strategies were presented by various developers, followed by detailed reviews and follow-up discussions to confirm the Town's position;
- Review of detailed development submissions; and
- Completion of additional engineering and Class Environmental Assessment studies to refine the functional servicing strategy.

The following updates affecting the functional design and area-specific project cost estimates have now been incorporated in this report.

1.2.1 Functional Design Updates

1. Alternatives to the functional design of the storm and sanitary collection systems, stormwater management facility, and site grading were presented on behalf of various developers in the MRSPA. In general, consideration of these alternatives resulted in the following updates to the functional design:

    - Refinement of the proposed site grading to allow up to a 400 mm grade difference along the rear yards of the existing homes on Funaro Crescent and Charlene Lane that back onto the southwest portion of the MRSPA; and

- Allowable use of manhole tees in place of conventional manhole structures for junctions in the storm sewer system that have a straight-through trunk sewer alignment and small diameter (750 mm diameter or less) lateral storm sewer connections.

2. The Town of Tecumseh has recently implemented a Town-wide standard for the installation of sewage ejector pumps for drainage of basement plumbing in all new developments, including the MRSPA. This standard was implemented to reduce the risk of basement flooding as a result of sanitary sewer surcharging that is known to occur during more extreme wet weather conditions. In light of the Town's requirements for sewage ejector pumps, the depth of cover for sanitary private drain connections at the property line has been reduced to 1.5 m, providing greater flexibility in addressing servicing conflicts.

3. The Town of Tecumseh identified an opportunity to incorporate the Baillargeon Drain drainage area within the MRSPA stormwater management facility without significantly altering the design of this facility. This would eliminate the need to enclose the Baillargeon Drain by incorporating these flows within a slightly larger diameter trunk storm sewer outlet to the MRSPA stormwater management facility, resulting in:

   - A notable reduction in servicing costs for the MRSPA;
   - The opportunity to control stormwater quality for the Baillargeon Drain, thereby allowing a normal level of quality control; and
   - Downstream benefits to the East Townline Drain under both existing conditions, as well as for the future enclosure of this drain.

   A Class EA Addendum Report was completed by the Town in December 2014. The Addendum Report was finalized in April 2015 to reflect public and agency input during this process, thereby formalizing this change. In particular, the Essex Region Conservation Authority requested further detailed hydrodynamic modelling to evaluate the related overland drainage and surface storage requirements for the MRSPA. The results of this additional modeling now provide more specific requirements for the functional design of the following:

   - Surface storage;
   - Inlet control restrictions; and
   - Allowable overland flow outlets.

These overland drainage criteria have now been incorporated as part of this Functional Servicing Report.

4. As a result of a more detailed evaluation of the existing Baillargeon Drain storm sewer system, it became evident that the northerly portion of this existing drainage area was to be directed through the MRSPA storm sewer system at Gouin Street. A 900 mm diameter storm sewer stub was previously constructed on Gouin Street at Lesperance Road for this purpose. The design of the MRSPA storm sewer system was updated accordingly.

1.2.2 Area-Specific Development Charges Updates

1. Following the December 2012 public meeting, Ray Bower Appraisal Services Inc. was retained by the Town to provide a sample and subsequent statistical analysis of detached single family residential building site prices, as outlined in their report entitled "Residential Building Site Prices 2009-2013", dated September 2013. This report served as a starting point to determine a fair and reasonable valuation for the lands upon which the proposed stormwater management facility will be located. A summary from this report can be found in ***Appendix D – Land Valuation Cost Analysis***. An update to the 2013 land valuation was subsequently completed by Ray Bower Appraisal Services Inc., and is outlined in their letter report dated April 30, 2015, which is also included in ***Appendix D – Land Valuation Cost Analysis***.

   A copy of the calculation table and supporting rationale that was used to arrive at the revised stormwater management facility land value and associated area-specific project cost estimates included herein.

2. The construction of roads external to the development lands that involve the extension of Jamsyl Drive, Street 'A' (opposite the Sylvestre Drive exit ramp from County Road 22) and Gouin Street to provide improved connectivity between the MRSPA and the external road network has been identified as an area-specific benefit. Accordingly, these roadway extensions and associated underground infrastructure improvements have been incorporated in the revised area-specific project cost estimates.

The associated land acquisition costs for the Jamsyl Drive and Street 'A' right of ways beyond the boundaries of the MRSPA have also been included in the revised area-specific project cost estimates. The valuation of these lands was undertaken by Ray Bower Appraisal Services Inc., as outlined in their report entitled Land Prices in Sylvestre Business Park, dated January 2015, which can be found in ***Appendix D – Land Valuation Cost Analysis***.

3. Additional studies have been completed to address the area-specific development requirements for the MRSPA. The area-specific project cost estimates have been updated to include fee estimates for a more complete list of related studies, including land valuation, legal, financing and engineering.

4. Based on further review, it was determined that an emergency back-up power supply would be required for both the proposed sanitary and stormwater pumping stations. The area-specific project cost estimates have been updated to reflect this change.

5. The enclosure of the East Townline Drain has been removed from the shareable cost, as it was determined that this enclosure is not necessary to accommodate development within the MRPSA.

6. The proposed storm sewer system, including elimination of the previously proposed enclosure of the Baillargeon Drain, has been updated to reflect the revisions outlined in the final Class EA Addendum Report for the MRSPA stormwater management facility, dated April 2015. The area-specific project cost estimates have been correspondingly updated.

7. Provisions for a temporary open channel and stormwater pump station to serve as an interim stormwater outlet solution (in place of the permanent trunk storm sewer system) have been removed from this report.

8. As a result of a more detailed evaluation of the existing Baillargeon Drain storm sewer system, the Town confirmed that the northerly portion of this drainage area was to be directed through the MRSPA storm sewer system at Gouin Street. The area-specific project cost estimates have been updated accordingly.

1.3 Background

In 1972, the Ministry of the Environment ordered the former Township of Sandwich South to service its Tecumseh Hamlet area with a sanitary sewer system under the provisions of the Ontario Water Resources Act. These boundaries were identified by Township Council and included lands south of County Road 22, east of Banwell Road, north of County Road 42 and west of Manning Road. The initial stages of the sanitary sewer system were completed in 1976. Sanitary sewers have since been added as development occurred.

In the early 1980's, additional lands beyond the original sanitary sewer service area (to the south of County Road 42) were proposed to be developed. Based on the findings of a feasibility study, an expansion of the sanitary sewer drainage boundary was approved and these lands were developed through the 1980's.

In 1990, the Town of Tecumseh completed a feasibility study for the expansion of the Tecumseh Hamlet sanitary sewer system to accommodate the MRSPA lands based on proposed light industrial land uses. In October 1996, the Manning Road Secondary Plan, Conceptual Plan and Servicing Report was completed to provide a basis for discussions with Council, property owners, residents and applicable agencies regarding the development of this area. Land use designations, population densities and servicing strategies were established in this report.

In June 2002, the Town completed a Water and Wastewater Master Plan that included the MRSPA. The latest revision to this Master Plan was completed in 2008. A financial plan update was completed in 2010 (refer to ***Appendix G***) that also included further revisions to specific water and wastewater projects, but these revisions were not formally incorporated as part of the Town's Master Plan.

In 2010, Dillon Consulting Limited (Dillon) completed a Class Environmental Assessment Study confirming that the preferred solution for addressing the required stormwater drainage needs of the MRSPA would consist of a regional stormwater management facility at the southerly limits of these lands. A Class EA Addendum was completed in April 2015 confirming the preferred alternative of incorporating the Baillargeon Drain in the proposed MRSPA stormwater management facility, including the confirmation of additional functional design criteria related to the overland drainage requirements.

In August 2011, the Town retained Dillon to undertake this Functional Servicing Report to confirm the site servicing requirements for the MRSPA related to storm and sanitary collection, and water distribution infrastructure, including confirmation of the corresponding estimated oversizing costs.

The following studies/reports were referenced during the completion of this Functional Servicing Report:

- Corporation of the Township of Sandwich South, Feasibility Study for the Expansion of the Tecumseh Hamlet Sanitary Sewer System (July 1990);
- Manning Road Secondary Plan, Conceptual Plan and Servicing Report (October 1996);
- Town of Tecumseh, Water and Wastewater Master Plan Update, Class EA Report (July 2008);
- Tecumseh Hamlet Traffic Study, Updated Interim Final Report (August 2008);
- Town of Tecumseh, Sandwich South Official Plan (Consolidated December 2008);
- Ministry of Transportation, County Road 19 (Manning Road) & County Road 22 Improvements, Environmental Study/Preliminary Design Report (Final Draft) (September 2008);
- Ministry of Transportation, Ontario Corporation of the County of Essex County Road 19 (Manning Road) & County Road 22 Improvements, Drainage and Hydrology Final Report (September 2008);
- Town of Tecumseh, Water and Wastewater Master Plan, Revised Water and Wastewater Servicing Strategy (April 2010) (***Appendix G***);
- Manning Road Secondary Plan Area, Stormwater Management Study, Class EA Environmental Study Report (April 2010);
- Tecumseh Hamlet Sanitary Sewer Flow Monitoring and Modeling Updates- Summary of Work Completed (Dec 2010) (***Appendix E***);
- Tecumseh Sanitary Modeling Update and Gouin Development Memo (2013) (***Appendix F***);
- Tecumseh Hamlet Secondary Plan Transportation Study, Final Report (January 2015); and
- Manning Road Secondary Plan Area, Stormwater Management Study, Class EA Addendum Report (April 2015).

1.4 Goals and Objectives of the Functional Servicing Report

The goals and objectives of this Functional Servicing Report are to:

1. Determine the servicing requirements for the development of the MRSPA, including confirmation of the design criteria for the required municipal services (stormwater management pond, storm sewers and overland drainage, sanitary sewers and watermains) that are to be used to complete the detailed design of this infrastructure;

2. Undertake a functional design of these facilities to satisfy the long range servicing needs of the planning district and provide a framework to facilitate the servicing of the MRSPA in an orderly manner; and

3. Estimate the shareable portion of the cost to implement access road extensions, a stormwater management facility, and sanitary collection infrastructure that would form the basis for an area-specific development charges study.

1.5 Land Ownership

As part of this study, it is anticipated that development of the subject lands will require the cooperation among the land owners. ***Figure 2.0 - Property Owners*** identifies the current land ownership within the MRSPA.

Every effort has been made to ensure that the functional design of the municipal infrastructure provides flexibility to accommodate the staged development of these lands. Since it is not possible to anticipate how development of these lands will take place as a result of market conditions, changes in land ownership, and other issues that may arise, temporary servicing measures may be deemed appropriate. The acceptability of any temporary servicing measures will be determined by the Town and regulatory agencies, while ensuring that the overall functional design of these services is not compromised.

2.0 STUDY AREA

2.1 Manning Road Secondary Plan Area (MRSPA)

The study area generally lies south of County Road 22, extending southerly to the Canadian Pacific Railway, and lies east of the existing residential Tecumseh Hamlet and west of Manning Road (County Road 19), as previously shown in ***Figure 1.0 - Study Area.***

2.2 Existing Land Uses

Currently, all of the undeveloped lands within this study area comprise agricultural uses and vacant property.

The existing land uses surrounding this undeveloped land include:

- Residential lands to the west;
- Industrial lands to the northeast;
- Commercial lands to the northwest;
- Railway lands to the south;
- County of Essex right-of-way to the north (County Road 22) and east (County Road 19); and
- Light industrial lands to the east (within the Town of Lakeshore).

2.3 Sandwich South Official Plan

This Functional Servicing Report generally conforms to the Sandwich South Official Plan, consolidated December 2008, any modifications to which would necessitate reconsideration of the functional servicing design (i.e. sanitary sewer capacity, stormwater runoff coefficients, population density, etc.).

2.4 Proposed Land Use Plan

Lands situated within the MRSPA are proposed to be developed as described below, and as summarized in ***Table 2.1: Proposed Land Use Areas in the Manning Road Secondary Plan Area.***

- ***Figure 3.0 - Proposed Land Use*** illustrates the proposed land uses based on the Sandwich South Official Plan;
- The MRSPA primarily consists of relatively large parcels of land that are currently owned by various individuals and/or corporations; and
- Immediately south of the Sylvestre Industrial Park, two parcels of land have been severed and zoned for institutional purposes.

Table 2.1: Proposed Land Use Areas in the Manning Road Secondary Plan Area

PROPOSED MRSPA LAND USES	AREA (Ha)	% TOTAL AREA
Residential	79.04	80.5%
Commercial	3.0	3.1%
Parkland	4.26	4.3%
Stormwater Management Facility and Pump Station	6.8	6.9%
Institutional	5.10	5.2%
Total	98.2	100 %

2.5 Soil Conditions/Characteristics

According to a soil survey conducted by the Department of Soils, Ontario Agricultural College, Guelph (1939), the soil conditions found within the MRSPA consists mainly of Brookston Clay, which are generally characterized as dark clay over mottled clay then blue-grey compact gritty clay with few stones. Within the northwest corner of the MRSPA, Brookston Clay Sand Spot Phase is identified, which may consist of mixed areas of shallow sand knolls less than 1 metre in thickness, over clay, intermixed with Brookston Clay and Clay Loam.

It should be noted that the cost estimates used to determine the area-specific project costs were generally based on the soil characteristics expected in this area.

Detailed soil investigations were not completed as part of this Functional Servicing Report. The developers/land owners will be responsible for soil investigations as part of the detailed design process for each phase of this development in order to determine the detailed design and construction requirements for servicing and pavements.

2.6 Topography

As identified in ***Figure 4.0 - Existing Land Topography***, lands to the south of the Baillargeon Drain slope easterly to the East Townline Drain (ETLD) along the west side of Manning Road. The existing residential lands to the west have been raised by as much as 1.2 metres to provide for sufficient cover on the sanitary sewer system, and also generally slope in an easterly direction.

Lands to the north of the Baillargeon Drain generally slope northerly to the Cyr Drain, which ultimately discharges to the East Townline Drain.

3.0 SANITARY DRAINAGE

3.1 General

The Tecumseh Hamlet Area of the Town of Tecumseh is served by a sanitary sewage collection system that directs sewage flows to the Little River Pollution Control Plant in the City of Windsor. The original system was installed in the 1970's as part of a Provincial Sewage Works Program by the Ministry of the Environment.

In 2008, the Town of Tecumseh constructed a sanitary relief sewer on County Road 22, which intercepts the Lesperance Road trunk sanitary sewer and diverts the sewage flows from the Tecumseh Hamlet area to the new sanitary sewer outlet on Banwell Road, thereby relieving the Lesperance Road sanitary sewer north of County Road 22. A sluice gate, located in the sanitary sewer at Lesperance Road and County Road 22, currently diverts 100 percent of the sewage flows from the Tecumseh Hamlet area westerly into the sanitary relief sewer. This sluice gate may be adjusted to allow a portion of the Tecumseh Hamlet sewage flows to be re-introduced to the Town's sanitary sewer system north of County Road 22, as deemed appropriate.

In 2012, the Town of Tecumseh constructed a secondary 600 mm diameter sanitary sewer on Lesperance Road from County Road 22 to Westlake Drive, located parallel to the existing 600 mm diameter sanitary sewer. This new 600 mm diameter sanitary sewer is intended to serve as an interim means of conveying additional flows from the MRSPA to the sluice gate at the intersection of Lesperance Road and County Road 22, at which point the sluice gate may be adjusted to allow a corresponding amount of flow to be directed north. The short term servicing opportunities based on the capacity limitations of the existing sanitary sewer system, as well as the long-term improvements necessary to accommodate the complete servicing of the MRSPA are described in further detail in Section 3.3 of this report.

3.2 Sanitary Sewer Design Criteria

In order to establish the proposed sanitary sewer sizes, the following design criteria were selected for the purposes of this Functional Servicing Report. These design criteria are in accordance with generally accepted engineering practice and reflect current Town of Tecumseh standards (2008 Water Wastewater Master Plan) and Ministry of the Environment and Climate Change guidelines.

SANITARY SEWER DESIGN CRITERIA

- Minimum sewer size = 200 mm diameter
- Minimum cover of sanitary private drain connections at property line = 1.5 metres (associated with sewage ejector pumps for basement plumbing)
- Minimum pipe slopes = See table below

Sewer Size (mm)	Minimum Slopes in Metres per 100 metres
200	0.40
250	0.28
300	0.22
375	0.15
400	0.14
450	0.12

- Minimum Full Flow Velocity = 0.6 m/s
- Maximum Full Flow Velocity = 3.0 m/s
- Hydraulic Losses across manholes:
  - Straight through 20 mm
  - 45 degree bend or less 30 mm
  - 45 degree to 90 degree bend 60 mm
- Hydraulic sewer sizing using Manning's Equation
- Manning's Roughness Coefficient 'n' = 0.013
- Infiltration allowance/peak extraneous flow = 0.19 L/Ha/s (16,415 L/Ha/day)
- Peaking factor based on the Harmon Formula

- Population densities = See table below
- Average daily domestic sewage flow = 300 L/Cap/Day

Proposed Land Use	Population Densities
Commercial (1)	93.3 persons/Ha
Institutional/School (2)	Site Specific
Park/Open Space (3)	0 persons/Ha
Residential	2.8 persons/unit, 15 units/hectare

1. Commercial population density is based on MOE&CC Design Guidelines for Sewage Works (2008).
2. Population density of institutional/school area shall be established prior to development based on the capacity of the Sylvestre sanitary sewer system and pumping station.
3. No washroom facilities considered for the park land.

3.3 Proposed MRSPA Sanitary Servicing Strategy

The sanitary sewer servicing strategy identified in the Town of Tecumseh's Water Wastewater Master Plan (2008) recommended that the south portion of the MRSPA (south of the Baillargeon Drain) would be directed to a proposed East Tecumseh Trunk Sewer outlet, to be located along the CPR tracks to the south. In order to facilitate sanitary servicing of the MRSPA, the Town subsequently considered the alternative of including these southerly MRSPA sewage flows as part of the Lesperance Road sanitary sewer at Westlake Drive. This revision to the sanitary servicing strategy was confirmed in an April 2010 Water and Wastewater Servicing Review, as illustrated in ***Appendix G***, and now forms the basis for the functional design of the sanitary sewer system in the MRSPA.

3.3.1 Long-Term Sewage System Capacity Considerations

The existing 600 mm diameter sanitary sewer on Lesperance Road and the downstream sanitary relief sewer on County Road 22 currently do not have sufficient capacity to accommodate the ultimate sanitary flows that are expected to result from the complete development of the MRSPA. There are short-term strategies available to accommodate a substantial portion of the MRSPA development, as outlined in Section 3.3.2, but as the sanitary flows approach the limit of what may be reasonably accommodated, the following long-term sanitary servicing solution could be implemented by the Town:

- Continued efforts to eliminate excess extraneous flows from the sanitary sewer system; and

- Diversion of sanitary flows from the Lesperance Road sanitary sewer to the proposed West Tecumseh Hamlet trunk sanitary sewer, as illustrated in ***Figure 5.0 – Tecumseh Hamlet Sanitary Drainage Ultimate Servicing Strategy***.

These longer-term sanitary sewer system improvements have previously been identified as part of the Town's 2010 Water and Wastewater Servicing Review (see ***Appendix G***), and are now being further evaluated and formalized by the Town as part of a separate Class Environmental Assessment process for the Tecumseh Hamlet Secondary Plan Area that is currently underway. Subject to completion of the Class EA requirements, these longer-term improvements may be implemented to allow the complete development of the MRSPA to take place.

The extension of the sanitary collection system within the MRSPA may be undertaken by private developers as a condition of approvals under the Planning Act, based on which individual site servicing may proceed as Schedule A projects, as defined in the Municipal Class Environmental Assessment process.

The proposed MRSPA sanitary sewer system is illustrated in ***Figure 6.0 - Sanitary Outlets and Drainage Areas***.

3.3.2 Short-Term Sanitary Servicing Opportunities

In the short-term, and prior to the implementation of the Tecumseh Hamlet sanitary sewer system improvements outlined in Section 3.3.1 of this report, it has been confirmed that there are opportunities to accommodate a substantial degree of development within the MRSPA. Based on a hydraulic analysis of the Town's existing sanitary collection system, the basis for the short-term servicing solution lies in the flexibility to direct a limited amount of sanitary flows to the Lesperance Road sanitary sewer north of County Road 22 by adjusting the existing sluice gate, as outlined in a memo that has been included in ***Appendix F*** of this report.

Based on the existing sanitary sewer system conditions, it appears that the following short-term opportunities to accommodate additional sanitary flows exist, subject to allowing a corresponding amount of sanitary flows to be directed northerly by making adjustments to the sanitary sluice gate at Lesperance Road and County Road 22:

- A limited sanitary flow may be discharged directly to the 600 mm diameter sanitary sewer on Lesperance Road at the Gouin Street outlet, as outlined in ***Appendix F***; and

- The twin 600 mm diameter sanitary sewer on Lesperance Road between Westlake Drive and County Road 22 may accommodate limited sanitary flows from the MRSPA, including the proposed upgrading of the Sylvestre sanitary pump station.

Brief descriptions of the short-term sanitary servicing opportunities are outlined below.

3.3.2.1 Gouin Street Sanitary Sewer Outlet

The existing 375 mm diameter Gouin Street sanitary sewer is proposed to serve as the sanitary outlet for an 8.98 hectare residential development in a portion of the MRSPA, as shown on ***Figure 6.0 - Sanitary Outlets and Drainage Areas.***

A hydraulic analysis of the existing Tecumseh Hamlet sanitary collection system was completed by the Town to confirm the impact of this additional flow, particularly under wet weather conditions that have historically resulted in sewer surcharging. A copy of the memo outlining the results of this updated modelling is included in ***Appendix F***.

In order to accommodate these additional sewage flows in the Lesperance Road sanitary sewer, the recommended short-term measures involve:

- Diverting a maximum of 20 l/s of Tecumseh Hamlet sewage flows to the north of County Road 22 by adjusting the sluice gate at the intersection of Lesperance Road and County Road 22; and
- Installing the sanitary private drain connections in this development at an elevation of 180.84 m, or at a depth of cover of 1.5 m (whichever governs), to reduce basement flooding risks. The intent is to require the use of sewage ejector pumps, thereby eliminating gravity drainage of basement plumbing. This elevation was determined based on modeling that was completed to confirm the hydraulic grade line elevations under a design wet weather event. This is consistent with the Town's recent policy requiring the use of sewage ejector pumps for all new developments.

Subject to the implementation of these recommendations, sanitary servicing of the 8.98 hectare portion of the MRSPA through the extension of the Gouin Street sanitary sewer may be undertaken by private developers as a condition of approvals under the Planning Act, based on which these works would be considered Schedule A projects, as defined in the Municipal Class Environmental Assessment process.

3.3.2.2 Westlake Drive Sanitary Sewer Outlet

The existing 450 mm diameter sanitary sewer on Westlake Drive discharges to twin 600 mm diameter sanitary sewers on Lesperance Road, which drain northerly towards County Road 22 where a sluice gate is available to manually control the split in sewage flows between the County Road 22 diversion sewer to the west and the Lesperance Road sanitary sewer to the north. At the moment, the sluice gate directs 100 percent of the Tecumseh Hamlet sewage flows to the County Road 22 sanitary diversion sewer.

a) MRSPA Development

As noted, a substantial portion of development in the MRSPA may be accommodated in the short-term by adjusting the sluice gate to allow a corresponding amount of sewage flow to be directed northerly to the Lesperance Road sanitary sewer. General hydraulic modeling results are included in ***Appendix F***, though it is recommended that additional hydraulic modeling of specific MRSPA development proposals should be completed by the Town to reconfirm the allowable sluice gate adjustments that may be permitted.

As part of updated hydraulic modeling, the benefits arising from the Lakewood sanitary pump station and sanitary surcharge storage sewer currently being implemented by the Town across Lakewood Park should be confirmed. These improvements are expected to result in attenuation of wet weather flow conditions in the downstream Little River sanitary sewer and Cedarwood pump station outlet, and may provide opportunities to accommodate additional flows that may be directed north of County Road 22 from the MRSPA development.

It should also be recognized that the Lakewood sanitary pump station at Manning Road and Little River Boulevard is currently proposed to operate at a peak discharge rate of 225 litres per second, which is 15 percent more than the capacity of the previous Hayes sanitary pump station (195 litres per second), resulting in a flow increase of approximately 30 litres per second. This may have an impact on the sanitary flows that are allowed to be directed northerly at the County Road 22 sluice gate. If required, there are opportunities to adjust the Lakewood pump station discharge back to the previous capacity of the Hayes sanitary pump station to accommodate additional flows from the MRSPA.

b) Sylvestre Sanitary Pump Station Outlet

The institutionally zoned lands north of the Baillargeon Drain and east of Street A were included in the design sanitary drainage area for the existing 250 mm diameter sanitary sewer on Sylvestre Drive and the Sylvestre sanitary pumping station outlet. The Sylvestre sanitary pump station currently has a capacity of approximately 11 L/s, though it has been designed to accommodate future improvements to realize its ultimate design capacity is 32 L/s.

Any proposed upgrades to the Sylvestre sanitary pump station to improve its current discharge capacity should be evaluated through additional hydraulic modeling assessments of the existing sanitary sewer collection system to confirm the allowable adjustments to the sluice gate at County Road 22.

In the short-term, it may be possible to accommodate the sewage flows from the proposed institutional lands within the existing Sylvestre Industrial Park sanitary collection system, subject to confirmation of the available sanitary sewer capacity.

In the long-term, the Sylvestre sanitary pump station may be upgraded to its ultimate design capacity, including provisions for stand-by power, and the existing 150 mm diameter forcemain that now discharges to the twin 600 mm diameter Lesperance trunk sewer through an easement may be incorporated into the MRSPA sewage flows at the Westlake Drive sewer outlet.

3.4 MRSPA Sanitary Drainage Functional Design

The functional design of the MRSPA trunk sanitary sewer system is illustrated in ***Figure 6.0 - Sanitary Outlets and Drainage Areas***. The detailed sewer design calculation sheets and detailed sewer layout (***Figure A1 - Detailed Sanitary Sewer Layout***) have been included in ***Appendix A – Sanitary Sewer Plan and Design Sheets.***

The proposed sanitary sewers range in size from 200 mm to 450 mm diameter. Sewer invert elevations and gradients were designed to ensure proper drainage of the entire MRSPA subject to the constraints outlined above.

It should be noted that while conflicts between the sanitary and storm sewers were assessed, a re-evaluation of these conflicts should be performed for any proposed changes to the sewer alignments and/or invert elevations outlined in ***Appendix A and B***.

3.5 Sanitary Private Drain Connections

The profile of the proposed sanitary sewer system is dictated by the available sanitary sewer outlet elevations, conflicts with other municipal infrastructure, and the proposed site grading. The Town of Tecumseh has recently implemented a Town-wide standard for the installation of sewage ejector pumps for drainage of basement plumbing in all new developments, including the MRSPA. This standard was implemented to reduce the risk of basement flooding as a result of sanitary sewer surcharging that is known to occur during more extreme wet weather conditions.

In light of the Town's requirement for sewage ejector pumps, the depth of cover for sanitary private drain connections at the property line shall be 1.5 m. The sanitary sewer system functional design was based on a minimum cover of 2.4 metres to provide a degree of flexibility, though less cover could be considered for upstream portions of local sewers, where appropriate.

3.6 Sanitary Pump Station

In order to achieve appropriate sanitary sewer depths, it was determined that a sanitary pumping station (PS) would be required to serve the southern portion of the MRSPA. The proposed location of the sanitary PS is within the future park lands at the intersection of Street A and Street B, as shown in ***Figure 6.0 - Sanitary Outlets and Drainage Areas.***

The proposed sanitary PS will consist of a 3.6 metre diameter precast concrete wet well to a depth of approximately 7.5 m below grade. The gravity inlet to the sanitary PS will include a drop pipe to introduce the sewage at the pump suction elevation, preventing air entrainment and reducing stringy solids entanglement on the pumps.

The proposed sanitary PS will include two submersible pumps, each rated for 27.1 L/s with a power draw of approximately 5 hp. One pump will operate as duty and one pump as standby. One pump will include an internal recirculation nozzle to reduce solids build-up within the wet well. Heavy duty sewage rated or chopper pumps would be recommended. The submersible pumps are to be removable without entering the station, using a rail and break-away elbow system. The check valves and pump isolation valves will be located within the station and will require confined space entry to service. A service platform and access ladder should be considered.

The proposed sanitary PS will have a stand-alone NEMA 4X control panel that will be located within 3.5 m of the sanitary PS. It is recommended that the sanitary PS be equipped with a gravity overflow as well as an emergency back-up power supply. Provisions for a SCADA interconnection and a high water level alarm are also recommended.

4.0 STORMWATER DRAINAGE

4.1 General

Stormwater collection and management systems generally consist of a network of open drains, storm sewers, pump stations, overland flood routes, and stormwater management facilities.

Under existing conditions, The MRSPA lands are served by the following drainage outlets, with corresponding stormwater drainage areas as shown in ***Figure 7.0 – Existing Stormwater Drainage Areas:***

- Cyr Drain;
- Baillargeon Drain; and
- East Townline Drain (ETLD).

The proposed storm sewer drainage and stormwater management requirements for the development of the MRSPA have been incorporated as part of this Functional Servicing Report, and described in further detail below.

4.2 Requirements for Maintaining Existing Drainage

Based on the staging of development, developers must maintain, by means of temporary or permanent measures, all existing surface and sub-surface drainage systems to ensure that runoff from any adjacent lands is directed toward appropriate stormwater outlets. Developers will also be required to mitigate any possible flooding impacts on adjacent properties. Sediment and erosion control measures must also be designed, implemented and maintained to address potential impacts during all stages of site development.

Each developer will be responsible to fully assess existing farm tile drainage systems and implement measures to abandon and remove all existing tile drains within their proposed development to eliminate the risk of flooding from these sub-surface drainage systems. This will also include all measures necessary to maintain drainage tile flows from the balance of the remaining adjacent lands by effectively intercepting and redirecting these sub-surface drainage systems to a suitable outlet.

4.3 Proposed Storm Sewer Design

The proposed storm sewers for the MRSPA were designed based on generally accepted engineering principles and current Town and Provincial standards, as described below:

Table 4.1: Storm Sewer Design Criteria

Parameter	Design Criteria
Local and Collector Roads	1:5 Year Return Period
Storm Sewer Design	Rational Method, including integration of the Baillargeon Drain based on hydrodynamic modeling.
Hydraulic Storm Sewer Sizing	Manning's Equation
Manning's Roughness Coefficient 'n'	0.013
IDF Rainfall Data	Windsor AES (MRSPA) Chicago 4 Hour Storm Event (Baillargeon Drain)
Initial Time of Concentration (T_c)	20 Minutes
Minimum Velocity	0.60 m/s
Maximum Velocity	3.0 m/s

The runoff coefficients for the MRSPA are outlined below in Table 4.2 based on the proposed land uses shown in ***Figure 3***.

Table 4.2: Runoff Coefficients

Proposed Land Use	Runoff Coefficient
Residential (1)	0.40
Commercial	0.70
Institutional – Retirement home/school	0.70
Park/Open Space	0.20

1) Assumed roof leaders and sump pumps will not be directly connected to the storm sewer.
2) Where drainage areas contain multiple land uses, a weighted average coefficient was used.

It should be noted that due to the complexity of the storm drainage system, the proposed MRSPA storm sewer design downstream of its confluence with the Baillargeon Drain was based on hydrodynamic modeling results using the Autodesk SSA model for the Chicago 4 hour, 1:5 year return period storm event. Accordingly, the MRSPA storm sewer design sheets included in ***Appendix B*** reflect the following two methodologies:

- Hydrodynamic Link Routing Method (i.e. Saint Venant Equations); and
- Rational Method Calculations.

The use of the Saint Venant equations in the Autodesk SSA model enables the computation of various dynamic flow parameters for more complex drainage systems such as this, including backwater effects, flow reversal, surcharging and looped connections.

It was determined that the design peak flow contribution from the Baillargeon Drain area would be 2600 L/s with a corresponding time to peak inflow of 101 minutes, which was incorporated in the storm sewer design sheet at its confluence with the proposed MRSPA storm sewer system at MH 77a, and continuing downstream to the outlet at the proposed MRSPA SWM facility.

The proposed MRSPA storm sewer system is shown in ***Figure B1 - Detailed Storm Sewer Layout***. The detailed storm sewer design calculation sheets have been included in ***Appendix B - Storm Sewer Plan and Design Sheets.***

The storm sewer invert elevations are based on the proposed site grading, as well as the design normal water level of the proposed stormwater management pond. Since the natural gradient of the lands are sloping toward the north (approximately 1.3 m fall from south to north), whereas the proposed storm sewers drain southerly, the trunk storm sewer outlet would be approximately 7.3 m deep at the outlet to the proposed stormwater management pond.

4.4 Drain Enclosures and Abandonments

This MRSPA is comprised of three storm drainage areas, which are served by municipal drains located within and adjacent to the study area boundary. The existing drainage boundaries and locations of these municipal drains are illustrated in ***Figure 7.0 – Existing Stormwater Drainage Areas,*** and are described in further detail below.

4.4.1 Baillargeon Drain

The existing Baillargeon Drain flows from an enclosed drain outlet at Candlewood Drive, easterly to the ETLD on the west side of Manning Road (County Road 19). As described previously, the stormwater flows from the Baillargeon Drain are proposed to be redirected to the MRSPA storm drainage system. It is proposed that alternations to the Baillargeon Drain be addressed under the Drainage Act. ***Figure 8.0 - Storm Trunk Sewer Functional Design*** illustrates the proposed enclosure and connection of the Baillargeon Drain to the MRSPA storm sewer system.

It is also important to note that as part of the Lesperance Road reconstruction in the late 1990's, the Baillargeon Drain drainage area was divided into sub-catchment areas as part of the Lesperance Road storm sewer design, with the northerly portion of this drainage area to be directed through the MRSPA storm sewer system, as shown in ***Figure 7.0 – Existing Stormwater Drainage Area***. A 900 mm diameter storm sewer stub was provided for future extension easterly on Gouin Street, through the MRSPA development to the Baillargeon Drain.

In order to address existing and interim drainage requirements as development proceeds, temporary measures may be required to maintain flows within the Baillargeon Drain. These requirements are to be identified during the detailed design stage.

The property owner/developer shall ensure that the final design and construction of the Baillargeon Drain enclosure will be coordinated and approved by the Essex Region Conservation Authority (ERCA) and other applicable regulatory agencies, as required.

4.4.2 Cyr Drain

The Cyr Drain is an open drain located approximately 300 metres east of Lesperance Road along the rear of the residential lots fronting Lesperance Road, extending from Gouin Street to the Country Road 22 right-of-way. This drain continues along County Road 22, draining easterly to the East Townline Drain at Manning Road. The drain serves the north portion of the MRSPA, as shown in ***Figure 7 – Existing Stormwater Drainage Areas***.

As development proceeds within the north portion of the MRPSA, the Cyr Drain drainage area will be reduced as stormwater flows are redirected to the MRSPA pond. Drainage of undeveloped lands must be maintained as development proceeds, including the rear yards of existing residential properties fronting Lesperance Road. As the Cyr Drain is enclosed and flows are redirected to accommodate development, the upstream portion of the Cyr Drain within the MRSPA may be abandoned under the Drainage Act.

Despite the redirection of minor system flows from the northern portion of the MRSPA to the proposed MRSPA pond, the Cyr Drain will continue to serve as a major overland drainage outlet to the allowable release rates for the 1:100 year storm event, as described in the April 2015 Functional Servicing Modelling Memo included in ***Appendix H***, and as noted in ***Figure 11***.

4.4.3 East Townline Drain

The proposed enclosure of the ETLD was outlined in the 2008 County Road 22 and Manning Road (County Road 19) Environmental Study Report (ESR) as part of the future improvement and widening of Manning Road (County Road 19). A drainage report under the Drainage Act will ultimately be required for the proposed enclosure.

The preliminary design of the ETLD enclosure in the 2008 ESR was based on the controlled 500 L/s discharge rate from the proposed MRSPA stormwater management facility, with contributing lands to the south of the CPR tracks being redirected to Pike Creek, and with the direct connection of the Baillargeon Drain to the ETLD.

As a result of the proposed drainage revisions identified herein, particularly the re-direction of the Baillargeon Drain to the proposed MRSPA SWM facility, an updated design of the ETLD enclosure will be required to reflect the ultimate stormwater strategy for this drainage area.

4.5 Proposed Stormwater Management Requirements

A Class EA Environmental Study Report was completed in 2010 entitled, Manning Road Secondary Plan Area Stormwater Management Study (Class EA Environmental Study Report). The purpose of this report was to identify the preferred design solution required to address the stormwater management needs for development of the MRSPA. Based on consultation with the public, government agencies and land owners, as well as detailed analysis of alternative solutions, it was determined that a regional stormwater management pond located at the south end of the site (north of the CPR tracks) was the preferred option.

Subsequently, the Town considered the opportunity of incorporating the runoff from the Baillargeon Drain as part of this regional stormwater management pond. This alternative was evaluated in an Addendum to the 2010 Class EA, which was finalized in April 2015 to confirm that this revision would serve as the preferred stormwater management solution for this area. As a result of feedback arising from agency consultations, particularly from the Essex Region Conservation Authority, a more detailed dual drainage hydrodynamic model was developed to evaluate the overland drainage and surface storage requirements for the MRSPA. The results of this additional modeling, which are now included in ***Appendix H - Functional Servicing Modelling Memo***, provide more specific requirements for the functional design of the following parameters:

- Inlet control restrictions into the storm sewer system during the 1:100 year event (L/s/ha);
- Required on-site surface storage requirements (m^3/ha); and
- Restricted major system overland flow rates into the downstream outlets (L/s/ha).

The detailed design of the storm drainage system for the MRSPA must incorporate this stormwater management design criteria to achieve a fully integrated drainage solution for the MRSPA, as summarized in ***Figure 11 – Development Stormwater Management Criteria***.

4.6 Proposed Stormwater Management Facility

The proposed stormwater management facility was designed to address both the quality and quantity of stormwater runoff from the MRSPA and the Baillargeon Drain drainage areas. The proposed stormwater management facility consists of a wet pond and a stormwater pump station outlet to the East Townline Drain.

The stormwater management facility is illustrated in ***Figure 9.0 – Stormwater Pond and Future CR19 Grade Separation at CPR Tracks***. It is expected that the detailed design of this facility will conform to the requirements identified in the April 2010 SWM Class EA as well as any updates identified in the subsequent April 2015 SWM Class EA Addendum report.

The proposed stormwater management facility should be constructed in no more than two (2) stages, the extents of which are to be determined based on the design requirements and direction from the Town of Tecumseh.

Based on the Environmental Study Report completed for County Road 22 and Manning Road (County Road 19), a grade separation has been proposed at the CPR tracks and Manning Road (County Road 19), which should be considered in establishing the final location of the stormwater management pond and stormwater pump station. Based on the relative implementation schedules of the stormwater pond and the grade separation works, provisions may also be required for a temporary easement to accommodate a detour road through these lands. Coordination with the County of Essex will be required for the design and implementation of this facility.

4.7 Proposed Site Grading, Overland Drainage and Surface Storage

Developers will be required to establish the proposed road grades as generally shown in ***Figure 10.0 – Proposed Site Grading for Overland Flood Route*** in order to ensure that overland flow during the 1:100 year storm even can be routed along the road and/or designated corridors to the appropriate outlets that have been identified.

For storm events beyond the 1:5 year event, sufficient surface depression storage is to be incorporated in roadways and site grading to temporarily retain this runoff volume until it can drain through the storm sewer system to the proposed stormwater management facility. During the 1:100 year storm event, overland drainage routes are to allow relief/discharge of excess runoff volume to the corresponding outlets at the Cyr Drain, East Townline Drain and the proposed MRSPA stormwater management facility, as shown in ***Figure 11 – Development Stormwater Management Criteria***.

Surface depression storage for storms up to the 1:100 year event should be limited to depths of no more than 300 mm. Developers will be required to provide grading plans and surface storage calculations that support these requirements. The storage requirements have been included as part of the updated stormwater management functional design modelling memo outlined in the MRSPA SWM Class EA Addendum Report provided within ***Appendix H***, the corresponding results of which are also summarized in ***Figure 11 – Development Stormwater Management Criteria.***

It should be noted that there is an existing grade differential at the southwest limits of the MRSPA adjacent to the existing developments that would be largely eliminated as a result of the proposed site grading. It is expected that the fill materials required to achieve the proposed site grading may be obtained from the excavation of the proposed stormwater management facility and other excess excavated materials associated with site servicing and home building. All costs associated with temporary stockpiling, placement and compaction of fill materials to achieve the proposed site grading will be the direct responsibility of individual developers, and has not been considered a shareable cost under the proposed area-specific development charge.

Geodetic Benchmarks for this area have been established, as detailed in ***Appendix C – Geodetic Benchmark Report***. These benchmarks are to be used for the detailed design and construction of developments within the MRSPA.

5.0 POTABLE WATER DISTRIBUTION

5.1 General

The Town of Tecumseh's potable water supply system is served by the Windsor Utilities Commission (WUC). The WUC system supplies the Town of Tecumseh with potable water that meets peak hourly domestic demands and fire protection, which is further supplemented by an elevated water storage tower within the Town of Tecumseh.

In order to analyze the needs of development in the MRSPA, a hydraulic model was built at a functional level of detail and integrated into an existing model of the Town's water distribution system. The Town of Tecumseh provided a water model in WaterCAD Version 4.5 format that was last updated in 2003. The model included the original Tecumseh Water Treatment Plant and high lift pumps, which have since been decommissioned. Consequently, the Town's water model required broad updates to the latest software platform, and to adjust for changes that have occurred since 2003.

The Town provided background information, including the Town's Water and Wastewater Master Plan Update, July 31, 2008, and a memo entitled Tecumseh Water Treatment Plant (WTP) Upgrades, dated August 2003, that outlined phasing options for a high lift pump. The information required to update the distribution system water demands and water supply capacities was not available for this evaluation.

5.2 Model Review

The model provided by the Town was converted to WaterCAD V8I for use in the MRSPA evaluation. The high lift pumps were incorporated in the model to simulate a minimum level of service to the distribution system. The base initial settings in the model were adjusted in order to simulate conditions that reasonably approximate current base water distribution system pressures. For this purpose, the high lift pumps in the Town's base model were activated at 100 L/s and 272 L/s both at 61m Total Dynamic Head (TDH). Although the Town no longer receives water from these high lift pumps, it is assumed that the service conditions from WUC provide overall water capacity and pressure which are equal to or exceed the previous delivery system. Required flow and pressure at the four tie-in locations to service the MRSPA were estimated based on these assumptions.

The original model provided by the Town included the following:

1. Water supply from WUC approximated with former high lift pumping station present in the base model:
    a. 2 pumps at 100 L/s @ 61 m TDH.
    b. 2 pumps at 272 L/s @ 61 m TDH.
    c. Capacities are similar to quantities provided in a memo entitled Tecumseh Water Treatment Plant (WTP) Upgrades, dated August 2003.

2. One elevated storage tank with the following water operating elevations:
    a. Minimum: 214.10 m.
    b. Maximum: 226.30 m.
    c. The Total Water Level (TWL) will be assumed at 226.30 m.
    d. The Low Water Level (LWL) (after a fire) will be assumed at 20% full, or 216.54 m.
    e. The average water level will be assumed 50% full, or 220.20 m.

3. The overall water demands applied in the model are equal to 138 L/s under average day conditions. These demands could not be compared to present actual demands but variability in actual demands is not expected to impact the required flow and pressure requirements at the MRSPA tie-in locations.

The following model updates were required in order to analyze and determine servicing requirements for the MRSPA:

- The watermain on Manning Road was extended from north of St. Gregory's Street to St. Thomas Street with a 250 mm main (as per as-built information).
- The following pipe diameters were adjusted on County Road 42 to match the Town of Tecumseh's online mapping information:
    - County Road 42 between St. Alphonse Street and Lesperance Road (changed from 150 mm diameter cast iron (CI), with roughness coefficient (C) =100 to 250 mm diameter with C=130); and
    - County Road 42 between Lesperance Road midway to Strawberry Drive (changed from 150 mm diameter CI, with C=100 to 250 mm diameter, with C=130).

- Added pipe network for MRSPA study area.
- Created element symbology for visualization of results.
- Applied proposed unit water demands for MRSPA.

Based on the above, the model was not significantly updated from the 2003 version supplied by the Town.

5.3 Design Criteria

In order to establish the required watermain sizes, the following design criteria were used. This design criteria is in keeping with sound engineering practice and represents current Town and Provincial standards.

WATER DESIGN CRITERIA

The demands are allocated on the basis of number of units (residential) or area (commercial/industrial) at a unit rate identified in the Town's Water and Wastewater Master Plan Update, Class EA Report (2008), ***Table 7.1: Water Demand Criteria***, namely:

• Residential:	347 L/capita/d
• Institutional/Commercial/Industrial (ICI):	21,430 L/ha/d (Town's Master Plan)
	28,000 L/ha/d (Recommended MOE Guideline)
• Maximum Day Demand Peak Factor:	2.0 x Average Day Demand
• Peak Hour Demand Peak Factor:	3.0 x Average Day Demand

The Master Plan ICI demand rate is less than the current MOE design guideline value of 28,000 L/ha/d (MOE, 2008). The MOE guideline value was conservatively used instead.

The Manning Road Secondary Plan Area functional design demand density is as follows:

• Low Density Residential:	2.8 persons/unit
• Residential Density:	15 units/ha
• Commercial:	93.3 persons/ha

Based on these unit rates and an overall residential area of 80.4 ha, a total of approximately 1,206 residential units were modeled in the study area. The total residential average day demand is 13.56 L/s (1,171.75 m^3/d). The commercial area is 3.2 ha with a net demand of 1.037 L/s. The institutional area is 5.2 ha with a net demand of 1.685 L/s. These demands were allocated uniformly within the hydraulic model based on the parcel information. The overall average day demand for the MRSPA is 16.28 L/s.

5.4 Model Results

The proposed MRSPA watermain pipe network was established within the proposed road alignments with 250 mm, 200 mm and 150 mm diameter watermains. Individual services were not modelled. The junction elevations were set using the Town's GIS elevation data. The study area tie-in locations to the existing water system are at the following locations:

- Lesperance Road at Westlake Drive;
- Desro Drive;
- Gouin Street at Deslippe Drive;
- Manning Road at "Street B" and
- Manning Road at "Street C".

The preferred water distribution design is depicted on ***Figure 12- Watermain Network.***

5.4.1 Steady State Conditions

The initial review suggests Average Day Demand (ADD), Maximum Day Demand (MDD) and Peak Hour Demands (PHD) can be met based on pressure from the existing elevated storage tank. The study area demands can be met for ADD, MDD, and PHD with minimum flow and pressure conditions at the study area connections to the existing system. The MRSPA is primarily serviced by Desro Drive, with other connections providing reinforcement to the MRSPA. The minimum required flow and pressure capacities are summarized in the following table.

Table 5.1: Required Study Area Connection Conditions for Average, Maximum and Peak Demands per Hydraulic Model

Study Area Connection Location	Average Day		Maximum Day		Peak Hour	
	Flow [L/s]	Pressure [kPa]	Flow [L/s]	Pressure [kPa]	Flow [L/s]	Pressure [kPa]
Lesperance Road at Westlake Drive	0.61	369.5	1.26	410.1	3.82	360.4
Desro Drive	16.86	389.0	33.71	430.5	29.64	380.4
Gouin Street at Deslippe Drive	-3.96	364.6	-7.94	402.3	3.53	353.4
Manning Road at "Street B"	3.46	368.5	6.92	405.7	7.47	355.9
Manning Road at "Street C"	-0.43	362.8	-0.89	399.2	4.65	349.5
Total Model Inflow	**16.54**		**33.06**		**49.11**	

Note: Negative flow indicates that water leaves the study area and re-enforces the existing distribution system.

5.4.2 Fire Flow

The Town of Tecumseh does not presently have a Fire Master Plan or by-law which establishes the design requirement for fire flow. Based on conversations with the Town's staff, the following thresholds were identified as desirable benchmarks:

- Residential Fire Flow: > 60 L/s
- Commercial/Institutional Fire Flow: > 150 L/s

The model evaluates fire flow in the study area by applying maximum day baseline demands throughout the system and then evaluates each junction to identify the available fire flow at 140 kPa (20 psi) residual pressure. The fire flow is evaluated with the elevated tower at an elevation of 216.54 m (20% full). This elevation is intended to reflect the available water volume following a fire. The available fire flows range from 60.8 L/s up to 276.8 L/s with a mean available fire flow rate of 160.7 L/s.

The fire flow available in the proposed commercial area along Westlake Drive is 172 L/s assuming a single 200 mm supply. This meets the threshold requirement of 150 L/s.

The residential fire flow is universally above 60 L/s and therefore meets the minimum requirement. The weakest fire flow location is a dead-end on the Deslippe Drive extension. This can be improved by "looping" the main back to the 150 mm distribution lines to the east.

The fire node that is expected to place the greatest strain on the study area water network is the institutional lands. This location is a high demand location, located farthest from the water source at Desro Drive. The fire flow requirements to meet the 149 L/s fire flow at this institutional location are summarized in the table below.

Table 5.2: Required Study Area Connection Conditions for 149 L/s Fire Flow to Institutional Location

Study Area Connection Location	Max Day + Fire Flow	
	Flow [L/s]	Pressure [kPa]
Lesperance Road at Westlake Drive	15.56	271.3
Desro Drive	68.27	293.3
Gouin Street at Deslippe Drive	27.36	246.2
Manning Road at "Street B"	38.17	189.8
Manning Road at "Street C"	33.06	174.8
Total Model Inflow	**182.42**	

5.5 Discussion

The initial review suggests ADD, MDD, and PHD demands can be met based on pressure from the existing elevated storage tower. The available fire flow in the MRSPA study area ranges from 60.8 L/s up to 276.8 L/s (mean 160.7 L/s). All fire flow requirements will require detailed analysis based on insurance requirements for specific buildings. The hydrant spacing for residential areas was not evaluated as part of this model and will require confirmation during detailed design that suitability of fire flows are met based on the Town of Tecumseh's current standards.

This initial review indicates that the proposed ICI demands can be met based on maintenance of water level in the elevated storage tower and the provision of adequate flow and pressure at the interconnections with the WUC. This evaluation was conducted on the basis of back-estimating the required flow and pressure at the study area connection points. Prior to development in the MRSPA, it is recommended that available flow and pressures at tie-in points are available and maintained.

6.0 AGENCY APPROVALS

6.1 Town of Tecumseh – Water Department

Approval for modifications to the Town's Drinking Water Works Permit is required from the Town of Tecumseh for the proposed watermains required to service the MRSPA. Town approval was not obtained as part of this report.

6.2 Ministry of the Environment and Climate Change

Ministry of the Environment and Climate Change (MOE&CC) Environmental Compliance Approvals are required for the proposed storm and sanitary sewers, pump stations, and stormwater management facility required to service the MRSPA. These approvals have not been obtained as part of this report.

The Class Environmental Assessment requirements associated with the proposed stormwater management facility, including the recent amendments to incorporate the Baillargeon Drain, have been completed by the Town, whereas these requirements related to the proposed improvements to the Tecumseh Hamlet sanitary sewer collection system are underway, but not yet finalized by the Town.

The sanitary sewer system Class EA must be finalized, including implementation of the associated improvements before sanitary servicing within the majority of the MRSPA can be undertaken, as noted in Section 3.3 of this report.

6.3 Essex Region Conservation Authority

Essex Region Conservation Authority (ERCA) was consulted throughout the development of the 2010 Manning Road Secondary Plan Area, Stormwater Management Study and Class EA Environmental Study Report and the subsequent April 2015 SWM Class EA Addendum report. ERCA must continue to be consulted to confirm their approval requirements for connections to regulated drains, including the detailed design of the proposed stormwater management pond, overland flood routes, fill placement, drain enclosures and any temporary stormwater drainage measures.

6.4 Mitigation Measures and Additional Approval Requirements

Reference should be made to the April 2015 SWM Class EA Addendum Report, in which various impacts and mitigating measures have been identified. To comply with the Ontario Environmental Assessment Act, all of the mitigation measures identified in the April 2015 Addendum Report must be incorporated into the design and/or construction of the infrastructure for the MRSPA.

Additional approvals for the development of these lands may also be required. These approvals will be the responsibility of the individual land owners/developers. Consultation and approvals will be addressed during the Draft Plan of Subdivision process as well as the detailed design process, which are to be followed by each developer as part of their development. These additional approvals may include:

- Drainage Report for the Baillargeon Drain and approval of the enclosure under the Fisheries Act;
- Ministry of Natural Resources and Forestry Endangered Species Act Approval; and
- Town of Tecumseh Approval.

7.0 IMPLEMENTATION

7.1 General

This Functional Servicing Report provides a framework for the coordinated servicing of the MRSPA. The recommended functional design of the site services identified herein should be updated from time to time as development proceeds, and as any changes to the servicing requirements are identified.

The design criteria and the overall functional servicing plans provide a basis upon which developers and the Town can evaluate development proposals.

Implementation of the plan will require cooperation between land owners, developers, the Town and regulatory agencies.

7.2 Temporary Stormwater Drainage Facilities

The Town recognizes that developers and land owner groups may not be in a position to implement and/or utilize the ultimate stormwater servicing strategy outlined herein. Subject to Essex Region Conservation Authority approval, the Town will consider limited temporary stormwater management and drainage facilities to accommodate staging of development. These temporary facilities must:

- Be designed to meet the criteria established in this functional servicing report and the Town of Tecumseh's standards;
- Allow for ultimately achieving the recommended functional storm sewer design as the temporary measures are decommissioned;
- Not encumber the ability of others to service their lands;
- Be removed, if requested by the Town, at the developer's expense when no longer needed; and
- Be sustainable and be maintained by the developer.

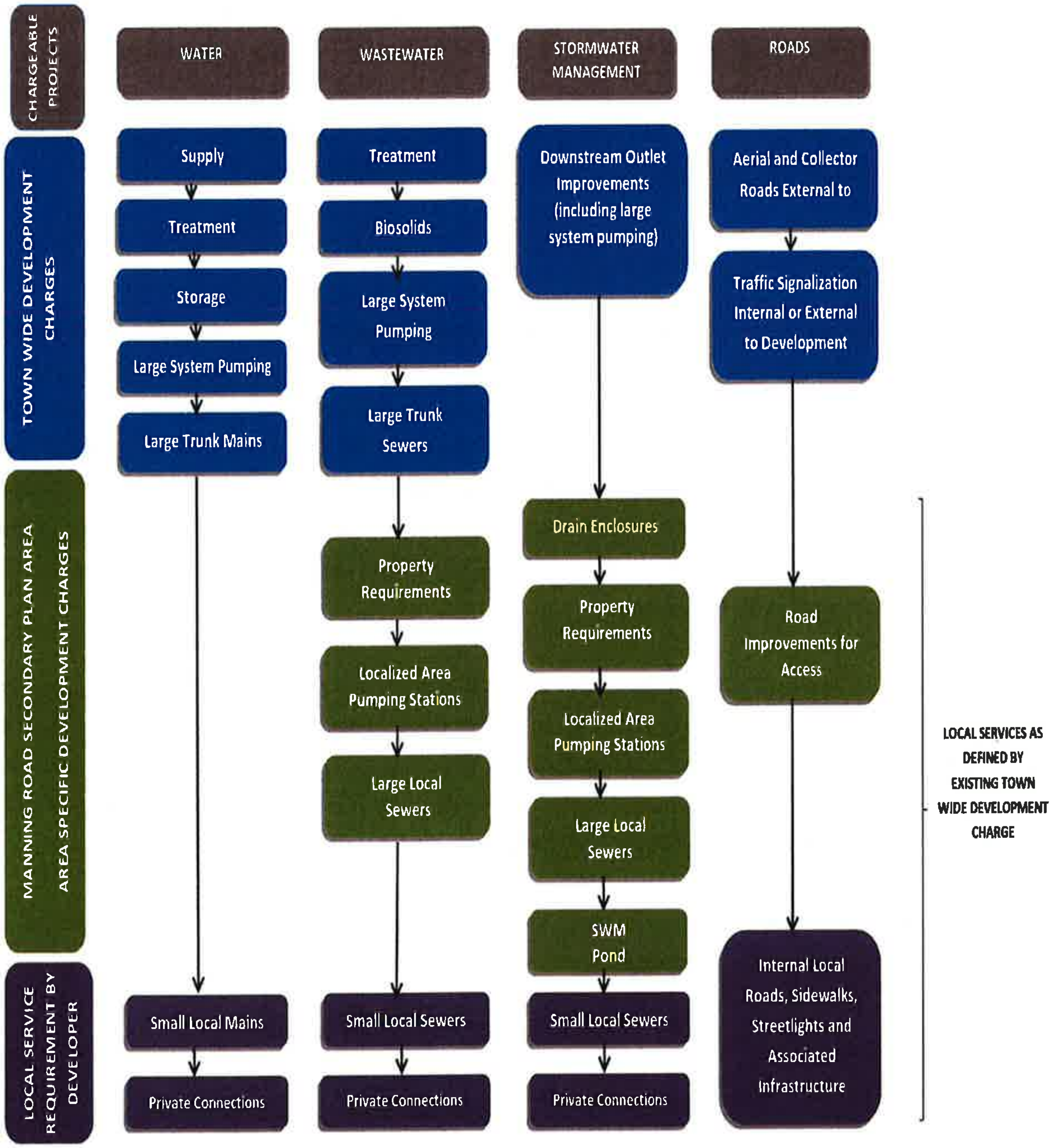
Quality and quantity control must be implemented and approved by the Town of Tecumseh and ERCA for temporary stormwater measures. Any temporary stormwater management or drainage facilities proposed will require the developer to carry all costs associated with construction, maintenance and removal, with suitable securities established with the Town until such time that the facility is removed and the permanent stormwater outlet has been fully utilized.

8.0 AREA-SPECIFIC PROJECT COSTS

8.1 General

The Town provides a wide range of services to the community and has an extensive inventory of infrastructure, facilities, lands, works and equipment. The Town regularly assesses whether infrastructure and community services required to support development are eligible to be incorporated as part of the development charges that apply to all new development within the Town, as well as whether additional area-specific charges should be applied within specific areas. As with all new developments, the Manning Road Secondary Plan Area will be subject to Town-wide development charges. In addition, it has been determined that area-specific development charges would be applicable. The overall concept for the application of development charges is illustrated in ***Table 8.1: Framework for Development Charges***.

Table 8.1: Framework for Development Charges



8.2 Summary of Chargeable Projects

Cost estimates have been completed for various components of the required site services and related studies that have been determined to be of mutual benefit for the development of lands in the MRSPA, as shown in ***Table 8.2: Area-Specific Project Cost Estimates***. Base costs have also been included to account for the portion of larger diameter infrastructure that would be considered the local servicing component that each developer would be directly responsible for. A further description of the area-specific chargeable projects is provided in the following sections of this report.

8.2.1 Land Acquisitions

The value of the lands required for the proposed stormwater management facility and storm pump station have been included as an area-specific project cost. As outlined in ***Appendix D – Land Valuation Cost Analysis***, the determination of this land value included a property appraisal to establish the market value for these lands if they were developed, which was then reduced by the estimated costs that would have been incurred by the developer to realize that developed land value. In this way, the property owner of these lands would be fairly compensated for the return that they would have realized (and that other developers in the MRSPA are benefiting from) for the use of these lands to accommodate the overall MRSPA stormwater management requirements.

In addition, there are land acquisitions required for the extension of Jamsyl Drive and Street 'A' beyond the MRSPA boundary to improve the connectivity of the local road network. The land acquisition costs associated with these roadway extensions are included in the project cost estimates based on a property appraisal completed in January 2015, which is included in ***Appendix D – Land Valuation Cost Analysis***. The need for these road extensions are further described in Section 8.2.6.

Land dedications to address parkland requirements will be addressed separately under a By-law passed in accordance with Section 42 of the Planning Act.

8.2.2 Stormwater Management

Stormwater management costs have not been considered in the current Town-wide development charges for this area, based on which the following have been included as area-specific project costs:

- Stormwater management pond, including landscaping;
- Storm pump station and emergency back-up power supply; and
- Related Class Environmental Assessment and preliminary engineering reports.

There are no base costs applicable to these stormwater management costs.

Individual developers will also be directly responsible for land acquisition and site grading to implement overland flood routes, which have not been included as area-specific project costs, at the following locations:

- Cyr Drain at Country Road 22;
- East Townline Drain along Manning Road at Jamsyl Drive and at Street B;
- Ditch Inlet Catchbasin and connection to the proposed MRSPA storm sewer system at the overland flow easement that extends from Charlene Lane; and
- MRSPA stormwater management facility.

8.2.3 Storm Sewers

The oversizing costs for storm sewer infrastructure above an established base cost have been included as area-specific project costs. The base costs represent the local servicing requirement that would be the direct responsibility of individual developers and is not part of the area-specific shareable costs, as identified below:

- 750 mm diameter storm sewer at a 3.0 metre depth; and
- 1500 mm diameter storm manhole.

Storm private drain connections are the direct responsibility of the individual developers.

8.2.4 Sanitary Sewers and Pump Station

The proposed sanitary pumping station, including standby power that is required to service the MRSPA has been included as an area-specific project cost.

There are no oversizing costs applicable for sanitary sewer infrastructure above the established base costs, which represent the local servicing requirement that would be the direct responsibility of individual developers, as identified below:

- 450 mm diameter sanitary sewer at a 5.0 metre depth; and
- 1500 mm diameter sanitary manhole.

Sanitary private drain connections are the direct responsibility of the individual developers.

8.2.5 Watermains

There are no oversizing costs applicable for watermain infrastructure above the established base costs, which represent the local servicing requirement that would be the direct responsibility of individual developers, as identified below:

- 375 mm diameter watermain at a 1.5 metre depth, including fire hydrants.

Individual developers will be responsible for the costs related to any easements that may be required to construct watermains at locations where interconnections are needed. In addition, water service connections and appurtenances are the direct responsibility of the individual developers.

8.2.6 Extension of Existing Roadways and Underground Services

The extension of Jamsyl Drive, Street 'A' and Gouin Street are required to provide necessary roadway connectivity between the MRSPA and the external road network (see ***Figure 3.0 - Proposed Land Use***). This roadwork will also include the extension of sewers and watermains, as required for servicing connections into the MRSPA system. The costs associated with these extensions are included as area-specific project costs. The following identifies the associated work included in the costs for these extensions:

8.2.6.1 Jamsyl Drive Extension

The estimated costs for the extension of Jamsyl Drive include the following:

- Removals, clearing, stripping and road excavation;
- Granular road base and asphalt pavement, including barrier curbs;
- Concrete sidewalks on both sides of the proposed roadway; and
- Restoration, including topsoil and seeding of boulevards.

8.2.6.2 Street 'A' Extension

The estimated costs for the extension of Street 'A' include the following:

- Clearing, stripping and road excavation;
- Granular road base and asphalt pavement, including barrier curbs;
- Concrete sidewalks on both sides of the proposed roadway; and
- Restoration, including topsoil and seeding of boulevards.

8.2.6.3 Gouin Street Extension

The estimated costs for the extension of Gouin Street include the following:

- Clearing, stripping and road excavation;
- Granular road base and asphalt pavement, including barrier curbs;
- Concrete sidewalks on both sides of the proposed roadway;
- Restoration, including topsoil and seeding of boulevards;
- Extension of the 300 mm diameter sanitary sewer;
- Extension of the 900 mm diameter storm sewer within the limits of the MRSPA only; and
- Extension of the 250 mm diameter watermain.

8.2.6.4 Westlake Drive Extension and Related Improvements

The County of Essex and the Ministry of Transportation of Ontario completed the County Road 19 and County Road 22 Environmental Study/Preliminary Design Report in November 2008. In accordance with that study, the County is currently proceeding with the detailed design for the implementation of interim improvements to the existing Sylvestre Drive exit ramp from the eastbound lanes of County Road 22, east of Lesperance Road. Ultimately, these improvements would also include the extension of Westlake Drive to complete the roadway connection to Lesperance Road, including:

- Widening the westbound approach of Westlake Drive at Lesperance Road to provide an auxiliary turn lane, including land acquisitions on the north side of Westlake Drive to increase the right-of-way from 15.3 metres to 20 metres; and
- Signalization of the Westlake Drive/Lesperance Road intersection.

More recently, the Tecumseh Hamlet Secondary Plan Transportation Study was completed by the Town in January 2015, which included a detailed assessment of the traffic operations and associated roadway and intersection requirements for Westlake Drive. This assessment included consideration of the proposed extension of Street 'A' to Westlake Drive at the intersection with the Sylvestre Drive exit ramp from County Road 22. In general, the following improvements to Westlake Drive have been identified:

- Widen the westbound approach of Westlake Drive at Lesperance Road to incorporate an exclusive right turn lane, including the property acquisitions outlined above;
- Signalize the Westlake Drive/Lesperance Road intersection, as outlined above;

- Incorporate an all-way stop control or a roundabout at the Street 'A'/Westlake/Sylvestre/button-hook intersection, including a separate channelized right turn lane (or roundabout bypass lane) on the southbound approach; and
- In the long-term, Westlake Drive (between Street 'A' and Lesperance Road) is expected to serve a dual function as a collector road (eastbound) and an arterial linkage (westbound) and should consist of a three-lane cross section, with two westbound lanes and one eastbound lane.

The costs associated with the proposed extension and related improvements to Westlake Drive (including the recommended intersection at Street 'A'), as noted above, have not been identified as an area-specific shareable project. While there may be portions of these road improvements that may be deemed the responsibility of directly benefiting land owners/developers, no area-specific shareable costs have been included for these proposed road improvements. The responsibilities for the costs to implement the proposed Westlake Drive extension and related roadway improvements have yet to be established.

8.2.7 Projects Not Included in the Area-Specific Development Projects

The following projects are not considered area-specific projects associated with the MRSPA. Costs for the following projects will be assessed under the Town-wide development charges:

- Road/intersection widening and traffic control signal improvements;
- Upgrading the Manning Road watermain from a 200 mm diameter to a 400 mm diameter, as may be required to support development throughout the Town;
- Upgrading the Sylvestre sewage pump station capacity to include the proposed development of the MRSPA, including abandoning the existing forcemain discharge and incorporating standby power; and
- Sanitary sewer improvements within the Tecumseh Hamlet sewer system, as required to relieve the Lesperance Road trunk sanitary sewer and provide the capacity required to accommodate the complete development of the MRSPA.

8.3 Area-Specific Development Charges

It is the Town's expectation that each developer would pay the full cost of implementing the infrastructure required to service the Manning Road Secondary Plan Area. Since the proposed works outlined herein are deemed a "local service" under the Town's Development Charge (DC) bylaw, these works are not currently part of the Town-Wide Development Charges by-law. The Town is considering a separate area-specific development charges by-law that would facilitate the cost sharing of oversized infrastructure and other infrastructure facilities that provide benefits to the overall servicing requirements of the MRSPA.

Through an area-specific development charges by-law, the Town will be in a position to facilitate the co-operation of developers in the equitable sharing of costs to implement the required road extensions, trunk storm sewers, stormwater management facilities, and storm and sanitary pumping stations to accommodate development of the MRSPA. An amendment to the existing Development Charge By-Law (or a separate bylaw) will be required to incorporate and implement the cost sharing aspects of this Functional Servicing Report.

In order to treat all developers and land owners fairly, the Town may require that land owner agreements be established to share the costs of the trunk facilities. This may be necessary since some lands are needed for "public" purposes, including stormwater management facilities, natural heritage areas, open drains and trail/greenway features.

The area-specific project costs are summarized in ***Table 8.2: Area-Specific Project Cost Estimates***. It is recommended that the Town of Tecumseh establish the area-specific development charges for the infrastructure requirements of servicing the MRSPA on this basis.

TABLE 8.2: AREA-SPECIFIC PROJECT COST ESTIMATES

	PROJECT	ESTIMATED QUANTITY	CAPITAL COSTS	CAPITAL COST ENG/CONT ONLY (25%)	BASE COST	BASE COST ENG/CONT ONLY (25%)	NET DEVELOPMENT CHARGES*	COMMENTS
STORM SEWER SYSTEM								
1	Storm Sewer Drainage Pipe							Assuming trunk storm sewers 825 mm dia. or larger are a shareable cost. Base cost of 750 mm dia. storm sewers at 3.0 m depth represents the local servicing requirement that would be the responsibility of individual developers.
	a) 2100 mm dia., Concrete A257.2 65-D	751	$1,680,224	$420,056	$368,088	$92,022	$1,640,170	
	b) 1500 mm dia., Concrete A257.2 65-D	589	$831,190	$207,798	$288,708	$72,177	$678,103	
	c) 1200 mm dia., Concrete A257.2 65-D	89	$86,926	$21,732	$43,463	$10,866	$54,329	
	d) 1050 mm dia., Concrete A257.2 65-D	287	$211,955	$52,989	$140,630	$35,158	$89,156	
	e) 900 mm dia., Concrete A257.2 65-D	693	$467,715	$116,929	$339,619	$84,905	$160,120	
	f) 825 mm dia., Concrete A257.2 65-D	279	$159,332	$39,833	$136,563	$34,141	$28,461	
	Sub-Total	**2688**	**$3,437,342**	**$859,336**	**$1,317,071**	**$329,268**	**$2,650,339**	
2	Storm Sewer Manholes							Assuming all MHs 1800 mm dia. or greater are a shareable cost. Base cost of 1500mm dia. MH at 4.0 m depth represents the local servicing requirement that would be the responsibility of individual developers.
	a) 1800mm dia., Precast (MH 51, 52, 53, 58, 59, 85, 86, 89, 102, 103)	10	$167,270	$41,818	$71,750	$17,938	$119,400	
	b) 2400mm dia., Precast (MH 79, 80)	2	$39,175	$9,794	$14,350	$3,588	$31,031	
	c) 3000mm dia., Precast (MH 82, 100)	2	$43,050	$10,763	$14,350	$3,588	$35,875	
	d) 3600mm dia., Precast (MH 50, 76, 35)	3	$104,760	$26,190	$21,525	$5,381	$104,044	
	e) 1500 x 1500 mm Manhole Tee, Precast (MH 77, 78)	2	$19,510	$4,878	$14,350	$3,588	$6,450	
	f) 2100 x 1500 mm Manhole Tee, Precast (MH 1, 11, 14, 21, 31)	5	$64,850	$16,213	$35,875	$8,969	$36,219	
	Sub-Total	**24**	**$438,615**	**$109,654**	**$172,200**	**$43,050**	**$333,019**	
TOTAL STORM SEWER SYSTEM			**$3,875,957**	**$968,989**	**$1,489,271**	**$372,318**	**$2,983,358**	
STORMWATER MANAGEMENT FACILITIES AND PUMP STATIONS								
3	Stormwater Management Pond							There are no base costs associated with the stormwater management facility, with the complete cost being considered shareable. These costs do not include land acquisition, which is considered separately below.
	a) Pond Excavation and Grading	L.S.	$2,460,000	$615,000	N/A	N/A	$3,075,000	
	b) Landscaping	L.S.	$1,793,750	$448,438	N/A	N/A	$2,242,188	
	Sub-Total		**$4,253,750**	**$1,063,438**	N/A	N/A	**$5,317,188**	
4	Stormwater Pumping Station, including standby power.	L.S.	$753,375	$188,344	N/A	N/A	$941,719	
TOTAL STORMWATER MANAGEMENT FACILITIES AND PUMP			**$5,007,125**	**$1,251,781**	-	-	**$6,258,906**	
STORMWATER MANAGEMENT LAND COSTS								
5	Land acquisition for Stormwater Management Pond	L.S.	$1,655,138	-	N/A	N/A	$1,655,138	The land valuation costs for the stormwater management facility were determined by Ray Bower Land Appaisal Services Inc., the Town of Tecumseh and Dillon Consulting Limited, as outlined in Appendix D of this report.
TOTAL STORMWATER MANAGEMENT LAND COSTS			**$1,655,138**	-	-	-	**$1,655,138**	
TOTAL STORM WATER MANAGEMENT COSTS							**$10,897,402**	
SANITARY DRAINAGE								
1	Sanitary Sewer Drainage Pipe	This cost is the direct responsibility of the developer.						Sanitary sewers up to 450mm dia. represents the local servicing requirment that would be the responsibility of individual developers. There are no proposed sanitary sewers that exceed the base cost, resulting in no area-specific cost sharing for sanitary sewers.
2	Sanitary Sewer Manholes	This cost is the direct responsibility of the developer.						
TOTAL SANITARY DRAINAGE			-	-	-	-	**$0**	
SANITARY PUMP STATION								
3	Sanitary Pumping Station including Standby Power	L.S.	$553,500	$138,375	N/A	N/A	$691,875	There are no base costs associated with the proposed sanitary pumping station, with the complete cost being considered shareable.
TOTAL SANITARY PUMP STATION			**$553,500**	**$138,375**	-	-	**$691,875**	
TOTAL WASTEWATER COSTS							**$691,875**	
WATERMAIN								
1	Watermain Pipe	This cost is the direct responsibility of the developer.						Watermains up to 375mm dia. represents the local servicing requirment that would be the responsibility of individual developers. There are no proposed watermains that exceed the base cost, resulting in no area-specific cost sharing for watermains.
2	Land Acquisition for Watermain	This cost is the direct responsibility of the developer.						Land acquisition required for looping the watermains will be considered the direct responsibility of individual
TOTAL WATER COSTS							**$0.00**	

Note: Capital Costs and Base Costs are based on 2015 construction cost estimates.

TABLE 8.2: AREA-SPECIFIC PROJECT COST ESTIMATE (Cont'd)

	PROJECT	ESTIMATED QUANTITY	CAPITAL COSTS	CAPITAL COST ENG/CONT ONLY (25%)	BASE COST	BASE COST ENG/CONT ONLY (25%)	NET DEVELOPMENT CHARGES*	COMMENTS
ROADS								
1	Internal MRSPA Road Network	This cost is the direct responsibility of the developer.						Based on the Local Service Level in the current DC Background Report, there will not be any DC road-based projects. Signals at Manning road intersections are partial funded by the current DC By-law and DC background
2	Jamsyl Drive Extension (External) a) Land Acquisition Cost	L.S.	$99,229	-	N/A	N/A	$99,229	Cost associated with the extension of infrastructure services and roadways to the MRSPA, as outlined in Section 8.2.6 of this report. Land Acquisition Cost was determined as outlined in Appendix D of this report: $3.40/sq.ft x 29,185 sq.ft = $99.229.00
	b) Roadways & Infrastructure Cost	L.S.	$71,750	$17,938	N/A	N/A	$89,688	
3	Street "A" Extension (External) a) Land Acquisition Cost	L.S.	$90,169	-	N/A	N/A	$90,169	Cost associated with the extension of infrastructure services and roadways to the MRSPA, as outlined in Section 8.2.6 of this report. Land Acquisition Cost was determined as outlined in Appendix D of this report: $4.60/sq.ft x 19,602 sq.ft = $90,169.00
	b) Roadways & Infrastructure Cost	L.S.	$74,928	$18,732	N/A	N/A	$93,659	
4	Gouin Extension (External), including 900 mm dia. Storm Sewer extension	L.S.	$90,200	$22,550	N/A	N/A	$112,750	Cost associated with the extension of infrastructure services and roadways to the MRSPA, as outlined in Section 8.2.6 of this report. 900 mm diameter storm sewer costs within the limits of the MRSPA have been included, whereas the 900 mm diameter storm sewer outside the MRSPA will be the responsibility of the Town.
	Sub-Total		**$426,276**	**$59,219**			**$485,495**	
TOTAL ROAD COSTS							**$485,495**	
REQUIRED DRAIN WORKS UNDER AREA SPECIFIC DEVELOPMENT CHARGES								
1	Enclosure of the Baillargeon Drain a) 1350 mm dia., Concrete A257.2 65-D	60	$73,800	$18,450	N/A	N/A	$92,250	Only the partial enclosure of the Baillargeon Drain, as required to connect to the MRSPA storm sewer system has been included. The abandonment and infilling of the balance of the Baillargeon Drain will be considered the direct responsibility of individual developers.
	b) Manhole at Storm Sewer including Drop Structure (MH 77A)	1	$42,025	$10,506	N/A	N/A	$52,531	
	c) Manhole at Storm Sewer including Drop Structure (MH 77B)	1	$18,265	$4,566	N/A	N/A	$22,831	
	d) Ditch Inlet Catch Basin at Northwest corner of Charlelene Lane, including 300 mm dia. Connection to Storm Trunk	L.S.	$16,656	$4,164	N/A	N/A	$20,820	
	Sub-Total		**$150,746**	**$37,687**			**$188,433**	
TOTAL DRAIN WORKS							**$188,433**	
REQUIRED STUDIES UNDER AREA SPECIFIC DEVELOPMENT CHARGES								
1	*Mandatory Background Studies:* a) 2010 SWM Class EA (Dillon)	L.S.	$200,000	-	N/A	N/A	$200,000	Engineering and consulting services incurred by the Town to complete preliminary design studies and reports related to the development of the MRSPA.
	b) 2015 SWM Class EA Addendum Report (Dillon)	L.S.	$97,000	-	N/A	N/A	$97,000	
	c) Draft MRSPA Functional Servicing Report (Dillon)	L.S.	$115,000	-	N/A	N/A	$115,000	
	d) Final MRSPA Functional Servicing Report Updates (Dillon)	L.S.	$55,000	-	N/A	N/A	$55,000	
	e) Baillargeon Drain Studies (Dillon) i) Preliminary Hydraulic Study	L.S.	$20,000	-	N/A	N/A	$20,000	
	ii) Detailed Hydraulic Modeling Report	L.S.	$72,000	-	N/A	N/A	$72,000	
	iii) Allowance for Drainage Act Report	L.S.	$50,000	-	N/A	N/A	$50,000	
	f) Memo for Gouin Street Sanitary Sewer Capacity Assessment (Dillon)	L.S.	$2,500	-	N/A	N/A	$2,500	
	g) Archaelogical Stage 1 (Fisher Consulting)	L.S.	$2,500	-	N/A	N/A	$2,500	
	h) Archaelogical Stage 2 (Fisher Consulting)	L.S.	$4,500	-	N/A	N/A	$4,500	
	i) Area Specific DC Study (Watson)	L.S.	$31,600	-	N/A	N/A	$31,600	
	j) Provision for Area Specific DC Update Study (Watson)	L.S.	$15,000	-	N/A	N/A	$15,000	
	k) Legal Costs (Wolf Hooker)	L.S.	$10,000	-	N/A	N/A	$10,000	
	l) Land Appraisal (Ray Bower Appraisal Services) i) SWM Pond Land Valuation	L.S.	$24,000	-	N/A	N/A	$24,000	
	ii) SWM Pond Land Valuation Update	L.S.	$3,500	-	N/A	N/A	$3,500	
	iii) Jamsyl and Street A Land Valuation	L.S.	$5,300	-	N/A	N/A	$5,300	
	Sub-Total		**$707,900**				**$707,900**	
TOTAL STUDIES							**$707,900**	

Note: Capital Costs and Base Costs are based on 2015 construction cost estimates.

TABLE 8.2: AREA-SPECIFIC PROJECT COST ESTIMATES (Cont'd)

	PROJECT	ESTIMATED QUANTITY	CAPITAL COSTS	CAPITAL COST ENG/CONT ONLY (25%)	BASE COST	BASE COST ENG/CONT ONLY (25%)	NET DEVELOPMENT CHARGES*	COMMENTS
REQUIRED MISCELLANEOUS WORKS UNDER TOWN WIDE DEVELOPMENT CHARGES								
1	Manning Road Watermain Upgrade to 400 mm						N/A	Cost for upgrades are included in the Town Wide Development Charges.
2	Upgrade to Sylvester Pumping Station						N/A	Cost for upgrades are included in the Town Wide Development Charges.
3	Abandon forcemain outlet from Sylvestre Pump Station						N/A	Cost for upgrades are included in the Town Wide Development Charges.
4	Sanitary Sewer upgrades required to outlet to Westlake						N/A	Cost for upgrades are included in the Town Wide Development Charges.
TOTAL MISCELLANEOUS WORKS							$0.00	
TOTAL AREA-SPECIFIC PROJECT COSTS							$12,971,104	

Note: Capital Costs and Base Costs are based on 2015 construction cost estimates.

The projects and costs shown in ***Table 8.2: Area-Specific Project Cost Estimates*** would be shared by developers (net of the base cost that each developer is responsible for) for the developable lands in the MRSPA, as set out in ***Table 8.3: Developable Land in the Manning Road Secondary Planning Area***.

Table 8.3: Developable Land in the Manning Road Secondary Planning Area

DEVELOPER	TOTAL AREA (Ha)	NON DEVELOPABLE AREA (Ha)	DEVELOPABLE AREA (Ha)	% TOTAL DEVELOPABLE AREA
Demarse	2.8	---	2.8	3.2%
Dragecevic/Lesperance	6.8	---	6.8	7.8%
Kauric	1.6	---	1.6	1.83%
Lecce	0.3	---	0.3	0.34%
St. Louis	2.4	---	2.4	2.8%
Sylvestre	32.9	4.26	28.64	32.8%
Valente	43.0	6.8	36.2	41.6%
Zohil	2.7	---	2.7	3.1%
Bolivar	0.2	---	0.2	0.23%
Deslippe Drive Extension	5.5	---	5.5	6.3%
Total	98.2	11.06	87.14	100%

* These areas were originally taken from the Development Plan per the Town of Tecumseh Planning and Engineering Department.

The total developable area excludes lands designated for the stormwater management pond facility, the parkland, and the lands required for the sanitary pumping station.

9.0 CONCLUSIONS AND RECOMMENDATIONS

The functional servicing requirements outlined within this report should be used as a guide for the detailed design of these services as development proceeds in phases. We recommend the following:

1. That the area-specific project costs identified in ***Table 8.2: Area-Specific Project Cost Estimates*** form the basis for the area-specific development charges by-law;
2. That the detailed design drawings and any supporting engineering studies be reviewed by the Town for conformance to the design requirements outlined in this report; and
3. That any proposed deviations from the Functional Servicing Report be reviewed in detail to ensure that the overall site servicing for the MRSPA is not compromised.

Flavio R. Forest, P.Eng.,
Project Manager

FIGURES

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TECUMSEH

April 2015

Project No. 11-5366-1000

Manning Road Secondary Plan Area Functional Servicing Report
in the Town of Tecumseh

FIGURE 1.0
STUDY AREA

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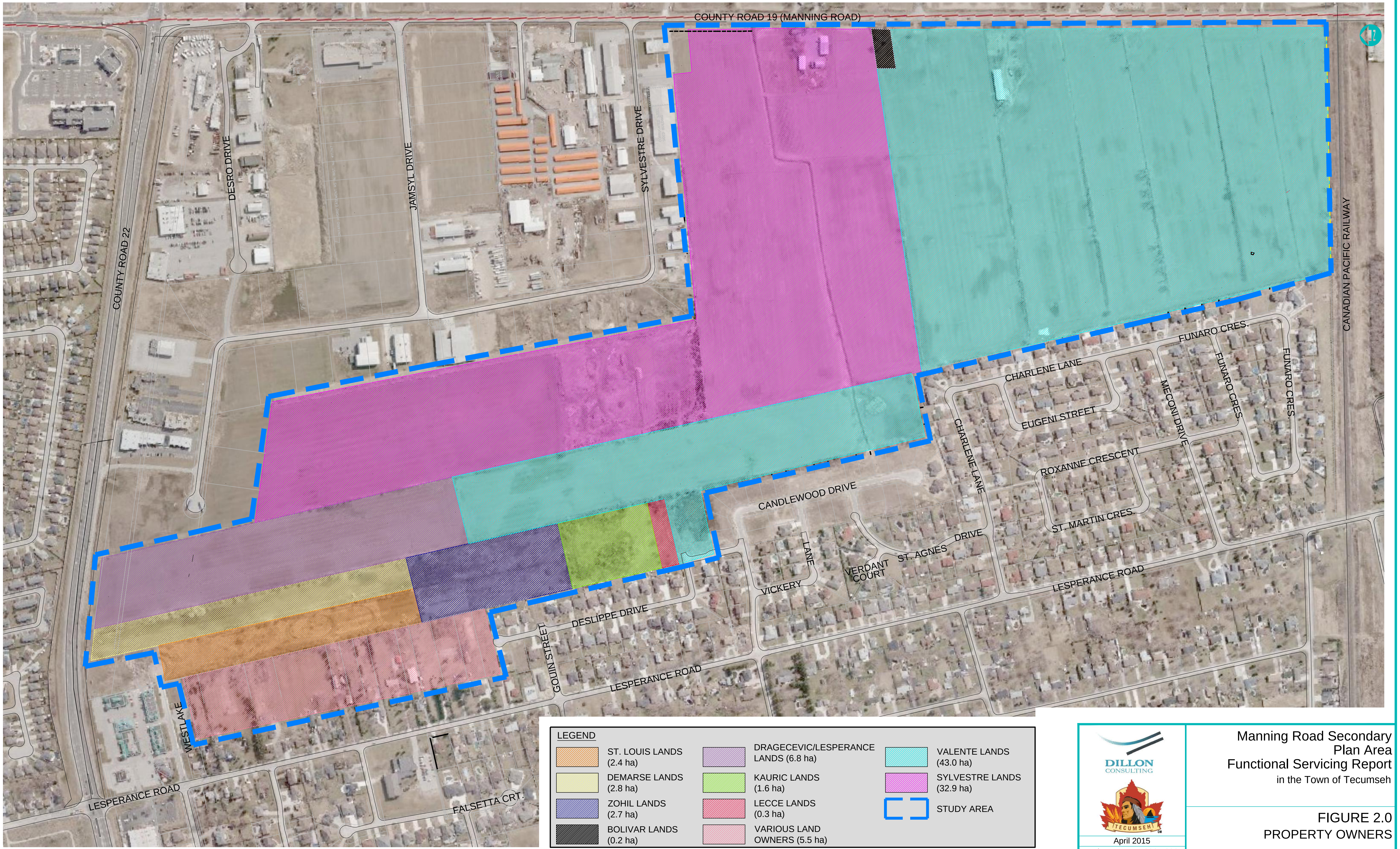

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Manning Road Secondary Plan Area Functional Servicing Report in the Town of Tecumseh

FIGURE 2.0
PROPERTY OWNERS

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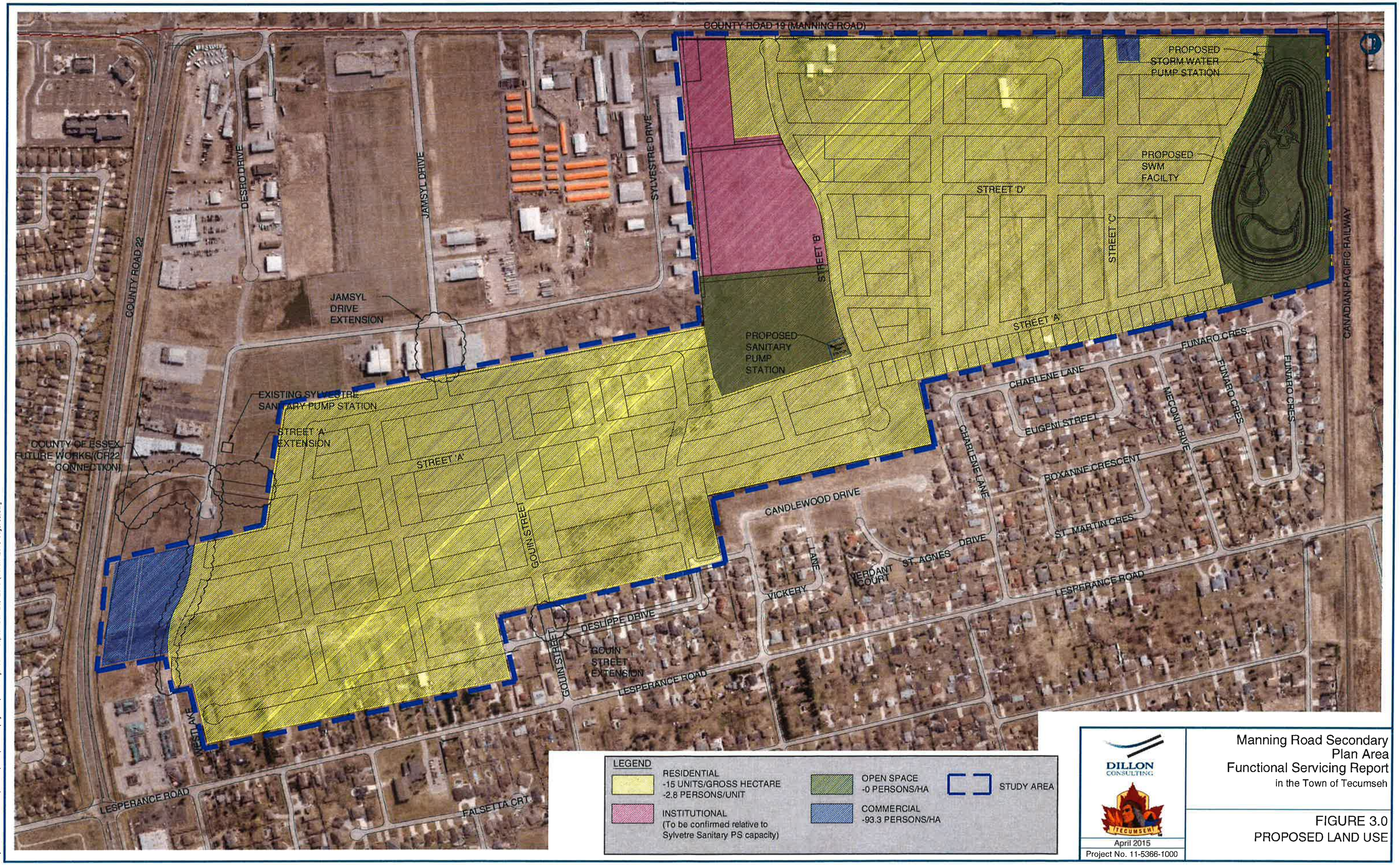
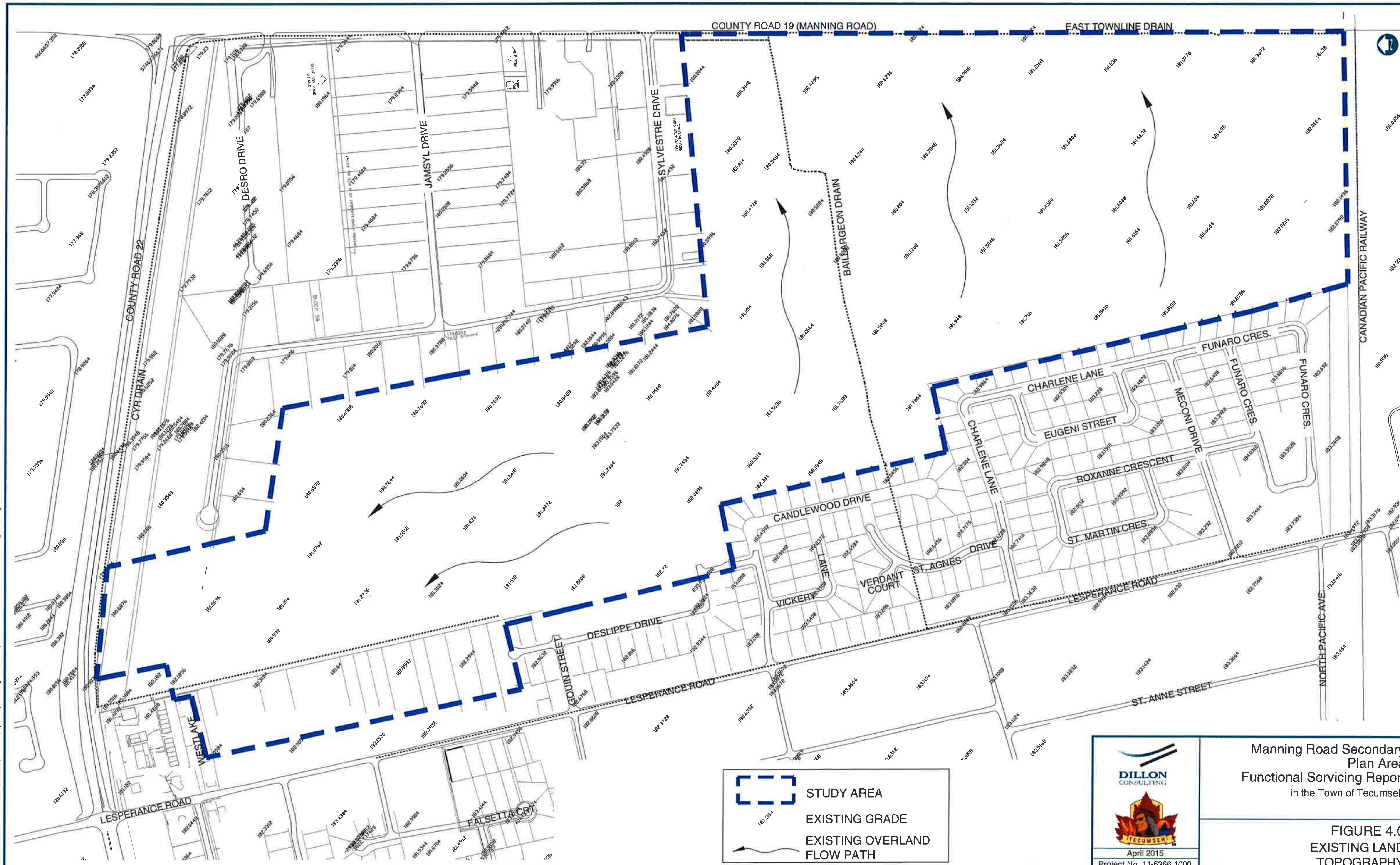


FIGURE 3.0
PROPOSED LAND USE



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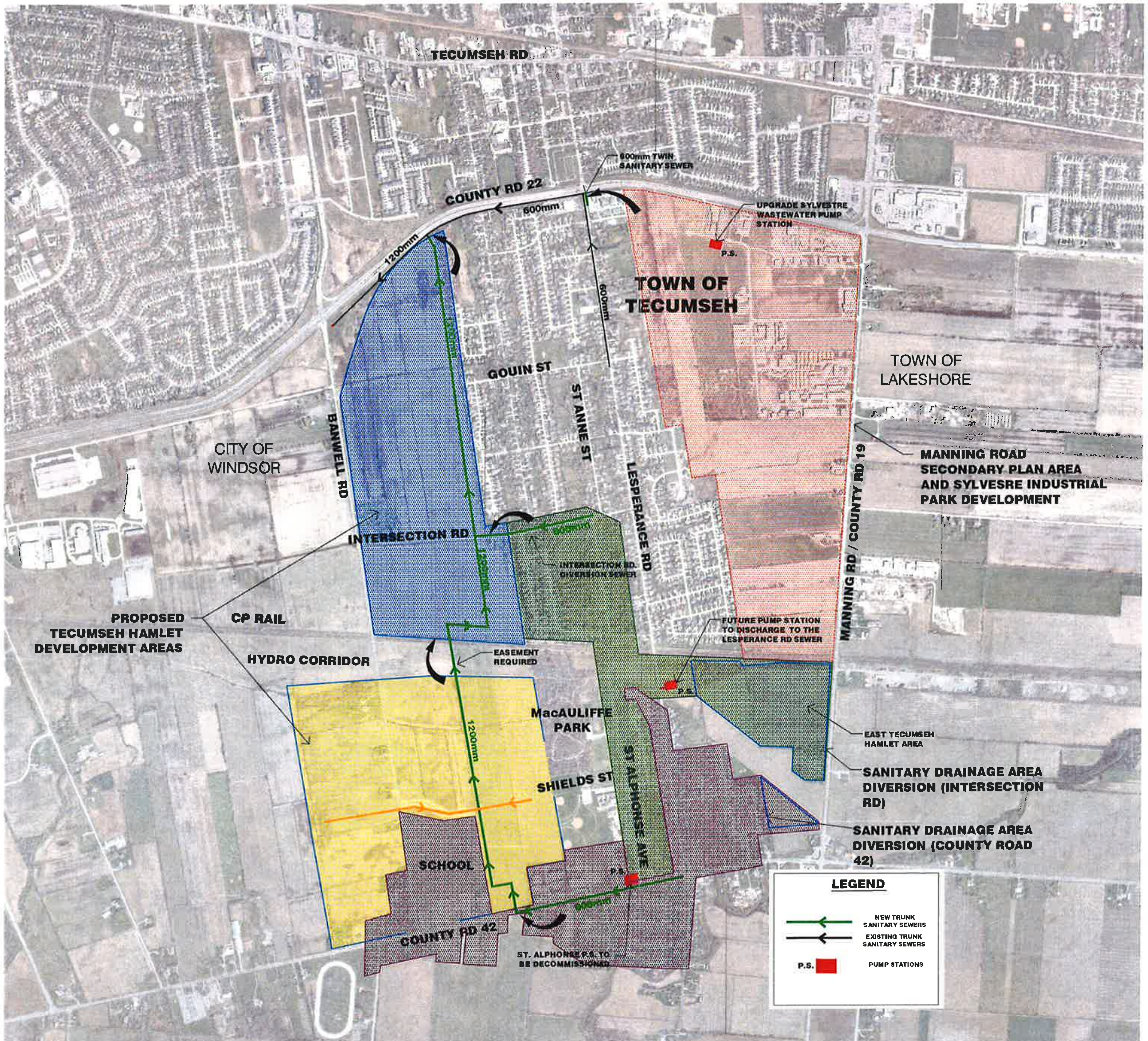

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Manning Road Secondary Plan Area Functional Servicing Report in the Town of Tecumseh

FIGURE 5.0

TECUMSEH HAMLET SANITARY DRAINAGE ULTIMATE SERVICING STRATEGY

April 2015

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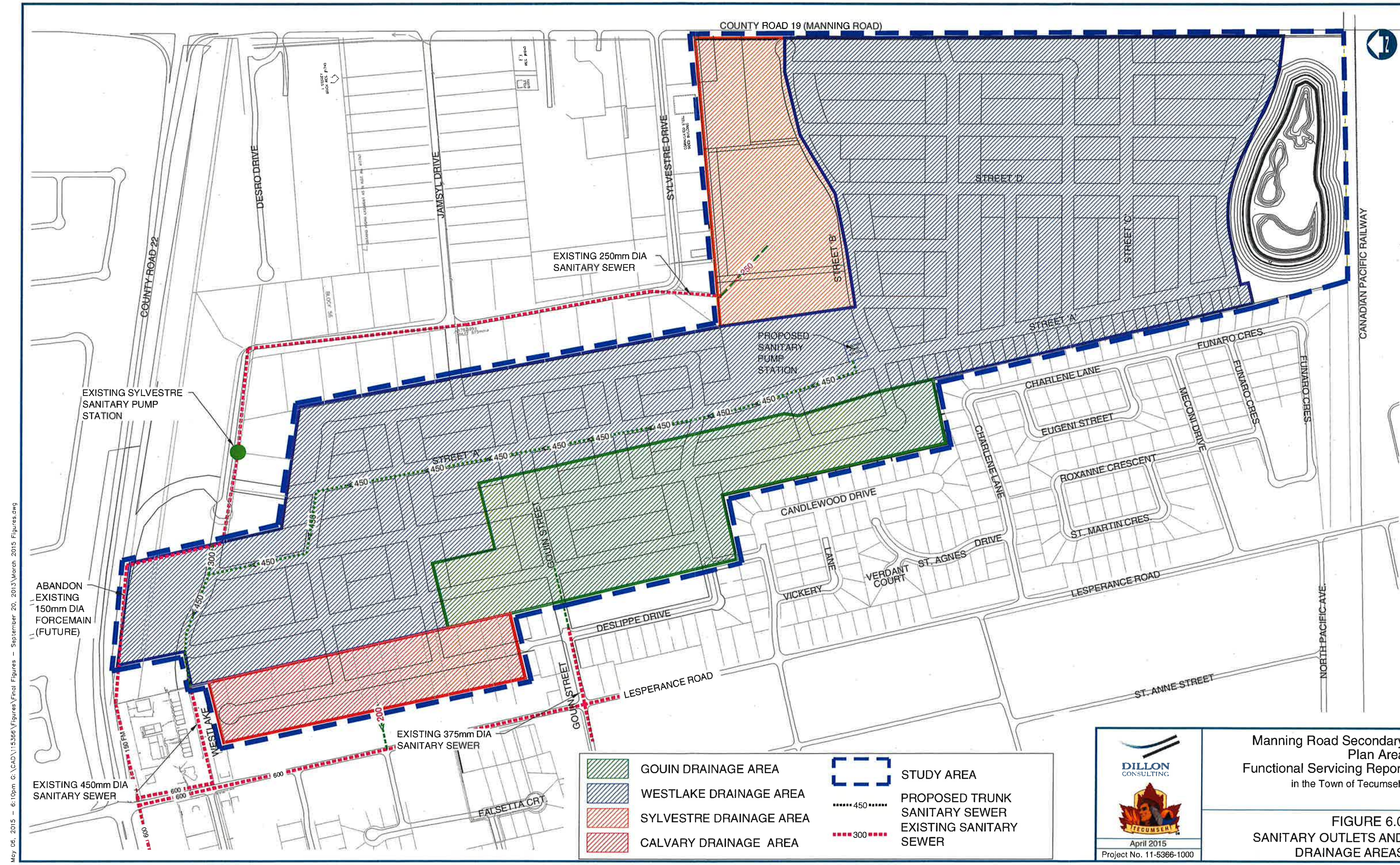
COUNTY ROAD 19 (MANNING ROAD)
COUNTY ROAD 22
DESRO DRIVE
JAMSYL DRIVE
SYLVESTRE DRIVE
STREET 'D'
STREET 'B'
STREET 'C'
STREET 'A'
CANADIAN PACIFIC RAILWAY
EXISTING 250mm DIA SANITARY SEWER
PROPOSED SANITARY PUMP STATION
EXISTING SYLVESTRE SANITARY PUMP STATION
FUNARO CRES.
CHARLENE LANE
EUGENI STREET
MECONI DRIVE
ROXANNE CRESCENT
CANDLEWOOD DRIVE
ST. MARTIN CRES.
ST. AGNES DRIVE
VERDANT COURT
VICKERY LANE
LESPERANCE ROAD
DESLIPPE DRIVE
GOUIN STREET
NORTH PACIFIC AVE.
ST. ANNE STREET
WESTLAKE
FALSETTA CRT.
ABANDON EXISTING 150mm DIA FORCEMAIN (FUTURE)
EXISTING 375mm DIA SANITARY SEWER
EXISTING 450mm DIA SANITARY SEWER
150 FM
450
300
250
200
600
GOUIN DRAINAGE AREA
WESTLAKE DRAINAGE AREA
SYLVESTRE DRAINAGE AREA
CALVARY DRAINAGE AREA
STUDY AREA
PROPOSED TRUNK SANITARY SEWER
EXISTING SANITARY SEWER
DILLON CONSULTING
TECUMSEH
April 2015
Project No. 11-5366-1000
Manning Road Secondary Plan Area
Functional Servicing Report
in the Town of Tecumseh
FIGURE 6.0
SANITARY OUTLETS AND DRAINAGE AREAS
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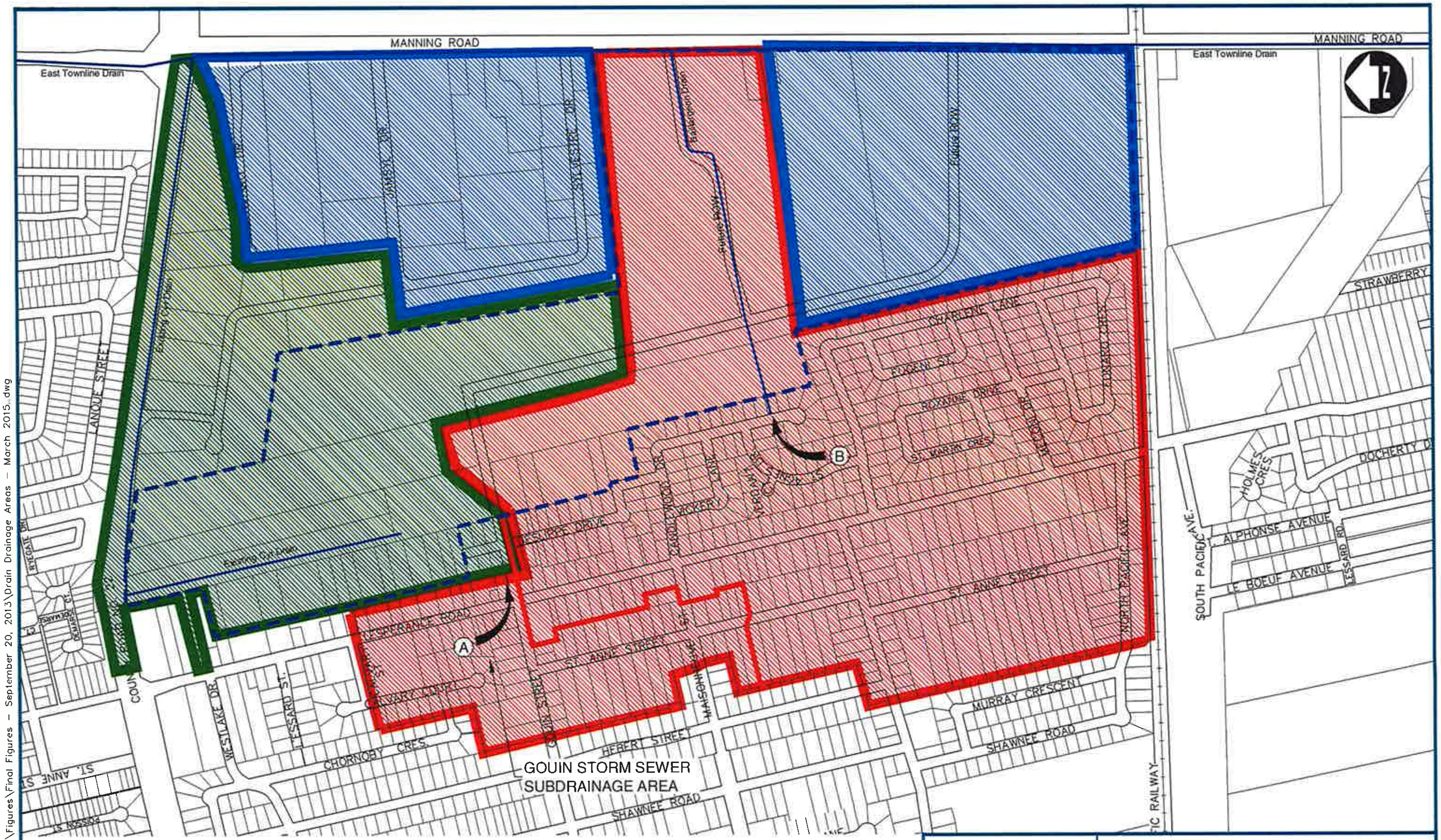

LEGEND

- Baillargeon Drain Drainage Area
- Cyr Drain Drainage Area
- East Townline Drain Drainage Area
- MSRPA Study Area

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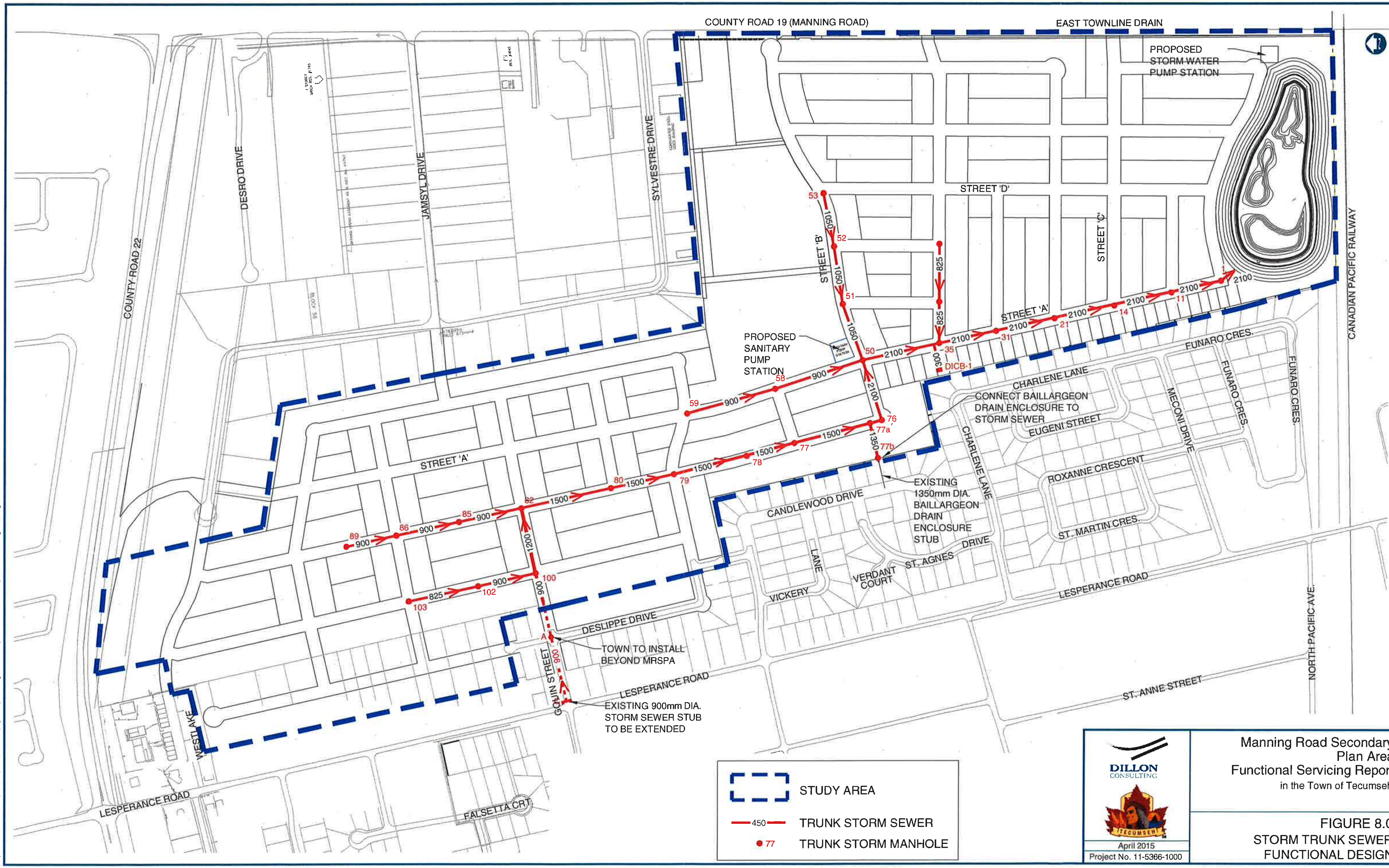
April 2015
Project No. 11-5366-1000

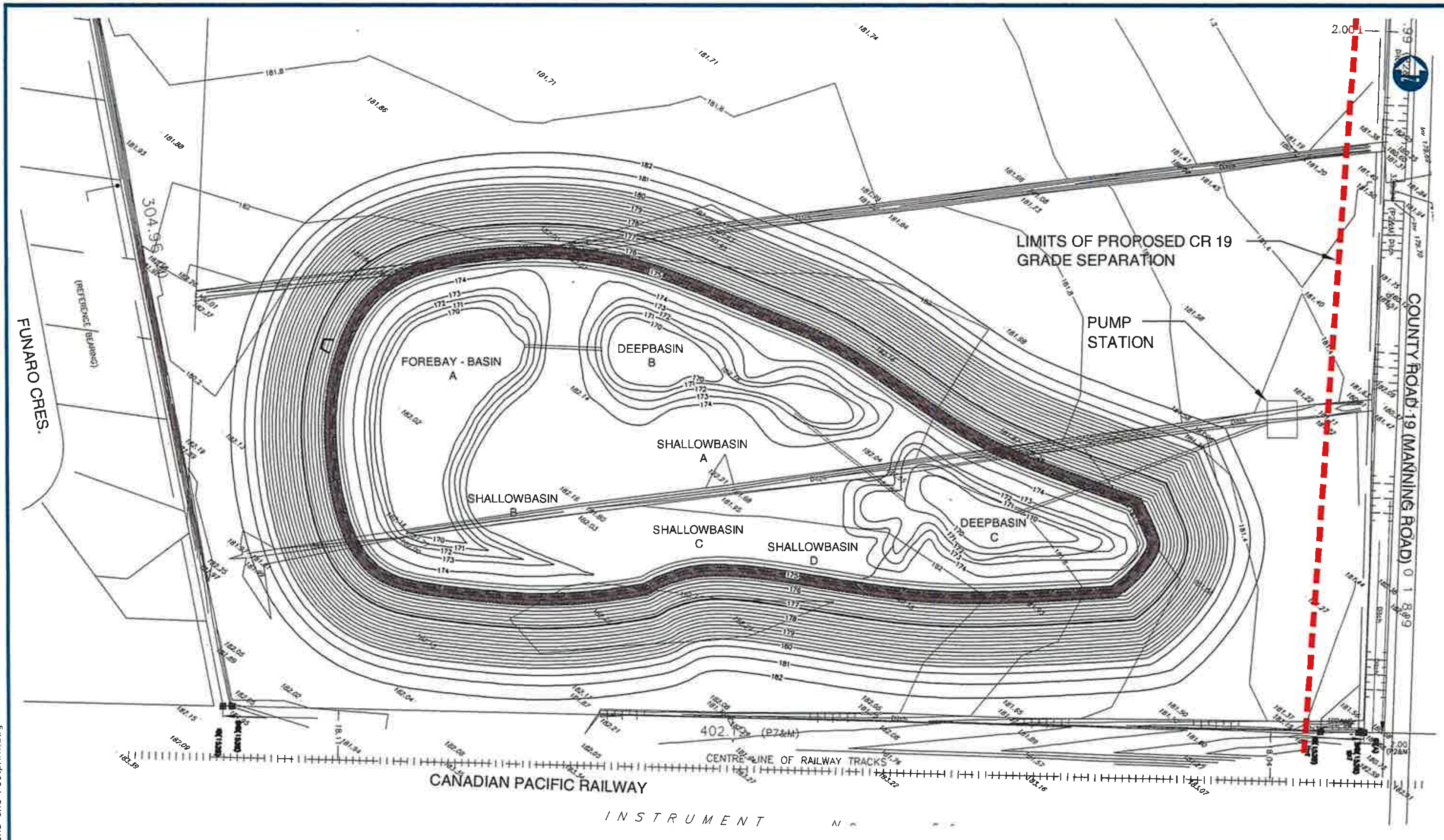
Manning Road Secondary Plan Area
Functional Servicing Report
in the Town of Tecumseh

FIGURE 7.0
EXISTING STORMWATER DRAINAGE AREAS

May 06, 2015 - 6:12pm G:\CAD\115366\Figures\Final Figures - September 20, 2013\Drain Drainage Areas - March 2015.dwg



COUNTY ROAD 19 (MANNING ROAD)
EAST TOWNLINE DRAIN
PROPOSED STORM WATER PUMP STATION
COUNTY ROAD 22
DESRO DRIVE
JAMSYL DRIVE
SYLVESTRE DRIVE
STREET 'B'
STREET 'D'
STREET 'C'
STREET 'A'
CANADIAN PACIFIC RAILWAY
PROPOSED SANITARY PUMP STATION
CONNECT BAILLARGEON DRAIN ENCLOSURE TO STORM SEWER
EXISTING 1350mm DIA. BAILLARGEON DRAIN ENCLOSURE STUB
TOWN TO INSTALL BEYOND MRSPA
EXISTING 900mm DIA. STORM SEWER STUB TO BE EXTENDED
FUNARO CRES.
CHARLENE LANE
EUGENI STREET
MECONI DRIVE
ROXANNE CRESCENT
CANDLEWOOD DRIVE
ST. MARTIN CRES.
ST. AGNES DRIVE
VERDANT COURT
VICKERY LANE
LESPERANCE ROAD
DESLIPPE DRIVE
GOUIN STREET
WESTLAKE
ST. ANNE STREET
NORTH PACIFIC AVE.
FALSETTA CRT
STUDY AREA
TRUNK STORM SEWER
TRUNK STORM MANHOLE
Manning Road Secondary Plan Area
Functional Servicing Report
in the Town of Tecumseh
DILLON CONSULTING
TECUMSEH
April 2015
Project No. 11-5366-1000
FIGURE 8.0
STORM TRUNK SEWER FUNCTIONAL DESIGN
May 06, 2015 – 6:13pm G:\CAD\115366\Figures\Final Figures – September 20, 2013\March 2015 Figures.dwg



DILLON CONSULTING

TECUMSEH

April 2015

Project No. 11-5366-1000

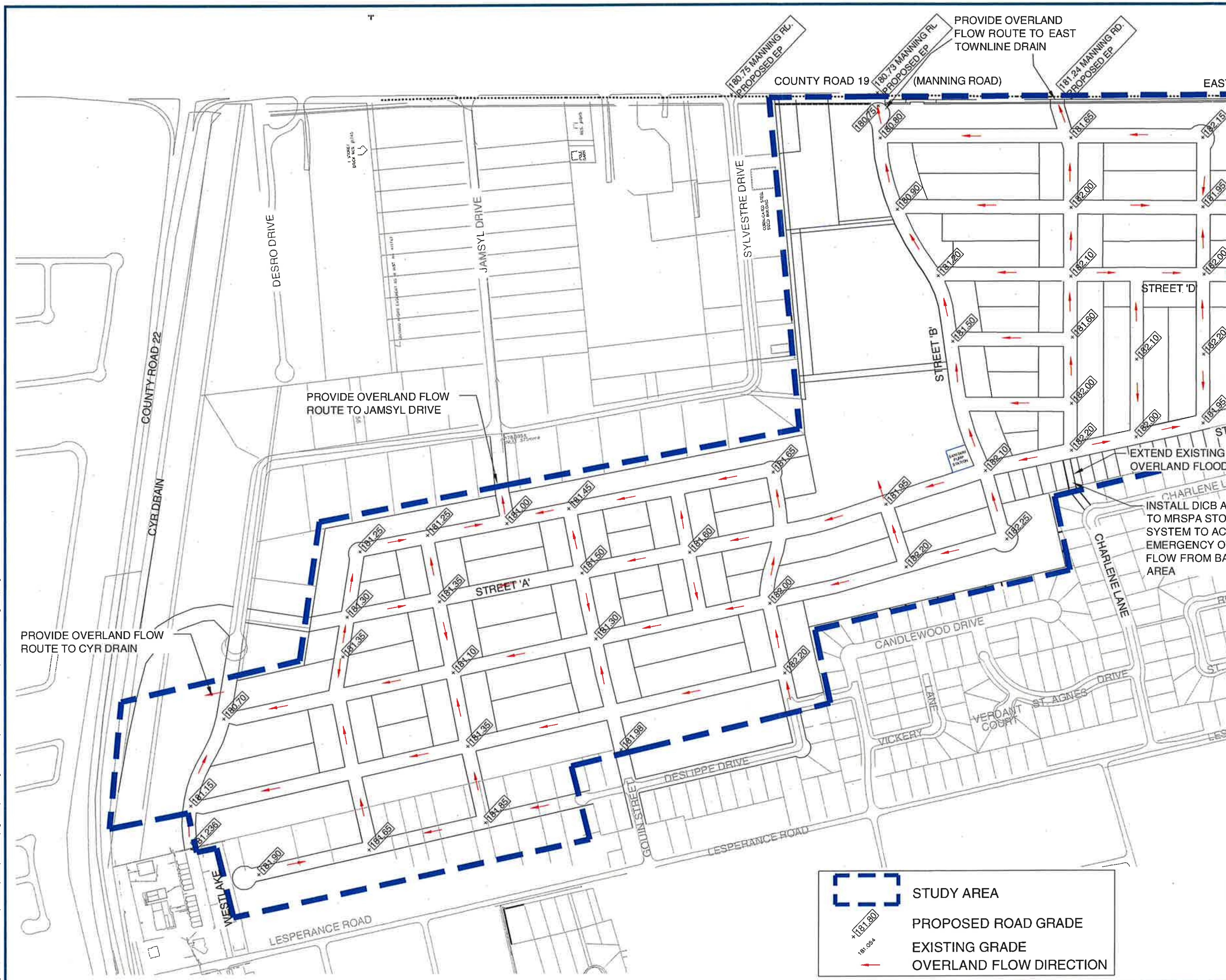
Manning Road Secondary Plan Area Functional Servicing Report

in the Town of Tecumseh

FIGURE 9.0

STORMWATER POND AND FUTURE CR 19 GRADE SEPARATION AT CPR TRACKS

May 06, 2015 - 6:15pm G:\CAD\15366\Pond and Footprint.dwg



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TECUMSEH

April 2015

Project No. 11-5366-1000

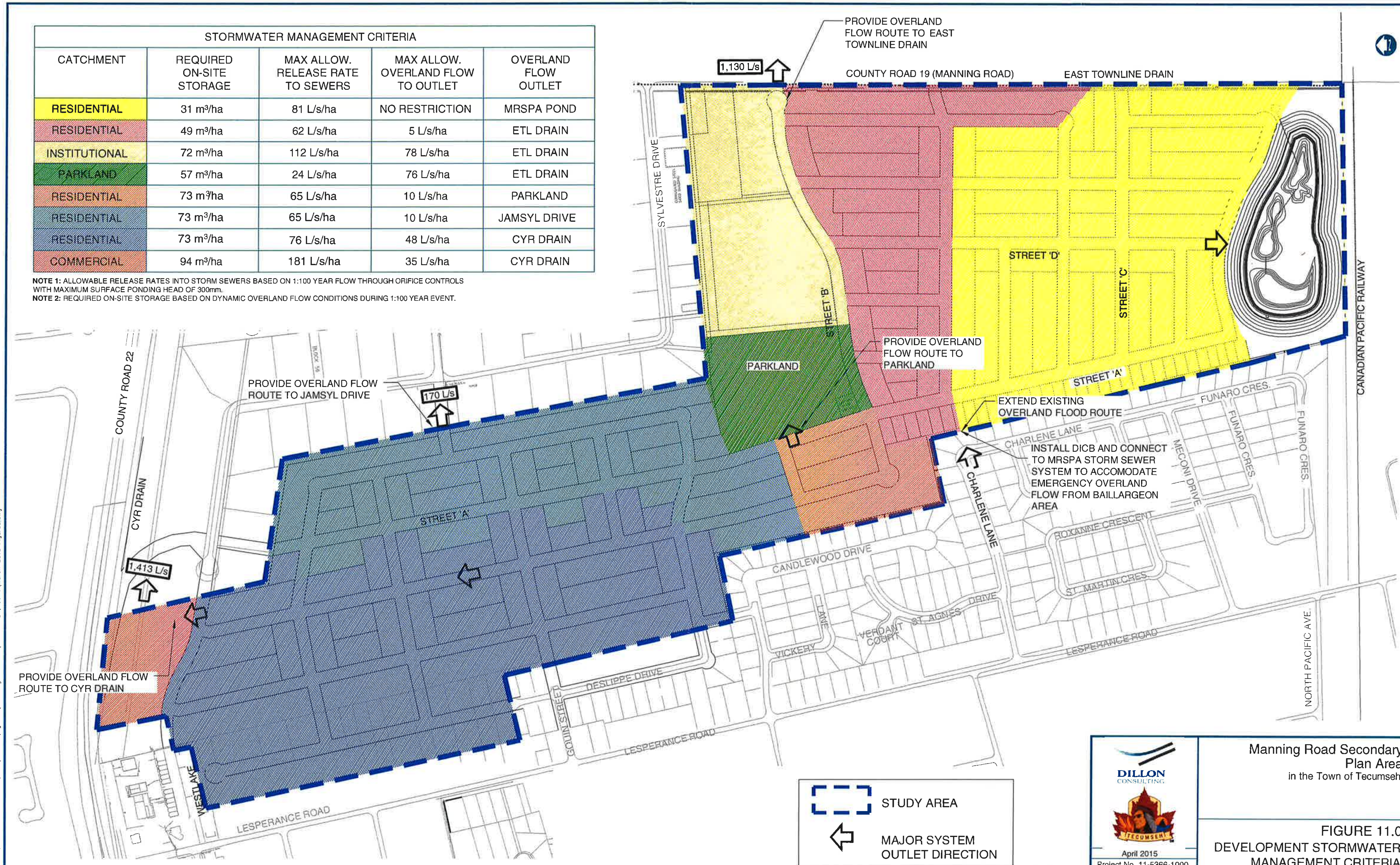
Manning Road Secondary Plan Area
Functional Servicing Report
in the Town of Tecumseh

FIGURE 10.0
PROPOSED SITE GRADING FOR OVERLAND FLOOD ROUTE

May 06, 2015 – 6:16pm G:\CAD\115366\Figures\Final Figures – September 20, 2013\March 2015 Figures.dwg

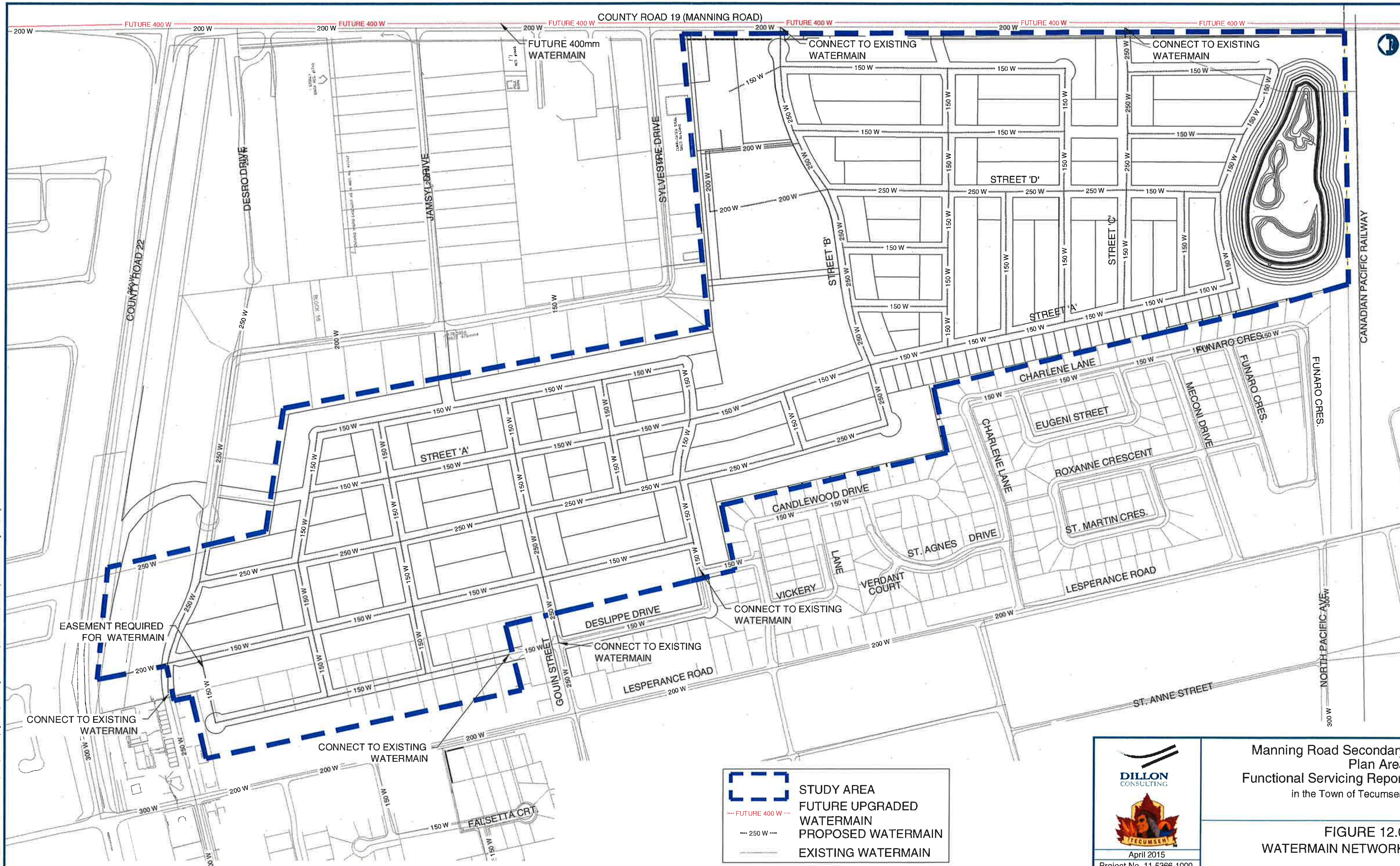
STORMWATER MANAGEMENT CRITERIA				
CATCHMENT	REQUIRED ON-SITE STORAGE	MAX ALLOW. RELEASE RATE TO SEWERS	MAX ALLOW. OVERLAND FLOW TO OUTLET	OVERLAND FLOW OUTLET
RESIDENTIAL	31 m^3/ha	81 L/s/ha	NO RESTRICTION	MRSPA POND
RESIDENTIAL	49 m^3/ha	62 L/s/ha	5 L/s/ha	ETL DRAIN
INSTITUTIONAL	72 m^3/ha	112 L/s/ha	78 L/s/ha	ETL DRAIN
PARKLAND	57 m^3/ha	24 L/s/ha	76 L/s/ha	ETL DRAIN
RESIDENTIAL	73 m^3/ha	65 L/s/ha	10 L/s/ha	PARKLAND
RESIDENTIAL	73 m^3/ha	65 L/s/ha	10 L/s/ha	JAMSYL DRIVE
RESIDENTIAL	73 m^3/ha	76 L/s/ha	48 L/s/ha	CYR DRAIN
COMMERCIAL	94 m^3/ha	181 L/s/ha	35 L/s/ha	CYR DRAIN

NOTE 1: ALLOWABLE RELEASE RATES INTO STORM SEWERS BASED ON 1:100 YEAR FLOW THROUGH ORIFICE CONTROLS WITH MAXIMUM SURFACE PONDING HEAD OF 300mm.
NOTE 2: REQUIRED ON-SITE STORAGE BASED ON DYNAMIC OVERLAND FLOW CONDITIONS DURING 1:100 YEAR EVENT.



Manning Road Secondary Plan Area
in the Town of Tecumseh

FIGURE 11.0
DEVELOPMENT STORMWATER MANAGEMENT CRITERIA



Manning Road Secondary Plan Area
Functional Servicing Report
in the Town of Tecumseh

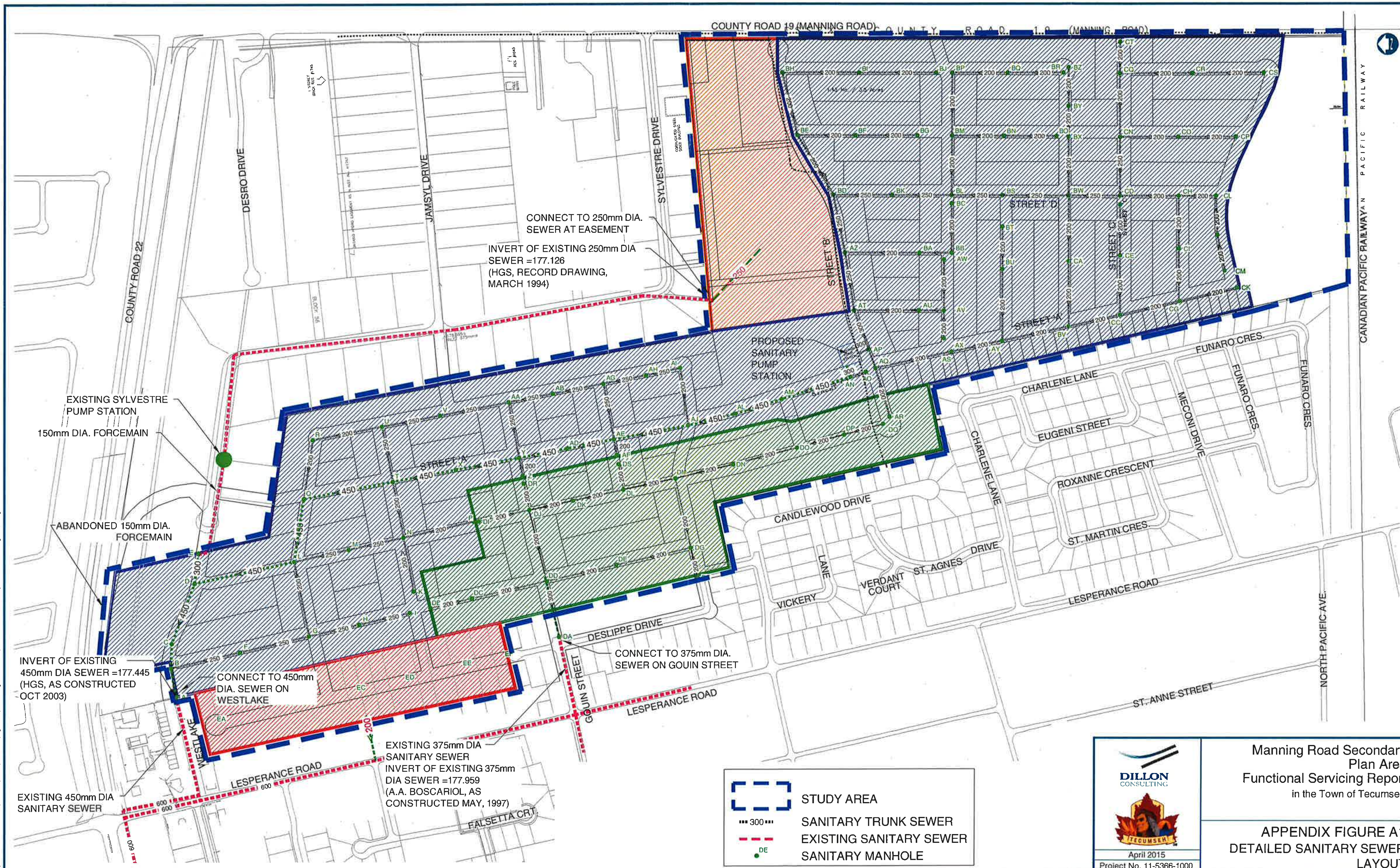
April 2015
Project No. 11-5366-1000

FIGURE 12.0
WATERMAIN NETWORK

May 07, 2015 – 9:39am G:\CAD\115366\Figures\Final Figures – September 20, 2013\March 2015 Figures.dwg

APPENDIX A

SANITARY SEWER PLAN AND DESIGN SHEETS



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MANNING SECONDARY PLANNING AREA - WESTLAKE DRIVE OUTLET
SANITARY SEWER FUNCTIONAL DESIGN SHEET

Project Name: MSPA Functional Design
Project No: 11-5366
Town of Tecumseh

The Peaking Factor was derived:
Using Harmon Formula= Y (Y or N)
From a Table= N
Value from table=

Residential Average Daily Flow= 300 L/Cap.D
Peak Extraneous Flow= 0.190 L/Ha.S

Outlet Invert Elevation= 177.330
Mannings 'n'= 0.013
Total Area= 63.36

Basement Floor Elevation =
or
Hydraulic Grade Line Cover = 2.40

Ground Elevation at Outlet = 181.236
HGL at Outlet = 177.895

Location			Flow Characteristics								Sewer Design/Profile										Cover			Hydraulic Grade Line	
ROAD/STN	LOCATION FROM MH	TO MH	INDIVIDUAL POP	AREA (ha.)	CUMULATIVE POP	AREA (ha.)	PEAKING FACTOR M	POP FLOW Q(p) (L/s)	PEAK EXTR. FLOW Q(i) (L/s)	PEAK DESIGN FLOW Q(d) (L/s)	CAPACITY (L/s)	LENGTH (m)	PIPE DIA (mm)	Wall Thickness (mm)	SLOPE (%)	UPPER INVERT (m)	LOWER INVERT (m)	FALL (m)	VELOCITY (m/s)	DROP IN LOWER MANHOLE (m)	Ground Elevation Upper MH	Cover @ Up MH (m)	Cover @ Low MH (m)	HGL Elev at Upstream MH	HGL Elev vs. Grnd Elev @ Up MH
AREA S110	CH	CI	14.3	0.34	14	0.34	4.398	0.218	0.065	**0.28**	**20.74**	85.5	200	15	0.40	179.644	179.302	0.342	0.66	0.020	182.350	2.491	3.083	175.995	OKAY
AREA S109	CI	CG	17.8	0.42	32	0.76	4.350	0.485	0.145	**0.63**	**20.74**	85.1	200	15	0.40	179.282	178.942	0.340	0.66	0.060	182.600	3.103	3.693	175.995	OKAY
AREA S97	CD	CE	25.6	0.61	26	0.61	4.365	0.388	0.116	**0.50**	**20.74**	98.9	200	15	0.40	179.368	178.972	0.396	0.66	0.020	182.650	3.067	3.613	175.994	OKAY
AREA S96	CE	CC	30.7	0.73	56	1.34	4.304	0.842	0.255	**1.10**	**20.74**	95.9	200	15	0.40	178.952	178.569	0.384	0.66	0.060	182.800	3.633	4.166	175.994	OKAY
AREA S93	BW	CA	30.7	0.73	31	0.73	4.353	0.463	0.139	**0.60**	**20.74**	105.6	200	15	0.40	179.592	179.169	0.422	0.66	0.020	182.200	2.393	2.966	175.989	OKAY
AREA S92	CA	BV	37.0	0.88	68	1.61	4.286	1.006	0.306	**1.31**	**20.74**	105.4	200	15	0.40	179.149	178.726	0.422	0.66	0.550	182.350	2.986	3.807	175.988	OKAY
AREA S86	BT	BU	38.6	0.92	39	0.92	4.336	0.582	0.175	**0.76**	**20.74**	58.0	200	15	0.40	179.519	179.287	0.232	0.66	0.020	182.100	2.366	2.748	175.969	OKAY
AREA S85	BU	AY	31.1	0.74	70	1.66	4.283	1.037	0.315	**1.35**	**20.74**	115.9	200	15	0.40	179.267	178.803	0.464	0.66	1.700	182.250	2.768	3.632	175.968	OKAY
AREA S108	CK	CG	23.6	0.56	24	0.56	4.370	0.359	0.107	**0.47**	**20.74**	96.6	200	15	0.40	179.288	178.902	0.386	0.66	0.020	182.450	2.947	3.733	175.995	OKAY
AREA S95	CG	CC	22.3	0.53	78	1.86	4.272	1.157	0.353	**1.51**	**20.74**	88.3	200	15	0.40	178.882	178.529	0.353	0.66	0.020	182.850	3.753	4.206	175.995	OKAY
AREA S91	CC	BV	21.4	0.51	156	3.71	4.186	2.264	0.705	**2.97**	**20.74**	77.7	200	15	0.40	178.509	178.198	0.311	0.66	0.020	182.950	4.226	4.337	175.993	OKAY
AREA S84	BV	AY	26.3	0.64	250	5.96	4.111	3.572	1.132	**4.70**	**20.74**	98.4	200	15	0.40	178.178	177.784	0.394	0.66	0.881	182.750	4.357	4.651	175.987	OKAY
AREA S63	AY	AS	21.6	0.52	342	8.14	4.054	4.811	1.546	**6.36**	**20.74**	84.9	200	15	0.40	177.103	176.764	0.340	0.66	0.020	182.650	5.332	5.371	175.966	OKAY
AREA S59	AS	AP	42.4	1.01	427	10.16	4.009	5.939	1.930	**7.87**	**20.74**	148.7	200	15	0.40	176.744	176.149	0.595	0.66	0.600	182.350	5.391	5.686	175.934	OKAY
AREA S105	CM	CL	38.6	0.92	39	0.92	4.336	0.582	0.175	**0.76**	**20.74**	123.6	200	15	0.40	179.678	179.184	0.494	0.66	0.060	182.450	2.557	2.751	176.194	OKAY
AREA S106	CL	CH	19.7	0.47	58	1.39	4.301	0.872	0.264	**1.14**	**20.74**	65.9	200	15	0.40	179.124	178.860	0.264	0.66	0.020	182.150	2.811	3.275	176.194	OKAY
AREA S107	CH	CD	31.6	0.75	90	2.14	4.256	1.328	0.407	**1.73**	**20.74**	95.1	200	15	0.40	178.840	178.460	0.380	0.66	0.500	182.350	3.295	3.975	176.193	OKAY
AREA S98	CS	CR	58.8	1.40	59	1.40	4.300	0.878	0.266	**1.14**	**20.74**	117.0	200	15	0.40	179.752	179.284	0.468	0.66	0.020	182.150	2.183	2.801	176.211	OKAY
AREA S99	CR	CQ	31.1	0.74	90	2.14	4.256	1.328	0.407	**1.73**	**20.74**	117.3	200	15	0.40	179.264	178.795	0.469	0.66	0.060	182.300	2.821	3.390	176.210	OKAY
AREA S102	CP	CO	52.5	1.25	53	1.25	4.310	0.786	0.238	**1.02**	**20.74**	94.2	200	15	0.40	179.138	178.761	0.377	0.66	0.020	182.150	2.797	3.274	176.200	OKAY
AREA S103	CO	CN	26.9	0.64	79	1.89	4.270	1.177	0.359	**1.54**	**20.74**	94.2	200	15	0.40	178.741	178.364	0.377	0.66	0.060	182.250	3.294	3.771	176.199	OKAY
AREA S100	CT	CQ	[illegible]	0.48	45	0.48	4.324	0.672	0.091	**0.76**	**20.74**	51.3	200	15	0.40	178.960	178.755	0.205	0.66	0.020	182.450	3.275	3.430	176.207	OKAY
AREA S101	CQ	CN	[illegible]	0.87	173	3.49	4.170	2.507	0.663	**3.17**	**20.74**	102.7	200	15	0.40	178.735	178.324	0.411	0.66	0.020	182.400	3.450	3.811	176.206	OKAY
AREA S104	CN	CD	13.9	0.33	266	5.71	4.100	3.792	1.085	**4.88**	**32.57**	94.8	250	15	0.30	178.304	178.020	0.284	0.66	0.060	182.350	3.781	4.365	176.197	OKAY
AREA S88	BZ	BY	19.7	0.47	20	0.47	4.381	0.300	0.089	**0.39**	**20.74**	62.7	200	15	0.40	179.158	178.907	0.251	0.66	0.020	181.650	2.277	2.728	176.180	OKAY
AREA S89	BY	BX	12.2	0.29	32	0.76	4.350	0.482	0.144	**0.63**	**20.74**	49.7	200	15	0.40	178.887	178.688	0.199	0.66	0.020	181.850	2.748	3.097	176.179	OKAY
AREA S90	BX	BW	14.3	0.34	46	1.10	4.322	0.693	0.209	**0.90**	**20.74**	95.1	200	15	0.40	178.668	178.288	0.380	0.66	0.600	182.000	3.117	3.697	176.179	OKAY
AREA S80	BO	BN	37.6	0.90	38	0.90	4.338	0.567	0.170	**0.74**	**20.74**	85.0	200	15	0.40	179.460	179.120	0.340	0.66	0.020	182.000	2.325	2.415	176.153	OKAY
AREA S81	BN	BM	22.3	0.53	60	1.43	4.298	0.894	0.271	**1.16**	**20.74**	85.0	200	15	0.40	179.100	178.760	0.340	0.66	0.900	181.750	2.435	2.575	176.152	OKAY
AREA S77	BR	BQ	42.8	1.02	43	1.02	4.328	0.644	0.194	**0.84**	**20.74**	90.7	200	15	0.40	179.134	178.771	0.363	0.66	0.020	181.650	2.301	2.564	176.158	OKAY
AREA S78	BQ	BP	31.1	0.74	74	1.76	4.277	1.098	0.334	**1.43**	**20.74**	90.7	200	15	0.40	178.751	178.388	0.363	0.66	0.060	181.550	2.584	2.847	176.157	OKAY
AREA S79	BP	BM	35.5	0.85	109	2.61	4.233	1.609	0.495	**2.10**	**20.74**	101.9	200	15	0.40	178.328	177.920	0.408	0.66	0.060	181.450	2.907	3.415	176.155	OKAY
AREA S82	BM	BL	33.7	0.80	203	4.84	4.146	2.923	0.919	**3.84**	**20.74**	96.0	200	15	0.40	177.860	177.476	0.384	0.66	0.400	181.550	3.475	3.959	176.151	OKAY
AREA S72	BG	BF	42.4	1.01	42	1.01	4.329	0.638	0.192	**0.83**	**20.74**	100.5	200	15	0.40	178.870	178.468	0.402	0.66	0.020	181.550	2.465	2.617	176.066	OKAY
AREA S73	BF	BE	23.1	0.55	66	1.56	4.289	0.976	0.296	**1.27**	**20.74**	94.2	200	15	0.40	178.448	178.071	0.377	0.66	0.900	181.300	2.637	2.664	176.065	OKAY
AREA S69	BJ	BI	54.6	1.30	55	1.30	4.307	0.817	0.247	**1.06**	**20.74**	124.8	200	15	0.40	178.687	178.188	0.499	0.66	0.020	181.450	2.548	2.797	176.075	OKAY
AREA S70	BI	BH	44.1	1.05	99	2.35	4.245	1.455	0.447	**1.90**	**20.74**	124.8	200	15	0.40	178.168	177.668	0.499	0.66	0.060	181.200	2.817	3.067	176.074	OKAY
AREA S71	BH	BE	25.2	0.60	124	2.95	4.217	1.814	0.561	**2.37**	**20.74**	104.3	200	15	0.40	177.608	177.191	0.417	0.66	0.020	180.950	3.127	3.544	176.069	OKAY
AREA S74	BE	BD	21.0	0.50	210	5.01	4.140	3.025	0.952	**3.98**	**20.74**	112.6	200	15	0.40	177.171	176.721	0.450	0.66	0.300	180.950	3.564	4.214	176.064	OKAY
AREA S67	BC	BB	35.7	0.85	36	0.85	4.342	0.538	0.162	**0.70**	**20.74**	79.9	200	15	0.40	177.190	176.871	0.320	0.66	0.060	181.650	4.245	4.664	175.972	OKAY
AREA S66	BB	AZ	34.4	0.82	70	1.67	4.283	1.043	0.317	**1.36**	**20.74**	159.0	200	15	0.40	176.811	176.175	0.636	0.66	0.060	181.750	4.724	4.960	175.972	OKAY
AREA S64	BB	AV	36.1	0.86	36	0.86	4.341	0.544	0.163	**0.71**	**20.74**	93.2	200	15	0.40	176.884	176.511	0.373	0.66	0.060	181.750	4.651	5.424	175.878	OKAY
AREA S62	AX	AV	20.2	0.48	20	0.48	4.380	0.307	0.091	**0.40**	**20.74**	67.5	200	15	0.40	176.781	176.511	0.270	0.66	0.060	182.350	5.354	5.424	175.878	OKAY
AREA S61	AV	AT	26.5	0.63	47	1.11	4.321	0.699	0.211	**0.91**	**20.74**	145.0	200	15	0.40	176.451	175.871	0.580	0.66	0.060	182.150	5.484	5.664	175.878	OKAY
AREA S94	CD	BW	30.5	0.73	387	8.58	4.029	5.411	1.629	**7.04**	**32.57**	84.0	250	15	0.30	177.960	177.708	0.252	0.66	0.020	182.650	4.425	4.227	176.190	OKAY
AREA S87	BW	BS	36.5	0.87	470	10.55	3.988	6.501	2.004	**8.51**	**32.57**	107.8	250	15	0.30	177.688	177.365	0.323	0.66	0.020	182.200	4.247	4.270	176.179	OKAY
AREA S83	BS	BL	19.7	0.47	489	11.02	3.979	6.759	2.093	**8.85**	**32.57**	82.7	250	15	0.30	177.345	177.096	0.248	0.66	0.020	181.900	4.290	4.289	176.156	OKAY
AREA S76	BL	BK	18.1	0.43	710	16.28	3.891	9.597	3.093	**12.69**	**32.57**	96.2	250	15	0.30	177.076	176.788	0.289	0.66	0.020	181.650	4.309	4.347	176.138	OKAY
AREA S75	BK	BD	27.3	0.65	738	16.93	3.881	9.941	3.217	**13.16**	**32.57**	95.7	250	15	0.30	176.768	176.481	0.287	0.66	0.060	181.400	4.367	4.404	176.094	OKAY
AREA S68	BD	AZ	21.0	0.50	969	22.44	3.809	12.816	4.264	**17.08**	**32.57**	95.3	250	15	0.30	176.421	176.135	0.286	0.66	0.020	181.150	4.464	4.950	176.047	OKAY
AREA S65	AZ	AT	18.9	0.45	1058	24.56	3.784	13.903	4.667	**18.57**	**32.57**	94.5	250	15	0.30	176.115	175.831	0.284	0.66	0.020	181.350	4.970	5.654	175.969	OKAY
AREA S60	AT	AP	18.1	0.43	1123	26.10	3.767	14.686	4.959	**19.65**	**52.97**	67.5	300	15	0.30	175.811	175.609	0.203	0.75	0.060	181.750	5.624	6.126	175.877	OKAY
AREA S53	AR	AQ	42.4	1.01	42	1.01	4.329	0.638	0.192	**0.83**	**20.74**	148.7	200	15	0.40	179.338	178.744	0.595	0.66	2.000	182.350	2.797	3.391	175.935	OKAY
PS INLET	AP	PUMP	0.0	0.00	1549	36.26	3.669	19.742	6.889	**26.63**	**43.25**	17.4	300	15	0.20	175.549	175.514	0.035	0.61	-4.000	182.050	6.186	6.321	175.849	OKAY

MANNING SECONDARY PLANNING AREA - WESTLAKE DRIVE OUTLET
SANITARY SEWER FUNCTIONAL DESIGN SHEET

Project Name: MSPA Functional Design
Project No: 11-5366
Town of Tecumseh

The Peaking Factor was derived:
Using Harmon Formula= Y (Y or N)
From a Table= N
Value from table=

Residential Average Daily Flow= 300 L/Cap.D
Peak Extraneous Flow= 0.190 L/Ha.S

Outlet Invert Elevation= 177.330
Mannings 'n'= 0.013
Total Area= 63.36

Basement Floor Elevation =
or
Hydraulic Grade Line Cover = 2.40

Ground Elevation at Outlet = 181.236
HGL at Outlet = 177.895

Location			Flow Characteristics								Sewer Design/Profile										Cover			Hydraulic Grade Line	
ROAD/STN	LOCATION FROM MH	LOCATION TO MH	INDIVIDUAL POP	INDIVIDUAL AREA (ha.)	CUMULATIVE POP	CUMULATIVE AREA (ha.)	PEAKING FACTOR M	POP FLOW Q(p) (L/s)	PEAK EXTR. FLOW Q(i) (L/s)	PEAK DESIGN FLOW Q(d) (L/s)	CAPACITY (L/s)	LENGTH (m)	PIPE DIA. (mm)	Wall Thickness (mm)	SLOPE (%)	UPPER INVERT (m)	LOWER INVERT (m)	FALL (m)	VELOCITY (m/s)	DROP IN LOWER MANHOLE (m)	Ground Elevation Upper MH	Cover @ Up MH (m)	Cover @ Low MH (m)	HGL Elev at Upstream MH	HGL Elev vs. Grnd Elev @ Up MH
PS OUTLET	PUMP	AN	0.0	0.00	1549	36.26	3.669	19.742	6.889	**26.63**	**98.76**	19.1	450	15	0.12	179.514	179.491	0.023	0.62	0.075	182.150	2.171	2.194	178.239	OKAY
AREA S58	AO	AN	7.1	0.17	7	0.17	4.428	0.110	0.032	**0.14**	**20.74**	27.0	200	15	0.40	179.544	179.436	0.108	0.66	0.020	182.150	2.391	2.499	178.237	OKAY
AREA S45	AI	AJ	26.5	0.63	26	0.63	4.363	0.401	0.120	**0.52**	**20.74**	94.1	200	15	0.40	179.462	179.086	0.376	0.66	0.060	182.100	2.423	2.549	178.212	OKAY
AREA S43	AF	AE	14.7	0.35	15	0.35	4.397	0.224	0.067	**0.29**	**20.74**	25.7	200	15	0.40	179.019	178.916	0.103	0.66	0.060	181.650	2.416	2.569	178.200	OKAY
AREA S39	AI	AH	27.3	0.65	27	0.65	4.361	0.413	0.124	**0.54**	**31.47**	57.4	250	15	0.28	179.611	179.450	0.161	0.64	0.060	182.100	2.224	2.285	178.200	OKAY
AREA S40	AH	AG	19.3	0.46	47	1.11	4.321	0.699	0.211	**0.91**	**31.47**	70.3	250	15	0.28	179.390	179.194	0.197	0.64	0.020	182.000	2.345	2.391	178.200	OKAY
AREA S41	AG	AE	28.6	0.68	75	1.79	4.275	1.116	0.340	**1.46**	**31.47**	91.9	250	15	0.28	179.174	178.916	0.257	0.64	0.060	181.850	2.411	2.519	178.200	OKAY
AREA S36	Z	Y	12.2	0.29	12	0.29	4.406	0.186	0.055	**0.24**	**20.74**	29.4	200	15	0.40	178.807	178.689	0.118	0.66	0.060	181.550	2.528	2.696	178.182	OKAY
AREA S28	AG	AB	22.3	0.53	22	0.53	4.374	0.338	0.101	**0.44**	**31.47**	84.1	250	15	0.28	179.467	179.231	0.235	0.64	0.020	181.850	2.118	2.304	178.183	OKAY
AREA S29	AB	AA	20.2	0.48	42	1.01	4.329	0.638	0.192	**0.83**	**31.47**	73.0	250	15	0.28	179.211	179.007	0.204	0.64	0.060	181.800	2.324	2.428	178.183	OKAY
AREA S30	AA	Y	28.6	0.68	71	1.69	4.281	1.055	0.321	**1.38**	**31.47**	92.0	250	15	0.28	178.947	178.689	0.258	0.64	0.060	181.700	2.488	2.646	178.182	OKAY
AREA S23	AA	V	32.3	0.77	32	0.77	4.349	0.488	0.146	**0.63**	**31.47**	113.0	250	15	0.28	179.317	179.001	0.316	0.64	0.020	181.700	2.118	2.334	178.156	OKAY
AREA S24	V	U	28.1	0.67	60	1.44	4.297	0.902	0.274	**1.18**	**31.47**	95.3	250	15	0.28	178.981	178.714	0.267	0.64	0.060	181.600	2.354	2.471	178.156	OKAY
AREA S25	U	T	28.6	0.68	89	2.12	4.257	1.316	0.403	**1.72**	**31.47**	91.0	250	15	0.28	178.654	178.399	0.255	0.64	0.060	181.450	2.531	2.636	178.156	OKAY
AREA S20	U	R	34.4	0.82	34	0.82	4.345	0.520	0.156	**0.68**	**20.74**	113.4	200	15	0.40	178.908	178.455	0.454	0.66	0.060	181.450	2.327	2.630	178.134	OKAY
AREA S21	R	Q	28.6	0.68	63	1.50	4.293	0.939	0.285	**1.22**	**31.47**	96.6	250	15	0.28	178.395	178.124	0.270	0.64	0.020	181.300	2.640	2.761	178.134	OKAY
AREA S18	T	N	33.2	0.79	33	0.79	4.348	0.501	0.150	**0.65**	**20.74**	92.5	200	15	0.40	178.895	178.525	0.370	0.66	0.060	181.300	2.190	2.460	178.121	OKAY
AREA S16	P	N	38.6	0.92	39	0.92	4.336	0.582	0.175	**0.76**	**20.74**	116.2	200	15	0.40	178.958	178.485	0.473	0.66	0.020	181.350	2.177	2.500	178.122	OKAY
AREA S15	N	M	21.0	0.5	134	3.20	4.206	1.963	0.608	**2.57**	**31.47**	90.2	250	15	0.28	178.465	178.213	0.253	0.64	0.020	181.200	2.470	2.672	178.121	OKAY
AREA S14	M	L	26.0	0.62	160	3.82	4.181	2.329	0.726	**3.06**	**31.47**	90.2	250	15	0.28	178.193	177.940	0.253	0.64	0.020	181.150	2.692	2.895	178.119	OKAY
AREA S4	E	D	[illegible]	0.68	63	0.68	4.293	0.946	0.129	**33.07**	**48.35**	53.0	300	15	0.25	177.913	177.781	0.133	0.68	0.060	180.750 0.150	2.522	2.704	178.150	OKAY
AREA S12	K	N	41.6	0.99	42	0.99	4.330	0.625	0.188	**0.81**	**20.74**	99.9	200	15	0.40	178.925	178.525	0.400	0.66	0.060	181.500 0.150	2.360	2.460	178.122	OKAY
AREA S11	L	G	37.4	0.89	37	0.89	4.339	0.563	0.169	**0.73**	**20.74**	123.6	200	15	0.40	178.734	178.239	0.494	0.66	0.020	181.100	2.151	2.846	177.993	OKAY
[illegible]	SYL	E								**32.00**															
AREA S8	I	H	30.7	0.73	31	0.73	4.353	0.463	0.139	**0.60**	**31.47**	83.4	250	15	0.28	178.726	178.493	0.234	0.64	0.020	181.500	2.509	2.642	177.993	OKAY
AREA S7	H	G	27.3	0.65	58	1.38	4.301	0.866	0.262	**1.13**	**31.47**	83.4	250	15	0.28	178.473	178.239	0.234	0.64	0.020	181.400	2.662	2.796	177.993	OKAY
AREA S6	G	F	44.5	1.06	140	3.33	4.201	2.040	0.633	**2.67**	**31.47**	114.0	250	15	0.28	178.219	177.900	0.319	0.64	0.020	181.300	2.816	3.085	177.992	OKAY
AREA S5	F	B	47.0	1.12	187	4.45	4.159	2.699	0.846	**3.54**	**31.47**	114.0	250	15	0.28	177.880	177.561	0.319	0.64	0.060	181.250	3.105	3.324	177.990	OKAY
AREA S57	AN	AM	26.5	0.63	1583	37.06	3.663	20.132	7.041	**27.17**	**98.76**	117.5	450	15	0.12	179.416	179.275	0.141	0.62	0.020	182.150	2.269	2.310	178.237	OKAY
AREA S52	AM	AL	15.5	0.37	1599	37.43	3.659	20.313	7.112	**27.42**	**98.76**	80.0	450	15	0.12	179.255	179.159	0.096	0.62	0.020	182.050	2.330	2.326	178.227	OKAY
AREA S51	AL	AJ	13.9	0.33	1612	37.76	3.657	20.473	7.174	**27.65**	**98.76**	77.6	450	15	0.12	179.139	179.046	0.093	0.62	0.020	181.950	2.346	2.339	178.219	OKAY
AREA S44	AJ	AE	30.2	0.72	1669	39.11	3.646	21.129	7.431	**28.56**	**98.76**	124.8	450	15	0.12	179.026	178.876	0.150	0.62	0.020	181.850	2.359	2.359	178.212	OKAY
AREA S38	AE	AD	13.0	0.31	1772	41.56	3.626	22.311	7.896	**30.21**	**98.76**	76.6	450	15	0.12	178.856	178.764	0.092	0.62	0.020	181.700	2.379	2.421	178.200	OKAY
AREA S37	AD	Y	17.6	0.42	1790	41.98	3.623	22.513	7.976	**30.49**	**98.76**	79.3	450	15	0.12	178.744	178.649	0.095	0.62	0.020	181.650	2.441	2.486	178.191	OKAY
AREA S27	Y	X	24.4	0.56	1897	44.54	3.603	23.739	8.463	**32.20**	**98.76**	104.2	450	15	0.12	178.629	178.504	0.125	0.62	0.020	181.600	2.506	2.481	178.182	OKAY
AREA S26	X	T	29.4	0.70	1927	45.24	3.598	24.072	8.596	**32.67**	**98.76**	104.2	450	15	0.12	178.484	178.359	0.125	0.62	0.020	181.450	2.501	2.476	178.169	OKAY
AREA S22	T	Q	35.7	0.85	2051	48.21	3.577	25.480	9.160	**34.64**	**98.76**	145.9	450	15	0.12	178.339	178.164	0.175	0.62	0.060	181.300	2.496	2.521	178.155	OKAY
AREA S19	Q	L	17.6	0.42	2132	50.13	3.564	26.384	9.525	**35.91**	**98.76**	103.1	450	15	0.12	178.104	177.980	0.124	0.62	0.060	181.150	2.581	2.655	178.133	OKAY
AREA S13	L	D	65.5	1.56	2395	56.40	3.524	29.306	10.716	**40.02**	**98.76**	149.7	450	15	0.12	177.920	177.741	0.180	0.62	0.020	181.100	2.715	2.594	178.117	OKAY
AREA S3	D	C	[illegible]	1.00	2552	58.08	3.501	31.025	11.035	**74.06**	**98.76**	102.1	450	15	0.12	177.721	177.598	0.123	0.62	0.020	180.800	2.614	3.187	178.088	OKAY
AREA S2	C	B	[illegible]	0.34	2584	58.42	3.497	31.371	11.100	**74.47**	**98.76**	47.7	450	15	0.12	177.578	177.521	0.057	0.62	0.020	181.250	3.207	3.164	178.019	OKAY
AREA S1	B	A	[illegible]	0.00	2771	62.87	3.472	33.398	11.945	**77.34**	**98.76**	46.8	450	15	0.12	177.501	177.445	0.056	0.62	0.000	181.150	3.184	3.740	177.986	OKAY
WESTLAKE	A	Ex. MH	16.6	0.52	2787	63.39	3.469	33.578	12.044	**77.82**	110.42	76.5	450	15	0.15	177.445	177.330	0.115	0.69	0.000	181.650	3.740	3.441	177.952	OKAY

Residential Area - pop. density of 15 units/Ha, 2.8 p/unit
[illegible]
[illegible]
Resulting flow at the connection to the Westlake sewer.

MANNING SECONDARY PLANNING AREA - GOUIN DRAINAGE AREA
SANITARY SEWER FUNCTIONAL DESIGN SHEET

Project Name: MRSPA Functional Design
Project No: 11-5366
Town of Tecumseh

The Peaking Factor was derived:
Using Harmon Formula= Y (Y or N)
From a Table= N
Value from table=

Residential Average Daily Flow= 300 L/Cap.D
Peak Extraneous Flow= 0.190 L/Ha.S

Outlet Invert Elevation= 177.959
Mannings 'n'= 0.013
Total Area= 13.060

Basement Floor Elevation =
or
Hydraulic Grade Line Cover = 2.40

Ground Elevation at Outlet = 181.800
HGL at Outlet = 178.325

Location			Flow Characteristics									Sewer Design/Profile										Cover			Hydraulic Grade Line	
ROAD/STN	LOCATION FROM MH	LOCATION TO MH	INDIVIDUAL POP	INDIVIDUAL AREA (ha.)	CUMULATIVE POP	CUMULATIVE AREA (ha.)	PEAKING FACTOR M	POP FLOW Q(p) (L/s)	PEAK EXTR. FLOW Q(i) (L/s)	PEAK DESIGN FLOW Q(d) (L/s)	CAPACITY (L/s)	LENGTH (m)	PIPE DIA. (mm)	Wall Thickness (mm)	SLOPE (%)	UPPER INVERT (m)	LOWER INVERT (m)	FALL (m)	VELOCITY (m/s)	DROP IN LOWER MANHOLE (m)	Ground Elevation Upper MH	Cover @ Up MH (m)	Cover @ Low MH (m)	HGL Elev at Upstream MH	HGL Elev vs. Grnd Elev @ Up MH
AREA 17	DI	DJ	21.0	0.50	21	0.50	4.378	0.319	0.095	**0.41**	**19.40**	84.1	200	15	0.35	178.922	178.628	0.294	0.62	0.060	181.300	2.163	2.657	178.377	OKAY
AREA 43	DS	DL	19.7	0.47	20	0.47	4.381	0.300	0.089	**0.39**	**19.40**	41.0	200	15	0.35	179.382	179.238	0.144	0.62	0.060	181.650	2.053	2.347	178.408	OKAY
AREA 36	DR	DJ	19.3	0.46	19	0.46	4.382	0.294	0.087	**0.38**	**19.40**	42.6	200	15	0.35	178.717	178.568	0.149	0.62	0.000	181.550	2.618	2.717	178.377	OKAY
AREA 9	DB	DC	31.5	0.75	32	0.75	4.351	0.476	0.143	**0.62**	**19.40**	69.3	200	15	0.35	178.871	178.629	0.243	0.62	0.020	181.500	2.414	2.906	178.337	OKAY
AREA 10	DC	DD	47.5	1.13	79	1.88	4.270	1.171	0.357	**1.53**	**19.40**	117.2	200	15	0.35	178.609	178.198	0.410	0.62	0.060	181.750	2.926	3.537	178.337	OKAY
AREA 47	DM	DG	36.5	0.87	37	0.87	4.340	0.551	0.165	**0.72**	**19.40**	116.3	200	15	0.35	179.510	179.103	0.407	0.62	0.060	182.050	2.325	3.032	178.347	OKAY
AREA 46	DF	DG	10.9	0.26	11	0.26	4.411	0.167	0.049	**0.22**	**19.40**	50.0	200	15	0.35	179.278	179.103	0.175	0.62	0.060	182.600	3.107	3.032	178.347	OKAY
AREA 31	DG	DE	48.7	1.16	96	2.29	4.248	1.419	0.435	**1.85**	**19.40**	124.8	200	15	0.35	179.043	178.607	0.437	0.62	0.000	182.350	3.092	3.329	178.347	OKAY
AREA 32	DE	DD	45.4	1.08	142	3.37	4.199	2.064	0.640	**2.70**	**19.40**	116.6	200	15	0.35	178.607	178.198	0.408	0.62	0.060	182.150	3.329	3.537	178.343	OKAY
AREA 54	DQ	DP	41.2	0.98	41	0.98	4.331	0.619	0.186	**0.81**	**19.40**	64.9	200	15	0.35	180.703	180.476	0.227	0.62	0.000	182.350	1.432	1.560	178.433	OKAY
AREA 55	DP	DO	36.5	0.87	78	1.85	4.272	1.153	0.352	**1.50**	**19.40**	79.8	200	15	0.35	180.476	180.196	0.279	0.62	0.000	182.250	1.559	1.739	178.433	OKAY
AREA 48	DO	DN	33.6	0.80	111	2.65	4.231	1.635	0.504	**2.14**	**19.40**	97.0	200	15	0.35	180.196	179.857	0.340	0.62	0.000	182.150	1.739	2.028	178.431	OKAY
AREA 49	DN	DM	49.6	1.18	161	3.83	4.181	2.335	0.728	**3.06**	**19.40**	107.5	200	15	0.35	179.857	179.480	0.376	0.62	0.000	182.100	2.028	2.355	178.427	OKAY
AREA 42	DM	DL	26.0	0.62	187	4.45	4.159	2.699	0.846	**3.54**	**19.40**	86.3	200	15	0.35	179.480	179.178	0.302	0.62	0.000	182.050	2.355	2.407	178.418	OKAY
AREA 34	DL	DK	27.3	0.65	234	5.57	4.122	3.349	1.058	**4.41**	**19.40**	82.8	200	15	0.35	179.178	178.889	0.290	0.62	0.000	181.800	2.407	2.546	178.408	OKAY
AREA 35	DK	DJ	18.9	0.45	253	6.02	4.109	3.607	1.144	**4.75**	**19.40**	74.5	200	15	0.35	178.889	178.628	0.261	0.62	0.060	181.650	2.546	2.657	178.393	OKAY
AREA 33	DJ	DD	34.9	0.83	328	7.81	4.062	4.626	1.484	**6.11**	**19.40**	122.7	200	15	0.35	178.568	178.138	0.429	0.62	0.000	181.500	2.717	3.597	178.377	OKAY
GOUIN STREET	DD	DA	0.0	0.00	549	13.06	3.953	7.529	2.481	**10.01**	**43.25**	89.7	300	15	0.20	178.138	177.959	0.179	0.61	0.000	181.950	3.497	3.526	178.335	OKAY

Residential Area - pop. density of 15 units/Ha, 2.8 p/unit.
Critical Depth Area
Resulting flow at Gouin Outlet

MANNING SECONDARY PLANNING AREA - CALVARY DRAINAGE AREA
SANITARY SEWER FUNCTIONAL DESIGN SHEET

Project Name: MRSPA Functional Design
Project No: 11-5366
Town of Tecumseh

The Peaking Factor was derived:
Using Harmon Formula= Y (Y or N)
From a Table= N
Value from table=

Residential Average Daily Flow= 300 L/Cap.D
Peak Extraneous Flow= 0.190 L/Ha.S

Outlet Invert Elevation= 177.362
Mannings 'n'= 0.013
Total Area= 5.310

Basement Floor Elevation =
or
Hydraulic Grade Line Cover = 2.40

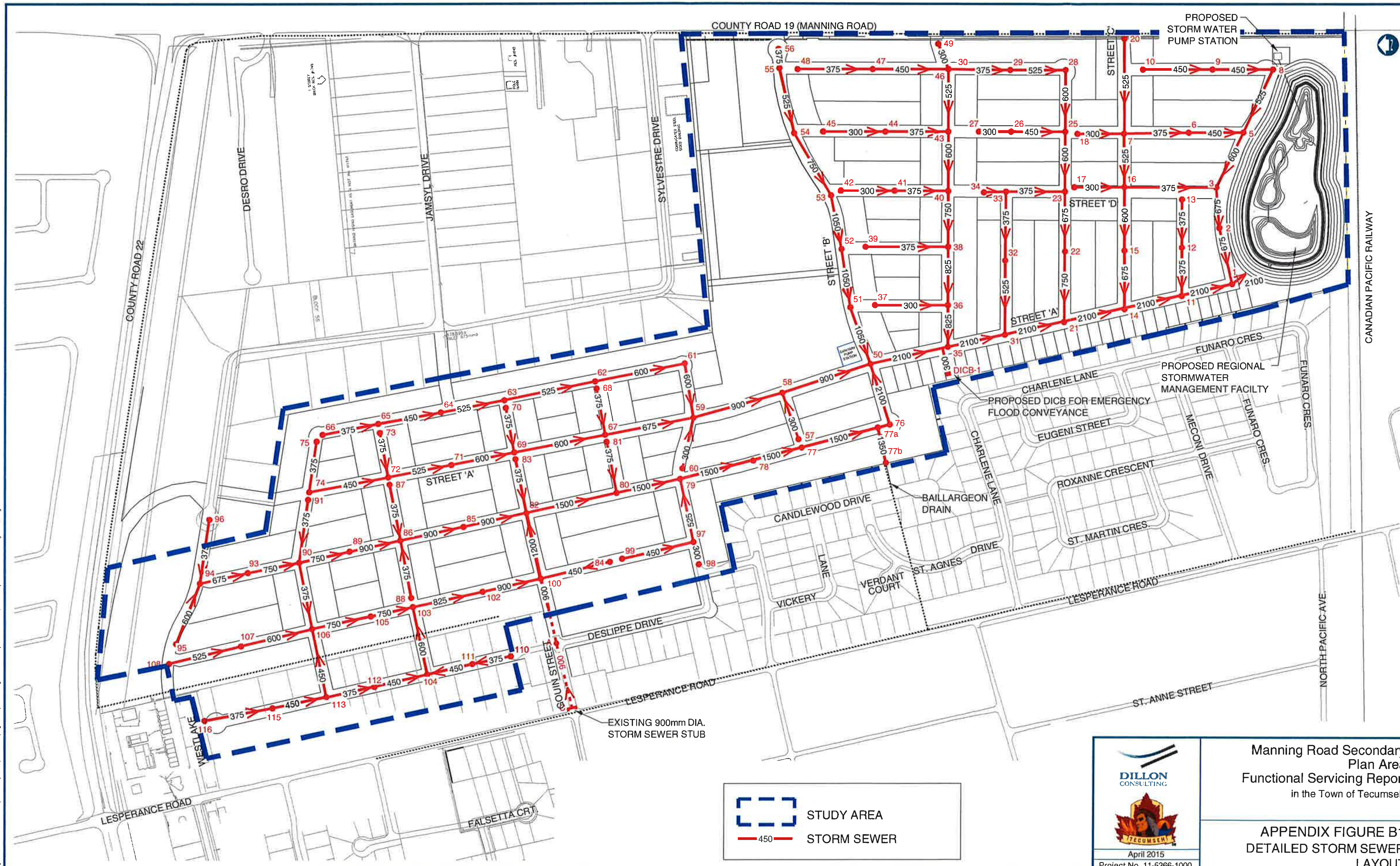
Ground Elevation at Outlet = 181.194
HGL at Outlet = 177.562

Location			Flow Characteristics								Sewer Design/Profile										Cover			Hydraulic Grade Line	
ROAD/STN	LOCATION FROM MH	LOCATION TO MH	INDIVIDUAL POP	INDIVIDUAL AREA (ha.)	CUMULATIVE POP	CUMULATIVE AREA (ha.)	PEAKING FACTOR M	POP FLOW Q(p) (L/s)	PEAK EXTR. FLOW Q(i) (L/s)	PEAK DESIGN FLOW Q(d) (L/s)	CAPACITY (L/s)	LENGTH (m)	PIPE DIA. (mm)	Wall Thickness (mm)	SLOPE (%)	UPPER INVERT (m)	LOWER INVERT (m)	FALL (m)	VELOCITY (m/s)	DROP IN LOWER MANHOLE (m)	Ground Elevation Upper MH	Cover @ Up MH (m)	Cover @ Low MH (m)	HGL Elev at Upstream MH	HGL Elev vs. Grnd Elev @ Up MH
AREA 111	EA	EB	52.6	1.49	63	1.49	4.294	0.933	0.283	**1.22**	**20.74**	113.5	200	15	0.40	179.281	178.827	0.454	0.66	0.020	182.050	2.554	2.958	177.588	OKAY
AREA 112	EB	EC	50.4	1.20	113	2.69	4.229	1.659	0.511	**2.17**	**20.74**	114.3	200	15	0.40	178.807	178.350	0.457	0.66	0.060	182.000	2.978	3.335	177.587	OKAY
AREA 115	EF	EE	30.7	0.73	31	0.73	4.353	0.463	0.139	**0.60**	**20.74**	78.9	200	15	0.40	179.374	179.058	0.316	0.66	0.020	182.350	2.761	2.777	177.587	OKAY
AREA 114	EE	ED	43.3	1.03	74	1.76	4.277	1.098	0.334	**1.43**	**20.74**	85.7	200	15	0.40	179.038	178.696	0.343	0.66	0.020	182.050	2.797	3.089	177.587	OKAY
AREA 113	ED	EC	36.1	0.86	110	2.62	4.232	1.617	0.498	**2.11**	**20.74**	81.5	200	15	0.40	178.676	178.350	0.326	0.66	0.060	182.000	3.109	3.335	177.585	OKAY
LESPERANCE	EC	Ex. MH	0.0	0.00	223	5.31	4.130	3.198	1.009	**4.21**	**20.74**	119.4	200	15	0.40	178.290	177.812	0.478	0.66	0.450	181.900	3.395	3.723	177.582	OKAY

Residential Area - pop. density of 15 units/Ha, 2.8 p/unit.
Resulting flow at the connection to the Lesperance sewer.

APPENDIX B

STORM SEWER PLAN AND DESIGN SHEETS



Manning Road Secondary Plan Area
Functional Servicing Report
in the Town of Tecumseh

DILLON CONSULTING

April 2015
Project No. 11-5366-1000

APPENDIX FIGURE B1
DETAILED STORM SEWER LAYOUT

May 06, 2015 – 6:37pm G:\CAD\115366\Figures\Final Figures – September 20, 2013\March 2015 Figures.dwg

MANNING ROAD SECONDARY PLANING AREA SERVICING PLAN
STORM SEWER DESIGN SHEET

Project Name: MRSPA Servicing Plan
Project No: 11-5366

Based on 1:5 Year AES Storm Event
Town of Tecumseh

Intensity Option # 2

1) Intensity (i) = a/(t+b)^c a= b= c=

2) Intensity (i) = a*t^b a= 32.000 b= -0.712

3) Insert Intensity i=

Total Area (ha)= 184.06 Outlet Invert Elevation= 175.000 Ground Elevation @ Outlet = 182.00 High Water Level at Outlet= 176.64

Location												Sewer Design / Profile										Cover			Hydraulic Grade Line		
Road /Stations	From MH	To MH	Area (ha)	Run. Coef.	2.78AC	Accum. 2.78AC	T of In (min)	T of F (min)	T of Conc. (min)	Intensity (mm/hr)	Exp. Flow (L/s)	Capacity (L/s)	Velocity (m/s)	Wall Thickness (mm)	Length (m)	Pipe Dia. (mm)	Slope (%)	Invert Up MH	Invert Low MH	Fall (m)	Drop Across Low MH	Ground Elev Up MH	Cover @ Up MH (m)	Cover @ Low MH (m)	HGL Elevation at Upstream MH	HGL Elev vs. Grnd Elev @ Up MH	HGL Elev vs. Obvert @ Up MH
See Page 2 for West Drainage Area Details																											
AREA 82	A	100	0.24	0.40	0.27	18.95	20.0	1.09	33.42	48.54	919.76	957.93	1.51	121.0	98.2	900	0.28	179.871	179.596	0.27	0.600	181.980	1.09	1.38	178.21	Okay	HGL intersects Obvert
AREA 65	98	97	0.27	0.40	0.30	0.30	20.0	0.72	20.00	69.96	21.01	61.16	0.87	70.0	37.2	300	0.40	178.057	177.908	0.15	0.060	182.250	3.82	3.92	177.55	Okay	HGL intersects Obvert
AREA 101	108	107	1.25	0.40	1.39	1.39	20.0	2.42	20.00	69.96	97.25	177.32	0.82	89	119.0	525	0.17	179.531	179.329	0.20	0.020	181.150	1.01	1.23	178.59	Okay	HGL intersects Obvert
AREA 100	107	106	1.07	0.40	1.19	2.58	20.0	2.36	22.42	64.49	166.39	237.81	0.84	95	119.0	600	0.15	179.309	179.130	0.18	0.020	181.175	1.17	1.40	178.53	Okay	HGL intersects Obvert
AREA 96	106	105	0.84	0.40	0.93	6.83	20.0	1.71	25.40	59.01	402.89	416.55	0.94	108	96.8	750	0.14	179.110	178.975	0.14	0.020	181.225	1.26	1.47	178.44	Okay	HGL intersects Obvert
AREA 95	105	103	0.57	0.40	0.63	7.46	20.0	1.15	27.12	56.33	420.32	445.31	1.01	108	69.5	750	0.16	178.955	178.843	0.11	0.020	181.300	1.49	1.65	178.31	Okay	HGL intersects Obvert
AREA 81	103	102	1.01	0.40	1.12	12.14	20.0	1.53	28.26	54.69	664.12	673.28	1.26	114	115.7	825	0.22	178.823	178.569	0.25	0.020	181.350	1.59	2.09	178.21	Okay	HGL intersects Obvert
AREA 80	102	100	0.81	0.40	0.90	13.04	20.0	1.38	29.80	52.67	687.09	746.41	1.17	121	97.1	900	0.17	178.549	178.384	0.17	0.020	181.600	2.03	2.40	177.97	Okay	HGL intersects Obvert
AREA 67	84	100	1.23	0.40	1.37	1.37	20.0	2.41	20.00	69.96	95.69	127.50	0.80	64	116.0	450	0.20	178.996	178.764	0.23	0.400	182.000	2.49	2.52	177.96	Okay	HGL intersects Obvert
AREA 66	99	97	1.06	0.40	1.18	1.18	20.0	2.49	20.00	69.96	82.47	127.50	0.80	64	120.0	450	0.20	178.148	177.908	0.24	0.060	182.000	3.34	3.78	177.63	Okay	HGL intersects Obvert
AREA 64	97	79	0.87	0.40	0.97	2.45	20.0	2.08	22.49	64.34	157.41	182.46	0.84	89	105.0	525	0.18	177.848	177.659	0.19	0.910	182.200	3.74	3.73	177.53	Okay	HGL intersects Obvert
AREA 106	96	94	0.73	0.70	1.42	1.42	20.0	1.42	20.00	69.96	99.39	135.81	1.23	76	105.0	375	0.60	178.699	178.069	0.63	0.060	180.750	1.60	2.18	178.64	Okay	HGL intersects Obvert
AREA 99	90	106	0.87	0.40	0.97	0.97	20.0	2.26	20.00	69.96	67.68	89.40	0.81	76	110.0	375	0.26	179.656	179.370	0.29	0.260	181.000	0.89	1.40	178.60	Okay	HGL intersects Obvert
AREA 93	91	90	0.52	0.40	0.58	0.58	20.0	1.98	20.00	69.96	40.45	96.03	0.87	76	103.3	375	0.30	179.486	179.176	0.31	1.500	181.300	1.36	1.37	178.12	Okay	HGL intersects Obvert
AREA 90	87	86	0.81	0.40	0.90	0.90	20.0	1.77	20.00	69.96	63.02	96.03	0.87	76	92.5	375	0.30	179.536	179.259	0.28	1.900	181.350	1.36	1.39	177.99	Okay	HGL intersects Obvert
AREA 94	88	86	0.86	0.40	0.96	0.96	20.0	1.82	20.00	69.96	66.91	96.03	0.87	76	94.9	375	0.30	178.744	178.459	0.28	1.100	181.350	2.16	2.19	178.01	Okay	HGL intersects Obvert
AREA 76	83	82	0.76	0.40	0.85	0.85	20.0	1.71	20.00	69.96	59.13	96.03	0.87	76	89.4	375	0.30	179.714	179.446	0.27	2.400	181.500	1.33	1.40	177.74	Okay	HGL intersects Obvert
AREA 79	100	82	0.83	0.40	0.92	34.28	20.0	0.94	34.51	47.44	1626.59	2135.42	1.89	127	106.0	1200	0.30	178.364	178.046	0.32	1.000	181.800	2.11	1.93	177.83	Okay	HGL intersects Obvert
AREA 71	81	80	0.72	0.40	0.80	0.80	20.0	1.62	20.00	69.96	56.01	96.03	0.87	76	84.4	375	0.30	177.148	176.895	0.25	0.020	181.600	4.00	4.15	177.58	Okay	Okay
AREA 62	60	59	0.18	0.40	0.20	0.20	20.0	1.62	20.00	69.96	14.00	61.16	0.87	70	84.3	300	0.40	176.927	176.590	0.34	0.060	182.000	4.70	4.87	177.46	Okay	Okay
AREA 105	95	94	1.54	0.70	3.00	3.00	20.0	2.21	20.00	69.96	209.66	245.60	0.87	95	115.0	600	0.16	179.093	178.909	0.18	0.900	181.100	1.31	1.10	178.43	Okay	HGL intersects Obvert
AREA 104	94	93	0.88	0.40	0.98	5.40	20.0	1.22	22.21	64.94	350.40	385.21	1.08	102	78.7	675	0.21	178.009	177.844	0.17	0.020	180.700	1.91	2.18	178.30	Okay	HGL intersects Obvert
AREA 103	93	90	0.69	0.40	0.77	6.16	20.0	1.45	23.43	62.51	385.29	431.17	0.98	108	85.0	750	0.15	177.824	177.696	0.13	0.020	180.800	2.12	2.45	178.16	Okay	HGL intersects Obvert
AREA 98	90	89	0.61	0.40	0.68	7.42	20.0	1.24	24.88	59.90	444.41	497.87	1.13	108	84.0	750	0.20	177.676	177.508	0.17	0.020	181.000	2.47	2.68	178.06	Okay	HGL intersects Obvert
AREA 97	89	86	0.49	0.40	0.54	7.96	20.0	1.36	26.12	57.85	460.78	652.72	1.03	121	84.0	900	0.13	177.488	177.379	0.11	0.020	181.050	2.54	2.70	177.93	Okay	HGL intersects Obvert
AREA 78	86	85	0.70	0.40	0.78	10.60	20.0	1.71	27.48	55.79	591.41	652.72	1.03	121	105.0	900	0.13	177.359	177.222	0.14	0.020	181.100	2.72	2.96	177.87	Okay	HGL intersects Obvert
AREA 77	85	82	0.69	0.40	0.77	11.37	20.0	1.71	29.19	53.45	607.60	652.72	1.03	121	105.0	900	0.13	177.202	177.066	0.14	0.020	181.200	2.98	3.21	177.76	Okay	HGL intersects Obvert
AREA 72	82	80	0.96	0.40	1.07	47.56	20.0	1.99	35.44	46.55	2214.07	2235.37	1.26	152	150.8	1500	0.10	177.046	176.895	0.15	0.020	181.300	2.60	2.95	177.64	Okay	HGL intersects Obvert
AREA 63	80	79	0.61	0.40	0.68	49.04	20.0	1.40	37.43	44.78	2195.96	2235.37	1.26	152	105.9	1500	0.10	176.875	176.769	0.11	0.020	181.500	2.97	3.58	177.49	Okay	HGL intersects Obvert
AREA 92	75	74	0.62	0.40	0.69	0.69	20.0	1.71	20.00	69.96	48.23	89.40	0.81	76	83.0	375	0.26	179.683	179.467	0.22	1.400	181.250	1.12	1.38	178.67	Okay	HGL intersects Obvert
AREA 88	73	72	0.68	0.40	0.76	0.76	20.0	1.52	20.00	69.96	52.90	89.40	0.81	76	73.6	375	0.26	179.848	179.657	0.19	2.000	181.250	0.95	1.24	178.49	Okay	HGL intersects Obvert
AREA 83	70	69	0.67	0.40	0.75	0.75	20.0	1.51	20.00	69.96	52.12	89.40	0.81	76	73.5	375	0.26	180.032	179.841	0.19	2.600	181.450	0.97	1.21	178.15	Okay	HGL intersects Obvert
AREA 73	68	67	0.67	0.40	0.75	0.75	20.0	1.57	20.00	69.96	52.12	89.40	0.81	76	76.3	375	0.26	178.141	177.943	0.20	1.100	181.525	2.93	3.21	177.79	Okay	HGL intersects Obvert
AREA 91	74	72	0.84	0.40	0.93	1.62	20.0	2.21	21.71	65.99	107.14	156.16	0.98	64	130.0	450	0.30	178.067	177.677	0.39	0.020	181.300	2.72	3.16	178.61	Okay	Okay
AREA 87	72	71	0.64	0.40	0.71	3.09	20.0	1.91	23.92	61.60	190.42	197.08	0.91	89	104.1	525	0.21	177.657	177.438	0.22	0.020	181.350	3.08	3.32	178.42	Okay	Okay
AREA 86	71	69	0.64	0.40	0.71	3.80	20.0	2.08	25.82	58.33	221.82	237.81	0.84	95	105.0	600	0.15	177.418	177.261	0.16	0.020	181.375	3.26	3.54	178.22	Okay	Okay
AREA 75	69	67	0.79	0.40	0.88	5.43	20.0	2.32	27.90	55.20	299.52	307.01	1.09	95	151.1	600	0.25	177.241	176.863	0.38	0.020	181.500	3.56	4.04	178.08	Okay	Okay
AREA 70	67	59	0.81	0.40	0.90	7.07	20.0	2.33	30.22	52.14	368.78	375.92	1.05	102	146.8	675	0.20	176.843	176.550	0.29	0.020	181.600	3.98	4.50	177.72	Okay	Okay
AREA 89	66	65	0.76	0.40	0.85	0.85	20.0	1.75	20.00	69.96	59.13	96.03	0.87	76	91.1	375	0.30	178.476	178.203	0.27	0.020	181.250	2.32	2.60	178.64	Okay	HGL intersects Obvert
AREA 85	65	64	0.72	0.40	0.80	1.65	20.0	1.76	21.75	65.91	108.48	156.16	0.98	64	103.8	450	0.30	178.183	177.872	0.31	0.020	181.250	2.55	2.61	178.53	Okay	HGL intersects Obvert
AREA 84	64	63	0.72	0.40	0.80	2.45	20.0	2.08	23.51	62.36	152.55	182.46	0.84	89	105.0	525	0.18	177.852	177.663	0.19	0.020	181.000	2.53	3.17	178.38	Okay	Okay
AREA 74	63	62	0.98	0.40	1.09	3.54	20.0	2.53	25.58	58.71	207.61	215.03	0.99	89	151.0	525	0.25	177.643	177.265	0.38	0.020	181.450	3.19	3.65	178.25	Okay	Okay
AREA 69	62	61	1.14	0.40	1.27	4.80	20.0	2.29	28.12	54.89	263.70	307.01	1.09	95	149.1	600	0.25	177.245	176.873	0.37	0.060	181.525	3.58	4.08	177.90	Okay	Okay
AREA 68	61	59	0.48	0.40	0.53	5.34	20.0	1.37	30.41	51.92	277.12	307.01	1.09	95	89.2	600	0.25	176.813	176.590	0.22	0.060	181.650	4.14	4.54	177.62	Okay	Okay
AREA 60	79	78	0.90	0.40	1.00	52.49	20.0	1.54	38.83	43.62	2289.86	2344.48	1.33	152	122.9	1500	0.11	176.749	176.614	0.14	0.020	182.000	3.60	3.83	177.39	Okay	HGL Intersects Obvert
AREA 59	78	77	0.76	0.40	0.85	53.34	20.0	0.94	40.37	42.43	2263.02	2548.72	1.44	152	81.4	1500	0.13	176.594	176.488	0.11	0.010	182.100	3.85	4.06	177.26	Okay	HGL Intersects Obvert
AREA 56	77	77a	1.69	0.40	1.88	55.21	20.0	1.48	41.31	41.74	2304.65	2548.72	1.44	152	128.2	1500	0.13	176.478	176.311	0.17	0.060	182.200	4.07	4.24	177.18	Okay	HGL intersects Obvert
AREA 55	76	50	0.75	0.40	0.83	143.02	20.0	0.92	101.68	21.98	3143.59	6487.67	1.87	203	103.2	2100	0.14	176.165	176.021	0.14	0.060	182.250	3.78	3.78	177.03	Okay	HGL intersects Obvert
AREA 58	57	58	0.17	0.40	0.19	0.19	20.0	1.54	20.00	69.96	13.23	61.16	0.87	70	79.9	300	0.40	176.632	176.313	0.32	0.060	182.200	5.20	5.27	177.24	Okay	Okay
AREA 61	59	58	1.05	0.40	1.17	13.78	20.0	2.14	32.55	49.46	681.44	746.41	1.17	121	151.0	900	0.17	176.530	176.273	0.26	0.020	181.825	4.27	4.66	177.44	Okay	Okay
AREA 57	58	50	0.82	0.40	0.91	14.88	20.0	2.08	34.70	47.26	703.20	768.05	1.21	121	151.0	900	0.18	176.253	175.981	0.27	0.020	181.950	4.68	5.10	177.23	Okay	Okay

MANNING ROAD SECONDARY PLANING AREA SERVICING PLAN
STORM SEWER DESIGN SHEET

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Intensity Option # 2

1) Intensity (i) = a/(t+b)^c a= b= c=

2) Intensity (i) = a*t^b a= 32.000 b= -0.712

3) Insert Intensity i=

Based on 1:5 Year AES Storm Event
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Total Area (ha)= 184.06 Outlet Invert Elevation= 175.000 Ground Elevation @ Outlet = 182.00 High Water Level at Outlet= 176.64

Location														Sewer Design / Profile								Cover			Hydraulic Grade Line		
Road /Stations	From MH	To MH	Area (ha)	Run. Coef.	2.78AC	Accum. 2.78AC	T of In (min)	T of F (min)	T of Conc. (min)	Intensity (mm/hr)	Exp. Flow (L/s)	Capacity (L/s)	Velocity (m/s)	Wall Thickness (mm)	Length (m)	Pipe Dia. (mm)	Slope (%)	Invert Up MH	Invert Low MH	Fall (m)	Drop Across Low MH	Ground Elev Up MH	Cover @ Up MH (m)	Cover @ Low MH (m)	HGL Elevation at Upstream MH	HGL Elev vs. Grnd Elev @ Up MH	HGL Elev vs. Obvert @ Up MH
AREA 54	56	55	0.20	0.40	0.22	0.22	20.0	0.57	20.00	69.96	**15.56**	**103.73**	0.94	76	32.0	375	0.35	178.282	178.170	0.11	0.020	180.750	2.02	2.18	177.55	Okay	HGL intersects Obvert
AREA 54	55	54	1.74	0.40	1.93	2.16	20.0	2.01	20.57	68.58	**147.95**	**192.33**	0.89	89	107.0	525	0.20	178.150	177.936	0.21	0.020	180.800	2.04	2.35	177.54	Okay	HGL intersects Obvert
AREA 52/53	54	53	1.85	0.60	3.11	5.26	20.0	2.03	22.58	64.18	**337.83**	**431.17**	0.98	108	119.0	750	0.15	177.916	177.738	0.18	0.020	180.900	2.13	2.60	177.42	Okay	HGL intersects Obvert
AREA 51	53	52	4.74	0.67	8.78	14.04	20.0	1.16	24.61	60.36	**847.45**	**1158.55**	1.34	133	93.0	1050	0.18	177.718	177.550	0.17	0.020	181.200	2.30	2.77	177.31	Okay	HGL intersects Obvert
AREA 50	52	51	0.43	0.40	0.48	14.52	20.0	1.20	25.77	58.42	**848.07**	**1158.55**	1.34	133	96.0	1050	0.18	177.530	177.357	0.17	0.020	181.500	2.79	3.26	177.22	Okay	HGL intersects Obvert
AREA 49	51	50	4.53	0.22	2.77	17.29	20.0	1.22	26.96	56.56	**977.82**	**1158.55**	1.34	133	98.0	1050	0.18	177.337	177.161	0.18	1.200	181.800	3.28	3.76	177.13	Okay	HGL intersects Obvert
AREA 45	45	44	0.70	0.40	0.77	0.77	20.0	1.94	20.00	69.96	**54.07**	**61.16**	0.87	70	101.0	300	0.40	179.374	178.970	0.40	0.020	180.950	1.21	2.11	177.98	Okay	HGL intersects Obvert
AREA 44	44	43	0.47	0.40	0.52	1.30	20.0	1.96	21.94	65.49	**84.84**	**96.03**	0.87	76	102.0	375	0.30	178.950	178.644	0.31	0.300	181.450	2.05	2.91	177.66	Okay	HGL intersects Obvert
AREA 43	42	41	0.70	0.40	0.77	0.77	20.0	1.68	20.00	69.96	**54.07**	**61.16**	0.87	70	87.0	300	0.40	178.811	178.463	0.35	0.020	181.200	2.02	2.82	177.71	Okay	HGL intersects Obvert
AREA 42	41	40	0.47	0.40	0.52	1.30	20.0	1.67	21.68	66.07	**85.59**	**96.03**	0.87	76	87.0	375	0.30	178.443	178.182	0.26	0.060	181.650	2.76	3.47	177.44	Okay	HGL intersects Obvert
AREA 41	39	38	0.91	0.40	1.01	1.01	20.0	2.22	20.00	69.96	**70.72**	**110.89**	1.00	76	134.0	375	0.40	179.684	179.148	0.54	1.200	181.525	1.39	2.00	177.34	Okay	HGL intersects Obvert
AREA 40	37	36	0.72	0.40	0.80	0.80	20.0	2.29	20.00	69.96	**56.01**	**61.16**	0.87	70	119.0	300	0.40	180.161	179.685	0.48	1.900	181.850	1.32	1.94	177.42	Okay	HGL intersects Obvert
AREA 39	49	46	0.09	0.40	0.10	0.10	20.0	0.85	20.00	69.96	**7.00**	**61.16**	0.87	70	44.0	300	0.40	179.513	179.337	0.18	0.800	181.550	1.67	1.94	177.58	Okay	HGL intersects Obvert
AREA 47	48	47	1.02	0.40	1.13	1.13	20.0	2.36	20.00	69.96	**79.35**	**96.03**	0.87	76	123.0	375	0.30	179.232	178.863	0.37	0.020	180.800	1.12	1.91	178.04	Okay	HGL intersects Obvert
AREA 46	47	46	0.63	0.40	0.70	1.83	20.0	2.56	22.36	64.63	**118.57**	**127.50**	0.80	64	123.0	450	0.20	178.843	178.597	0.25	0.060	181.225	1.87	2.54	177.79	Okay	HGL intersects Obvert
AREA 38	46	43	0.78	0.40	0.86	2.80	20.0	2.08	24.91	59.83	**167.32**	**177.32**	0.82	89	102.0	525	0.17	178.537	178.364	0.17	0.020	181.650	2.50	3.02	177.58	Okay	HGL intersects Obvert
AREA 37	43	40	0.72	0.40	0.80	4.89	20.0	1.61	26.99	56.52	**276.27**	**281.38**	1.00	95	96.0	600	0.21	178.344	178.142	0.20	0.020	182.000	2.96	3.26	177.42	Okay	HGL intersects Obvert
AREA 36	40	38	0.72	0.40	0.80	6.99	20.0	1.46	28.60	54.24	**378.99**	**459.02**	1.04	108	91.0	750	0.17	178.122	177.968	0.15	0.020	182.100	3.12	2.77	177.23	Okay	HGL intersects Obvert
AREA 35	38	36	0.80	0.40	0.89	8.89	20.0	1.52	30.06	52.35	**465.15**	**555.94**	1.04	114	95.0	825	0.15	177.948	177.805	0.14	0.020	181.600	2.71	3.26	177.13	Okay	HGL intersects Obvert
AREA 34	36	35	0.50	0.40	0.55	10.24	20.0	0.94	31.58	50.54	**517.35**	**641.95**	1.20	114	68.0	825	0.20	177.785	177.649	0.14	1.900	182.000	3.28	3.61	177.03	Okay	HGL intersects Obvert
AREA 32	34	33	0.49	0.40	0.54	0.54	20.0	0.71	20.00	69.96	**38.12**	**61.16**	0.87	70	36.7	300	0.40	179.882	179.736	0.15	0.060	182.075	1.82	1.94	177.40	Okay	HGL intersects Obvert
AREA 31	33	32	0.69	0.40	0.77	1.31	20.0	2.15	20.71	68.25	**89.63**	**96.03**	0.87	76	112.0	375	0.30	179.676	179.340	0.34	0.020	182.050	1.92	2.31	177.34	Okay	HGL intersects Obvert
AREA 30	32	31	1.04	0.40	1.16	2.47	20.0	2.46	22.85	63.62	**157.13**	**177.32**	0.82	89	121.0	525	0.17	179.320	179.114	0.21	3.500	182.100	2.17	2.27	177.05	Okay	HGL intersects Obvert
AREA 26	27	26	0.64	0.40	0.71	0.71	20.0	1.03	20.00	69.96	**49.79**	**61.16**	0.87	70	53.5	300	0.40	179.974	179.760	0.21	0.020	182.000	1.66	1.84	177.65	Okay	HGL intersects Obvert
AREA 25	26	25	0.80	0.40	0.89	1.60	20.0	1.85	21.03	67.50	**107.79**	**127.50**	0.80	64	89.0	450	0.20	179.740	179.562	0.18	0.500	181.975	1.72	1.87	177.50	Okay	HGL intersects Obvert
AREA 24	33	23	0.78	0.40	0.87	0.87	20.0	1.84	20.00	69.96	**60.92**	**96.03**	0.87	76	95.9	375	0.30	180.407	180.119	0.29	1.300	182.050	1.19	1.43	177.28	Okay	HGL intersects Obvert
AREA 28	46	29	0.86	0.40	0.95	0.95	20.0	1.93	20.00	69.96	**66.75**	**96.03**	0.87	76	100.8	375	0.30	179.815	179.512	0.30	0.020	181.650	1.38	1.94	177.70	Okay	HGL intersects Obvert
AREA 27	29	28	1.01	0.40	1.12	2.08	20.0	1.69	21.93	65.52	**136.09**	**192.33**	0.89	89	90.0	525	0.20	179.492	179.312	0.18	0.060	181.900	1.79	2.22	177.55	Okay	HGL intersects Obvert
AREA 23	28	25	0.72	0.40	0.80	2.88	20.0	1.86	23.62	62.15	**178.84**	**253.16**	0.90	95	100.0	600	0.17	179.252	179.082	0.17	0.020	182.150	2.20	2.17	177.46	Okay	HGL intersects Obvert
AREA 22	25	23	0.37	0.40	0.41	4.88	20.0	1.55	25.48	58.88	**287.55**	**294.47**	1.04	95	97.0	600	0.23	179.062	178.839	0.22	0.020	181.950	2.19	2.47	177.38	Okay	HGL intersects Obvert
AREA 21	23	22	0.58	0.40	0.64	6.39	20.0	1.54	27.03	56.45	**360.94**	**375.92**	1.05	102	97.0	675	0.20	178.819	178.625	0.19	0.020	182.000	2.40	2.80	177.16	Okay	HGL intersects Obvert
AREA 20	22	21	1.03	0.40	1.15	7.54	20.0	1.70	28.57	54.27	**409.15**	**497.87**	1.13	108	115.0	750	0.20	178.605	178.375	0.23	2.900	182.200	2.74	2.72	176.98	Okay	HGL intersects Obvert
AREA 18	18	7	0.16	0.40	0.18	0.18	20.0	1.46	20.00	69.96	**12.76**	**61.16**	0.87	70	76.0	300	0.40	180.499	180.195	0.30	0.060	181.950	1.08	1.34	177.27	Okay	HGL intersects Obvert
AREA 17	17	16	0.74	0.40	0.83	0.83	20.0	1.58	20.00	69.96	**57.80**	**61.16**	0.87	70	82.0	300	0.40	180.329	180.001	0.33	0.060	182.000	1.30	1.48	177.40	Okay	HGL intersects Obvert
AREA 16	20	7	1.31	0.64	2.33	2.33	20.0	3.13	20.00	69.96	**163.06**	**177.32**	0.82	89	153.9	525	0.17	180.416	180.155	0.26	0.020	182.000	0.97	1.13	177.48	Okay	HGL intersects Obvert
AREA 15	7	16	0.32	0.40	0.36	2.87	20.0	1.63	23.13	63.08	**180.97**	**192.33**	0.89	89	86.8	525	0.20	180.135	179.961	0.17	0.020	181.900	1.15	1.27	177.26	Okay	HGL intersects Obvert
AREA 14	16	15	0.55	0.40	0.62	4.31	20.0	1.64	24.76	60.10	**259.09**	**347.34**	1.23	95	121.0	600	0.32	179.941	179.554	0.39	0.020	181.850	1.21	1.63	177.10	Okay	HGL intersects Obvert
AREA 13	15	14	0.80	0.40	0.89	5.20	20.0	1.44	26.40	57.41	**298.46**	**394.27**	1.10	102	95.0	675	0.22	179.534	179.325	0.21	4.000	181.875	1.56	1.80	176.89	Okay	HGL intersects Obvert
AREA 12	13	12	0.33	0.40	0.36	0.36	20.0	1.50	20.00	69.96	**25.28**	**96.03**	0.87	76	78.0	375	0.30	180.457	180.223	0.23	0.020	181.850	0.94	1.28	176.80	Okay	HGL intersects Obvert
AREA 11	12	11	0.43	0.40	0.47	0.84	20.0	1.50	21.50	66.46	**55.50**	**96.03**	0.87	76	78.0	375	0.30	180.203	179.969	0.23	4.800	181.950	1.30	1.68	176.79	Okay	HGL intersects Obvert
AREA 5	7	6	0.79	0.40	0.88	0.88	20.0	2.02	20.00	69.96	**61.46**	**96.03**	0.87	76	105.2	375	0.30	180.689	180.373	0.32	0.020	181.950	0.81	1.05	177.43	Okay	HGL intersects Obvert
AREA 4	6	5	0.86	0.40	0.95	1.83	20.0	1.87	22.02	65.34	**119.73**	**127.50**	0.80	64	90.0	450	0.20	180.353	180.173	0.18	0.400	181.875	1.01	1.16	177.30	Okay	HGL intersects Obvert
AREA 3	16	3	1.12	0.40	1.25	1.25	20.0	3.08	20.00	69.96	**87.13**	**89.40**	0.81	76	149.8	375	0.26	180.345	179.955	0.39	0.400	181.850	1.05	1.34	177.33	Okay	HGL intersects Obvert
AREA 8	10	9	1.07	0.40	1.19	1.19	20.0	2.37	20.00	69.96	**83.24**	**127.50**	0.80	64	114.0	450	0.20	180.679	180.451	0.23	0.020	182.050	0.86	0.99	177.65	Okay	HGL intersects Obvert
AREA 7	9	8	0.96	0.40	1.06	2.25	20.0	1.77	22.37	64.60	**145.54**	**148.15**	0.93	64	99.0	450	0.27	180.431	180.163	0.27	0.020	181.950	1.01	1.22	177.55	Okay	HGL intersects Obvert
AREA 6	8	5	0.25	0.40	0.28	2.53	20.0	1.70	24.14	61.19	**154.86**	**239.45**	1.11	89	113.0	525	0.31	180.143	179.793	0.35	0.020	181.900	1.14	1.44	177.29	Okay	HGL intersects Obvert
AREA 2	5	3	0.21	0.40	0.23	4.60	20.0	1.70	25.84	58.29	**267.96**	**274.59**	0.97	95	99.0	600	0.20	179.773	179.575	0.20	0.020	181.850	1.38	1.48	177.15	Okay	HGL intersects Obvert
AREA 1	3	2	0.49	0.40	0.54	6.38	20.0	0.99	27.54	55.71	**355.51**	**394.27**	1.10	102	65.4	675	0.22	179.555	179.411	0.14	0.020	181.750	1.42	1.76	176.96	Okay	HGL intersects Obvert
AREA 1	2	1	0.49	0.40	0.54	6.92	20.0	1.41	28.53	54.33	**375.99**	**394.27**	1.10	102	93.3	675	0.22	179.391	179.186	0.21	4.160	181.950	1.78	2.04	176.84	Okay	HGL intersects Obvert
AREA 48	50	35	0.81	0.40	0.90	176.09	20.0	1.10	102.60	21.84	**3845.78**	**6715.38**	1.94	203	128.0	2100	0.15	175.961	175.769	0.19	0.020	182.100	3.84	4.13	177.00	Okay	HGL intersects Obvert
AREA 33	35	31	0.65	0.40	0.72	187.05	20.0	0.92	103.70	21.67	**4054.18**	**6006.41**	1.73	203	96.0	2100	0.12	175.749	175.634	0.12	0.020	182.200	4.15	4.06	176.94	Okay	HGL intersects Obvert
AREA 29	31	21	0.58	0.40	0.65	190.16	20.0	0.95	104.62	21.54	**4095.85**	**6006.41**	1.73	203	99.0	2100	0.12	175.614	175.495	0.12	0.020	182.000	4.08	4.15	176.88	Okay	HGL intersects Obvert
AREA 19	21	14	0.59	0.40	0.65	198.36	20.0	0.92	105.58	21.40	**4244.87**	**6251.67**	1.80	203	100.0	2100	0.13	175.475	175.345	0.13	0.020	181.950	4.17	4.25	176.83	Okay	HGL intersects Obvert
AREA 10	14	11	0.54	0.40	0.60	204.15	20.0	0.86	106.50	21.27	**4341.87**	**6487.67**	1.87	203	97.0	2100	0.14	175.325	175.189	0.14	0.020	181.900	4.27	4.61	176.77	Okay	HGL intersects Obvert
AREA 9	11	1	0.55	0.40	0.61	205.60	20.0	0.78	107.36	21.15	**4347.51**	**6487.67**	1.87	203	88.0	2100	0.14	175.169	175.046	0.12	0.020	182.100	4.63	4.65	176.71	Okay	HGL intersects Obvert
OUTLET	1	POND	0.00	0.40	0.00	212.52	20.0	0.18	108.15	21.04	**4470.68**	**6251.67**	1.80	203	20.0	2100	0.13	175.026	175.000	0.03		182.000	4.67	4.70	176.65	Okay	HGL intersects Obvert

MANNING ROAD SECONDARY PLANING AREA SERVICING PLAN
STORM SEWER DESIGN SHEET

Project Name: MRSPA Servicing Plan
Project No: 11-5366

Based on 1:5 Year AES Storm Event
Town of Tecumseh

Intensity Option # 2

1) Intensity (i) = a/(t+b)^c a= b= c=

2) Intensity (i) = a*t^b a= 32.000 b= -0.712

3) Insert Intensity I=

Total Area (ha)= 184.06 Outlet Invert Elevation= 175.000 Ground Elevation @ Outlet = 182.00 High Water Level at Outlet= 176.64

Location													
Road /Stations	From MH	To MH	Area (ha)	Run. Coef.	2.78AC	Accum. 2.78AC	T of In (min)	T of F (min)	T of Conc. (min)	Intensity (mm/hr)	Exp. Flow (L/s)	Capacity (L/s)	Velocity (m/s)
AREA 107	116	115	1.17	0.40	1.30	1.30	20	1.98	20.00	69.96	**91.02**	**103.73**	0.94
AREA 108	115	113	0.94	0.40	1.05	2.35	20	1.52	21.98	65.42	**153.51**	**156.16**	0.98
375 MM	113	106	0.00	0.40	0.00	2.35	20	1.90	23.50	62.37	**146.36**	**156.16**	0.98
AREA 109	113	112	0.80	0.40	0.89	0.89	20	1.52	20.00	69.96	**62.24**	**92.78**	0.84
AREA 110	112	104	0.94	0.40	1.05	1.93	20	1.22	21.52	66.42	**128.51**	**191.26**	1.20
AREA 112	110	111	0.66	0.40	0.73	0.73	20	1.31	20.00	69.96	**51.35**	**57.21**	0.81
AREA 111	111	104	0.80	0.40	0.89	1.62	20	1.17	21.31	66.86	**108.55**	**168.67**	1.06
375 MM	104	103	0.00	0.40	0.00	3.56	20	1.83	22.74	63.85	**227.22**	**288.00**	1.02
Baillargeon Drain*	77b	77a	78.21	0.4	86.97	86.97	20	0.49	101.00	22.09	**2600.00**	**2923.42**	2.04
EX. 1	C	A	0.001	0.35	0.00	17.07	20	1.34	32.09	49.97	**852.84**	**905.16**	1.42
	77a	76	0.001	0.4	0.00	142.19	20	0.19	101.49	22.01	**3129.51**	**5130.63**	1.72

	Sewer Design / Profile								Cover			Hydraulic Grade Line		
Road /Stations	Wall Thickness (mm)	Length (m)	Pipe Dia. (mm)	Slope (%)	Invert Up MH	Invert Low MH	Fall (m)	Drop Across Low MH	Ground Elev Up MH	Cover @ Up MH (m)	Cover @ Low MH (m)	HGL Elevation at Upstream MH	HGL Elev vs. Grnd Elev @ Up MH	HGL Elev vs. Obvert @ Up MH
AREA 107	76	111.3	375	0.35	180.486	180.096	0.39	0.02	181.950	1.01	1.23	179.30	Okay	HGL Intersects Obvert
AREA 108	64	89.8	450	0.30	180.076	179.807	0.27	0.06	181.775	1.18	1.33	179.00	Okay	HGL Intersects Obvert
375 MM	64	112.2	450	0.30	179.747	179.410	0.34	0.3	181.650	1.39	1.30	178.74	Okay	HGL Intersects Obvert
AREA 109	76	76.4	375	0.28	180.160	179.946	0.21	0.02	181.650	1.04	1.35	178.64	Okay	HGL intersects Obvert
AREA 110	64	88.2	450	0.45	179.926	179.529	0.40	0.06	181.750	1.31	1.81	178.55	Okay	HGL intersects Obvert
AREA 112	70	63.8	300	0.35	180.033	179.810	0.22	0.02	182.050	1.65	1.77	178.66	Okay	HGL intersects Obvert
AREA 111	64	74.5	450	0.35	179.790	179.529	0.26	0.06	181.950	1.65	1.81	178.48	Okay	HGL Intersects Obvert
375 MM	95	111.7	600	0.22	179.469	179.223	0.25	0.4	181.850	1.69	1.43	178.37	Okay	HGL intersects Obvert
Baillargeon Drain*	159	60	1350	0.30	178.231	178.051	0.18	1.80	181.95	2.21	2.64	177.19	Okay	HGL intersects Obvert
EX. 1	121	114.1	900	0.25	180.756	180.471	0.29	0.6	182.8	1.02	0.49	178.46	Okay	HGL intersects Obvert
	191	20	1950	0.13	176.251	176.225	0.03	0.06	182.2	3.81	3.88	177.04	Okay	HGL Intersects Obvert

APPENDIX C

GEODETIC BENCHMARK REPORT

VERHAEGEN STUBBERFIELD HARTLEY BREWER BEZAIRE INC.
WINDSOR LEAMINGTON
ONTARIO LAND SURVEYORS

Bernard J. Bezaire, O.L.S.
Andrew S. Mantha, B.Sc., O.L.S.
Roy A. Simone, B.Sc., O.L.S.
Brian Coad, B.Sc., O.L.S.

475 Devonshire Rd., Suite 200
WINDSOR, ON. N8Y 2L5
519-258-1772
Fax 519-258-1791
email: windsor.office@vshbbsurveys.com

RE: Manning Road Secondary Plan Area Geodetic Benchmarks
Established by Verhaegen Stubberfield Hartley Brewer Bezaire Inc. September 2012

Origin of Geodetic Elevations:

Station: 0011959U3036, CGVD-1928:197, First Order Vertical Accuracy
Location: St Anne's Roman Catholic Church, At corner of Lesperance Street and Tecumseh Road. Tablet in East Stone Foundation wall, 5.03m from Northeast corner, 41cm above ground level.

Set Geodetic Benchmarks:

Benchmark 4-26206 01: Geodetic Elevation: 180.810m

PKnail in top of Concrete Pump Station located on the South side of Sylvestre Drive opposite municipal number 1606 Sylvestre Drive.
The PKnail is located in the Northeast corner 0.8m South from the North face and 0.8m West from the East face of concrete pad.

Benchmark 4-26206 02: Geodetic Elevation: 181.746m

Top of Railway Spike in the West side of wood utility pole located at the Southwest corner of Sylvestre Drive.
The Railway Spike is 0.3m above grade and 26.2m West of the Northwest corner of building at municipal number 13315 Sylvestre Drive.

Benchmark 4-26206 03: Geodetic Elevation: 182.854m

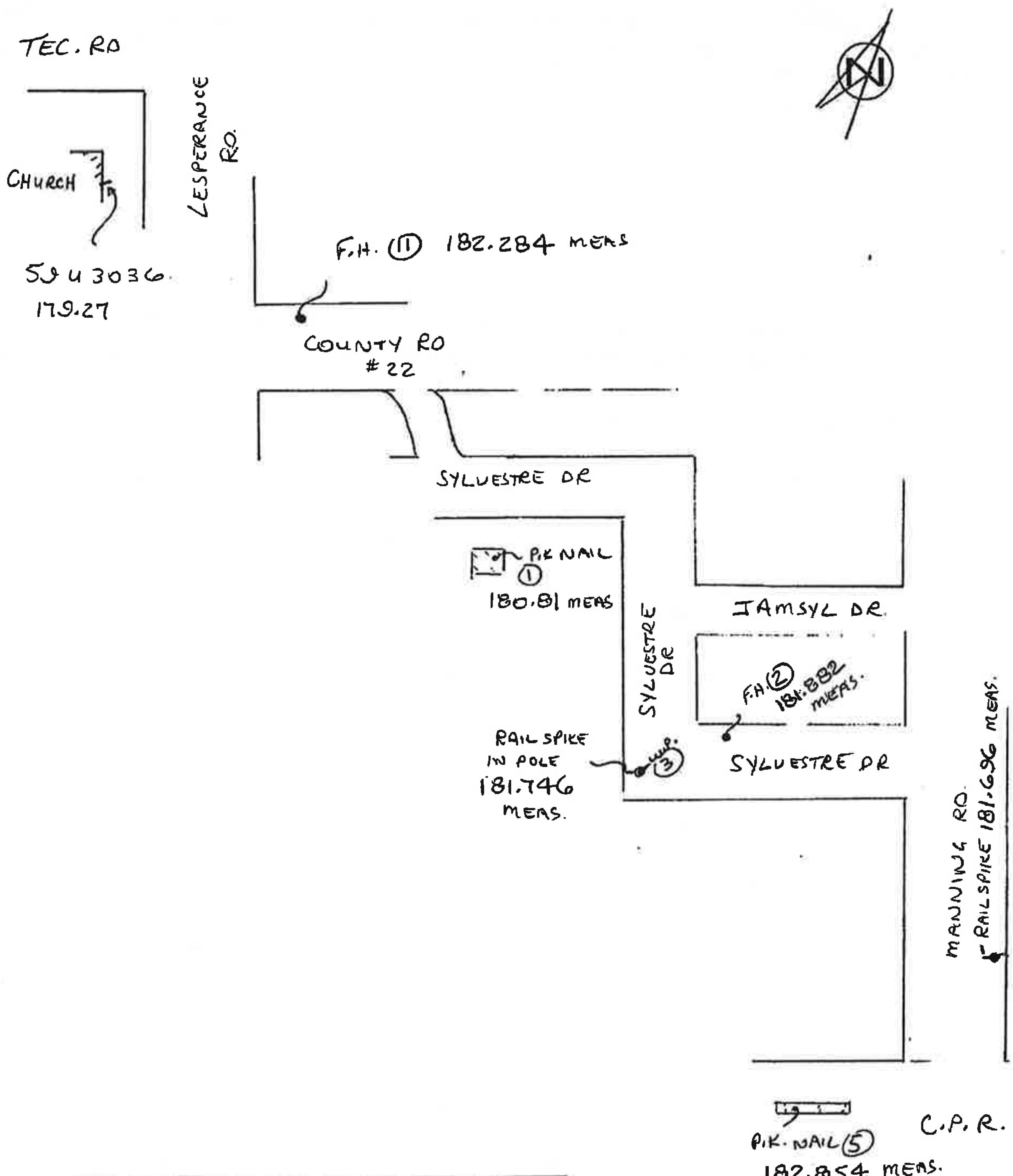
PKnail in top of Concrete Wall of Concrete Culvert on the North side of Canadian Pacific Railway tracks West of Manning Road.
The Concrete Wall of Concrete Culvert is 6.0m West of the West side of pavement of Manning Road and 1.9m North of the North rail of the railway tracks. The PKnail is located 0.6m East of the West face and 0.2m North of the South face.

DATE SEPT 4/12 FIELD CREW GC JJC JC JOB № 4-26206

LOT PT LOT 154-156 WEATHER CLOUDY RAIN 75°F FILE

~~PLAN~~ or CON. 1, 2 METRIC ■ PLAN FILE

MUNICIPALITY TEC IMPERIAL ☐ PAGE 7 OF 11



VERHAEGEN STUBBERFIELD HARTLEY BREWER BEZAIRE INC

ONTARIO LAND SURVEYORS

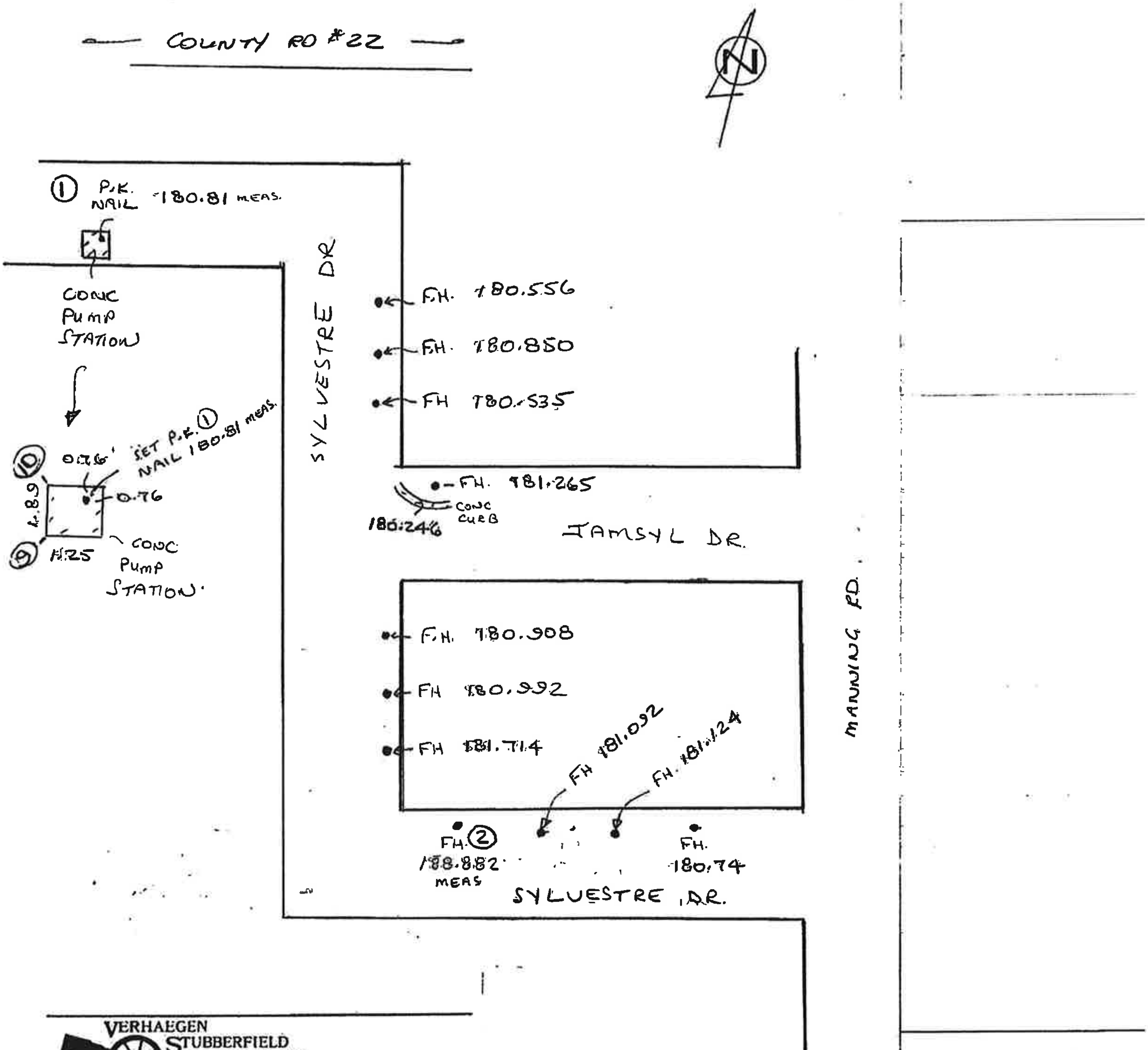
WINDSOR 1-519-258-1772
LEAMINGTON 1-519-322-2375

DATE Sept 4/12 FIELD CREW GC JJC JC JOB № 4-26206

LOT PT LOT 154-156 WEATHER CLOUDY RAIN 75°F FILE

~~PLAN~~ or CON. 1, 2 METRIC ■ PLAN FILE

MUNICIPALITY TEC IMPERIAL □ PAGE 9 OF 11



DATE SEPT 4/12 FIELD CREW GC JTC JC JOB № 4-26206

LOT PT LOT 154-156 WEATHER CLOUDY RAIN 75°F FILE

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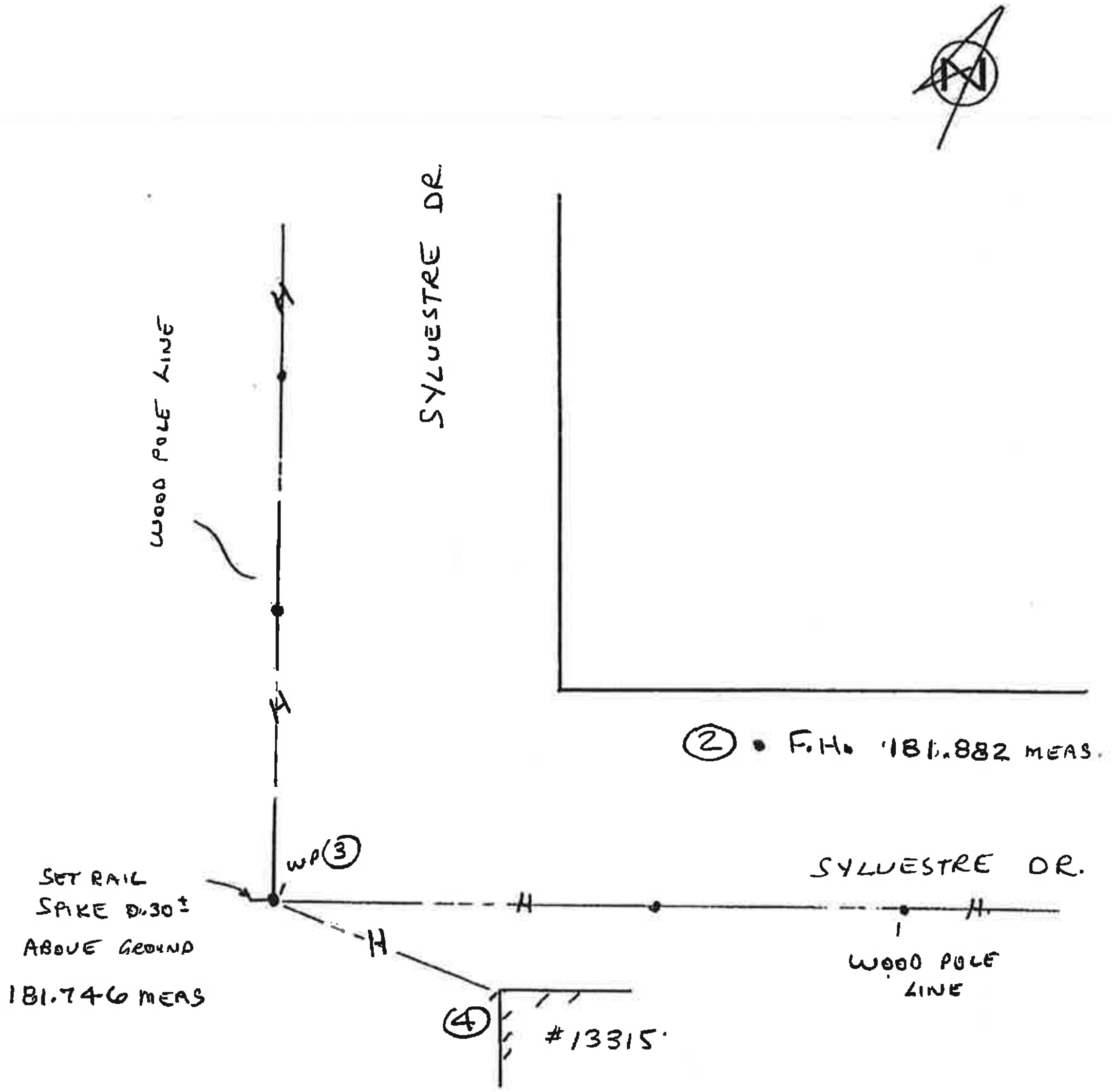
MUNICIPALITY TE IMPERIAL ☐ PAGE 10 OF 11



VERHAEGEN STUBBERFIELD HARTLEY BREWER BEZAIRE INC
ONTARIO LAND SURVEYORS

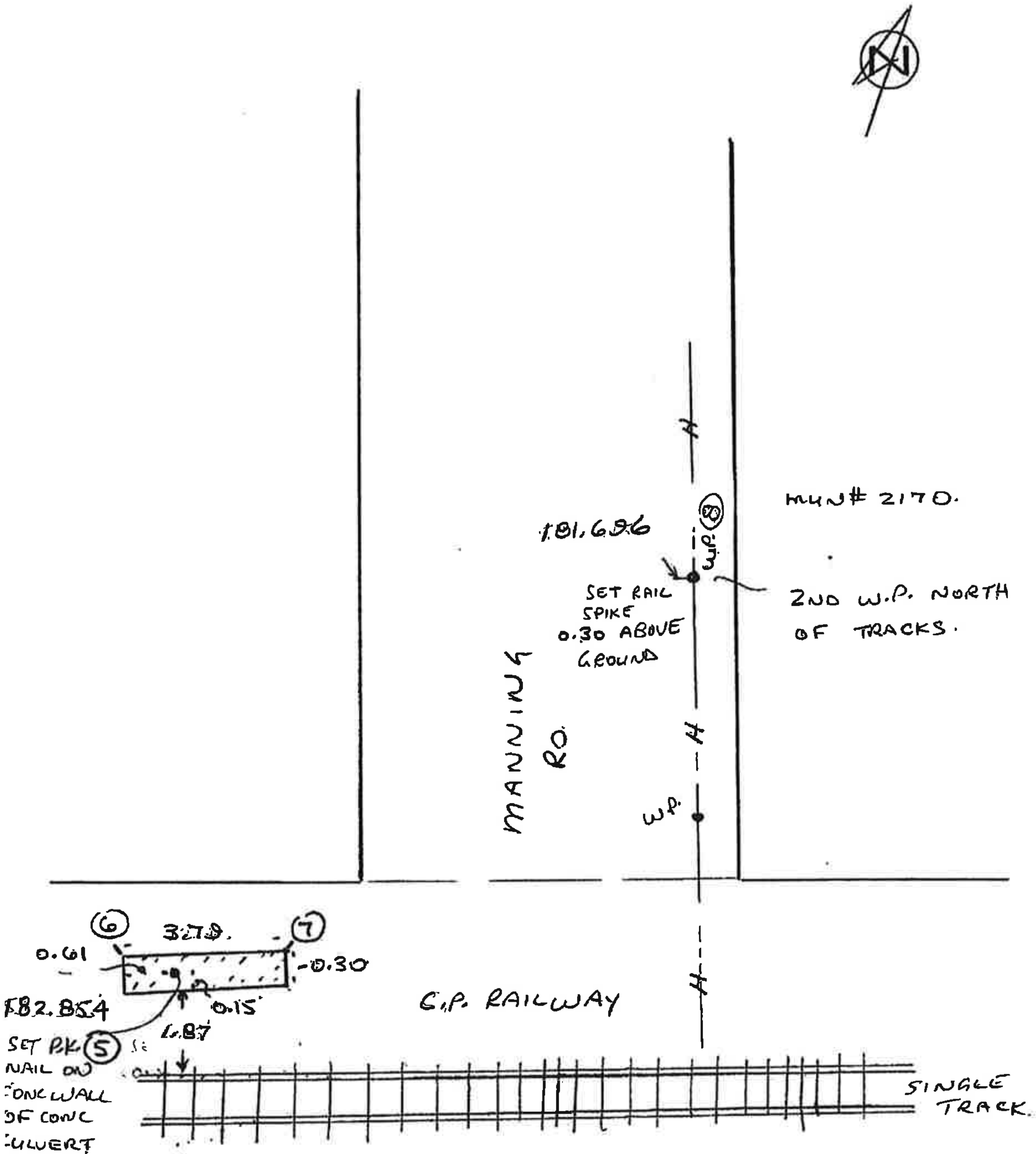
WINDSOR 1-519-258-1772
LEAMINGTON 1-519-322-2375

DATE SEPT 4/12 FIELD CREW GC JC JC JOB № 4-26206

LOT PT LOT 154-156 WEATHER CLOUDY RAIN 75°F FILE

~~PLAN~~ or CON. 1, 2 METRIC ■ PLAN FILE

MUNICIPALITY TEC. IMPERIAL ☐ PAGE 11 OF 11



VERHAEGEN STUBBERFIELD HARTLEY BREWER BEZAIRE INC

ONTARIO LAND SURVEYORS

WINDSOR 1-519-258-1772
LEAMINGTON 1-519-322-2375

APPENDIX D

LAND VALUATION COST ANALYSIS

The foregoing study examined sales of vacant sites available for the development of single family detached dwellings between January 2009 and May 2013. The parameters of the search were locations in the Town of LaSalle, the City of Windsor, the Town of Tecumseh and the Town of Lakeshore. All four municipalities are adjoining and situated in the north part of Essex County, Ontario.

The preceding summary of the statistical analysis excludes the Town of Tecumseh in that there were an insufficient number of sales transactions in Tecumseh during this period to warrant a separate analysis. Our research indicated that the only residential subdivision developed in the Town of Tecumseh during this period was located on Candlewood Drive wherein a total of 29 sales were discovered. Candlewood Drive features custom design detached residences on large lots, typically with 75' to 80' frontages. The lot prices varied from $85,000 to $130,200 (Average $112,066; Median $120,000). These sales were included in the statistical analysis of the entire population of 891 sales.

The transactions analyzed included individual sales and 'bulk' sales. Most individual transactions are typically cash sales. 'Bulk' sales involve the transfer of several properties, typically from a single developer to a single builder. In these transactions, often 'builders terms' are offered wherein a vendor may agree to hold a mortgage at a preferred interest rate or minimal payment requirement, until such time as a house is built and sold. In certain cases, a 'bulk' sales discount may apply wherein a vendor may discount the sales price. Past studies undertaken have suggested that discounts typically range between 10% and 15%.

The purpose of this study is to provide the Town of Tecumseh with a sample and statistical analysis of detached single family residential building site prices. Therefore, the statistical results include both individual site sales and 'bulk' sales; sites located in the competing areas of the Towns of LaSalle and Lakeshore and the City of Windsor; and all sites suitable for development of detached single family residences regardless of size.

Based strictly upon the foregoing statistical analysis and resulting probabilities, the following conclusions may be drawn:

Typical Lot Size:	**65' x 125'**
Typical Lot Area:	**8,125 square feet.**
Typical Front Foot Price:	**$1,200**
Typical Square Foot Price:	**$9.60**

RESIDENTIAL BUILDING SITE PRICES

UPDATE

City of Windsor

Town of LaSalle

Town of Tecumseh

Town of Lakeshore

RAY BOWER APPRAISAL SERVICES INC.

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APRIL 2015

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Professional Real Estate Advisory Service
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April 30, 2015

Mr. Brian Hillman
Director, Planning and Building Services
Town of Tecumseh,
917 Lesperance Road,
Tecumseh, ON
N8N 1W9

Re: Manning Road Secondary Plan Area
Area Specific Development Charges

Dear Mr. Hillman,

In response to your request, I have review the consultation report provided for the above described matter and herein provide you with my opinion as to a value conclusion as of April 2015.

Residential Building Site Prices Study - 2009-2013

By way of summary, the above noted report was prepared to assist in applying land prices for incorporation into the Area Specific Development Charge for the Manning Road Secondary Plan Area (MRSPA). The value conclusions is based on a statistical analysis of residential building site sales between January 2009 and September 2013 that took place in the Town of Tecumseh as well as the immediately surrounding municipalities of the City of Windsor, Town of LaSalle and Town of Lakeshore.

In updating the conclusions to better reflect prices as of April 2015, we have examined overall residential real estate average prices in Essex County during the past two years. In addition, we have examined additional sales data involving residential building site sales that transacted subsequent to September 2013.

The vacant land sale price statistics provided by the Windsor Essex County Association of Realtors (WECAR) include all vacant land sales regardless of the Official Plan designation, zoning or potential use. Therefore, vacant commercial and industrial sites are included in with the vacant residential sites sales statistics. Further, the population of sales is relatively small in the course of a year and a statistical analysis of this data may be misleading. As you are aware, it was for these reasons that we undertook the original September 2013 study wherein we isolated the vacant land sales from both MLS statistics and additional sources, which were relevant to the assignment.

None-the-less, an examination at the overall improved average residential sale prices can provide some insight into the action of the local residential market. The following statistics provide the average residential sale price. The statistics include the sale prices of detached single family dwellings.

	2013	Units Sold	2014	Units Sold	Change	1st Qtr.2015	Units Sold	Change
Avg. Residential Sale Price (Essex County)	$183,428	5180	$191,406	5211	4%	$189,091	1148	-1%
City of Windsor	$169,445	3384	$172,812	3374	2%	$172,997	788	0%
Tecumseh/St.Clair Beach/Sand.South	$262,283	252	$252,105	229	-4%	$237,157	61	-6%
Lakeshore	$290,824	282	$329,185	301	13%	$341,309	49	4%
Combined	$277,355	534	$295,881	530	7%	$283,552.00	110	-4%

The overall average residential sale prices increased between 2% (City of Windsor) and 7% (Tecumseh and Lakeshore) in 2014. The number of units sold were approximately the same for both 2013 and 2014 indicating that the market is relatively balanced in terms of both supply and demand.

The most recent CMHC information also suggests a relatively stable new housing market. For example, housing starts in the Essex County area in the 4th quarter of 2014 were 216 units, compared to 219 units in the 4th quarter of 2013. On the other hand, for the year, housing starts increased 14% in 2014 from 708 units in 2013 to 806 units in 2014, marking the first year of growth following two years of stabilization. New house prices overall increased 9% in 2014, partially attributed to rising construction costs. It is noted, however, that price gains in Amherstburg and LaSalle were actually offset by price declines in Lakeshore. Prices were virtually unchanged in the City of Windsor.

In addition to the foregoing, we have conducted research into sales of residential building sites that transacted subsequent to September 2013. The parameters of the search and methodology of the analysis are consistent with the *Residential Building Site Prices 2009-2013* study.[1]

Section 6 - Overall Sale Price Statistics

The analysis of the overall sale prices of residential building site initially examined 890 transactions up to September 2013. We have conducted research into an additional 169 sales that transacted subsequent to September 2013. They have been incorporated into the statistical analysis on a square foot basis with the following result.

SECTION 6 **Overall Sale Price Statistics**

	Variables	*Avg.PSF*	*Change*
September 2013	890	$9.00	
Update - 2015	1059	$9.16	1.8%

The above statistical calculation would indicate that the addition of 169 sale prices has resulted in a combined average approximately 1.8% higher than originally reported. It should be noted that the overall average for the additional 169 sale prices was $9.99 per square foot which is approximately 4.1% higher than the conclusion of $9.60 per square foot (See SECTION 9).

1 The *Residential Building Site Prices 2009-2013* study undertook an analysis of building site size statistics. This update only examines sale price statistics under the assumption that the typical lot area and size conclusions remain as reported.

Based upon the foregoing, it appears that residential building lot prices in the areas of concern are indeed rising. The following table summarizes the unit sale prices by year.

SECTION 6 **Averages by Year**

	Lot Price	Change	*PSF*	Change
2009	$75,575		$9.03	
2010	$73,405	-2.9%	$9.45	4.7%
2011	$66,499	-9.4%	$8.74	-7.5%
2012	$70,925	6.7%	$9.09	4.0%
2013	$82,469	16.3%	$9.93	9.2%
2014	$81,570	-1.1%	$10.14	2.1%
2015	$89,157	9.3%	$9.17	-9.6%

While overall average lot prices during the first 3 months of 2015 have increased 9.3%, the unit price appears to have decreased -9.6%. This would indicate that the actual lot sizes are larger. Unfortunately, this update only examines eleven (11) additional sales in 2015, a number that may not produce a reliable indication of the trend of prices. Combining the 2014 and 2015 sales results in an average price of $10.05 per square foot.

Section 7 - Municipal Statistics

The following tables provides a summary of the statistical analysis undertaken in Section 7. The additional sales examined have been incorporated into the statistical analysis on a square foot basis with the following result.

Windsor Sale Price Statistics

	Variables	*Avg.PSF*	*Change*
September 2013	274	$10.29	
Update - 2015	57	$10.36	0.7%

LaSalle Sale Price Statistics

	Variables	*Avg.PSF*	*Change*
September 2013	180	$9.77	
Update - 2015	27	$10.07	3.1%

Lakeshore Sale Price Statistics

	Variables	*Avg.PSF*	*Change*
September 2013	314	$7.22	
Update - 2015	30	$7.24	0.3%

City of Windsor prices demonstrated average prices increases since September 2013 between 2.4% and 6.9% depending on the specific subdivision. The Town of Lakeshore experience greater increases between 4.7% and 17.5%, again depending on the specific subdivision. LaSalle prices demonstrated the largest increases between 32% and 36%, however, the sales involved only two subdivisions and the sample size was relatively small.

Section 8 - Summary

The *Residential Building Site Prices Study - 2009-2013* undertook an analysis of prices in the City of Windsor and Towns of LaSalle and Lakeshore primarily due to the fact that there were insufficient sales of vacant residential building sites in the Town of Tecumseh during that period. However, we analyzed an additional 55 sales of residential building sites in the Town of Tecumseh that transacted subsequent to September 2013 as follows:

Town of Tecumseh - Sales Subsequent to September 2013

	Average
Avg. Lot Price	$92,590
Median Lot Price	$91,800
Avg. PSF	$9.62
Median PSF	$10.30

Current Town of Tecumseh data indicates that the average unit sale price is similar to the average price conclusion in the *Residential Building Site Prices Study - 2009-2013.* However, the median sale price of $10.30 per square foot may actually provide a better indication of the typical price in that one half of the sale prices were below $10.30 per square foot and one half of the sale prices were above $10.30 per square foot. The unit price of $10.30 per square foot is approximately 7.3% higher than the conclusion in the *Residential Building Site Prices Study - 2009-2013* and tend to be supported by the analysis of the overall residential sale price increase being experienced in Essex County based on MLS statistics.

Other factors affecting vacant residential land prices include weather (as we are all aware, the past two winters have been extremely harsh by Essex County standards); a shift in demand from detached single family dwelling to townhouses; employment; population growth; affordability; etc. Also, vacant land, being a non-wasting asset, typically appreciates faster than improved properties because vacant land is not subject to depreciation. Further, the carrying costs of vacant land are relatively low compared to improved properties and owners of vacant land can afford to hold onto the asset for longer periods of time.

The foregoing analysis, as with the *Residential Building Site Prices Study - 2009-2013,* is not intended to estimate the actual sizes and prices of residential building sites that will eventually evolve in the Manning Road Secondary Planning Area. It is intended to provide the Town of Tecumseh with a 'benchmark' for the Area Specific Development Charges.

Therefore, based strictly upon the foregoing analysis and in concert with the *Residential Building Site Prices Study - 2009-2013* , it is my conclusion that for purposes of the MRSP Area Specific Development Charges, the Land Costs should be increased by 7% as of April 2015.

Stormwater Management Facility Land Valuation Table

Value $98,505 per acre | **Statistic Model**

Typical frontage	65	feet
Typical Depth	125	feet
Typical Area	8125	sq.ft.
Per Front Foot Price	$1,284	per FF
Lot Value	$83,460	

Parkfee (PF)

PF	=	Per Lot Park Fee			
a	=	Per Lot Sale Price			
	=	**$83,460**			
Area Specific Development Charge					
ADC	=	**$1.99**	per sq.ft.		
Servicing Costs					
SC	=	**$450.00**	per front foot		
b	=	SC x Frontage			
	=	**$29,250**			
c	=	ADC x Area			
	=	**$16,134**			
Total		$45,384	per lot		
PF	=	0.0476 ((0.875 x a) - (0.75 x b) -(c))			
	=	0.0476	$73,028	$21,938	$16,134
	=	0.0476	$34,956		
PF	=	**$1,664**	**per lot**		
	=	$25.60	per front foot		

Pondland Valuation (X)

Density	=	(43,560)-(L+33)(33)/W(L+33)				
	=	43560	5214	10270		
	=	**3.7337877**	per acre			
X	=	Purchase Price for Pond Land				
Land Area	=		**6.8**	hectares		
	or		16.8 acres			
Lots	=	**62.73707**	Lots available			
Developable Area	=		**87.14**	hectares		
	or		215.3 acres			
Lots	=	**804**	Lots available			
DLV	=	***Developable Lots Value***				
	=	(Lot Price) x (Number of lots)				
	=	$83,460	62.737073			
	=	$5,236,036				
SC	=	***Servicing Costs***				
	=	$450	per front foot			
	=	$29,250	per lot			
	=	$1,835,059	total for	62.737073 lots		
NB	=	***Noise Barrier***				
	=	**$250,000**				
ADC	=	***Area Specific Development Charge***				
	=	$1.99	per sq.ft.			
	=	$16,134	per lot			
	=	$1,012,205	total for	62.737073 lots		
X	=	(0.875 x DLV)	(0.85 x SC)	*+ NB*	*ADC*	*PF*
	=	$4,581,532	$1,559,800	$250,000	$1,012,205	$104,388
	=	$1,655,138				
	or	**$98,505 per acre**				

Stormwater Management Facility Land Valuation Rationale

The Stormwater Management Facility ("SWM Facility") land valuation is based on the fact that each development must contribute SWM Facility land to provide for the quality and quantity of the storm water emanating from any given development in the Manning Road Secondary Plan Area. The problem is one of determining the fair value to be used as the purchase price for the SWM Facility land to be included in the Local Development Charge. The method of distributing this cost over the whole of the Development Area is contained within the DC itself. The only exercise we need to concern ourselves with is that of determining the fair purchase price for the SWM Facility land. In this case the fair value to be used for the pond land purchase price is that value which represents the present value of the land in the state required for the release of building permits by Council net of the costs required to realize this value. This approach assures that the owners of the SWM Facility land receive similar consideration for their lands when compared to that realized by the owners of the development lands. Accordingly there is no opportunity lost to the owners of the SWM Facility land.

The formula $\mathbf{X} = \mathbf{G}(\mathbf{a} - 0.125\mathbf{a} - 0.85\mathbf{b} - \mathbf{c} - \mathbf{d})$

where :
- **X** = the total purchase price for the SWM Facility land,
- **a** = the estimated per lot sale price (lot yield).
- 0.125**a** = the engineering, legal, administrative costs including real estate fees.
- 0.85**b** = the adjusted per lot servicing cost; adjusted as compensation for the services installed along the single tier frontage, plus the cost/lot for the construction of the noise barrier,
- **c** = the applicable per lot area-specific development charge,
- **d** = the applicable per lot park fee,
- **G** = the gross number of lots that could have been constructed on the SWM Facility land,

mathematically illustrates this philosophy. That is, that the SWM Facility land value shall be the value of the SWM Facility land at the time the building permits are released by Council minus the costs i.e. the inputs that would have been required to realize this value. Since these inputs are not required by the owner of the SWM Facility land, the value of the property at the time of the release of building permits minus the cost of the inputs represents the fair valuation of the property and hence fair remuneration to the owner of the SWM Facility land.

The formula when mathematically reduced becomes:

$$X = G(0.875a - .85b - c - d)$$

All values and assumptions used to calculate the purchase price shall be subject to the verification of and approval of the Town. The Town shall be entitled to use any and all necessary measures to ensure the accuracy of the values provided, including but not limited to the use of a certified appraiser.

The detailed land valuation calculations are shown in the attached Stormwater Management Facility Land Valuation table, an explanation of which is provided in the following Sample Calculation.

Sample Calculation

a) Calculation of the SWM Facility Land Value:

The area of the SWM Facility land = 6.8ha = 16.8 acres

The number of lots in the SWM Facility land (G) = 62.737 lots based on 3.734 lots /acre, where the assumed lot size is:

L = 125 ft and W = 65 ft

Developable land area = 87.14ha = 215.3 acres = 804 lots (based on 3.734 lots/acre)

a = $1,284/ft x 65ft/lot frontage = $83,460/lot

b = $450/ft x 65ft/lot frontage = $29,250/lot

Noise Barrier Cost = $250,000/62.737 lots = $3,984.89/lot

c = $12,971,104/(804 lots x 8,125 ft^2/lot) = $1.99/$ft^2$ (net lot area basis)

d = $1,664/lot (net lot area basis)

Then:

X = 62.737(.875(83,460) – (.85(29,250) + 3,984.89) – 16,134 – 1,664)

X = $ 1,655,138 (calculated value from attached table)

Therefore, the value of the SWM Facility land (based on the calculated values from the attached table) is $ 1,655,138 as the payment for 16.8 acres of SWM Facility land.

Calculation of the Factor for "a"

The yield from any one lot is reduced by the administrative inputs required to realize the yield. The costs for engineering, legal, survey and administration costs, including real estate fees has been estimated at 12.5% of the lot yield. Accordingly the yield for any one lot value **a** is reduced by .125 to .875**a**.

Calculation of the Adjustment Factor for "b"

The area of land fronting on serviced roadways was calculated to be 3 acres. At a density (as calculated below) of 3.734 lots per acre (L=125, W=65) then this 3 acres would yield 11.20 lots. A reduction of 2 lots was used to reduce the yield to account for the reduction in servicing costs due to the fact that the laterals etc. will not have to be installed. Therefore, 9.20 of 62.737 lots (factor of 0.15) would be fronting on serviced roadways, with the balance (or 1- 0.15=0.85) of the 62.737 lots being considered to have actually been serviced by the developer and the costs for doing so are therefore recoverable. Accordingly, the lot servicing cost value **b** is reduced by .15 to .85b.

Calculation of the per acre Lot Density

The per acre Lot Density formula is: **D** = (43,560 – 33(L + 33)) / W(L+33)

Where L is the length and W is the width of the lot, as shown in the attached figure.

For this area, an expected representative lot size is L=125 ft and W=65 ft, therefore:

D = (43,560 – 33(158)) / 65(158)

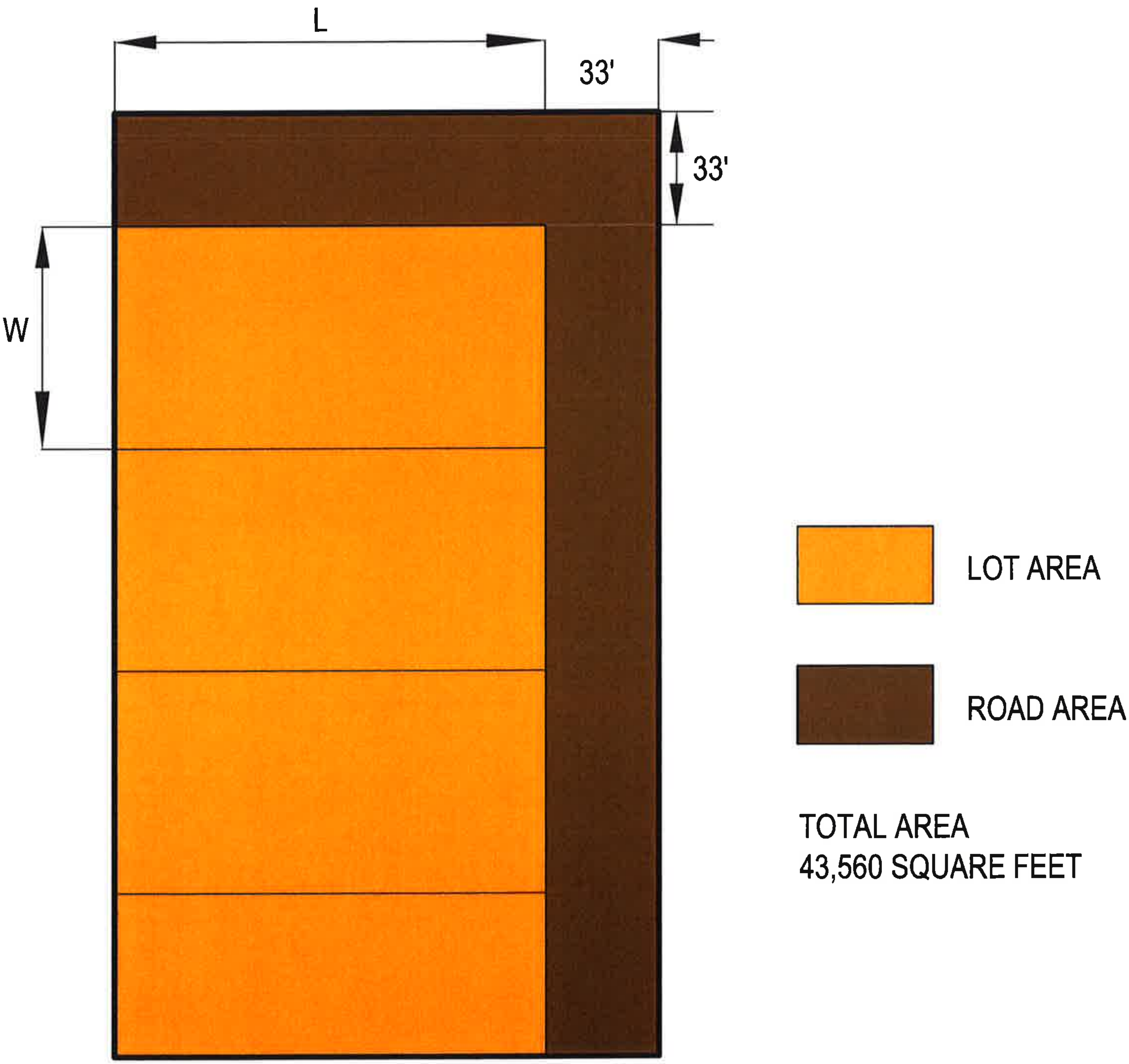
D = 3.734 lots/acre

LOT DENSITY FORMULA RATIONALE:

$$D = (43{,}560 - (L+33)\,33) / W\,(L+33)$$

$W = 65 \qquad L = 125$

$$D = (43{,}560 - (158)\,33) / 65\,(158)$$
$$= (43{,}560 - 5{,}214) / 10{,}270$$
$$= 3.734 \text{ LOTS / ACRE}$$



Durocher, Maggie

From: Brian Hillman <bhillman@tecumseh.ca>
Sent: Friday, April 17, 2015 2:13 PM
Subject: FW: Report for Tecumseh

From: Ray Bower [mailto:rbower@bowerappraisal.com]
Sent: April-17-15 1:47 PM
To: Brian Hillman
Subject: RE: Report for Tecumseh

Brian,

For the purposes of the MRSPA Specific Development Charges, and with reference to the Consultation Report (*Land Prices in Sylvestre Park*) dated January 2015, the Industrial land prices statistical summary (Page 13) indicates current prices for this type of property in this type of location of approximately $3.25 to $3.50 per square foot **(Say $3.40).** Also note that the other industrial land sales examined (Page 15), represent sales in *Sylvestre Park*, however, they are somewhat dated and require a major upward time adjustment. Keep in mind that the $3.40 psf price is 'generic' in nature as other factors such as size, shape. specific location, access, zoning, etc., can influence a specific industrial property price. However, for the sake of the MRSPA Specific Development Charges , $3.40 per square foot is reasonable.

Similarly, the Commercial Land Prices (Page 22) suggest current prices for this type of property in the $4.56 to $4.63 per square foot. **(Say $4.60).** Similarly, other factors would ultimately determine a specific property value.

Finally, I believe the foregoing prices remain as reported as of April 17th 2015 as I am not aware of any additional sales data or economic conditions that would have an effect on the conclusions of the Consultation Report.

If you have any further questions, please do not hesitate to contact me personally.

Ray

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Brian Hillman
Director, Planning and Building Services

Consultation Report

Land Prices
in
Sylvestre Business Park
Tecumseh, Ontario, Canada

PREPARED FOR:

Mr. Brian Hillman
Director, Planning and Building Services
Town of Tecumseh
917 Lesperance Road
Tecumseh, Ontario, Canada N8N 1W9

REPORT PREPARED BY:

Mr. Ray Bower, B.Comm., AACI, P.App., FRI
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Windsor, Ontario, Canada N8W 4B4

January 2015

RAY BOWER
APPRAISAL SERVICES INC.

✦✦✦✦

Professional Real Estate Advisory Service

January 16, 2015

Mr. Brian Hillman
Director, Planning and Building Services
Town of Tecumseh
917 Lesperance Rd. Tecumseh, ON
N8N 1W9

Dear Mr. Hillman

In accordance with your request, this report will serve to provide you with various market information as of January 2015 regarding prices for vacant lands located in and around the *Sylvestre Business Park*, in the Town of Tecumseh, Ontario.

Should you have any additional questions, do not hesitate to contact me personally.

Respectfully

RAY BOWER APPRAISAL SERVICES INC.

Ray Bower, B.Comm., AACI, P.App., FRI

RB/ms
Enc.

2739 Chandler Road * Windsor, Ontario * N8W 4B4

(Phone) 519-944-5005 (Fax) 519-944-5105

info@bowerappraisal.com

SCOPE OF THE REPORT

The Scope of the Report refers to the due diligence undertaken by the author including any terms of reference from the client and encompasses the necessary research and analysis to prepare a report in accordance with the "Canadian Uniform Standards of Professional Appraisal Practice," of the Appraisal Institute of Canada.

In regard to this report, the following steps were taken:

- Research in gathering market information involved our in-house records, CMHC Reports, MLS data of the Windsor-Essex County Association of Realtors (WECAR) and various other Real Estate Boards, Teranet Enterprises Inc., and Real Track Market Surveys.

PURPOSE OF THE REPORT

The purpose of this report is to provide information on prices of industrial and commercial lands applicable to similar lands located in the *Sylvestre Business Park*, in the Town of Tecumseh, Ontario, as of January 2015.

INTENDED USE and USER OF THE REPORT

The report is intended to assist Mr. Brian Hillman, Director of Planning and building services, to assist in negotiations for lands located in Sylvestre Business Park.

EFFECTIVE DATE

The effective date of this report is January 2015. The report was performed in accordance with market conditions pertaining as of that date.

ECONOMIC CONDITIONS

Provincial Summary

Ontario's real Gross Domestic Product (GDP) increased 1.0% (4.0% annualized) in the third quarter of 2014, following a 0.8% (3.2% annualized) advance in the second quarter[1]. The strong third-quarter gain was led by higher household and business spending, along with robust export growth.

Household spending increased 0.8% in the third quarter, following a gain of 1.0% in the second quarter. Driving the third-quarter advance was a 3.9% rise in durable goods spending, boosted by a solid increase in automobile purchases. Spending on semi-durables (+0.6%) and services (+0.4%) also contributed to the overall rise in consumer expenditures.

Investment in residential construction grew 2.4% in the third quarter, following a strong 5.2% advance in the second quarter. Spending on ownership transfer costs (+6.5%) and new housing construction (+4.9%) increased, while renovation activities (-2.0%) were lower.

Business capital spending on machinery and equipment rose 2.5% in the third quarter, following a 3.3% gain in each of the previous two quarters. Non-residential construction edged down 0.3%. Businesses increased inventories by $2.9 billion ($2007), after accumulating $4.2 billion worth of stocks in the second quarter. Exports advanced 3.0% in the third quarter of 2014, the strongest quarterly gain in three years. Imports were also stronger, rising 1.0% in the third quarter. Overall, trade was the largest contributor to Ontario's third quarter real GDP growth.

Current dollar GDP increased 1.5% in the third quarter of 2014, the strongest quarterly gain since the fourth quarter of 2010. Economy-wide prices, as measured by the GDP implicit price index, advanced 0.6% in the third quarter.

Real economic production on an industry basis grew by 1.0% (4.1% annualized) in the third quarter of 2014, after rising 1.0% in the second quarter. Production by goods-producing industries advanced 1.3%, while output by services-producing industries increased 0.9%.

[1] Ontario Ministry of Finance - Economic Accounts - December 2014

ECONOMIC CONDITIONS

Regional Summary

According to the latest CMHC publication, there will be only modest economic growth in the next three years. Although employment will decline slightly in the Windsor area in 2014, slight growth is expected to occur in both 2015 and 2016. This growth will be driven by the ongoing economic recovery in the US and local infrastructure projects. Goods producing employment is expected to continue to strengthen. Rising demand for auto parts should increase employment in the manufacturing sector.

Several local infrastructure projects are currently underway in the Windsor area, supporting construction employment. Construction employment will also be supported by the Detroit River International Crossing (DRIC) which should commence construction with the completion of the Herb Gray Parkway. In addition, ICT (information and creative technology) and agribusiness are growing industries.

Services sector employment has not fared as well and will continue to lag behind the goods-producing sector. However, the lower Canadian dollar should lead to an increase in crossborder shopping which will support the retail sector in Windsor.

Keeping younger adults in Windsor is a challenge. The labour force for those 25-44 continues to shrink. The labour force in this age group has declined by more than 6,000 in the past year. The unemployment rate in 2014 is expected to decrease to 8.5%, in 2015 to 8.2% and in 2016 to 7.8%. Employment growth should outpace growth in the labour force. However, the number of people entering, rejoining or delaying retirement from the labour force will keep the unemployment rate elevated. With slight employment declines in 2014, there will be little to no wage growth. Wage growth will pick up in 2015 and 2016 as the economy continues to strengthen, particularly among higher wage sectors.

Consistent with the view of Canadian economic forecasters, CMHC expects interest rates to remain unchanged until the latter parts of 2015 and then begin to increase gradually. Gradual increases in mortgage rates from historic lows are not expected to significantly impact housing demand. According to CMHC's base case scenario for 2014, CMHC expects the one-year mortgage rate to be in the 3.00% to 3.25% range, while the five-year rate is forecast to be within the 5.0% to 5.5% range. For 2015, the one-year mortgage rate is expected to be in the 3.20% to 4.00% range, while the five-year rate is forecast to be within the 5.25% to 6.00% range. For 2016, the one-year mortgage rate is expected to be in the 3.7% to 4.6% range, while the five-year rate is forecast to be within the 5.55% to 6.45% range.[2]

[2] CMHC Housing Market Outlook - Fall 2014

SYLVESTER BUSINESS PARK

The *Sylvestre Business Park* is located southwest of the intersection of County Road 22 and County Road 19 (Manning Road) in the northerly settlement area of the Town of Tecumseh. The location is approximately 13 km south-east of the central downtown business district of Windsor. As a result of a zoning change in 2003, to allow highway commercial uses and prohibit industrial uses in a portion of the park, it possesses a mix of approximately 40-45 industrial and commercial establishments.[3]

As of 2003, the *Sylvestre Business Park* was dominated by commercial/office uses with 62% of land devoted to this category.[4] This trend in uses continued into 2013-2014. The predominance is explained by its proximity to the County Road 22 and Manning Road intersection and the other strictly commercial nodes on the north side of County Road 22. Historically, manufacturing has played a smaller role within this employment area. Sensitivity to existing and future land uses is important in developing an appropriate policy environment for this business park area.

The lands abutting this employment area to the west and south are designated for residential, institutional and parkland purposes.

The area is serviced with municipal piped water and municipal sanitary sewers, with the exception of development along the east-west section of Sylvestre Drive which is serviced by individual private septic facilities. Capacity exists in the sanitary sewer system to connect these lands into the municipal sanitary sewer system.[5]

At present, one ingress-only road accesses the area off County Road 22. There are two access roads off Manning Road.

The *Sylvestre Business Park* area is divided into two major zoning designations. The majority of the area is zoned *C3 Commercial* which permits a wide variety of commercial uses. The area on the west side of Manning Road and Sylvestre Drive is zoned *M1-Manufacturing*, which also provides a wide range of permitted industrial uses. A small area on the west side of Sylvestre Drive is zoned *M1-8 Manufacturing*. The zoning map and permitted uses for each zoning designation appear on the following pages.

---

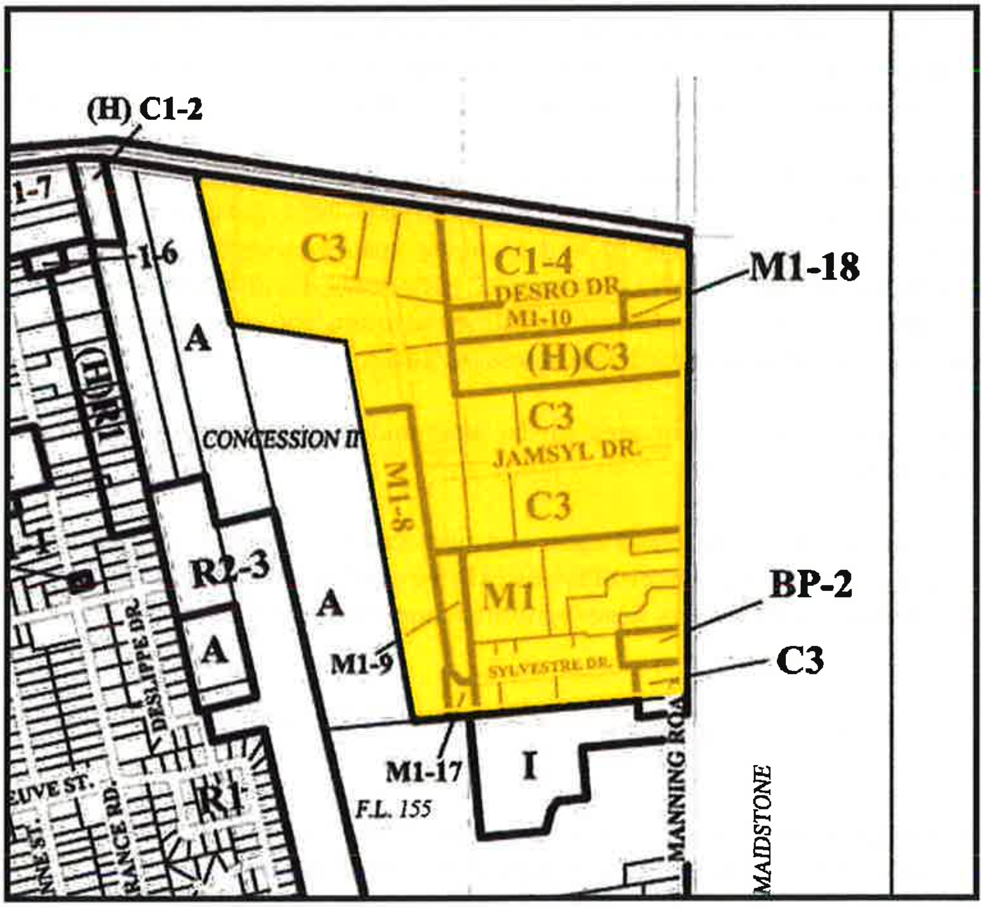
[3] Tecumseh 2033 - New Official Plan Process

[4] IBID

[5] IBID

SYLVESTER BUSINESS PARK

Zoning Map (Bylaw 85-18)



The north-east corner of *Sylvestre Business Park* is zoned *C1-4 Commercial*, a site specific designation permitting a marine and sporting goods establishment ; a power and sail boat establishment and a recreational vehicles and equipment establishment. An area on the south side of Desro Drive is zoned *M1-10 manufacturing* which permits the same uses as permitted in the *M1-Manufacturing* designation, with restrictions on having municipal piped water and a MOE approved sanitary sewage disposal system, save and except a septic tank and tile field system.

SYLVESTER BUSINESS PARK

Zoning - Permitted Uses *C3 - Commercial*

a) cinemas, theatres, bowling alleys, bingo halls, health studios, and other commercial recreation and entertainment establishments; assembly halls; private clubs;

b) restaurants; delicatessens; liquor, beer and wine stores; hotels, motels and taverns;

c) home improvement and furnishing stores; home and auto supply stores; warehouse retail stores; nursery and garden stores; catalogue stores; building supply centres and lumber yards;

d) wholesale businesses;

e) automobile sales and service establishments; boat and recreation vehicle sales and service establishments; automobile rental establishments; automobile repair garages; automobile service stations; gas bars;

f) convenience stores; video rental establishments; retail stores;

g) business service establishments; data processing establishments; duplicating shops; printing establishments; repair and rental establishments; commercial storage units;

h) clinics; animal clinics;

i) offices, general and professional; financial institutions; professional studies; day nurseries; personal service shops; funeral homes;

j) accessory uses.

SYLVESTER BUSINESS PARK

Zoning - Permitted Uses *M1 - Manufacturing*

a) automobile body repair shop;
b) automobile repair garage;
c) blueprinting and printing establishments;
d) building supplies centre or lumber yard;
e) commercial grain handling and storage facility;
f) concrete or wood products factory or manufacturing use, excluding a concrete batching plant;
g) construction company;
h) contractor's yard or shop;
i) establishments for the storage or processing of agricultural produce;
j) existing agricultural uses;
k) food catering services;
l) machine or welding shop;
m) manufacturing of small electrical or machine components;
n) metal fabricating;
o) non-effluent producing industrial uses;
p) offices and retail or wholesale outlets related to permitted industrial uses, carried on in the same building;
q) repair depots including machine repair shops;
r) existing salvage yards or scrap yards; 126
s) service shop;
t) tire repair shop;
u) tool and die companies;
v) truck or transport terminals, only where there is a permanent building and office provided in addition to loading, unloading and storage;
w) warehousing and supply or storage uses (outdoor and indoor);
x) woodworking shops;
y) accessory buildings or uses, including a dwelling or dwelling unit.

SYLVESTER BUSINESS PARK

Zoning - Permitted Uses *M1-8 Manufacturing*

(i) blueprinting and printing establishments;
(ii) building supplies centre or lumber yard;
(iii) commercial grain handling and storage facility;
(iv) establishments for the storage or processing of agricultural produce;
(v) existing agricultural uses;
(vi) food catering services;
(vii) manufacturing of small electrical or machine components;
(viii) offices and retail or wholesale outlets related to permitted industrial uses, carried on in the same building;
(ix) service shops;
(x) tool and die companies;
(xi) warehousing;

The above permitted uses in the *M1-8 Manufacturing* designation are all permitted in the *M1 Manufacturing* designation, however, there are 14 fewer permitted uses available.

INDUSTRIAL LAND SALES

We have conducted research into relevant market data pertaining to relevant vacant land sales. A summary of these findings appear on the following pages.

Sale #1

South Side Croft Drive, Lakeshore

Sale Price:	$165,000
Sale Date:	July 2012
Site Size:	1.27 acres
Zoning:	*MU-5 Mixed Use*
Sale Price/SF.:	$2.99
Description:	Located on the south side of Croft Drive, between Pike Creek and Patillo Road in the Town of Lakeshore.

Sale #2

Crowder Court, Tecumseh

Sale Price:	$105,000
Sale Date:	June 2013
Site Size:	0.74 Acres
Zoning:	*M1 Manufacturing*
Sale Price/SF:	$3.26
Description:	Located on the south side of Crowder Court, south of North Talbot Road in the *Oldcastle Business Park.*

INDUSTRIAL LAND SALES

Sale #3

5485 Di Cocco Drive, Tecumseh

Sale Price:	$75,000
Sale Date:	October 2013
Site Size:	0.5 Acres
Zoning:	*M1 Manufacturing*
Sale Price/SF.:	$3.44
Description:	Located on the north west corner of the intersection of Di Cocco Drive and McCord Lane within the *Oldcastle Industrial Park.*

Sale #4

451 Silver Creek Industrial Drive, Lakeshore

Sale Price:	$177,000
Sale Date:	February 2014
Site Size:	1.01 Acres
Zoning:	*M1 Manufacturing*
Sale Price /SF:	$4.03
Description:	Located on the south side of Silver Creek Industrial Drive, west of Patillo Road in the *Silver Creek Industrial Park.*

INDUSTRIAL LAND SALES

Sale #5

North Side Jutras Drive North, Lakeshore

Sale Price:	$125,000
Sale Date:	May 2014
Site Size:	1.02 Acres
Zoning:	*M1 Manufacturing*
Sale Price/SF:	$2.82
Description:	Located on the north side of Jutras Drive, west of Patillo Road in the *Amtec Industrial Park.*

Sale #6

North Side Jutras Drive North, Lakeshore

Sale Price:	$478,500
Sale Date:	May 2014
Site Size:	3.06 Acres
Zoning:	*M1 Manufacturing*
Sale Price /SF:	$3.60
Description:	Located on the north side of Jutras Drive, west of Patillo Road in the *Amtec Industrial Park.*

INDUSTRIAL LAND SALES

Listing #7

473 Jutras South, Lakeshore

List Price: $379,900
List Date: June 2014
Site Size: 2.95 Acres
Zoning: *M1 Manufacturing*
Asking Price/SF: $2.96
Description: Located on the north side of Jutras Drive North, in the *Amtec Industrial Park.*

Sale #8

East Side Sylvestre, Tecumseh

Sale Price: $130,000
Sale Date: June 2004
Site Size: 0.69 Acres
Zoning: *M1-8 Manufacturing*
Sale Price /SF: $4.33
Description: Located on the west side of Sylvestre Drive within the *Sylvestre Business Park.*

INDUSTRIAL LAND SALES

Sale #9

1865 Sylvestre, Tecumseh

Sale Price:	$85,000
Sale Date:	October 2006
Site Size:	0.68 Acres
Zoning:	*M1-8 Manufacturing*
Sale Price /SF:	$2.87
Description:	Located on the west side of Sylvestre Drive within the *Sylvestre Business Park.*

Summary

	Address	Municipality	Sale	Date	Size (AC)	Sale/AC	Size (SF)	Sale/SF	Zoning
1	South Side Croft	Lakeshore	$165,000	Jul-12	1.27	$129,921	55156	$2.99	MU-5
2	V/L Crowder	Tecumseh	$105,000	Jun-13	0.74	$141,892	32234	$3.26	M1
3	5485 DiCocco Court	Tecumseh	$75,000	Oct-13	0.50	$150,000	21780	$3.44	M1
4	451 Silver Creek	Lakeshore	$177,000	Feb-14	1.01	$175,248	43896	$4.03	M1
5	North Side Jutras N	Lakeshore	$125,000	May-14	1.02	$122,549	44327	$2.82	M1
6	North Side Jutras N	Lakeshore	$478,500	May-14	3.06	$156,373	133003	$3.60	M1
7	473 Jutras S	Lakeshore	$379,900	Listing	2.95	$128,780	128502	$2.96	M1
			Average			**$143,537**		**$3.30**	
			Median			**$141,892**		**$3.26**	
			Weighted			**$141,393**		**$3.25**	

	Address	Municipality	Sale	Date	Size (AC)	Sale/AC	Size (SF)	Sale/SF	Zoning
8	East Side Sylvestre	Tecumseh	$130,000	Jun-04	0.69	$188,406	30056	$4.33	M1-8
9	1865 Sylvestre	Tecumseh	$85,000	Oct-06	0.68	$125,000	29621	$2.87	M1-8
			Average			**$156,703**		**$3.60**	

INDUSTRIAL LAND SALES

The foregoing 9 comparables consist of vacant Industrial/Mixed Use lands located within the Town of Tecumseh and neighbouring Town of Lakeshore. Comparables #1 through #6 consist of vacant lands that have transacted between June 2012 and May 2014. The site sizes range between 0.50 acres and 3.06 acres. Sale prices per acre range between $122,549 and $175,248. Sale prices per square foot range between $2.82 and $4.03 with an average, median and weighted average of $3.30, $3.26 and $3.25 respectively.

Currently, there are no MLS listings for vacant Industrial sites located within the *Sylvester Industrial Park* in the Town of Tecumseh. Comparable #7 consists of an expired listing located within the *Amtec Industrial Park* in the Town of Lakeshore. Comparables #8 and #9 consist of older vacant land sales situated within the *Sylvester Business Park*.

Comparable #1 is located on the south side of Croft Drive, between Pike Creek and Patillo Road in the Town of Lakeshore, approximately 2 km east of *Sylvestre Business Park*. Croft Drive runs parallel to County Road 22 and allows both ingress and egress, but only from the east bound lanes of County Road 22. Additional access is via East Pike Creek Road and Advance Drive. This interior site is irregular, rectangular in configuration and contains 1.27 acres (55,156 SF). The property is zoned *MU-5 Mixed Use* which allows for a various Commercial and Industrial uses. Permitted uses include a light or heavy manufacturing facility, contractor's yard, a shopping centre, private club, personal service shop, retail establishment, pharmacy etc. Sale #1 sold in a private transaction from *Sylvestre Developments Ltd.* to *Lakeshore Business Centre Ltd,* in July 2012 for $165,000 or $2.99 per square foot of land. A building has been constructed on the site.

Comparable #2 consists of an Industrial site containing 0.74 acres (32,234 SF) located on the south side of Moro Drive, south of North Talbot Road in the *Oldcastle Business Park*, south-west of the subject property in the Town of Tecumseh. The site is situated at the end of Crowder Crescent and has an irregular frontage. The property is zoned *M1 Manufacturing*. Sale #2 was listed on MLS services of the Windsor Essex County Association of Realtors in October 2010 at an asking price of $120,000. The property sold in May 2013 for $105,000 ($3.26/SF) after a marketing time of over 2 years.

Comparable #3 is situated on the north west corner of the intersection of DiCocco Court and McCord Lane within the *Oldcastle Business Park*. This location benefits from a corner influence. The site is irregular in shape and contains 0.50 acres or 21,780 square feet. The property is zoned *M1 Manufacturing*. Sale #3 conveyed in a private transaction in October 2013 for $75,000 ($3.44/SF). A previous sale of $75,000 in April 2013 was noted.

Comparable #4 consists of an interior industrial site located on the south side of Silver Creek Industrial Drive, west of Patillo Road in the *Silver Creek Industrial Park* within the Town of Lakeshore. The site is rectangular in configuration, having a frontage of 110 feet. It is zoned *M1 General Employment* which allows for light and heavy industrial use as well as a printing establishment, public storage and accessory retail use. Sale #4 was purchased by *Caps Canada Corporation* in February 2014 for $177,000 or $4.03 per square foot of land. A previous sale of $106,000 ($2.41/SF) in December 2012 is noted.

INDUSTRIAL LAND SALES

Comparable #5 involves the sale of a 1.02 acre parcel located on the north side of Jutras Drive North, west of Patillo Road in the *Amtec Industrial Park* in the Town of Lakeshore. The site is rectangular in configuration and is zoned *M1 General Employment*. Sale #5 was purchased by an adjoining property owner in May 2014 for $125,000 or a unit price of $2.82 per square foot of land. A previous sale in March 2013 for $90,000 ($2.03/SF) is noted.

Comparable #6 is located just west of Comparable Sale #5 along Jutras Drive North in the *Amtec Industrial Park* in the Town of Lakeshore. This site contains a total of 3.06 acres and consists of two adjoining properties. The property was purchased by *Novadmed Canada Limited* in May 2014 for a total of $478,500 or $3.60 per square foot. The parcel was previously purchased by *Mandarino Holdings Inc.* in September 2008 for $$210,000.

Comparable #7 consists of an expired listing located in the *Amtec Industrial Park*. The property was first made available for sale in January 2011 at an asking price of $389,900. The list price was reduced in March 2012 to $379,900 ($2.96/SF) and the property was removed from the market in September 2014. The site is zoned *M1 General Employment* and backs onto Little Baseline Road.

Comparable #8 and #9 are both located within the *Sylvestre Business Park*. Sale #8 transacted in June 2004 and was purchased by an adjoining property owner to the north, *Chalut Holdings*. The parcel sold for $130,000 or a unit price of $4.33 per square foot of land. Sale #9 consists of a 0.68 acre parcel which was purchased by *Jamsyl Group Inc.* from *M. Mutter & Associates* in October 2006 for $85,000 or $2.87 per square foot of land.

In addition to the foregoing, the following chart involves transactions that took place within the *Sylvester Industrial Park* when it was originally being developed. The lands are zoned *M1-8* and *M1-10*.

	Address	Municipality	Sale	Date	Size (AC)	Sale/AC	Size (SF)	Sale/SF
10	13405 Desro	Tecumseh	$47,500	Jan-94	0.49	$96,939	21344	$2.23
11	13405 Desro	Tecumseh	$51,000	Feb-95	0.59	$86,441	25700	$1.98
12	13395 Desro	Tecumseh	$47,000	Feb-95	0.48	$97,917	20909	$2.25
13	1755 Sylvestre	Tecumseh	$91,460	Sep-95	1.09	$83,908	47480	$1.93
14	13315 Sylvestre	Tecumseh	$65,000	Jan-96	0.76	$85,526	33106	$1.96
15	13375 Desro	Tecumseh	$59,900	Nov-96	0.55	$108,909	23958	$2.50
16	13320 Desro	Tecumseh	$100,000	Jun-01	2.44	$40,984	106286	$0.94
			Average			$85,803		$1.97
			Median			$86,441		$1.98
			Weighted			$90,146		$2.07

FACTORS AFFECTING INDUSTRIAL LAND PRICES

Various factors affect or influence the price of industrial lands, all of which are analyzed in a formal appraisal report. The factors include *Layout* wherein square or rectangular sites, as opposed to long narrow or irregularly shaped sites tend to command higher prices due to the optimum utility for development.

Accessibility can also affect a property's price depending on the needs of the owner with regard to visibility or access to major transportation routes. Properties in the *Sylvestre Business Park* can be accessed from Manning Road as well as an ingress access from the east bound lane of County Road 22. For industrial uses, there would be little resistance to the restricted County Road 22 access difficulties as Manning Road provides a direct link to Highway 401 and south-western Ontario markets. Location with regard to *proximity* to major manufacturing facilities may also affect prices, particularly if the large manufacturing concern has proximity requirements.

Economies of Scale suggest that as the size of a site decreases, the unit price tends to increase, all other factors being equal. However, this relationship tends to cease once a site size is too small (or narrow) to afford optimum development. On the other hand, *Assemblage* suggests that a small property's unit price can increase by combining it with an adjoining property which in turn would afford greater utility or re-development potential.

SUPPLY and DEMAND CHARACTERISTICS of INDUSTRIAL LANDS

In determining the current demand requirements, we have taken a sample of 63 sales of vacant industrial lands in Windsor, LaSalle, Tecumseh and Lakeshore, that transacted subsequent to January 2006. The breakdown of these sites by size is as follows:

Size	Number
Under 1.0 acre	11 (17%)
1.0 to 1.99 acres	16 (25%)
2.0 to 4.99 acres	16 (25%)
5.0 to 7.99 acres	10 (16%)
Over 8.0 acres	10 (16%)

From a demand perspective, 67% of all sales involve sites contain less than 5.0 acres, and 50% of all sales involve sites between 1.0 and 4.99 acres. The lands in *Sylvestre Business Park* situated in the *M1 Manufacturing* or *M1-8 Manufacturing* designations contain between 1 and 5 acres with smaller divisions likely. This appears to be the ideal sizes for light industrial uses.

SUPPLY and DEMAND CHARACTERISTICS of INDUSTRIAL LANDS

Although there are signs of an economic recovery in the general Windsor/Essex County real estate market, the demand for new development, particularly smaller light industrial development, remains low. This is partially attributed to the recent high increases in construction costs and the hesitancy of the market to commit to long term industrial development. Further, the market may be cautious as to the future of the Chrysler's commitment to Windsor.

The inventory of improved light industrial properties remains relatively high, although some improvement in the supply side of the economic equation is noted . For example, at the end of the year 2012 there were 35 industrial properties available for lease and 39 available for sale. Currently, there are 26 available for lease and 34 available for sale.

In real estate markets in general, prices are determined by the supply and demand factors at any given point in time. However, the market is rarely in balance for an extended period. Assuming the demand for sites under 5 acres remains relatively stable, the *Sylvestre Business Park* industrially zoned sites should command maximum prices.

COMMERCIAL/MIXED USE LAND SALES

We have conducted research into relevant market data pertaining to relevant vacant land sales. A summary of these findings appear on the following pages.

Sale #17

1628 County Road 22, Lakeshore

Sale Price:	$900,000
Sale Date:	February 2010
Site Size:	4.11 Acres
Zoning:	*MU - Mixed Use*
Sale Price/SF:	$5.03
Description:	Located on the north side of County Road 22, just west of Willow Woods Drive.

Sale #18

North Side Croft, Lakeshore

Sale Price:	$117,000
Sale Date:	December 2010
Site Size:	1.03 Acres
Zoning:	*MU - Mixed Use*
Sale Price /SF:	$2.61
Description:	Located on the north side of Croft Drive within the *Sylvestre Industrial Park.*

COMMERCIAL/MIXED USE LAND SALES

Sale #19

13278 Tecumseh Road East, Lakeshore

Sale Price:	$875,900
Sale Date:	September 2011
Site Size:	3.42 Acres
Zoning:	*C4 Commercial*
Sale Price/SF:	$5.87
Description:	Located on the north side of Tecumseh Road East, west of Manning Road.

Sale #20

11629 County Road 42, Tecumseh

Sale Price:	$95,000
Sale Date:	May 2013
Site Size:	0.75 Acres
Zoning:	*CM 1 Commercial*
Sale Price /SF:	$2.91
Description:	Located on the south side of County Road 42, west of Lesperance.

COMMERCIAL/MIXED USE LAND SALES

Sale #21

1297 County Road 22, Lakeshore

Sale Price:	$1,100,000
Sale Date:	March 2014
Site Size:	4.6 Acres
Zoning:	*MU - Mixed Use*
Sale Price/AC:	$5.49
Description:	Located on the south west corner of the intersection of Renaud Line and County Road 22.

Sale #22

1628 County Road 22, Lakeshore

Sale Price:	$750,000
Sale Date:	October 2014
Site Size:	4.11 Acres
Zoning:	*MU - Mixed Use*
Sale Price /SF:	$4.19
Description:	Located on the north side of County Road 22, just west of Willow Woods Drive.

COMMERCIAL/MIXED USE LAND SALES

Sale #23

North Side Advance, Lakeshore

Sale Price:	$1,082,050
Sale Date:	October 2014
Site Size:	6.41 Acres
Zoning:	*MU - Mixed Use*
Sale Price/SF:	$3.88
Description:	Located on the north side of Advance Boulevard, east of Patillo Road, in *the Advance Industrial Park.*

Listing #24

12059 County Road 42, Tecumseh

Asking Price:	$429,900
List Date:	August 2014
Site Size:	1.39 Acres
Zoning:	*CM Commercial*
Asking Price/SF:	$7.03
Description:	Located on the south side of County Road 42, south west of the subject Industrial Park.

COMMERCIAL/MIXED USE LAND SALES

Summary

	Address	Municipality	Sale	Date	Size (AC)	Sale/AC	Size (SF)	Sale/SF
17	1628 County Rd 22	Lakeshore	$900,000	Feb-10	4.11	$218,978	179032	$5.03
18	North Side Croft	Lakeshore	$117,000	Dec-10	1.03	$113,592	44867	$2.61
19	13278 Tecumseh E	Tecumseh	$875,000	Sep-11	3.42	$255,848	148975	$5.87
20	11629 County Rd 42	Tecumseh	$95,000	May-13	0.75	$126,667	32615	$2.91
21	1297 County Rd 22	Lakeshore	$1,100,000	Mar-14	4.6	$239,130	200376	$5.49
22	1628 County Rd 22	Lakeshore	$750,000	Oct-14	4.11	$182,482	179032	$4.19
23	North Side Advance	Lakeshore	$1,082,050	Oct-14	6.41	$168,807	279219	$3.88
24	12059 County Rd 42	Tecumseh	$429,900	Listing	1.39	$309,281	61162	$7.03
			Average			**$201,848**		**$4.63**
			Median			**$200,730**		**$4.61**
			Weighted			**$198,652**		**$4.56**

The foregoing 8 comparables consist of vacant Commercial/Mixed Use lands containing between 0.75 and 6.41 acres which are located within the Town of Tecumseh and neighbouring Town of Lakeshore.

Comparables #17 through #23 consist of sales that have conveyed between February 2010 and October 2014. Sale prices per acre range between $113,592 and $239,130. Sale prices per square foot range between $2.61 and $5.87 with an average of $4.63, a median of $4.61 and weighted average of $4.56.

There are no Commercial properties located within the *SylvesterBusinessl Park* in the Town of Tecumseh which are currently listed on MLS. Comparable #24 consists of a current MLS listing located along County Road 42, approximately 2 km south west of the subject development.

Comparable #17 involves the sale of a 4.11 Acre (179,380 SF) parcel located on the north side of County Road 22, just west of Willow Wood Drive in the Town of Lakeshore. This places the property approximately 6 km east of the subject Industrial Park. This interior site is rectangular in shape and is zoned MU Mixed Use, which allows for a mixture of Commercial and Industrial uses. Sale #17 was listed on MLS services of the Windsor Essex County Association of Realtors in January 2008 for $1,200,000. The property sold in February 2010 for $900,000 or a unit price of $5.03 per square foot of land. The site was purchased to be improved by a strip plaza. A previous sale of $445,000 ($2.49/SF) in May 2005 is noted.

COMMERCIAL/ MIXED USE LAND SALES

Comparable #18 consists of a 1.03 Acre (44,867 SF) site located on the north side of Croft Drive within the *Sylvester Industrial Park* in the Town of Lakeshore. The site is rectangular in shape and has exposure to County Road #22. The lot is zoned *MU Mixed Use* and the surrounding development consists of various light manufacturing establishments and a newly constructed plaza. Sale #18 was purchased by *Ecodevelopments Windsor* in a private transaction in December 2010 for $117,000 or $2.61 per square foot of land.

Comparable #19 is situated on the north side of Tecumseh Road East, west of Manning Road in the Town of Tecumseh. The site is irregular in shape and contains 3.42 Acres or 148,975 square feet. The property is zoned *C4 Commercial* and is now improved by a Medical Centre. Sale #19 conveyed in a private transaction in September 2011 for $875,000 ($5.87/SF). A previous sale of $500,000 in December 1990 is noted.

Comparable #20 consists of an interior Commercial site located on the south side of County Road #42, west of Lesperance Road in the Town of Tecumseh. The site is rectangular in configuration and is zoned *CM 1 Commercial/Industrial*. Permitted uses include an automobile repair establishment, construction company, light manufacturing uses, restaurant, service shop, warehouse, food catering etc. Sale #20 was purchased by *Thomas Kauric* from *M. Mutter & Associates* in May 2013 for $95,000 or $2.91 per square foot of land. A previous sale of $80,000 ($2.45/SF) in November 1999 is noted.

Comparable #21 involves the sale of a 4.6 Acre parcel is situated on the south west corner of the intersection of Renaud Line and County Road #22 in the Town of Lakeshore. This location benefits from a corner influence. The site is rectangular in configuration and is zoned *MU - Mixed Use*. Sale #21 was purchased by the *Windsor Family Credit Union* in March 2014 for $1,100,000 or a unit price of $5.49 per square foot of land. The property was purchased for the future construction of a banking institution.

Comparable #22 is a resale of Sale #17. The property was listed on MLS for $1,450,000 in February 2011. This listing expired and the site was re-listed in October 2011 for $1,500,000. The property went into receivership and was made available for purchase on MLS in April 2014 for $795,000 under Power of Sale proceedings. It sold in October for $750,000 or $4.19 per square foot of land.

Comparable #23 is the most recent transaction having conveyed in October 2014. The property is located on the north side of Advance Boulevard, east of Patillo Road in the *Advance Industrial Park* within the Town of Lakeshore. This parcel contains 6.41 acres and is zoned *MU- Mixed Use*. The property was purchased by the *Roman Catholic Episcopal Corporation of the Diocese of London in Ontario* from *Lakeshore Oasis* for $1,082,050 or $3.88 per sqaure foot of land. The site is to be improved by a new church.

Comparable #24 is a current MLS listing. This property is located on the south side of County Road #42, approximately 2 km south west of *Sylvestre Business Park*. The site contains 1.39 acres (61,162 SF) and is available for purchase at the asking price of $429,900 or $7.03 per square foot of land. The property was listed in August of 2014 and remains active.

COMMERCIAL/ MIXED USE LAND SALES

In addition to the foregoing, the following chart involves transactions that took place within the *Sylvester Business Park* when it was originally being developed. These sites have exposure to County Road #22 and are zoned *C3* and *C1-4 Commercial.*

	Address	Municipality	Sale	Date	Size (AC)	Sale/AC	Size (SF)	Sale/SF
25	1610 Sylvester	Tecumseh	$110,000	Jun-98	1.28	$85,938	55757	$1.97
26	1608 Sylvester	Tecumseh	$190,000	Nov-99	1.59	$119,497	69260	$2.74
27	13320 Desro	Tecumseh	$100,000	Jun-01	2.43	$41,152	105851	$0.94
			Average			**$82,196**		**$1.89**
			Median			**$85,938**		**$1.97**

FACTORS AFFECTING COMMERCIAL/MIXED USE LAND PRICES

As with vacant industrial lands, various characteristics and factors also affect or influence the price of commercial/mixed lands. The factors include *Layout* wherein square or rectangular sites, as opposed to long narrow or irregularly shaped sites tend to command higher prices due to the optimum utility for development and on-site parking.

Accessibility and *Visibility* affect a commercial property's price. Most commercially developed areas rely on customers, whether impulse or destination buyers. Locations with signalized intersections tend to attract commercial development. Ease of access and egress are also important factors. The location of or within a commercial development can also influence prices whether it's a corner location; internal or mid-block location; pad location; etc.

The commercial properties in the *Sylvestre Business Park* have high visibility, particularly those lands situated in the commercially zoned area fronting on County Road 22. However, access to this location can be difficult. At present, from County Road 22 there is only one direct ingress available and only to east bound traffic. To exit the area, one must travel to Manning Road.

SUPPLY and DEMAND CHARACTERISTICS of COMMERCILA/MIXED USE LANDS

The following statistics were supplied by the Windsor Essex County Association of Realtors (WECAR).

	2014	2015
Total Retail Listings:	169	164
Total Retail Sales:	9	18
Total Office Listings:	169	164
Total Office Sales:	9	18

The above total include sales and leases.

Total Plaza Listings:	76	80
Total Plaza Sales:	8	2

In the Foundation Report[6] prepared for the County of Essex (2011) in anticipation of the new County Official Plan, the authors indicated that there was a 2,060 acre supply of vacant commercial land in the County. They noted that the greatest potential commercial land supply existed in the Town of Lakeshore, with a vacant commercial supply of over 760 acres. The Town of Tecumseh had a had a supply of 309 acres. The report concluded that Essex County had an excess supply of both commercial and employment land and that these lands had limited development potential, due primarily to their geographic location and lack of other attractive market characteristics.

[6] Essex County Official Plan Review - August 2011 - N. Barry Lyon Consultants Limited.

QUALIFICATIONS OF APPRAISER

Ray Bower is an experienced professional Real Estate Appraiser, having been associated with one of the largest Real Estate Brokerages in Essex County, Ontario between 1972 and 1992. In 1993 ***Ray Bower Appraisal Services Inc.*** opened an independent firm which today is one of the most experienced Real Estate Appraising & Consulting firms in Canada.

He has extensive experience in appraisal, consulting and appraisal reviews on residential, multi-residential, commercial and industrial properties; vacant lands, air rights, water lots, partial takings, etc. Reports have been completed for mortgage purposes, litigation, transfers, expropriations, tax purposes, assessment appeals, proposed developments, rental studies, market analysis, feasibility analysis, Highest & Best Use studies, etc.

APPRAISAL INSTITUTE OF CANADA

Member - Professional Standards Adjudicating Committee 1998 - 2000
Member - Appraisal Institute of Canada Standards Committee 2000 - 2005
Chairman - Appraisal Institute of Canada Standards Committee 2005 - 2009
Chairman - Standards Committee - IVS Sub-Committee 2009 - 2010
Special Investigator - Professional Practice AIC - 2010-2011
Chairman - Professional Practice Seminar Redevelopment Committee - 2011-2012

Certified Lecturer - Appraisal Standards Seminar 1994 - Current

ONTARIO ASSOCIATION (OAIC) Appraisal Institute of Canada

Chairman - Windsor Chapter 1983 - 1989
Member - Board of Directors 1988 - 1996
Chairman - Professional Development Committee 1989 - 1991
Chairman - Professional Practice Investigating Committee 1990 - 1992
Chairman - Finance/Management Committee 1992 - 1994
Co-Chairman - Fee Appraiser's Symposium - Toronto Ontario 2002 - 2011

President of the Ontario Association (OAIC)
Appraisal Institute of Canada 1994 - 1995

Member - Professional Development Committee - 2000 -
Member - Public & Government Relations Committee - 2014 -

QUALIFICATIONS OF APPRAISER

EDUCATION EXPERIENCE

University of Windsor - **B.Comm**, 1970 -Bachelor of Commerce
Honours Business Administration

Appraisal Institute of Canada - **AACI, P.App.,** 1986
Accredited Appraiser Canadian Institute

Real Estate Institute of Canada - **FRI,** 1986
Fellow of the Real Estate Institute

PUBLISHED ARTICLES

Primun Non Nocere - Canadian Property Valuation - Vol.49 Bk.3 - 2005
The Standards: A Living Document - Canadian Property Valuation - Vol.51 Bk.2 - 2007
Standards Rules - The Ethical Nuances - Canadian Property Valuation - Vol.51 Bk.4 - 2007
Promoting a Positive Professional Perception - Canadian Property Valuation - Vol.52 Bk.1- 2008
Primer on International Valuation Standards - Canadian Property Valuation - Vol.52 Bk.4 - 2008
The New Professional Practice Seminar - Canadian Property Valuation - Vol.56 Bk.1 - 2012

AWARDS

CERTIFICATE OF MEMBERSHIP AWARD - 2012

In recognition of a minimum of 40 years of dedication to the
Windsor Essex County Association of Realtors.

PRESIDENT'S AWARD OF EXCELLENCE - 2012

The President's Award recognizes a member of the Appraisal Institute of Canada who has demonstrated significant contribution to the profession and Appraisal Institute community in such areas as leadership, AIC affairs, government promotion of the profession, research and education.

MEMBERSHIP

- Appraisal Institute of Canada
- Real Estate Institute of Canada
- Arbitration and Mediation Institute of Ontario Inc.
- Ontario Expropriation Association

APPENDIX E

TECUMSEH HAMLET SANITARY SEWER FLOW MONITORING AND MODELING UPDATES - SUMMARY OF WORK COMPLETED (2010)

AECOM
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Technical Memorandum

To	Robert Filipov, P.Eng., Town of Tecumseh	Page	1
CC	Kirby McArdle, P.Eng., Town of Tecumseh		
Subject	Tecumseh Hamlet Sanitary Sewer Flow Monitoring and Modeling Updates-Summary of Work Completed		
From	Hitesh Lad, P.Eng., and Jonathan Bastien		
Date	December 21, 2010	Project Number	60153946

1. Background

In 2005, the Town of Tecumseh completed the Infiltration and Inflow (I/I) Control Study (CH2M Hill, January 2005) which identified significant sources of extraneous flows within the existing collection system, primarily in the Tecumseh Hamlet and St. Clair Beach areas. As part of the study, a calibrated sanitary sewer model was developed by CH2M Hill.

Based on the recommendations presented in the I/I Study, the Town of Tecumseh initiated monitoring of the sanitary sewer and completed several storm sewer upgrades as part of the road reconstruction projects in Tecumseh, St. Clair Beach and Tecumseh Hamlet areas. The projects included construction of dedicated storm sewer service connections to each lot to permit connection of foundation drains and roof leaders to the storm sewer system instead of sanitary sewer system; and repairs of sanitary sewers and manholes that contribute to infiltration of stormwater into the sanitary sewer system.

In accordance with the 2004 Wastewater Agreement between the City of Windsor and the Town of Tecumseh, the City of Windsor in 2007 constructed the Northeast Windsor Trunk Sanitary Sewer (NE-WTSS) to the south side of the intersection of Banwell Road and County Road 22 (CR 22) to provide a new outlet for the Town of Tecumseh with discharge to the Little River PCP.

Subsequently, the Town of Tecumseh proposed construction of a relief sewer on CR 22 with discharge to a newly constructed NE-WTSS to address capacity limitations in the Lesperance Road trunk sewer north of CR 22 by diverting the flow away from the Lesperance Road trunk sewer at CR 22. In order to confirm that the proposed diversion flows from the Lesperance Road trunk sewer were adequate and appropriate to address capacity limitations within the sewer system, the sewer model developed in 2005 was updated by CH2M Hill in 2008 to include the proposed CR 22 relief sewer.

The Town completed construction of a 600mm relief sewer and a 1200mm outlet sewer on County Road 22 in April 2009. As part of the on-going road reconstruction projects, the Town also completed St. Alphonse Avenue and South Pacific Avenue reconstruction projects in Tecumseh Hamlet in late 2009. A number of storm service connections were provided to permit disconnection of foundation drains from the sanitary sewer system; and repairs to the sanitary sewers and manholes were completed on St. Alphonse Avenue.

2. Study Objectives and Scope

The Town of Tecumseh retained AECOM to undertake a flow monitoring and modeling update for the sanitary sewer system in Tecumseh Hamlet. The primary objective of the study is to evaluate the hydraulic performance of the sanitary sewer system in Tecumseh Hamlet under existing conditions and future development scenarios. The study was initiated to confirm the assumptions of previous modeling that indicated the Lesperance Road trunk sewer would have additional capacity after the installation of County Road 22 relief sewer, and to establish the effectiveness of the on-going sanitary sewer rehabilitation works in removing the sources of I/I from the sanitary sewer system.

The scope of this study is limited to the following main activities related to the sanitary sewer system within the Tecumseh Hamlet:

- Undertake a wastewater flow monitoring program for a period of four (4) months
- Provide a detailed analysis of the data collected from the flow monitoring program
- Update the existing XP-SWMM hydraulic model to reflect the changes in sewer system including the construction of a relief sewer on CR 22
- Update the existing SWMHYMO hydrologic model based on current flow monitoring data
- Provide wastewater flow projections for growth areas and potential development scenarios within the Manning Road Secondary Plan Area
- Summarize impacts of potential developments on the existing sewer system.

3. Current Study Status

A flow monitoring program and update to the existing XP-SWMM hydraulic model for the sewer system within Tecumseh Hamlet was completed. As a next step, AECOM was to start updating the existing SWMHYMO hydrologic model and re-calibrate the model to reflect current flow monitoring data. At that stage, the study was put on hold as a result of issues in obtaining the required hydrologic modeling data previously undertaken for the system by CH2M Hill.

It is our understanding that the Town has since decided to update the overall model of the north Tecumseh wastewater collection system that includes the areas of Tecumseh, St. Clair Beach and Tecumseh Hamlet. This overall model will then be used to assess the hydraulic performance of the sewer system under existing and future development scenarios. As the update of the overall model is scheduled to commence in the near future, the current evaluation of the sewer system within Tecumseh Hamlet area was deemed no longer required.

This technical memorandum has been prepared to summarize the activities undertaken to date for the study. It primarily provides a detailed analysis of the data collected from the flow monitoring program. It also provides wastewater flow projections for various potential development scenarios within the Manning Road Secondary Plan area. The analysis and wastewater flow projections presented herein would provide a basis for evaluation of the sewer system as part of the future update of the overall model.

4. Flow Monitoring and Analysis

4.1 Flow Monitoring Program

AMG Environmental was retained to complete flow monitoring within the sanitary sewer system of Tecumseh Hamlet. Flow monitors equipped with redundant pressure transducers and doppler ultrasonic velocity sensors were installed at selected locations in order to measure flow depths and velocities. Data was collected continuously from February 3, 2010 to June 15, 2010 at five minute intervals. Using the collected data, flows within the sanitary sewer system were calculated during data post-processing by AMG Environmental.

For this study, three (3) flow monitoring stations were installed at the following locations within the Tecumseh Hamlet sanitary sewer system:

- Manhole TH 14 – Country Road 42 at LeBouef Avenue;
- Manhole TH 78 – St. Anne Street immediately north of Intersection Road; and,
- Manhole TH 113 – Lesperance Road immediately north of L'Essard Street.

Figure 1 shows the locations of flow monitoring stations along with total catchment area, the Institutional/ Commercial /Industrial (ICI) catchment area and the residential population corresponding to each flow monitoring station.

In addition, rainfall data was obtained from a tipping-bucket rain gauge located on the roof of the Town Water Works office at Tecumseh Road and Lacasse Boulevard. Data was collected from February 3, 2010 to June 15, 2010. The rainfall gauge data was used to calculate accumulated rainfall depths and rainfall intensities during data post-processing by AMG Environmental.

AMG Environmental maintained and processed the collected data from the flow monitors and rain gauge on their website. AECOM retrieved and reviewed the relevant data from AMG's website, and carried out a detailed analysis of the data as presented in the following sections.

4.2 Wet Weather Flow Analysis

4.2.1 Rainfall Data

For the rainfall data analysis, a cessation in precipitation of over six hours was adopted as signifying a new event. **Table 1** shows the total rainfall depth, storm duration and average intensity over the total duration for rainfall events during the monitoring program with a total rainfall depth of 15 mm or greater. Also provided are the maximum average intensities over 10, 30 and 60 minute intervals during the storm. **Table 2** shows the latest available Intensity-Duration-Frequency (IDF) data for the Atmospheric Environment Services (AES) rain station located at the Windsor Airport.

Storms 1 to 4 had total rainfall depths ranging from 16.0 to 29.5 mm and durations ranged from 7.8 to 24.2 hours. The maximum average intensity over any 10 minute interval ranged from 10.7 to 18.3 mm/hr. Based on a comparison of the 10, 30 and 60 minute maximum average intensities to the available IDF data, these four storms had a return period of less than 2 years.

Table 1: Rainfall Data for Selected Storm Events with a Total Rainfall Depth of 15 mm or Greater

Storm ID	Storm Start Time	Storm End Time	Total Rainfall Depth (mm)	Storm Duration (hours)	Average Intensity Over Total Duration (mm/hr)	Maximum Average Intensity (mm/hr)		
						10 min interval	30 min interval	60 min interval
1	07/04/2010 6:40	08/04/2010 6:50	28.7	24.2	1.2	13.7	6.9	6.7
2	02/05/2010 17:30	03/05/2010 1:20	16.0	7.8	2.0	18.3	11.7	8.1
3	07/05/2010 8:50	07/05/2010 22:05	16.8	13.3	1.3	10.7	6.1	4.8
4	11/05/2010 7:05	11/05/2010 19:35	29.5	12.5	2.4	10.7	8.6	6.9
5	04/06/2010 21:25	04/06/2010 21:55	23.9	0.5	47.8	97.5	47.2	N/A
6	05/06/2010 20:40	06/06/2010 3:40	73.4	7.0	10.5	109.7	59.4	39.1

Table 2: Intensity-Duration-Frequency Data for Windsor Airport

Duration (minutes)	Average Rainfall Intensity (mm/hr) by Return Period					
	2 Years	5 Years	10 Years	25 Years	50 Years	100 Years
10	81.3	102.8	117.0	135.0	148.3	161.5
30	44.0	58.7	68.4	80.7	89.8	98.9
60	27.2	36.6	42.8	50.6	56.4	62.1

A storm event on June 4, 2010 (Storm 5) had 23.9 mm of rainfall over a duration of 30 minutes. The maximum average intensity over any 10 minute interval was 97.5 mm/hr. The storm had a return period between 2 and 5 years.

A relatively large storm event on June 5-6, 2010 (Storm 6) had 73.4 mm of rainfall over a duration of 7 hours. The maximum average intensity over any 10 minute interval was 109.7 mm/hr. Based on a comparison of the maximum average intensities to available IDF data, the storm had a return period between 5 and 10 years.

4.2.2 Flows in the Sanitary Sewer System

Table 3 shows the average and peak flows during the runoff period associated with each rainfall event. The runoff period was determined through a wet weather flow separation analysis, which involved a visual review of the flow data. The runoff event period and duration, as well as the total rainfall during the runoff event, are also shown in Table 3.

This approach ensured that the average and peak flows reported for each rainfall event included the runoff contributions due to rainfall generated inflow, as well as fast and slow infiltration within the sewer catchment. Inflow is runoff contributed to the sanitary sewer system from directly connected sources such as roof leaders and yard drains. Fast infiltration is runoff contributed to the system through foundations drains or weeping tiles. Slow infiltration is runoff or groundwater contributions to the system through cracked pipes and leaky joints.

Table 3: Average and Peak Flows at Each Monitoring Station for Selected Storm Events

ID	Runoff Start Time	Runoff End Time	Runoff Period (hours)	Total Rainfall Depth (mm)	Total Flow (L/s)						Average Rain Generated I/I					
					TH 14		TH 78		TH 113		TH 14		TH 78		TH 113	
					Avg	Peak	Avg	Peak	Avg	Peak	(L/s)	(L/ha/ day)	(L/s)	(L/ha/ day)	(L/s)	(L/ha/ day)
1	07/04/ 2010 6:40	10/04/ 2010 0:00	65.3	28.7	9.6	19.0	50.6	104.4	79.4	158.7	6.6	10,723	43.7	17,973	69.4	20,680
2	02/05/ 2010 17:30	04/05/ 2010 1:45	32.3	16.0	8.8	15.2	30.8	53.8	43.1	74.2	4.9	7,935	23.5	9,664	34.6	10,315
3	07/05/ 2010 8:50	09/05/ 2010 2:00	41.2	18.6	9.7	15.7	44.0	78.5	58.0	96.6	5.5	8,987	36.5	15,013	49.2	14,656
4	11/05/ 2010 7:05	13/05/ 2010 1:45	42.7	29.5	12.6	24.6	67.5	133.0	89.7	185.8	8.7	14,258	60.8	**25,012**	80.7	24,039
5	04/06/ 2010 21:25	05/06/ 2010 16:30	19.1	24.1	5.8	12.8	38.7	75.7	45.2	93.8	2.6	4,209	32.7	13,463	36.5	10,877
6	05/06/ 2010 20:40	08/06/ 2010 2:00	53.3	77.2	13.3	36.4	87.7	183.8	138.5	326.0	10.1	16,492	83.0	**34,162**	131.3	**39,129**

For the four storm events with a return period of less than 2 years, the average flow over the runoff period ranged from 43.1 to 89.7 L/s (with a peak flow ranging from 74.2 to 185.8 L/s) at the downstream monitoring station (TH 113).

For the June 5 storm event which had a return period of between 5 and 10 years, the average flow over the runoff period was 138.5 L/s (with a peak flow of 326.0 L/s) at TH 113. The recorded peak flow of 326 L/s is well above the estimated sewer capacity of 200 L/s at this location.

For the June 4 storm event which had a return period of between 2 and 5 years, the average flow at monitoring station TH 113 was 45.2 L/s (with a peak flow of 93.8 L/s). These flows are similar to those found for the May 2 and May 7 storms, which had lower total rainfall depths. Intense storms typically occur over a smaller area. It is expected that the June 4 storm occurred over a smaller portion of the catchment, resulting in a reduced effective rainfall depth and runoff flows.

Table 3 also provides the average rainfall generated inflow and infiltration (I/I) flows at each monitoring station. The rainfall generated I/I flows were separated from the total runoff event flows by removing the estimated domestic use flows at each recorded time interval. Domestic use flows were determined as per the Dry Weather Flow Analysis presented in **Section 4.3**. The rainfall generated I/I flows includes runoff contributions due to both direct inflows as well as slow and fast infiltration. For the four storm events with a return period less than 2 years, the average rainfall generated flow at the downstream monitoring station (TH 113) ranged from 34.6 to 80.7 L/s. For the June 5 storm event, the average rainfall generated flow at TH 113 was 131.3 L/s. The rainfall generated I/I flows account for approximately 80 - 95% of the total flows at TH 113 during a major runoff event.

At monitoring station TH 113, the average rainfall generated I/I flow ranged from 10,315 to 39,129 L/ha/day, based on the total catchment area of 290 ha. The MOE guidelines for sanitary sewer design recommend an allowance of 864 to 24,192 L/ha/day for total I/I (which includes contributions from inflow, slow and fast infiltration). Values outside the MOE guidelines recommended values are shown in bold in Table 3. The major rainfall event on June 5 resulted in average rainfall generated I/I flows which exceed the MOE guidelines recommended values at monitoring stations TH 78 and TH 113. In addition, the May 5 event resulted in average rainfall generated I/I flow which exceeded the MOE guidelines recommended values at the TH 78 monitoring station.

4.3 Dry Weather Flow Analysis

4.3.1 Approach

The Dry Weather Flow (DWF) analysis of the flow monitoring data generally represents an evaluation of dry weather flow conditions during spring, as the monitoring period was from February 3, 2010 to June 15, 2010. The estimated Dry Weather Infiltration (DWI) is expected to be higher than the annual average due to raised groundwater levels during the spring. The analysis involved the following procedure:

- Determination of days of dry weather flow during period of monitoring;
- Estimation of Dry Weather Infiltration (DWI) volume for each day of dry weather flow;
- Estimation of Domestic DWF volume for each day of dry weather flow; and,
- Evaluation of the short and medium term temporal variation in DWF conditions.

For each day of dry weather flow, the flow data at the three monitoring stations were analyzed. The DWI was estimated as 90% of the total measured flow occurring between 3:00 and 5:00 am. This total flow was extrapolated to a daily value. The DWI represents slow infiltration baseflow into the sanitary sewer system from groundwater infiltration. It was assumed that the majority of flow during the 3:00 to 5:00 am time period would be due to DWI, as opposed to domestic uses. This approach is equivalent to that used in the Town's *Inflow and Infiltration Control Study* completed by CH2M Hill.

The Domestic DWF represents the actual domestic sewage flow. The Domestic DWF was determined as the difference between the daily total measured flow volume (Daily Total DWF) and the Daily DWI volume for each selected day of dry weather flow.

The Dry Weather Flow analysis evaluated the Total DWF, DWI and Domestic DWF volumes over the following sample subsets:

- All dry weather flow days
- All dry weather flow weekdays (for entire data set as well as by half months)
- All dry weather flow weekend days (for entire data set as well as by half months)

Weekdays were evaluated separately from weekends as a result of the typical variation in flows between work days and weekends. Residential flows generally increase on weekends, while commercial and industrial flows typically decrease on weekends. An evaluation for each month was undertaken to review temporal variations in dry weather flows. Initial review of the data showed observable variations in typical flow patterns over the first and second halves of each month for the months of March – May, therefore each of these half months was evaluated separately. For February, there was no apparent variation in flows between the first and second halves of the month.

4.3.2 Dry Weather Flow Days

Days of dry weather flow were defined as full days, starting at midnight, for which there was no recorded rainfall. In addition, the selection criteria included a maximum allowable total rainfall depth of 2 mm in the 12 hours prior to the start of a dry weather day. **Table 4** summarizes the selected days of dry weather flow.

Table 4: Selected Days of Dry Weather Flow

February	March	April	May
05/02/2010	01/03/2010	01/04/2010	04/05/2010
06/02/2010	02/03/2010	02/04/2010	09/05/2010
07/02/2010	03/03/2010	04/04/2010	10/05/2010
08/02/2010	04/03/2010	10/04/2010	15/05/2010
09/02/2010	05/03/2010	11/04/2010	16/05/2010
10/02/2010	06/03/2010	12/04/2010	19/05/2010
11/02/2010	07/03/2010	14/04/2010	20/05/2010
12/02/2010	08/03/2010	15/04/2010	24/05/2010
13/02/2010	09/03/2010	16/04/2010	25/05/2010
14/02/2010	10/03/2010	17/04/2010	26/05/2010
15/02/2010	16/03/2010	18/04/2010	27/05/2010
16/02/2010	17/03/2010	19/04/2010	28/05/2010
17/02/2010	18/03/2010	20/04/2010	29/05/2010
18/02/2010	19/03/2010	22/04/2010	30/05/2010
19/02/2010	20/03/2010	23/04/2010	
20/02/2010	24/03/2010	27/04/2010	
21/02/2010	26/03/2010	28/04/2010	
	27/03/2010	30/04/2010	
	30/03/2010		
	31/03/2010		

4.3.3 Average Dry Weather Flow Patterns

Figure 2 and 3 show the average daily DWF pattern for each monitoring station. The flows shown at each time interval are based on the average measured flow for that time interval over all dry weather flow days. Values are shown in L/s and Litres per capita per day (Lpcd). It is suggested that these patterns be used within the calibration of the overall model for this area.

The average daily DWF pattern shows the expected diurnal cycling which results from variations in domestic use over a typical day. The flow per capita per day is similar for monitoring stations TH 78 and TH 113. The increased flow per capita per day shown for monitoring station TH 14 is the result of larger Industrial/Commercial/Institutional (ICI) contributions and a smaller residential population. ICI accounts for 57% of the total contributing area for station TH 14, whereas for monitoring stations TH 78 and TH113 the ICI proportion is 15 – 20%. The residential population per hectare of total catchment area for monitoring station TH 14 is 7 persons / ha, while for TH 78 and TH 113 the value is approximately 12 persons / ha.

4.3.4 Dry Weather Flow Average Daily Volumes

The Daily Total DWF, Daily DWI and Daily Domestic DWF volumes and Total DWF flow time series were reviewed for each of the three monitoring stations. **Table 5** shows the average Daily Total DWF, Daily DWI and Daily Domestic DWF volumes for all three monitoring stations. Averages and standard deviations are provided over the entire data set of dry weather flow days, as well as for over all weekdays and all weekend days within the entire data set. For all three monitoring stations, there was an observed variation in flows between weekdays and weekends.

The flow data was compared to the following sanitary sewer design criteria recommended in the Town's 2008 Master Plan Update:

- Average domestic wastewater flow: 300 Lpcd
- Peak Infiltration / Inflow: 16,415 L/ha/d

Monitoring Stations TH 78 and TH 113 were found to have average domestic flow rates volumes of approximately 200 – 210 Lpcd. Although this is below the Town design criterion of 300 Lpcd, this is the actual domestic sewage flow recorded during the monitoring period and is not to be used as a design criterion for sanitary sewer design. Review of the *Inflow and Infiltration Control Study* completed by CH2M Hill revealed that the previously measured domestic sewage flow values ranged from 172 - 309 Lpcd. The observed average domestic flow rates are lower than the MOE guidelines recommended values of 225 – 450 Lpcd.

The observed average Daily DWI per area ranges from 3,750 – 4,650 L/ha/d. The DWI volumes are well below the Town design criterion of 16,415 L/ha/d.

Table 5: DWF Results at Each Monitoring Station for DWF Days – Statistics for Entire Sample Set

		Monitoring Station TH 14					Monitoring Station TH 78					Monitoring Station TH 113				
		Daily Total DWF Volume (L)	Daily DWI Volume (L)	Daily DWI (L /ha)	Daily Domestic DWF Volume (L)	Daily Domestic DWF (Lpcd)	Daily Total DWF Volume (L)	Daily DWI Volume (L)	Daily DWI (L /ha)	Daily Domestic DWF Volume (L)	Daily Domestic DWF (Lpcd)	Daily Total DWF Volume (L)	Daily DWI Volume (L)	Daily DWI (L /ha)	Daily Domestic DWF Volume (L)	Daily Domestic DWF (Lpcd)
DWF Days - All Days	Avg	423,287	214,766	4,052	208,521	579	1,463,962	968,168	4,610	495,794	201	2,032,583	1,281,240	4,418	751,344	207
	Std Dev	157,215	174,206	3,287	79,298	220	536,752	496,203	2,363	75,455	31	861,326	805,373	2,777	130,966	36
DWF Days - All Weekday	Avg	429,419	221,586	4,181	207,833	577	1,460,644	965,890	4,599	494,754	201	2,042,961	1,283,594	4,426	759,366	209
	Std Dev	156,604	182,870	3,450	78,699	219	505,703	466,628	2,222	77,567	31	840,866	794,751	2,740	136,814	38
DWF Days - All Weekend	Avg	408,265	198,057	3,737	210,207	584	1,472,091	973,750	4,637	498,341	203	2,007,159	1,275,471	4,398	731,687	202
	Std Dev	161,763	154,001	2,906	82,789	230	620,434	575,385	2,740	71,882	29	931,639	851,853	2,937	116,300	32

4.3.5 Evaluation of Temporal Variations in Dry Weather Flow

An analysis was also undertaken of the temporal variations in DWF between the months of recorded data for the Tecumseh Hamlet service area. **Table 6** shows the Daily Total DWF, Daily DWI and Daily Domestic DWF volumes for monitoring station TH 113 for all the evaluated monthly sample sets. Averages and standard deviations are provided.

Average Daily Total DWF volumes for weekdays range from 1,025,750 L to 3,287,150 L. For weekend days, the average Daily Total DWF volumes range from 1,129,650 L to 3,152,350 L. The average Daily Total DWF volumes were consistently lower in the second half of each month, compared to the volume in the first half of that same month. Differences ranged from 376,150 L to 1,159,700 L. No definitive trend was found with regards to the variations between weekday and weekend volumes. Sometimes the weekend values were greater than corresponding weekday values, and sometimes less, dependent on the month.

For Domestic DWF volumes, average daily values ranged from 178 Lpcd to 244 Lpcd on weekdays, and 168 Lpcd to 238 Lpcd on weekends. No definitive trends were observed between flows over the first and second halves of each month, as well as for the variations between weekday and weekend volumes.

For DWI volumes, average daily values ranged from 1,300 L/ha/d to 8,283 L/ha/d on weekdays and 1,800 L/ha/d to 8,025 L/ha/d on weekends. The average DWI volumes were consistently lower in the second half of each month. Differences ranged from 1,100 L/ha/d to 3775 L/ha/d. No definitive trend was found with regards to the variations between weekday and weekend volumes.

Figures 4 – 7 show the Total DWF flows at monitoring station TH 113 for each dry weather flow day, separated by month. On each Figure, the weekdays and weekends as well as the events within the first and second halves of the month are highlighted with different colours. Note that in some instances, dry weather flow days shown in the Figures were removed from the ultimate Dry Weather Flow analysis as it appeared that these days were outliers. The outliers are shown in grey in the Figures.

The Figures show the noticeable variations in Total DWF flows between the months as well as between the first and second halves of each month. The figures also highlight the variations in flows between weekdays and weekends.

Table 6: DWF Results at Monitoring Station TH 113 for DWF Days – Statistics for all Sample Sets

	Daily Total DWF Volume (L)	Daily DWI Volume (L)	Daily DWI (L /ha)	Daily Domestic DWF Volume (L)	Daily Domestic DWF (Lpcd)
DWF Days - All Days					
Average	2,032,583	1,281,240	4,418	751,344	207
Standard Deviation	861,326	805,372	2,777	130,966	36
DWF Days - All Weekdays					
Average	2,042,961	1,283,594	4,426	759,366	209
Standard Deviation	840,866	794,751	2,740	136,814	38
DWF Days - All Weekends					
Average	2,007,159	1,275,471	4,398	731,687	202
Standard Deviation	931,639	851,853	2,937	116,300	32
DWF Days - All Weekdays - February					
Average	1,025,726	378,100	1,304	647,625	178
Standard Deviation	92,044	51,751	178	83,808	23
DWF Days - All Weekends - February					
Average	1,129,666	519,252	1,790	610,414	168
Standard Deviation	295,138	221,919	765	82,377	23
DWF Days - All Weekdays - 1st Half of March					
Average	3,287,137	2,402,156	8,283	884,981	244
Standard Deviation	309,147	393,821	1,358	244,029	67
DWF Days - All Weekends - 1st Half of March					
Average	3,152,344	2,288,930	7,893	863,413	238
Standard Deviation	3,429	42,094	145	45,523	12
DWF Days - All Weekdays - 2nd Half of March					
Average	2,534,312	1,777,544	6,129	756,768	208
Standard Deviation	509,841	532,936	1,838	68,190	19
DWF Days - All Weekends - 2nd Half of March					
Average	1,992,637	1,193,505	4,115	799,131	220
Standard Deviation	143,838	102,066	352	41,772	11
DWF Days - All Weekdays - 1st Half of April					
Average	2,084,284	1,277,397	4,405	806,887	222
Standard Deviation	48,604	115,760	399	85,430	23
DWF Days - All Weekends - 1st Half of April					
Average	2,692,323	1,922,986	6,631	769,338	212
Standard Deviation	845,570	846,967	2,921	101,576	28

Table 6: (Continued)

	Daily Total DWF Volume (L)	Daily DWI Volume (L)	Daily DWI (L /ha)	Daily Domestic DWF Volume (L)	Daily Domestic DWF (Lpcd)
DWF Days - All Weekdays – 2nd Half of April					
Average	1,708,119	961,762	3,316	746,356	206
Standard Deviation	441,817	464,173	1,601	54,760	15
DWF Days - All Weekends - 2nd Half of April					
Average	1,710,958	909,112	3,135	801,846	221
Standard Deviation	66,284	32,418	112	33,866	9
DWF Days - All Weekdays - 1st Half of May					
Average	2,370,035	1,645,334	5,674	724,701	200
Standard Deviation	58,049	41,841	144	16,208	4
DWF Days - All Weekends - 1st Half of May					
Average	3,132,306	2,323,672	8,013	808,634	223
Standard Deviation	374,036	422,171	1,456	98,511	27
DWF Days - All Weekdays - 2nd Half of May					
Average	1,971,460	1,177,613	4,061	793,847	219
Standard Deviation	686,787	730,169	2,518	89,234	25
DWF Days - All Weekends - 2nd Half of May					
Average	2,134,349	1,379,692	4,758	754,657	208
Standard Deviation	1,244,201	1,144,140	3,945	127,744	35

4.3.6 Discussion

The estimated DWI volumes are consistently greater than the Domestic DWF volumes. This indicates that inflow and infiltration contributes a larger proportion to the total sewer flow than domestic use. The exception is February, and is expected to be the result of reduced groundwater infiltration due to lower groundwater table levels and the presence of frozen or partially frozen soils.

The maximum average daily volumes for Total DWF, DWI and Domestic DWF all correspond to the first half of March and the minimum volumes all occurred in February. Review of the volumes indicates that inflow and infiltration is the significant contributor to the total sewer flows during the times of maximum flows. It is to be expected that groundwater infiltration during March (the spring melt time of year) would be significant.

Thus, it is recommended that any works designed to improve system performance should consider reducing system I/I.

The reasoning behind the consistent trends in increased observed flows during the second halves of each month, as well as the varying trends in volumes between weekdays and weekends, is expected to be a result of external forcing factors, such as domestic use and ICI usage pattern changes. Further investigation of the reasons was not completed at this time, as the focus of the study was on the evaluation of the sewer system performance under various future development scenarios.

5. Updates to the Tecumseh Hamlet Sanitary Sewer Model

The previous XP-SWMM hydraulic model, originally developed by CH2M Hill for the Town, was reviewed. The model was then updated to reflect the following changes in the sewer system:

- Revise the CR 22 relief sewer details, based on as-built plans; and,
- Confirm sewer system details as per Town GIS data.

The relief sewer details within the original model were based on design plans. For this evaluation, the model was updated to reflect the as-built details including revisions to the section of the Lesperance Road trunk sewer from Westlake Drive to CR 22 to account for the as-built manhole 11A inverts.

Based on review of the Town's GIS data, the following minor revisions to the model were made:

- Three (3) existing sewer sections across drainage divides (under typical flow conditions) were added to the model. The revised model will allow for flows across the drainage divides under flooded conditions, such as during a major storm event,
    - section of the Lesperance Road sewer to the immediate south of Holmes Crescent (200 mm diameter);
    - section of the Lesperance Road sewer between Intersection Road and Gouin Street (200 mm diameter);
    - section of the Shawnee Road sewer between Intersection Road and Westlake Drive (200 mm diameter);
- Section of the Poisson Street sewer to the immediate north of Arbour Street (250 mm diameter), to account for the potential flow path north along Poisson Street under flooded conditions.

The revised XP-SWMM hydraulic model has been provided with this memorandum.

6. Wastewater Flow Projections for Manning Road Secondary Plan Area

6.1 Location

Existing development in Tecumseh Hamlet has occurred with a north-south orientation parallel to Lesperance Road. The vacant lands on the east and west of the existing developed area have been identified as future growth areas. The Manning Road Secondary Plan Area, located on east side of the Hamlet north of CP Railway, is further identified as a priority development area by the Town. It is situated between existing developments parallel to Lesperance Road and Manning Road Business Park Area/Manning Road as shown on **Figure 8**.

Manning Road Secondary Plan Area consists of approximately 88 hectares of area and includes several parcels of land owned by different individuals and/or corporations. The existing Baillargeon Drain, which is a Municipal Drain, traverses the area from west to east.

6.2 Wastewater Flow Projections

For the purpose of this study, the Manning Road Secondary Plan Area has been divided in six (6) sub-areas as identified on **Figure 9**. The wastewater flow projections were established based on full development of all available lands within these sub-areas. The design criteria utilized for this study are generally based on the criteria established in the Town's Water and Wastewater Master Plan Update (AECOM, July 2008), as summarized below:

- Residential Units Density: 10 Units/ha. (Low End) to 20 Units/ha. (High End)
- Population Density per Unit: 3.2 persons/unit
- Average Wastewater Generation Rate: 300 Lpcd
- Peak Factor for Wastewater: Harmon's Formula
- Peak Infiltration Allowance: 16,415 L/ha.day

A summary of the projected population and peak wastewater flows for the Manning Road Secondary Plan Area is presented in **Table 7**, and detailed calculations are attached at the end of this memorandum.

Table 7: Projected Wastewater Flow for Build-Out of Manning Road Secondary Plan Area

Sub-Area ID	Land Area (ha.)	Build-Out Population		Build-Out Peak Wastewater Flow (L/s)	
		Low End (1)	High End (2)	Low End (1)	High End (2)
1	13.2	422	844	8.4	13.8
2	13.3	426	852	8.5	13.9
3	13.0	416	832	8.3	13.6
4	5.0	160	320	3.3	5.5
5	9.2	294	588	5.9	9.8
6	34.3	1,098	2,196	20.9	33.6
Build-Out	**88.0**	**2,816**	**5,632**	**50.6**	**79.2**

Notes:
1. Based on a development of 10 residential units/ hectare and 3.2 persons/unit.
2. Based on a development of 20 residential units/ hectare and 3.2 persons/unit.

6.3 Short-Term Development Scenarios

According to the preferred wastewater servicing strategy presented in the 2008 Water and Wastewater Master Plan Update, the lands north of Baillargeon Drain in the Manning Road Secondary Plan Area would outlet to the Lesperance Road Trunk Sewer, and the remainder of the lands south of Baillargeon Drain would be directed to the new East Tecumseh Trunk Sewer adjacent to CP railway with outlet to the new West Tecumseh Trunk Sewer.

As stated earlier, this study was initiated to confirm the assumptions of previous modeling that indicated the Lesperance Road trunk sewer would have additional capacity after installation of County Road 22 relief sewer. Now that a relief sewer on CR 22 has become operational, evaluation of impacts of various development scenarios in Manning Road Secondary Plan Area to the Lesperance Road Trunk Sewer would provide guidance for Town Staff and Development Proponents in formulating a wastewater collection system strategy within the area.

Since the staging of development in the Manning Road Secondary Plan Area is uncertain at this stage, not all possible development scenarios can be considered by this study. For the purpose of this study, it is assumed that the development would progress easterly from the existing developed area adjacent to Lesperance Road. In addition, development scenarios would only be considered for areas north of Baillargeon Drain (sub-areas 1 to 4) that would outlet to the Lesperance Road trunk sewer. For these areas, following two existing sewers have been identified with a potential to convey additional wastewater flow to the Lesperance Road Trunk Sewer:

- Westlake Drive Sewer: 450mm diameter sewer with a capacity of 110 L/s
- Gouin Street Sewer: 375 mm diameter with a capacity of 68 L/s

Based on a relative location of sub-areas (1 to 4) within the north part of Manning Road Secondary Plan Area, and proximity of these sub-areas to the above identified sewers, following four (4) potential short-term development scenarios have been selected for evaluation:

- Development Scenario 1: Development of Sub-areas 1 and 2 with Wastewater Flow Directed to Westlake Drive Sewer **(Figure 10)**
- Development Scenario 2: Development of Sub-areas 1 and 3 with Wastewater Flow Directed to Westlake Drive Sewer **(Figure 11)**
- Development Scenario 3: Development of Sub-areas 2 and 3 with Wastewater Flow Directed to Gouin Street Sewer **(Figure 12)**
- Development Scenario 4: Development of Sub-areas 2 and 4 with Wastewater Flow Directed to Gouin Street Sewer **(Figure 13)**

A summary of the projected population and peak wastewater flows for the above development scenarios is presented in **Table 8**, and detailed calculations are attached at the end of this memorandum.

Table 8: Projected Wastewater Flow for Short-Term Development Scenarios

Development Scenario	Sub-Areas Included	Total Land Area (ha.)	Build-Out Population		Build-Out Peak Wastewater Flow (L/s)		Wastewater Outlet
			Low End (1)	High End (2)	Low End (1)	High End (2)	
1	1 and 2	26.5	848	1,696	16.4	26.5	Westlake Drive Sewer
2	1 and 3	26.2	838	1,676	16.2	26.2	
3	2 and 3	26.3	842	1,684	16.2	26.3	Gouin Street Sewer
4	2 and 4	18.3	586	1,172	11.5	18.8	

Notes:

1. Based on a development of 10 residential units /hectare and 3.2 persons/unit.
2. Based on a development of 20 residential units/hectare and 3.2 persons/unit.

6.4 Evaluation of Impacts of Short-Term Development Scenarios

As stated earlier, the Town has now decided to update the overall model of the north Tecumseh wastewater collection system that includes the areas of Tecumseh, St. Clair Beach and Tecumseh Hamlet. This overall model will then be used to assess the hydraulic performance of the sewer system under existing and future development scenarios. Therefore, the evaluation of impacts of above development scenarios on the sewer system within Tecumseh Hamlet was not completed under this study.

The analysis of the wastewater flow monitoring data and wastewater flow projections presented in above sections would provide a basis for evaluation of the sewer system as part of the future update of the overall model.

7. Summary

A summary of the flow monitoring data is provided below:

- **Six Major Rainfall Events Recorded**: Six storm events were recorded with a total rainfall depths greater than 15 mm:
  - Storms on April 7, May 2, May 7 and May 11 had return periods of less than 2 years
  - A storm on June 4 had a return period of between 2 and 5 years
  - A storm on June 5 had a return period of between 5 and 10 years

- **Peak Flows Recorded during June 5 Storm Event**: The peak flows recorded at each Monitoring Station during the largest recorded event (June 5, 2010, with a total rainfall depth of 77.2 mm over a runoff period of 53.3 hours) were as follows, with the recorded flows at TH113 being greater than the sewer design capacity:
  - Monitoring Station TH 113: 326.0 L/s (Estimated Sewer Capacity = 200 L/s)
  - Monitoring Station TH 78: 183.8 L/s (Estimated Sewer Capacity = 200 L/s)
  - Monitoring Station TH 14: 36.4 L/s (Estimated Sewer Capacity = 42 L/s)

- **Rainfall Generated I/I during Storm Events**: The average rainfall generated I/I flow exceeded the MOE guidelines recommended design allowance of 864 to 24,192 L/ha/day for the following events:

- June 5, 2010 event: Average rainfall generated I/I flow of 34,162 L/ha/day at monitoring station TH 78, and 39,129 L/ha/day at monitoring station TH 113
- May 5, 2010 event: Average rainfall generated I/I flow of 25,012 L/ha/day at monitoring station TH 78.

- **Average Domestic DWF Rates within Allowable Range as per Design Criteria and Previous Studies**: Monitoring Stations TH78 and TH113 had average domestic DWF rates of 200 – 210 Lpcd:

    - This is below the Town design criterion of 300 Lpcd
    - This is within the range (172 - 309 Lpcd) reported in the *Inflow and Infiltration Control Study* completed by CH2M Hill

- **Estimated DWI volumes consistently greater than the Domestic DWF volumes**: This indicates that inflow and infiltration provides the significant contribution to the total sewer flows during times of higher flows. It is recommended that any works designed to improve system performance should consider reducing system I/I.

- **Temporal Variations in DWF Flows**: The reasoning behind increased flows during the second halves of each month, as well as the varying trends in volumes between weekdays and weekends, is expected to be a result of external forcing factors, such as domestic and ICI usage pattern changes.

LEGEND

Symbol	Description
— · —	Town of Tecumseh Boundary
— - —	Tecumseh Hamlet Boundary
	200mm Sanitary Sewer
	250mm Sanitary Sewer
	300mm Sanitary Sewer
	350mm Sanitary Sewer
375mm	375mm Trunk Sanitary Sewer
450mm	450mm Trunk Sanitary Sewer
525mm	525mm Trunk Sanitary Sewer
600mm	600mm Trunk Sanitary Sewer
o	Maintenance Hole
F/M	150mm Sanitary Forcemain
SPS □	Sewage Pumping/Lift Station
	Flow Monitor Location (February 3, 2010 to June 15, 2010)

NOTE:
Base plan from OBM mapping 1987–1988 supplied by Town of Tecumseh

Town of Tecumseh
Tecumseh Hamlet Sanitary Sewer Flow Monitoring and Modeling Update

Flow Monitoring Stations
(February 3, 2010 to June 15, 2010)

AECOM

AECOM Canada Ltd.
50 Sportsworld Crossing Road, Unit 290, Kitchener, Ontario N2P 0A4
T 519 650 5313 F 519 650 3424

FIGURE 1

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Figure 2: Daily DWF Pattern for Each Monitoring Station – Total Flow (including Domestic DWF and DWI)

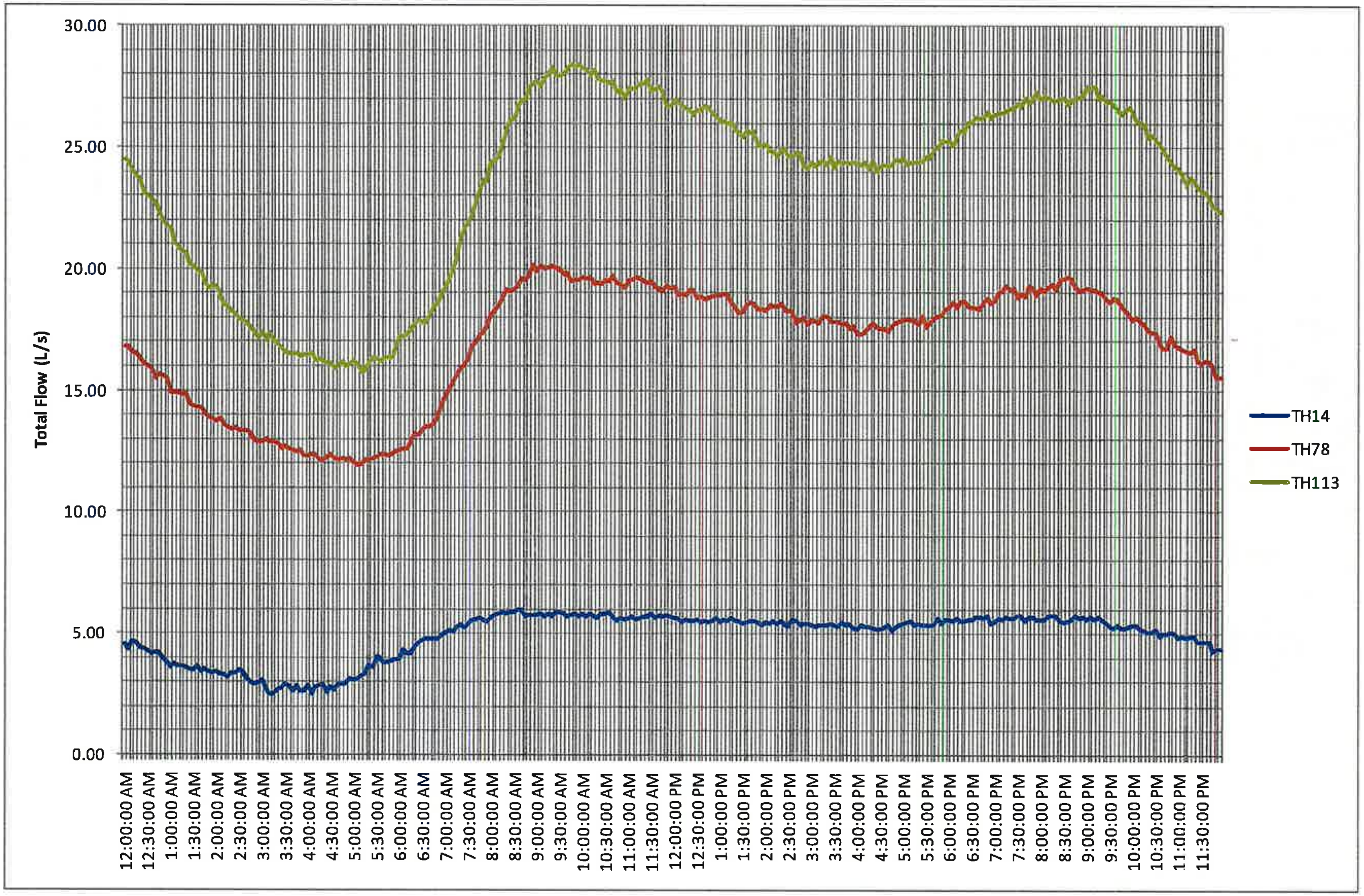


Figure 3: Daily DWF Pattern for Each Monitoring Station – Total DWF Rate (including Domestic DWF and DWI)

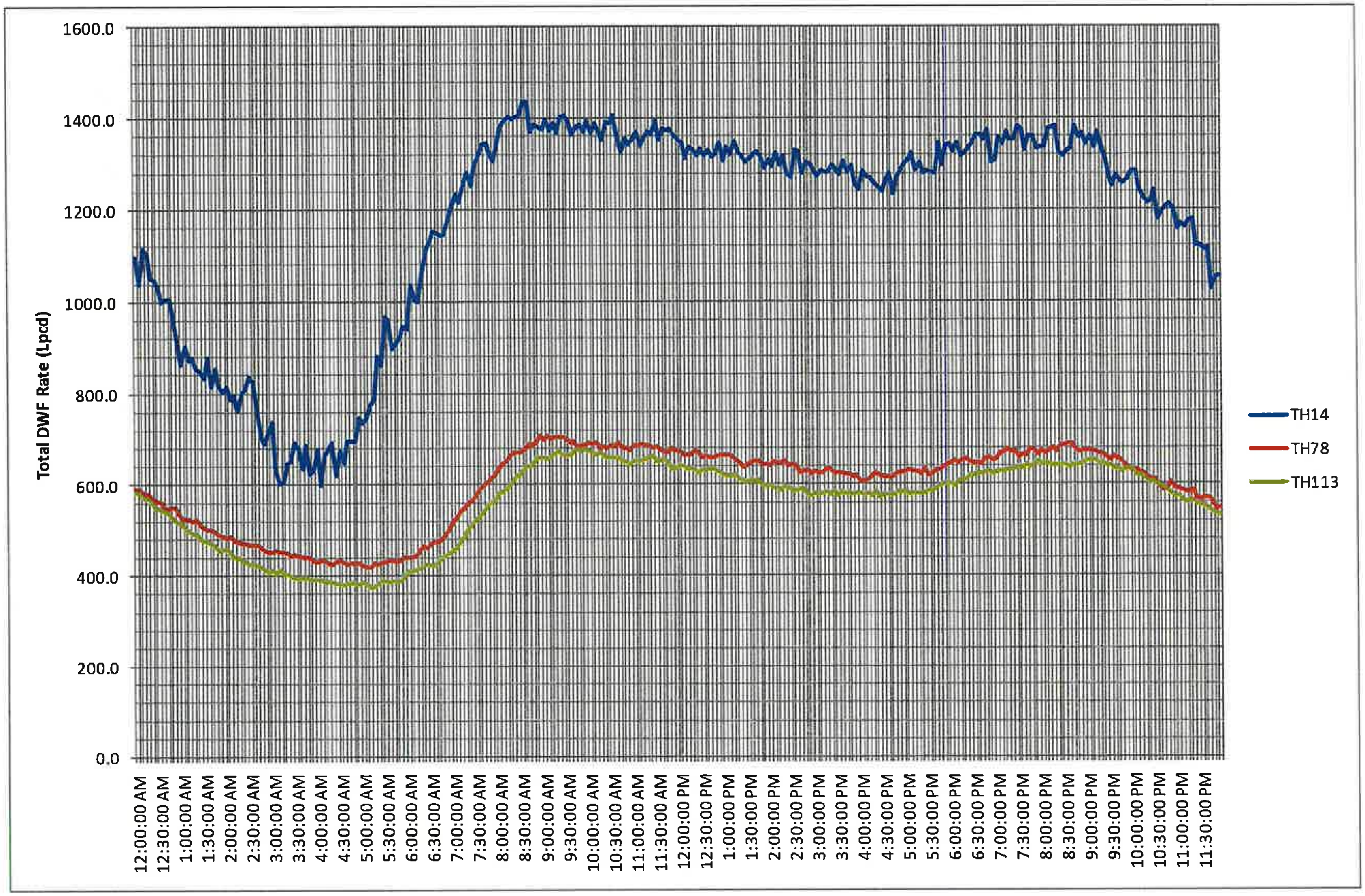


Figure 4: Measured Total DWF Flows for Monitoring Station TH 113 – February 2010

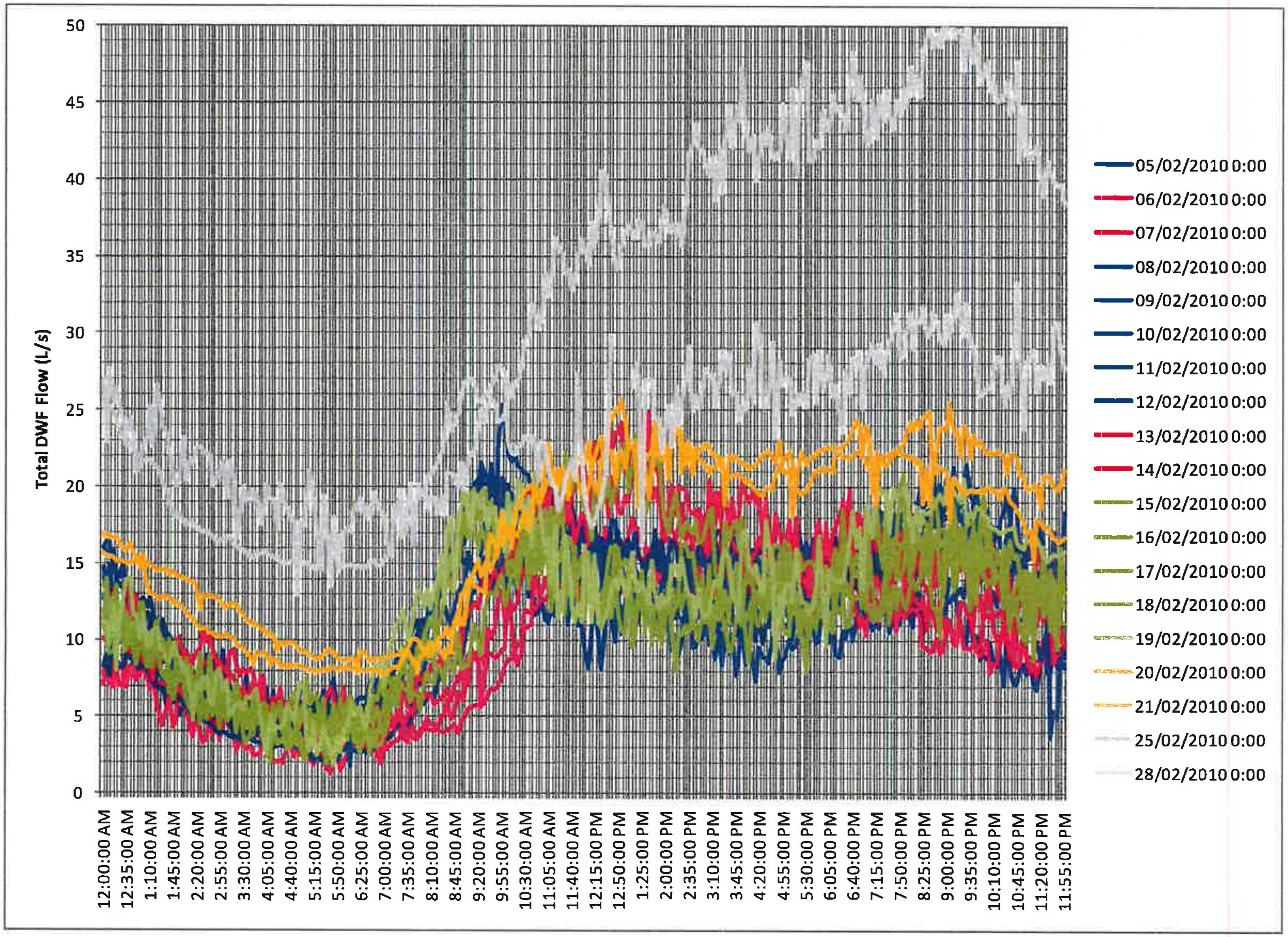


Figure 5: Measured Total DWF Flows for Monitoring Station TH 113 – March 2010

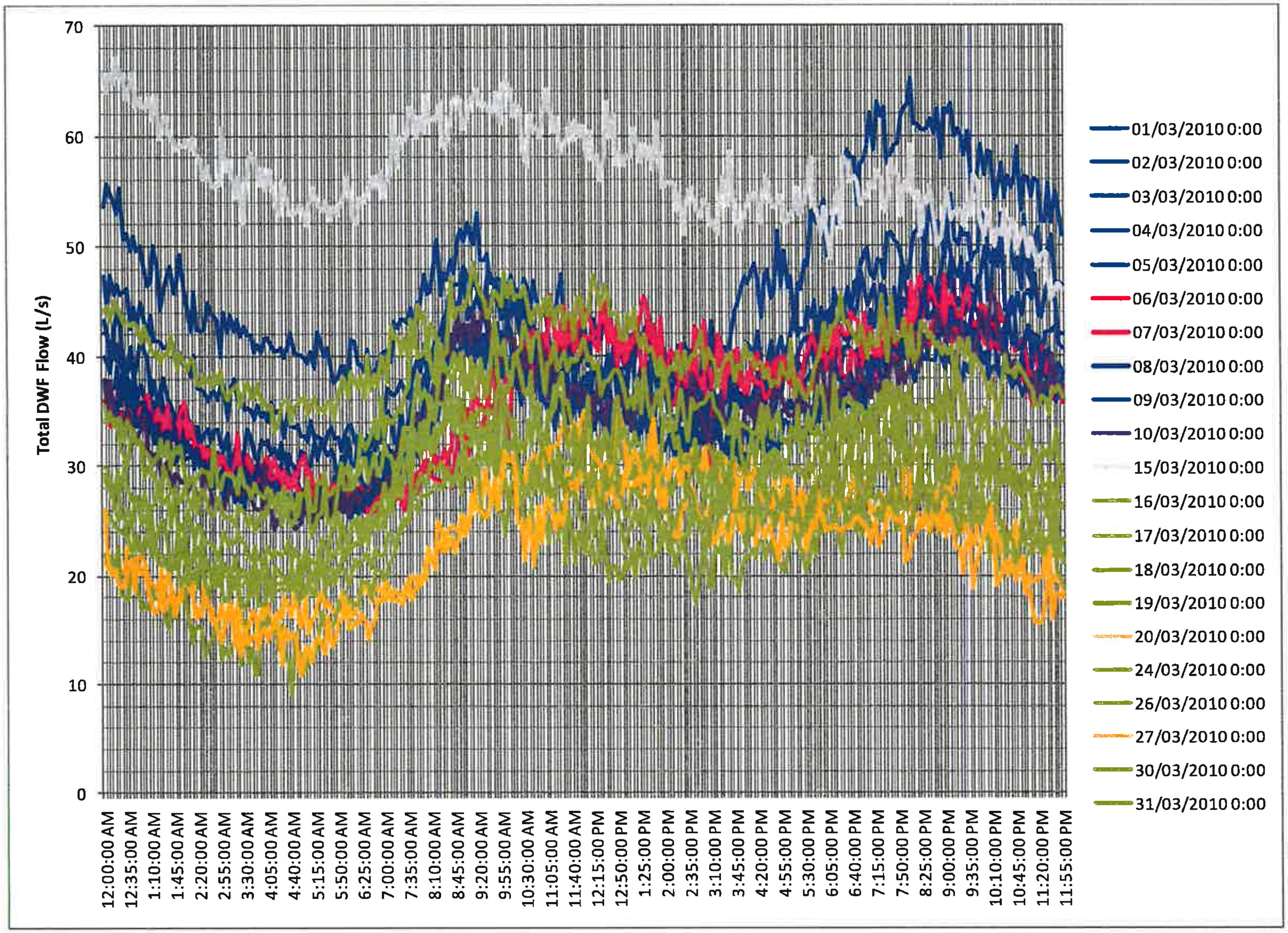


Figure 6: Measured Total DWF Flows for Monitoring Station TH 113 – April 2010

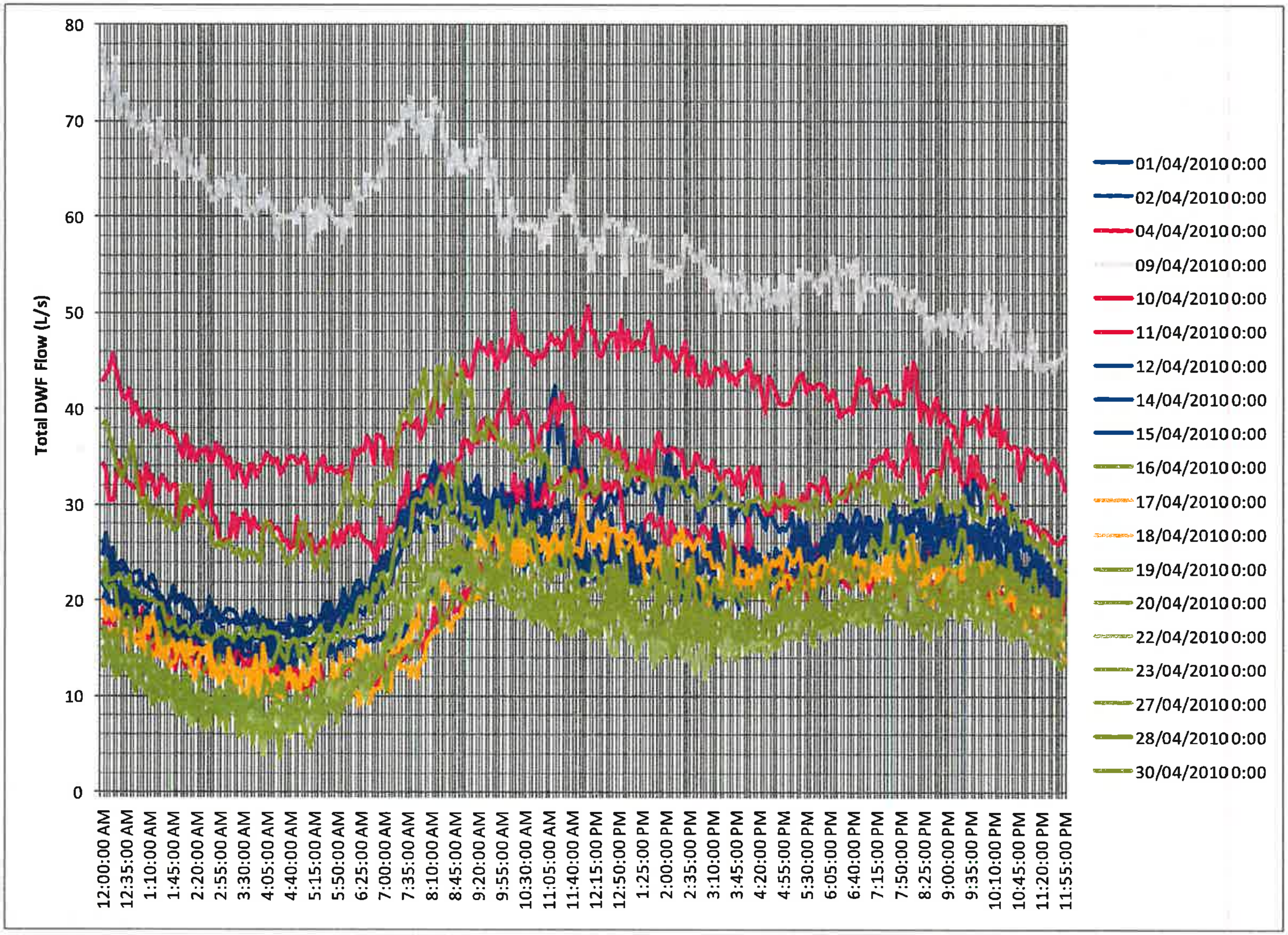
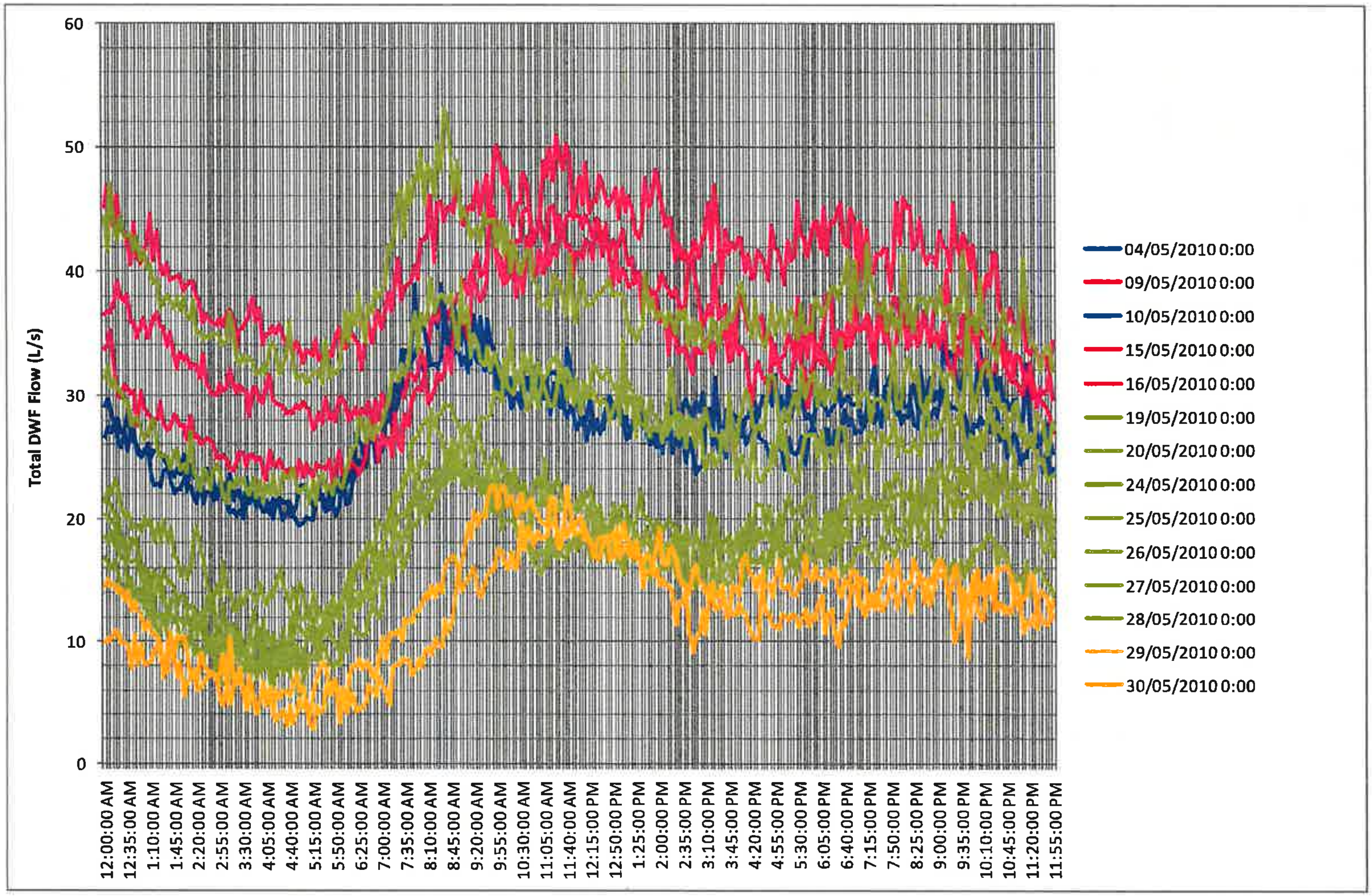
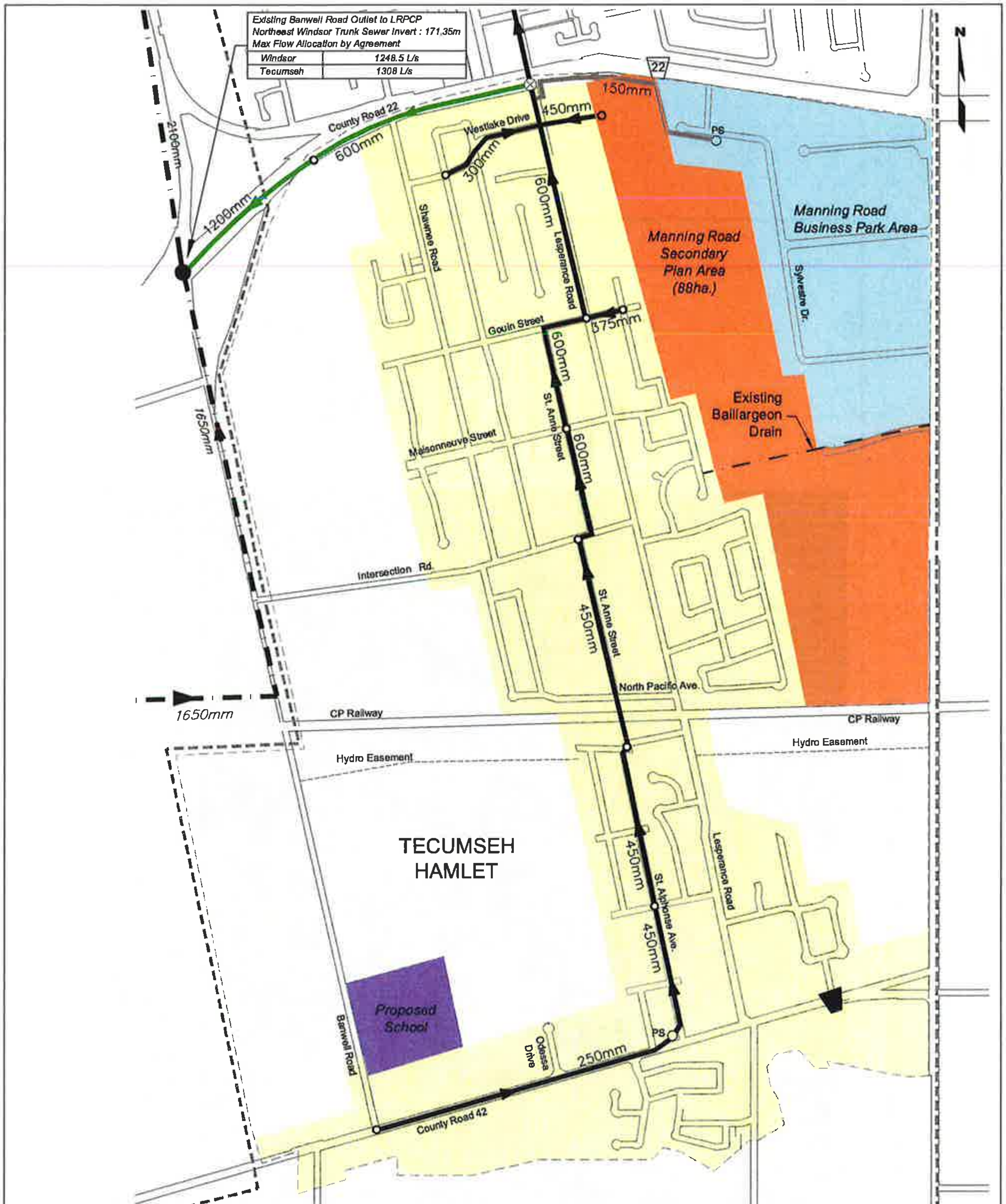


Figure 7: Measured Total DWF Flows for Monitoring Station TH 113 – May 2010





LEGEND

- Town Boundary
- Hamlet Boundary
- PS Existing Pumping Station (P.S.)
- Existing Outlet Location for Discharge of Monitored flow from Tecumseh to Little River Pollution Control Plant (LRPCP)
- Existing Flow Control Manhole
- Existing Trunk Sewer
- *Existing Relief Sewer*
- Existing Forcemain
- *Northeast Windsor Trunk Sewer (By City of Windsor)*
- Existing Developed Area
- Manning Road Business Park Area
- Manning Road Secondary Plan Area

Town of Tecumseh
Tecumseh Hamlet Sanitary Sewer Flow Monitoring and Modeling Update

Location of Manning Road Secondary Plan Area

AECOM

AECOM Canada Ltd.
50 Sportsworld Crossing Road, Unit 290, Kitchener, Ontario N2P 0A4
T 519.650.5313 F 519.650.3424

FIGURE 8

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Town of Tecumseh
Tecumseh Hamlet Sanitary Sewer Flow Monitoring and Modeling Update

LEGEND

PS ○ *Existing Pumping Station*

⊗ *Existing Flow Control Manhole*

Existing Trunk Sewer

Existing Relief Sewer

Existing Forcemain

5 / 9.2 ha. — *Sub-Area ID* / *Land Area in hectares*

Sub-Areas within Manning Road Secondary Plan Area

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50 Sportsworld Crossing Road, Unit 290, Kitchener, Ontario N2P 0A4
T519.650.5313 F519.650.3424

FIGURE 9

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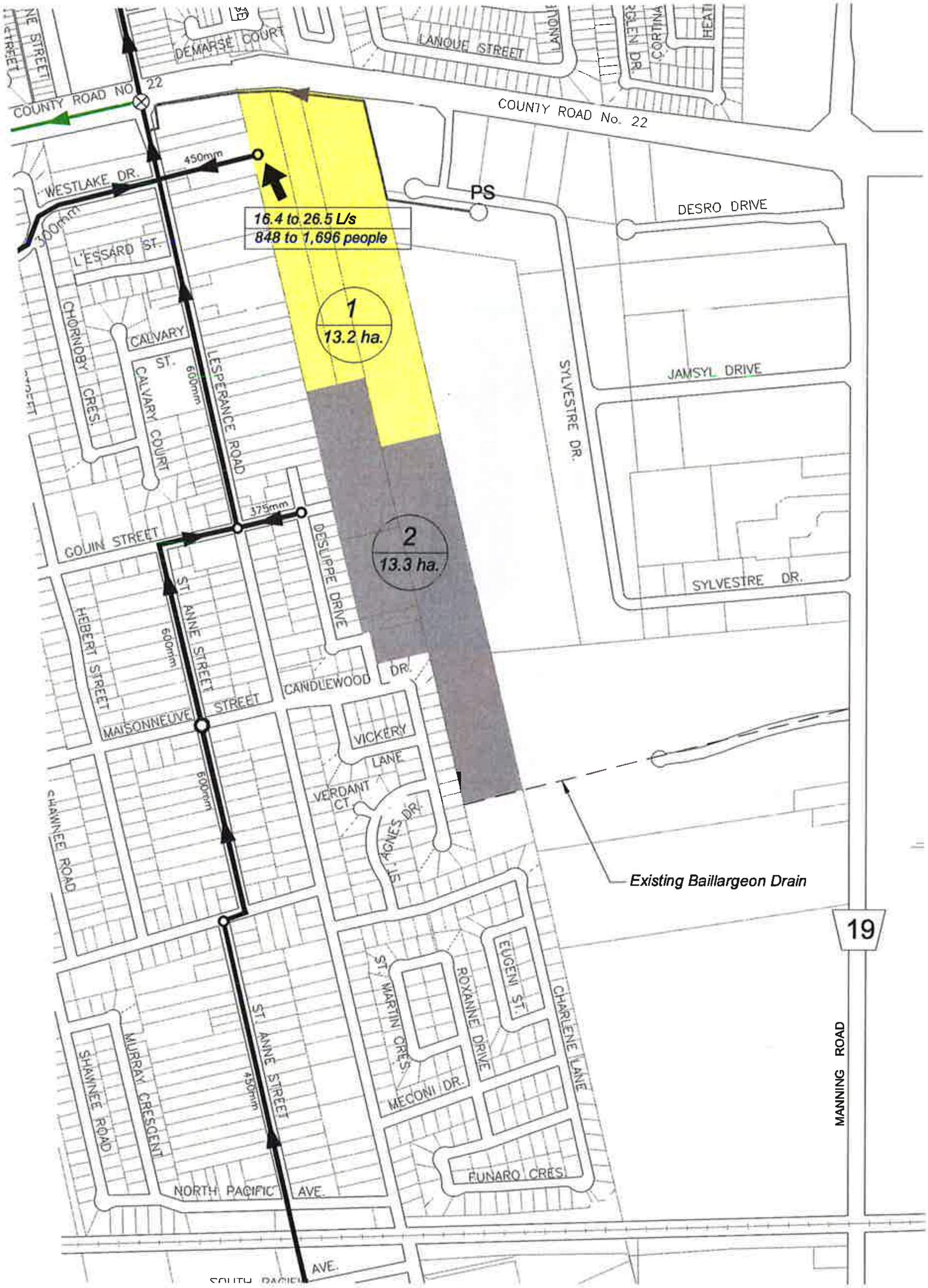

Town of Tecumseh
Tecumseh Hamlet Sanitary Sewer Flow Monitoring and Modeling Update

LEGEND

PS Existing Pumping Station

Existing Flow Control Manhole

Existing Trunk Sewer

Existing Relief Sewer

Existing Forcemain

16.4 to 26.5 L/s	Build-out Peak Flow Range
848 to 1,696 people	Build-out Population Range

5 — Sub-Area ID

9.2 ha. — Land Area in hectares

Development Scenario 1 with Wastewater Outlet to Westlake Drive Trunk Sewer

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FIGURE 10

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Town of Tecumseh
Tecumseh Hamlet Sanitary Sewer Flow
Monitoring and Modeling Update

LEGEND

Symbol	Description
PS ○	*Existing Pumping Station*
⊗	*Existing Flow Control Manhole*
➞	*Existing Trunk Sewer*
➞ (green)	*Existing Relief Sewer*
→	*Existing Forcemain*

16.4 to 26.5 L/s	*Build-out Peak Flow Range*
848 to 1,676 people	*Build-out Population Range*

5 / 9.2 ha. — *Sub-Area ID* / *Land Area in hectares*

Development Scenario 2 with Wastewater Outlet to Westlake Drive Trunk Sewer

AECOM

AECOM Canada Ltd.
50 Sportsworld Crossing Road, Unit 290, Kitchener, Ontario N2P 0A4
T 519.650.5313 F 519.650.3424

FIGURE 11

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LEGEND

PS ○ *Existing Pumping Station*

⊗ *Existing Flow Control Manhole*

Existing Trunk Sewer

Existing Relief Sewer

Existing Forcemain

16.4 to 26.5 L/s	*Build-out Peak Flow Range*
848 to 1,676 people	*Build-out Population Range*

5 / 9.2 ha. — *Sub-Area ID* / *Land Area in hectares*

Town of Tecumseh
Tecumseh Hamlet Sanitary Sewer Flow Monitoring and Modeling Update

Development Scenario 3 with Wastewater Outlet to Gouin Street Sewer

AECOM

AECOM Canada Ltd.
50 Sportsworld Crossing Road, Unit 290, Kitchener, Ontario N2P 0A4
T 519 650 5313 F 519 650 3424

FIGURE 12

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Town of Tecumseh
Tecumseh Hamlet Sanitary Sewer Flow Monitoring and Modeling Update

LEGEND

- PS ○ *Existing Pumping Station*
- ⊗ *Existing Flow Control Manhole*
- *Existing Trunk Sewer*
- *Existing Relief Sewer*
- *Existing Forcemain*

16.4 to 26.5 L/s	*Build-out Peak Flow Range*
848 to 1,676 people	*Build-out Population Range*

5 — *Sub-Area ID*
9.2 ha. — *Land Area in hectares*

Development Scenario 4 with Wastewater Outlet to Gouin Street Sewer

AECOM

AECOM Canada Ltd.
50 Sportsworld Crossing Road, Unit 290, Kitchener, Ontario N2P 0A4
T 519 650 5313 F 519.650.3424

FIGURE 13

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Wastewater Flow Projections for Manning Road Secondary Plan Area

Low End Projections: Based on a Development of 10 Residential Units per hectare

Sub-Area ID	Service Population			Domestic Flows			Average Day Infiltration/ Inflow Rate (MOE Guidelines)	Peak Infiltration/ Inflow Rate	Average Day Wastewater Flow (for Treatment Capacity)	Peak Flow (for Sewer Capacity)
	Gross Area	Residential Units @ 10 Units/ha.	Build-Out Population @3.2 ppu	Average Day Domestic Flow (@ 300 Lpcd)	Peak Factor (Harmon's Formula)	Peak Domestic Flow				
	Hectares	Units	Persons	m^3/day		L/s	Lpcd	L/ha/day	m^3/day	L/s
1	13.2	132	**422**	127	4.01	5.9	90	16,415	165	**8.4**
2	13.3	133	**426**	128	4.01	5.9	90	16,415	166	**8.5**
3	13.0	130	**416**	125	4.01	5.8	90	16,415	162	**8.3**
4	5.0	50	**160**	48	4.18	2.3	90	16,415	62	**3.3**
5	9.2	92	**294**	88	4.08	4.2	90	16,415	115	**5.9**
6	34.3	343	**1,098**	329	3.77	14.4	90	16,415	428	**20.9**
Combined Catchment Area	**88.0**	**880**	**2,816**	**845**	**3.47**	**33.9**	**90**	**16,415**	**1,098**	**50.6**

High End Projections: Based on a Development of 20 Residential Units per hectare

Sub-Area ID	Service Population			Domestic Flows			Average Day Infiltration/ Inflow Rate (MOE Guidelines)	Peak Infiltration/ Inflow Rate	Average Day Wastewater Flow (for Treatment Capacity)	Peak Flow (for Sewer Capacity)
	Gross Area	Residential Units @ 20 Units/ha.	Build-Out Population @3.2 ppu	Average Day Domestic Flow (@ 300 Lpcd)	Peak Factor (Harmon's Formula)	Peak Domestic Flow				
	Hectares	Units	Persons	m^3/day		L/s	Lpcd	L/ha/day	m^3/day	L/s
1	13.2	264	**844**	253	3.85	11.3	90	16,415	329	**13.8**
2	13.3	266	**852**	256	3.84	11.4	90	16,415	332	**13.9**
3	13.0	260	**832**	250	3.85	11.1	90	16,415	324	**13.6**
4	5.0	100	**320**	96	4.07	4.5	90	16,415	125	**5.5**
5	9.2	184	**588**	176	3.94	8.0	90	16,415	229	**9.8**
6	34.3	686	**2,196**	659	3.55	27.1	90	16,415	856	**33.6**
Combined Catchment Area	**88.0**	**1,760**	**5,632**	**1,690**	**3.20**	**62.5**	**90**	**16,415**	**2,196**	**79.2**

Wastewater Flow Projections for Development Scenario 1 within Manning Road Secondary Plan Area

Low End Projections: Based on a Development of 10 Residential Units per hectare

Included Sub-Areas	Service Population			Domestic Flows			Average Day Infiltration/ Inflow Rate (MOE Guidelines)	Peak Infiltration/ Inflow Rate	Average Day Wastewater Flow (for Treatment Capacity)	**Peak Flow (for Sewer Capacity)**
	Gross Area	Residential Units @ 10 Units/ha.	**Build-Out Population @3.2 ppu**	Average Day Domestic Flow (@ 300 Lpcd)	Peak Factor (Harmon's Formula)	Peak Domestic Flow				
	Hectares	Units	**Persons**	m^3/day		L/s	Lpcd	L/ha/day	m^3/day	**L/s**
	1	3	4	5	6	7	8	9	10	11
1	13.2	132	**422**	127	4.01	5.9	90	16,415	165	**8.4**
2	13.3	133	**426**	128	4.01	5.9	90	16,415	166	**8.5**
Combined Catchment Area	**26.5**	**265**	**848**	**254**	**3.85**	**11.3**	**90**	**16,415**	**331**	**16.4**

High End Projections: Based on a Development of 20 Residential Units per hectare

Included Sub-Areas	Service Population			Domestic Flows			Average Day Infiltration/ Inflow Rate (MOE Guidelines)	Peak Infiltration/ Inflow Rate	Average Day Wastewater Flow (for Treatment Capacity)	**Peak Flow (for Sewer Capacity)**
	Gross Area	Residential Units @ 20 Units/ha.	**Build-Out Population @3.2 ppu**	Average Day Domestic Flow (@ 300 Lpcd)	Peak Factor (Harmon's Formula)	Peak Domestic Flow				
	Hectares	Units	**Persons**	m^3/day		L/s	Lpcd	L/ha/day	m^3/day	**L/s**
	1	3	4	5	6	7	8	9	10	11
1	13.2	264	**844**	253	3.85	11.3	90	16,415	329	**13.8**
2	13.3	266	**852**	256	3.84	11.4	90	16,415	332	**13.9**
Combined Catchment Area	**26.5**	**530**	**1,696**	**509**	**3.64**	**21.4**	**90**	**16,415**	**661**	**26.5**

Wastewater Flow Projections for Development Scenario 2 within Manning Road Secondary Plan Area

Low End Projections: Based on a Development of 10 Residential Units per hectare

Included Sub-Areas	Service Population			Domestic Flows			Average Day Infiltration/ Inflow Rate (MOE Guidelines)	Peak Infiltration/ Inflow Rate	Average Day Wastewater Flow (for Treatment Capacity)	**Peak Flow (for Sewer Capacity)**
	Gross Area	Residential Units @ 10 Units/ha.	**Build-Out Population @3.2 ppu**	Average Day Domestic Flow (@ 300 Lpcd)	Peak Factor (Harmon's Formula)	Peak Domestic Flow				
	Hectares	Units	**Persons**	m^3/day		L/s	Lpcd	L/ha/day	m^3/day	**L/s**
1	13.2	132	**422**	127	4.01	5.9	90	16,415	165	**8.4**
3	13.0	130	**416**	125	4.01	5.8	90	16,415	162	**8.3**
Combined Catchment Area	**26.2**	**262**	**838**	**251**	**3.85**	**11.2**	**90**	**16,415**	**327**	**16.2**

High End Projections: Based on a Development of 20 Residential Units per hectare

Included Sub-Areas	Service Population			Domestic Flows			Average Day Infiltration/ Inflow Rate (MOE Guidelines)	Peak Infiltration/ Inflow Rate	Average Day Wastewater Flow (for Treatment Capacity)	**Peak Flow (for Sewer Capacity)**
	Gross Area	Residential Units @ 20 Units/ha.	**Build-Out Population @3.2 ppu**	Average Day Domestic Flow (@ 300 Lpcd)	Peak Factor (Harmon's Formula)	Peak Domestic Flow				
	Hectares	Units	**Persons**	m^3/day		L/s	Lpcd	L/ha/day	m^3/day	**L/s**
1	13.2	264	**844**	253	3.85	11.3	90	16,415	329	**13.8**
3	13.0	260	**832**	250	3.85	11.1	90	16,415	324	**13.6**
Combined Catchment Area	**26.2**	**524**	**1,676**	**503**	**3.64**	**21.2**	**90**	**16,415**	**654**	**26.2**

Wastewater Flow Projections for Development Scenario 3 within Manning Road Secondary Plan Area

Low End Projections: Based on a Development of 10 Residential Units per hectare

Included Sub-Areas	Service Population			Domestic Flows			Average Day Infiltration/ Inflow Rate (MOE Guidelines)	Peak Infiltration/ Inflow Rate	Average Day Wastewater Flow (for Treatment Capacity)	**Peak Flow (for Sewer Capacity)**
	Gross Area	Residential Units @ 10 Units/ha.	**Build-Out Population @3.2 ppu**	Average Day Domestic Flow (@ 300 Lpcd)	Peak Factor (Harmon's Formula)	Peak Domestic Flow				
	Hectares	Units	**Persons**	m^3/day		L/s	Lpcd	L/ha/day	m^3/day	**L/s**
2	13.3	133	**426**	128	4.01	5.9	90	16,415	166	**8.5**
3	13.0	130	**416**	125	4.01	5.8	90	16,415	162	**8.3**
Combined Catchment Area	**26.3**	**263**	**842**	**253**	**3.85**	**11.2**	**90**	**16,415**	**328**	**16.2**

High End Projections: Based on a Development of 20 Residential Units per hectare

Included Sub-Areas	Service Population			Domestic Flows			Average Day Infiltration/ Inflow Rate (MOE Guidelines)	Peak Infiltration/ Inflow Rate	Average Day Wastewater Flow (for Treatment Capacity)	**Peak Flow (for Sewer Capacity)**
	Gross Area	Residential Units @ 20 Units/ha.	**Build-Out Population @3.2 ppu**	Average Day Domestic Flow (@ 300 Lpcd)	Peak Factor (Harmon's Formula)	Peak Domestic Flow				
	Hectares	Units	**Persons**	m^3/day		L/s	Lpcd	L/ha/day	m^3/day	**L/s**
2	13.3	266	**852**	256	3.84	11.4	90	16,415	332	**13.9**
3	13.0	260	**832**	250	3.85	11.1	90	16,415	324	**13.6**
Combined Catchment Area	**26.3**	**526**	**1,684**	**505**	**3.64**	**21.3**	**90**	**16,415**	**657**	**26.3**

Wastewater Flow Projections for Development Scenario 4 within Manning Road Secondary Plan Area

Low End Projections: Based on a Development of 10 Residential Units per hectare

Included Sub-Areas	Service Population			Domestic Flows			Average Day Infiltration/ Inflow Rate (MOE Guidelines)	Peak Infiltration/ Inflow Rate	Average Day Wastewater Flow (for Treatment Capacity)	**Peak Flow (for Sewer Capacity)**
	Gross Area	Residential Units @ 10 Units/ha.	**Build-Out Population @3.2 ppu**	Average Day Domestic Flow (@ 300 Lpcd)	Peak Factor (Harmon's Formula)	Peak Domestic Flow				
	Hectares	Units	**Persons**	m^3/day		L/s	Lpcd	L/ha/day	m^3/day	**L/s**
2	13.3	133	**426**	128	4.01	5.9	90	16,415	166	**8.5**
4	5.0	50	**160**	48	4.18	2.3	90	16,415	62	**3.3**
Combined Catchment Area	**18.3**	**183**	**586**	**176**	**3.94**	**8.0**	**90**	**16,415**	**229**	**11.5**

High End Projections: Based on a Development of 20 Residential Units per hectare

Included Sub-Areas	Service Population			Domestic Flows			Average Day Infiltration/ Inflow Rate (MOE Guidelines)	Peak Infiltration/ Inflow Rate	Average Day Wastewater Flow (for Treatment Capacity)	**Peak Flow (for Sewer Capacity)**
	Gross Area	Residential Units @ 20 Units/ha.	**Build-Out Population @3.2 ppu**	Average Day Domestic Flow (@ 300 Lpcd)	Peak Factor (Harmon's Formula)	Peak Domestic Flow				
	Hectares	Units	**Persons**	m^3/day		L/s	Lpcd	L/ha/day	m^3/day	**L/s**
2	13.3	266	**852**	256	3.84	11.4	90	16,415	332	**13.9**
4	5.0	100	**320**	96	4.07	4.5	90	16,415	125	**5.5**
Combined Catchment Area	**18.3**	**366**	**1,172**	**352**	**3.75**	**15.3**	**90**	**16,415**	**457**	**18.8**

APPENDIX F

TECUMSEH SANITARY MODELING UPDATE AND GOUIN DEVELOPMENT MEMO (2013)

MEMO

DILLON CONSULTING

TO: Daniel R. Piescic, P.Eng., Town of Tecumseh

FROM: Flavio R. Forest, P.Eng.

DATE: December 6, 2013

SUBJECT: Tecumseh Sanitary Modeling Update & Gouin Development

OUR FILE: 12-5969

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1. TECUMSEH HAMLET SANITARY MODELING UPDATE

The previous updating of the sanitary sewer model for Tecumseh Hamlet was undertaken by AECOM in 2010-2011 in parallel with calibration activities using flow monitoring data collected in 2010. Dillon subsequently re-evaluated, recalibrated and continued to finalize the model to enable it to be compatible for future system wide integration with the sewer networks in Tecumseh and St. Clair Beach.

The calibration of the Tecumseh Hamlet model was based on three (3) storm events between April and June 2010, shown in Table 1.1 (AECOM, 2011)[1]. It is noteworthy that there were only a limited number of significant rainfall events during the calibration period (spring and early summer of 2010); however, one significant event occurring on June 5th resulted in substantial surcharging of the Hamlet's main trunk sewer (Lesperance Trunk Sewer). A summary of the rainfall events used for model calibration is presented below.

TABLE 1.1
WET WEATHER EVENTS IN 2010 USED FOR MODEL CALIBRATION

ID	Storm Event	Total Rainfall Depth (mm)	Storm Duration (hr)	Avg Intensity over Storm Duration (mm/hr)	Max Avg Intensity (mm/hr)			Return Period[1]
					10 min interval	30 min interval	60 min interval	
1	April 7, 2010[2]	28.7	24.2	1.2	13.7	6.9	6.7	< 2-year
2	May 11, 2010[2]	29.5	12.5	2.4	10.7	8.6	6.9	< 2-year
3	June 5, 2010[3]	73.4	7.0	10.5	109.7	59.4	39.1	10-year

1. Based on a comparison of the maximum average intensities to the available IDF data, as reported in the AECOM August 2011 Tech Memo.
2. Wet antecedent conditions
3. Dry antecedent conditions

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[1] Tecumseh Hamlet Sanitary Sewer Modeling Updates Tech Memo, AECOM, August 2011

The modelling updates completed by Dillon included a number of revisions and improvements that included:

- Validating and updating of the sanitary sewer details on Lesperance Road at County Road 22. At this location, all Hamlet sanitary flows are 100% diverted west to the Country Road 22 relief sewer. The installed sluice gate at the intersection of Lesperance Road and Country Rd 22 currently prevents any Tecumseh Hamlet flows from flowing north into Tecumseh;

- Incorporating and configuring the operational settings at the St. Alphonse and Sylvestre Pump Stations based on updated pump performance information provided by the Town. This activity also included conducting a sensitivity analysis of headloss parameters through the 786m force main at the Sylvestre PS, to better enable the selection of appropriate parameters to model the pump operations;

- Reviewing design flow information for Sylvestre lands and confirming the model flow contribution to the Sylvestre pump station;

- Adopting a revised approach for calibration where infiltration/inflow parameters (RTK values) unique to each of three areas in Tecumseh Hamlet were used. The three areas correspond to the regions upstream of the flow monitors (as an alternative to applying a single set of RTK values for the entire Tecumseh Hamlet). Calibration involved using monitored data at all three monitoring sites (TH113, TH078 and TH014);

- Re-calibrating the model to both observed flows and water levels at all flow stations, but focusing on levels during surcharging conditions (e.g. June 5, 2010 event); and,
- Adopting the 5-year, 24-hour Chicago design storm in evaluating existing system performance using the calibrated model;

As the April 7 and May 11 storms were significantly smaller events that were found to be coincident with wet antecedent conditions, the calibration exercises result in a unique set of infiltration/inflow parameters (RTK values) that were reflective of this conditions. In contrast, the second set of RTK values were derived based on calibration to the larger but drier antecedent condition event on June 5. The two sets of RTK parameters, for wet and dry antecedent conditions respectively, are shown in Appendix A and a summary is presented in Table 1.2.

TABLE 1.2
SUMMARY OF CALIBRATED INFILTRATION / INFLOW PARAMETERS FOR TECUMSEH HAMLET MODEL

Antecedent Condition	R-Total (RTK values)[1]	Event Used in Calibration
Wet	R-Total ranges from 0.10 to 0.19[2]	April 7 and May 11, 2010
Dry	R-Total ranges from 0.04 to 0.17[2]	June 5, 2010

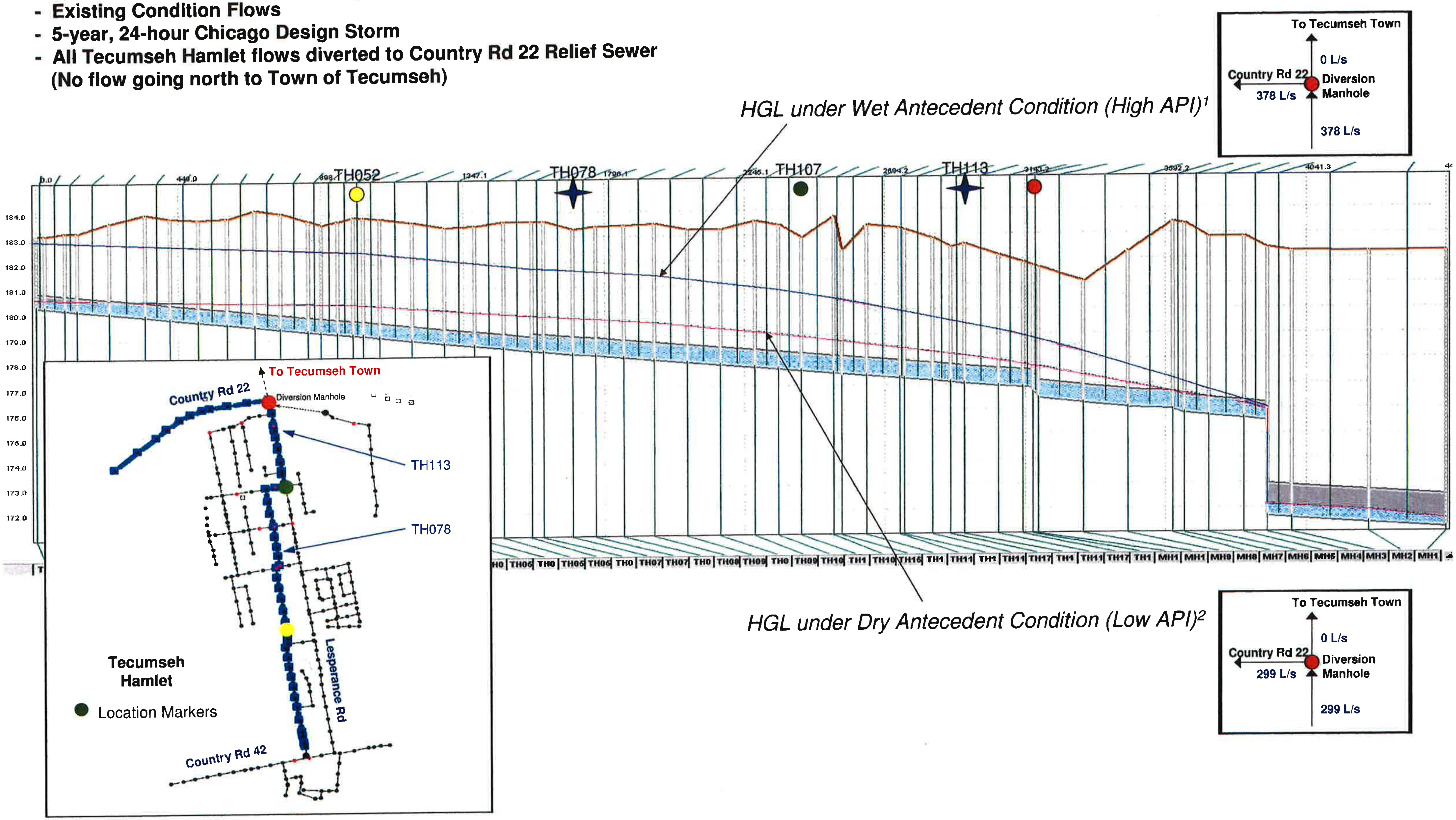
1. Calibrated RTK values presented in details in Appendix A.
2. Depending on the location, R-Total is different. See Appendix A.

The comparison of monitored and modelled results for the three (3) calibration events of April 7, May 11 and June 5, 2010 are also summarized in Appendix A.

Using the calibrated model, an evaluation of the existing system performance was conducted for the 5-year, 24-hour Chicago design storm. The hydraulic grade line (HGL) profile of the Lesperance trunk sewer is shown in Figure 1.1. Under wet antecedent conditions, the Lesperance trunk is found to surcharge along the entire length of sewer between County Rd 42 and County Rd 22. It is noteworthy that the HGL is generally less than 1.5m below the existing ground elevations at most locations upstream of manhole TH078 (St. Anne Street, north of Intersection Road). In contrast, when the antecedent condition is assumed to be dry, and the infiltration/inflow into the sewer system is substantially less, simulations indicate that the sewer only experiences minor surcharging with the HGL found to be in excess of 3.0m below the ground elevations along most of the Lesperance trunk sanitary sewer.

Figure 1.1: HGL Profile of Lesperance Trunk Sewer under Existing Conditions (with Different Antecedent Conditions)

- Existing Condition Flows
- 5-year, 24-hour Chicago Design Storm
- All Tecumseh Hamlet flows diverted to Country Rd 22 Relief Sewer (No flow going north to Town of Tecumseh)



Notes:

1. Wet antecedent conditions: using infiltration/inflow parameters (RTK values) determined based on calibration events of April 7 and May 11, 2010 (R-total ranging from 0.10 to 0.19)
2. Dry antecedent conditions: using infiltration/inflow parameters (RTK values) determined based on calibration event of June 5, 2010 (R-total ranging from 0.04 to 0.17)

2. MODEL INTEGRATION & EXISTING HYDRULIC PERFORMANCE

Upon completion of the modeling updates for Tecumseh Hamlet, this component of the model was integrated with the Tecumseh/St. Clair Beach model, which was also recently calibrated by Dillon. The construction of the composite model required the revision of simulation approaches, modification of select model parameters (e.g. hydraulic time step, etc.) and an evaluation of model stability to ensure its reliability in assessing the system's performance.

The 5-year, 24-hour Chicago design storm was again used to assess the system-wide composite model. Figures 2.1 and 2.2 illustrate the extent of surcharging under wet and dry antecedent conditions (for Tecumseh Hamlet). The corresponding graphical encodings of maximum pipe flow to design capacity are presented in Appendix B. It should be noted that, under existing condition, the Tecumseh Hamlet sewer network is separated from the Tecumseh sanitary sewer system north of County Road 22 by a sluice gate located at the intersection of Lesperance Road and County Road 22.

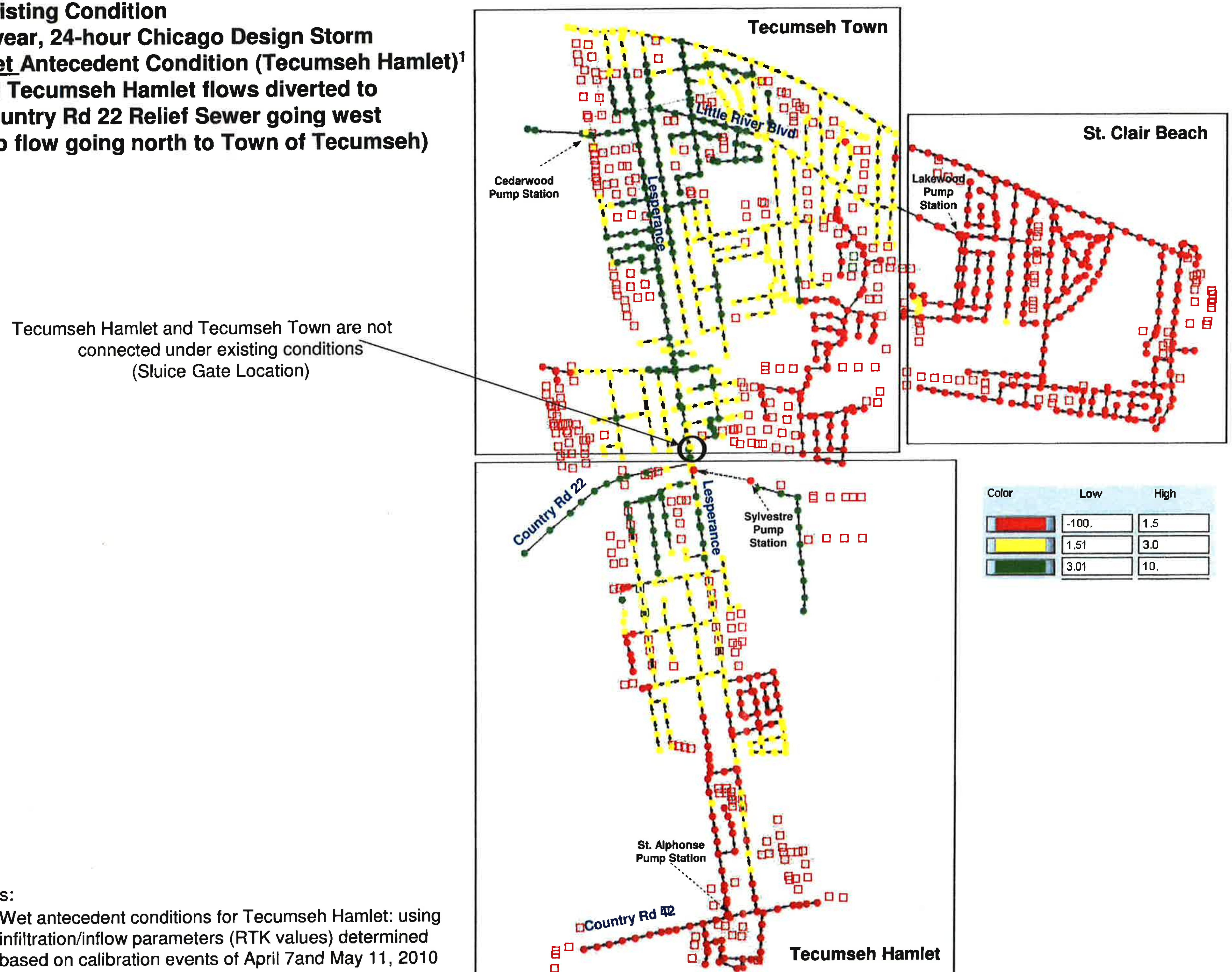
Tecumseh Hamlet

Figure 2.1 indicates that a large portion of the southern areas within Tecumseh Hamlet has its HGL less than 1.5m below ground elevation for the 5-year, 24-hour Chicago storm (wet antecedent conditions). The upper section of the Lesperance Trunk Sewer is generally surcharged with wide-spread risk of excessive surcharging under wet antecedent conditions (nodes in red).

In contrast, under a dry antecedent condition, most of the Tecumseh Hamlet system has the ability to accommodate the same 5-year, 24-hour Chicago storm owing to a substantially reduced infiltration/inflow contribution (Figure 2.2).

Figure 2.1: 5-year, 24-hour Chicago Design Storm - Depth of the Hydraulic Grade Line Below Ground

- **Existing Condition**
- **5-year, 24-hour Chicago Design Storm**
- **Wet Antecedent Condition (Tecumseh Hamlet)[1]**
- **All Tecumseh Hamlet flows diverted to Country Rd 22 Relief Sewer going west (No flow going north to Town of Tecumseh)**

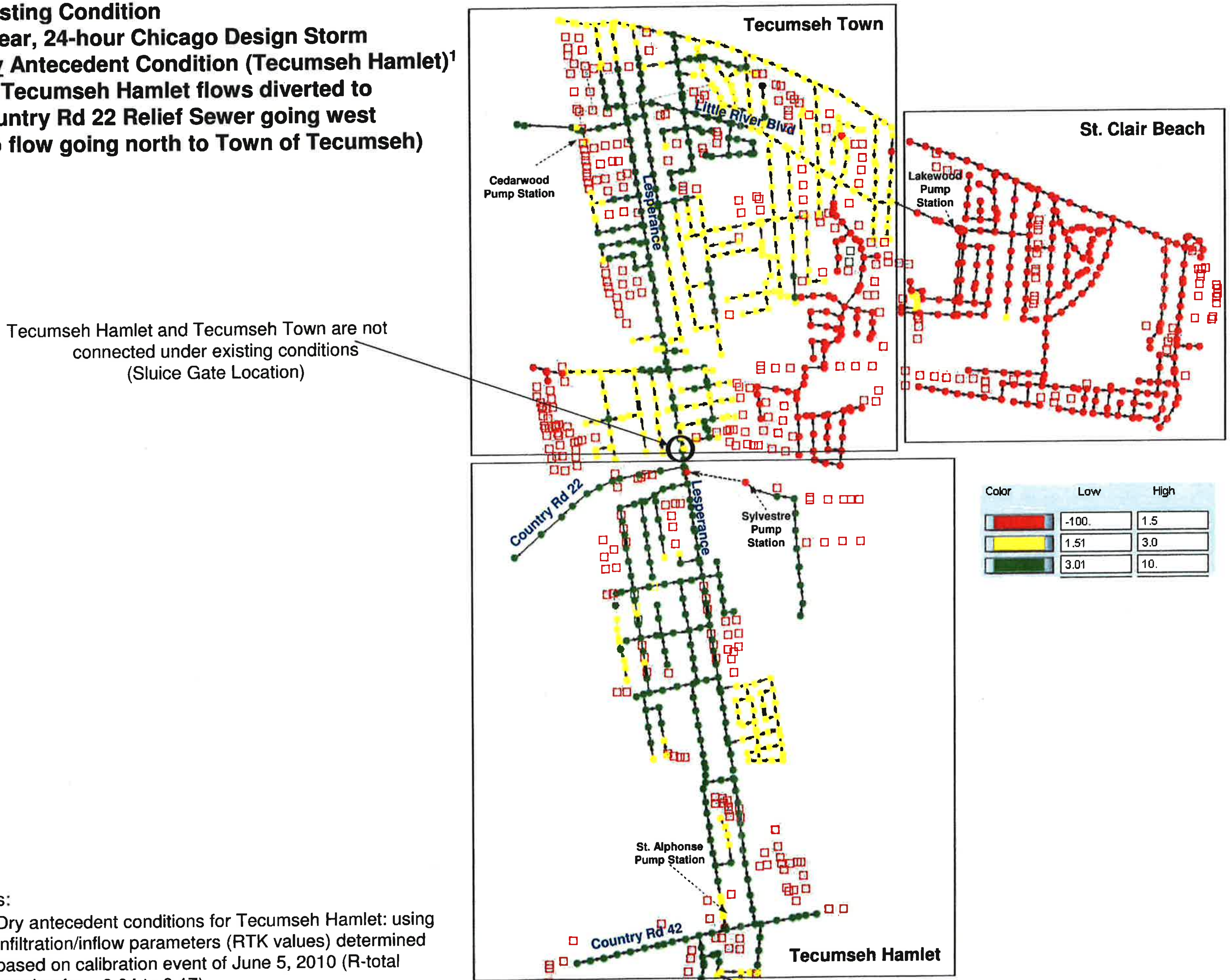


Notes:

1. Wet antecedent conditions for Tecumseh Hamlet: using infiltration/inflow parameters (RTK values) determined based on calibration events of April 7and May 11, 2010 (R-total ranging from 0.10 to 0.19)

Figure 2.2: 5-year, 24-hour Chicago Design Storm - Depth of the Hydraulic Grade Line Below Ground

- **Existing Condition**
- **5-year, 24-hour Chicago Design Storm**
- **Dry Antecedent Condition (Tecumseh Hamlet)[1]**
- **All Tecumseh Hamlet flows diverted to Country Rd 22 Relief Sewer going west (No flow going north to Town of Tecumseh)**



Notes:

1. Dry antecedent conditions for Tecumseh Hamlet: using infiltration/inflow parameters (RTK values) determined based on calibration event of June 5, 2010 (R-total ranging from 0.04 to 0.17)

3. GOUIN DEVELOPMENT

Within the Manning Road Secondary Planning Area, there is an 8.98 hectare site, east of Lesperance Road that is being proposed for residential development, herein referred to as the Gouin Development. The sanitary flow from this development is proposed to be directed to the Lesperance trunk sanitary sewer through the existing 375 mm diameter sanitary sewer on Gouin Street. The estimated peak sanitary flow from this site is 9.7 L/s.

In addition to the proposed residential site, a new 600 mm diameter twin sanitary sewer was recently installed on Lesperance Road, just upstream of the diversion manhole (see Figure 3.1). Consequently, the private sanitary connection from the commercial development east of Lesperance, as well as the forcemain servicing the Sylvestre sanitary sewer have been reconfigured. The following updates were made to the model to reflect the addition of the twin sanitary sewer:

- The commercial property east of Lesperance is now partially connected to the new sanitary sewer. There are two private drain connections servicing the commercial development (125 mm diameter and 250 mm diameter pipes).
  - The north connection (125 mm diameter pipe) has been confirmed to be still connected to the existing sanitary trunk sewer. This connection provides sanitary service to the smaller building in the northwest corner of the property. The peak sanitary flow has been estimated at approximately 0.08 L/s.
  - The south connection (250 mm diameter pipe) has been confirmed to be connected to the new 600 mm diameter twin sewer. The 250 mm diameter pipe provides sanitary service for most of the buildings, which has been estimated to have a peak sanitary flow of approximately 1.02 L/s.
  - The flows through the private drain connections include an infiltration allowance and peaking factor, which is considered a conservative assumption.
- The 150 mm diameter discharge forcemain servicing the Sylvestre sanitary sewer has been confirmed to be connected to the new 600 mm twin sanitary sewer.

The composite sanitary sewer model was used to evaluate the potential impact of the Gouin Development on the existing Lesperance sanitary sewer under the 5-year, 24-hour Chicago design storm. Figure 3.1 shows the resultant hydraulic grade line (HGL) of the Lesperance trunk sewer with the Gouin Development included. In comparing the model simulation results with and without the Gouin Development, it would appear that the change in HGL attributable to this development for both wet and dry antecedent conditions would not be considered significant, though it is important to note that the Lesperance trunk sewer is surcharged under this design storm (wet antecedent condition).

Interim Mitigation Options

While there are long term strategies available to mitigate the surcharging conditions along the Lesperance trunk sewer and other areas in the Hamlet, an interim strategy may be considered to mitigate the impact of the additional flow from the Gouin Development.

We understand that the existing sluice gate located at the intersection of Lesperance Road and County Rd 22 is now fully diverting sewage flows from the Tecumseh Hamlet to the recently constructed relief sewer on County Rd 22. There is an opportunity to partially open the sluice gate to allow a portion of the Tecumseh Hamlet flows to discharge northerly. Several flow relief scenarios were considered to examine the benefits and impacts of this approach, including:

- diversion of 20 L/s
- diversion of 50 L/s and
- fully opening the sluice gate with no flow restriction.

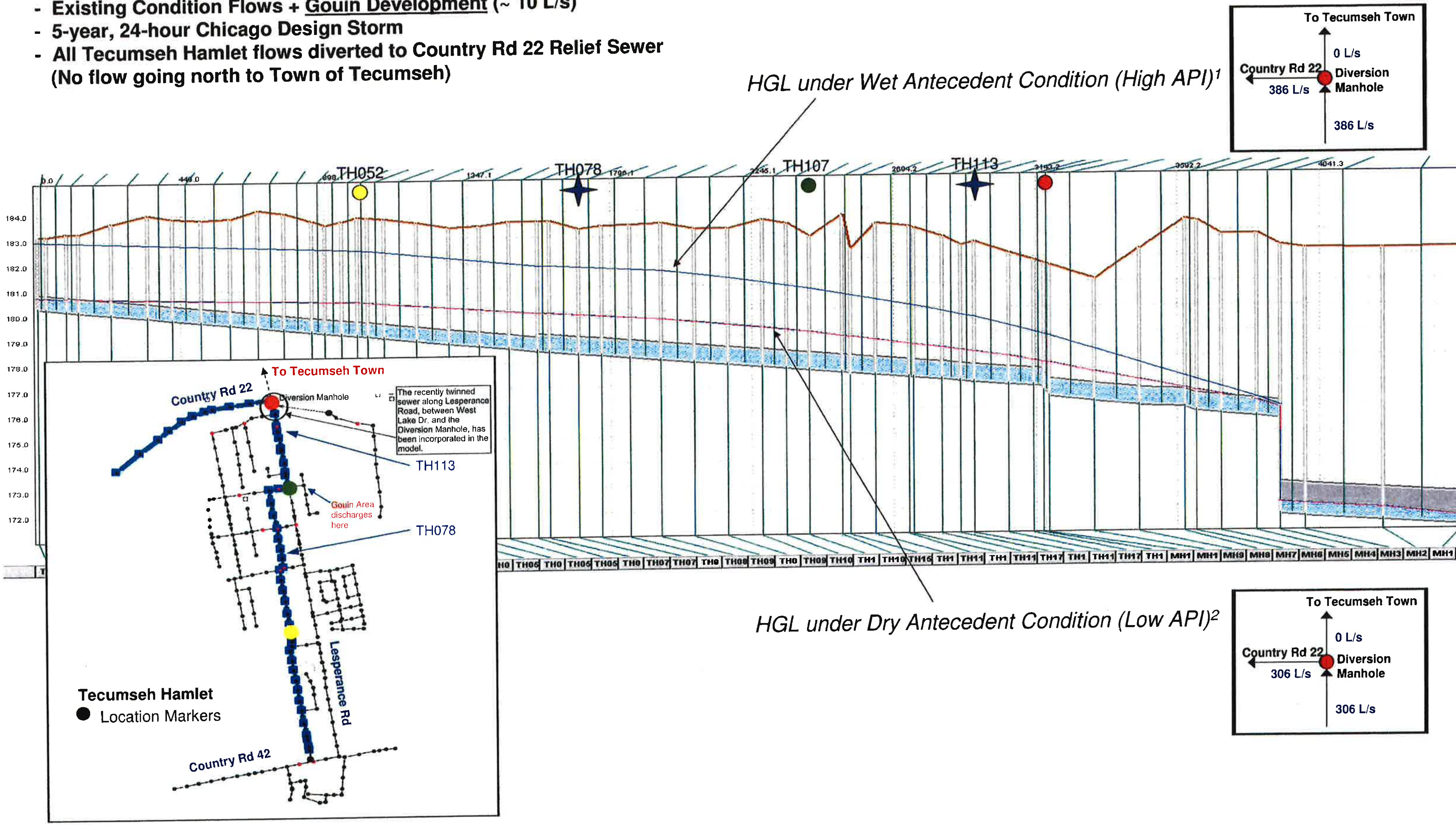
Both wet and dry antecedent conditions were considered. Modelled results are summarized in Table 3.1 and shown in Figure 3.2a.

Tecumseh Hamlet:

As illustrated in Figure 3.2a, as more Tecumseh Hamlet flows are allowed to discharge north of County Rd 22, there is a corresponding reduction in the HGL elevation along the Lesperance sewer within the Tecumseh Hamlet. The drop in HGL elevation (Δ HGL) is more significant under wet antecedent conditions, whereas the benefit is less apparent under dry antecedent conditions. Table 3.1 summarizes the extent of the change in HGL relative to the base scenario (i.e. no diversion). In fact, at manhole TH113, the change in HGL ranges from -0.12 m to as much as -1.48 m depending of the extent of flow diversion (wet antecedent conditions).

Figure 3.1: HGL Profile of Lesperance Trunk Sewer under Existing Conditions (with Gouin Development)

- Existing Condition Flows + Gouin Development (~ 10 L/s)
- 5-year, 24-hour Chicago Design Storm
- All Tecumseh Hamlet flows diverted to Country Rd 22 Relief Sewer (No flow going north to Town of Tecumseh)



Notes:

1. Wet antecedent conditions: using infiltration/inflow parameters (RTK values), determined based on calibration events of April 7 and May 11, 2010 (R-total ranging from 0.10 to 0.19)
2. Dry antecedent conditions: using infiltration/inflow parameters (RTK values), determined based on calibration event of June 5, 2010 (R-total ranging from 0.04 to 0.17)

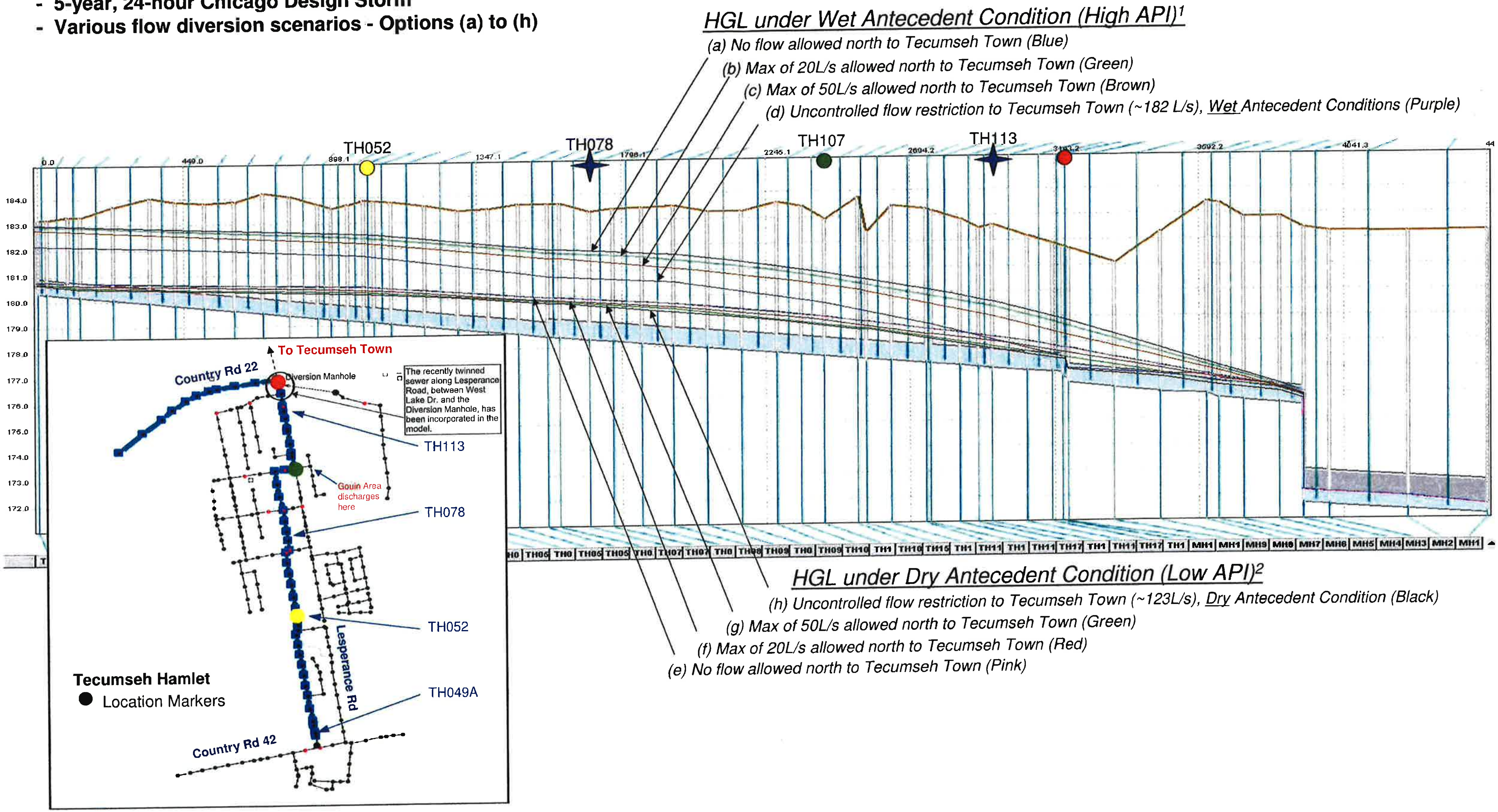
TABLE 3.1
IMPACTS OF FLOW DIVERSION ON LESPERANCE SEWER IN TECUMSEH HAMLET (UNDER EXISTING CONDITIONS WITH GOUIN DEVELOPMENT)

Flow Diversion Scenarios	Flow Diverted North to Tecumseh Town from Tecumseh Hamlet	HGL Elevation at Select Locations along Lesperance Sewer (in Tecumseh Hamlet)[3] Manhole ID				
		TH049A	TH052	TH078	TH113	
Wet Antecedent Condition (High API)[1]						
Option (a) (Base Scenario)	0 L/s	HGL = 182.974m Δ HGL = 0 m	HGL = 182.546m Δ HGL = 0 m	HGL = 181.759m Δ HGL = 0 m	HGL = 179.624m Δ HGL = 0 m	HGL drops ↓
-	10 L/s	HGL = 182.970m ΔHGL = -0.003m	HGL = 182.507m Δ HGL = -0.04m	HGL = 181.682m Δ HGL = -0.08m	HGL = 179.508m Δ HGL = -0.12m	
Option (b)	20 L/s	HGL = 182.811m Δ HGL = -0.16m	HGL = 182.296m Δ HGL = -0.25m	HGL = 181.383m Δ HGL = -0.38m	HGL = 179.104m Δ HGL = -0.52m	
Option (c)	50 L/s	HGL = 182.792m Δ HGL = -0.18m	HGL = 182.274m Δ HGL = -0.27m	HGL = 181.342m Δ HGL = -0.42m	HGL = 179.049m Δ HGL = -0.58m	
Option (d)	Uncontrolled diversion of flow ~ 182 L/s	HGL = 182.220m Δ HGL = -0.75m	HGL = 181.688m Δ HGL = -0.86m	HGL = 180.718m Δ HGL = -1.04m	HGL = 178.148m Δ HGL = -1.48m	
Dry Antecedent Condition (Low API)[2]						
Option (e)	0 L/s	HGL = 180.793m Δ HGL = 0 m	HGL = 180.517m Δ HGL = 0 m	HGL = 179.903m Δ HGL = 0 m	HGL = 178.258m Δ HGL = 0 m	HGL drops ↓
-	10 L/s	HGL = 180.732m Δ HGL = -0.06m	HGL = 180.464m Δ HGL = -0.05m	HGL = 179.839m Δ HGL = -0.06m	HGL = 178.172m Δ HGL = -0.09m	
Option (f)	20 L/s	HGL = 180.697m Δ HGL = -0.10m	HGL = 180.407m Δ HGL = -0.11m	HGL = 179.775m Δ HGL = -0.13m	HGL = 178.083m Δ HGL = -0.18m	
Option (g)	50 L/s	HGL = 180.664m Δ HGL = -0.13m	HGL = 180.291m Δ HGL = -0.23m	HGL = 179.624m Δ HGL = -0.28m	HGL = 177.841m Δ HGL = -0.42m	
Option (h)	Uncontrolled diversion of flow ~ 123 L/s	HGL = 180.664m Δ HGL = -0.13m	HGL = 180.283m Δ HGL = -0.23m	HGL = 179.610m Δ HGL = -0.29m	HGL = 177.815m Δ HGL = -0.44m	

1. Wet antecedent conditions: using infiltration/inflow parameters (RTK values) determined based on calibration events of April 7 and May 11, 2010 (R-total ranging from 0.10 to 0.19)
2. Dry antecedent conditions: using infiltration/inflow parameters (RTK values) determined based on calibration event of June 5, 2010 (R-total ranging from 0.04 to 0.17)
3. ΔHGL is estimated based on HGL elevation relative to the base scenario of option (a) or (e) for wet or dry antecedent condition respectively (e.g. Option (c) at TH049A has Δ HGL = 182.807m - 182.987m= -0.18m.)

Figure 3.2a: HGL Profile of Lesperance Trunk Sewer in Tecumseh Hamlet for Various Flow Diversion Scenarios

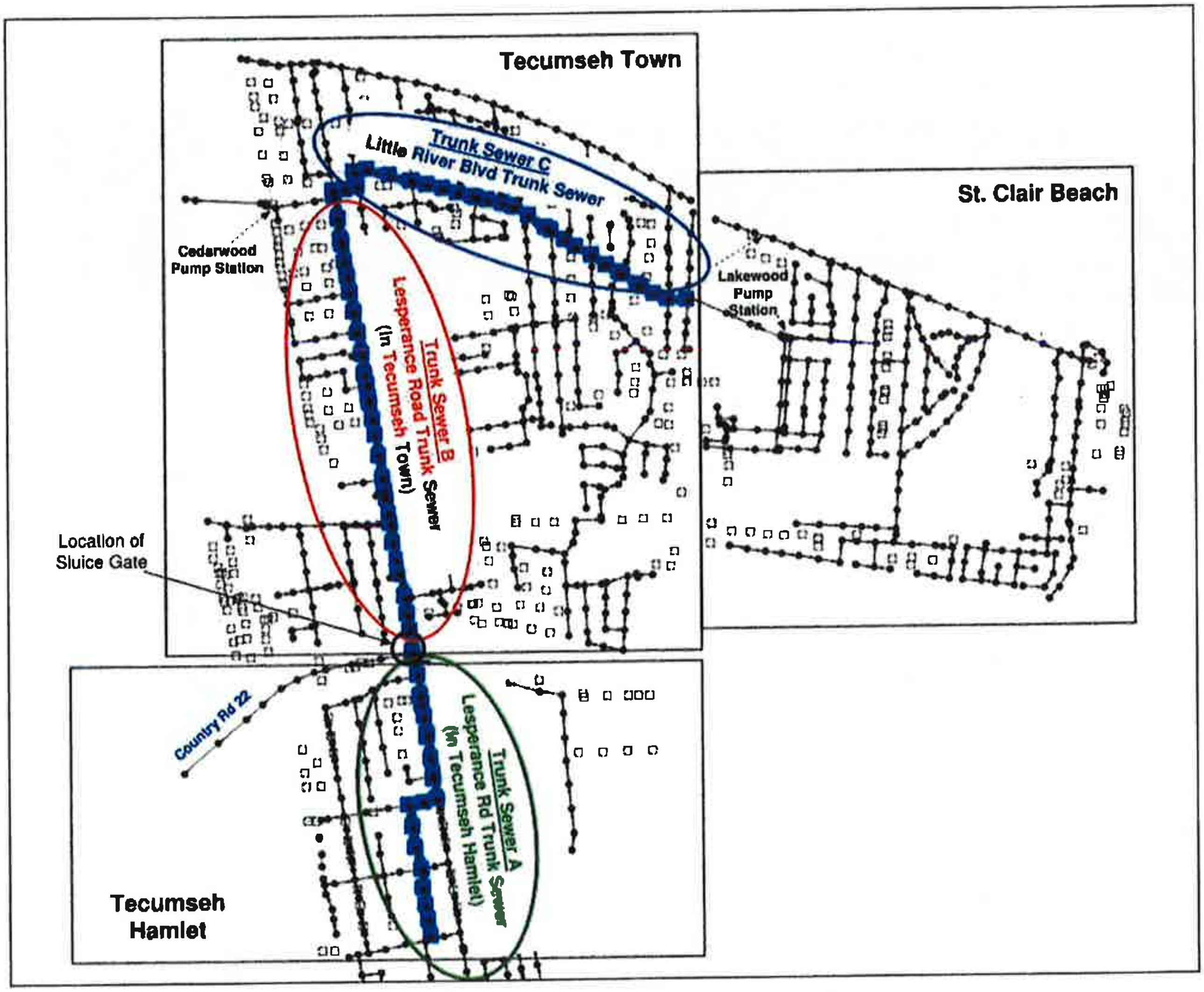
- **Existing Condition Flows + <u>Gouin Development</u> (~ 10 L/s)**
- **5-year, 24-hour Chicago Design Storm**
- **Various flow diversion scenarios - Options (a) to (h)**



Notes:
1. Wet antecedent conditions: using infiltration/inflow parameters (RTK values) determined based on calibration events of April 7 and May 11, 2010 (R-total ranging from 0.10 to 0.19)
2. Dry antecedent conditions: using infiltration/inflow parameters (RTK values) determined based on calibration event of June 5, 2010 (R-total ranging from 0.04 to 0.17)

Sanitary Sewers North of County Rd 22:

To assess the impact of diverting a portion of the Tecumseh Hamlet sanitary flows to the existing sanitary sewers north of County Rd 22, the HGLs of the two trunk sewers were examined. The schematic below shows the location of the two trunk sewers: Trunk Sewer B (Lesperance Sewer) and Trunk Sewer C (Little River Sewer).



First, it was found that the Trunk Sewer B on Lesperance Road between Country Road 22 and Little River Boulevard in Tecumseh had sufficient available capacity for the 5-year, 24-hour Chicago design storm event under both wet and dry antecedent conditions. The HGLs increased as more Tecumseh Hamlet flows were diverted to the north, but because there was capacity, the sewer was able to accommodate these additional flows with only minor surcharging occurring for options (d) and (h) (large flow diverted = 123 L/s to 182 L/s).

Trunk Sewer C in Tecumseh is located along Little River Boulevard and also conveys flows to the Cedarwood PS. The HGL elevations in this trunk sanitary sewer are influenced by the increased HGLs in Trunk Sewer B, as illustrated in Figure 3.2b and summarized in Table 3.2. As illustrated in Figure 3.2b, as more Hamlet flows are allowed to go north into Tecumseh Town, the

HGL elevation along the Little River trunk sewer increases due to changing tailwater condition near Cedarwood PS. While flow diversion of less than 50 L/s (options (a) to (c)) does not cause much change to the HGL, the higher flow diversions do. In fact, options (d) and (h) are causing the upstream section of Trunk Sewer C to experience HGL elevations that are within 1.5m of the ground surface.

TABLE 3.2
IMPACTS OF FLOW DIVERSION ON LITTLE RIVER BLVD SEWER IN TECUMSEH TOWN (UNDER EXISTING CONDITIONS WITH GOUIN DEVELOPMENT IN TECUMSEH HAMLET)

Flow Diversion Scenarios	Flow Diverted North to Tecumseh Town from Tecumseh Hamlet	HGL Elevation at Select Locations along Little River Blvd Sewer (in Tecumseh Town)[3] Manhole ID TE029	TE020	TE006	
Option (a)[1] or (e)[2] (Base Scenario)	0 L/s	HGL = 174..325m Δ HGL = 0 m	HGL = 173.349m Δ HGL = 0 m	HGL = 171.752m Δ HGL = 0 m	HGL rises ------------→
Option (b)[1] or (f)[2]	20 L/s	HGL = 174.402m Δ HGL = +0.08m	HGL = 173.469m Δ HGL = +0.12m	HGL = 171.880m Δ HGL = +0.13m	
Option (c)[1] or (g)[2]	50 L/s	HGL = 174.506m Δ HGL = +0.18m	HGL = 173.629m Δ HGL = +0.28m	HGL = 172.089m Δ HGL = +0.34m	
Option (d)[1]	Uncontrolled diversion of flow ~ 182 L/s	HGL =174.952 m Δ HGL = +0.63m	HGL = 174.178m Δ HGL = +0.83m	HGL = 172.842m Δ HGL = +1.09m	
Option (h)[2]	Uncontrolled diversion of flow ~ 123 L/s	HGL = 174.694m Δ HGL = +0.37m	HGL = 173.855m Δ HGL =+ 0.51m	HGL = 172.369m Δ HGL = +0.62m	

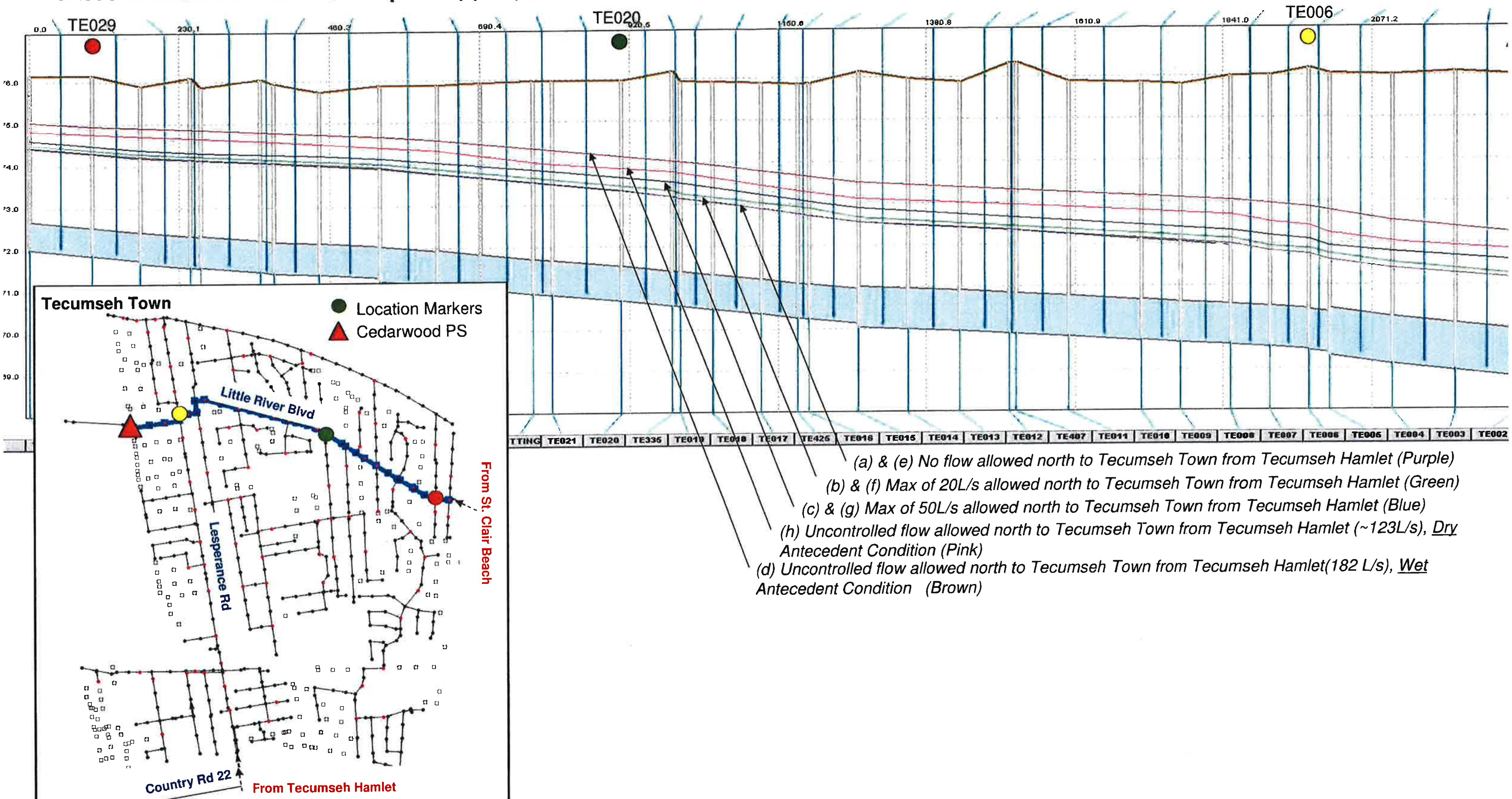
1. Wet antecedent conditions: using infiltration/inflow parameters (RTK values) determined based on calibration events of April 7 and May 11, 2010 (R-total ranging from 0.10 to 0.19)
2. Dry antecedent conditions: using infiltration/inflow parameters (RTK values) determined based on calibration event of June 5, 2010 (R-total ranging from 0.04 to 0.17)
3. ΔHGL is estimated based on HGL elevation relative to the base scenario of option (a) or (e) for wet or dry antecedent condition respectively.
(e.g. Option (c) at TE029 has Δ HGL = 174.506m – 174.325m= +0.18m.)

It would appear that while the additional sewage flow from the Gouin Development is approximately 10 L/s and only causes minor changes to the HGL along the Tecumseh Hamlet trunk sewer on Lesperance Road, there is an opportunity to introduce flow diversion to the north of County Rd 22 of at least 10 L/s that would offset and improve the HGL conditions within the Tecumseh Hamlet.

In order to ensure that the HGL within the Little River Boulevard Trunk Sewer C is not adversely affected, the flow diversion should be limited to a maximum rate of 20 L/s.

Figure 3.2b: HGL Profile of Little River Trunk Sewer in Tecumseh Town for Various Flow Diversion Scenarios

- Existing Condition Flows + Gouin Development (~ 10 L/s)
- 5-year, 24-hour Chicago Design Storm
- Various flow diversion scenarios: Options (a) to (h)



Notes:

1. Wet antecedent conditions: using infiltration/inflow parameters (RTK values) determined based on calibration events of April 7 and May 11, 2010 (R-total ranging from 0.10 to 0.19)
2. Dry antecedent conditions: using infiltration/inflow parameters (RTK values) determined based on calibration event of June 5, 2010 (R-total ranging from 0.04 to 0.17)

4. FINDINGS AND RECOMMENDATIONS

Interim Mitigation

The new 600 mm diameter twin sanitary sewer that was recently installed on Lesperance Road, is effective in providing added outlet capacity to serve the Manning Road Secondary Planning Area. However, it does not have a direct influence on the upstream HGL in the Lesperance Road sanitary sewer.

In order to accommodate the Gouin Development within the Tecumseh Hamlet, the recommended interim strategy is to divert a maximum of up to 20 L/s of Tecumseh Hamlet sewage flows to the north of County Rd 22 by adjusting the sluice gate at the intersection of Lesperance Road and County Road 22. The diversion of up to 20 L/s of Tecumseh Hamlet sewage flows can result in a reduction of the HGL along the Lesperance Trunk Sewer (option (b) and (f)) of anywhere between 0.16m to 0.52m (Table 3.1). The corresponding increase in HGL along the Little River Trunk Sewer in Tecumseh would be between 0.08m to 0.13m (Table 3.2).

Since the sanitary sewer system in the Tecumseh Hamlet has a history of surcharging under wet weather conditions, it is further recommended that sanitary private drain connections within the proposed Gouin Development be installed at an elevation that would prevent the gravity connection of basement plumbing to reduce the risk of basement flooding within these homes. As shown in Figure 3.1, the HGL elevation at which the Gouin Development would connect to the Lesperance Road sanitary sewer is 180.84m, which is the suggested minimum elevation at which sanitary private drain connections within the Gouin Development should be installed.

Long Term Mitigation

Based on the findings of the Tecumseh Hamlet sanitary collection system modelling, much of the Lesperance trunk sewer is surcharged during a 5-year, 24-hour Chicago design storm under wet antecedent conditions. This extent of sewer surcharging would be considered similar to the conditions under which the Tecumseh Hamlet has experienced basement flooding in the past.

It is recommended that the Town of Tecumseh continue to consider the planning and implementation of longer term strategies to reduce the risk of basement flooding in the Tecumseh Hamlet, including:

- Continue to monitor sanitary flows in the Tecumseh Hamlet and update the sanitary hydraulic model, as appropriate;
- Continue sanitary sewer improvements and implement measures to address improper sanitary plumbing connections to reduce infiltration and inflow (I & I); and
- Diversion of sanitary flows in the south portion of the Tecumseh Hamlet to the West Tecumseh Trunk sewer via proposed trunk sewers on Intersection Road and County Road 42, as shown in Figure 4.1.

We trust that we have addressed the updates to the Tecumseh Sanitary Model and the impacts of the proposed development of the Gouin site on the existing sanitary collection system; and that our conclusions and recommendations provide the Town with the relevant information required to address these matters in further detail. Please contact us should you wish to review our findings in further detail.

Flavio R. Forest, P.Eng.,
Project Manager

LICENSED PROFESSIONAL ENGINEER
F. R. FOREST
Dec 9 '13
PROVINCE OF ONTARIO

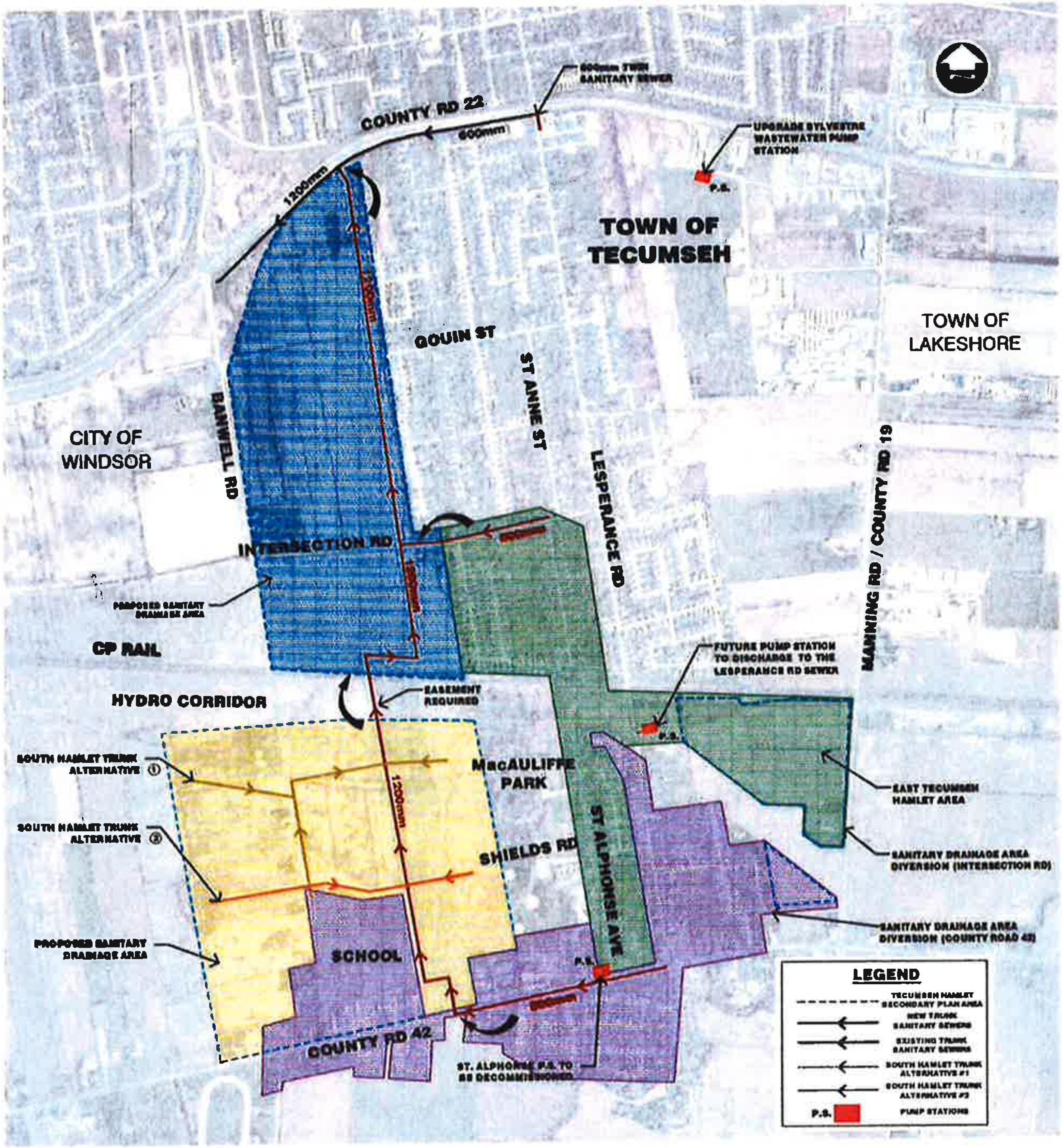


Figure 4.1: Future Plan (DRAFT) to Divert Sanitary Flows to the West Tecumseh Trunk Sewer (1200 mm dia) via Proposed Trunk (600 mm dia) Sewers on Intersection Road and County Road 42

APPENDIX A
SUMMARY OF MODEL CALIBRATION FOR TECUMSEH HAMLET

Summary of Infiltration Parameters (RTK) for Tecumseh Hamlet:

Smaller storm events with Wet Antecedent Conditions

	Event	R1	T1	K1	R2	T2	K2	R3	T3	K3	R-Total
1	Apr 7 - Applied RTK for manholes btn TH078 & TH112	0.02	0.5	16	0.06	1	25	0.07	2	35	**0.150**
	Apr 7 - Applied RTK for manholes btn St.Alphonse & TH078	0.05	0.5	16	0.07	1	25	0.07	2	35	**0.190**
	Apr 7 - Applied RTK for manholes upstream St. Alphonse	0.02	0.5	16	0.03	1	25	0.05	2	35	**0.100**
2	May 11 - Applied RTK for manholes btn TH078 & TH112	0.02	0.5	16	0.06	1	25	0.07	2	35	**0.150**
	May 11 - Applied RTK for manholes btn St.Alphonse & TH078	0.05	0.5	16	0.07	1	25	0.07	2	35	**0.190**
	May 11 - Applied RTK for manholes upstream St. Alphonse	0.02	0.5	16	0.03	1	25	0.05	2	35	**0.100**

Large storm event with Dry Antecedent Conditions

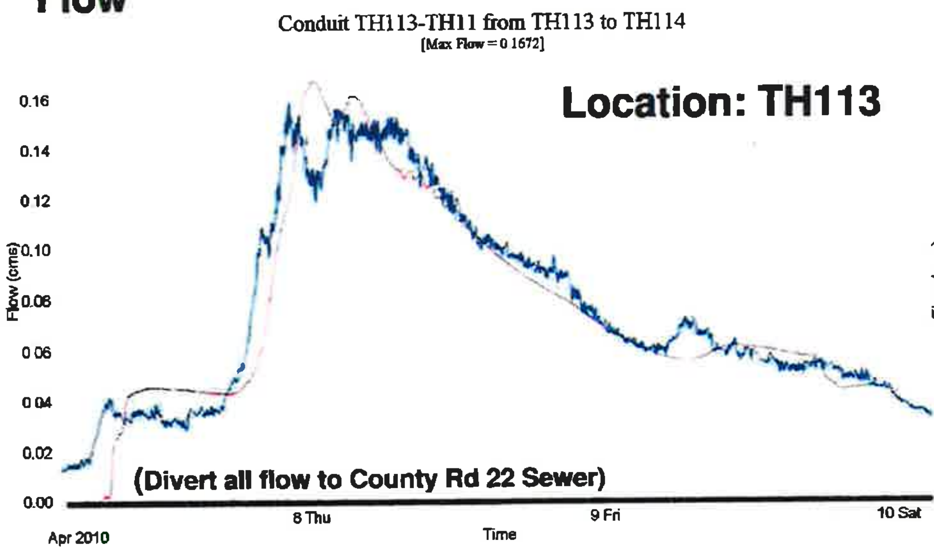
	Event	R1	T1	K1	R2	T2	K2	R3	T3	K3	R-Total
3	Jun 5 - Applied RTK for manholes btn TH078 & TH112	0.01	0.5	16	0.02	1	25	0.06	2	35	**0.090**
	Jun 5 - Applied RTK for manholes btn St.Alphonse & TH078	0.041	0.5	16	0.056	1	25	0.07	2	35	**0.167**
	Jun 5 - Applied RTK for manholes upstream St. Alphonse	0.01	0.5	16	0.02	1	25	0.01	2	35	**0.040**

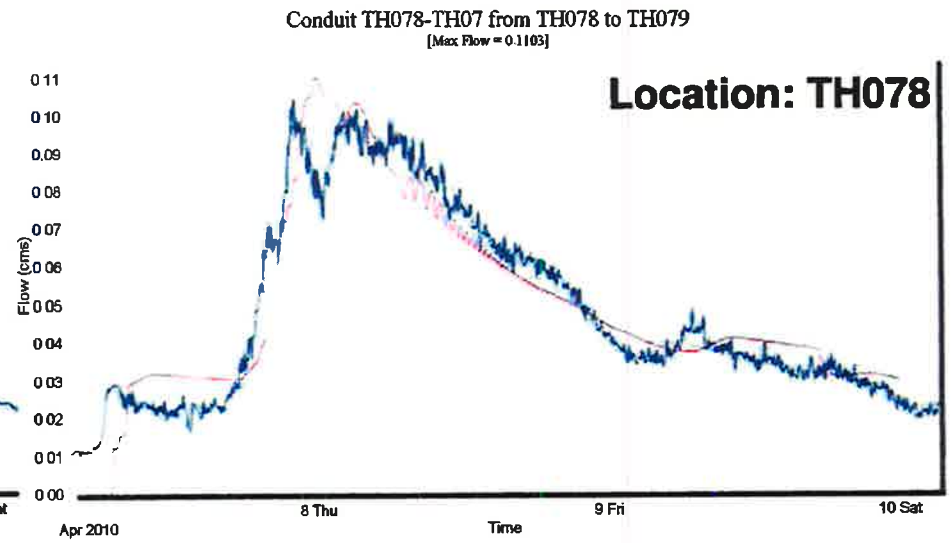

Flow monitor TH113
Applied RTK for manholes between TH078 and TH112
Flow monitor TH078
Applied RTK for manholes between St. Alphonse PS and TH078
Flow monitor TH014
Applied RTK for manholes upstream of St. Alphonse PS
TECUMSEH HAMLET
St.Alphonse PS
150mm
450mm
600mm
1200mm
300mm
375mm
1650mm
450mm
250mm
CP Railway
Hydro Easement

Storm # 1: April 7-10, 2010 Calibration Event
Storm # 2: May 11-13, 2010 Calibration Event
(Wet Antecedent Conditions)

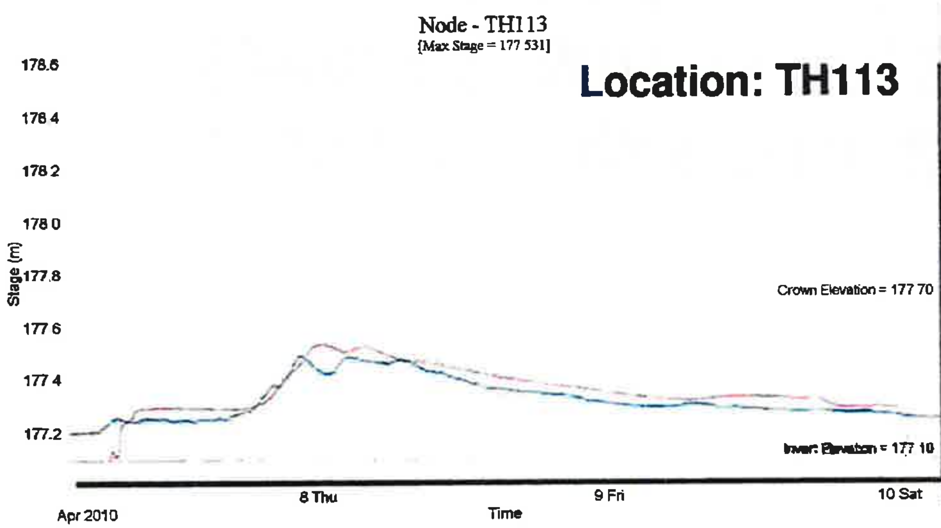
April 7-10 (Storm # 1)

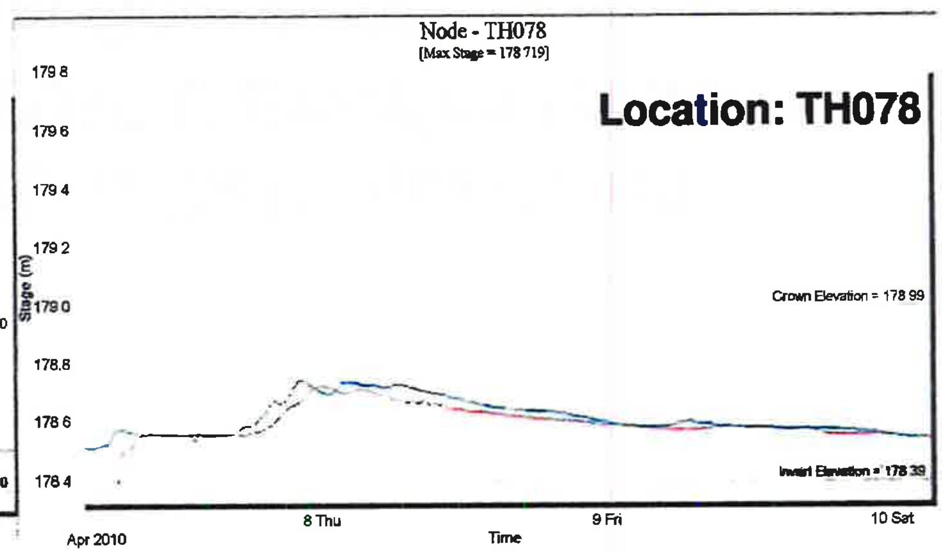
Flow





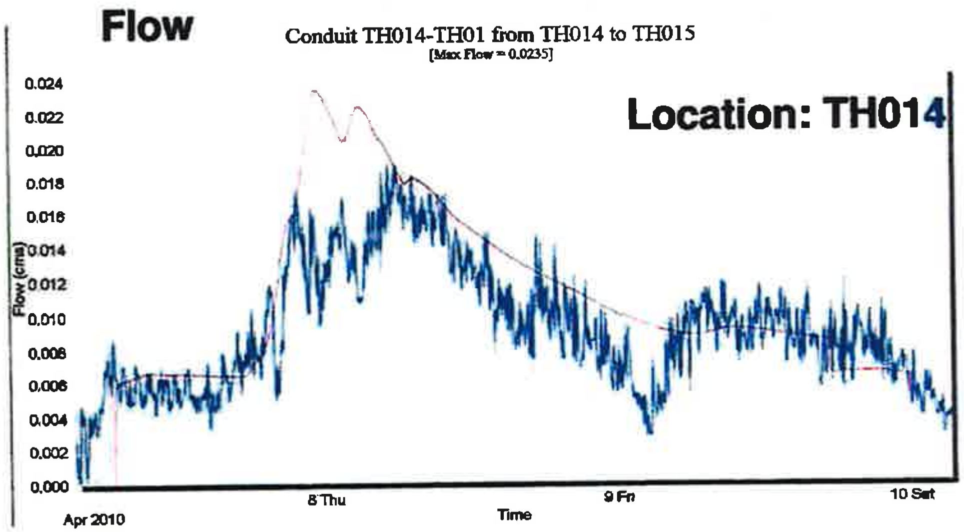
Water Level

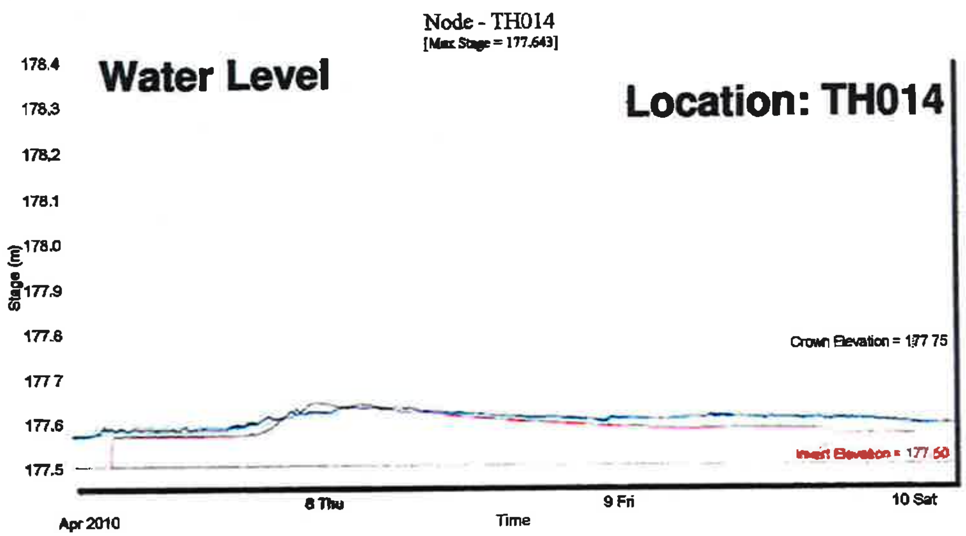




(Divert all flow to County Rd 22 Sewer)

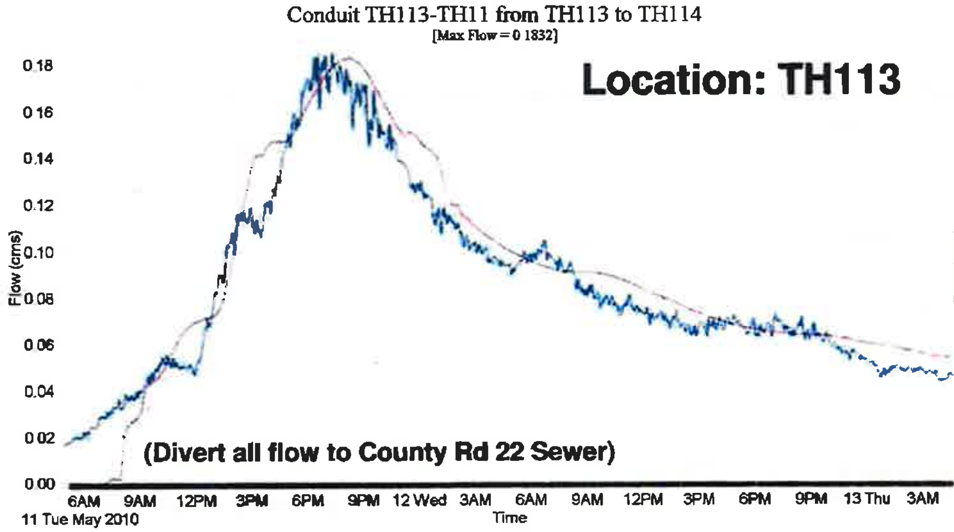
April 7-10 (Storm # 1)

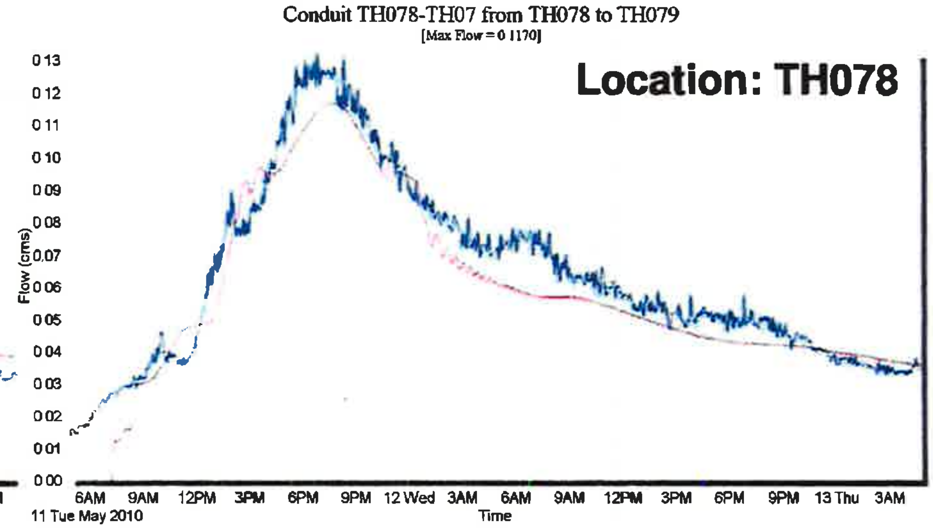




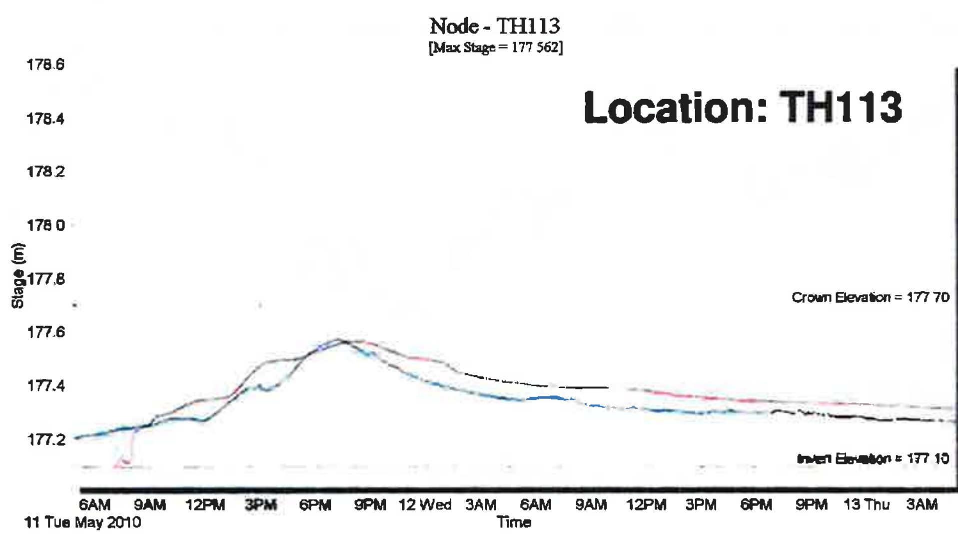
May 11-13 (Storm # 2)

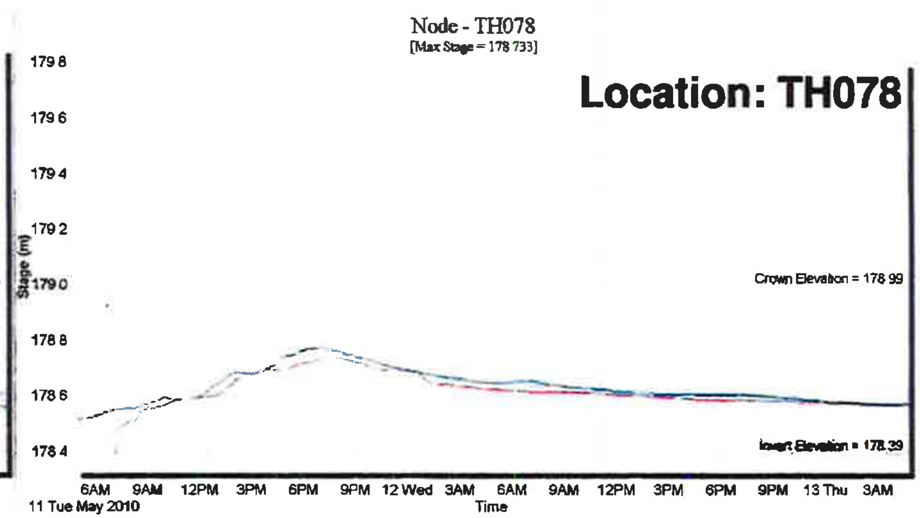
Flow





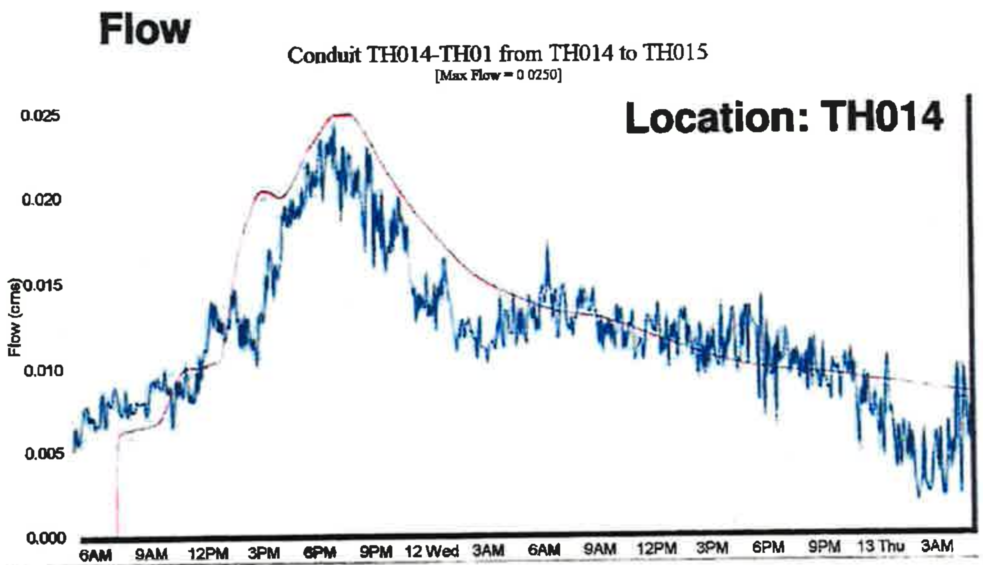
Water Level

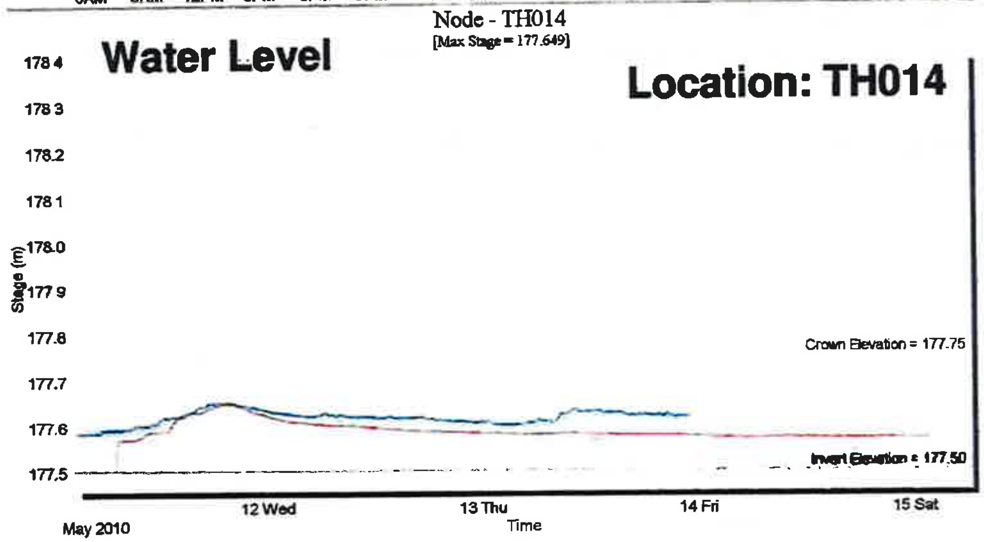




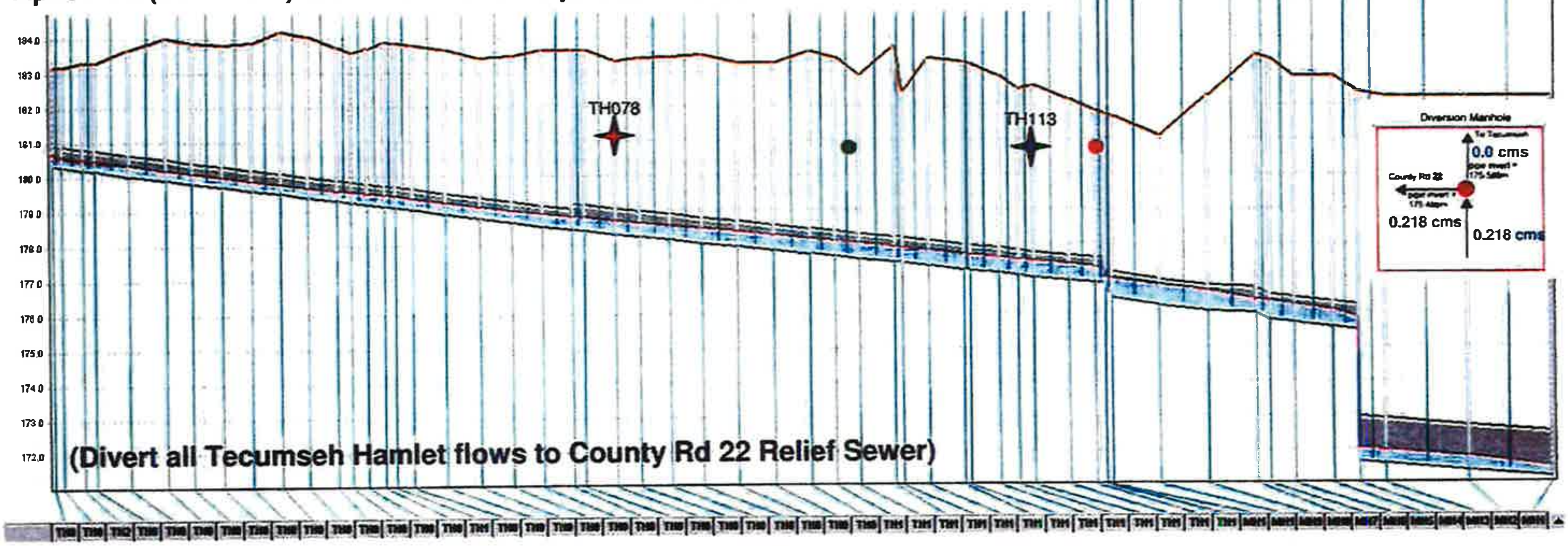
(Divert all flow to County Rd 22 Sewer)

May 11-13 (Storm # 2)

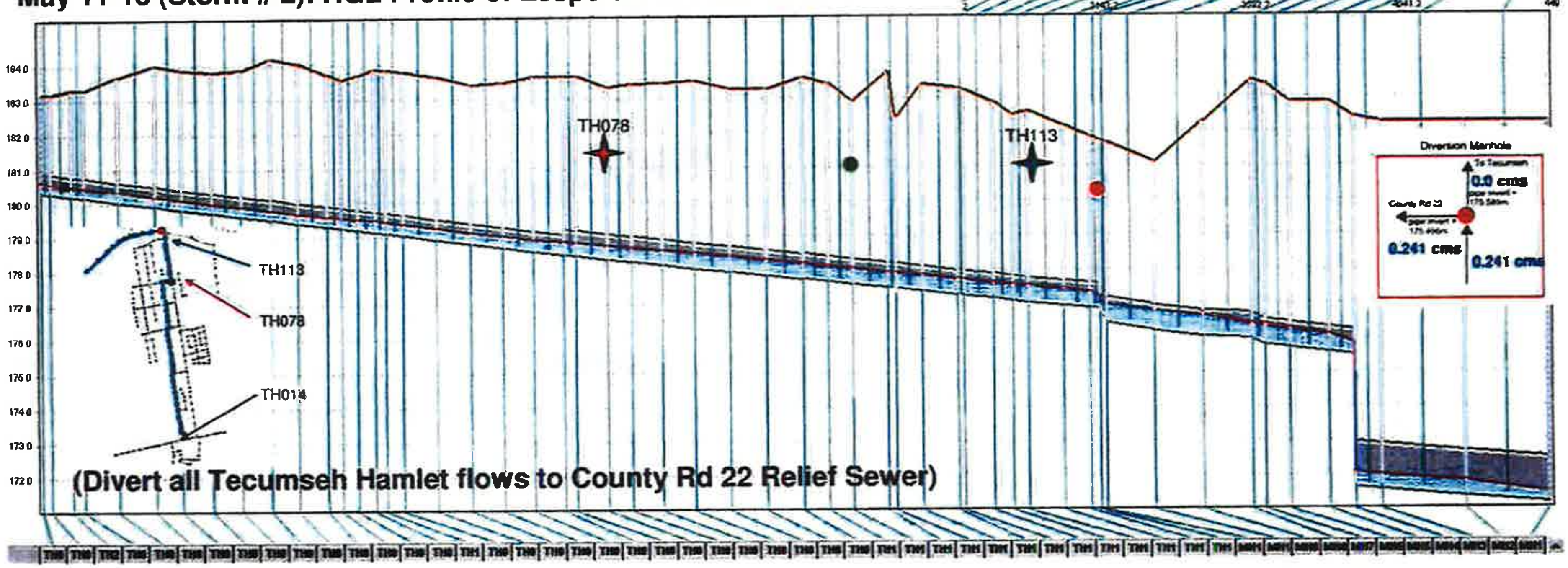




April 7-10 (Storm # 1): HGL Profile of Lesperance Trunk Sewer



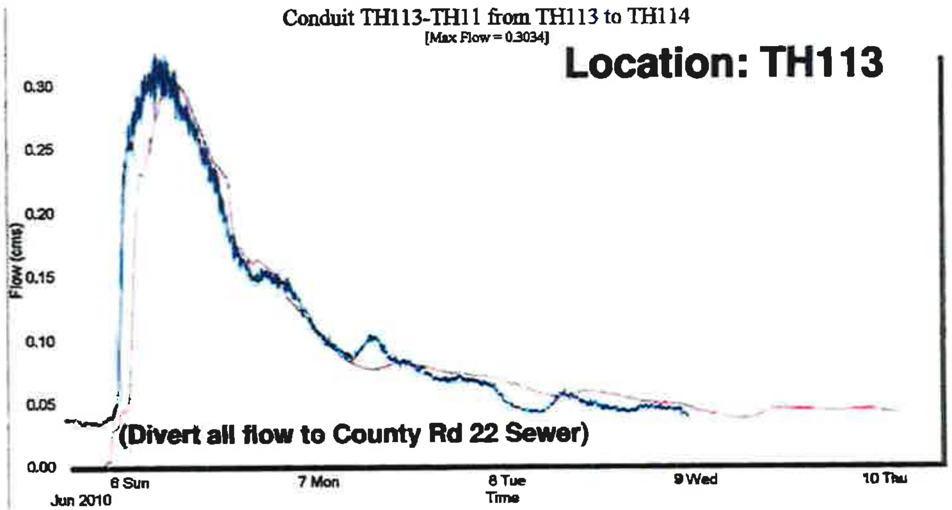
May 11-13 (Storm # 2): HGL Profile of Lesperance Trunk Sewer

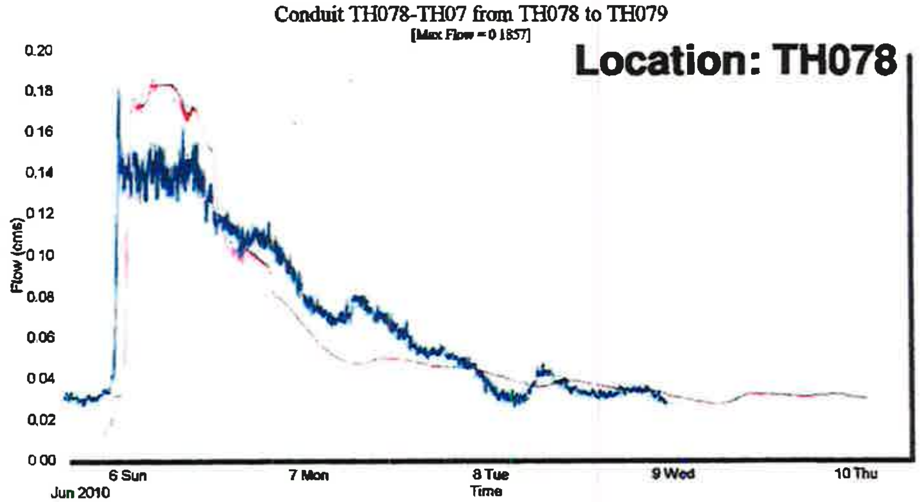


Storm # 3: June 5-8, 2010 Calibration Event
(Dry Antecedent Conditions)

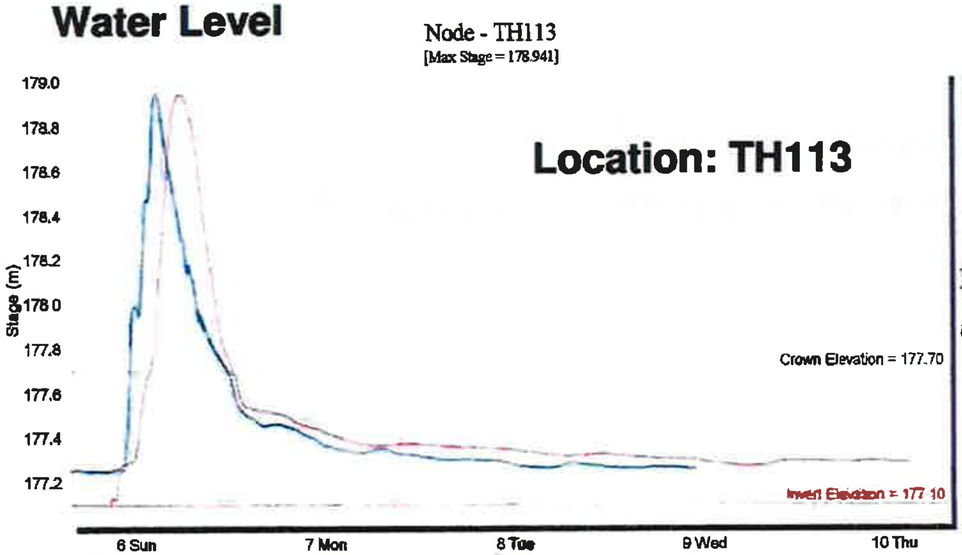
Jun 5-8 (Storm # 3)

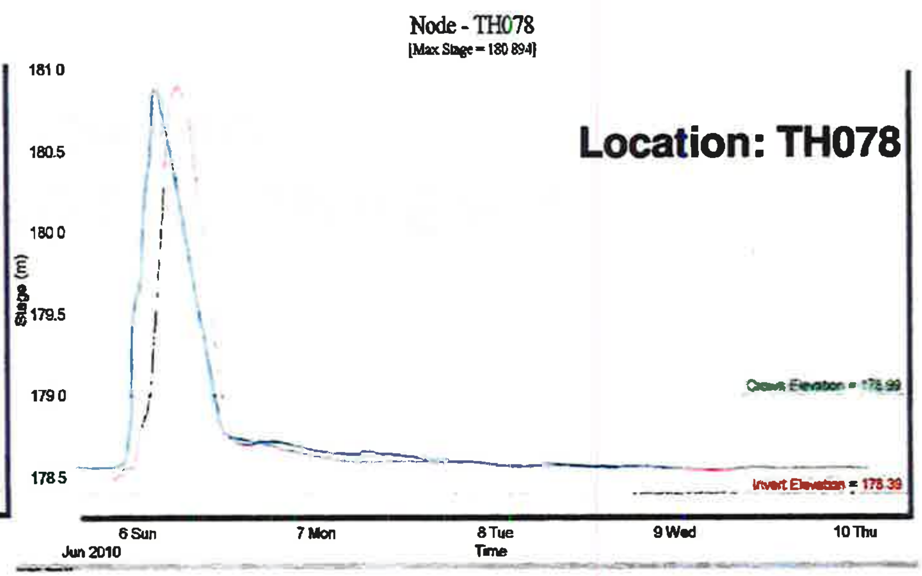
Flow





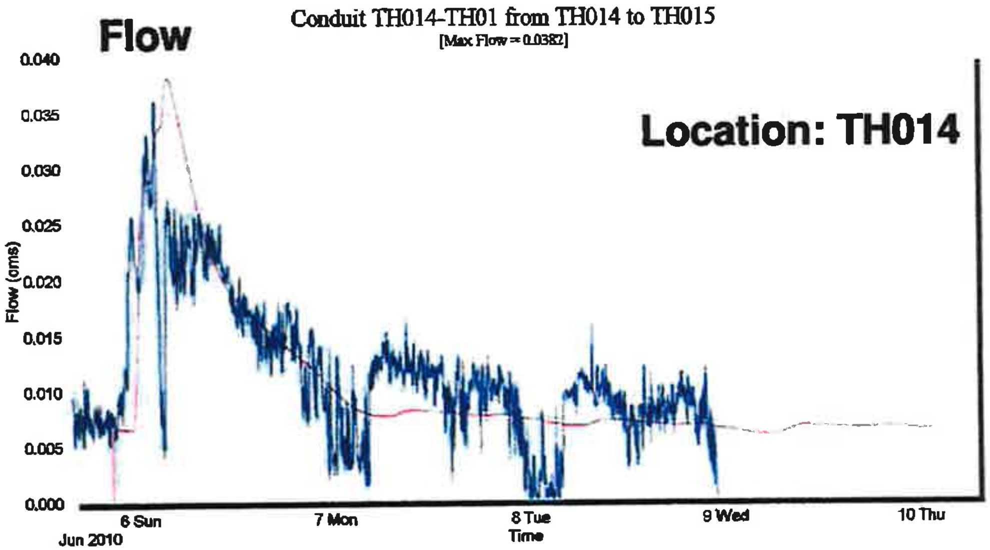
Water Level

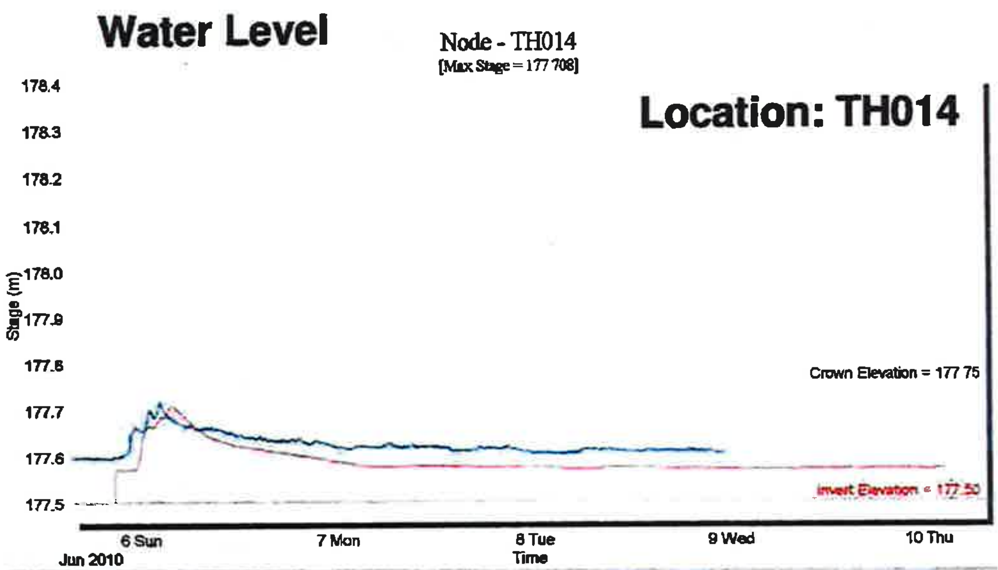




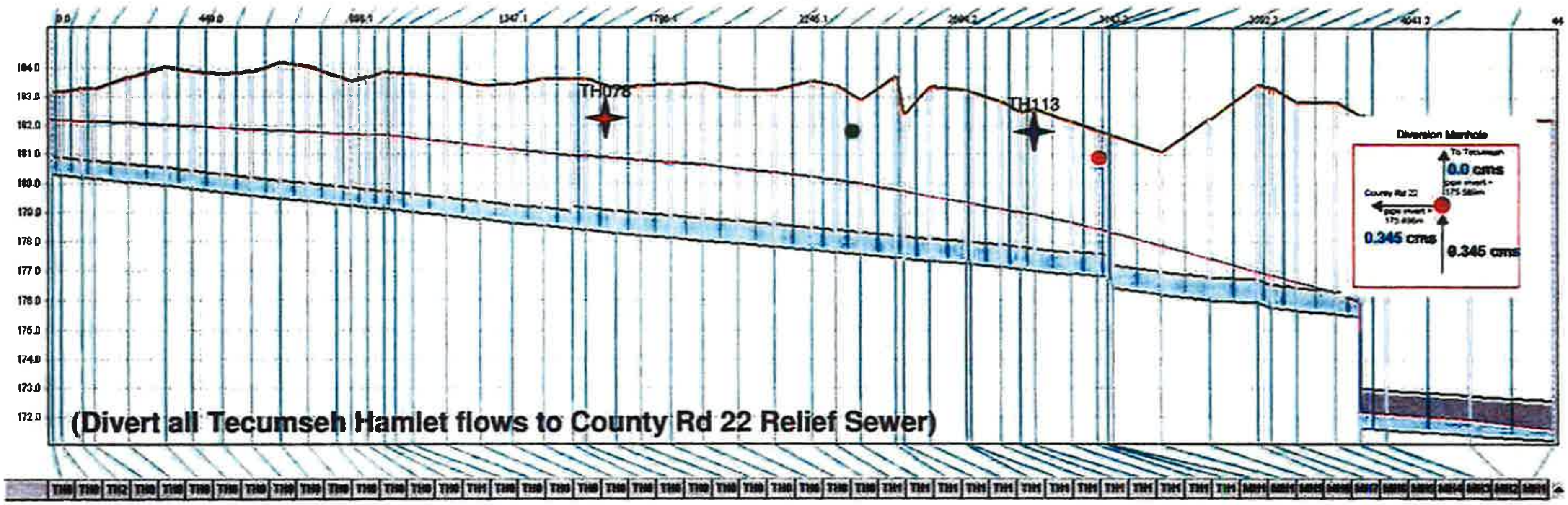
(Divert all flow to County Rd 22 Sewer)

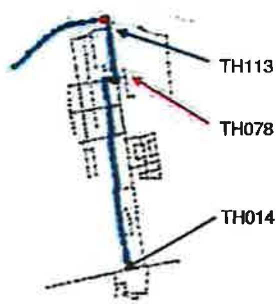
Jun 5-8 (Storm # 3)





Jun 5-8 (Storm # 3): HGL Profile of Lesperance Trunk Sewer

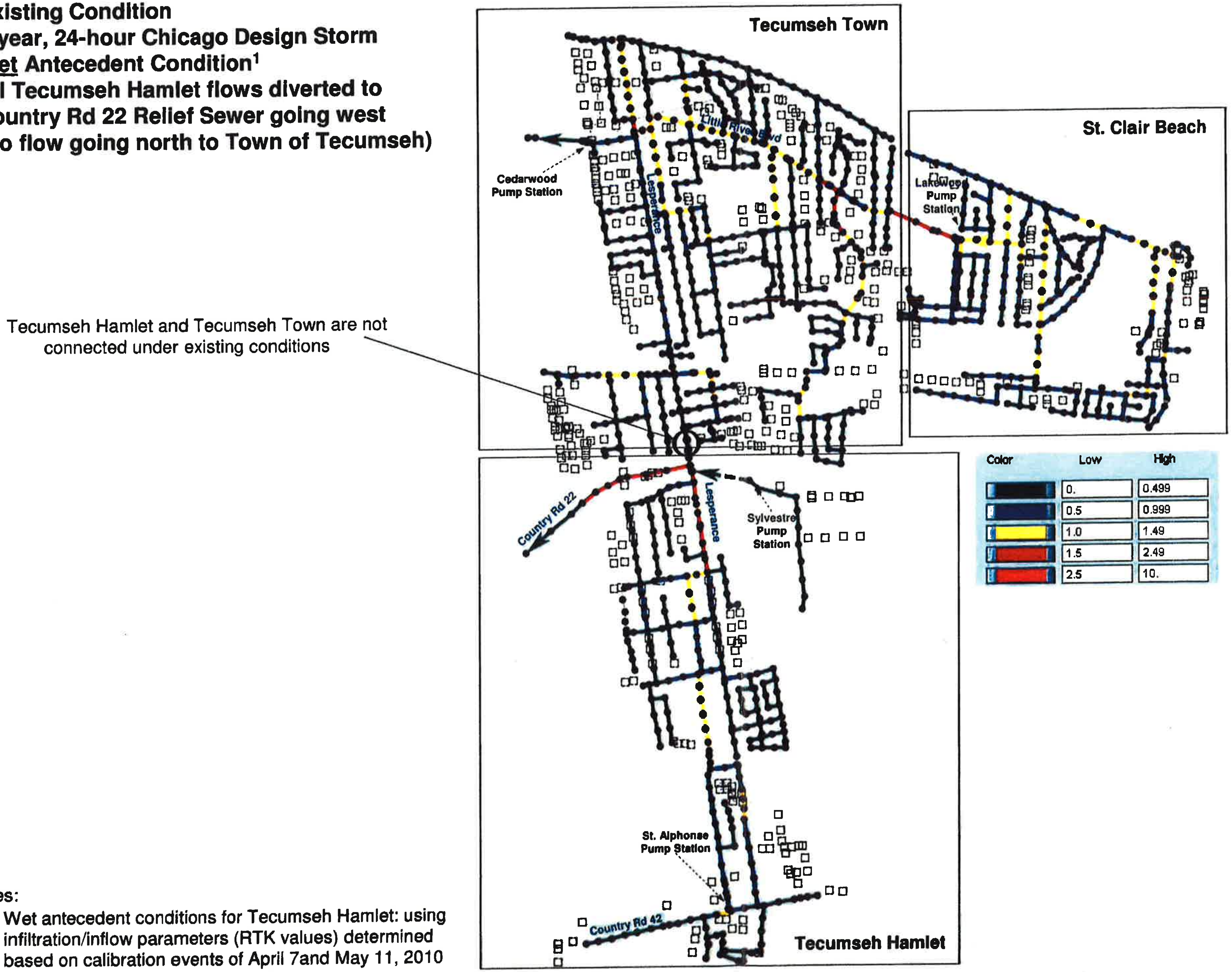




APPENDIX B
SYSTEM PERFORMANCE UNDER EXISTING CONDITIONS

Figure B-1: 5-year, 24-hour Chicago Design Storm – Ratio of Maximum Pipe Flow to Design Flow

- Existing Condition
- 5-year, 24-hour Chicago Design Storm
- Wet Antecedent Condition[1]
- All Tecumseh Hamlet flows diverted to Country Rd 22 Relief Sewer going west (No flow going north to Town of Tecumseh)



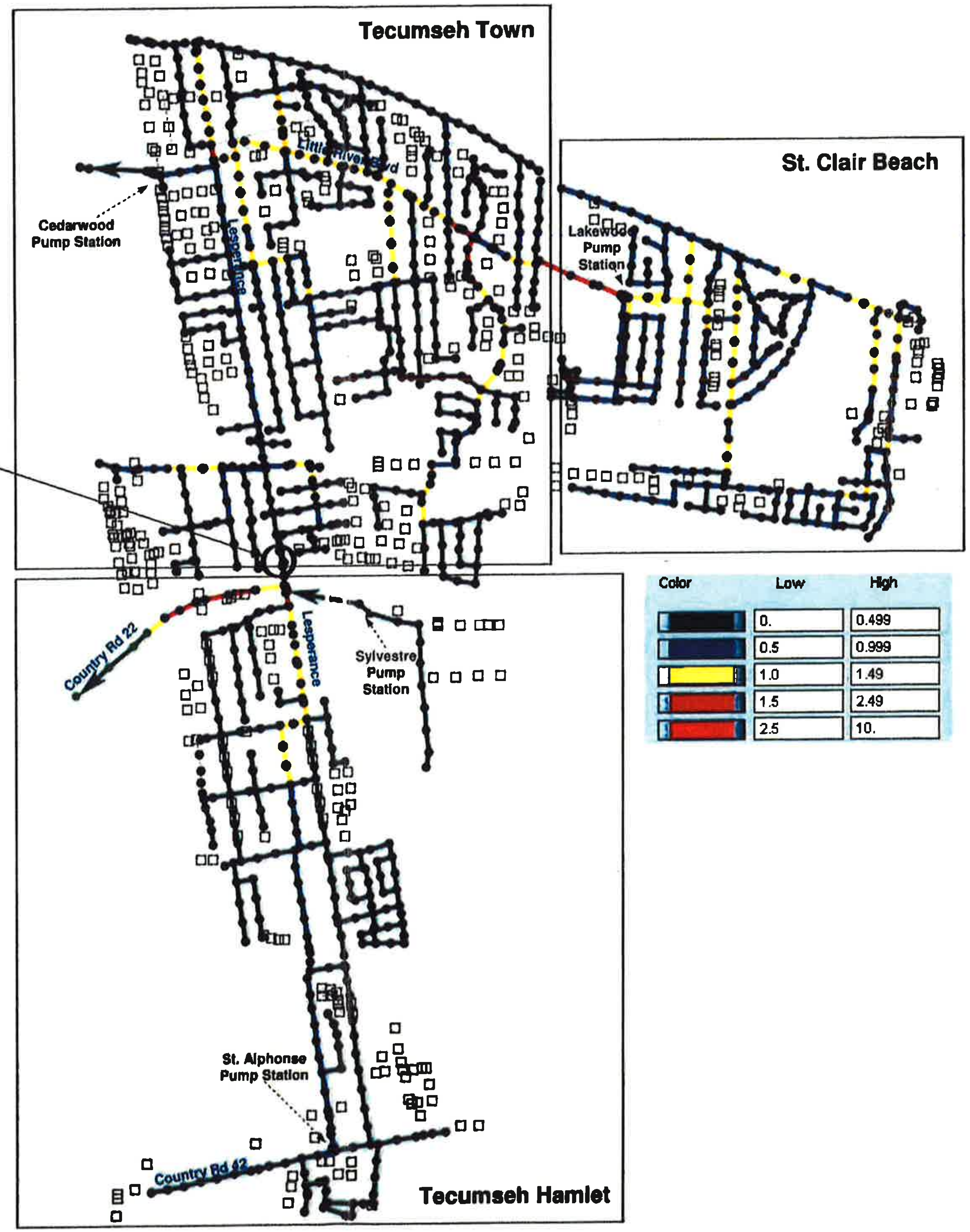
Notes:

1. Wet antecedent conditions for Tecumseh Hamlet: using infiltration/inflow parameters (RTK values) determined based on calibration events of April 7and May 11, 2010 (R-total ranging from 0.10 to 0.19)

Figure B-2: 5-year, 24-hour Chicago Design Storm – Ratio of Maximum Pipe Flow to Design Flow

- **Existing Condition**
- **5-year, 24-hour Chicago Design Storm**
- **Dry Antecedent Condition[1]**
- **All Tecumseh Hamlet flows diverted to Country Rd 22 Relief Sewer going west (No flow going north to Town of Tecumseh)**

Tecumseh Hamlet and Tecumseh Town are not connected under existing conditions



Notes:

1. Dry antecedent conditions for Tecumseh Hamlet: using infiltration/inflow parameters (RTK values) determined based on calibration event of June 5, 2010 (R-total ranging from 0.04 to 0.17)

APPENDIX G

2010 REVISED WATER AND WASTEWATER SERVICING REVIEW

Projects Located in Town of Tecumseh

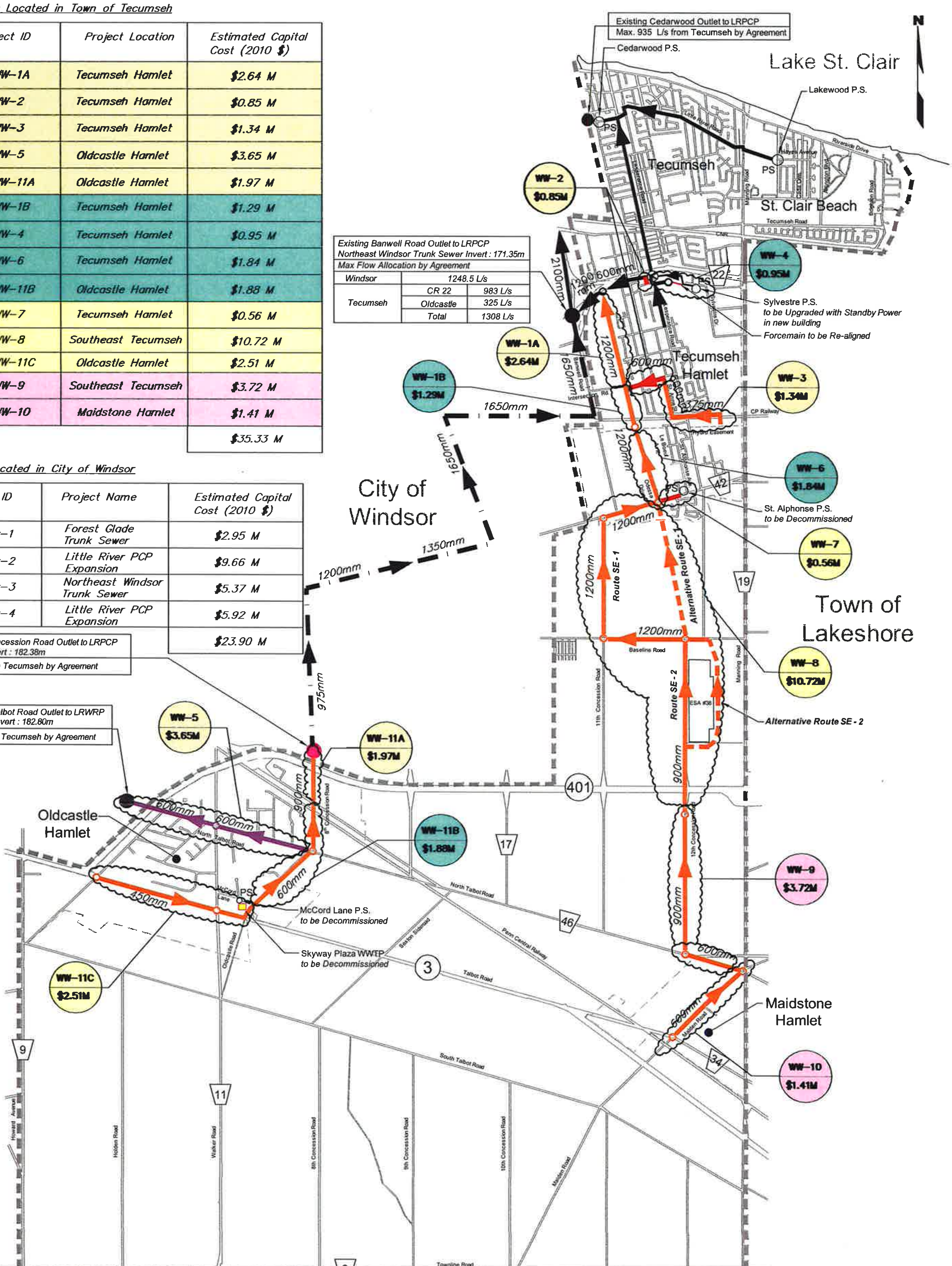
Project Timing	Project ID	Project Location	Estimated Capital Cost (2010 $)
5 year	WW-1A	Tecumseh Hamlet	$2.64 M
	WW-2	Tecumseh Hamlet	$0.85 M
	WW-3	Tecumseh Hamlet	$1.34 M
	WW-5	Oldcastle Hamlet	$3.65 M
	WW-11A	Oldcastle Hamlet	$1.97 M
5-10 year	WW-1B	Tecumseh Hamlet	$1.29 M
	WW-4	Tecumseh Hamlet	$0.95 M
	WW-6	Tecumseh Hamlet	$1.84 M
	WW-11B	Oldcastle Hamlet	$1.88 M
10-15 year	WW-7	Tecumseh Hamlet	$0.56 M
	WW-8	Southeast Tecumseh	$10.72 M
	WW-11C	Oldcastle Hamlet	$2.51 M
15-20 year	WW-9	Southeast Tecumseh	$3.72 M
	WW-10	Maidstone Hamlet	$1.41 M
			$35.33 M

Projects Located in City of Windsor

Project ID	Project Name	Estimated Capital Cost (2010 $)
Windsor-1	Forest Glade Trunk Sewer	$2.95 M
Windsor-2	Little River PCP Expansion	$9.66 M
Windsor-3	Northeast Windsor Trunk Sewer	$5.37 M
Windsor-4	Little River PCP Expansion	$5.92 M
		$23.90 M

Existing Banwell Road Outlet to LRPCP
Northeast Windsor Trunk Sewer Invert : 171.35m

Max Flow Allocation by Agreement		
Windsor		1248.5 L/s
Tecumseh	CR 22	983 L/s
	Oldcastle	325 L/s
	Total	1308 L/s



LEGEND

- Town Boundary
- Hamlet Boundary

EXISTING

- Trunk Sewer
- Forcemain
- Flow Control Maintenance Hole (FCMH)
- Skyway Plaza Wastewater Treatment Plant (WWTP)
- Pumping Station (P.S.)
- Outlet Location for Discharge of Monitored flow from Tecumseh to Little River Pollution Control Plant (LRPCP) or Lou Romano Water Reclamation Plant (LRWRP)

PROPOSED

- Northeast Windsor Trunk Sewer (By City of Windsor)
- Diversion Sewer
- Trunk Sewer to LRPCP
- Alternative Trunk Sewer Route to LRPCP
- Trunk Sewer to LRWRP
- Wastewater Forcemain
- Outlet Location for Discharge of Monitored flow from Tecumseh to Little River Pollution Control Plant (LRPCP)
- WW-1A $2.64M — Project ID / Estimated Capital Cost (2010$)

Notes:
The routing shown for proposed trunk sewers may be subject to chang based on approved development plans.

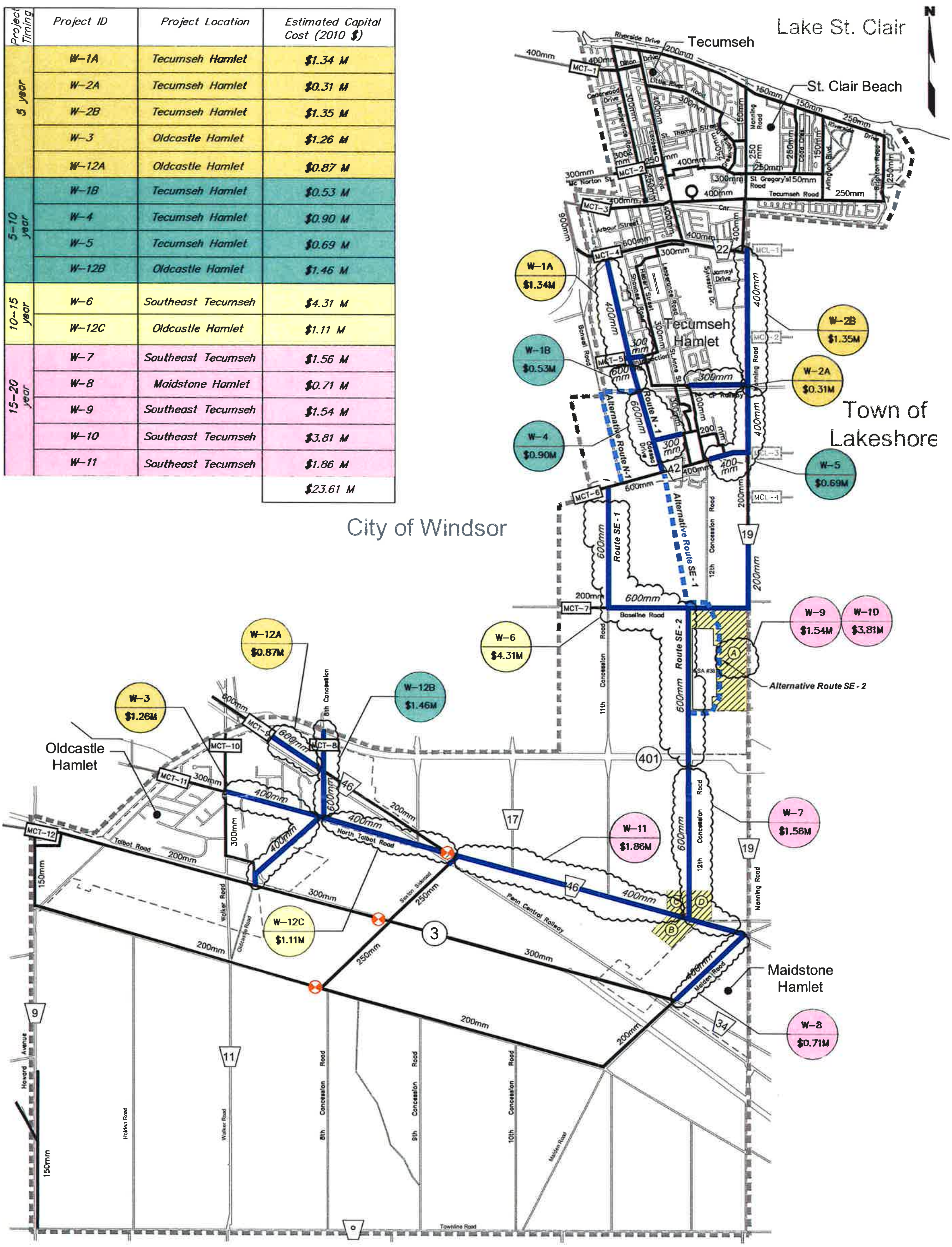
Town of Tecumseh Wastewater Servicing Review

2010 Revised Wastewater Servicing Strategy

AECOM
AECOM Canada Ltd.
50 Sportsworld Crossing Road, Suite 290, Kitchener, Ontario N2P 0A4
T 519 650 5313 F 519 650 3424

21 APRIL 10
NTS
60116269-D-6

Project Timing	Project ID	Project Location	Estimated Capital Cost (2010 $)
5 year	W-1A	Tecumseh Hamlet	$1.34 M
	W-2A	Tecumseh Hamlet	$0.31 M
	W-2B	Tecumseh Hamlet	$1.35 M
	W-3	Oldcastle Hamlet	$1.26 M
	W-12A	Oldcastle Hamlet	$0.87 M
5-10 year	W-1B	Tecumseh Hamlet	$0.53 M
	W-4	Tecumseh Hamlet	$0.90 M
	W-5	Tecumseh Hamlet	$0.69 M
	W-12B	Oldcastle Hamlet	$1.46 M
10-15 year	W-6	Southeast Tecumseh	$4.31 M
	W-12C	Oldcastle Hamlet	$1.11 M
15-20 year	W-7	Southeast Tecumseh	$1.56 M
	W-8	Maidstone Hamlet	$0.71 M
	W-9	Southeast Tecumseh	$1.54 M
	W-10	Southeast Tecumseh	$3.81 M
	W-11	Southeast Tecumseh	$1.86 M
			$23.61 M



LEGEND

Town Boundary
Hamlet Boundary

EXISTING

300mm Existing Trunk Watermain
Tecumseh Elevated Water Tank
MCT-2 Tecumseh Metering Chamber
MCL-2 Lakeshore Metering Chamber

PROPOSED

Trunk Watermain
Alternative Trunk Watermain Route
Alternative Site Locations for proposed Water Storage Facility and/or Booster Pumping Station.
Isolation Valve at Potential Pressure Zone Boundary.
W-12C $1.11M *Project ID* *Estimated Capital Cost (2010$)*

Notes:

The routing shown for proposed trunk watermains may be subject to change based on approved development plans.

Property requirements for proposed Water Storage Facility and/or Booster Pumping Station are to be finalized after a site selection process and may be different than shown.

Town of Tecumseh
Water Servicing Review

2010 Revised Water Servicing Strategy

AECOM

AECOM Canada Ltd. 50 Sportsworld Crossing Road, Suite 290, Kitchener, Ontario N2P 0A4

21 APRIL 10
NTS
60116269-D-07

APPENDIX H

FUNCTIONAL SERVICING MODELLING MEMO
MANNING ROAD SECONDARY PLAN (2015)

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1.0 INTRODUCTION

In April 2010, a Class Environmental Assessment study was completed to identify the preferred solution to address the stormwater management (SWM) requirements of the Manning Road Secondary Plan Area (MRSPA) in the Town of Tecumseh (Town). Since the completion of that study, the Town has been reviewing its stormwater servicing strategy in this area and identified the potential to expand the drainage area served by the proposed MRSPA SWM pond to include the Baillargeon Drain. An Addendum to the April 2010 Class EA was undertaken to confirm the feasibility of this alternative solution, which was finalized in March 2015. The existing drainage areas under consideration are illustrated within ***Figure 1***.

This report summarizes the results of the hydraulic and hydrologic modelling evaluation for the proposed alternative of incorporating the existing Baillargeon Drain area into the proposed MRSPA SWM pond in support of the Class EA Addendum. Furthermore, SWM functional design criteria for the related minor drainage system inlet controls, roadway surface storage and major overland drainage requirements for the MRSPA have now also been developed in response to comments received from the Essex Region Conservation Authority (ERCA) following the Notice of Filing of Addendum.

2.0 BACKGROUND

The stormwater management study for the MRSPA, titled the *Manning Road Secondary Plan Area - Stormwater Management Study Class EA Environmental Study Report - Final Report*, was completed in April 2010. The preferred solution resulting from this study consisted of a proposed stormwater management (SWM) pond located at the southerly limits of the study area to service the future MRSPA developments, discharging to the East Townline Drain (ETLD) along County Road 19 (CR 19) at a maximum pumping rate of 500 L/s. This solution also included the enclosure of the existing Baillargeon Drain, which discharges uncontrolled into the ETLD, south of Sylvestre Drive.

Following this study, the Town completed a draft Functional Servicing Report (FSR) for the MRSPA in October 2013, to serve as a guideline for the Town, regulatory agencies and landowners/developers to complete the orderly servicing of this area. This FSR will be updated by the Town to reflect the revised stormwater servicing requirements outlined herein. The layout of the current landowners/developers within the MRSPA is provided in ***Figure 2***.

Since the completion of the above noted reports, several studies and improvements have been completed along the ETLD. The opportunity to integrate and better utilize the capacity of the existing and proposed storm drainage infrastructure in the area by combining the existing Baillargeon Drain area as part of the proposed MRSPA stormwater management solution was subsequently identified during assessments of the ETLD. In addition to optimizing the storm drainage infrastructure, this alternative solution also presents an opportunity to improve the quality of stormwater runoff from the Baillargeon Drain.

This report summarizes the approach and methodology that was undertaken for the hydraulic and hydrologic modelling, including the comparative results and design considerations associated with the alternative storm drainage solution that is now being considered for this study area.

3.0 STORMWATER MANAGEMENT FACILITY CHARACTERISTICS - MRSPA

The proposed MRSPA SWM pond characteristics include the following:

- Approximately 200,600 m^3 of active storage volume in the pond for water quantity control.
- A minimum requirement of 5,400 m^3 of permanent pool volume is required for a "Normal level" of runoff water quality control as defined in the Stormwater Management Planning and Design Manual (MOE, 2003);
    - A total of 44,900 m^3 of permanent pool volume is provided in the functional design of this facility for a level of control beyond the "Normal level".
- 4,200 m^3 of extended detention volume for water quality control, pumped at a rate of 45 L/s; and providing in excess of 24 hours of drawdown time for the initial Chicago 25 mm - 4 hour storm event.
- Maximum pump rate of 500 L/s discharge into ETLD, which occurs once the extended detention volume has been exceeded.

Table 1 outlines the minimum MRSPA SWM pond volume and storage requirements the MRSPA area only.

Table 1: Minimum MRSPA Pond Volume Requirements

Drainage Area	103 ha
Permanent Pool (52 m^3/ha)	5,400 m^3
Extended Detention (40 m^3/ha)	4,200 m^3
Recommended Peak Storage Volume	72,100 m^3

The functional design of the pond has a total volume (including permanent pool, extended detention storage and available volume for all rainfall events) of approximately 245,500 m^3. Relative to the proposed contributing drainage area and the active storage volume provided, there appears to be excess volume available within the proposed pond to warrant further consideration of increasing the contributing drainage area to the pond, specifically through the addition of the Baillargeon Drain drainage area.

4.0 HYDRAULIC AND HYDROLOGIC MODELLING

The hydraulic and hydrologic analysis was completed using the Autodesk Storm and Sanitary Analysis (SSA) software, which allows for simulation of dynamic modelling conditions, including the response of the drainage system to rainfall events. The model software uses the EPA SWMM Hydrology Method and Hydrodynamic Link Routing method (i.e. Saint Venant Equations) to allow for an assessment of drainage system performance, including the downstream SWM pond, the routing of overland and storm sewer flows and consideration of surface storage requirements. The model was used to simulate the 2, 5, 10, 25, 50 and 100 year storm events for the proposed MRSPA drainage system with the inclusion of the Baillargeon Drain Area flows from the west.

The Autodesk SSA model has been developed to account for both minor and major system flows (dual drainage), including the routing of flows through the storm sewer network (minor system) and the overland drainage network (major system). The results of the analysis were used to:

- Calculate the required inlet restriction for each subcatchment for the 1:100 year event;
- Calculate the required surface ponding during a 1:100-year event;
- Calculate the storm sewer hydraulic grade line for the 1:100-year storm event;
- Evaluate overland flow and ponding volumes during the 100-year event;
- Determine the restricted major system runoff from the site to the overland flow outlets; and
- Assess the hydraulic impacts on the MRSPA SWM pond.

4.1 Design Storms

The hydrologic analysis was completed using the following synthetic design storms. The IDF parameters used to generate the design storms were taken from Windsor Airport Rainfall Data.

4 Hour Chicago Storms:
25 mm Chicago Storm
2-year Chicago storm
5-year Chicago storm
100-year Chicago storm

12 Hour Chicago Storms:
2-year Chicago storm
5-year Chicago storm
100-year Chicago storm

24 Hour Chicago Storms:
2-year Chicago storm
5-year Chicago storm
100-year Chicago storm

The 24-hour Chicago distribution generated the highest peak flows for both the minor and major systems during the 1:100 year storm event and was determined to be the critical storm distribution for the design of the drainage system and stormwater management facility for the MRSPA development. The 25 mm - 4 hour storm event was used as the water quality storm.

4.2 Drainage Areas

The delineation of drainage areas are outlined in ***Figure 1*** and described in further detail below.

4.2.1 Manning Road Secondary Planning Area (MRSPA)

The 103 hectare MRSPA area is currently undeveloped and is generally comprised of agricultural land uses. Future development of these lands will primarily result in residential uses, with some commercial and institutional development. The southern portion of these lands generally slopes east to the East Townline Drain, while the northern portion slopes north to the Cyr Drain.

Based on the proposed land uses, the following runoff coefficients have been used in the sewer design and modeling for this area:

- Parkland: C = 0.20
- Residential: C = 0.40
- Institutional: C = 0.70
- Commercial: C = 0.70

Based on the topography of the MRSPA site, the major overland drainage system is generally directed away from the proposed location of the MRSPA SWM facility at the southerly limits of these lands. Accordingly, runoff volumes for major rainfall events are proposed to be accommodated as follows:

- Temporary surface storage in roadways to a maximum depth of 300 mm, including inlet control devices within the catchbasins to provide an appropriate balance between runoff being conveyed by the storm sewer system and the temporary surface storage required within the roadways during larger storm events. Temporary surface storage will be discharged as follows:
  - To the proposed MRSPA SWM pond through the minor storm sewer system.
  - Runoff volumes in excess of the surface storage capacity of roadways will be conveyed through overland flow routes to the following drainage outlets, as shown in ***Figure 3***:
    - MRSPA SWM pond to the south;
    - East Townline Drain (ETLD) to the east; and
    - Cyr Drain to the north.

4.2.2 Baillargeon Drain Area

The existing Baillargeon Drain drainage area is approximately 96 ha in size and is primarily comprised of single family detached homes. These lands generally slope easterly, with the storm sewer system providing conveyance of storm runoff to an existing 1350 mm diameter storm sewer outlet pipe east of Candlewood Drive. The Baillargeon Drain conveys flow easterly and outlets to the East Townline Drain at CR 19, south of Sylvestre Drive.

The drainage characteristics of the Baillargeon Drain under major storm events were determined based on a review of the existing grades along its boundary with the MRSPA. It was observed that a previously designated emergency overland flood route to the MRSPA lands is identified within an easement that was established between existing homes on Charlene Lane. Based on further investigation, the existing grades within the overland flood easement appear to be at least 0.30 m higher than the existing roadway elevations. At this time, there are no alterations being proposed to the existing grades along this boundary that would result in an increase to overland flow contributions between the Baillargeon Drain area and the MRSPA.

This analysis was therefore based on surface runoff for major storm events up to the 1:100 year event being contained within the Baillargeon Drain drainage area boundaries, with drainage of surface storage taking place through the minor storm sewer system to the proposed MRSPA SWM pond.

In the case of more extreme events exceeding the 1:100 year storm condition, a new ditch inlet catchbasin is proposed to be incorporated at the downstream end of the overland flood easement, connecting to the MRSPA storm sewer system.

The existing surface elevations within the drainage area are illustrated in ***Figure 4.0 and 4.1***.

4.2.2.1 Model Calibration

Hydrodynamic modeling for the Baillargeon Drain area initially began by discretizing the watershed into a total of 19 subcatchments and incorporating the existing storm sewers exceeding 600 mm in diameter into the model. Each subcatchment area was assigned a percent impervious value based on the current land uses, with equivalent width values based on an estimate of existing flow lengths. Adjustments were made to the design parameters of four subcatchment areas to calibrate the model to the 1:2 year design storm capacity of the 1350 mm diameter storm outlet pipe from the upstream contributing area.

The storm sewer sizing for the future MRSPA network took into consideration the Autodesk SSA model results for time of concentration and peak inflows from the existing Baillargeon area during the Chicago 1:5 year 4 hour storm event. The representation of these variables for the Baillargeon Drain area within the MRSPA storm sewer design sheet combined the following two methodologies:

- Hydrodynamic Link Routing Method (i.e. Saint Venant Equations); and
- Rational Method Calculations.

The use of the Saint Venant equations within the model analysis enables the computation of backwater effects, flow reversal, surcharging and looped connections to name a few related to the future system. The flow can also be routed through a variety of different storage elements such as surface storage nodes and detention ponds.

It was determined that through analysis of the modelling results during the Chicago 1:5 year 4 hour storm event, a peak flow of 2600 L/s and the time of peak inflow occurrence of 101 minutes is to be used within the storm sewer design sheet and carried forward for the MRSPA development beginning at the confluence with the Baillargeon Drain storm sewer network at MH 77a. The storm sewer design sheet is provided within Appendix B of the Functional Servicing Report for the MRSPA.

5.0 HYDRODYNAMIC MODELLING APPROACH

The Autodesk SSA model has been developed to account for both minor and major system flows (dual drainage), including the routing of flows through the storm sewer network (minor system) and the overland drainage network (major system).

The hydrodynamic model for the MRSPA area was developed to represent the proposed drainage system as follows:

- Storm sewers were represented by "conveyance links" with the appropriate pipe size and inverts;
- Manholes were represented by "junctions" with the appropriate sump depths and grate elevations;
- Roadway surface storage was represented by "storage nodes" with a maximum storage depth of 300 mm; and
- Major system flow routes were interconnected between storage nodes with weirs to model overland flow conveyance to not exceed 300 mm in dynamic depth of surface storage during the 1:100 year event. The SSA model is capable of accounting for both static and dynamic storage within the storage nodes and can compute the overland flow between each subcatchment beyond the maximum ponding depths.

By using a hydrodynamic, dual drainage model, a more accurate representation of conveyance flows within the storm sewers and along the surface can be analyzed during the 1:100 year storm event. This allows for establishing stormwater management criteria that would be applicable during the detailed design stage of the MRSPA development, including:

- Restricted allowable release rates into the storm sewer system (L/s/ha);
- On-site surface storage requirements (m^3/ha); and
- Overland flow rates discharging to the existing downstream outlets (L/s/ha).

5.1 Modelling Scenarios

A series of modelling scenarios were chosen to assess the capacity of the proposed MRSPA stormwater management facility, including the impacts on the major and minor drainage systems, as described below:

Scenario 1: Preferred solution from the 2010 MRSPA SWM Class EA, with the design drainage area limited to the MRSPA, the SWM pond normal water level (NWL) at elevation 175.0 m, and a SWM pond discharge rate of 500 L/s.

Scenario 2: Same as Scenario 1, but with an expanded design drainage area to include the Baillargeon Drain, including corresponding upgrades to the storm sewer system to accommodate these additional flows.

Scenario 3: Same as Scenario 2, but with the SWM pond NWL lowered by 0.50m to an elevation of 174.5 m.

The modelling of Scenario 1 was updated from the VISUAL OTTHYMO Version 2.0 hydrologic model used in the 2010 SWM Class EA to the Autodesk SSA hydrologic model being used as part of this analysis, allowing for a more representative comparison to the proposed alternatives.

The hydraulic models for Scenarios 2 and 3 were further developed to account for both minor and major system flows *(dual drainage)*, allowing for an assessment of the related inlet control, surface storage, and overland drainage requirements for the MRSPA. The model was also used to assess the suitability of the resulting major system excess overland flow (beyond the surface storage capacity) that would be conveyed to both the East Townline Drain and Cyr Drain during the 1:100 year storm event.

5.2 Model Input Parameters

The detailed hydrologic input parameters for each scenario are provided within ***Appendix B***. This includes the drainage area, weighted Runoff CN values, Runoff Coefficients, subcatchment equivalent widths and average slopes. Model schematics identifying each subcatchment location in relation to the storm sewer layout is provided within ***Figures 5, 6, 7 and 8.***

The storm sewer information included in the SSA model is consistent with the storm sewer design sheet information included in the Functional Servicing Report for the MRSPA, and as-built information for the existing Baillargeon Drain storm sewer system.

5.3 Hydrodynamic Modelling

The hydrodynamic model was initially completed at a coarse level of detail to confirm the feasibility of the alternative stormwater drainage solution, followed by a more detailed model that was developed to confirm the functional design requirements of the proposed drainage infrastructure.

The detailed dual drainage model was developed utilizing an appropriate number, size and arrangement of subcatchment areas. The existing and proposed storm sewer system was modelled for pipe sizes that are generally larger than 600 mm in diameter. The surface storage requirements for major storm events were estimated with consideration for interconnection between each of the surface storage units.

6.0 MODELLING RESULTS

6.1 SWM Quantity Control

A comparison of the MRSPA pond storage requirements and associated drawdown times for each scenario are outlined in ***Table 2*** based on restricting the runoff from the 1:100 year storm event to a maximum discharge rate of 500 L/s. For both Scenarios 2 and 3, the increased HWL is lower than the lowest grade within the MRSPA area, as well as the top of bank elevation of the pond, providing a reasonable degree of freeboard.

Table 2: Pond Operating Characteristics (1:100 Year Event)

Scenario	Pond Inflow (m^3/s)	Normal Water Level (m)	1:100 Year Water Level (m)	Freeboard to Lowest Proposed MRSPA Surface Elevation of 180.70 m (m)	1:100 Year Active Storage Volume (excl. quality control) (m^3)	1:100 Year Drawdown Time (hrs)
1	6.6	175.00	177.14	3.56	72,058	54
2	10.15	175.00	178.88	1.80	120,874	84.8
3	10.15	174.50	178.62	2.08	122,462	97.5

The dynamic modelling of Scenario 2 and Scenario 3 is based on an inlet pipe invert to the pond of 175.00 m. The minor difference in active storage volumes and drawdown times reflect the change in the geometry of the pond arising from the varied normal water level elevation for each scenario.

Based on the results outlined in ***Table 2***, it is estimated that the addition of the Baillargeon Drain drainage area would result in approximately a 70 percent (50,404 m^3) increase in active storage within the MRSPA pond during a 1:100 year storm event. The impact of this increased runoff volume would result in the following:

- The 1:100 year water level in the SWM pond would increase from 177.14 to 178.62 (1.48 m increase - Scenario 3), reducing the freeboard to the lowest proposed surface elevation in the MRSPA from 3.56 m to 2.08 m (1.48 m freeboard reduction); and
- The time to drain down the pond facility beginning at the end of the 1:100 year storm event would increase from 2.25 days to 4.06 days for a 1:100 year storm event.

The results of the modelling for the preferred design (Scenario 3) is included within ***Appendix A through C***. This includes a detailed stage-storage table for the MRSPA SWM pond, hydraulic grade line profiles throughout the trunk storm sewer network, and SSA model output results.

Comments related to the noted changes to the MRSPA pond as a result of incorporating the Baillargeon Drain drainage area are described as follows:

6.1.1 Increased Baillargeon Drain Flows and MRSPA Water Level

The increased 1:100 year event water level resulting from incorporating the Baillargeon Drain drainage area can be accommodated in the proposed MRSPA storm sewer system and SWM pond without negatively affecting the level of service in the contributing drainage areas. The revised conditions would result in the following:

- Drainage of minor storm events without surcharging above the existing and proposed ground surface elevations;
- Improved drainage of minor and major storm events in the Baillargeon Drain drainage area as a result of outlet conditions that are improved over those that exist in the ETLD; and
- Increased surface storage requirements in the MRSPA, which may be accommodated by implementing the following measures:
  - Provide a 2100 mm diameter storm sewer outlet to the proposed MRSPA pond downstream of the confluence with the 1350 mm diameter Baillargeon Drain outlet;
  - Incorporate inlet control restrictions in the roadway catchbasins to balance the runoff in the major and minor drainage systems; and
  - Allow overland flows exceeding the surface storage capacity of the roadways to be released to the existing Cyr Drain and East Townline Drain, subject to confirmation that these overland flows do not exceed the existing conveyance capacity of these drains.

The hydraulic grade line profiles in the storm sewer system are included in ***Appendix A*** of this report.

6.1.2 Increased Drawdown Time

A risk analysis was completed to assess the resiliency of the proposed MRSPA pond to accommodate a storm during the 97.5 hour drawdown period following a 1:100 event. The following ***Table 3*** summarizes the incremental storage available (up to an extreme high water surface elevation of 180.50 m) during the drawdown period following a 1:100 year 24 hour storm, and the corresponding storm event that could be accommodated at each interval of time:

Table 3: MRSPA Pond Drawdown Summary

Drawdown Time (hrs)	WSEL (m)	Active Storage Available (m^3)	Active Storage Needed for Storm Event (m^3)	Storm Event Capacity in MRSPA Pond @ Time
0	178.62	78,152	55,779	1:5 year
12	178.20	93,549	101,408	1:25 year
24	177.64	113,050	101,408	1:25 year
26	177.54	116,581	116,570	1:50 year
30	177.34	123,000	122,462	1:100 year
48	176.36	153,215	122,462	1:100 year

The proposed MRSPA SWM pond is able to provide a reasonable level of service to address the risk of storm events immediately following a major 1:100 year storm based on the results outlined above. The active storage accounted for under this condition reflects the additional active storage volume in the pond up to an extreme water surface elevation of 180.50 m, which is still below the lowest proposed grade at the northern limits of the MRSPA (180.70).

6.2 SWM Quality Control

The water quality sizing requirements for each of the drainage areas that will contribute to the proposed MRSPA SWM pond are summarized below in ***Table 4***. The impervious values have been revised accordingly and weighted with respect to the future proposed land uses.

Table 4: Water Quality Pond Characteristics

Drainage Areas	Area (ha)	% Impervious	Required Total Quality Control Storage (m^3/ha)	Required Extended Detention (m^3/ha)	Required Permanent Pool (m^3/ha)	Required Total Storage Volume (m^3)	Required Extended Detention Storage (m^3)	Required Permanent Pool Volume (m^3)
MRSPA Area	103	37	92	40	52	9,476	4,120	5,356
Baillargeon Drain Area	93	30	90	40	50	8,370	3,720	4,650
Total	***196***	***34***	***91***	***40***	***51***	***17,846***	***7,840***	***10,006***

The water quality requirements are based on Table 3.2 of the MOE Stormwater Management Planning and Design Manual (March 2003) for a "Normal" level of protection.

Incorporating the Baillargeon Drain into the proposed MRSPA SWM Facility provides an opportunity to improve runoff quality for the respective drainage areas that currently has no measures in place. The criteria used in the model included the Chicago 25 mm - 4 hour storm event, which resulted in the following:

- 25 mm water surface elevation within the MRSPA Facility = 174.92 (0.42 m active depth)
- Water quality drawdown time = 37 hours

6.2.1 Permanent Pool Volume

The available permanent pool detention volume in the proposed MRSPA SWM pond is 28,419 m^3 at a normal water level of 174.50, which exceeds the minimum required volume identified in ***Table 4***.

6.2.2 Extended Detention Storage

The pump station outlet from the proposed MRSPA SWM pond is proposed to consist of low flow pumps to manage the extended detention outflow through the facility, as well as high flow pumps for all storms up to the 1:100 year event. The low flow pumps would operate up to an elevation of 0.34 m above the permanent pool level with a maximum flow rate of 0.045 m^3/s. The high flow pump arrangement would operate beginning from 0.19 m above the permanent pool level and have a maximum release rate of 0.5 m^3/s. The low flow and high flow pumps will work in conjunction from elevations 0.19 to 0.34 metres at a constant rate of 0.545 m^3/s. The water quality figure identified within ***Appendix B*** of the report show the results of the analysis for the water quality modelling during the 25 mm storm event.

During the 25 mm rainfall event, the drawdown from the MRSPA pond is between 24 – 48 hours, which meets the water quality requirements. Additionally, the extended detention total required storage volume for both the MRSPA as well as the Baillargeon area is 7,840 m^3, as outlined in ***Table 4.***

6.3 Baillargeon Drain Hydraulic Analysis

The hydraulic performance of the Baillargeon Drain will improve as a result of being redirected to the proposed MRSPA storm sewer system and SWM facility. The controlled outlet from the proposed MRSPA pond will provide considerable relief to the East Townline Drain.

The outlet conditions at the confluence of the 1350 mm diameter Baillargeon Drain outlet with the proposed MRSPA storm sewer will consist of a drop of approximately 1.8 m, while the northern portion of the Baillargeon Drain area will be separately accommodated by extending an existing 900 mm diameter storm sewer stub on Gouin Street to the MRSPA storm sewer. In addition, the tailwater conditions at the proposed MRSPA pond are considerably lower than the existing hydraulic conditions in the East Townline Drain under existing conditions.

A comparison of the hydraulic gradeline under existing and future conditions for MH EX4, located directly upstream of the Baillargeon Drain outlet along Candlewood Drive, is outlined below in ***Table 5***.

Table 5: Baillargeon Drain - Hydraulic Gradeline Comparison

Storm Event	Existing Conditions HGL @ U/S MH EX4 (m)	Future Conditions HGL @ U/S MH EX4 (m)
1:2 Year	181.51	181.24
1:5 Year	181.69	181.37
1:100 Year	181.82	181.68

7.0 MRSPA DEVELOPMENT STORMWATER MANAGEMENT CRITERIA

7.1 Minor System Flow Considerations

The SSA model analysis was completed using inlet control devices to restrict the amount of inflow and reduce the hydraulic elevations throughout the proposed storm sewer system. The detailed design for each phase of the MRSPA shall incorporate inlet control devices/orifice plates to limit flows into the storm sewer system. The restricted release rates into the storm sewer system during the 1:100 year event are identified in Section 8.0 and ***Figure 10*** of this report.

7.2 On-Site Surface Storage Consideration

The estimated maximum average surface storage capacity of the roadways in the MRSPA based on the proposed overland grades and a 300 mm dynamic ponding depth is approximately 90 m^3/ha. The maximum available surface storage value was determined based on a typical 8 m wide roadway with high points and catchbasins separated by 100m.

Storage nodes were established within the SSA model to estimate an appropriate balance between the required surface storage (roadway and parking lot) for each subcatchment in the MRSPA, the inlet control restrictions, and the allowable overland flow release rates to the Cyr Drain and East Townline Drain.

The surface storage volumes were analyzed and adjusted accordingly to ensure that during the 1:100 year event, overland flow to the proposed major system flow outlets were not exceeding the release rates under existing conditions and not adversely affecting the watercourses, as described in further detail below.

7.3 Major System Flow Considerations

Overland flows during the 1:100 year storm event exceeding the surface storage capacity of the roadways in the MRSPA are to be directed to the following drainage outlets (as identified in ***Figure 3*** of the report):

- MRSPA Stormwater Management Facility
- Cyr Drain
- East Townline Drain (ETLD)

The allowable major overland flows to the existing municipal drains were generally established as further described in Section 7.3.1 and 7.3.2 below.

Model analysis was completed for both the ELTD and Cyr Drain under both existing and future conditions to ensure that the major system overland flow from the MRSPA area during the 1:100 year storm event does not exceed the capacity of the downstream system. It was confirmed that the existing conditions within the Baillargeon Drain area and MRSPA lands were accounted for within the design of the East Townline Drain pump station outlet at Lake St. Clair. The major system overland flows during the 1:100 year event into the East Townline Drain will not have any negative effects on the downstream enclosure and pump station under future conditions.

7.3.1 Cyr Drain Analysis

Under existing conditions, the Cyr Drain consists of the following contributing areas, as shown in ***Figure 1***:

- CR 22 right-of-way from Lesperance Road to Manning Road (CR 19);
- Westlake Drive right-of-way east of Lesperance Road;
- Agriculture lands south of CR 22, between Lesperance Road and CR 19; and
- Industrial lands south of CR 22, at the southwest corner of CR 22 and CR 19.

Under future conditions, the MRSPA development will result in redirecting the majority of the existing agriculture lands (approximately 33.5 ha) to the proposed MRSPA SWM pond. This future condition will ultimately reduce the total drainage area to the Cyr Drain and East Townline Drain (as shown in this Environmental Study Report Addendum ***Figure 1*** and ***Figure 2***), and as outlined below in ***Table 6***:

Table 6: Cyr Drain – Drainage Area Comparison (Existing vs. Future)

Description	Existing Conditions	Future Conditions
Cyr Drain Drainage Area (ha)	45.3	11.8
MRSPA Major Overland Flow Drainage Area (ha)	-	*29.4
TOTAL (ha)	**45.3**	**41.2**

** The MRSPA contributing overland flow from the assigned area noted above under future conditions will spill over into the Cyr Drain once maximum surface storage is exceeded within the development lands along the northern boundary of the site.**

With the reduction of area within the Cyr Drain subwatershed as outlined above, it is proposed that the drain will act as a major system overland flow outlet from the northern portion of the MRSPA development. The major system overland flows will discharge into the Cyr Drain through a defined easement once the surface storage within the MRSPA has been exceeded during the 1:100 year event. The proposed overland flow routes are shown in ***Figure 3***.

To assess the impact that the MRSPA major system flows would have on the Cyr Drain, an Autodesk SSA hydrologic model was developed to evaluate the overall peak flow and water levels within the Cyr Drain under both existing and future developed conditions up to its confluence with the ETLD. The detailed model parameters for the Cyr Drain analysis are provided within ***Appendix B***. The MRSPA SSA model results are summarized below in ***Table 7*** and ***Table 8***, which outline the following:

- Existing Cyr Drain subcatchment flow that will be developed in the future with the MRSPA;
- Future development overland flow contribution from the MRSPA to the Cyr Drain;
- Existing flows from the Cyr Drain at the confluence to the ETLD; and
- Future flows from the Cyr Drain to the ETLD after development of the MRSPA.

Table 7: Existing and Future Peak Flows - Cyr Drain

Storm Event	Cyr Drain Peak Flows into East Townline Drain			Cyr Drain Inflows from MRSPA Lands		
	Existing (m^3/s)	Future (m^3/s)	Decrease (%)	*Existing Agriculture Land (m^3/s)	Future Major Overland Flow (m^3/s)	Decrease (%)
1:2 Year	0.53	0.18	66.0 %	0.47	0	100.0%
1:5 Year	0.83	0.28	66.3 %	0.74	0	100.0%
1:100 Year	1.77	1.61	9.0 %	1.42	1.41	0.70%

** Existing Agriculture Land peak flows represent the 33.5 ha currently contributing to the Cyr Drain, which will be developed and redirected in the future with development of the MRSPA.*

Based on the results outlined within ***Table 7***, future flows in the Cyr Drain during more frequent storm events are expected to be reduced by approximately 66% due to the reduction of contributing area from the MRSPA under future conditions.

While the frequent storm event runoff from the MRSPA would be redirected to the MRSPA pond in the future through the proposed storm sewer system, overland drainage cannot be redirected away from the Cyr Drain due to the natural topography of this area that slopes to the north. The major overland flow contribution from the MRSPA lands for the 1:100 year event will be reduced through on-site surface storage in the roadways (and directed to the proposed MRSPA pond through the storm sewer system), with the amount exceeding the required surface storage being allowed to overflow to the Cyr Drain to a level that does not exceed the existing contribution from the MRSPA.

The resulting water surface elevations within the Cyr Drain during the 1:100 year storm event under both existing and future conditions are summarized below in ***Table 8***. The flow from the MRSPA enters the Cyr Drain at Station 1+025 during both existing and future conditions.

Table 8: 1:100 Year Water Surface Elevation Comparison - Cyr Drain

STATION	*Existing Drain Characteristics		Existing Conditions		Future Conditions		WSEL Comparison
	Drain Bottom (m)	Edge of Gravel Shoulder (m)	Water Surface Elev. (m)	Flow Depth (m)	Water Surface Elev. (m)	Flow Depth (m)	Depth Decrease (exist. – fut) (m)
1+025	179.325	180.66	180.04	0.72	180.01	0.69	- 0.03
1+150	179.153	180.271	179.8	0.65	179.78	0.63	- 0.02
1+200	179.046	180.249	179.65	0.60	179.62	0.57	- 0.03
1+325	178.785	179.887	179.33	0.55	179.3	0.52	- 0.03
1+450	178.523	179.557	179.27	0.75	179.24	0.72	- 0.03
1+700	177.998	179.042	178.58	0.58	178.53	0.53	- 0.05

**Existing Drain Characteristics taken from the Cyr Municipal Drain Report (Bruce D. Crozier, February 1992)*

During the 1:100 year storm event, the water surface elevations within the Cyr Drain decrease from 0.02 m to 0.05m from the MRSPA major system overland flow location (1+025) to its confluence with the ETLD (1+700).

Based on the analysis completed for the Cyr Drain, the future flows within the system will have no adverse impact on the downstream watercourses. The model schematic is provided within ***Figure 9***.

7.3.2 East Townline Drain Analysis

Under development conditions, it is proposed that the Baillargeon Drain is directly connected to the MRSPA storm sewer system and conveyed into the proposed MRSPA SWM pond, which would have a release rate to the ETLD of 0.50 m^3/s. Under these development conditions, the ETLD would experience a significant reduction in flows.

Based on the degree to which the proposed MRSPA SWM pond would reduce the flows in the ETLD, it is proposed to allow a limited amount of overland flow to be directed to the ETLD, thereby reducing the required surface storage requirements in the MRSPA. It is proposed that major system overland flow routes to the ETLD be established at the following locations:

- At Street B; and
- At Jamsyl Drive.

A survey was completed along Jamsyl Drive confirming that the longitudinal grades of the roadway can accommodate overland drainage towards the ETLD. At the time of detailed design, it is proposed that the Jamsyl Drive/Sylvestre Drive intersection be reconstructed to accommodate the proposed road grades and that curb depressions. A conveyance swale must also be constructed at the Jamsyl Drive/Manning Road (CR 19) intersection to direct overland flows to the ETLD.

The model analysis results for the East Townline Drain under both existing and future conditions are summarized below in ***Table 9***. The proposed overland flow routes are shown in ***Figure 3***.

Table 9: Existing vs. Future Peak Flows – East Townline Municipal Drain

Storm Event	Existing Flows into ETLD			Future Flows into ETLD			
	*Baillargeon Drain (m^3/s)	MRSPA Lands (m^3/s)	Total (m^3/s)	MRSPA Pond (m^3/s)	Jamsyl Drive Outlet (m^3/s)	Street B Outlet (m^3/s)	Total (m^3/s)
1:2 Year	2.28	1.08	3.36	0.50	0	0	0.50
1:5 Year	2.69	1.56	4.28	0.50	0	0	0.50
1:100 Year	2.92	3.41	**6.10**	0.50	0.17	1.13	**1.80**

**Baillargeon Drain flows taken at Confluence to existing East Townline Drain*

Based on the results outlined above, the flows in the East Townline Drain flows from the 1:2 year to the 1:100 year events would be significantly reduced under future conditions, primarily due to the elimination of the direct connection with the Baillargeon Drain. Future flows will therefore have no negative impact on the existing East Townline Drain enclosure north of County Road 22.

8.0 STORMWATER MANAGEMENT CRITERIA

The detailed design of the storm drainage system for the MRSPA development is to incorporate the stormwater management criteria that have been outlined herein to achieve a fully integrated drainage solution for this area. The criteria has been developed based on the runoff coefficients outlined within ***Section 4.2.1*** for each proposed land use and the hydrodynamic dual drainage modelling completed and analyzed for the system. The stormwater management model was created to represent both minor and major system flows for the site as well as reasonable surface storage volumes that can be accommodated in both the roadway and parking lots for each subcatchment.

The stormwater management design criteria for each proposed land use is provided in ***Figure 10***, which includes the following:

- Inlet control restrictions into the storm sewer system (L/s/ha);
- Required on-site surface storage requirement (m^3/ha); and
- Restricted overland flow rate into the downstream flow outlets (L/s/ha).

9.0 CLIMATE CHANGE

While the Provincial Policy Statement references the need to consider the potential impacts of climate change while accommodating project needs, there is a lack of direction on the degree of increase/decrease and frequency of climate changes that should be used for assessment.

At this time, the concept of climate change is still an evolving term but needs to be addressed as it is expected to influence, directly and indirectly all elements of local development and watersheds. Climate change may cause potential impacts such as increase in phosphorus loading, increase in sediment and contaminants in flood transportation, reduction in ground water flows, and changes in precipitation, lake levels, erosion and ice cover. As such, potential impacts of climate change were considered on the effectiveness of the SWM works within the MRSPA development.

The drainage system and proposed MRSPA pond was evaluated by performing a sensitivity analysis on the system and applying a 20 percent increase to the 1:100 year, 24 hour Chicago design storm event. This methodology is taken from the City of Ottawa Sewer Design Guidelines, *(October 2012)*. The sensitivity of the system was analyzed and a summary of the pond results is as follows:

- High water surface elevation in the MRSPA pond increased from 178.62 m to 179.38 m (0.76 m increase);
- Freeboard from the lowest surface elevation within the MRSPA area to the high water level in the MRSPA pond decreased from 2.08 m to 1.32 m; and

- Freeboard from the top of the pond (180.50) decreased from 1.88 m to 1.12 m.

Based on this evaluation, the proposed MRSPA pond continues to provide sufficient freeboard during the 1:100 year (+20%) storm.

Inflow into the storm sewer system under climate change conditions will be affected by the increase of surface ponding and head along the roadway and parking lot areas throughout the MRSPA development as inlet control devices are to be installed within all catchbasins. The hydraulic gradeline within the system will change based on the slight increase in inflow as well as water level changes within the MRSPA Pond. The benefits of using inlet control devices for future climate change include:

- Reduction in the hydraulic gradeline elevations under more extreme events and climate change conditions; and
- Reduction of storm sewer backup into development properties.

Potential impacts under climate change within the MRSPA development through the use of inlet control devices include an increase of overland flow along the roadways and into the downstream outlets. These impacts include:

- Additional ponding within roadway and parking lot areas beyond 300 mm in depth; and
- Additional overland flow into the downstream outlets during larger storm events.

10.0 STAGING

10.1 MRSPA SWM Pond

It is expected that the Baillargeon Drain would be re-directed to the proposed MRSPA pond in the early stages of development in this area. In addition, approximately 15 ha of the MRSPA area are currently being considered as part of the early stages of development (Phase 1).

In order to satisfy the Phase 1 development requirements outlined above, we estimated the minimum required size for the first stage of the MRSPA pond, as follows:

- The water quality volume required for Stage 1 of the MRSPA development and Baillargeon Drain Area would be 9,720 m^3 *(Stage 1=1,350* m^3 + *8,370* m^3*).*
- The quantity control requirement would be 73,726 m^3 up to and including the 100 year storm event at a maximum water elevation within the facility of 177.57 m.
- Thus, the total volume required to meet both the water quality and quantity for Stage 1 of the MRSPA Area and Baillargeon Drain Area would be 83,446 m^3.

In sizing the facility, a substantial portion of the pond would be required as the initial stage of the pond construction to meet the water quantity and quality requirements. Therefore, based on the modelling completed as part of this report, it has been confirmed that approximately 55 percent of the pond would be required to accommodate the Baillargeon Drain and the development of approximately 15 hectares of MRSPA.

While it may be possible to consider a staged approach to the construction of this facility, its full implementation at the outset may be considered a more practical solution. In any event, the proposed MRSPA pond should be implemented in no more than two stages.

10.2 Interim Storm Inlet Considerations

It is anticipated that the northern portion of the MRSPA may be developed in advance of the southern portions. While the northern portion of the MRSPA undergoes development in phases in advance of the southern portions, it has been confirmed that these lands may be allowed temporary removal of inlet controls to the storm sewer system until the major overland flow outlet to the Cyr Drain is available, as shown in ***Figure 11***.

11.0 CONCLUSIONS AND RECOMMENDATIONS

1. The proposed MRSPA pond is capable of accommodating the addition of the Baillargeon Drain area flows. Based on the recommendation that the Baillargeon Drain area be added into the proposed MRSPA pond (Scenario 3), the following pond design and model results have been identified:

    - Provided Permanent Pool Volume of 44,900 m^3 at a Normal Water Level of 174.50;
    - Provided Active Storage Volume of 200,600 m^3 at a bank height of 180.50; and
    - 1:100 Year Active Storage Volume of 122,462 at a Water Level of 178.62 m.

2. The MRSPA SWM pond discharge to the ETLD is to be established at 500 L/s.

3. The current water quality requirement is for a normal level of treatment based on the Ministry of the Environment guidelines. This analysis has shown that water quality can be maintained to the normal level with both the permanent pool and the extended detention available within the MRSPA SWM pond.

4. Stormwater Management Criteria has been determined and set out within ***Figure 10*** of the modelling memo for the following:

- Restricted allowable release rate into the storm sewer system (L/s/ha);
- Required on-site surface storage requirement (m^3/ha); and
- Restricted overland flow rate into the downstream flow outlets (L/s/ha).

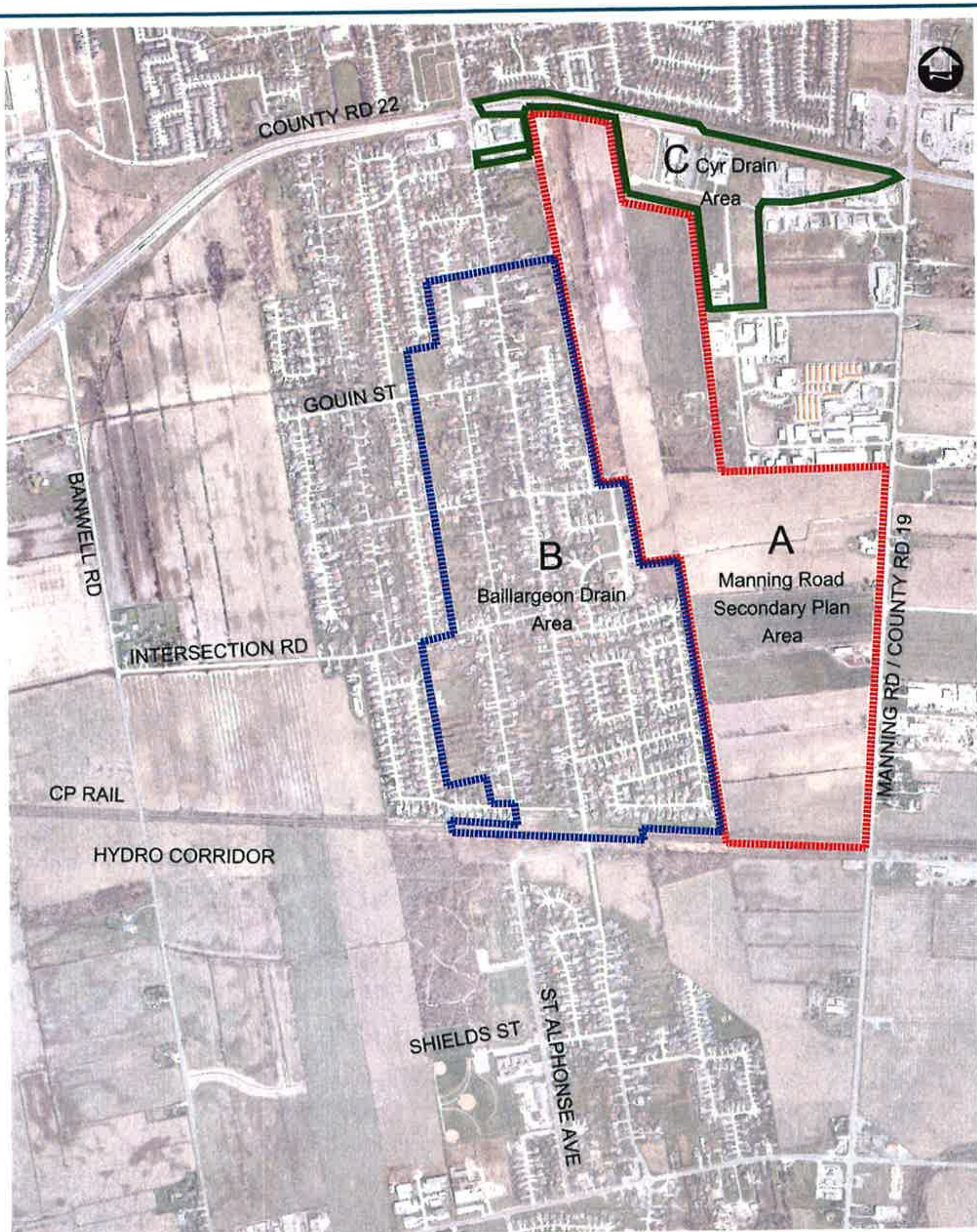
It is up to the individual developers to meet the stormwater management criteria requirements based on the proposed land use and major system outlet location.

5. Overland flow routes are to be directed to the following Drains:

- MRSPA Stormwater Management Facility;
- Cyr Drain;
  - Overland flow from the MRSPA during the 1:100 year storm event will have no adverse impact on the downstream watercourses.
- East Townline Drain (ETLD);
  - Major system overland flow during the 1:100 year event will not have any negative effects on the downstream enclosure and pump station under future conditions.

6. It is recommended that the proposed trunk sewers are increased in size from MH 101 to the MRSPA SWM pond to accommodate the contributions of the Baillargeon Drain. This is included in both Scenario 2 and Scenario 3 and provided in the storm sewer profiles within ***Appendix A.***

FIGURES



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March 2015

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in the Town of Tecumseh

FIGURE 1.0
OVERALL FUTURE DRAINAGE AREAS

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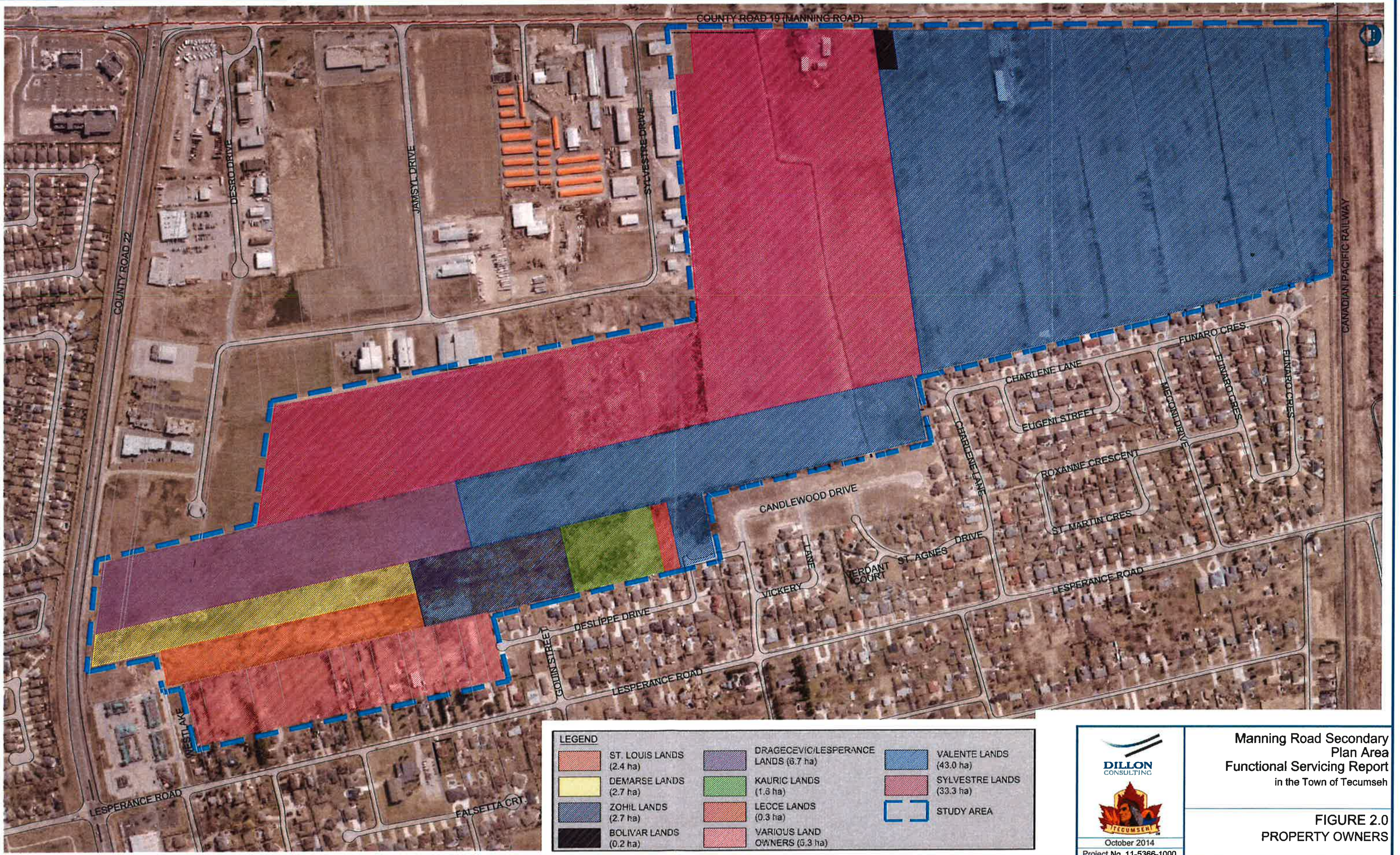

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FIGURE 2.0
PROPERTY OWNERS

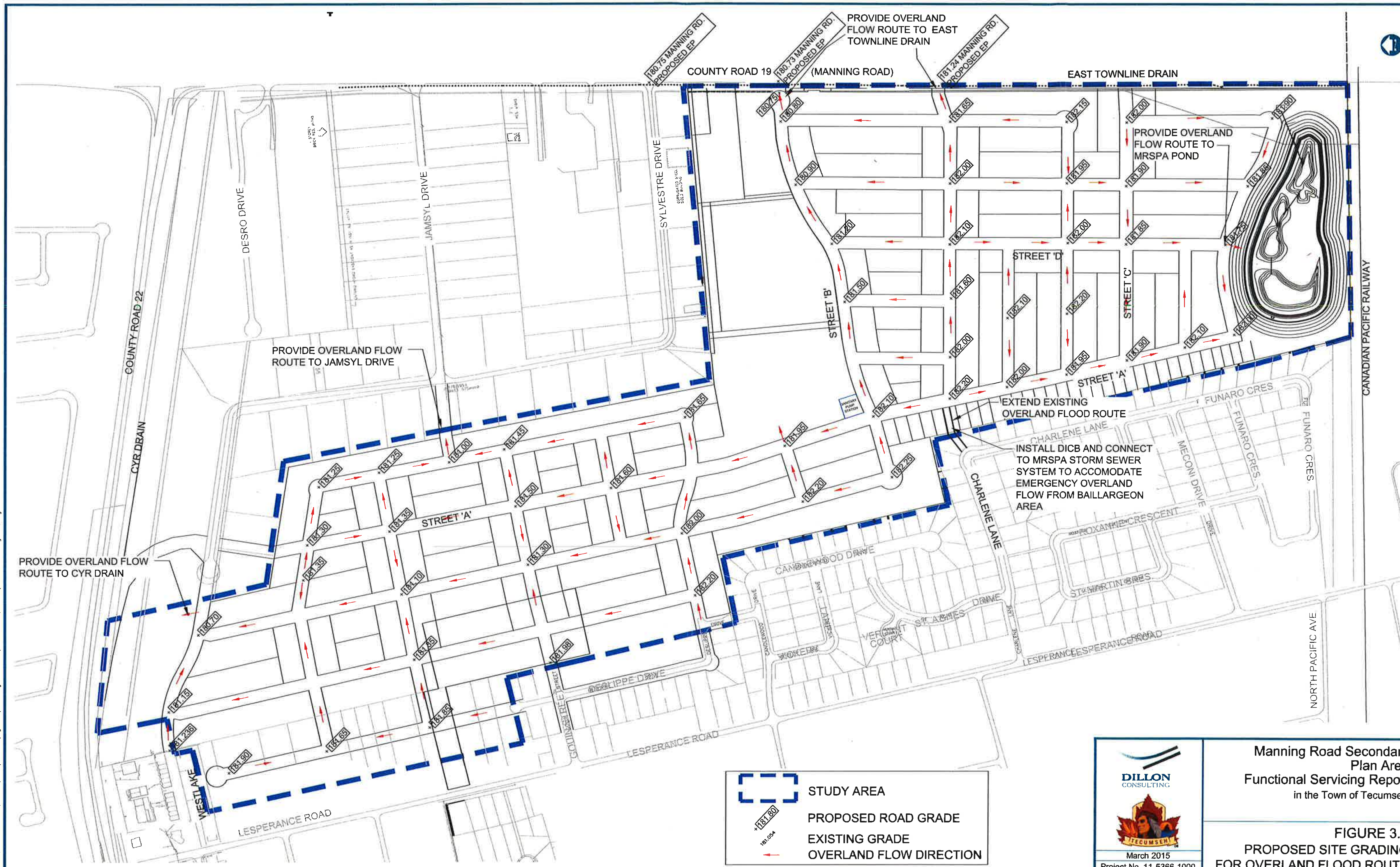

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FIGURE 3.0
PROPOSED SITE GRADING FOR OVERLAND FLOOD ROUTE

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October 2014
Project No. 11-5366-1000

FIGURE 4.0
EXISTING LAND TOPOGRAPHY

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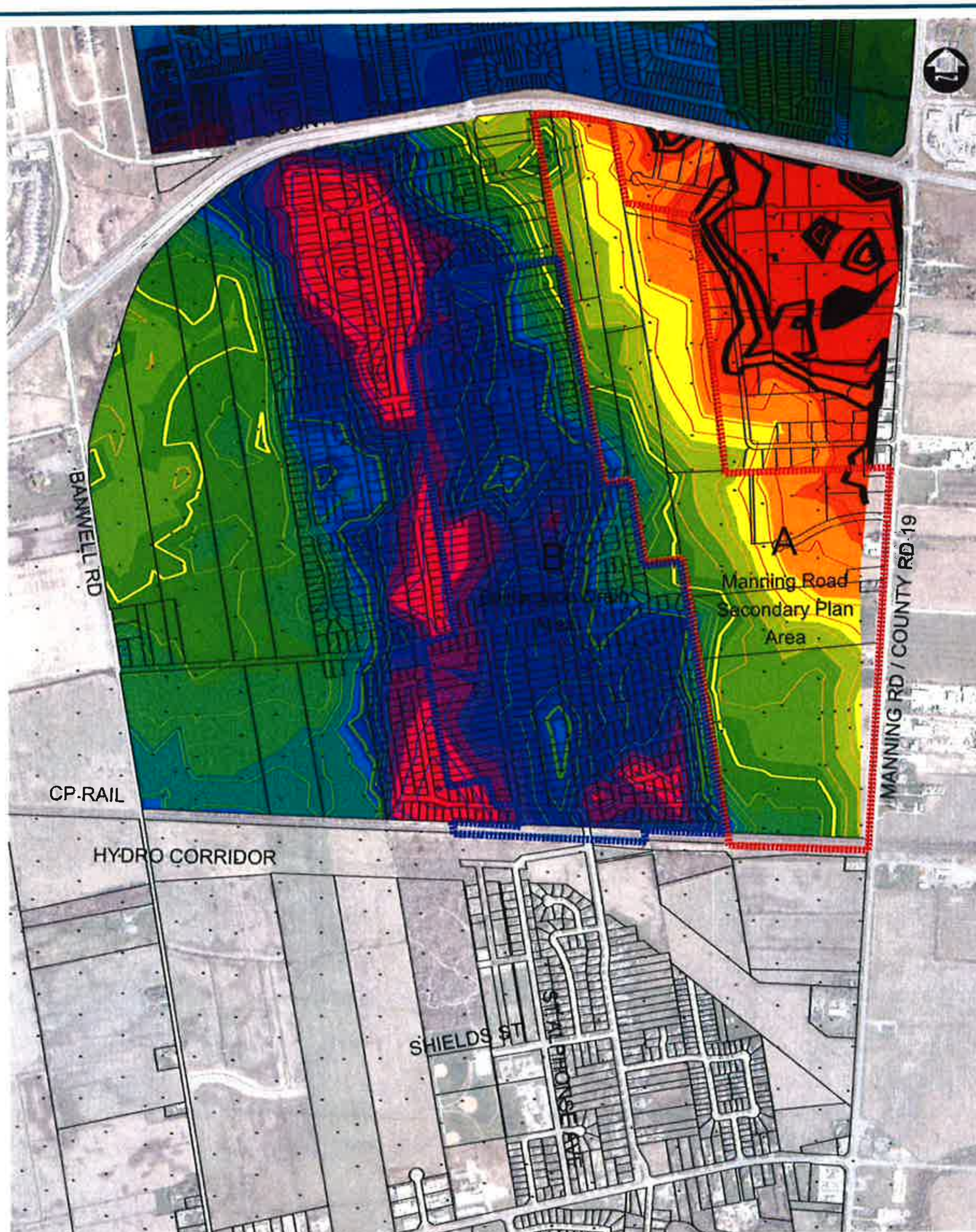

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FIGURE 4.1
EXISTING SURROUNDING LAND CONTOURS

Mar 09, 2015 - 10:25am G:\CAD\126309 Tecumseh Hamlet\PIOH Figures\PIC 2\XRefs\126309 Figure.dwg

SCENARIO 1: DRAINAGE AREA SCHEMATIC TO SPA POND - MRSPA AREA

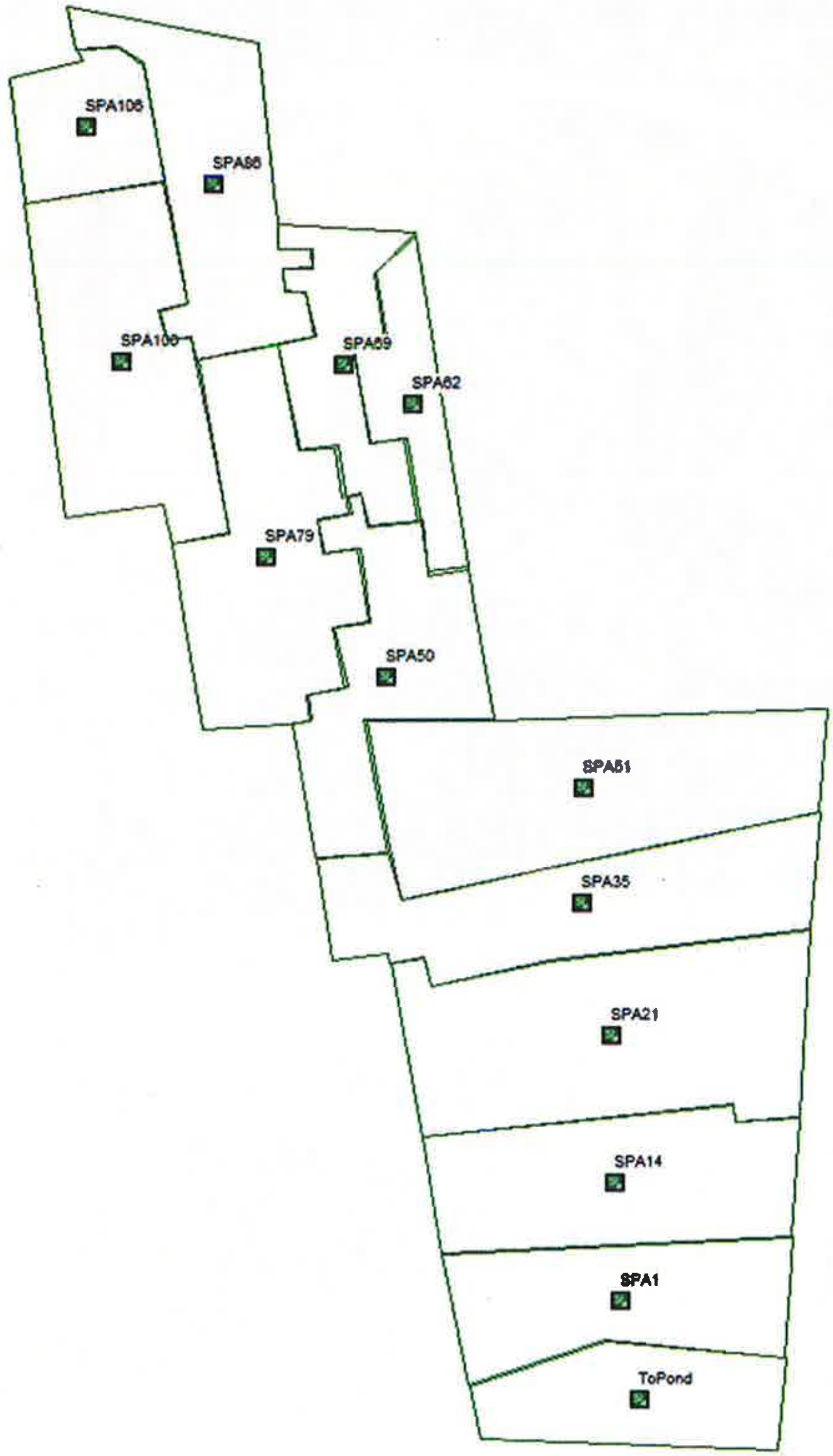


FIGURE 5.0

SCENARIO 1: STORM SEWER SCHEMATIC TO SPA POND - MRSPA AREA

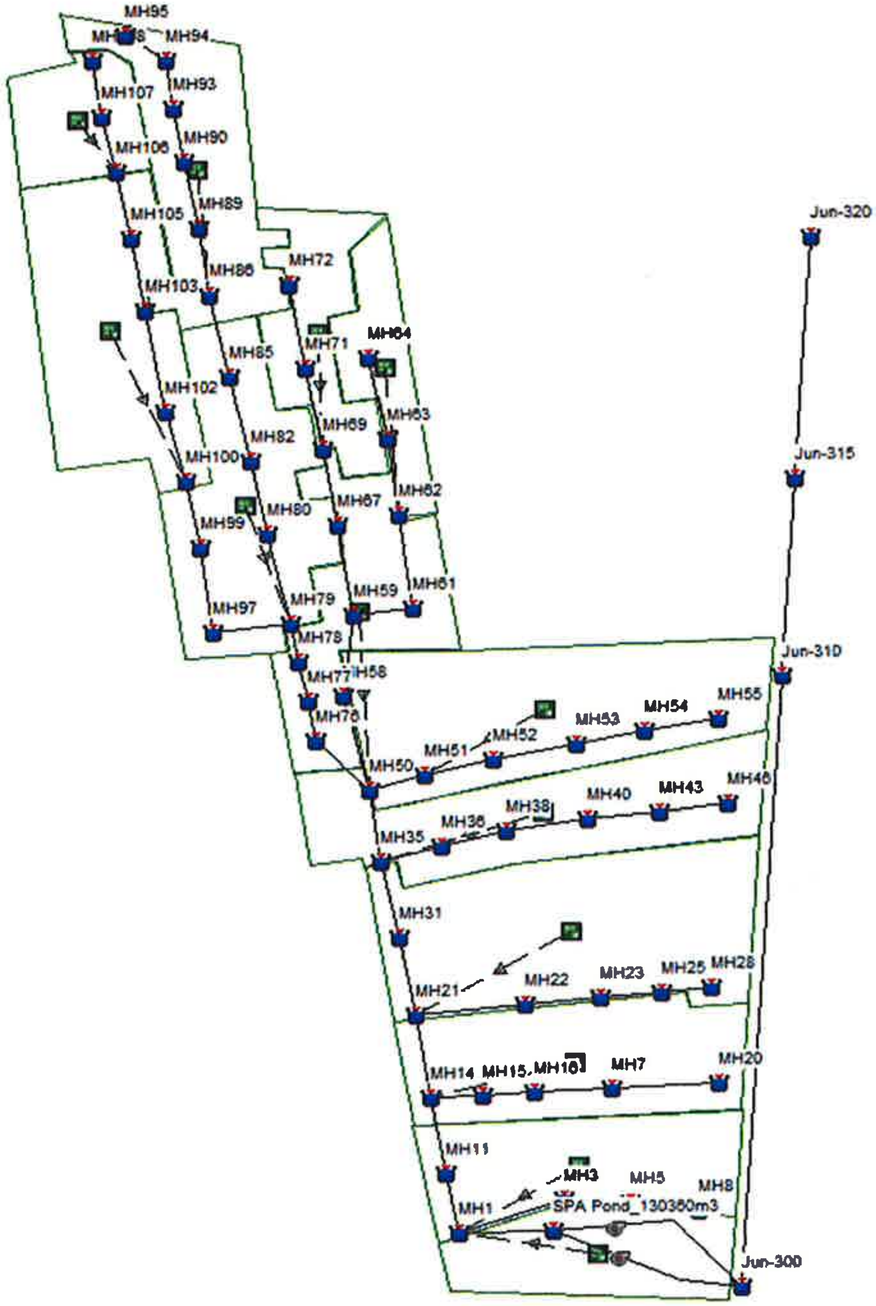
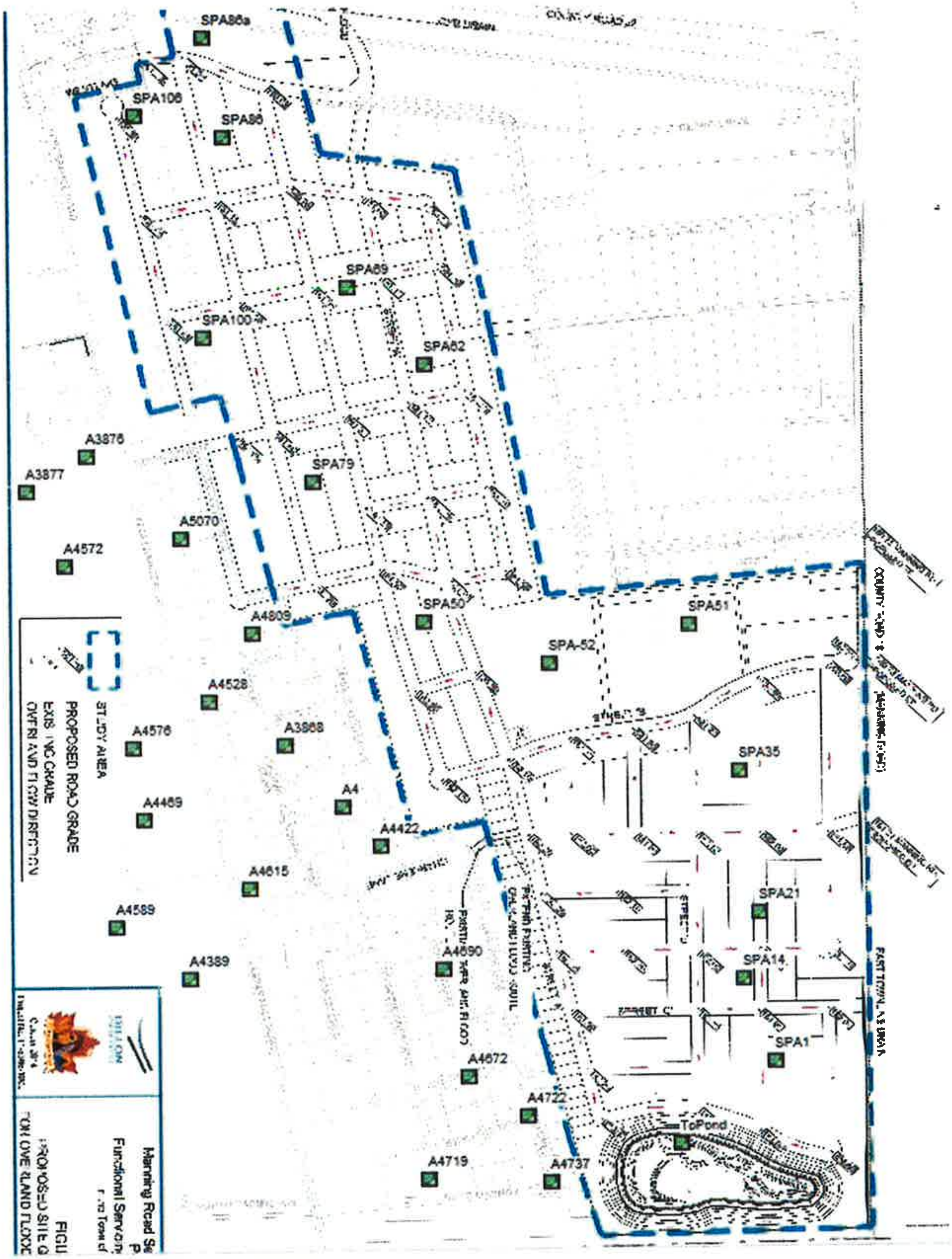


FIGURE 6.0

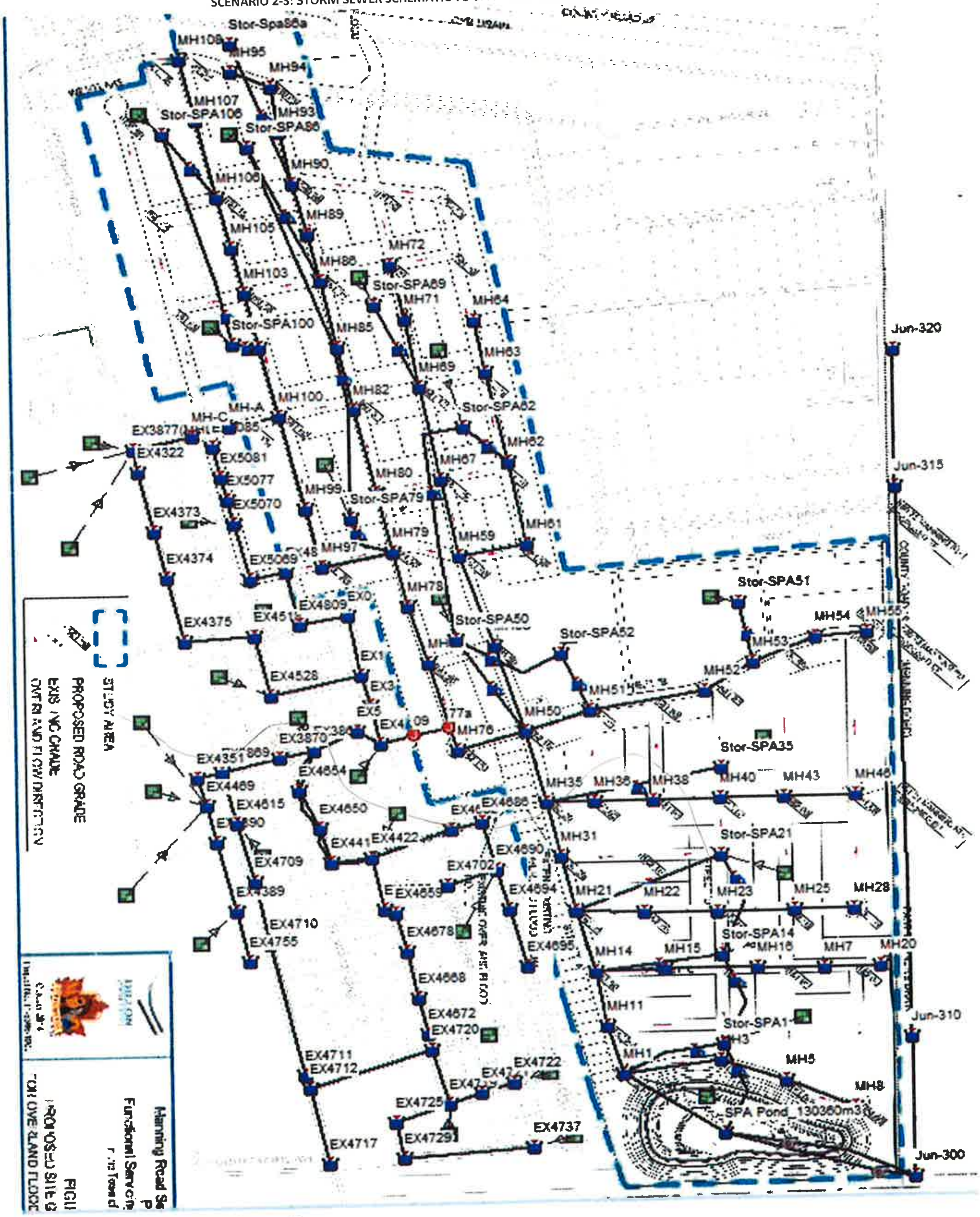
SCENARIO 2-3: DRAINAGE AREA SCHEMATIC TO SPA POND - MRSPA AREA + BAILLARGEON DRAIN



The model background image is used for road layout purposes only. The grades identified do not reflect the final grades within Figure 3.0

FIGURE 7.0

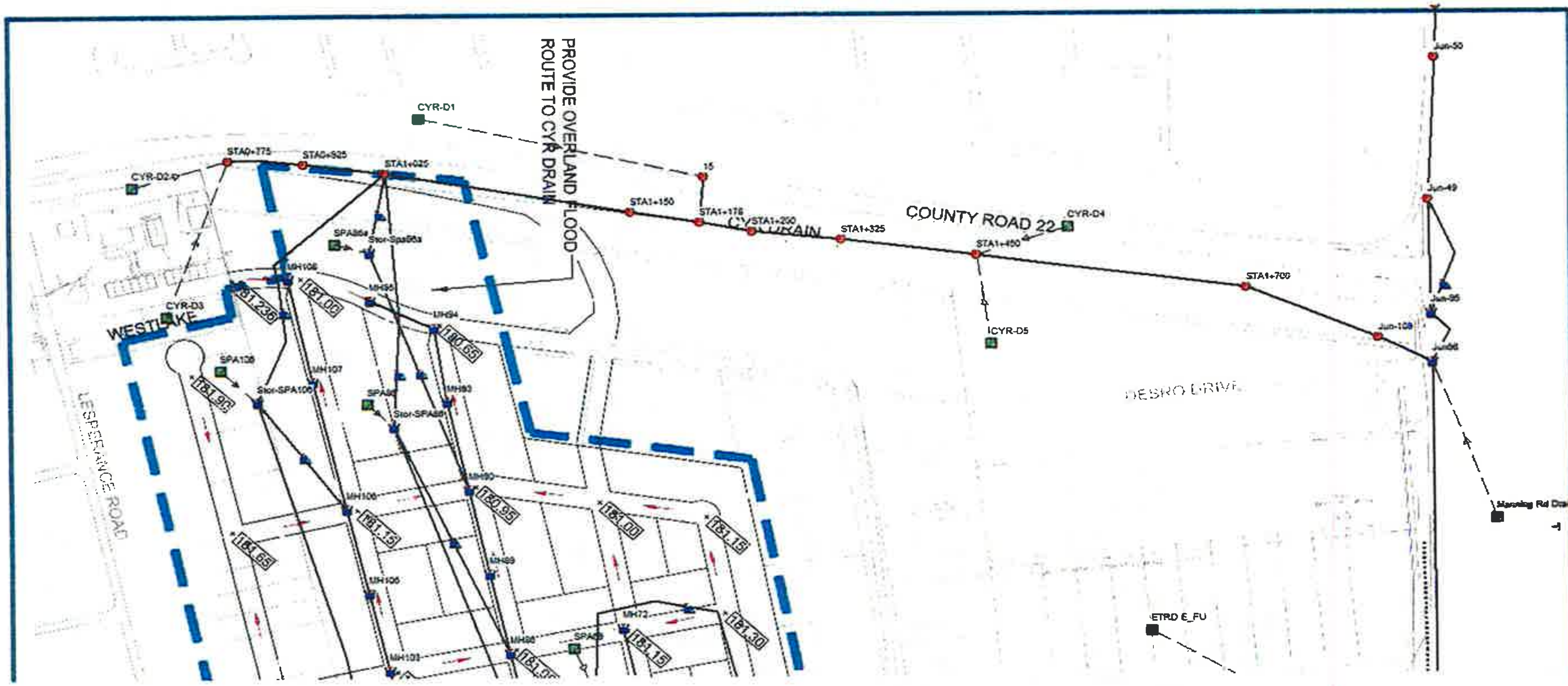
SCENARIO 2-3: STORM SEWER SCHEMATIC TO SPA POND - MRSPA AREA + BAILLARGEON DRAIN



The model background image is used for road layout purposes only. The grades identified do not reflect the final grades within Figure 3.0

FIGURE 8.0

CYR DRAIN ANALYSIS SCHEMATIC TO ETLD



The model background image is used for road layout purposes only. The grades identified do not reflect the final grades within Figure 3.0

FIGURE 9.0

STORMWATER MANAGEMENT CRITERIA				
CATCHMENT	REQUIRED ON-SITE STORAGE	MAX ALLOW. RELEASE RATE TO SEWERS	MAX ALLOW. OVERLAND FLOW TO OUTLET	OVERLAND FLOW OUTLET
RESIDENTIAL	31 m³/ha	81 L/s/ha	NO RESTRICTION	MRSPA POND
RESIDENTIAL	49 m³/ha	62 L/s/ha	5 L/s/ha	ETL DRAIN
INSTITUTIONAL	72 m³/ha	112 L/s/ha	78 L/s/ha	ETL DRAIN
PARKLAND	57 m³/ha	24 L/s/ha	76 L/s/ha	ETL DRAIN
RESIDENTIAL	73 m³/ha	65 L/s/ha	10 L/s/ha	PARKLAND
RESIDENTIAL	73 m³/ha	65 L/s/ha	10 L/s/ha	JAMSYL DRIVE
RESIDENTIAL	73 m³/ha	76 L/s/ha	48 L/s/ha	CYR DRAIN
COMMERCIAL	94 m³/ha	181 L/s/ha	35 L/s/ha	CYR DRAIN

NOTE 1: ALLOWABLE RELEASE RATES INTO STORM SEWERS BASED ON 1:100 YEAR FLOW THROUGH ORIFICE CONTROLS WITH MAXIMUM SURFACE PONDING HEAD OF 300mm.
NOTE 2: REQUIRED ON-SITE STORAGE BASED ON DYNAMIC OVERLAND FLOW CONDITIONS DURING 1:100 YEAR EVENT.

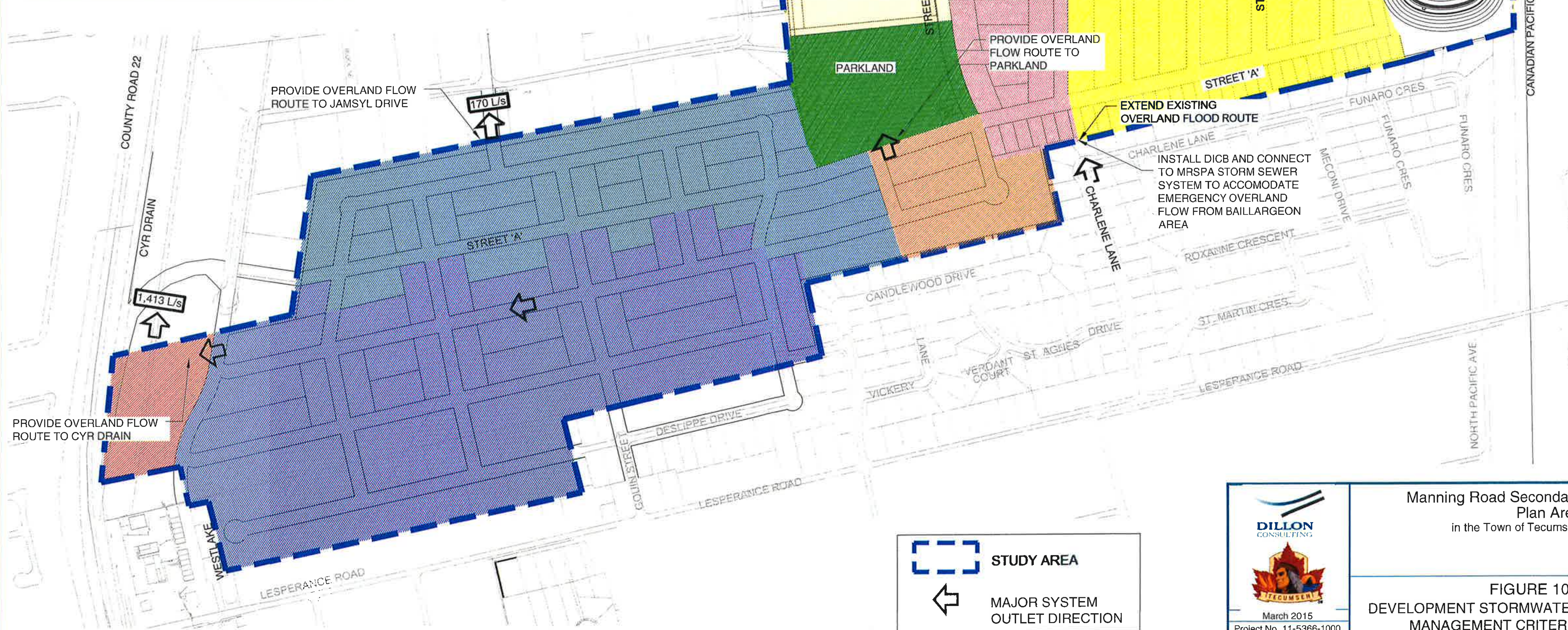


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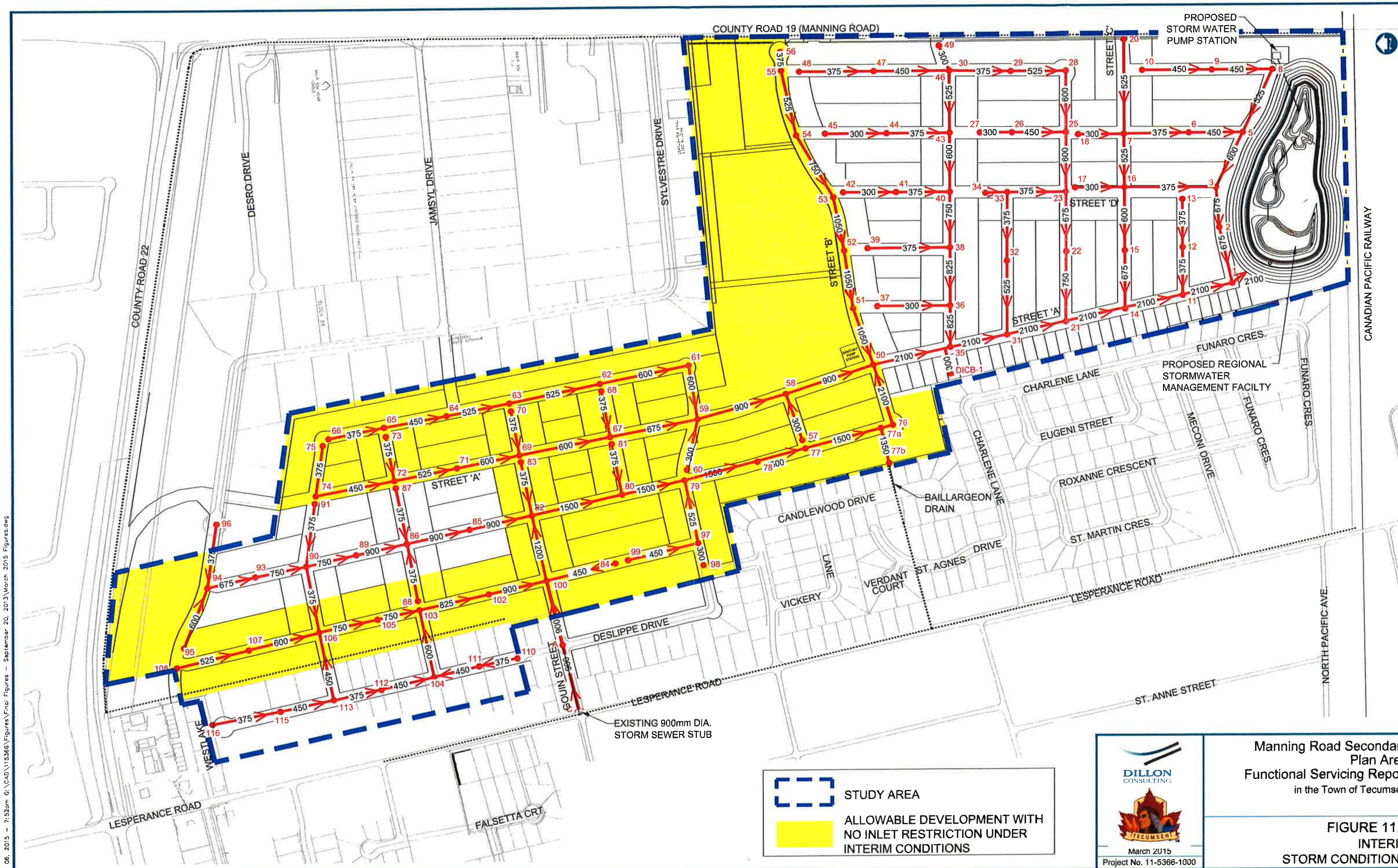
FIGURE 10
DEVELOPMENT STORMWATER MANAGEMENT CRITERIA



Manning Road Secondary Plan Area Functional Servicing Report in the Town of Tecumseh

FIGURE 11.0 INTERIM STORM CONDITIONS

APPENDIX A

TRUNK SEWER PROFILE PLOTS (1:100 YEAR EVENT)
PREFERRED SCENARIO 3

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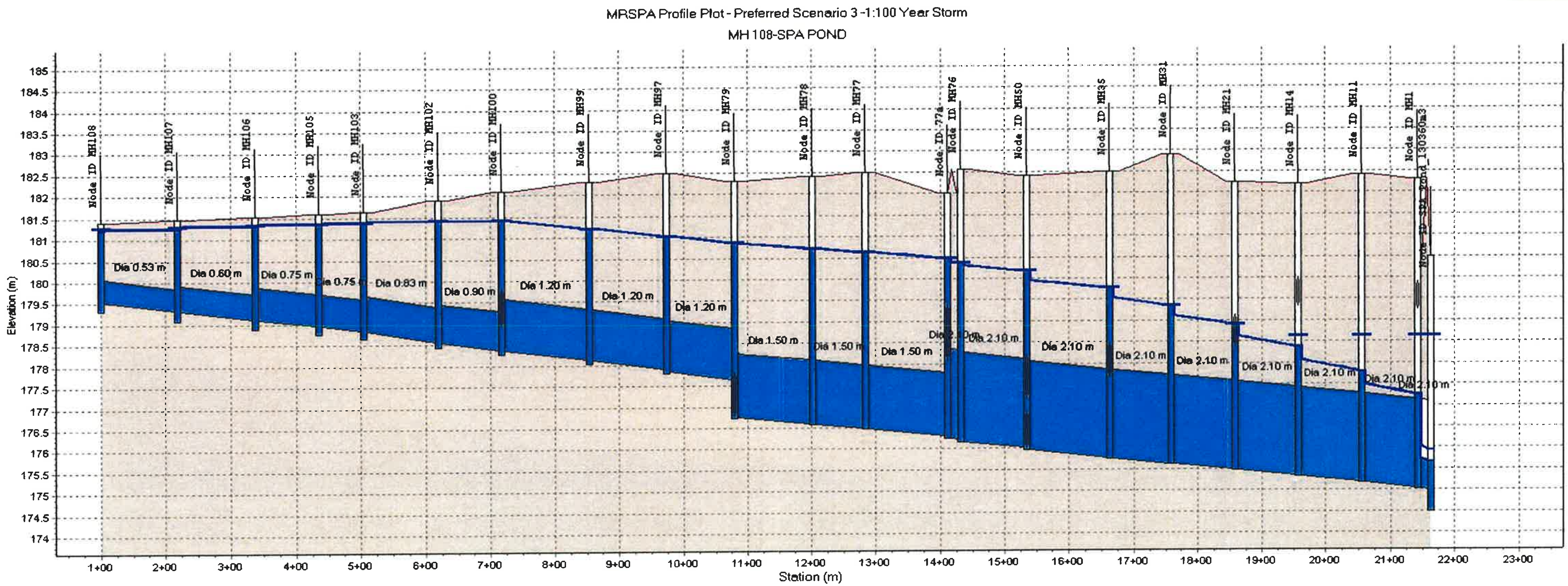
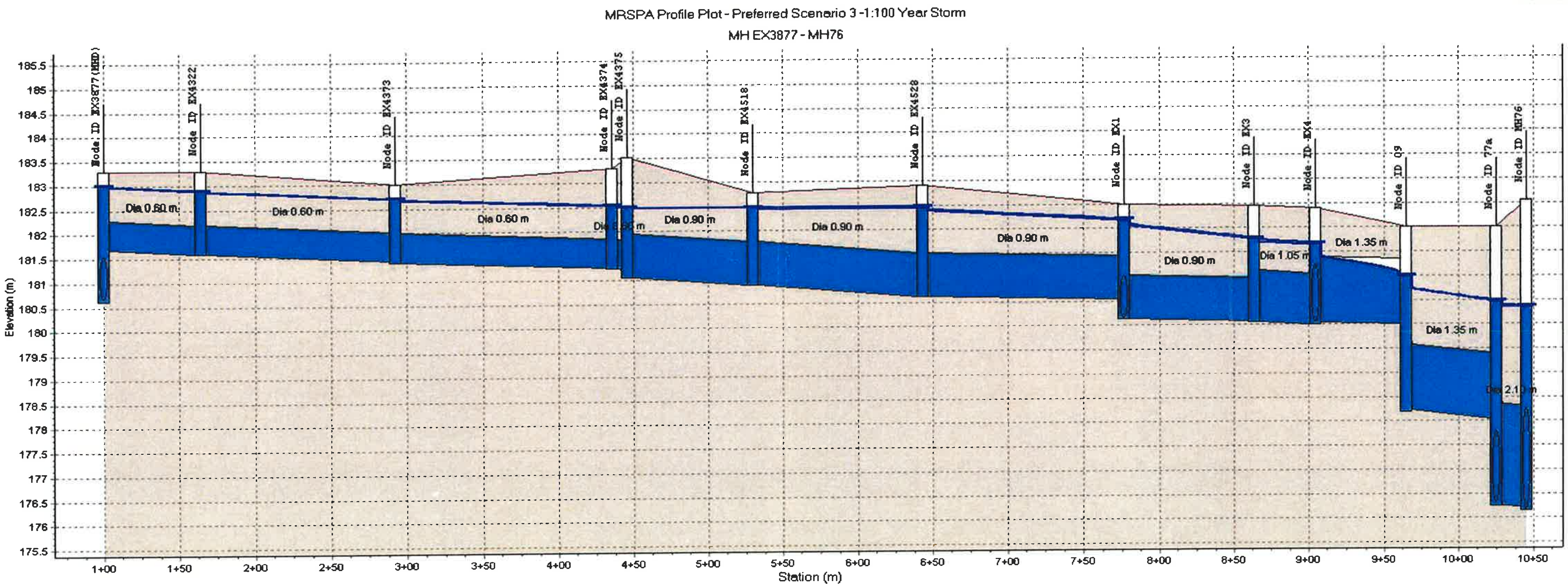


Note: Surface Elevations identified reflect the maximum ponding depths throughout the MRSPA system. Grade elevations are 300mm below ground elevations shown.



Note: Surface Elevations identified reflect the maximum ponding depths throughout the MRSPA system. Grade elevations are 300mm below ground elevations shown.

APPENDIX B

MODELLING INPUT/SUMMARY FILES

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Area ID	Catchment Area (ha)	Weighted CN	Runoff Coefficient	Percent Impervious (%)	Equivalent Width (m)	Average Slope (%)
Existing Baillargeon Drain Subcatchments						
A3868	6.82	90.00	0.48	40.0%	309.90	0.15
A3876	8.44	90.00	0.38	25.0%	272.40	0.15
A3877	2.77	90.00	0.38	25.0%	256.60	0.15
A4	5.92	90.00	0.48	40.0%	316.70	0.15
A4389	4.75	90.00	0.34	20.0%	135.80	0.15
A4422	6.73	90.00	0.48	40.0%	224.20	0.15
A4469	1.62	90.00	0.34	20.0%	204.90	0.15
A4528	5.80	90.00	0.38	25.0%	130.40	0.15
A4572	6.76	90.00	0.34	20.0%	204.90	0.15
A4576	6.46	90.00	0.34	20.0%	208.40	0.15
A4589	13.74	90.00	0.31	15.0%	330.90	0.15
A4615	2.88	90.00	0.48	40.0%	575.80	0.15
A4672	2.93	90.00	0.48	40.0%	188.90	0.15
A4690	4.21	90.00	0.48	40.0%	165.00	0.15
A4719	4.92	90.00	0.48	40.0%	185.70	0.15
A4722	1.30	90.00	0.48	40.0%	92.50	0.15
A4737	2.05	90.00	0.48	40.0%	222.30	0.15
A4809	1.74	90.00	0.45	35.0%	128.50	0.15
A5070	3.21	90.00	0.45	35.0%	133.90	0.15
MRSPA Subcatchments						
SPA1	7.70	90.00	0.40	28.0%	513.30	0.15
SPA100	7.40	90.00	0.40	28.0%	203.90	0.15
SPA106	5.90	90.00	0.40	28.0%	224.30	0.15
SPA14	6.20	90.00	0.40	28.0%	137.80	0.15
SPA21	9.30	90.00	0.40	28.0%	195.80	0.15
SPA35	12.00	90.00	0.40	28.0%	233.00	0.15
SPA50	10.20	90.00	0.40	28.0%	174.10	0.15
SPA51	11.30	94.10	0.69	70.0%	299.70	0.15
SPA52	2.50	94.10	0.22	3.0%	112.60	0.15
SPA62	2.60	90.00	0.40	28.0%	54.40	0.15
SPA69	4.00	90.00	0.40	28.0%	105.30	0.15
SPA79	8.70	90.00	0.40	28.0%	204.20	0.15
SPA86	5.46	90.00	0.40	28.0%	152.60	0.15
SPA86a	1.94	90.00	0.70	71.4%	150.93	0.15
ToPond	6.60	95.00	0.89	99.0%	167.90	0.15

Existing Cyr Drain Catchments					
Area ID	Catchment Area (ha)	Weighted CN	Percent Impervious (%)	Equivalent Width (m)	Average Slope (%)
CYR-1	1.89	90	33.2%	314.1	0.15
CYR-2	1.89	90	21.4%	86.6	0.15
CYR-3	0.23	90	76.8%	742.5	0.15
CYR-4	2.10	90	42.6%	12.5	0.15
CYR-5	5.72	90	28.9%	26.4	0.15
CYR-EXIST	*33.46*	*90*	-	*100.5*	*0.15*

MRSPA Preferred Scenario 3
SWM FACILITY STAGE-STORAGE TABLE

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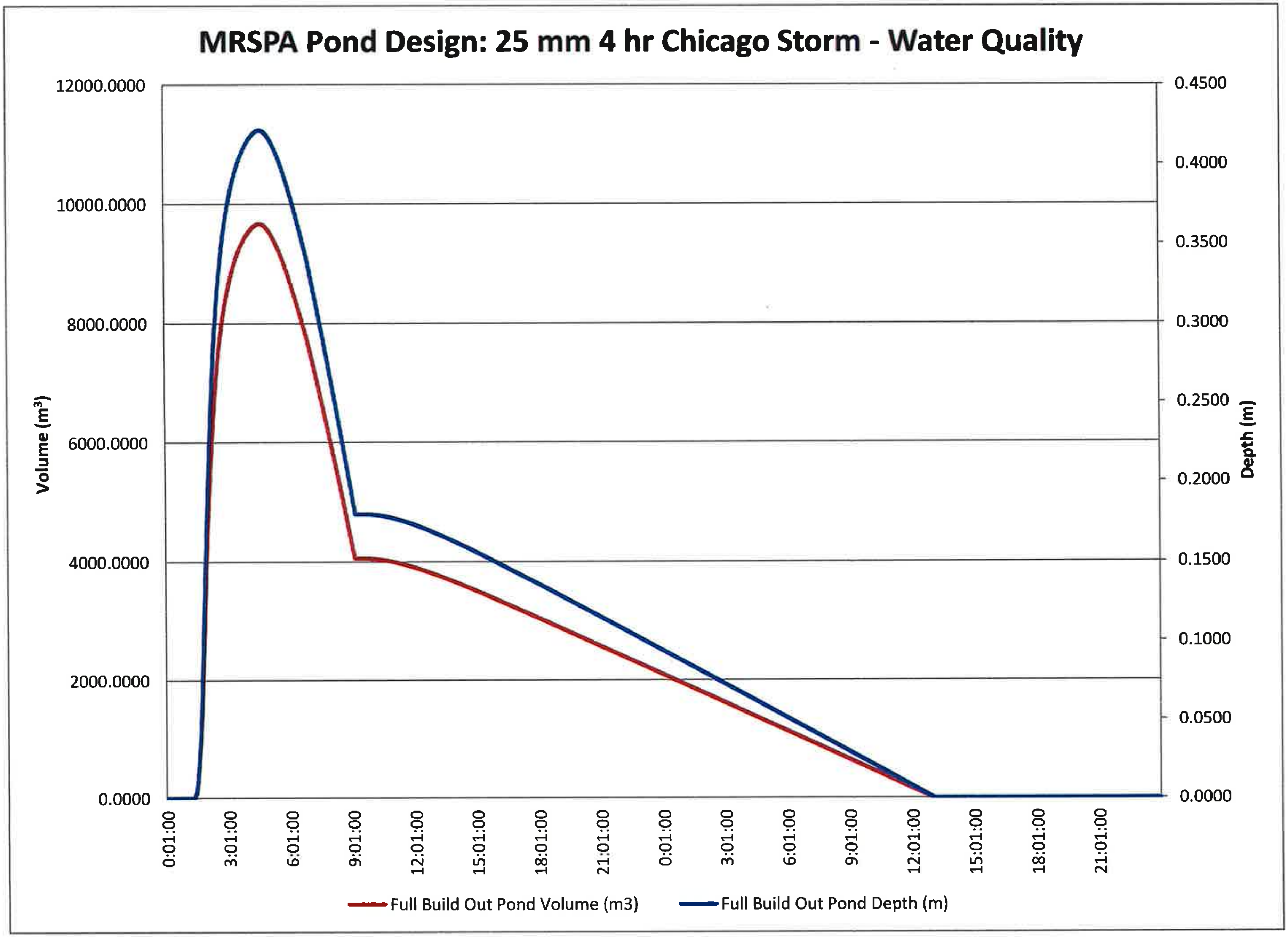
Stage	Active Depth (m)	Pond Elevation (m)	Area (m^2)	Volume		Outflow			Side Slopes (H:V)
				Incremental (m^3)	Total Active (m^3)	Low Flow Pump (L/s)	High Flow Pump (L/s)	Total (L/s)	
Normal Water Level	*0.00*	*174.50*	*22,233*	-	*0*	-	-	-	5 to 1
	0.25	174.75	23,083	5,665	5,665	45	500	545	5 to 1
	0.50	175.00	23,943	5,878	11,543	0	500	500	5 to 1
	0.75	175.25	24,888	6,104	17,647	0	500	500	5 to 1
	1.00	175.50	25,773	6,333	23,979	0	500	500	5 to 1
	1.25	175.75	26,667	6,555	30,534	0	500	500	5 to 1
1:2yr Water Elevation	**1.45**	**175.95**	**27,403**	5,516	**36,050**	**0**	**500**	**500**	**5 to 1**
	1.50	176.00	27,572	6,780	37,314	0	500	500	5 to 1
	1.75	176.25	28,485	7,007	44,321	0	500	500	5 to 1
	2.00	176.50	29,409	7,237	51,558	0	500	500	5 to 1
1:5yr Water Elevation	**2.14**	**176.64**	**29,937**	**4,221**	**55,779**	**0**	**500**	**500**	**5 to 1**
	2.25	176.75	30,343	7,469	59,027	0	500	500	5 to 1
	2.50	177.00	31,287	7,704	66,731	0	500	500	5 to 1
	2.75	177.25	32,238	7,941	74,671	0	500	500	5 to 1
1:10yr Water Elevation	**2.94**	**177.44**	**32,955**	**6,092**	**80,763**	**0**	**500**	**500**	**5 to 1**
	3.00	177.50	33,201	8,180	82,851	0	500	500	5 to 1
	3.25	177.75	34,175	8,422	91,273	0	500	500	5 to 1
	3.50	178.00	35,159	8,667	99,940	0	500	500	5 to 1
1:25yr Water Elevation	**3.54**	**178.04**	**35,323**	1,468	**101,408**	**0**	**500**	**500**	**5 to 1**
	3.75	178.25	36,152	8,914	108,854	0	500	500	5 to 1
1:50yr Water Elevation	**3.96**	**178.46**	**37,000**	**7,716**	**116,570**	**0**	**500**	**500**	**5 to 1**
	4.00	178.50	37,156	9,164	118,017	0	500	500	5 to 1
1:100yr Water Elevation	**4.12**	**178.62**	**37,637**	**4,445**	**122,462**	**0**	**500**	**500**	**5 to 1**
	4.25	178.75	38,169	9,416	127,433	0	500	500	5 to 1
	4.50	179.00	39,192	9,670	137,103	0	500	500	5 to 1
	4.75	179.25	40,227	9,927	147,031	0	500	500	5 to 1
1:100yr+20% Water Elevation	**4.88**	**179.38**	**40,751**	**5,241**	**152,271**	**0**	**500**	**500**	**5 to 1**
	5.00	179.50	41,271	10,187	157,218	0	500	500	5 to 1
	5.25	179.75	42,324	10,449	167,667	0	500	500	5 to 1
	5.50	180.00	43,387	10,714	178,381	0	500	500	5 to 1
	6.00	180.50	45,543	22,233	200,614	0	500	500	5 to 1



MRSPA Pond Design: 25 mm 4 hr Chicago Storm - Water Quality
12000.0000
10000.0000
8000.0000
6000.0000
4000.0000
2000.0000
0.0000
Volume (m³)
0.4500
0.4000
0.3500
0.3000
0.2500
0.2000
0.1500
0.1000
0.0500
0.0000
Depth (m)
0:01:00
3:01:00
6:01:00
9:01:00
12:01:00
15:01:00
18:01:00
21:01:00
0:01:00
3:01:00
6:01:00
9:01:00
12:01:00
15:01:00
18:01:00
21:01:00
Full Build Out Pond Volume (m3)
Full Build Out Pond Depth (m)

APPENDIX C

SWM MODELLING OUTPUT RESULTS (1:100 YEAR STORM EVENT) SCENARIO 3

Autodesk® Storm and Sanitary Analysis 2014 - Version 8.1.48 (Build 1)

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Project Description
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File Name ................. SC. 3_20150306__MRSPA+Baillargeon, RC=0.40 NWL=174.50-DualDR_model-NEW GRADES.SPF
Description ............... -MRSPA + Baillargeon Drain
                            -Main Trunk 1950mm dia. storm sewers upsized
                            to 2100mm dia. from previous design
                            - Subcatchments restricted to 5yr peak flow
                            into the minor system via orifice control.
                            - Four major system outlets
                                 1)MRSPA Pond
                                 2) ETLD
                                 3) Jamsyl Drive
                                 4) Cyr Drain

                            NWL = 174.5
                            POND OUTLET = 500L/s


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Analysis Options
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Flow Units ............... cms
Subbasin Hydrograph Method. EPA SWMM
Infiltration Method ...... SCS Curve Number
Link Routing Method ...... Hydrodynamic
Storage Node Exfiltration.. None
Starting Date ............ MAR-05-2013 00:00:00
Ending Date .............. MAR-07-2013 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Wet Time Step ............ 00:00:10
Dry Time Step ............ 01:00:00
Routing Time Step ........ 1.00 sec


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Element Count
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Number of rain gages ...... 1
Number of subbasins ....... 50
Number of nodes ........... 205
Number of links ........... 238
Number of pollutants ...... 0
Number of land uses ....... 0
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Raingage Summary
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Gage ID	Data Source	Data Type	Recording Interval min
Rain Gage-01	Chic 100yr 24hr15min	INTENSITY	15.00

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Subbasin Summary
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Subbasin ID	Total Area hectares	Equiv. Width m	Imperv. Area %	Average Slope %	Raingage
3	65.17	136.80	40.00	0.1000	Rain Gage-01
A3868	6.82	309.90	25.00	0.1500	Rain Gage-01
A3876	8.44	272.40	25.00	0.1500	Rain Gage-01
A3877	2.77	256.60	25.00	0.1500	Rain Gage-01
A4	5.92	316.70	25.00	0.1500	Rain Gage-01
A4389	4.75	135.80	20.00	0.1500	Rain Gage-01
A4422	6.72	224.20	25.00	0.1500	Rain Gage-01
A4469	1.62	82.00	20.00	0.1500	Rain Gage-01
A4528	5.80	130.40	25.00	0.1500	Rain Gage-01
A4572	6.76	204.90	20.00	0.1500	Rain Gage-01
A4576	6.46	208.40	20.00	0.1500	Rain Gage-01
A4589	13.74	330.90	15.00	0.1500	Rain Gage-01
A4615	2.88	575.80	25.00	0.1500	Rain Gage-01
A4672	2.93	188.90	40.00	0.1500	Rain Gage-01
A4690	4.21	165.00	40.00	0.1500	Rain Gage-01
A4719	4.92	185.70	40.00	0.1500	Rain Gage-01
A4722	1.29	92.50	40.00	0.1500	Rain Gage-01
A4737	2.04	222.30	40.00	0.1500	Rain Gage-01
A4809	1.74	128.50	35.00	0.1500	Rain Gage-01
A5070	3.21	133.90	35.00	0.1500	Rain Gage-01
CYR-D1	1.89	314.10	33.20	0.1500	Rain Gage-01
CYR-D2	1.89	86.60	21.40	0.1500	Rain Gage-01
CYR-D3	0.23	742.50	76.80	0.1500	Rain Gage-01
CYR-D4	2.10	12.50	42.60	0.1500	Rain Gage-01
CYR-D5	5.72	26.40	28.90	0.1500	Rain Gage-01
ETRD A	27.40	523.00	33.00	0.2000	Rain Gage-01
ETRD C_FU	23.50	435.00	60.00	0.0500	Rain Gage-01
ETRD E_FU	23.30	480.00	45.00	0.1000	Rain Gage-01
Manning Rd Drain A	12.52	331.00	94.00	0.0500	Rain Gage-01
Manning Rd Drain B	27.65	135.00	5.00	0.1500	Rain Gage-01
SPA1	7.70	513.30	28.00	0.1500	Rain Gage-01
SPA100	7.40	203.90	28.00	0.1500	Rain Gage-01
SPA106	5.90	224.30	28.00	0.1500	Rain Gage-01
SPA14	6.20	137.80	28.00	0.1500	Rain Gage-01

SPA21	9.30	195.80	28.00	0.1500	Rain Gage-01
SPA35	12.00	233.00	28.00	0.1500	Rain Gage-01
SPA50	10.20	174.10	28.00	0.1500	Rain Gage-01
SPA51	11.30	299.70	70.00	0.1500	Rain Gage-01
SPA-52	2.50	112.60	3.00	0.1500	Rain Gage-01
SPA62	2.60	54.40	28.00	0.1500	Rain Gage-01
SPA69	4.00	105.30	28.00	0.1500	Rain Gage-01
SPA79	8.70	204.20	28.00	0.1500	Rain Gage-01
SPA86	5.46	152.60	28.00	0.1500	Rain Gage-01
SPA86a	1.94	150.93	71.00	0.1500	Rain Gage-01
Sub-03	12.83	357.63	15.00	0.5000	Rain Gage-01
Sub-04	14.41	404.64	15.00	0.5000	Rain Gage-01
Sub-05	17.73	347.82	15.00	0.5000	Rain Gage-01
Sub-06	4.72	286.14	15.00	0.5000	Rain Gage-01
Sub-08	36.74	445.83	40.00	0.1000	Rain Gage-01
ToPond	6.60	167.90	99.00	0.1500	Rain Gage-01

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Node Summary
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Node ID	Element Type	Invert Elevation m	Maximum Depth m	Ponded Area m²	External Inflow
15	JUNCTION	178.60	2.00	0.000	
77a	JUNCTION	176.25	5.75	0.000	
77b	JUNCTION	178.20	3.80	0.000	
Jun-01	JUNCTION	174.00	2.66	0.000	
Jun-02	JUNCTION	172.70	4.35	0.000	
Jun-03	JUNCTION	174.40	2.22	0.000	
Jun-04	JUNCTION	174.38	2.21	0.000	
Jun-05	JUNCTION	174.54	2.29	0.000	
Jun-06	JUNCTION	174.62	2.57	0.000	
Jun-109	JUNCTION	177.35	4.00	0.000	
Jun-11	JUNCTION	174.55	2.58	0.000	
Jun-16	JUNCTION	174.21	2.41	0.000	
Jun-17	JUNCTION	173.87	2.59	0.000	
Jun-18	JUNCTION	174.17	2.17	0.000	
Jun-19	JUNCTION	174.23	2.14	0.000	
Jun-20	JUNCTION	174.19	2.08	0.000	
Jun-21	JUNCTION	174.17	2.22	0.000	
Jun-22	JUNCTION	174.17	2.22	0.000	
Jun-23	JUNCTION	174.17	2.10	0.000	
Jun-24	JUNCTION	174.10	2.10	0.000	
Jun-25	JUNCTION	174.15	2.10	0.000	
Jun-26	JUNCTION	174.07	2.10	0.000	
Jun-27	JUNCTION	174.09	2.04	0.000	
Jun-28	JUNCTION	174.11	2.03	0.000	
Jun-29	JUNCTION	174.13	2.54	0.000	
Jun-30	JUNCTION	174.04	2.54	0.000	

Jun-31	JUNCTION	173.98	2.56	0.000
Jun-32	JUNCTION	174.08	2.56	0.000
Jun-33	JUNCTION	174.03	2.40	0.000
Jun-34	JUNCTION	174.07	2.40	0.000
Jun-35	JUNCTION	173.99	2.31	0.000
Jun-36	JUNCTION	174.01	2.31	0.000
Jun-37	JUNCTION	174.01	2.35	0.000
Jun-38	JUNCTION	172.95	3.47	0.000
Jun-47	JUNCTION	172.91	3.33	0.000
Jun-49	JUNCTION	176.47	2.53	0.000
Jun-50	JUNCTION	176.23	2.77	0.000
Jun-51	JUNCTION	176.15	2.85	0.000
Jun-52	JUNCTION	176.22	2.78	0.000
Jun-53	JUNCTION	176.22	2.78	0.000
Jun-54	JUNCTION	175.75	3.25	0.000
Jun-55	JUNCTION	175.50	3.50	0.000
Jun-56	JUNCTION	175.28	3.73	0.000
Jun-57	JUNCTION	175.21	3.79	0.000
Jun-58	JUNCTION	174.95	4.05	0.000
Jun-59	JUNCTION	174.88	4.12	0.000
STA0+775	JUNCTION	179.90	1.45	0.000
STA0+925	JUNCTION	179.63	1.76	0.000
STA1+025	JUNCTION	179.33	1.90	0.000
STA1+150	JUNCTION	179.15	1.69	0.000
STA1+178	JUNCTION	178.74	1.92	0.000
STA1+200	JUNCTION	179.05	1.56	0.000
STA1+325	JUNCTION	178.79	1.52	0.000
STA1+450	JUNCTION	178.52	1.50	0.000
STA1+700	JUNCTION	178.00	1.50	0.000
ETLD-1	OUTFALL	180.50	1.85	0.000
ETLD-2a	OUTFALL	180.50	1.75	0.000
ETLD-2b	OUTFALL	180.50	1.85	0.000
ETLD-3	OUTFALL	180.50	1.85	0.000
ETLD-4	OUTFALL	180.50	1.85	0.000
Out-01	OUTFALL	172.70	0.00	0.000
Out-02	OUTFALL	175.79	1.95	0.000
Out-03	OUTFALL	176.54	2.29	0.000
Out-04	OUTFALL	173.20	5.00	0.000
Out-11	OUTFALL	175.00	2.00	0.000
CR22 Pond 19900m3	STORAGE	174.20	3.03	0.000
EX0	STORAGE	180.22	2.58	0.000
EX1	STORAGE	180.14	2.36	0.000
EX3	STORAGE	180.07	2.39	0.000
EX3868	STORAGE	180.23	2.20	0.000
EX3869	STORAGE	180.50	2.39	0.000
EX3870	STORAGE	180.39	2.50	0.000
EX3877(MHD)	STORAGE	180.62	2.68	0.000
EX4	STORAGE	180.00	2.40	0.000
EX4322	STORAGE	181.60	1.70	0.000
EX4351	STORAGE	180.76	2.24	0.000
EX4373	STORAGE	181.40	1.60	0.000

EX4374	STORAGE	181.24	2.06	0.000
EX4375	STORAGE	181.06	2.46	0.000
EX4389	STORAGE	181.37	1.63	0.000
EX4390	STORAGE	181.25	1.75	0.000
EX4419	STORAGE	180.62	2.25	0.000
EX4422	STORAGE	180.71	1.99	0.000
EX4469	STORAGE	180.86	2.54	0.000
EX4518	STORAGE	180.88	1.90	0.000
EX4528	STORAGE	180.62	2.28	0.000
EX4615	STORAGE	180.77	2.71	0.000
EX4650	STORAGE	180.47	2.09	0.000
EX4654	STORAGE	180.36	2.20	0.000
EX4658	STORAGE	180.83	1.88	0.000
EX4659	STORAGE	180.90	1.81	0.000
EX4668	STORAGE	181.31	1.86	0.000
EX4672	STORAGE	181.48	1.52	0.000
EX4678	STORAGE	181.12	1.90	0.000
EX4682	STORAGE	180.86	1.94	0.000
EX4686	STORAGE	180.97	2.03	0.000
EX4690	STORAGE	181.13	1.77	0.000
EX4694	STORAGE	181.27	1.53	0.000
EX4695	STORAGE	181.41	1.69	0.000
EX4702	STORAGE	181.26	1.44	0.000
EX4709	STORAGE	180.93	2.55	0.000
EX4710	STORAGE	181.09	2.23	0.000
EX4711	STORAGE	181.22	1.95	0.000
EX4712	STORAGE	181.50	2.00	0.000
EX4717	STORAGE	181.62	1.88	0.000
EX4719	STORAGE	181.60	2.20	0.000
EX4720	STORAGE	181.54	1.96	0.000
EX4721	STORAGE	181.66	1.74	0.000
EX4722	STORAGE	181.84	1.56	0.000
EX4725	STORAGE	181.68	2.02	0.000
EX4729	STORAGE	181.81	1.59	0.000
EX4737	STORAGE	181.98	1.62	0.000
EX4755	STORAGE	181.51	1.49	0.000
EX4809	STORAGE	180.52	2.04	0.000
EX4810	STORAGE	180.66	1.90	0.000
EX5	STORAGE	180.08	2.33	0.000
EX5069	STORAGE	180.74	1.83	0.000
EX5070	STORAGE	180.82	1.75	0.000
EX5077	STORAGE	180.91	1.65	0.000
EX5081	STORAGE	180.98	1.58	0.000
EX5085	STORAGE	181.05	1.51	0.000
Jun-1	STORAGE	175.16	6.84	0.000
Jun-300	STORAGE	179.00	3.55	0.000
Jun-310	STORAGE	177.00	4.30	0.000
Jun-315	STORAGE	176.34	4.20	0.000
Jun-320	STORAGE	175.57	4.31	0.000
Jun-95	STORAGE	176.41	2.49	0.000
MH1	STORAGE	175.03	7.27	0.000

MH100	STORAGE	178.27	3.83	0.000
MH102	STORAGE	178.44	3.47	0.000
MH103	STORAGE	178.65	3.00	0.000
MH105	STORAGE	178.76	2.85	0.000
MH106	STORAGE	178.89	2.63	0.000
MH107	STORAGE	179.09	2.39	0.000
MH108	STORAGE	179.31	2.09	0.000
MH11	STORAGE	175.17	7.23	0.000
MH14	STORAGE	175.32	6.88	0.000
MH15	STORAGE	179.53	2.64	0.000
MH16	STORAGE	179.94	2.21	0.000
MH20	STORAGE	180.39	1.91	0.000
MH21	STORAGE	175.47	6.78	0.000
MH22	STORAGE	178.51	3.99	0.000
MH23	STORAGE	178.68	3.62	0.000
MH25	STORAGE	178.86	3.39	0.000
MH28	STORAGE	179.05	3.40	0.000
MH3	STORAGE	179.54	2.51	0.000
MH31	STORAGE	175.61	7.29	0.000
MH35	STORAGE	175.75	6.75	0.000
MH36	STORAGE	177.79	4.51	0.000
MH38	STORAGE	177.95	3.95	0.000
MH40	STORAGE	178.12	4.28	0.000
MH43	STORAGE	178.33	3.97	0.000
MH46	STORAGE	178.53	3.42	0.000
MH5	STORAGE	179.76	2.39	0.000
MH50	STORAGE	175.96	6.44	0.000
MH51	STORAGE	177.28	4.82	0.000
MH52	STORAGE	177.41	4.39	0.000
MH53	STORAGE	177.54	3.96	0.000
MH54	STORAGE	177.74	3.46	0.000
MH55	STORAGE	177.98	3.12	0.000
MH58	STORAGE	176.25	6.00	0.000
MH59	STORAGE	176.53	5.59	0.000
MH61	STORAGE	176.72	5.23	0.000
MH62	STORAGE	177.01	4.82	0.000
MH63	STORAGE	177.33	4.42	0.000
MH64	STORAGE	177.54	3.76	0.000
MH67	STORAGE	176.77	5.13	0.000
MH69	STORAGE	177.09	4.71	0.000
MH7	STORAGE	180.11	2.14	0.000
MH71	STORAGE	177.32	4.35	0.000
MH72	STORAGE	177.53	4.12	0.000
MH76	STORAGE	176.16	6.38	0.000
MH77	STORAGE	176.48	6.02	0.000
MH78	STORAGE	176.59	5.81	0.000
MH79	STORAGE	176.74	5.56	0.000
MH8	STORAGE	180.12	2.08	0.000
MH80	STORAGE	176.84	4.96	0.000
MH82	STORAGE	176.98	4.62	0.000
MH85	STORAGE	177.14	4.36	0.000

MH86	STORAGE	177.29	4.11	0.000
MH89	STORAGE	177.42	3.88	0.000
MH90	STORAGE	177.61	3.69	0.000
MH93	STORAGE	177.76	3.44	0.000
MH94	STORAGE	177.93	3.07	0.000
MH95	STORAGE	179.01	2.34	0.000
MH97	STORAGE	177.80	4.70	0.000
MH99	STORAGE	178.04	4.26	0.000
MH-A	STORAGE	179.12	3.19	0.000
MH-C	STORAGE	180.00	3.10	0.000
SPA Pond_130360m3	STORAGE	174.50	6.00	0.000
Stor-02	STORAGE	173.50	6.50	0.000
Stor-SPA1	STORAGE	180.35	1.70	0.000
Stor-SPA100	STORAGE	179.95	1.70	0.000
Stor-SPA106	STORAGE	179.60	1.70	0.000
Stor-SPA14	STORAGE	180.45	1.70	0.000
Stor-SPA21	STORAGE	180.60	1.70	0.000
Stor-SPA35	STORAGE	180.20	1.70	0.000
Stor-SPA50	STORAGE	180.30	1.70	0.000
Stor-SPA51	STORAGE	179.20	1.70	0.000
Stor-SPA52	STORAGE	180.05	1.70	0.000
Stor-SPA62	STORAGE	179.90	1.70	0.000
Stor-SPA69	STORAGE	179.75	1.70	0.000
Stor-SPA79	STORAGE	179.95	1.70	0.000
Stor-SPA86	STORAGE	179.55	1.70	0.000
Stor-Spa86a	STORAGE	180.01	1.70	0.000

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Link Summary
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Link ID	From Node	To Node	Element Type	Length m	Slope %	Manning's Roughness
1	Out-11	Jun-1	CONDUIT	90.0	0.3778	0.0150
Culvert D10	Jun-22	Jun-23	CONDUIT	8.0	0.0038	0.0150
Culvert D11	Jun-25	Jun-24	CONDUIT	3.6	1.3812	0.0150
Culvert D12	Jun-27	Jun-26	CONDUIT	5.5	0.3610	0.0150
Culvert D13	Jun-29	Jun-28	CONDUIT	4.6	0.4376	0.0150
Culvert D14	Jun-30	Jun-31	CONDUIT	5.1	1.1650	0.0150
Culvert D15	Jun-32	Jun-33	CONDUIT	5.7	0.8803	0.0150
Culvert D16	Jun-34	Jun-35	CONDUIT	5.1	1.5595	0.0150
Culvert D17	Jun-36	Jun-37	CONDUIT	5.8	0.0052	0.0150
Culvert D7	Jun-16	Jun-17	CONDUIT	4.1	8.3130	0.0130
Culvert D8	Jun-19	Jun-18	CONDUIT	7.9	0.7614	0.0130
Culvert D9	Jun-20	Jun-21	CONDUIT	8.1	0.2481	0.0150
Culvert R1	Jun-06	Jun-05	CONDUIT	31.4	0.2546	0.0150
Culvert R2	Jun-03	Jun-04	CONDUIT	30.5	0.0656	0.0130
Cyr Drain	Jun-109	CR22 Pond 19900m3	CHANNEL	650.0	0.1000	0.0350
CYR-1	STA0+775	STA0+925	CHANNEL	150.0	0.1800	0.0320
CYR-2	STA0+925	STA1+025	CHANNEL	100.0	0.3000	0.0320

CYR-3	STA1+025	STA1+150	CHANNEL	125.0	0.1376	0.0320
CYR-4	STA1+150	STA1+178	CHANNEL	28.0	0.2143	0.0320
CYR-5	STA1+178	STA1+200	CHANNEL	22.0	0.2100	0.0320
CYR-6	STA1+200	STA1+325	CHANNEL	125.0	0.2088	0.0320
CYR-7	STA1+325	STA1+450	CHANNEL	125.0	1.1947	0.0320
CYR-8	STA1+450	STA1+700	CHANNEL	250.0	0.2100	0.0320
CYR-9	STA1+700	Jun-109	CHANNEL	116.0	0.5586	0.0320
Drain R1	Jun-06	Jun-11	CHANNEL	210.5	0.0285	0.0320
Drain R2	Jun-05	Jun-04	CHANNEL	239.2	0.0669	0.0320
Drain R3	Jun-03	Jun-16	CHANNEL	16.0	1.1860	0.0320
Enclosed_ETLD1	Jun-300	Jun-310	CONDUIT	990.1	0.2020	0.0150
EX14a	EX4650	EX4654	CONDUIT	64.0	0.1688	0.0150
EX14b	EX4650	EX4654	CONDUIT	64.0	0.1688	0.0150
EX15b	EX4654	EX3868	CONDUIT	49.0	0.1612	0.0150
EXB1	EX4695	EX4694	CONDUIT	88.0	0.1409	0.0150
EXB10	EX4659	EX4658	CONDUIT	7.0	0.1714	0.0150
EXB11	EX4658	EX4422	CONDUIT	105.0	0.0571	0.0150
EXB12a	EX4422	EX4419	CONDUIT	53.0	0.1679	0.0150
EXB12b	EX4422	EX4419	CONDUIT	53.0	0.1679	0.0150
EXB13a	EX4419	EX4650	CONDUIT	52.0	0.2885	0.0150
EXB13b	EX4419	EX4650	CONDUIT	52.0	0.2885	0.0150
EXB15a	EX4654	EX3868	CONDUIT	49.0	0.1612	0.0150
EXB2	EX4694	EX4690	CONDUIT	69.0	0.1884	0.0150
EXB3	EX4690	EX4686	CONDUIT	97.0	0.1289	0.0150
EXB4	EX4686	EX4682	CONDUIT	61.0	0.1803	0.0150
EXB5	EX4682	EX4422	CONDUIT	119.0	0.1235	0.0150
EXB6	EX4702	EX4690	CONDUIT	83.0	0.1398	0.0150
EXB7	EX4672	EX4668	CONDUIT	93.0	0.1828	0.0150
EXB8	EX4668	EX4678	CONDUIT	71.0	0.2676	0.0150
EXB9	EX4678	EX4659	CONDUIT	70.0	0.0943	0.0150
EXG1	EX5085	EX5081	CONDUIT	70.0	0.1000	0.0150
EXG2	EX5081	EX5077	CONDUIT	83.0	0.0843	0.0150
EXG3	EX5077	EX5070	CONDUIT	86.0	0.1023	0.0150
EXG4	EX5070	EX5069	CONDUIT	85.0	0.0906	0.0150
EXG5	EX5069	EX4810	CONDUIT	57.0	0.1123	0.0150
EXG6	EX4810	EX4809	CONDUIT	103.0	0.0825	0.0150
EXG7	EX4809	EX0	CONDUIT	46.0	0.6043	0.0150
EXG8	EX0	EX1	CONDUIT	113.0	0.0708	0.0150
EXO1	EX4717	EX4712	CONDUIT	132.0	0.0970	0.0150
EXO10	EX5	EX4	CONDUIT	44.0	0.0682	0.0150
EXO11	EX4	77b	CONDUIT	60.0	0.0667	0.0150
EXO12	EX4755	EX4389	CONDUIT	107.0	0.1308	0.0150
EXO13	EX4389	EX4390	CONDUIT	108.0	0.1046	0.0150
EXO14	EX4390	EX4469	CONDUIT	102.0	0.1088	0.0150
EXO15	EX4469	EX4351	CONDUIT	82.0	0.0744	0.0150
EXO16	EX4351	EX3869	CONDUIT	14.0	0.2786	0.0150
EXO2	EX4712	EX4711	CONDUIT	83.0	0.2373	0.0150
EXO3	EX4711	EX4710	CONDUIT	117.0	0.1111	0.0150
EXO4	EX4710	EX4709	CONDUIT	123.0	0.1268	0.0150
EXO5	EX4709	EX4615	CONDUIT	120.0	0.1250	0.0150
EXO6	EX4615	EX3869	CONDUIT	123.0	0.0976	0.0150

EXO7	EX3869	EX3870	CONDUIT	2.0	5.5000	0.0150
EXO8	EX3870	EX3868	CONDUIT	106.0	0.1509	0.0150
EXO9	EX3868	EX5	CONDUIT	63.0	0.1587	0.0150
EXPK10	EX4528	EX1	CONDUIT	134.0	0.0522	0.0150
EXPK11	EX1	EX3	CONDUIT	87.0	0.0632	0.0150
EXPK12	EX3	EX4	CONDUIT	41.0	0.1707	0.0150
EXPK4	EX3877(MHD)	EX4322	CONDUIT	64.0	0.1406	0.0150
EXPK5	EX4322	EX4373	CONDUIT	128.0	0.1328	0.0150
EXPK6	EX4373	EX4374	CONDUIT	144.0	0.0972	0.0150
EXPK7	EX4374	EX4375	CONDUIT	10.0	0.1000	0.0150
EXPK8	EX4375	EX4518	CONDUIT	84.0	0.2024	0.0150
EXPK9	EX4518	EX4528	CONDUIT	113.0	0.2212	0.0150
EXY1	EX4737	EX4729	CONDUIT	125.0	0.1336	0.0150
EXY2	EX4729	EX4725	CONDUIT	88.0	0.1500	0.0150
EXY3	EX4725	EX4719	CONDUIT	65.0	0.1308	0.0150
EXY4	EX4719	EX4720	CONDUIT	59.0	0.0966	0.0150
EXY5	EX4722	EX4721	CONDUIT	114.0	0.1553	0.0150
EXY6	EX4721	EX4719	CONDUIT	49.0	0.1367	0.0150
EXY7	EX4720	EX4712	CONDUIT	45.0	0.0978	0.0150
Link-01	77a	MH76	CONDUIT	20.0	0.1300	0.0150
Link-04	MH-A	MH100	CONDUIT	98.2	0.2505	0.0130
Link-109	Jun-310	Jun-315	CONDUIT	324.3	0.2035	0.0150
Link-110	Jun-315	Jun-320	CONDUIT	387.4	0.1987	0.0150
Link-111	Jun-320	CR22 Pond 19900m3	CONDUIT	187.6	0.1972	0.0150
Link-12	Jun-18	Jun-17	CHANNEL	64.5	0.4652	0.0320
Link-14	Jun-19	Jun-20	CHANNEL	28.5	0.1405	0.0320
Link-16	Jun-21	Jun-22	CHANNEL	28.9	0.0011	0.0320
Link-18	Jun-23	Jun-24	CHANNEL	36.4	0.1921	0.0320
Link-20	Jun-25	Jun-26	CHANNEL	22.2	0.3607	0.0320
Link-22	Jun-28	Jun-27	CHANNEL	12.5	0.1604	0.0320
Link-23	77b	77a	CONDUIT	60.0	0.3000	0.0150
Link-24	Jun-29	Jun-30	CHANNEL	21.1	0.4265	0.0320
Link-26	Jun-32	Jun-31	CHANNEL	11.1	0.9025	0.0320
Link-28	Jun-34	Jun-33	CHANNEL	23.4	0.1707	0.0320
Link-30	Jun-36	Jun-35	CHANNEL	15.3	0.1310	0.0320
Link-32	Jun-38	Jun-37	CHANNEL	23.2	0.2590	0.0320
Link-33	STA1+178	15	CONDUIT	120.6	0.1160	0.0130
Link-38	Jun-03	Jun-16	CHANNEL	14.1	0.0022	0.0320
Link-42	Jun-38	Jun-47	CONDUIT	25.0	0.1400	0.0150
Link-43	Jun-47	Jun-02	CONDUIT	117.0	0.1397	0.0130
Link-44	Stor-02	Out-04	CONDUIT	27.4	1.0953	0.0150
Link-45	Jun-16	Stor-02	CONDUIT	250.9	1.1358	0.0150
Link-46	Jun-17	Stor-02	CONDUIT	249.4	1.1266	0.0150
Link-48	Jun-19	Stor-02	CONDUIT	191.5	1.4152	0.0150
Link-49	Jun-03	Stor-02	CONDUIT	264.3	1.0782	0.0150
Link-51	Jun-95	Jun-49	CONDUIT	127.5	0.1004	0.0150
Link-52	Jun-49	Jun-50	CONDUIT	243.2	0.0983	0.0150
Link-53	Jun-50	Jun-51	CONDUIT	35.1	0.2279	0.0150
Link-54	Jun-52	Jun-51	CONDUIT	103.7	0.0685	0.0150
Link-55	Jun-52	Jun-53	CONDUIT	16.0	0.0063	0.0150
Link-56	Jun-53	Jun-54	CONDUIT	31.4	1.4936	0.0240

Link-57	Jun-54	Jun-55	CONDUIT	127.0	0.3150	0.0150
Link-58	Jun-55	Jun-56	CONDUIT	104.0	0.2163	0.0150
Link-59	Jun-56	Jun-57	CONDUIT	30.3	0.2145	0.0150
Link-60	Jun-57	Jun-58	CONDUIT	209.0	0.1244	0.0150
Link-61	Jun-23	Stor-02	CONDUIT	150.7	1.6924	0.0150
Link-63	Jun-58	Jun-59	CONDUIT	30.0	0.2333	0.0150
Link-64	Jun-59	Jun-11	CONDUIT	230.0	0.1435	0.0150
Link-C-A	MH-C	MH-A	CONDUIT	114.1	0.2498	0.0150
LinkD-C	EX3877(MHD)	MH-C	CONDUIT	21.4	0.0888	0.0150
PipeA	MH76	MH50	CONDUIT	103.2	0.1395	0.0150
Pipe-B	MH50	MH35	CONDUIT	128.0	0.1500	0.0150
Pipe-C	MH35	MH31	CONDUIT	96.0	0.1198	0.0150
Pipe-D	MH31	MH21	CONDUIT	99.0	0.1202	0.0150
Pipe-E	MH21	MH14	CONDUIT	100.0	0.1300	0.0150
Pipe-F	MH14	MH11	CONDUIT	97.0	0.1402	0.0150
Pipe-G	MH11	MH1	CONDUIT	88.0	0.1398	0.0150
PipeTo-Pond	MH1	SPA Pond_130360m3CONDUIT		20.0	0.1300	0.0150
SPAB1	MH28	MH25	CONDUIT	100.0	0.1700	0.0150
SPAB2	MH25	MH23	CONDUIT	97.0	0.2299	0.0150
SPAB3	MH23	MH22	CONDUIT	97.0	0.2000	0.0150
SPAB4	MH22	MH21	CONDUIT	115.0	0.2000	0.0150
SPABL1	MH8	MH5	CONDUIT	113.0	0.3106	0.0150
SPABL2	MH5	MH3	CONDUIT	99.0	0.2000	0.0150
SPABL3	MH3	MH1	CONDUIT	158.8	0.2198	0.0150
SPAG1	MH95	MH94	CONDUIT	115.0	0.1600	0.0150
SPAG2	MH94	MH93	CONDUIT	78.7	0.2097	0.0150
SPAG3	MH93	MH90	CONDUIT	85.0	0.1518	0.0150
SPAG4	MH90	MH89	CONDUIT	84.0	0.2012	0.0150
SPAG5	MH89	MH86	CONDUIT	84.0	0.1310	0.0150
SPAG6	MH86	MH85	CONDUIT	105.0	0.1305	0.0150
SPAG8	MH82	MH80	CONDUIT	150.8	0.1001	0.0150
SPAG9	MH80	MH79	CONDUIT	104.1	0.1018	0.0150
SPAO1	MH72	MH71	CONDUIT	104.1	0.2104	0.0150
SPAO2	MH71	MH69	CONDUIT	105.0	0.1495	0.0150
SPAO3	MH69	MH67	CONDUIT	151.1	0.2502	0.0150
SPAO4	MH67	MH59	CONDUIT	146.8	0.1996	0.0150
SPAO5	MH59	MH58	CONDUIT	151.0	0.1702	0.0150
SPAO6	MH58	MH50	CONDUIT	151.0	0.1801	0.0150
SPAPK1	MH64	MH63	CONDUIT	105.0	0.1800	0.0150
SPAPK2	MH63	MH62	CONDUIT	151.0	0.2503	0.0150
SPAPK3	MH62	MH61	CONDUIT	149.1	0.2495	0.0150
SPAPK4	MH61	MH59	CONDUIT	89.2	0.2500	0.0150
SPAPL1	MH20	MH7	CONDUIT	153.9	0.1696	0.0150
SPAPL2	MH7	MH16	CONDUIT	86.8	0.2005	0.0150
SPAPL3	MH16	MH15	CONDUIT	121.0	0.3198	0.0150
SPAPL4	MH15	MH14	CONDUIT	95.0	0.2200	0.0150
SPAR1	MH46	MH43	CONDUIT	102.0	0.1706	0.0150
SPAR2	MH43	MH40	CONDUIT	96.0	0.2000	0.0150
SPAR3	MH40	MH38	CONDUIT	91.0	0.1692	0.0150
SPAR4	MH38	MH36	CONDUIT	95.0	0.1505	0.0150
SPAR5	MH36	MH35	CONDUIT	68.0	0.2000	0.0150

SPAY1	MH55	MH54	CONDUIT	107.0	0.2000	0.0150
SPAY2	MH54	MH53	CONDUIT	119.0	0.1504	0.0150
SPAY3	MH53	MH52	CONDUIT	93.0	0.1806	0.0150
SPAY4	MH52	MH51	CONDUIT	96.0	0.1802	0.0150
SPAY5	MH51	MH50	CONDUIT	98.0	0.1796	0.0150
SPG7	MH85	MH82	CONDUIT	105.0	0.1295	0.0150
Z1	MH77	77a	CONDUIT	128.2	0.1303	0.0150
Z10	MH106	MH105	CONDUIT	96.8	0.1405	0.0150
Z11	MH107	MH106	CONDUIT	119.0	0.1504	0.0150
Z12	MH108	MH107	CONDUIT	119.0	0.1697	0.0150
Z2	MH78	MH77	CONDUIT	81.4	0.1302	0.0150
Z3	MH79	MH78	CONDUIT	122.9	0.1098	0.0150
Z4	MH97	MH79	CONDUIT	105.0	0.1800	0.0150
Z5	MH99	MH97	CONDUIT	120.0	0.1700	0.0150
Z6	MH100	MH99	CONDUIT	137.0	0.1701	0.0150
Z7	MH102	MH100	CONDUIT	97.1	0.1699	0.0150
Z8	MH103	MH102	CONDUIT	115.7	0.2204	0.0150
Z9	MH105	MH103	CONDUIT	69.5	0.1597	0.0150
LowFlowPump	SPA Pond_130360m3Jun-300		TYPE2 PUMP			
Pump-02	SPA Pond_130360m3Jun-300		TYPE2 PUMP			
Pump-03	CR22 Pond 19900m3Jun-95		TYPE2 PUMP			
16	Stor-Spa86a	MH90	ORIFICE			
SPA1	Stor-SPA1	MH1	ORIFICE			
SPA100	Stor-SPA100	MH102	ORIFICE			
SPA106	Stor-SPA106	MH106	ORIFICE			
SPA14	Stor-SPA14	MH14	ORIFICE			
SPA21	Stor-SPA21	MH21	ORIFICE			
SPA35	Stor-SPA35	MH35	ORIFICE			
SPA50	Stor-SPA50	MH50	ORIFICE			
SPA51	Stor-SPA51	MH53	ORIFICE			
SPA52	Stor-SPA52	MH51	ORIFICE			
SPA62	Stor-SPA62	MH62	ORIFICE			
SPA69	Stor-SPA69	MH69	ORIFICE			
SPA79	Stor-SPA79	MH79	ORIFICE			
SPA86	Stor-SPA86	MH86	ORIFICE			
01	Stor-SPA14	Stor-SPA1	WEIR			
02	Stor-SPA1	SPA Pond_130360m3WEIR				
03	Stor-SPA51	ETLD-2a	WEIR			
04	Stor-SPA21	Stor-SPA14	WEIR			
05	Stor-SPA35	ETLD-1	WEIR			
06	Stor-SPA52	ETLD-2b	WEIR			
07	Stor-SPA50	Stor-SPA62	WEIR			
08	Stor-SPA79	Stor-SPA86	WEIR			
09	Stor-SPA100	Stor-SPA106	WEIR			
10	Stor-SPA62	ETLD-3	WEIR			
11	Stor-SPA69	ETLD-4	WEIR			
12	Stor-SPA106	STA1+025	WEIR			
13	Stor-SPA86	STA1+025	WEIR			
14	Stor-SPA50	Stor-SPA52	WEIR			
15	Stor-Spa86a	STA1+025	WEIR			
Weir-01	Jun-01	Jun-02	WEIR			

Weir-02	Jun-04	Jun-03	WEIR
Weir-03	Jun-06	Jun-05	WEIR
Weir-04	Jun-20	Jun-21	WEIR
Weir-05	Jun-22	Jun-23	WEIR
Weir-07	Jun-28	Jun-29	WEIR
Weir-08	Jun-30	Jun-31	WEIR
Weir-09	Jun-18	Jun-19	WEIR
Weir-10	Jun-16	Jun-17	WEIR
Weir-11	Jun-24	Jun-25	WEIR
Weir-12	Jun-26	Jun-27	WEIR
Weir-15	Jun-36	Jun-37	WEIR
Weir-16	Jun-34	Jun-35	WEIR
Weir-17	Jun-32	Jun-33	WEIR
Weir-19	Jun-04	Out-02	WEIR
Weir-20	Jun-06	Out-03	WEIR
Weir-39	Jun-95	Jun-49	WEIR
Outlet-01	Jun-02	Out-01	OUTLET

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Cross Section Summary
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Link ID	Shape	Depth/ Diameter m	Width m	No. of Barrels	Cross Sectional Area m²	Full Flow Hydraulic Radius m	Design Flow Capacity cms
1	CIRCULAR	1.50	1.50	1	1.77	0.38	3.77
Culvert D10	RECT_CLOSED	1.99	3.30	1	6.57	0.62	1.96
Culvert D11	RECT_CLOSED	1.80	5.37	1	9.66	0.67	58.21
Culvert D12	RECT_CLOSED	2.03	2.97	1	6.04	0.60	17.27
Culvert D13	RECT_CLOSED	2.00	3.64	1	7.28	0.65	23.99
Culvert D14	RECT_CLOSED	2.03	2.97	1	6.04	0.60	31.02
Culvert D15	RECT_CLOSED	1.95	3.45	1	6.72	0.62	30.65
Culvert D16	RECT_CLOSED	1.95	2.94	1	5.74	0.59	33.46
Culvert D17	RECT_CLOSED	2.27	4.80	1	10.90	0.77	4.42
Culvert D7	RECT_CLOSED	2.06	2.65	1	5.46	0.58	84.13
Culvert D8	RECT_CLOSED	2.08	3.21	1	6.68	0.63	33.02
Culvert D9	RECT_CLOSED	2.01	3.33	1	6.69	0.63	16.26
Culvert R1	RECT_CLOSED	1.86	5.49	1	10.21	0.69	26.95
Culvert R2	RECT_CLOSED	1.30	5.57	1	7.25	0.53	9.32
Cyr Drain	TRAPEZOIDAL	4.00	17.00	1	36.00	1.91	50.01
CYR-1	IRREGULAR	1.45	15.05	1	10.23	0.72	10.89
CYR-2	IRREGULAR	1.76	20.85	1	16.55	0.85	25.52
CYR-3	IRREGULAR	1.69	15.50	1	12.03	0.93	13.33
CYR-4	IRREGULAR	1.57	16.45	1	11.89	0.81	14.92
CYR-5	IRREGULAR	1.56	17.35	1	12.09	0.78	14.70
CYR-6	IRREGULAR	1.52	19.60	1	15.08	0.75	17.77
CYR-7	IRREGULAR	1.50	63.65	1	48.84	1.99	110.61
CYR-8	IRREGULAR	1.50	23.55	1	16.08	0.67	17.63
CYR-9	IRREGULAR	1.50	23.55	1	16.08	0.67	28.75

Drain R1	IRREGULAR	2.57	20.11	1	15.58	1.31	9.83
Drain R2	IRREGULAR	2.21	34.45	1	15.81	0.85	11.46
Drain R3	IRREGULAR	2.22	35.39	1	13.21	0.40	24.38
Enclosed_ETLD1	CIRCULAR	0.85	0.85	1	0.57	0.21	0.61
EX14a	CIRCULAR	0.68	0.68	1	0.36	0.17	0.30
EX14b	CIRCULAR	0.68	0.68	1	0.36	0.17	0.30
EX15b	CIRCULAR	0.68	0.68	1	0.36	0.17	0.29
EXB1	CIRCULAR	0.53	0.53	1	0.22	0.13	0.14
EXB10	CIRCULAR	0.68	0.68	1	0.36	0.17	0.30
EXB11	CIRCULAR	0.68	0.68	1	0.36	0.17	0.17
EXB12a	CIRCULAR	0.68	0.68	1	0.36	0.17	0.30
EXB12b	CIRCULAR	0.68	0.68	1	0.36	0.17	0.30
EXB13a	CIRCULAR	0.68	0.68	1	0.36	0.17	0.39
EXB13b	CIRCULAR	0.68	0.68	1	0.36	0.17	0.39
EXB15a	CIRCULAR	0.68	0.68	1	0.36	0.17	0.29
EXB2	CIRCULAR	0.53	0.53	1	0.22	0.13	0.16
EXB3	CIRCULAR	0.68	0.68	1	0.36	0.17	0.26
EXB4	CIRCULAR	0.68	0.68	1	0.36	0.17	0.31
EXB5	CIRCULAR	0.68	0.68	1	0.36	0.17	0.26
EXB6	CIRCULAR	0.53	0.53	1	0.22	0.13	0.14
EXB7	CIRCULAR	0.60	0.60	1	0.28	0.15	0.23
EXB8	CIRCULAR	0.68	0.68	1	0.36	0.17	0.38
EXB9	CIRCULAR	0.68	0.68	1	0.36	0.17	0.22
EXG1	CIRCULAR	0.75	0.75	1	0.44	0.19	0.31
EXG2	CIRCULAR	0.75	0.75	1	0.44	0.19	0.28
EXG3	CIRCULAR	0.75	0.75	1	0.44	0.19	0.31
EXG4	CIRCULAR	0.75	0.75	1	0.44	0.19	0.29
EXG5	CIRCULAR	0.75	0.75	1	0.44	0.19	0.32
EXG6	CIRCULAR	0.75	0.75	1	0.44	0.19	0.28
EXG7	CIRCULAR	0.90	0.90	1	0.64	0.23	1.22
EXG8	CIRCULAR	0.90	0.90	1	0.64	0.23	0.42
EXO1	CIRCULAR	0.60	0.60	1	0.28	0.15	0.17
EXO10	CIRCULAR	1.20	1.20	1	1.13	0.30	0.88
EXO11	CIRCULAR	1.35	1.35	1	1.43	0.34	1.19
EXO12	CIRCULAR	0.53	0.53	1	0.22	0.13	0.13
EXO13	CIRCULAR	0.60	0.60	1	0.28	0.15	0.17
EXO14	CIRCULAR	0.60	0.60	1	0.28	0.15	0.18
EXO15	CIRCULAR	1.05	1.05	1	0.87	0.26	0.65
EXO16	CIRCULAR	1.20	1.20	1	1.13	0.30	1.78
EXO2	CIRCULAR	0.60	0.60	1	0.28	0.15	0.26
EXO3	CIRCULAR	0.68	0.68	1	0.36	0.17	0.24
EXO4	CIRCULAR	0.68	0.68	1	0.36	0.17	0.26
EXO5	CIRCULAR	0.68	0.68	1	0.36	0.17	0.26
EXO6	CIRCULAR	0.68	0.68	1	0.36	0.17	0.23
EXO7	CIRCULAR	1.20	1.20	1	1.13	0.30	7.93
EXO8	CIRCULAR	1.20	1.20	1	1.13	0.30	1.31
EXO9	CIRCULAR	1.20	1.20	1	1.13	0.30	1.35
EXPK10	CIRCULAR	0.90	0.90	1	0.64	0.23	0.36
EXPK11	CIRCULAR	0.90	0.90	1	0.64	0.23	0.39
EXPK12	CIRCULAR	1.05	1.05	1	0.87	0.26	0.98
EXPK4	CIRCULAR	0.60	0.60	1	0.28	0.15	0.20

EXPK5	CIRCULAR	0.60	0.60	1	0.28	0.15	0.19
EXPK6	CIRCULAR	0.60	0.60	1	0.28	0.15	0.17
EXPK7	CIRCULAR	0.60	0.60	1	0.28	0.15	0.17
EXPK8	CIRCULAR	0.90	0.90	1	0.64	0.23	0.71
EXPK9	CIRCULAR	0.90	0.90	1	0.64	0.23	0.74
EXY1	CIRCULAR	0.53	0.53	1	0.22	0.13	0.14
EXY2	CIRCULAR	0.53	0.53	1	0.22	0.13	0.14
EXY3	CIRCULAR	0.60	0.60	1	0.28	0.15	0.19
EXY4	CIRCULAR	0.75	0.75	1	0.44	0.19	0.30
EXY5	CIRCULAR	0.53	0.53	1	0.22	0.13	0.15
EXY6	CIRCULAR	0.60	0.60	1	0.28	0.15	0.20
EXY7	CIRCULAR	0.75	0.75	1	0.44	0.19	0.30
Link-01	CIRCULAR	2.10	2.10	1	3.46	0.53	5.42
Link-04	CIRCULAR	0.90	0.90	1	0.64	0.23	0.91
Link-109	CIRCULAR	0.85	0.85	1	0.57	0.21	0.61
Link-110	CIRCULAR	1.50	1.50	1	1.77	0.38	2.73
Link-111	RECT_CLOSED	1.80	2.40	1	4.32	0.51	8.21
Link-12	IRREGULAR	2.17	32.71	1	12.98	0.27	11.61
Link-14	IRREGULAR	2.08	31.74	1	12.90	0.30	6.82
Link-16	IRREGULAR	2.22	35.64	1	16.56	0.93	1.61
Link-18	IRREGULAR	2.10	36.39	1	15.38	0.83	18.60
Link-20	IRREGULAR	2.10	32.56	1	13.58	0.95	24.70
Link-22	IRREGULAR	2.03	40.47	1	14.13	0.81	15.31
Link-23	CIRCULAR	1.35	1.35	1	1.43	0.34	2.53
Link-24	IRREGULAR	2.54	34.62	1	26.59	0.96	52.99
Link-26	IRREGULAR	2.56	31.36	1	25.91	1.05	79.60
Link-28	IRREGULAR	2.40	31.97	1	21.36	1.07	28.83
Link-30	IRREGULAR	2.31	36.88	1	16.19	1.07	19.12
Link-32	IRREGULAR	2.35	36.53	1	22.09	0.90	32.83
Link-33	CIRCULAR	1.20	1.20	1	1.13	0.30	1.33
Link-38	IRREGULAR	2.22	35.39	1	13.21	0.40	1.04
Link-42	RECT_CLOSED	1.80	3.00	1	5.40	0.56	9.18
Link-43	RECT_CLOSED	1.80	3.00	1	5.40	0.56	10.58
Link-44	RECT_CLOSED	5.00	5.00	1	25.00	1.25	202.44
Link-45	RECT_CLOSED	0.15	4.00	1	0.60	0.07	0.74
Link-46	RECT_CLOSED	0.15	4.00	1	0.60	0.07	0.74
Link-48	RECT_CLOSED	0.15	4.00	1	0.60	0.07	0.83
Link-49	RECT_CLOSED	0.15	4.00	1	0.60	0.07	0.72
Link-51	RECT_CLOSED	1.80	2.44	1	4.39	0.52	5.98
Link-52	RECT_CLOSED	1.80	2.40	1	4.32	0.51	5.80
Link-53	RECT_CLOSED	1.80	2.40	1	4.32	0.51	8.83
Link-54	RECT_CLOSED	1.80	2.40	1	4.32	0.51	4.84
Link-55	RECT_CLOSED	2.00	2.50	1	5.00	0.56	1.78
Link-56	CIRCULAR	1.50	1.50	1	1.77	0.38	4.68
Link-57	RECT_CLOSED	1.80	2.40	1	4.32	0.51	10.38
Link-58	RECT_CLOSED	1.80	2.40	1	4.32	0.51	8.60
Link-59	RECT_CLOSED	1.80	4.80	1	8.64	0.65	20.12
Link-60	RECT_CLOSED	1.80	3.00	1	5.40	0.56	8.65
Link-61	RECT_CLOSED	0.15	4.00	1	0.60	0.07	0.90
Link-63	RECT_CLOSED	1.80	4.80	1	8.64	0.65	20.98
Link-64	RECT_CLOSED	1.80	3.00	1	5.40	0.56	9.29

Link-C-A	CIRCULAR	0.90	0.90	1	0.64	0.23	0.78
LinkD-C	CIRCULAR	0.90	0.90	1	0.64	0.23	0.47
PipeA	CIRCULAR	2.10	2.10	1	3.46	0.53	5.61
Pipe-B	CIRCULAR	2.10	2.10	1	3.46	0.53	5.82
Pipe-C	CIRCULAR	2.10	2.10	1	3.46	0.53	5.20
Pipe-D	CIRCULAR	2.10	2.10	1	3.46	0.53	5.21
Pipe-E	CIRCULAR	2.10	2.10	1	3.46	0.53	5.42
Pipe-F	CIRCULAR	2.10	2.10	1	3.46	0.53	5.63
Pipe-G	CIRCULAR	2.10	2.10	1	3.46	0.53	5.62
PipeTo-Pond	CIRCULAR	2.10	2.10	1	3.46	0.53	5.42
SPAB1	CIRCULAR	0.60	0.60	1	0.28	0.15	0.22
SPAB2	CIRCULAR	0.60	0.60	1	0.28	0.15	0.26
SPAB3	CIRCULAR	0.68	0.68	1	0.36	0.17	0.33
SPAB4	CIRCULAR	0.75	0.75	1	0.44	0.19	0.43
SPABL1	CIRCULAR	0.53	0.53	1	0.22	0.13	0.21
SPABL2	CIRCULAR	0.60	0.60	1	0.28	0.15	0.24
SPABL3	CIRCULAR	0.68	0.68	1	0.36	0.17	0.34
SPAG1	CIRCULAR	0.60	0.60	1	0.28	0.15	0.21
SPAG2	CIRCULAR	0.68	0.68	1	0.36	0.17	0.33
SPAG3	CIRCULAR	0.75	0.75	1	0.44	0.19	0.38
SPAG4	CIRCULAR	0.75	0.75	1	0.44	0.19	0.43
SPAG5	CIRCULAR	0.90	0.90	1	0.64	0.23	0.57
SPAG6	CIRCULAR	0.90	0.90	1	0.64	0.23	0.57
SPAG8	CIRCULAR	1.05	1.05	1	0.87	0.26	0.75
SPAG9	CIRCULAR	1.05	1.05	1	0.87	0.26	0.76
SPAO1	CIRCULAR	0.53	0.53	1	0.22	0.13	0.17
SPAO2	CIRCULAR	0.60	0.60	1	0.28	0.15	0.21
SPAO3	CIRCULAR	0.60	0.60	1	0.28	0.15	0.27
SPAO4	CIRCULAR	0.68	0.68	1	0.36	0.17	0.33
SPAO5	CIRCULAR	0.90	0.90	1	0.64	0.23	0.65
SPAO6	CIRCULAR	0.90	0.90	1	0.64	0.23	0.67
SPAPK1	CIRCULAR	0.53	0.53	1	0.22	0.13	0.16
SPAPK2	CIRCULAR	0.53	0.53	1	0.22	0.13	0.19
SPAPK3	CIRCULAR	0.60	0.60	1	0.28	0.15	0.27
SPAPK4	CIRCULAR	0.60	0.60	1	0.28	0.15	0.27
SPAPL1	CIRCULAR	0.53	0.53	1	0.22	0.13	0.15
SPAPL2	CIRCULAR	0.53	0.53	1	0.22	0.13	0.17
SPAPL3	CIRCULAR	0.60	0.60	1	0.28	0.15	0.30
SPAPL4	CIRCULAR	0.68	0.68	1	0.36	0.17	0.34
SPAR1	CIRCULAR	0.53	0.53	1	0.22	0.13	0.15
SPAR2	CIRCULAR	0.60	0.60	1	0.28	0.15	0.24
SPAR3	CIRCULAR	0.75	0.75	1	0.44	0.19	0.40
SPAR4	CIRCULAR	0.82	0.82	1	0.53	0.21	0.48
SPAR5	CIRCULAR	0.82	0.82	1	0.53	0.21	0.56
SPAY1	CIRCULAR	0.53	0.53	1	0.22	0.13	0.17
SPAY2	CIRCULAR	0.75	0.75	1	0.44	0.19	0.37
SPAY3	CIRCULAR	1.05	1.05	1	0.87	0.26	1.01
SPAY4	CIRCULAR	1.05	1.05	1	0.87	0.26	1.00
SPAY5	CIRCULAR	1.05	1.05	1	0.87	0.26	1.00
SPG7	CIRCULAR	0.90	0.90	1	0.64	0.23	0.56
Z1	CIRCULAR	1.50	1.50	1	1.77	0.38	2.21

Z10	CIRCULAR	0.75	0.75	1	0.44	0.19	0.36
Z11	CIRCULAR	0.60	0.60	1	0.28	0.15	0.21
Z12	CIRCULAR	0.53	0.53	1	0.22	0.13	0.15
Z2	CIRCULAR	1.50	1.50	1	1.77	0.38	2.21
Z3	CIRCULAR	1.50	1.50	1	1.77	0.38	2.03
Z4	CIRCULAR	1.20	1.20	1	1.13	0.30	1.43
Z5	CIRCULAR	1.20	1.20	1	1.13	0.30	1.39
Z6	CIRCULAR	1.20	1.20	1	1.13	0.30	1.39
Z7	CIRCULAR	0.90	0.90	1	0.64	0.23	0.65
Z8	CIRCULAR	0.82	0.82	1	0.53	0.21	0.58
Z9	CIRCULAR	0.75	0.75	1	0.44	0.19	0.39

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Transect Summary
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Transect CYR-1

Area:

0.0036	0.0078	0.0124	0.0176	0.0232
0.0293	0.0360	0.0431	0.0507	0.0588
0.0674	0.0765	0.0861	0.0961	0.1067
0.1177	0.1292	0.1412	0.1537	0.1667
0.1802	0.1941	0.2086	0.2235	0.2395
0.2570	0.2759	0.2963	0.3181	0.3414
0.3662	0.3924	0.4200	0.4491	0.4795
0.5106	0.5422	0.5740	0.6062	0.6387
0.6715	0.7046	0.7380	0.7718	0.8060
0.8417	0.8790	0.9178	0.9581	1.0000

Hrad:

0.0374	0.0704	0.1005	0.1286	0.1550
0.1803	0.2047	0.2283	0.2513	0.2808
0.3088	0.3352	0.3604	0.3846	0.4079
0.4305	0.4524	0.4737	0.4946	0.5151
0.5351	0.5549	0.5743	0.5947	0.6231
0.6475	0.6685	0.6868	0.7029	0.7173
0.7303	0.7422	0.7532	0.7637	0.7755
0.7884	0.8053	0.8231	0.8416	0.8605
0.8799	0.8995	0.9194	0.9395	0.9535
0.9631	0.9726	0.9820	0.9911	1.0000

Width:

0.0914	0.1030	0.1146	0.1262	0.1378
0.1495	0.1611	0.1727	0.1843	0.1958
0.2072	0.2186	0.2300	0.2415	0.2529
0.2643	0.2758	0.2872	0.2986	0.3101
0.3215	0.3329	0.3444	0.3581	0.3923
0.4264	0.4605	0.4946	0.5287	0.5628
0.5969	0.6310	0.6651	0.6993	0.7209
0.7358	0.7432	0.7505	0.7578	0.7651
0.7724	0.7797	0.7870	0.7943	0.8186
0.8549	0.8912	0.9274	0.9637	1.0000

Transect CYR-2

Area:

0.0028	0.0061	0.0099	0.0141	0.0188
0.0239	0.0294	0.0354	0.0418	0.0487
0.0560	0.0638	0.0720	0.0806	0.0897
0.0992	0.1091	0.1195	0.1304	0.1416
0.1538	0.1671	0.1814	0.1968	0.2133
0.2305	0.2481	0.2674	0.2915	0.3161
0.3410	0.3667	0.3939	0.4227	0.4530
0.4849	0.5184	0.5531	0.5883	0.6237
0.6592	0.6951	0.7311	0.7674	0.8039
0.8406	0.8776	0.9161	0.9569	1.0000

Hrad:

0.0373	0.0695	0.0990	0.1270	0.1533
0.1785	0.2028	0.2263	0.2493	0.2718
0.2940	0.3158	0.3374	0.3587	0.3799
0.4008	0.4217	0.4424	0.4630	0.4856
0.5134	0.5375	0.5588	0.5777	0.5948
0.6128	0.6320	0.6370	0.6403	0.6502
0.6630	0.6848	0.7046	0.7227	0.7395
0.7552	0.7700	0.7852	0.8025	0.8212
0.8408	0.8612	0.8823	0.9038	0.9257
0.9479	0.9685	0.9792	0.9898	1.0000

Width:

0.0687	0.0799	0.0906	0.1005	0.1105
0.1205	0.1304	0.1404	0.1503	0.1603
0.1702	0.1802	0.1902	0.2001	0.2101
0.2200	0.2300	0.2400	0.2499	0.2629
0.2873	0.3117	0.3362	0.3606	0.3850
0.3935	0.4010	0.5025	0.5547	0.5591
0.5635	0.5983	0.6333	0.6684	0.7034
0.7384	0.7734	0.7918	0.7969	0.8020
0.8071	0.8122	0.8173	0.8224	0.8275
0.8326	0.8452	0.8968	0.9484	1.0000

Transect CYR-3

Area:

0.0039	0.0084	0.0135	0.0191	0.0252
0.0320	0.0392	0.0471	0.0555	0.0644
0.0739	0.0840	0.0946	0.1058	0.1175
0.1298	0.1426	0.1560	0.1700	0.1845
0.1996	0.2152	0.2314	0.2484	0.2665
0.2857	0.3059	0.3267	0.3479	0.3700
0.3931	0.4173	0.4425	0.4687	0.4959
0.5242	0.5535	0.5839	0.6152	0.6475
0.6799	0.7125	0.7451	0.7778	0.8107
0.8440	0.8796	0.9174	0.9576	1.0000

Hrad:

0.0335	0.0629	0.0897	0.1146	0.1381
0.1605	0.1822	0.2031	0.2236	0.2436

0.2633	0.2827	0.3019	0.3209	0.3396
0.3583	0.3768	0.3951	0.4134	0.4316
0.4497	0.4677	0.4857	0.5096	0.5328
0.5540	0.5739	0.5940	0.6186	0.6460
0.6717	0.6957	0.7183	0.7397	0.7599
0.7791	0.7975	0.8150	0.8319	0.8495
0.8687	0.8886	0.9091	0.9302	0.9516
0.9658	0.9755	0.9845	0.9927	1.0000

Width:

0.0966	0.1094	0.1222	0.1349	0.1477
0.1605	0.1733	0.1860	0.1988	0.2116
0.2244	0.2372	0.2500	0.2628	0.2756
0.2883	0.3011	0.3139	0.3267	0.3395
0.3523	0.3651	0.3779	0.4015	0.4279
0.4542	0.4708	0.4807	0.4953	0.5189
0.5425	0.5661	0.5897	0.6133	0.6369
0.6605	0.6841	0.7077	0.7313	0.7431
0.7453	0.7475	0.7497	0.7519	0.7541
0.7886	0.8415	0.8943	0.9472	1.0000

Transect CYR-4

Area:

0.0034	0.0073	0.0118	0.0167	0.0221
0.0280	0.0344	0.0413	0.0487	0.0566
0.0650	0.0739	0.0833	0.0932	0.1036
0.1145	0.1259	0.1378	0.1502	0.1630
0.1764	0.1903	0.2047	0.2202	0.2384
0.2569	0.2757	0.2947	0.3139	0.3340
0.3561	0.3802	0.4063	0.4345	0.4648
0.4968	0.5295	0.5625	0.5957	0.6293
0.6631	0.6973	0.7317	0.7665	0.8017
0.8383	0.8764	0.9161	0.9573	1.0000

Hrad:

0.0359	0.0674	0.0961	0.1227	0.1478
0.1718	0.1949	0.2174	0.2393	0.2608
0.2819	0.3027	0.3233	0.3436	0.3638
0.3838	0.4036	0.4234	0.4430	0.4625
0.4820	0.5014	0.5207	0.5395	0.5584
0.5787	0.5999	0.6217	0.6437	0.6722
0.6977	0.7190	0.7369	0.7520	0.7648
0.7771	0.7919	0.8082	0.8257	0.8441
0.8632	0.8829	0.9030	0.9235	0.9402
0.9532	0.9656	0.9775	0.9890	1.0000

Width:

0.0844	0.0958	0.1073	0.1188	0.1302
0.1417	0.1531	0.1646	0.1760	0.1875
0.1989	0.2104	0.2218	0.2333	0.2447
0.2562	0.2676	0.2791	0.2905	0.3020
0.3134	0.3249	0.3363	0.4165	0.4223
0.4282	0.4340	0.4398	0.4457	0.4843
0.5312	0.5780	0.6248	0.6716	0.7185

0.7477	0.7545	0.7613	0.7682	0.7750
0.7818	0.7886	0.7955	0.8023	0.8243
0.8594	0.8946	0.9297	0.9649	1.0000

Transect CYR-5

Area:

0.0033	0.0071	0.0115	0.0162	0.0215
0.0273	0.0335	0.0403	0.0475	0.0552
0.0634	0.0720	0.0812	0.0908	0.1010
0.1116	0.1227	0.1343	0.1463	0.1589
0.1720	0.1860	0.2012	0.2175	0.2349
0.2531	0.2717	0.2905	0.3096	0.3299
0.3518	0.3753	0.4002	0.4267	0.4547
0.4843	0.5154	0.5480	0.5820	0.6168
0.6520	0.6878	0.7240	0.7606	0.7978
0.8354	0.8739	0.9142	0.9562	1.0000

Hrad:

0.0367	0.0689	0.0982	0.1254	0.1510
0.1756	0.1992	0.2222	0.2446	0.2666
0.2882	0.3095	0.3305	0.3513	0.3720
0.3924	0.4127	0.4329	0.4530	0.4730
0.4956	0.5216	0.5446	0.5652	0.5836
0.6023	0.6221	0.6427	0.6674	0.6954
0.7200	0.7416	0.7608	0.7780	0.7934
0.8075	0.8204	0.8324	0.8446	0.8590
0.8744	0.8905	0.9072	0.9244	0.9419
0.9597	0.9716	0.9815	0.9910	1.0000

Width:

0.0800	0.0909	0.1018	0.1126	0.1235
0.1344	0.1453	0.1561	0.1670	0.1779
0.1887	0.1996	0.2105	0.2214	0.2322
0.2431	0.2540	0.2648	0.2757	0.2866
0.3020	0.3270	0.3519	0.3769	0.4046
0.4122	0.4176	0.4231	0.4391	0.4733
0.5075	0.5417	0.5760	0.6102	0.6444
0.6786	0.7128	0.7470	0.7731	0.7838
0.7945	0.8052	0.8159	0.8265	0.8372
0.8479	0.8814	0.9210	0.9605	1.0000

Transect CYR-6

Area:

0.0026	0.0058	0.0093	0.0133	0.0179
0.0237	0.0307	0.0390	0.0484	0.0590
0.0709	0.0840	0.0977	0.1115	0.1257
0.1401	0.1548	0.1698	0.1850	0.2005
0.2163	0.2323	0.2486	0.2651	0.2820
0.2990	0.3165	0.3353	0.3553	0.3768
0.3997	0.4239	0.4495	0.4764	0.5048
0.5345	0.5652	0.5963	0.6275	0.6590
0.6908	0.7229	0.7552	0.7877	0.8205
0.8537	0.8880	0.9238	0.9612	1.0000

Hrad:

0.0371	0.0692	0.0983	0.1252	0.1523
0.1734	0.1903	0.2051	0.2189	0.2325
0.2459	0.2601	0.2807	0.3026	0.3252
0.3482	0.3715	0.3947	0.4180	0.4412
0.4643	0.4873	0.5101	0.5328	0.5553
0.5776	0.6041	0.6324	0.6577	0.6802
0.7005	0.7189	0.7356	0.7509	0.7651
0.7783	0.7933	0.8099	0.8273	0.8454
0.8641	0.8832	0.9027	0.9225	0.9424
0.9594	0.9700	0.9803	0.9903	1.0000

Width:

0.0727	0.0841	0.0956	0.1070	0.1312
0.1618	0.1924	0.2231	0.2537	0.2843
0.3156	0.3410	0.3478	0.3545	0.3612
0.3680	0.3747	0.3814	0.3882	0.3949
0.4017	0.4084	0.4151	0.4219	0.4286
0.4353	0.4558	0.4905	0.5253	0.5600
0.5947	0.6295	0.6642	0.6990	0.7337
0.7685	0.7807	0.7871	0.7936	0.8001
0.8066	0.8130	0.8195	0.8260	0.8324
0.8494	0.8871	0.9247	0.9624	1.0000

Transect CYR-7

Area:

0.0023	0.0049	0.0079	0.0111	0.0147
0.0187	0.0229	0.0278	0.0333	0.0394
0.0459	0.0528	0.0604	0.0685	0.0772
0.0865	0.0965	0.1072	0.1191	0.1325
0.1474	0.1637	0.1815	0.2006	0.2211
0.2427	0.2654	0.2892	0.3142	0.3403
0.3675	0.3958	0.4253	0.4558	0.4874
0.5193	0.5513	0.5837	0.6162	0.6489
0.6819	0.7150	0.7484	0.7820	0.8161
0.8510	0.8868	0.9236	0.9613	1.0000

Hrad:

0.0370	0.0700	0.1001	0.1283	0.1550
0.1806	0.1996	0.2115	0.2252	0.2485
0.2725	0.2884	0.3048	0.3217	0.3390
0.3550	0.3689	0.3782	0.3719	0.3710
0.3739	0.3798	0.3879	0.4002	0.4159
0.4331	0.4504	0.4680	0.4857	0.5036
0.5216	0.5398	0.5580	0.5763	0.6039
0.6387	0.6732	0.7075	0.7416	0.7754
0.8090	0.8424	0.8755	0.9085	0.9274
0.9414	0.9557	0.9702	0.9850	1.0000

Width:

0.0630	0.0712	0.0795	0.0878	0.0961
0.1044	0.1161	0.1329	0.1496	0.1602
0.1700	0.1850	0.2000	0.2150	0.2300
0.2462	0.2642	0.2864	0.3237	0.3611

0.3985	0.4359	0.4732	0.5072	0.5374
0.5661	0.5949	0.6236	0.6523	0.6810
0.7098	0.7385	0.7672	0.7959	0.8118
0.8173	0.8229	0.8284	0.8340	0.8396
0.8451	0.8507	0.8563	0.8618	0.8807
0.9046	0.9284	0.9523	0.9761	1.0000

Transect CYR-8

Area:

0.0025	0.0054	0.0089	0.0128	0.0172
0.0221	0.0274	0.0332	0.0395	0.0463
0.0536	0.0612	0.0691	0.0773	0.0859
0.0949	0.1041	0.1137	0.1237	0.1339
0.1446	0.1556	0.1670	0.1788	0.1911
0.2038	0.2170	0.2311	0.2482	0.2684
0.2918	0.3184	0.3482	0.3810	0.4165
0.4530	0.4897	0.5267	0.5639	0.6014
0.6390	0.6769	0.7151	0.7534	0.7921
0.8318	0.8724	0.9140	0.9565	1.0000

Hrad:

0.0405	0.0751	0.1063	0.1351	0.1625
0.1887	0.2141	0.2389	0.2632	0.2871
0.3189	0.3554	0.3899	0.4230	0.4547
0.4851	0.5145	0.5430	0.5706	0.5974
0.6234	0.6479	0.6716	0.6945	0.7167
0.7383	0.7594	0.7829	0.7979	0.8033
0.8019	0.7958	0.7868	0.7808	0.7763
0.7798	0.7880	0.7995	0.8136	0.8297
0.8474	0.8663	0.8863	0.9071	0.9247
0.9398	0.9549	0.9700	0.9850	1.0000

Width:

0.0618	0.0727	0.0836	0.0944	0.1053
0.1162	0.1271	0.1379	0.1488	0.1597
0.1687	0.1763	0.1839	0.1916	0.1992
0.2068	0.2144	0.2220	0.2297	0.2373
0.2452	0.2549	0.2646	0.2743	0.2840
0.2937	0.3035	0.3527	0.4244	0.4961
0.5679	0.6402	0.7130	0.7774	0.8272
0.8325	0.8378	0.8430	0.8483	0.8536
0.8589	0.8642	0.8694	0.8747	0.8899
0.9119	0.9339	0.9560	0.9780	1.0000

Transect XS-01

Area:

0.0069	0.0144	0.0225	0.0312	0.0405
0.0504	0.0608	0.0717	0.0830	0.0947
0.1068	0.1193	0.1322	0.1455	0.1592
0.1733	0.1878	0.2026	0.2179	0.2336
0.2497	0.2662	0.2830	0.3003	0.3180
0.3361	0.3545	0.3734	0.3927	0.4124
0.4324	0.4529	0.4738	0.4950	0.5167

0.5388	0.5617	0.5859	0.6111	0.6375
0.6650	0.6937	0.7235	0.7545	0.7866
0.8207	0.8583	0.8993	0.9441	1.0000

Hrad:

0.0370	0.0705	0.1013	0.1301	0.1572
0.1832	0.2088	0.2354	0.2610	0.2857
0.3097	0.3329	0.3556	0.3777	0.3994
0.4206	0.4414	0.4618	0.4819	0.5017
0.5212	0.5405	0.5595	0.5783	0.5969
0.6153	0.6336	0.6517	0.6696	0.6875
0.7051	0.7227	0.7401	0.7575	0.7747
0.7932	0.8160	0.8370	0.8564	0.8744
0.8912	0.9070	0.9219	0.9359	0.9493
0.9684	0.9842	0.9962	1.0052	1.0000

Width:

0.1085	0.1175	0.1265	0.1356	0.1446
0.1533	0.1614	0.1674	0.1734	0.1794
0.1854	0.1914	0.1974	0.2034	0.2094
0.2154	0.2214	0.2274	0.2335	0.2395
0.2455	0.2515	0.2575	0.2635	0.2695
0.2755	0.2815	0.2875	0.2935	0.2996
0.3056	0.3116	0.3176	0.3236	0.3296
0.3379	0.3550	0.3722	0.3894	0.4066
0.4237	0.4409	0.4581	0.4753	0.4924
0.5403	0.5929	0.6456	0.7203	1.0000

Transect XS-02

Area:

0.0062	0.0130	0.0204	0.0281	0.0363
0.0448	0.0537	0.0629	0.0725	0.0824
0.0927	0.1034	0.1145	0.1259	0.1376
0.1498	0.1623	0.1751	0.1884	0.2019
0.2159	0.2302	0.2449	0.2599	0.2753
0.2911	0.3072	0.3237	0.3406	0.3578
0.3754	0.3934	0.4117	0.4303	0.4494
0.4688	0.4886	0.5087	0.5298	0.5539
0.5817	0.6133	0.6513	0.6958	0.7423
0.7904	0.8402	0.8918	0.9450	1.0000

Hrad:

0.0399	0.0772	0.1118	0.1455	0.1776
0.2082	0.2374	0.2655	0.2926	0.3188
0.3442	0.3690	0.3932	0.4168	0.4400
0.4627	0.4851	0.5071	0.5287	0.5501
0.5712	0.5921	0.6127	0.6332	0.6534
0.6735	0.6934	0.7132	0.7328	0.7523
0.7716	0.7909	0.8100	0.8290	0.8480
0.8668	0.8856	0.9043	0.9314	0.9588
0.9786	0.9918	0.9930	0.9879	0.9858
0.9857	0.9875	0.9906	0.9948	1.0000

Width:

0.1181	0.1269	0.1357	0.1424	0.1489

0.1555	0.1620	0.1685	0.1750	0.1815
0.1880	0.1945	0.2010	0.2075	0.2140
0.2205	0.2270	0.2335	0.2400	0.2466
0.2531	0.2596	0.2661	0.2726	0.2791
0.2856	0.2921	0.2986	0.3051	0.3116
0.3181	0.3246	0.3311	0.3376	0.3442
0.3507	0.3572	0.3637	0.3993	0.4650
0.5307	0.6057	0.7567	0.8164	0.8467
0.8770	0.9073	0.9379	0.9690	1.0000

Transect XS-03

Area:

0.0073	0.0152	0.0238	0.0330	0.0428
0.0533	0.0644	0.0761	0.0882	0.1007
0.1135	0.1268	0.1404	0.1544	0.1688
0.1835	0.1986	0.2141	0.2300	0.2462
0.2628	0.2798	0.2971	0.3148	0.3329
0.3514	0.3702	0.3894	0.4090	0.4290
0.4493	0.4700	0.4910	0.5125	0.5343
0.5565	0.5790	0.6019	0.6252	0.6489
0.6729	0.6974	0.7231	0.7514	0.7830
0.8188	0.8592	0.9035	0.9505	1.0000

Hrad:

0.0351	0.0671	0.0967	0.1245	0.1508
0.1759	0.2000	0.2253	0.2512	0.2764
0.3012	0.3253	0.3487	0.3717	0.3941
0.4161	0.4376	0.4588	0.4796	0.5000
0.5202	0.5401	0.5597	0.5791	0.5983
0.6172	0.6360	0.6546	0.6730	0.6912
0.7093	0.7272	0.7451	0.7628	0.7803
0.7978	0.8151	0.8324	0.8495	0.8666
0.8836	0.9005	0.9226	0.9412	0.9605
0.9754	0.9849	0.9908	0.9958	1.0000

Width:

0.1500	0.1625	0.1749	0.1874	0.1999
0.2124	0.2248	0.2346	0.2424	0.2501
0.2574	0.2648	0.2721	0.2794	0.2868
0.2941	0.3014	0.3087	0.3161	0.3234
0.3307	0.3381	0.3454	0.3527	0.3601
0.3674	0.3747	0.3820	0.3894	0.3967
0.4040	0.4114	0.4187	0.4260	0.4334
0.4407	0.4480	0.4553	0.4627	0.4700
0.4773	0.4847	0.5326	0.5852	0.6635
0.7507	0.8378	0.9012	0.9506	1.0000

Transect XS-100

Area:

0.0007	0.0030	0.0067	0.0118	0.0178
0.0246	0.0323	0.0407	0.0497	0.0592
0.0692	0.0796	0.0905	0.1019	0.1137
0.1260	0.1388	0.1521	0.1664	0.1842

0.2057	0.2289	0.2523	0.2759	0.2998
0.3238	0.3481	0.3726	0.3973	0.4222
0.4473	0.4726	0.4982	0.5240	0.5500
0.5763	0.6030	0.6301	0.6577	0.6857
0.7142	0.7431	0.7724	0.8021	0.8323
0.8629	0.8946	0.9280	0.9631	1.0000

Hrad:

0.0178	0.0355	0.0533	0.0747	0.0979
0.1197	0.1406	0.1624	0.1873	0.2114
0.2346	0.2572	0.2792	0.3006	0.3216
0.3422	0.3625	0.3825	0.4045	0.4198
0.4276	0.4373	0.4503	0.4654	0.4820
0.4997	0.5180	0.5368	0.5560	0.5754
0.5949	0.6145	0.6342	0.6538	0.6734
0.6996	0.7257	0.7510	0.7758	0.8000
0.8236	0.8468	0.8695	0.8917	0.9135
0.9349	0.9535	0.9706	0.9860	1.0000

Width:

0.0393	0.0786	0.1179	0.1481	0.1699
0.1916	0.2134	0.2325	0.2449	0.2574
0.2699	0.2824	0.2949	0.3074	0.3199
0.3324	0.3449	0.3574	0.4215	0.5213
0.6112	0.6169	0.6226	0.6283	0.6340
0.6397	0.6454	0.6511	0.6568	0.6626
0.6683	0.6740	0.6797	0.6854	0.6911
0.7021	0.7135	0.7249	0.7363	0.7477
0.7591	0.7705	0.7819	0.7933	0.8047
0.8161	0.8616	0.9077	0.9539	1.0000

Transect XS-100b

Area:

0.0074	0.0151	0.0233	0.0318	0.0406
0.0499	0.0595	0.0694	0.0798	0.0905
0.1017	0.1134	0.1256	0.1383	0.1514
0.1650	0.1791	0.1937	0.2087	0.2243
0.2403	0.2568	0.2737	0.2912	0.3091
0.3275	0.3464	0.3659	0.3863	0.4079
0.4306	0.4545	0.4795	0.5056	0.5329
0.5612	0.5898	0.6186	0.6476	0.6768
0.7063	0.7362	0.7666	0.7975	0.8288
0.8605	0.8927	0.9256	0.9612	1.0000

Hrad:

0.0298	0.0573	0.0830	0.1071	0.1300
0.1517	0.1724	0.1923	0.2115	0.2291
0.2458	0.2621	0.2782	0.2939	0.3095
0.3248	0.3400	0.3550	0.3698	0.3845
0.3991	0.4136	0.4279	0.4422	0.4564
0.4705	0.4845	0.5011	0.5206	0.5390
0.5566	0.5739	0.5910	0.6082	0.6254
0.6443	0.6652	0.6869	0.7091	0.7317
0.7596	0.7888	0.8176	0.8462	0.8745

	0.9026	0.9305	0.9565	0.9792	1.0000
Width:					
	0.1871	0.1962	0.2054	0.2146	0.2237
	0.2329	0.2421	0.2512	0.2605	0.2713
	0.2832	0.2950	0.3069	0.3188	0.3306
	0.3425	0.3543	0.3662	0.3781	0.3899
	0.4018	0.4136	0.4255	0.4373	0.4492
	0.4611	0.4729	0.4912	0.5194	0.5477
	0.5759	0.6041	0.6324	0.6606	0.6889
	0.7040	0.7092	0.7143	0.7195	0.7246
	0.7345	0.7457	0.7569	0.7681	0.7793
	0.7905	0.8017	0.8399	0.9199	1.0000

Transect XS-101a

Area:					
	0.0066	0.0135	0.0207	0.0282	0.0360
	0.0442	0.0527	0.0614	0.0705	0.0800
	0.0897	0.0997	0.1101	0.1207	0.1317
	0.1430	0.1548	0.1671	0.1798	0.1931
	0.2068	0.2210	0.2357	0.2509	0.2666
	0.2828	0.2995	0.3167	0.3343	0.3525
	0.3711	0.3934	0.4216	0.4520	0.4827
	0.5136	0.5447	0.5761	0.6078	0.6401
	0.6729	0.7062	0.7401	0.7745	0.8094
	0.8448	0.8808	0.9184	0.9581	1.0000
Hrad:					
	0.0352	0.0677	0.0979	0.1262	0.1528
	0.1781	0.2021	0.2252	0.2474	0.2688
	0.2895	0.3096	0.3292	0.3483	0.3669
	0.3837	0.3982	0.4127	0.4272	0.4419
	0.4565	0.4713	0.4860	0.5008	0.5156
	0.5305	0.5453	0.5602	0.5751	0.5901
	0.6058	0.6224	0.6300	0.6392	0.6521
	0.6675	0.6849	0.7050	0.7312	0.7574
	0.7836	0.8097	0.8357	0.8617	0.8874
	0.9131	0.9381	0.9600	0.9807	1.0000
Width:					
	0.1568	0.1641	0.1714	0.1787	0.1861
	0.1934	0.2007	0.2080	0.2153	0.2227
	0.2300	0.2373	0.2446	0.2520	0.2593
	0.2682	0.2796	0.2910	0.3024	0.3138
	0.3252	0.3367	0.3481	0.3595	0.3709
	0.3823	0.3937	0.4051	0.4165	0.4279
	0.4511	0.5874	0.7071	0.7118	0.7166
	0.7214	0.7262	0.7325	0.7448	0.7571
	0.7694	0.7817	0.7940	0.8064	0.8187
	0.8310	0.8490	0.8993	0.9497	1.0000

Transect XS-101b

Area:					
	0.0062	0.0130	0.0204	0.0283	0.0367

0.0458	0.0554	0.0654	0.0758	0.0864
0.0972	0.1083	0.1197	0.1314	0.1433
0.1555	0.1679	0.1807	0.1936	0.2069
0.2204	0.2342	0.2483	0.2626	0.2772
0.2920	0.3073	0.3253	0.3469	0.3721
0.3996	0.4273	0.4552	0.4832	0.5114
0.5398	0.5685	0.5978	0.6275	0.6576
0.6882	0.7193	0.7509	0.7829	0.8156
0.8497	0.8851	0.9220	0.9603	1.0000

Hrad:

0.0315	0.0601	0.0864	0.1110	0.1343
0.1565	0.1777	0.2014	0.2256	0.2490
0.2715	0.2933	0.3146	0.3353	0.3555
0.3753	0.3946	0.4136	0.4322	0.4504
0.4684	0.4861	0.5035	0.5206	0.5376
0.5543	0.5720	0.5873	0.5964	0.6011
0.6077	0.6183	0.6317	0.6471	0.6640
0.6844	0.7090	0.7336	0.7581	0.7826
0.8070	0.8313	0.8554	0.8795	0.9021
0.9234	0.9437	0.9632	0.9820	1.0000

Width:

0.1612	0.1750	0.1889	0.2027	0.2166
0.2304	0.2443	0.2528	0.2591	0.2655
0.2720	0.2786	0.2852	0.2918	0.2984
0.3050	0.3116	0.3182	0.3248	0.3314
0.3380	0.3446	0.3512	0.3578	0.3644
0.3710	0.4013	0.4904	0.5796	0.6687
0.6843	0.6881	0.6920	0.6958	0.6997
0.7065	0.7179	0.7294	0.7409	0.7524
0.7638	0.7753	0.7868	0.7983	0.8262
0.8610	0.8957	0.9305	0.9652	1.0000

Transect XS-102b
Area:

0.0068	0.0139	0.0212	0.0288	0.0366
0.0446	0.0529	0.0616	0.0706	0.0800
0.0898	0.1000	0.1107	0.1218	0.1333
0.1453	0.1577	0.1705	0.1838	0.1975
0.2117	0.2263	0.2413	0.2568	0.2727
0.2890	0.3058	0.3231	0.3416	0.3613
0.3822	0.4043	0.4312	0.4600	0.4890
0.5182	0.5477	0.5779	0.6087	0.6402
0.6723	0.7050	0.7384	0.7724	0.8070
0.8422	0.8784	0.9167	0.9573	1.0000

Hrad:

0.0345	0.0669	0.0974	0.1264	0.1539
0.1803	0.2045	0.2272	0.2492	0.2706
0.2905	0.3095	0.3283	0.3468	0.3651
0.3832	0.4011	0.4188	0.4364	0.4539
0.4713	0.4885	0.5057	0.5227	0.5397
0.5566	0.5735	0.5770	0.5747	0.5745

0.5762	0.5792	0.5843	0.6049	0.6269
0.6497	0.6779	0.7060	0.7336	0.7609
0.7879	0.8146	0.8410	0.8671	0.8929
0.9186	0.9415	0.9622	0.9817	1.0000

Width:

0.1583	0.1639	0.1695	0.1751	0.1807
0.1863	0.1935	0.2019	0.2103	0.2187
0.2282	0.2381	0.2481	0.2581	0.2680
0.2780	0.2879	0.2979	0.3078	0.3178
0.3278	0.3377	0.3477	0.3576	0.3676
0.3776	0.3875	0.4081	0.4352	0.4622
0.4892	0.5384	0.6545	0.6588	0.6630
0.6673	0.6814	0.6958	0.7102	0.7246
0.7391	0.7535	0.7679	0.7823	0.7968
0.8112	0.8484	0.8989	0.9495	1.0000

Transect XS-103b

Area:

0.0073	0.0148	0.0224	0.0302	0.0381
0.0462	0.0544	0.0628	0.0713	0.0801
0.0894	0.0992	0.1095	0.1203	0.1316
0.1434	0.1557	0.1685	0.1818	0.1956
0.2099	0.2247	0.2400	0.2559	0.2722
0.2890	0.3064	0.3242	0.3425	0.3614
0.3811	0.4023	0.4248	0.4488	0.4744
0.5020	0.5315	0.5623	0.5938	0.6261
0.6591	0.6928	0.7272	0.7624	0.7983
0.8349	0.8730	0.9133	0.9556	1.0000

Hrad:

0.0352	0.0680	0.0989	0.1279	0.1554
0.1815	0.2063	0.2300	0.2527	0.2701
0.2861	0.3020	0.3179	0.3337	0.3496
0.3655	0.3814	0.3972	0.4131	0.4289
0.4448	0.4606	0.4765	0.4923	0.5082
0.5240	0.5398	0.5557	0.5715	0.5873
0.6098	0.6308	0.6499	0.6676	0.6894
0.7105	0.7299	0.7510	0.7727	0.7948
0.8172	0.8397	0.8624	0.8852	0.9080
0.9305	0.9489	0.9667	0.9837	1.0000

Width:

0.1628	0.1661	0.1694	0.1728	0.1761
0.1794	0.1827	0.1861	0.1894	0.1986
0.2097	0.2208	0.2319	0.2429	0.2540
0.2651	0.2762	0.2873	0.2983	0.3094
0.3205	0.3316	0.3426	0.3537	0.3648
0.3759	0.3870	0.3980	0.4091	0.4202
0.4495	0.4809	0.5123	0.5437	0.5845
0.6273	0.6699	0.6859	0.7019	0.7179
0.7338	0.7498	0.7658	0.7818	0.7978
0.8162	0.8622	0.9081	0.9541	1.0000

Transect XS-104b

Area:

0.0065	0.0134	0.0206	0.0281	0.0359
0.0441	0.0525	0.0613	0.0704	0.0799
0.0900	0.1012	0.1136	0.1271	0.1410
0.1554	0.1701	0.1852	0.2007	0.2166
0.2328	0.2495	0.2665	0.2840	0.3018
0.3200	0.3386	0.3576	0.3770	0.3968
0.4170	0.4375	0.4585	0.4800	0.5027
0.5265	0.5514	0.5776	0.6055	0.6348
0.6658	0.6982	0.7314	0.7653	0.8006
0.8375	0.8758	0.9157	0.9571	1.0000

Hrad:

0.0326	0.0630	0.0916	0.1187	0.1444
0.1690	0.1927	0.2155	0.2375	0.2588
0.2633	0.2682	0.2750	0.2906	0.3127
0.3344	0.3556	0.3764	0.3969	0.4170
0.4369	0.4565	0.4758	0.4949	0.5137
0.5323	0.5508	0.5691	0.5871	0.6051
0.6229	0.6405	0.6580	0.6807	0.7027
0.7233	0.7427	0.7667	0.7892	0.8102
0.8300	0.8499	0.8708	0.8914	0.9110
0.9299	0.9482	0.9659	0.9831	1.0000

Width:

0.1533	0.1607	0.1681	0.1755	0.1829
0.1903	0.1977	0.2051	0.2124	0.2198
0.2443	0.2707	0.2973	0.3146	0.3235
0.3324	0.3413	0.3502	0.3591	0.3681
0.3770	0.3859	0.3948	0.4037	0.4126
0.4215	0.4304	0.4394	0.4483	0.4572
0.4661	0.4750	0.4839	0.5066	0.5320
0.5574	0.5827	0.6185	0.6548	0.6910
0.7273	0.7518	0.7666	0.7909	0.8258
0.8606	0.8955	0.9303	0.9652	1.0000

Transect XS-105b

Area:

0.0070	0.0142	0.0217	0.0295	0.0376
0.0459	0.0545	0.0633	0.0725	0.0818
0.0916	0.1017	0.1122	0.1232	0.1347
0.1468	0.1594	0.1725	0.1862	0.2004
0.2152	0.2305	0.2463	0.2627	0.2796
0.2971	0.3151	0.3336	0.3527	0.3723
0.3930	0.4148	0.4377	0.4617	0.4868
0.5130	0.5405	0.5696	0.6002	0.6321
0.6648	0.6981	0.7320	0.7666	0.8018
0.8380	0.8759	0.9155	0.9569	1.0000

Hrad:

0.0332	0.0644	0.0939	0.1218	0.1484
0.1739	0.1984	0.2219	0.2447	0.2667
0.2853	0.3033	0.3210	0.3361	0.3510

0.3659	0.3808	0.3959	0.4109	0.4260
0.4411	0.4563	0.4715	0.4867	0.5019
0.5172	0.5325	0.5478	0.5631	0.5818
0.6043	0.6252	0.6449	0.6636	0.6814
0.6986	0.7220	0.7442	0.7653	0.7870
0.8098	0.8328	0.8559	0.8792	0.9025
0.9240	0.9443	0.9636	0.9821	1.0000

Width:

0.1618	0.1679	0.1740	0.1801	0.1861
0.1922	0.1983	0.2044	0.2105	0.2165
0.2255	0.2347	0.2439	0.2558	0.2681
0.2804	0.2926	0.3049	0.3172	0.3295
0.3418	0.3541	0.3664	0.3786	0.3909
0.4032	0.4155	0.4278	0.4401	0.4574
0.4827	0.5079	0.5331	0.5584	0.5836
0.6089	0.6433	0.6781	0.7129	0.7353
0.7500	0.7646	0.7792	0.7939	0.8085
0.8418	0.8813	0.9209	0.9604	1.0000

Transect XS-106b

Area:

0.0067	0.0138	0.0213	0.0291	0.0373
0.0459	0.0548	0.0641	0.0738	0.0839
0.0943	0.1051	0.1162	0.1277	0.1397
0.1522	0.1652	0.1787	0.1926	0.2071
0.2220	0.2374	0.2533	0.2697	0.2866
0.3040	0.3218	0.3402	0.3590	0.3784
0.3991	0.4216	0.4463	0.4731	0.5014
0.5302	0.5595	0.5893	0.6195	0.6503
0.6815	0.7132	0.7454	0.7781	0.8112
0.8456	0.8817	0.9194	0.9589	1.0000

Hrad:

0.0323	0.0622	0.0901	0.1164	0.1413
0.1650	0.1878	0.2096	0.2307	0.2512
0.2711	0.2904	0.3096	0.3272	0.3435
0.3596	0.3757	0.3917	0.4076	0.4234
0.4392	0.4549	0.4705	0.4862	0.5017
0.5173	0.5328	0.5482	0.5636	0.5802
0.6016	0.6256	0.6476	0.6673	0.6871
0.7081	0.7298	0.7520	0.7746	0.7974
0.8204	0.8435	0.8666	0.8898	0.9125
0.9311	0.9493	0.9668	0.9837	1.0000

Width:

0.1645	0.1733	0.1821	0.1909	0.1997
0.2085	0.2173	0.2261	0.2349	0.2437
0.2525	0.2613	0.2699	0.2799	0.2915
0.3032	0.3148	0.3265	0.3381	0.3498
0.3614	0.3731	0.3847	0.3964	0.4080
0.4196	0.4313	0.4429	0.4546	0.4710
0.5141	0.5629	0.6125	0.6621	0.6805
0.6920	0.7035	0.7150	0.7265	0.7380

0.7495	0.7609	0.7724	0.7839	0.7983
0.8387	0.8790	0.9193	0.9597	1.0000

Transect XS-107b

Area:

0.0073	0.0150	0.0229	0.0312	0.0397
0.0486	0.0577	0.0672	0.0770	0.0871
0.0974	0.1081	0.1191	0.1304	0.1421
0.1542	0.1667	0.1796	0.1930	0.2069
0.2212	0.2359	0.2511	0.2667	0.2828
0.2993	0.3163	0.3337	0.3516	0.3699
0.3889	0.4088	0.4297	0.4515	0.4743
0.4981	0.5236	0.5519	0.5828	0.6163
0.6507	0.6856	0.7211	0.7571	0.7937
0.8313	0.8708	0.9121	0.9551	1.0000

Hrad:

0.0366	0.0708	0.1028	0.1330	0.1617
0.1891	0.2153	0.2404	0.2647	0.2881
0.3108	0.3329	0.3544	0.3746	0.3935
0.4113	0.4285	0.4455	0.4625	0.4793
0.4961	0.5128	0.5295	0.5461	0.5627
0.5792	0.5956	0.6121	0.6285	0.6448
0.6488	0.6528	0.6578	0.6639	0.6709
0.6787	0.7028	0.7233	0.7409	0.7627
0.7865	0.8111	0.8364	0.8620	0.8880
0.9124	0.9358	0.9581	0.9794	1.0000

Width:

0.1636	0.1703	0.1769	0.1836	0.1902
0.1969	0.2035	0.2102	0.2168	0.2235
0.2302	0.2368	0.2435	0.2510	0.2593
0.2685	0.2782	0.2880	0.2977	0.3075
0.3172	0.3270	0.3368	0.3465	0.3563
0.3660	0.3758	0.3855	0.3953	0.4050
0.4249	0.4459	0.4668	0.4878	0.5087
0.5297	0.5875	0.6461	0.7047	0.7464
0.7580	0.7695	0.7811	0.7926	0.8041
0.8428	0.8821	0.9214	0.9607	1.0000

Transect XS-108b

Area:

0.0073	0.0150	0.0229	0.0310	0.0394
0.0481	0.0571	0.0664	0.0759	0.0856
0.0957	0.1060	0.1166	0.1276	0.1390
0.1509	0.1635	0.1766	0.1903	0.2046
0.2195	0.2350	0.2510	0.2677	0.2849
0.3027	0.3211	0.3400	0.3596	0.3797
0.4005	0.4218	0.4437	0.4661	0.4892
0.5129	0.5382	0.5653	0.5941	0.6246
0.6570	0.6911	0.7268	0.7629	0.7993
0.8364	0.8744	0.9135	0.9552	1.0000

Hrad:

0.0372	0.0718	0.1040	0.1343	0.1629
0.1900	0.2159	0.2406	0.2643	0.2872
0.3093	0.3304	0.3501	0.3693	0.3837
0.3976	0.4116	0.4259	0.4404	0.4551
0.4699	0.4849	0.4999	0.5151	0.5304
0.5458	0.5612	0.5768	0.5924	0.6080
0.6237	0.6395	0.6553	0.6712	0.6871
0.7065	0.7298	0.7508	0.7699	0.7875
0.8040	0.8196	0.8359	0.8544	0.8767
0.9038	0.9304	0.9563	0.9794	1.0000

Width:

0.1616	0.1674	0.1732	0.1791	0.1849
0.1907	0.1966	0.2024	0.2082	0.2141
0.2199	0.2260	0.2331	0.2402	0.2519
0.2645	0.2772	0.2898	0.3024	0.3150
0.3276	0.3402	0.3528	0.3655	0.3781
0.3907	0.4033	0.4159	0.4285	0.4412
0.4538	0.4664	0.4790	0.4916	0.5042
0.5265	0.5647	0.6029	0.6412	0.6794
0.7176	0.7558	0.7770	0.7818	0.7920
0.8114	0.8309	0.8673	0.9336	1.0000

Transect XS-109b

Area:

0.0076	0.0153	0.0231	0.0311	0.0393
0.0478	0.0568	0.0663	0.0763	0.0869
0.0979	0.1095	0.1215	0.1341	0.1472
0.1608	0.1749	0.1895	0.2047	0.2203
0.2365	0.2531	0.2703	0.2880	0.3062
0.3249	0.3441	0.3638	0.3841	0.4048
0.4261	0.4478	0.4701	0.4929	0.5162
0.5400	0.5647	0.5913	0.6199	0.6506
0.6831	0.7160	0.7492	0.7826	0.8165
0.8508	0.8856	0.9209	0.9587	1.0000

Hrad:

0.0357	0.0687	0.0995	0.1284	0.1542
0.1773	0.1984	0.2190	0.2389	0.2584
0.2776	0.2963	0.3148	0.3331	0.3511
0.3689	0.3865	0.4039	0.4212	0.4384
0.4555	0.4724	0.4893	0.5061	0.5228
0.5394	0.5559	0.5724	0.5888	0.6052
0.6215	0.6378	0.6540	0.6702	0.6864
0.7025	0.7230	0.7435	0.7617	0.7779
0.7936	0.8109	0.8291	0.8519	0.8786
0.9052	0.9317	0.9578	0.9806	1.0000

Width:

0.1771	0.1804	0.1838	0.1871	0.1936
0.2030	0.2149	0.2267	0.2386	0.2504
0.2623	0.2741	0.2860	0.2979	0.3097
0.3216	0.3334	0.3453	0.3571	0.3690
0.3808	0.3927	0.4045	0.4164	0.4282

0.4401	0.4519	0.4638	0.4756	0.4875
0.4994	0.5112	0.5231	0.5349	0.5468
0.5586	0.5932	0.6409	0.6885	0.7361
0.7617	0.7673	0.7728	0.7809	0.7916
0.8022	0.8128	0.8353	0.9176	1.0000

Transect XS-110b

Area:

0.0076	0.0155	0.0239	0.0326	0.0418
0.0513	0.0612	0.0715	0.0822	0.0933
0.1047	0.1166	0.1290	0.1419	0.1552
0.1691	0.1834	0.1981	0.2134	0.2291
0.2453	0.2620	0.2792	0.2968	0.3149
0.3335	0.3526	0.3721	0.3922	0.4127
0.4337	0.4551	0.4771	0.4995	0.5230
0.5483	0.5752	0.6037	0.6339	0.6649
0.6961	0.7275	0.7591	0.7911	0.8232
0.8556	0.8883	0.9231	0.9603	1.0000

Hrad:

0.0320	0.0615	0.0891	0.1151	0.1397
0.1630	0.1854	0.2069	0.2276	0.2478
0.2671	0.2848	0.3022	0.3193	0.3361
0.3527	0.3692	0.3854	0.4014	0.4173
0.4331	0.4488	0.4643	0.4797	0.4951
0.5103	0.5255	0.5406	0.5556	0.5706
0.5855	0.6003	0.6151	0.6304	0.6506
0.6691	0.6865	0.7031	0.7197	0.7387
0.7589	0.7801	0.8047	0.8344	0.8643
0.8942	0.9237	0.9510	0.9763	1.0000

Width:

0.1897	0.1993	0.2088	0.2184	0.2279
0.2375	0.2470	0.2566	0.2661	0.2754
0.2852	0.2968	0.3085	0.3202	0.3319
0.3435	0.3552	0.3669	0.3785	0.3902
0.4019	0.4135	0.4252	0.4369	0.4486
0.4602	0.4719	0.4836	0.4952	0.5069
0.5186	0.5302	0.5419	0.5557	0.5963
0.6369	0.6775	0.7181	0.7531	0.7590
0.7649	0.7708	0.7767	0.7825	0.7884
0.7942	0.8190	0.8793	0.9397	1.0000

Transect XS-112b

Area:

0.0078	0.0156	0.0237	0.0318	0.0401
0.0485	0.0571	0.0658	0.0747	0.0836
0.0927	0.1020	0.1119	0.1223	0.1334
0.1452	0.1576	0.1706	0.1843	0.1986
0.2136	0.2292	0.2455	0.2624	0.2799
0.2981	0.3170	0.3365	0.3566	0.3774
0.3988	0.4209	0.4436	0.4670	0.4910
0.5156	0.5409	0.5669	0.5935	0.6209

0.6499	0.6805	0.7128	0.7473	0.7840
0.8229	0.8632	0.9057	0.9513	1.0000

Hrad:

0.0386	0.0741	0.1068	0.1372	0.1655
0.1920	0.2169	0.2404	0.2627	0.2838
0.3040	0.3201	0.3316	0.3436	0.3561
0.3691	0.3825	0.3963	0.4103	0.4246
0.4391	0.4539	0.4688	0.4839	0.4991
0.5145	0.5299	0.5455	0.5612	0.5770
0.5929	0.6088	0.6249	0.6410	0.6571
0.6733	0.6896	0.7059	0.7223	0.7436
0.7664	0.7880	0.8113	0.8389	0.8654
0.8918	0.9205	0.9477	0.9741	1.0000

Width:

0.1557	0.1584	0.1611	0.1638	0.1665
0.1692	0.1719	0.1746	0.1773	0.1800
0.1827	0.1889	0.2018	0.2146	0.2275
0.2403	0.2532	0.2660	0.2789	0.2917
0.3045	0.3174	0.3302	0.3431	0.3559
0.3688	0.3816	0.3945	0.4073	0.4201
0.4330	0.4458	0.4587	0.4715	0.4844
0.4972	0.5101	0.5229	0.5358	0.5609
0.5936	0.6263	0.6628	0.7080	0.7532
0.7929	0.8155	0.8770	0.9385	1.0000

Transect XS-113b

Area:

0.0067	0.0138	0.0214	0.0295	0.0379
0.0469	0.0562	0.0660	0.0763	0.0870
0.0981	0.1099	0.1221	0.1348	0.1481
0.1619	0.1762	0.1910	0.2063	0.2221
0.2385	0.2554	0.2727	0.2906	0.3091
0.3280	0.3475	0.3674	0.3879	0.4089
0.4304	0.4525	0.4750	0.4981	0.5217
0.5458	0.5704	0.5956	0.6223	0.6505
0.6803	0.7117	0.7447	0.7788	0.8131
0.8477	0.8830	0.9201	0.9591	1.0000

Hrad:

0.0333	0.0639	0.0923	0.1190	0.1441
0.1681	0.1910	0.2133	0.2348	0.2547
0.2735	0.2920	0.3101	0.3280	0.3456
0.3630	0.3802	0.3972	0.4141	0.4308
0.4474	0.4639	0.4803	0.4966	0.5129
0.5290	0.5451	0.5611	0.5770	0.5929
0.6087	0.6245	0.6402	0.6559	0.6716
0.6872	0.7028	0.7222	0.7448	0.7659
0.7859	0.8053	0.8238	0.8437	0.8652
0.8878	0.9162	0.9452	0.9730	1.0000

Width:

0.1653	0.1759	0.1866	0.1972	0.2079
0.2185	0.2292	0.2394	0.2497	0.2613

0.2736	0.2859	0.2983	0.3106	0.3230
0.3353	0.3476	0.3600	0.3723	0.3846
0.3970	0.4093	0.4216	0.4340	0.4463
0.4586	0.4710	0.4833	0.4956	0.5080
0.5203	0.5326	0.5450	0.5573	0.5696
0.5820	0.5943	0.6180	0.6557	0.6934
0.7311	0.7688	0.8071	0.8178	0.8234
0.8290	0.8638	0.9092	0.9546	1.0000

Transect XS-114b

Area:

0.0085	0.0174	0.0267	0.0365	0.0468
0.0575	0.0686	0.0801	0.0920	0.1043
0.1169	0.1300	0.1434	0.1572	0.1714
0.1859	0.2008	0.2161	0.2318	0.2479
0.2643	0.2811	0.2983	0.3159	0.3338
0.3522	0.3709	0.3900	0.4094	0.4293
0.4495	0.4701	0.4911	0.5127	0.5357
0.5600	0.5855	0.6124	0.6406	0.6700
0.7006	0.7315	0.7626	0.7940	0.8257
0.8579	0.8914	0.9262	0.9624	1.0000

Hrad:

0.0308	0.0594	0.0862	0.1115	0.1355
0.1583	0.1806	0.2023	0.2233	0.2436
0.2633	0.2824	0.3011	0.3192	0.3370
0.3544	0.3715	0.3883	0.4047	0.4210
0.4370	0.4527	0.4683	0.4837	0.4989
0.5139	0.5288	0.5436	0.5582	0.5727
0.5871	0.6014	0.6155	0.6335	0.6510
0.6679	0.6844	0.7008	0.7175	0.7346
0.7540	0.7757	0.7984	0.8219	0.8499
0.8814	0.9120	0.9418	0.9711	1.0000

Width:

0.2269	0.2385	0.2501	0.2617	0.2733
0.2853	0.2960	0.3058	0.3157	0.3256
0.3355	0.3454	0.3552	0.3651	0.3750
0.3849	0.3948	0.4046	0.4145	0.4244
0.4343	0.4442	0.4540	0.4639	0.4738
0.4837	0.4936	0.5034	0.5133	0.5232
0.5331	0.5429	0.5528	0.5827	0.6167
0.6507	0.6848	0.7188	0.7528	0.7869
0.8038	0.8100	0.8163	0.8225	0.8335
0.8556	0.8917	0.9278	0.9639	1.0000

Transect XS-20

Area:

0.0058	0.0122	0.0190	0.0263	0.0339
0.0418	0.0500	0.0585	0.0673	0.0764
0.0857	0.0954	0.1054	0.1156	0.1261
0.1370	0.1481	0.1595	0.1712	0.1832
0.1955	0.2081	0.2209	0.2341	0.2475

0.2613	0.2753	0.2896	0.3043	0.3192
0.3344	0.3499	0.3657	0.3817	0.3981
0.4148	0.4317	0.4490	0.4665	0.4843
0.5024	0.5226	0.5492	0.5835	0.6258
0.6783	0.7413	0.8181	0.9064	1.0000

Hrad:

0.0492	0.0941	0.1355	0.1757	0.2161
0.2546	0.2915	0.3269	0.3612	0.3943
0.4264	0.4577	0.4882	0.5180	0.5471
0.5757	0.6037	0.6313	0.6584	0.6851
0.7115	0.7375	0.7632	0.7885	0.8137
0.8385	0.8632	0.8876	0.9118	0.9358
0.9597	0.9833	1.0068	1.0302	1.0534
1.0765	1.0995	1.1224	1.1451	1.1678
1.1903	1.2192	1.2369	1.2348	1.2170
1.1838	1.1411	1.0857	1.0374	1.0000

Width:

0.0631	0.0683	0.0734	0.0776	0.0806
0.0836	0.0867	0.0897	0.0927	0.0958
0.0988	0.1018	0.1048	0.1079	0.1109
0.1139	0.1170	0.1200	0.1230	0.1260
0.1291	0.1321	0.1351	0.1382	0.1412
0.1442	0.1472	0.1503	0.1533	0.1563
0.1594	0.1624	0.1654	0.1684	0.1715
0.1745	0.1775	0.1805	0.1836	0.1866
0.1896	0.2392	0.3157	0.3967	0.4900
0.5995	0.7071	0.8883	0.9442	1.0000

Transect XS-35

Area:

0.0069	0.0141	0.0216	0.0295	0.0377
0.0463	0.0552	0.0644	0.0740	0.0840
0.0943	0.1050	0.1161	0.1276	0.1395
0.1517	0.1643	0.1773	0.1906	0.2043
0.2184	0.2329	0.2477	0.2630	0.2786
0.2945	0.3109	0.3276	0.3447	0.3622
0.3800	0.3982	0.4168	0.4358	0.4551
0.4749	0.4949	0.5154	0.5363	0.5575
0.5791	0.6010	0.6239	0.6487	0.6758
0.7060	0.7480	0.8121	0.8984	1.0000

Hrad:

0.1064	0.2052	0.2975	0.3845	0.4669
0.5453	0.6204	0.6910	0.7588	0.8245
0.8884	0.9507	1.0115	1.0711	1.1296
1.1870	1.2435	1.2992	1.3541	1.4083
1.4619	1.5149	1.5674	1.6194	1.6709
1.7221	1.7728	1.8232	1.8732	1.9230
1.9725	2.0216	2.0706	2.1193	2.1678
2.2161	2.2641	2.3120	2.3597	2.4073
2.4547	2.5020	1.7448	1.6962	1.6208
1.5616	1.4920	1.2022	0.9961	1.0000

Width:

0.0593	0.0621	0.0649	0.0677	0.0705
0.0733	0.0761	0.0791	0.0823	0.0854
0.0886	0.0917	0.0949	0.0981	0.1012
0.1044	0.1075	0.1107	0.1138	0.1170
0.1201	0.1233	0.1264	0.1296	0.1327
0.1359	0.1390	0.1422	0.1453	0.1485
0.1516	0.1548	0.1579	0.1611	0.1642
0.1674	0.1705	0.1737	0.1768	0.1800
0.1831	0.1863	0.2003	0.2164	0.2393
0.2872	0.4300	0.6531	0.7773	1.0000

Transect XS-40

Area:

0.0070	0.0144	0.0225	0.0310	0.0401
0.0498	0.0599	0.0704	0.0813	0.0925
0.1041	0.1160	0.1284	0.1410	0.1541
0.1674	0.1812	0.1953	0.2098	0.2246
0.2398	0.2553	0.2712	0.2874	0.3040
0.3210	0.3383	0.3560	0.3741	0.3925
0.4112	0.4303	0.4498	0.4696	0.4898
0.5104	0.5313	0.5525	0.5742	0.5962
0.6185	0.6412	0.6642	0.6878	0.7153
0.7497	0.7917	0.8415	0.9066	1.0000

Hrad:

0.1517	0.2907	0.4198	0.5410	0.6558
0.5476	0.6281	0.7066	0.7840	0.8589
0.9316	1.0023	1.0712	1.1385	1.2044
1.2689	1.3322	1.3944	1.4556	1.5159
1.5753	1.6339	1.6918	1.7490	1.8056
1.8616	1.9171	1.9721	2.0266	2.0806
2.1343	2.1876	2.2405	2.2930	2.3452
2.3972	2.4488	2.5002	2.5513	2.6021
2.6528	2.7032	2.7534	2.6979	2.3217
2.0038	1.7984	1.6605	1.4325	1.0000

Width:

0.0660	0.0709	0.0758	0.0807	0.0856
0.0905	0.0943	0.0979	0.1012	0.1044
0.1077	0.1110	0.1143	0.1175	0.1208
0.1241	0.1274	0.1306	0.1339	0.1372
0.1405	0.1437	0.1470	0.1503	0.1536
0.1568	0.1601	0.1634	0.1667	0.1699
0.1732	0.1765	0.1798	0.1830	0.1863
0.1896	0.1929	0.1961	0.1994	0.2027
0.2060	0.2092	0.2125	0.2259	0.2809
0.3497	0.4184	0.5067	0.6928	1.0000

Transect XS-45

Area:

0.0067	0.0138	0.0214	0.0294	0.0378
0.0467	0.0561	0.0659	0.0761	0.0867

0.0977	0.1091	0.1208	0.1329	0.1453
0.1581	0.1712	0.1847	0.1986	0.2128
0.2274	0.2423	0.2576	0.2733	0.2893
0.3056	0.3223	0.3394	0.3569	0.3747
0.3928	0.4113	0.4302	0.4494	0.4690
0.4890	0.5093	0.5299	0.5509	0.5723
0.5940	0.6161	0.6386	0.6621	0.6916
0.7280	0.7734	0.8283	0.9039	1.0000

Hrad:

0.1309	0.2517	0.3643	0.4702	0.5706
0.6664	0.7584	0.8467	0.6674	0.7314
0.7935	0.8541	0.9131	0.9708	1.0273
1.0827	1.1372	1.1907	1.2434	1.2954
1.3466	1.3972	1.4473	1.4968	1.5458
1.5943	1.6424	1.6900	1.7373	1.7843
1.8309	1.8772	1.9232	1.9689	2.0144
2.0596	2.1046	2.1494	2.1940	2.2384
2.2826	2.3266	2.3704	2.1657	1.8438
1.6041	1.4012	1.2744	0.9843	1.0000

Width:

0.0674	0.0717	0.0761	0.0804	0.0848
0.0891	0.0934	0.0978	0.1022	0.1057
0.1092	0.1127	0.1162	0.1197	0.1231
0.1266	0.1301	0.1336	0.1371	0.1406
0.1441	0.1476	0.1511	0.1546	0.1581
0.1616	0.1651	0.1686	0.1721	0.1756
0.1791	0.1826	0.1861	0.1896	0.1931
0.1965	0.2000	0.2035	0.2070	0.2105
0.2140	0.2175	0.2210	0.2551	0.3210
0.3960	0.4897	0.5834	0.8775	1.0000

Transect XS-50

Area:

0.0056	0.0117	0.0182	0.0252	0.0327
0.0406	0.0490	0.0577	0.0667	0.0761
0.0857	0.0957	0.1060	0.1167	0.1277
0.1390	0.1507	0.1627	0.1750	0.1877
0.2007	0.2141	0.2278	0.2418	0.2562
0.2709	0.2859	0.3013	0.3170	0.3331
0.3495	0.3662	0.3833	0.4007	0.4184
0.4365	0.4549	0.4736	0.4937	0.5164
0.5417	0.5704	0.6028	0.6387	0.6782
0.7222	0.7801	0.8456	0.9145	1.0000

Hrad:

0.0449	0.0859	0.1237	0.1592	0.1927
0.2247	0.2580	0.2911	0.3231	0.3538
0.3831	0.4117	0.4396	0.4668	0.4936
0.5198	0.5456	0.5711	0.5961	0.6208
0.6452	0.6694	0.6932	0.7169	0.7403
0.7635	0.7865	0.8094	0.8321	0.8546
0.8770	0.8993	0.9214	0.9434	0.9653

0.9871	1.0089	1.0305	1.0585	1.0804
1.1005	1.1181	1.1290	1.1345	1.1359
1.1308	1.1032	1.0774	1.0473	1.0000

Width:

0.0610	0.0660	0.0709	0.0758	0.0807
0.0856	0.0894	0.0926	0.0958	0.0992
0.1027	0.1062	0.1097	0.1133	0.1168
0.1203	0.1239	0.1274	0.1309	0.1344
0.1380	0.1415	0.1450	0.1486	0.1521
0.1556	0.1591	0.1627	0.1662	0.1697
0.1733	0.1768	0.1803	0.1838	0.1874
0.1909	0.1944	0.1980	0.2234	0.2504
0.2821	0.3196	0.3570	0.3945	0.4319
0.5201	0.6720	0.6974	0.7882	1.0000

Transect XS-55

Area:

0.0057	0.0119	0.0186	0.0257	0.0333
0.0415	0.0501	0.0591	0.0685	0.0781
0.0880	0.0982	0.1086	0.1194	0.1304
0.1417	0.1533	0.1651	0.1773	0.1897
0.2024	0.2154	0.2287	0.2422	0.2561
0.2702	0.2846	0.2992	0.3142	0.3294
0.3450	0.3608	0.3769	0.3932	0.4099
0.4268	0.4440	0.4615	0.4793	0.4973
0.5157	0.5343	0.5532	0.5725	0.6020
0.6634	0.7409	0.8214	0.9057	1.0000

Hrad:

0.0479	0.0916	0.1321	0.1700	0.2059
0.2401	0.2729	0.3069	0.3435	0.3784
0.4118	0.4443	0.4759	0.5068	0.5370
0.5665	0.5955	0.6239	0.6519	0.6793
0.7064	0.7331	0.7595	0.7855	0.8112
0.8366	0.8617	0.8866	0.9113	0.9357
0.9600	0.9840	1.0079	1.0316	1.0551
1.0784	1.1017	1.1247	1.1477	1.1705
1.1932	1.2158	1.2383	1.2618	1.2727
1.2043	1.1280	1.0759	1.0366	1.0000

Width:

0.0598	0.0647	0.0696	0.0744	0.0793
0.0842	0.0890	0.0930	0.0955	0.0981
0.1010	0.1038	0.1066	0.1095	0.1123
0.1151	0.1180	0.1208	0.1236	0.1265
0.1293	0.1321	0.1350	0.1378	0.1406
0.1435	0.1463	0.1491	0.1520	0.1548
0.1576	0.1605	0.1633	0.1661	0.1690
0.1718	0.1747	0.1775	0.1803	0.1832
0.1860	0.1888	0.1917	0.2099	0.4714
0.7168	0.8028	0.8161	0.8974	1.0000

Transect XS-60

Area:

0.0064	0.0134	0.0208	0.0288	0.0372
0.0461	0.0556	0.0655	0.0759	0.0866
0.0976	0.1090	0.1207	0.1328	0.1452
0.1580	0.1711	0.1846	0.1984	0.2126
0.2271	0.2420	0.2573	0.2728	0.2888
0.3050	0.3217	0.3386	0.3560	0.3737
0.3917	0.4101	0.4288	0.4479	0.4673
0.4871	0.5072	0.5277	0.5485	0.5697
0.5912	0.6131	0.6354	0.6589	0.6868
0.7228	0.7699	0.8300	0.9059	1.0000

Hrad:

0.0418	0.0801	0.1156	0.1489	0.1805
0.2106	0.2395	0.2674	0.2977	0.3274
0.3563	0.3838	0.4107	0.4370	0.4627
0.4880	0.5127	0.5371	0.5611	0.5847
0.6080	0.6310	0.6538	0.6763	0.6985
0.7205	0.7424	0.7640	0.7855	0.8068
0.8279	0.8489	0.8698	0.8905	0.9111
0.9316	0.9520	0.9723	0.9924	1.0125
1.0325	1.0525	1.0757	1.1023	1.1275
1.1364	1.1257	1.0978	1.0535	1.0000

Width:

0.0664	0.0714	0.0764	0.0813	0.0863
0.0913	0.0963	0.1012	0.1047	0.1079
0.1112	0.1147	0.1181	0.1216	0.1251
0.1286	0.1321	0.1355	0.1390	0.1425
0.1460	0.1495	0.1529	0.1564	0.1599
0.1634	0.1668	0.1703	0.1738	0.1773
0.1808	0.1842	0.1877	0.1912	0.1947
0.1981	0.2016	0.2051	0.2086	0.2121
0.2155	0.2190	0.2263	0.2398	0.3161
0.4075	0.5286	0.6731	0.8459	1.0000

Transect XS-65

Area:

0.0060	0.0124	0.0193	0.0267	0.0346
0.0429	0.0516	0.0609	0.0705	0.0805
0.0908	0.1014	0.1123	0.1235	0.1350
0.1468	0.1590	0.1714	0.1841	0.1972
0.2105	0.2242	0.2382	0.2524	0.2670
0.2819	0.2971	0.3126	0.3284	0.3445
0.3610	0.3777	0.3947	0.4121	0.4297
0.4477	0.4659	0.4845	0.5034	0.5226
0.5421	0.5619	0.5837	0.6137	0.6521
0.6970	0.7480	0.8116	0.8938	1.0000

Hrad:

0.0479	0.0919	0.1328	0.1713	0.2077
0.2425	0.2760	0.3082	0.3425	0.3769
0.4103	0.4428	0.4745	0.5055	0.5358
0.5654	0.5946	0.6232	0.6513	0.6790

0.7063	0.7333	0.7599	0.7862	0.8122
0.8379	0.8634	0.8886	0.9136	0.9384
0.9630	0.9874	1.0116	1.0357	1.0596
1.0834	1.1070	1.1306	1.1539	1.1772
1.2003	1.2234	1.2411	1.2371	1.2179
1.1991	1.1750	1.1296	1.0698	1.0000

Width:

0.0534	0.0574	0.0614	0.0654	0.0694
0.0735	0.0775	0.0815	0.0845	0.0871
0.0898	0.0924	0.0951	0.0977	0.1003
0.1030	0.1056	0.1082	0.1109	0.1135
0.1162	0.1188	0.1214	0.1241	0.1267
0.1294	0.1320	0.1346	0.1373	0.1399
0.1426	0.1452	0.1478	0.1505	0.1531
0.1557	0.1584	0.1610	0.1637	0.1663
0.1689	0.1716	0.2204	0.2958	0.3589
0.4123	0.4656	0.6205	0.8042	1.0000

Transect XS-70

Area:

0.0040	0.0084	0.0132	0.0183	0.0239
0.0298	0.0361	0.0428	0.0498	0.0572
0.0648	0.0726	0.0808	0.0891	0.0978
0.1067	0.1158	0.1252	0.1349	0.1448
0.1549	0.1654	0.1760	0.1870	0.1982
0.2096	0.2214	0.2333	0.2455	0.2580
0.2708	0.2838	0.2970	0.3105	0.3245
0.3400	0.3590	0.3817	0.4082	0.4388
0.4796	0.5281	0.5794	0.6335	0.6903
0.7489	0.8091	0.8711	0.9347	1.0000

Hrad:

0.0495	0.0942	0.1353	0.1737	0.2099
0.2444	0.2775	0.3095	0.3421	0.3765
0.4099	0.4424	0.4741	0.5051	0.5353
0.5650	0.5941	0.6227	0.6509	0.6786
0.7059	0.7329	0.7596	0.7860	0.8121
0.8379	0.8636	0.8889	0.9141	0.9391
0.9639	0.9886	1.0131	1.0374	1.0686
1.1022	1.1259	1.1369	1.1379	1.1289
1.0925	1.0566	1.0295	1.0092	0.9958
0.9891	0.9871	0.9887	0.9932	1.0000

Width:

0.0635	0.0693	0.0751	0.0809	0.0866
0.0924	0.0982	0.1040	0.1090	0.1130
0.1169	0.1207	0.1246	0.1285	0.1324
0.1363	0.1402	0.1440	0.1479	0.1518
0.1557	0.1596	0.1635	0.1673	0.1712
0.1751	0.1790	0.1829	0.1868	0.1906
0.1945	0.1984	0.2023	0.2062	0.2194
0.2587	0.3155	0.3723	0.4291	0.5123
0.7121	0.7544	0.7967	0.8391	0.8727

0.8982	0.9236	0.9491	0.9745	1.0000

Transcect XS-75

Area:

0.0042	0.0089	0.0141	0.0198	0.0261
0.0328	0.0400	0.0475	0.0553	0.0634
0.0718	0.0805	0.0894	0.0987	0.1082
0.1180	0.1280	0.1384	0.1490	0.1599
0.1711	0.1825	0.1943	0.2063	0.2186
0.2312	0.2440	0.2572	0.2706	0.2843
0.2983	0.3125	0.3271	0.3419	0.3570
0.3726	0.3896	0.4096	0.4338	0.4672
0.5100	0.5558	0.6045	0.6561	0.7095
0.7645	0.8211	0.8792	0.9388	1.0000

Hrad:

0.0453	0.0856	0.1224	0.1566	0.1889
0.2196	0.2528	0.2860	0.3191	0.3514
0.3828	0.4133	0.4430	0.4720	0.5004
0.5283	0.5556	0.5825	0.6089	0.6350
0.6607	0.6861	0.7111	0.7359	0.7604
0.7847	0.8088	0.8327	0.8563	0.8798
0.9032	0.9263	0.9493	0.9722	0.9950
1.0234	1.0517	1.0782	1.0914	1.0776
1.0483	1.0256	1.0076	0.9941	0.9867
0.9836	0.9841	0.9872	0.9927	1.0000

Width:

0.0719	0.0801	0.0882	0.0964	0.1045
0.1126	0.1186	0.1239	0.1286	0.1331
0.1376	0.1421	0.1466	0.1511	0.1557
0.1602	0.1647	0.1692	0.1737	0.1782
0.1827	0.1872	0.1917	0.1962	0.2007
0.2052	0.2098	0.2143	0.2188	0.2233
0.2278	0.2323	0.2368	0.2413	0.2458
0.2624	0.2893	0.3565	0.4407	0.6360
0.7171	0.7631	0.8091	0.8499	0.8749
0.8999	0.9249	0.9500	0.9750	1.0000

Transect XS-80

Area:

0.0049	0.0105	0.0169	0.0240	0.0319
0.0406	0.0499	0.0598	0.0700	0.0804
0.0911	0.1020	0.1132	0.1245	0.1361
0.1480	0.1601	0.1724	0.1849	0.1977
0.2107	0.2239	0.2374	0.2511	0.2650
0.2792	0.2936	0.3082	0.3231	0.3382
0.3535	0.3691	0.3849	0.4009	0.4171
0.4336	0.4504	0.4674	0.4872	0.5103
0.5370	0.5680	0.6079	0.6570	0.7087
0.7624	0.8180	0.8757	0.9354	1.0000

Hrad:

0.0413	0.0774	0.1102	0.1406	0.1693

0.1969	0.2259	0.2589	0.2922	0.3262
0.3591	0.3912	0.4225	0.4529	0.4827
0.5118	0.5403	0.5682	0.5956	0.6225
0.6489	0.6750	0.7006	0.7258	0.7507
0.7752	0.7994	0.8233	0.8470	0.8703
0.8934	0.9163	0.9390	0.9614	0.9837
1.0057	1.0276	1.0536	1.0835	1.1039
1.1164	1.1194	1.1026	1.0753	1.0552
1.0404	1.0299	1.0229	1.0187	1.0000

Width:

0.0731	0.0836	0.0941	0.1046	0.1151
0.1256	0.1344	0.1396	0.1438	0.1471
0.1503	0.1535	0.1568	0.1600	0.1633
0.1665	0.1697	0.1730	0.1762	0.1794
0.1827	0.1859	0.1891	0.1924	0.1956
0.1988	0.2021	0.2053	0.2085	0.2118
0.2150	0.2182	0.2215	0.2247	0.2279
0.2312	0.2344	0.2507	0.2986	0.3466
0.3945	0.4802	0.6338	0.7053	0.7332
0.7612	0.7892	0.8171	0.8451	1.0000

Transect XS-85

Area:

0.0060	0.0125	0.0196	0.0273	0.0356
0.0444	0.0537	0.0636	0.0741	0.0852
0.0968	0.1088	0.1211	0.1338	0.1468
0.1601	0.1737	0.1877	0.2020	0.2166
0.2316	0.2469	0.2625	0.2784	0.2946
0.3112	0.3281	0.3454	0.3629	0.3808
0.3990	0.4176	0.4364	0.4556	0.4751
0.4950	0.5151	0.5356	0.5565	0.5776
0.5991	0.6209	0.6432	0.6682	0.6965
0.7308	0.7823	0.8443	0.9131	1.0000

Hrad:

0.0408	0.0778	0.1119	0.1439	0.1740
0.2028	0.2304	0.2571	0.2829	0.3082
0.3338	0.3630	0.3914	0.4192	0.4462
0.4727	0.4987	0.5241	0.5491	0.5737
0.5978	0.6216	0.6451	0.6683	0.6911
0.7137	0.7360	0.7581	0.7800	0.8017
0.8231	0.8444	0.8655	0.8865	0.9072
0.9279	0.9484	0.9687	0.9890	1.0091
1.0291	1.0490	1.0712	1.0929	1.1081
1.1149	1.0964	1.0707	1.0448	1.0000

Width:

0.0596	0.0649	0.0703	0.0756	0.0809
0.0863	0.0916	0.0970	0.1023	0.1076
0.1126	0.1157	0.1188	0.1219	0.1250
0.1281	0.1312	0.1343	0.1374	0.1405
0.1436	0.1467	0.1498	0.1529	0.1560
0.1591	0.1622	0.1653	0.1684	0.1715

0.1746	0.1777	0.1808	0.1839	0.1870
0.1901	0.1932	0.1963	0.1994	0.2025
0.2056	0.2087	0.2220	0.2533	0.2846
0.3996	0.5568	0.6213	0.6858	1.0000

Transect XS-90

Area:

0.0045	0.0095	0.0150	0.0210	0.0274
0.0344	0.0419	0.0498	0.0581	0.0667
0.0754	0.0845	0.0938	0.1034	0.1132
0.1232	0.1336	0.1441	0.1550	0.1660
0.1774	0.1889	0.2008	0.2129	0.2252
0.2378	0.2507	0.2638	0.2771	0.2908
0.3046	0.3187	0.3331	0.3477	0.3626
0.3778	0.3931	0.4088	0.4247	0.4422
0.4664	0.4987	0.5395	0.5881	0.6422
0.7053	0.7759	0.8486	0.9233	1.0000

Hrad:

0.0487	0.0925	0.1326	0.1700	0.2053
0.2390	0.2714	0.3039	0.3415	0.3778
0.4131	0.4473	0.4807	0.5133	0.5451
0.5763	0.6068	0.6368	0.6662	0.6952
0.7237	0.7519	0.7796	0.8070	0.8341
0.8608	0.8873	0.9135	0.9395	0.9652
0.9907	1.0160	1.0411	1.0660	1.0908
1.1154	1.1398	1.1641	1.1882	1.2129
1.2238	1.2153	1.1890	1.1539	1.1212
1.0824	1.0465	1.0234	1.0086	1.0000

Width:

0.0611	0.0674	0.0738	0.0801	0.0865
0.0929	0.0992	0.1051	0.1083	0.1116
0.1148	0.1181	0.1214	0.1246	0.1279
0.1312	0.1344	0.1377	0.1409	0.1442
0.1475	0.1507	0.1540	0.1572	0.1605
0.1638	0.1670	0.1703	0.1736	0.1768
0.1801	0.1833	0.1866	0.1899	0.1931
0.1964	0.1996	0.2029	0.2062	0.2639
0.3631	0.4703	0.5775	0.6614	0.7467
0.8788	0.9227	0.9485	0.9742	1.0000

Transect XS-95

Area:

0.0065	0.0135	0.0211	0.0291	0.0376
0.0467	0.0563	0.0663	0.0769	0.0880
0.0995	0.1114	0.1236	0.1362	0.1491
0.1623	0.1759	0.1898	0.2041	0.2187
0.2336	0.2489	0.2645	0.2805	0.2968
0.3135	0.3305	0.3478	0.3655	0.3835
0.4018	0.4205	0.4396	0.4590	0.4787
0.4987	0.5191	0.5399	0.5610	0.5824
0.6042	0.6263	0.6487	0.6734	0.7037

0.7401	0.7848	0.8400	0.9137	1.0000

Hrad:

0.0415	0.0795	0.1148	0.1478	0.1790
0.2088	0.2373	0.2649	0.2915	0.3177
0.3459	0.3738	0.4011	0.4277	0.4538
0.4792	0.5042	0.5287	0.5528	0.5764
0.5998	0.6228	0.6454	0.6678	0.6899
0.7118	0.7335	0.7549	0.7761	0.7972
0.8181	0.8388	0.8593	0.8797	0.9000
0.9201	0.9401	0.9600	0.9798	0.9994
1.0190	1.0385	1.0579	1.0801	1.0922
1.0976	1.0950	1.0785	1.0396	1.0000

Width:

0.0729	0.0784	0.0839	0.0894	0.0949
0.1003	0.1058	0.1113	0.1168	0.1221
0.1261	0.1299	0.1335	0.1372	0.1409
0.1446	0.1482	0.1519	0.1556	0.1593
0.1630	0.1666	0.1703	0.1740	0.1777
0.1813	0.1850	0.1887	0.1924	0.1961
0.1997	0.2034	0.2071	0.2108	0.2144
0.2181	0.2218	0.2255	0.2292	0.2328
0.2365	0.2402	0.2439	0.2959	0.3581
0.4339	0.5299	0.7081	0.8606	1.0000

Transect XS-BD101
Area:

0.0041	0.0083	0.0125	0.0168	0.0212
0.0256	0.0303	0.0352	0.0403	0.0458
0.0515	0.0576	0.0640	0.0707	0.0777
0.0851	0.0927	0.1007	0.1091	0.1177
0.1267	0.1359	0.1455	0.1554	0.1657
0.1762	0.1871	0.1983	0.2098	0.2217
0.2339	0.2463	0.2591	0.2723	0.2857
0.2995	0.3136	0.3280	0.3427	0.3577
0.3731	0.3888	0.4048	0.4211	0.4378
0.4552	0.4734	0.5228	0.6762	1.0000

Hrad:

0.0872	0.1670	0.2403	0.3082	0.3712
0.4267	0.4766	0.5246	0.5692	0.6095
0.6497	0.6896	0.7293	0.7689	0.8083
0.8476	0.8868	0.9260	0.9650	1.0039
1.0428	1.0817	1.1204	1.1592	1.1979
1.2365	1.2751	1.3137	1.3522	1.3907
1.4292	1.4677	1.5061	1.5445	1.5829
1.6213	1.6597	1.6980	1.7364	1.7747
1.8130	1.8513	1.8896	1.9278	1.9529
1.9458	1.9428	1.7922	1.4068	1.0000

Width:

0.0090	0.0092	0.0093	0.0095	0.0096
0.0099	0.0104	0.0109	0.0115	0.0122
0.0129	0.0136	0.0143	0.0150	0.0157

0.0164	0.0171	0.0178	0.0185	0.0192
0.0199	0.0206	0.0213	0.0220	0.0227
0.0234	0.0241	0.0248	0.0255	0.0262
0.0269	0.0276	0.0283	0.0290	0.0297
0.0304	0.0311	0.0318	0.0325	0.0332
0.0339	0.0346	0.0353	0.0360	0.0370
0.0388	0.0407	0.2191	0.4577	1.0000

Transect XS-BD102

Area:

0.0032	0.0066	0.0099	0.0134	0.0169
0.0204	0.0240	0.0277	0.0315	0.0353
0.0391	0.0431	0.0471	0.0511	0.0552
0.0594	0.0637	0.0682	0.0728	0.0776
0.0826	0.0878	0.0932	0.0987	0.1044
0.1104	0.1164	0.1227	0.1292	0.1358
0.1426	0.1496	0.1568	0.1641	0.1717
0.1794	0.1873	0.1954	0.2043	0.2148
0.2268	0.2403	0.2553	0.2718	0.3113
0.4321	0.5544	0.6783	0.8058	1.0000

Hrad:

0.0810	0.1579	0.2312	0.3011	0.3681
0.4324	0.4941	0.5536	0.6111	0.6665
0.7203	0.7724	0.8230	0.8722	0.9201
0.9639	0.9988	1.0287	1.0591	1.0899
1.1211	1.1526	1.1844	1.2165	1.2489
1.2815	1.3144	1.3474	1.3806	1.4140
1.4475	1.4812	1.5150	1.5489	1.5830
1.6171	1.6514	1.6860	1.7297	1.7595
1.7790	1.7910	1.7979	1.8017	1.5671
1.1844	1.0599	1.0362	1.0538	1.0000

Width:

0.0100	0.0102	0.0104	0.0106	0.0108
0.0110	0.0112	0.0114	0.0115	0.0117
0.0119	0.0121	0.0123	0.0125	0.0127
0.0129	0.0134	0.0139	0.0145	0.0150
0.0156	0.0161	0.0167	0.0172	0.0178
0.0183	0.0189	0.0195	0.0200	0.0206
0.0211	0.0217	0.0222	0.0228	0.0233
0.0239	0.0244	0.0250	0.0297	0.0343
0.0390	0.0436	0.0483	0.0529	0.3099
0.3738	0.3741	0.3846	0.3959	1.0000

Transect XS-BD103

Area:

0.0044	0.0090	0.0136	0.0183	0.0232
0.0281	0.0331	0.0382	0.0435	0.0488
0.0542	0.0597	0.0653	0.0710	0.0769
0.0831	0.0895	0.0962	0.1031	0.1102
0.1176	0.1253	0.1332	0.1413	0.1497
0.1583	0.1672	0.1763	0.1856	0.1952

	0.2051	0.2152	0.2255	0.2361	0.2469
	0.2580	0.2693	0.2812	0.2950	0.3110
	0.3292	0.3495	0.3719	0.3966	0.4240
	0.4545	0.4880	0.5246	0.6612	1.0000
Hrad:					
	0.0791	0.1541	0.2254	0.2934	0.3584
	0.4208	0.4806	0.5382	0.5938	0.6475
	0.6995	0.7500	0.7989	0.8411	0.8755
	0.9099	0.9444	0.9790	1.0136	1.0483
	1.0830	1.1178	1.1526	1.1874	1.2223
	1.2572	1.2921	1.3270	1.3620	1.3970
	1.4320	1.4670	1.5021	1.5371	1.5722
	1.6073	1.6424	1.6871	1.7267	1.7541
	1.7724	1.7841	1.7915	1.8006	1.8147
	1.8235	1.8295	1.8344	1.4746	1.0000
Width:					
	0.0102	0.0104	0.0106	0.0109	0.0111
	0.0113	0.0115	0.0117	0.0120	0.0122
	0.0124	0.0126	0.0128	0.0132	0.0138
	0.0143	0.0149	0.0154	0.0160	0.0165
	0.0171	0.0177	0.0182	0.0188	0.0193
	0.0199	0.0204	0.0210	0.0215	0.0221
	0.0227	0.0232	0.0238	0.0243	0.0249
	0.0254	0.0260	0.0291	0.0339	0.0388
	0.0437	0.0486	0.0534	0.0589	0.0658
	0.0728	0.0797	0.0866	0.5403	1.0000

Transect XS-BD105

Area:					
	0.0026	0.0053	0.0082	0.0111	0.0142
	0.0175	0.0208	0.0243	0.0279	0.0316
	0.0354	0.0394	0.0435	0.0477	0.0521
	0.0567	0.0614	0.0663	0.0714	0.0767
	0.0821	0.0877	0.0935	0.0995	0.1056
	0.1119	0.1184	0.1250	0.1319	0.1389
	0.1460	0.1534	0.1609	0.1686	0.1764
	0.1845	0.1927	0.2011	0.2096	0.2188
	0.2293	0.2411	0.2541	0.2684	0.2895
	0.3478	0.4479	0.5898	0.7735	1.0000
Hrad:					
	0.0923	0.1787	0.2602	0.3375	0.4111
	0.4816	0.5494	0.6148	0.6780	0.7394
	0.7990	0.8572	0.9137	0.9630	1.0098
	1.0563	1.1024	1.1482	1.1938	1.2392
	1.2843	1.3292	1.3740	1.4186	1.4630
	1.5073	1.5515	1.5956	1.6396	1.6834
	1.7272	1.7709	1.8146	1.8581	1.9016
	1.9450	1.9884	2.0317	2.0761	2.1499
	2.2131	2.2645	2.3064	2.3410	2.2776
	1.9545	1.5831	1.3013	1.1205	1.0000
Width:					

0.0105	0.0110	0.0115	0.0119	0.0124
0.0129	0.0134	0.0139	0.0144	0.0149
0.0154	0.0158	0.0163	0.0170	0.0177
0.0183	0.0190	0.0197	0.0204	0.0211
0.0217	0.0224	0.0231	0.0238	0.0245
0.0252	0.0258	0.0265	0.0272	0.0279
0.0286	0.0292	0.0299	0.0306	0.0313
0.0320	0.0326	0.0333	0.0341	0.0388
0.0438	0.0487	0.0537	0.0587	0.1474
0.3118	0.4763	0.6407	0.8052	1.0000

Transect XS-R3

Area:

0.0059	0.0128	0.0207	0.0296	0.0395
0.0503	0.0620	0.0741	0.0867	0.0996
0.1128	0.1264	0.1402	0.1544	0.1689
0.1837	0.1989	0.2143	0.2301	0.2462
0.2626	0.2794	0.2964	0.3138	0.3315
0.3495	0.3678	0.3865	0.4055	0.4247
0.4443	0.4643	0.4845	0.5051	0.5260
0.5472	0.5687	0.5905	0.6127	0.6352
0.6580	0.6811	0.7049	0.7302	0.7572
0.7866	0.8247	0.8739	0.9331	1.0000

Hrad:

0.0340	0.0635	0.0903	0.1152	0.1387
0.1613	0.1886	0.2157	0.2442	0.2722
0.2995	0.3262	0.3521	0.3775	0.4023
0.4266	0.4505	0.4739	0.4969	0.5196
0.5419	0.5639	0.5855	0.6069	0.6280
0.6488	0.6694	0.6898	0.7100	0.7300
0.7498	0.7694	0.7888	0.8081	0.8272
0.8462	0.8650	0.8837	0.9023	0.9208
0.9391	0.9574	0.9800	1.0023	1.0219
1.0376	1.0449	1.0374	1.0202	1.0000

Width:

0.0907	0.1047	0.1187	0.1327	0.1467
0.1607	0.1685	0.1755	0.1804	0.1849
0.1894	0.1939	0.1985	0.2030	0.2075
0.2120	0.2165	0.2211	0.2256	0.2301
0.2346	0.2391	0.2436	0.2482	0.2527
0.2572	0.2617	0.2662	0.2707	0.2753
0.2798	0.2843	0.2888	0.2933	0.2978
0.3024	0.3069	0.3114	0.3159	0.3204
0.3250	0.3295	0.3469	0.3701	0.3933
0.4635	0.6179	0.7755	0.8925	1.0000

Transect XS-ResStreet

Area:

0.0006	0.0024	0.0053	0.0095	0.0148
0.0213	0.0291	0.0379	0.0480	0.0593
0.0717	0.0854	0.1002	0.1162	0.1334

	0.1518	0.1714	0.1921	0.2141	0.2372
	0.2613	0.2856	0.3098	0.3341	0.3584
	0.3826	0.4069	0.4311	0.4554	0.4797
	0.5039	0.5282	0.5524	0.5767	0.6011
	0.6257	0.6507	0.6759	0.7014	0.7271
	0.7532	0.7795	0.8061	0.8329	0.8601
	0.8875	0.9152	0.9432	0.9715	1.0000
Hrad:					
	0.0131	0.0263	0.0394	0.0526	0.0657
	0.0789	0.0920	0.1051	0.1183	0.1314
	0.1446	0.1577	0.1709	0.1840	0.1971
	0.2103	0.2234	0.2366	0.2497	0.2629
	0.2831	0.3093	0.3355	0.3617	0.3879
	0.4141	0.4402	0.4664	0.4925	0.5186
	0.5447	0.5708	0.5969	0.6230	0.6490
	0.6746	0.6999	0.7248	0.7493	0.7735
	0.7974	0.8210	0.8443	0.8674	0.8901
	0.9126	0.9348	0.9568	0.9785	1.0000
Width:					
	0.0414	0.0827	0.1241	0.1654	0.2068
	0.2482	0.2895	0.3309	0.3722	0.4136
	0.4549	0.4963	0.5377	0.5790	0.6204
	0.6617	0.7031	0.7445	0.7858	0.8272
	0.8460	0.8460	0.8460	0.8460	0.8460
	0.8460	0.8461	0.8461	0.8461	0.8461
	0.8461	0.8461	0.8461	0.8462	0.8549
	0.8646	0.8743	0.8840	0.8936	0.9033
	0.9130	0.9226	0.9323	0.9420	0.9516
	0.9613	0.9710	0.9807	0.9903	1.0000

```
**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......        51.492       108.945
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         9.742        20.613
Surface Runoff ...........        38.785        82.061
Final Surface Storage ....         2.964         6.272
Continuity Error (%) .....        -0.000


**************************        Volume        Volume
Flow Routing Continuity        hectare-m       Mliters
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......        38.785       387.857
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........        29.656       296.562
```

Surface Flooding	0.000	0.000
Evaporation Loss	0.000	0.000
Initial Stored Volume	0.282	2.824
Final Stored Volume	9.491	94.907
Continuity Error (%)	-0.202	

****
Composite Curve Number Computations Report
****

Subbasin 3

Soil/Surface Description	Area (ha)	Soil Group	CN
-	65.17	-	75.00
Composite Area & Weighted CN	65.17		75.00

Subbasin A3868

Soil/Surface Description	Area (ha)	Soil Group	CN
-	6.82	-	90.00
Composite Area & Weighted CN	6.82		90.00

Subbasin A3876

Soil/Surface Description	Area (ha)	Soil Group	CN
-	8.44	-	90.00
Composite Area & Weighted CN	8.44		90.00

Subbasin A3877

Soil/Surface Description	Area (ha)	Soil Group	CN
-	2.77	-	90.00
Composite Area & Weighted CN	2.77		90.00

Subbasin A4

Area Soil

Soil/Surface Description	(ha)	Group	CN
-	5.92	-	90.00
Composite Area & Weighted CN	5.92		90.00

Subbasin A4389

Soil/Surface Description	Area (ha)	Soil Group	CN
-	4.75	-	90.00
Composite Area & Weighted CN	4.75		90.00

Subbasin A4422

Soil/Surface Description	Area (ha)	Soil Group	CN
-	6.72	-	90.00
Composite Area & Weighted CN	6.72		90.00

Subbasin A4469

Soil/Surface Description	Area (ha)	Soil Group	CN
-	1.62	-	90.00
Composite Area & Weighted CN	1.62		90.00

Subbasin A4528

Soil/Surface Description	Area (ha)	Soil Group	CN
-	5.80	-	90.00
Composite Area & Weighted CN	5.80		90.00

Subbasin A4572

Soil/Surface Description	Area (ha)	Soil Group	CN
-	6.76	-	90.00
Composite Area & Weighted CN	6.76		90.00

Subbasin A4576

Soil/Surface Description	Area (ha)	Soil Group	CN
-	6.46	-	90.00
Composite Area & Weighted CN	6.46		90.00

Subbasin A4589

Soil/Surface Description	Area (ha)	Soil Group	CN
-	13.74	-	90.00
Composite Area & Weighted CN	13.74		90.00

Subbasin A4615

Soil/Surface Description	Area (ha)	Soil Group	CN
-	2.88	-	90.00
Composite Area & Weighted CN	2.88		90.00

Subbasin A4672

Soil/Surface Description	Area (ha)	Soil Group	CN
-	2.93	-	90.00
Composite Area & Weighted CN	2.93		90.00

Subbasin A4690

Soil/Surface Description	Area (ha)	Soil Group	CN
-	4.21	-	90.00
Composite Area & Weighted CN	4.21		90.00

Subbasin A4719

Soil/Surface Description	Area (ha)	Soil Group	CN
-	4.92	-	90.00

Composite Area & Weighted CN	4.92		90.00

Subbasin A4722

Soil/Surface Description	Area (ha)	Soil Group	CN
-	1.29	-	90.00
Composite Area & Weighted CN	1.29		90.00

Subbasin A4737

Soil/Surface Description	Area (ha)	Soil Group	CN
-	2.04	-	90.00
Composite Area & Weighted CN	2.04		90.00

Subbasin A4809

Soil/Surface Description	Area (ha)	Soil Group	CN
-	1.74	-	90.00
Composite Area & Weighted CN	1.74		90.00

Subbasin A5070

Soil/Surface Description	Area (ha)	Soil Group	CN
-	3.21	-	90.00
Composite Area & Weighted CN	3.21		90.00

Subbasin CYR-D1

Soil/Surface Description	Area (ha)	Soil Group	CN
-	1.89	-	90.00
Composite Area & Weighted CN	1.89		90.00

Subbasin CYR-D2

Area Soil

Soil/Surface Description	(ha)	Group	CN
-	1.89	-	90.00
Composite Area & Weighted CN	1.89		90.00

Subbasin CYR-D3

Soil/Surface Description	Area (ha)	Soil Group	CN
-	1.89	-	90.00
Composite Area & Weighted CN	1.89		90.00

Subbasin CYR-D4

Soil/Surface Description	Area (ha)	Soil Group	CN
-	1.89	-	90.00
Composite Area & Weighted CN	1.89		90.00

Subbasin CYR-D5

Soil/Surface Description	Area (ha)	Soil Group	CN
-	1.89	-	90.00
Composite Area & Weighted CN	1.89		90.00

Subbasin ETRD A

Soil/Surface Description	Area (ha)	Soil Group	CN
-	27.40	-	88.30
Composite Area & Weighted CN	27.40		88.30

Subbasin ETRD C_FU

Soil/Surface Description	Area (ha)	Soil Group	CN
-	23.50	-	92.90
Composite Area & Weighted CN	23.50		92.90

Subbasin ETRD E_FU

Soil/Surface Description	Area (ha)	Soil Group	CN
-	23.30	-	91.60
Composite Area & Weighted CN	23.30		91.60

Subbasin Manning Rd Drain A

Soil/Surface Description	Area (ha)	Soil Group	CN
-	11.00	-	98.00
Composite Area & Weighted CN	11.00		98.00

Subbasin Manning Rd Drain B

Soil/Surface Description	Area (ha)	Soil Group	CN
-	27.65	-	88.30
Composite Area & Weighted CN	27.65		88.30

Subbasin SPA1

Soil/Surface Description	Area (ha)	Soil Group	CN
-	7.70	-	90.00
Composite Area & Weighted CN	7.70		90.00

Subbasin SPA100

Soil/Surface Description	Area (ha)	Soil Group	CN
-	7.40	-	90.00
Composite Area & Weighted CN	7.40		90.00

Subbasin SPA106

Soil/Surface Description	Area (ha)	Soil Group	CN
-	5.90	-	90.00

Composite Area & Weighted CN	5.90		90.00

Subbasin SPA14

Soil/Surface Description	Area (ha)	Soil Group	CN
-	6.20	-	90.00
Composite Area & Weighted CN	6.20		90.00

Subbasin SPA21

Soil/Surface Description	Area (ha)	Soil Group	CN
-	9.30	-	90.00
Composite Area & Weighted CN	9.30		90.00

Subbasin SPA35

Soil/Surface Description	Area (ha)	Soil Group	CN
-	12.00	-	90.00
Composite Area & Weighted CN	12.00		90.00

Subbasin SPA50

Soil/Surface Description	Area (ha)	Soil Group	CN
-	10.20	-	90.00
Composite Area & Weighted CN	10.20		90.00

Subbasin SPA51

Soil/Surface Description	Area (ha)	Soil Group	CN
-	11.30	-	94.10
Composite Area & Weighted CN	11.30		94.10

Subbasin SPA-52

Area Soil

Soil/Surface Description	(ha)	Group	CN
-	2.50	-	94.10
Composite Area & Weighted CN	2.50		94.10

Subbasin SPA62

Soil/Surface Description	Area (ha)	Soil Group	CN
-	2.60	-	90.00
Composite Area & Weighted CN	2.60		90.00

Subbasin SPA69

Soil/Surface Description	Area (ha)	Soil Group	CN
-	4.00	-	90.00
Composite Area & Weighted CN	4.00		90.00

Subbasin SPA79

Soil/Surface Description	Area (ha)	Soil Group	CN
-	8.70	-	90.00
Composite Area & Weighted CN	8.70		90.00

Subbasin SPA86

Soil/Surface Description	Area (ha)	Soil Group	CN
-	5.46	-	90.00
Composite Area & Weighted CN	5.46		90.00

Subbasin SPA86a

Soil/Surface Description	Area (ha)	Soil Group	CN
-	1.94	-	90.00
Composite Area & Weighted CN	1.94		90.00

Subbasin Sub-03

Soil/Surface Description	Area (ha)	Soil Group	CN
-	12.83	-	79.00
Composite Area & Weighted CN	12.83		79.00

Subbasin Sub-04

Soil/Surface Description	Area (ha)	Soil Group	CN
-	14.41	-	79.00
Composite Area & Weighted CN	14.41		79.00

Subbasin Sub-05

Soil/Surface Description	Area (ha)	Soil Group	CN
-	17.73	-	79.00
Composite Area & Weighted CN	17.73		79.00

Subbasin Sub-06

Soil/Surface Description	Area (ha)	Soil Group	CN
-	4.72	-	79.00
Composite Area & Weighted CN	4.72		79.00

Subbasin Sub-08

Soil/Surface Description	Area (ha)	Soil Group	CN
-	36.74	-	75.00
Composite Area & Weighted CN	36.74		75.00

Subbasin ToPond

Soil/Surface Description	Area (ha)	Soil Group	CN
-	6.60	-	95.00

```
Composite Area & Weighted CN                              6.60                      95.00


**************************************************
EPA SWMM Time of Concentration Computations Report
**************************************************

        Tc = (0.94 * (L^0.6) * (n^0.6)) / ((i^0.4) * (S^0.3))

        Where:

        Tc = Time of Concentration (min)
        L  = Flow Length (ft)
        n  = Manning's Roughness
        i  = Rainfall Intensity (in/hr)
        S  = Slope (ft/ft)

-------------
Subbasin 3
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        Flow length (m):                                  4764.10
        Pervious Manning's Roughness:                     0.10000
        Impervious Manning's Roughness:                   0.01500
        Pervious Rainfall Intensity (mm/hr):              4.73674
        Impervious Rainfall Intensity (mm/hr):            4.73674
        Slope (%):                                        0.10000
        Computed TOC (minutes):                            887.75

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Subbasin A3868
-----------------

        Flow length (m):                                   219.97
        Pervious Manning's Roughness:                     0.10000
        Impervious Manning's Roughness:                   0.01500
        Pervious Rainfall Intensity (mm/hr):              4.73674
        Impervious Rainfall Intensity (mm/hr):            4.73674
        Slope (%):                                        0.15000
        Computed TOC (minutes):                            141.98

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Subbasin A3876
-----------------

        Flow length (m):                                   309.95
        Pervious Manning's Roughness:                     0.10000
        Impervious Manning's Roughness:                   0.01500
        Pervious Rainfall Intensity (mm/hr):              4.73674
        Impervious Rainfall Intensity (mm/hr):            4.73674
        Slope (%):                                        0.15000
```

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Computed TOC (minutes):                        174.42

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Subbasin A3877
-----------------

Flow length (m):                               107.99
Pervious Manning's Roughness:                  0.10000
Impervious Manning's Roughness:                0.01500
Pervious Rainfall Intensity (mm/hr):           4.73674
Impervious Rainfall Intensity (mm/hr):         4.73674
Slope (%):                                     0.15000
Computed TOC (minutes):                         92.65

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Subbasin A4
--------------

Flow length (m):                               187.02
Pervious Manning's Roughness:                  0.10000
Impervious Manning's Roughness:                0.01500
Pervious Rainfall Intensity (mm/hr):           4.73674
Impervious Rainfall Intensity (mm/hr):         4.73674
Slope (%):                                     0.15000
Computed TOC (minutes):                        128.81

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Subbasin A4389
-----------------

Flow length (m):                               350.07
Pervious Manning's Roughness:                  0.10000
Impervious Manning's Roughness:                0.01500
Pervious Rainfall Intensity (mm/hr):           4.73674
Impervious Rainfall Intensity (mm/hr):         4.73674
Slope (%):                                     0.15000
Computed TOC (minutes):                        195.04

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Subbasin A4422
-----------------

Flow length (m):                               299.96
Pervious Manning's Roughness:                  0.10000
Impervious Manning's Roughness:                0.01500
Pervious Rainfall Intensity (mm/hr):           4.73674
Impervious Rainfall Intensity (mm/hr):         4.73674
Slope (%):                                     0.15000
Computed TOC (minutes):                        171.02

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Subbasin A4469
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        Flow length (m):                            198.05
        Pervious Manning's Roughness:              0.10000
        Impervious Manning's Roughness:            0.01500
        Pervious Rainfall Intensity (mm/hr):       4.73674
        Impervious Rainfall Intensity (mm/hr):     4.73674
        Slope (%):                                 0.15000
        Computed TOC (minutes):                     138.58

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Subbasin A4528
-----------------

        Flow length (m):                            444.86
        Pervious Manning's Roughness:              0.10000
        Impervious Manning's Roughness:            0.01500
        Pervious Rainfall Intensity (mm/hr):       4.73674
        Impervious Rainfall Intensity (mm/hr):     4.73674
        Slope (%):                                 0.15000
        Computed TOC (minutes):                     216.65

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Subbasin A4572
-----------------

        Flow length (m):                            329.97
        Pervious Manning's Roughness:              0.10000
        Impervious Manning's Roughness:            0.01500
        Pervious Rainfall Intensity (mm/hr):       4.73674
        Impervious Rainfall Intensity (mm/hr):     4.73674
        Slope (%):                                 0.15000
        Computed TOC (minutes):                     188.24

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Subbasin A4576
-----------------

        Flow length (m):                            310.03
        Pervious Manning's Roughness:              0.10000
        Impervious Manning's Roughness:            0.01500
        Pervious Rainfall Intensity (mm/hr):       4.73674
        Impervious Rainfall Intensity (mm/hr):     4.73674
        Slope (%):                                 0.15000
        Computed TOC (minutes):                     181.33

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Subbasin A4589
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```

Flow length (m):	415.23
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	224.08

Subbasin A4615

Flow length (m):	50.00
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	58.37

Subbasin A4672

Flow length (m):	155.00
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	100.66

Subbasin A4690

Flow length (m):	255.03
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	135.72

Subbasin A4719

Flow length (m):	264.94
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500

```
        Pervious Rainfall Intensity (mm/hr):       4.73674
        Impervious Rainfall Intensity (mm/hr):     4.73674
        Slope (%):                                 0.15000
        Computed TOC (minutes):                     138.86

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Subbasin A4722
-----------------

        Flow length (m):                            140.00
        Pervious Manning's Roughness:              0.10000
        Impervious Manning's Roughness:            0.01500
        Pervious Rainfall Intensity (mm/hr):       4.73674
        Impervious Rainfall Intensity (mm/hr):     4.73674
        Slope (%):                                 0.15000
        Computed TOC (minutes):                      94.70

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Subbasin A4737
-----------------

        Flow length (m):                             91.99
        Pervious Manning's Roughness:              0.10000
        Impervious Manning's Roughness:            0.01500
        Pervious Rainfall Intensity (mm/hr):       4.73674
        Impervious Rainfall Intensity (mm/hr):     4.73674
        Slope (%):                                 0.15000
        Computed TOC (minutes):                      73.61

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Subbasin A4809
-----------------

        Flow length (m):                            135.02
        Pervious Manning's Roughness:              0.10000
        Impervious Manning's Roughness:            0.01500
        Pervious Rainfall Intensity (mm/hr):       4.73674
        Impervious Rainfall Intensity (mm/hr):     4.73674
        Slope (%):                                 0.15000
        Computed TOC (minutes):                      97.22

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Subbasin A5070
-----------------

        Flow length (m):                            239.96
        Pervious Manning's Roughness:              0.10000
        Impervious Manning's Roughness:            0.01500
        Pervious Rainfall Intensity (mm/hr):       4.73674
        Impervious Rainfall Intensity (mm/hr):     4.73674
        Slope (%):                                 0.15000
```

Computed TOC (minutes): 137.28

Subbasin CYR-D1

Flow length (m):	60.20
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	60.87

Subbasin CYR-D2

Flow length (m):	218.59
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	145.48

Subbasin CYR-D3

Flow length (m):	3.14
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	5.48

Subbasin CYR-D4

Flow length (m):	1678.40
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	409.32

Subbasin CYR-D5

Flow length (m):	2166.67
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	542.47

Subbasin ETRD A

Flow length (m):	523.90
Pervious Manning's Roughness:	0.25000
Impervious Manning's Roughness:	0.01300
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.20000
Computed TOC (minutes):	355.03

Subbasin ETRD C_FU

Flow length (m):	540.23
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.05000
Computed TOC (minutes):	232.11

Subbasin ETRD E_FU

Flow length (m):	485.42
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.10000
Computed TOC (minutes):	214.04

Subbasin Manning Rd Drain A

Flow length (m): 378.25
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 4.73674
Impervious Rainfall Intensity (mm/hr): 4.73674
Slope (%): 0.05000
Computed TOC (minutes): 104.05

Subbasin Manning Rd Drain B

Flow length (m): 2048.15
Pervious Manning's Roughness: 0.10000
Impervious Manning's Roughness: 0.01500
Pervious Rainfall Intensity (mm/hr): 4.73674
Impervious Rainfall Intensity (mm/hr): 4.73674
Slope (%): 0.15000
Computed TOC (minutes): 624.07

Subbasin SPA1

Flow length (m): 150.01
Pervious Manning's Roughness: 0.10000
Impervious Manning's Roughness: 0.01500
Pervious Rainfall Intensity (mm/hr): 4.73674
Impervious Rainfall Intensity (mm/hr): 4.73674
Slope (%): 0.15000
Computed TOC (minutes): 110.12

Subbasin SPA100

Flow length (m): 362.92
Pervious Manning's Roughness: 0.10000
Impervious Manning's Roughness: 0.01500
Pervious Rainfall Intensity (mm/hr): 4.73674
Impervious Rainfall Intensity (mm/hr): 4.73674
Slope (%): 0.15000
Computed TOC (minutes): 187.10

Subbasin SPA106

Flow length (m): 263.04
Pervious Manning's Roughness: 0.10000
Impervious Manning's Roughness: 0.01500

Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	154.24

Subbasin SPA14

Flow length (m):	449.93
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	212.85

Subbasin SPA21

Flow length (m):	474.97
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	219.88

Subbasin SPA35

Flow length (m):	515.02
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	230.82

Subbasin SPA50

Flow length (m):	585.87
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000

Computed TOC (minutes): 249.38

Subbasin SPA51

Flow length (m):	377.04
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	113.21

Subbasin SPA-52

Flow length (m):	222.02
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	166.60

Subbasin SPA62

Flow length (m):	477.94
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	220.70

Subbasin SPA69

Flow length (m):	379.87
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	192.29

Subbasin SPA79

Flow length (m):	426.05
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	206.00

Subbasin SPA86

Flow length (m):	357.80
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	185.51

Subbasin SPA86a

Flow length (m):	128.54
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	58.16

Subbasin Sub-03

Flow length (m):	358.61
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.50000
Computed TOC (minutes):	143.00

Subbasin Sub-04

Flow length (m):	356.12
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.50000
Computed TOC (minutes):	142.41

Subbasin Sub-05

Flow length (m):	509.85
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.50000
Computed TOC (minutes):	176.62

Subbasin Sub-06

Flow length (m):	164.90
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.50000
Computed TOC (minutes):	89.72

Subbasin Sub-08

Flow length (m):	823.99
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.10000
Computed TOC (minutes):	309.78

Subbasin ToPond

Flow length (m):	393.09
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500

Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	76.12

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Subbasin Runoff Summary
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Subbasin ID	Total Rainfall mm	Total Runon mm	Total Evap. mm	Total Infil. mm	Total Runoff mm	Peak Runoff cms	Runoff Coefficient	Time of Concentration days	hh:mm:ss
3	108.94	0.00	0.00	30.32	66.35	2.35	0.609	0	14:47:44
A3868	108.95	0.00	0.00	17.29	85.75	0.92	0.787	0	02:21:59
A3876	108.95	0.00	0.00	17.29	85.58	1.02	0.785	0	02:54:25
A3877	108.94	0.00	0.00	17.29	85.97	0.48	0.789	0	01:32:39
A4	108.95	0.00	0.00	17.29	85.82	0.85	0.788	0	02:08:48
A4389	108.94	0.00	0.00	18.44	84.22	0.48	0.773	0	03:15:02
A4422	108.94	0.00	0.00	17.29	85.60	0.82	0.786	0	02:51:01
A4469	108.95	0.00	0.00	18.44	84.57	0.20	0.776	0	02:18:34
A4528	108.94	0.00	0.00	17.29	85.28	0.62	0.783	0	03:36:38
A4572	108.94	0.00	0.00	18.44	84.26	0.70	0.773	0	03:08:14
A4576	108.94	0.00	0.00	18.44	84.31	0.68	0.774	0	03:01:19
A4589	108.95	0.00	0.00	19.60	82.75	1.09	0.760	0	03:44:04
A4615	108.95	0.00	0.00	17.29	86.12	0.66	0.790	0	00:58:22
A4672	108.94	0.00	0.00	13.83	89.52	0.59	0.822	0	01:40:39
A4690	108.95	0.00	0.00	13.83	89.39	0.73	0.821	0	02:15:42
A4719	108.95	0.00	0.00	13.83	89.38	0.84	0.820	0	02:18:51
A4722	108.95	0.00	0.00	13.83	89.54	0.27	0.822	0	01:34:41
A4737	108.95	0.00	0.00	13.83	89.61	0.47	0.823	0	01:13:36
A4809	108.95	0.00	0.00	14.99	88.34	0.34	0.811	0	01:37:13
A5070	108.95	0.00	0.00	14.99	88.18	0.52	0.809	0	02:17:16
CYR-D1	108.95	0.00	0.00	15.40	89.66	0.46	0.823	0	01:00:52
CYR-D2	108.94	0.00	0.00	18.12	86.26	0.24	0.792	0	02:25:29
CYR-D3	108.95	0.00	0.00	5.35	100.85	0.08	0.926	0	00:05:29
CYR-D4	108.95	0.00	0.00	13.23	89.63	0.17	0.823	0	06:49:19
CYR-D5	108.94	0.00	0.00	16.39	83.47	0.33	0.766	0	09:02:28
ETRD A	108.94	0.00	0.00	17.79	85.80	3.16	0.788	0	05:55:01
ETRD C_FU	108.94	0.00	0.00	6.73	98.33	2.94	0.903	0	03:52:06
ETRD E_FU	108.94	0.00	0.00	10.81	93.88	3.23	0.862	0	03:34:02
Manning Rd Drain A	108.95	0.00	0.00	0.30	107.48	2.34	0.987	0	01:44:02
Manning Rd Drain B	108.94	0.00	0.00	25.23	70.59	0.61	0.648	0	10:24:04
SPA1	108.95	0.00	0.00	16.60	88.13	1.29	0.809	0	01:50:07
SPA100	108.94	0.00	0.00	16.60	87.75	0.92	0.805	0	03:07:05
SPA106	108.95	0.00	0.00	16.60	87.93	0.82	0.807	0	02:34:14
SPA14	108.95	0.00	0.00	16.60	87.57	0.72	0.804	0	03:32:50
SPA21	108.95	0.00	0.00	16.60	87.52	1.06	0.803	0	03:39:52
SPA35	108.95	0.00	0.00	16.60	87.43	1.32	0.803	0	03:50:49

SPA50	108.94	0.00	0.00	16.60	87.28	1.07	0.801	0	04:09:22
SPA51	108.94	0.00	0.00	4.24	101.54	2.45	0.932	0	01:53:12
SPA-52	108.94	0.00	0.00	13.72	89.82	0.23	0.824	0	02:46:36
SPA62	108.94	0.00	0.00	16.60	87.51	0.29	0.803	0	03:40:42
SPA69	108.94	0.00	0.00	16.60	87.71	0.49	0.805	0	03:12:17
SPA79	108.95	0.00	0.00	16.60	87.62	1.03	0.804	0	03:25:59
SPA86	108.94	0.00	0.00	16.60	87.76	0.69	0.805	0	03:05:30
SPA86a	108.95	0.00	0.00	6.69	99.29	0.58	0.911	0	00:58:09
Sub-03	108.95	0.00	0.00	37.31	67.73	1.04	0.622	0	02:23:00
Sub-04	108.94	0.00	0.00	37.31	67.73	1.17	0.622	0	02:22:24
Sub-05	108.94	0.00	0.00	37.31	67.42	1.30	0.619	0	02:56:37
Sub-06	108.94	0.00	0.00	37.31	68.19	0.51	0.626	0	01:29:43
Sub-08	108.95	0.00	0.00	30.32	74.21	3.36	0.681	0	05:09:46
ToPond	108.95	0.00	0.00	0.12	106.44	1.47	0.977	0	01:16:07

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Node Depth Summary
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Node ID	Average Depth Attained m	Maximum Depth Attained m	Maximum HGL Attained m	Time of Max Occurrence days	Time of Max Occurrence hh:mm	Total Flooded Volume ha-mm	Total Time Flooded minutes	Retention Time hh:mm:ss
15	0.52	1.12	179.72	0	08:24	0	0	0:00:00
77a	1.95	4.25	180.50	0	08:30	0	0	0:00:00
77b	0.49	2.81	181.01	0	08:28	0	0	0:00:00
Jun-01	0.37	0.37	174.37	0	00:00	0	0	0:00:00
Jun-02	0.39	1.66	174.36	0	00:00	0	0	0:00:00
Jun-03	0.72	1.90	176.30	0	08:34	0	0	0:00:00
Jun-04	0.75	1.94	176.32	0	08:34	0	0	0:00:00
Jun-05	0.80	1.93	176.47	0	08:33	0	0	0:00:00
Jun-06	0.73	1.88	176.50	0	08:33	0	0	0:00:00
Jun-109	0.24	1.17	178.52	0	09:02	0	0	0:00:00
Jun-11	0.92	2.06	176.61	0	08:32	0	0	0:00:00
Jun-16	0.89	2.09	176.30	0	08:34	0	0	0:00:00
Jun-17	1.22	2.39	176.26	0	08:35	0	0	0:00:00
Jun-18	0.89	2.02	176.19	0	08:35	0	0	0:00:00
Jun-19	0.82	1.92	176.15	0	08:35	0	0	0:00:00
Jun-20	0.82	1.91	176.10	0	08:35	0	0	0:00:00
Jun-21	0.82	1.89	176.06	0	08:35	0	0	0:00:00
Jun-22	0.79	1.86	176.03	0	08:35	0	0	0:00:00
Jun-23	0.78	1.82	175.99	0	08:35	0	0	0:00:00
Jun-24	0.82	1.85	175.95	0	08:35	0	0	0:00:00
Jun-25	0.76	1.79	175.94	0	08:35	0	0	0:00:00
Jun-26	0.82	1.84	175.91	0	08:35	0	0	0:00:00
Jun-27	0.77	1.76	175.85	0	08:35	0	0	0:00:00
Jun-28	0.73	1.71	175.82	0	08:35	0	0	0:00:00

Jun-29	0.69	1.64	175.77	0	08:34	0	0	0:00:00
Jun-30	0.75	1.69	175.73	0	08:34	0	0	0:00:00
Jun-31	0.79	1.69	175.67	0	08:34	0	0	0:00:00
Jun-32	0.67	1.55	175.63	0	08:33	0	0	0:00:00
Jun-33	0.70	1.55	175.58	0	08:32	0	0	0:00:00
Jun-34	0.62	1.45	175.52	0	08:32	0	0	0:00:00
Jun-35	0.67	1.39	175.38	0	08:32	0	0	0:00:00
Jun-36	0.61	1.27	175.28	0	08:32	0	0	0:00:00
Jun-37	0.59	1.21	175.22	0	08:32	0	0	0:00:00
Jun-38	0.57	1.64	174.59	0	08:32	0	0	0:00:00
Jun-47	0.51	1.50	174.42	0	08:32	0	0	0:00:00
Jun-49	0.55	1.58	178.05	0	08:42	0	0	0:00:00
Jun-50	0.69	1.79	178.02	0	08:41	0	0	0:00:00
Jun-51	0.75	1.85	178.00	0	08:40	0	0	0:00:00
Jun-52	0.64	1.76	177.98	0	08:40	0	0	0:00:00
Jun-53	0.60	1.71	177.93	0	08:39	0	0	0:00:00
Jun-54	0.55	1.58	177.33	0	08:30	0	0	0:00:00
Jun-55	0.51	1.74	177.24	0	08:30	0	0	0:00:00
Jun-56	0.49	1.78	177.06	0	08:30	0	0	0:00:00
Jun-57	0.53	1.82	177.03	0	08:30	0	0	0:00:00
Jun-58	0.60	1.89	176.84	0	08:31	0	0	0:00:00
Jun-59	0.65	1.93	176.81	0	08:31	0	0	0:00:00
STA0+775	0.04	0.33	180.22	0	08:00	0	0	0:00:00
STA0+925	0.04	0.40	180.02	0	08:24	0	0	0:00:00
STA1+025	0.06	0.69	180.02	0	08:24	0	0	0:00:00
STA1+150	0.06	0.63	179.78	0	08:24	0	0	0:00:00
STA1+178	0.38	0.97	179.72	0	08:23	0	0	0:00:00
STA1+200	0.08	0.58	179.62	0	08:22	0	0	0:00:00
STA1+325	0.04	0.51	179.30	0	08:34	0	0	0:00:00
STA1+450	0.13	0.71	179.24	0	08:35	0	0	0:00:00
STA1+700	0.09	0.54	178.53	0	09:02	0	0	0:00:00
ETLD-1	0.00	0.00	180.50	0	00:00	0	0	0:00:00
ETLD-2a	0.00	0.00	180.50	0	00:00	0	0	0:00:00
ETLD-2b	0.00	0.00	180.50	0	00:00	0	0	0:00:00
ETLD-3	0.00	0.00	180.50	0	00:00	0	0	0:00:00
ETLD-4	0.00	0.00	180.50	0	00:00	0	0	0:00:00
Out-01	0.00	0.00	172.70	0	00:00	0	0	0:00:00
Out-02	0.00	0.00	175.79	0	00:00	0	0	0:00:00
Out-03	0.00	0.00	176.54	0	00:00	0	0	0:00:00
Out-04	0.00	0.00	173.20	0	00:00	0	0	0:00:00
Out-11	0.00	0.00	175.00	0	00:00	0	0	0:00:00
CR22 Pond 19900m3	0.32	1.37	175.57	0	11:03	0	0	0:00:00
EX0	0.33	2.02	182.24	0	08:03	0	0	0:00:00
EX1	0.37	2.06	182.20	0	08:03	0	0	0:00:00
EX3	0.40	1.73	181.80	0	08:02	0	0	0:00:00
EX3868	0.47	1.93	182.16	0	09:12	0	0	0:00:00
EX3869	0.38	2.09	182.59	0	08:17	0	0	0:00:00
EX3870	0.43	2.10	182.49	0	08:34	0	0	0:00:00
EX3877(MHD)	0.30	2.38	183.00	0	08:28	0	0	0:00:00
EX4	0.46	1.68	181.68	0	08:01	0	0	0:00:00
EX4322	0.05	1.30	182.90	0	08:03	0	0	0:00:00

EX4351	0.34	1.93	182.69	0	08:11	0	0	0:00:00
EX4373	0.06	1.30	182.70	0	08:28	0	0	0:00:00
EX4374	0.06	1.30	182.54	0	08:02	0	0	0:00:00
EX4375	0.09	1.45	182.51	0	08:02	0	0	0:00:00
EX4389	0.28	1.35	182.72	0	10:48	0	0	0:00:00
EX4390	0.29	1.46	182.71	0	09:04	0	0	0:00:00
EX4419	0.33	1.74	182.36	0	07:54	0	0	0:00:00
EX4422	0.33	1.70	182.41	0	09:07	0	0	0:00:00
EX4469	0.39	2.24	183.10	0	08:02	0	0	0:00:00
EX4518	0.12	1.60	182.48	0	08:16	0	0	0:00:00
EX4528	0.25	1.86	182.48	0	08:02	0	0	0:00:00
EX4615	0.40	2.39	183.16	0	08:00	0	0	0:00:00
EX4650	0.36	1.80	182.27	0	11:09	0	0	0:00:00
EX4654	0.39	1.85	182.21	0	09:19	0	0	0:00:00
EX4658	0.31	1.59	182.42	0	11:12	0	0	0:00:00
EX4659	0.28	1.52	182.42	0	10:12	0	0	0:00:00
EX4668	0.21	1.26	182.57	0	07:55	0	0	0:00:00
EX4672	0.20	1.23	182.71	0	08:41	0	0	0:00:00
EX4678	0.26	1.37	182.49	0	07:54	0	0	0:00:00
EX4682	0.30	1.64	182.50	0	07:55	0	0	0:00:00
EX4686	0.29	1.61	182.58	0	07:54	0	0	0:00:00
EX4690	0.28	1.48	182.60	0	08:17	0	0	0:00:00
EX4694	0.20	1.23	182.50	0	08:51	0	0	0:00:00
EX4695	0.17	1.19	182.60	0	07:54	0	0	0:00:00
EX4702	0.22	1.16	182.41	0	11:28	0	0	0:00:00
EX4709	0.38	2.14	183.07	0	07:56	0	0	0:00:00
EX4710	0.40	1.89	182.98	0	07:56	0	0	0:00:00
EX4711	0.40	1.66	182.88	0	09:58	0	0	0:00:00
EX4712	0.38	1.65	183.15	0	07:57	0	0	0:00:00
EX4717	0.31	1.54	183.16	0	07:56	0	0	0:00:00
EX4719	0.38	1.74	183.33	0	08:00	0	0	0:00:00
EX4720	0.38	1.66	183.20	0	08:05	0	0	0:00:00
EX4721	0.34	1.44	183.11	0	09:14	0	0	0:00:00
EX4722	0.30	1.27	183.11	0	10:45	0	0	0:00:00
EX4725	0.34	1.59	183.27	0	08:00	0	0	0:00:00
EX4729	0.33	1.30	183.11	0	10:22	0	0	0:00:00
EX4737	0.30	1.33	183.31	0	08:38	0	0	0:00:00
EX4755	0.21	1.19	182.71	0	12:25	0	0	0:00:00
EX4809	0.22	1.74	182.26	0	08:06	0	0	0:00:00
EX4810	0.21	1.60	182.26	0	08:17	0	0	0:00:00
EX5	0.46	1.81	181.89	0	08:01	0	0	0:00:00
EX5069	0.19	1.53	182.26	0	08:22	0	0	0:00:00
EX5070	0.18	1.45	182.27	0	08:37	0	0	0:00:00
EX5077	0.13	1.35	182.26	0	09:18	0	0	0:00:00
EX5081	0.11	1.28	182.26	0	09:40	0	0	0:00:00
EX5085	0.10	1.21	182.26	0	09:50	0	0	0:00:00
Jun-1	0.54	1.89	177.05	0	08:00	0	0	0:00:00
Jun-300	0.52	0.64	179.64	0	08:00	0	0	0:00:00
Jun-310	0.58	1.41	178.41	0	08:20	0	0	0:00:00
Jun-315	0.49	1.71	178.05	0	08:15	0	0	0:00:00
Jun-320	0.30	1.29	176.86	0	08:15	0	0	0:00:00

Jun-95	0.71	1.66	178.08	0	08:43	0	0	0:00:00
MH1	2.71	3.60	178.63	0	21:50	0	0	0:00:00
MH100	0.48	3.14	181.41	0	08:43	0	0	0:00:00
MH102	0.43	2.98	181.41	0	08:44	0	0	0:00:00
MH103	0.42	2.74	181.39	0	08:49	0	0	0:00:00
MH105	0.46	2.61	181.36	0	08:58	0	0	0:00:00
MH106	0.46	2.45	181.34	0	09:01	0	0	0:00:00
MH107	0.34	2.20	181.29	0	09:11	0	0	0:00:00
MH108	0.32	1.95	181.26	0	09:27	0	0	0:00:00
MH11	2.63	3.46	178.63	0	21:45	0	0	0:00:00
MH14	2.54	3.30	178.63	0	21:41	0	0	0:00:00
MH15	0.00	0.00	179.53	0	00:00	0	0	0:00:00
MH16	0.00	0.00	179.94	0	00:00	0	0	0:00:00
MH20	0.00	0.00	180.39	0	00:00	0	0	0:00:00
MH21	2.46	3.44	178.91	0	08:30	0	0	0:00:00
MH22	0.09	0.40	178.91	0	08:30	0	0	0:00:00
MH23	0.12	0.23	178.91	0	08:29	0	0	0:00:00
MH25	0.00	0.00	178.86	0	00:00	0	0	0:00:00
MH28	0.00	0.00	179.05	0	00:00	0	0	0:00:00
MH3	0.00	0.00	179.54	0	00:00	0	0	0:00:00
MH31	2.39	3.74	179.35	0	08:32	0	0	0:00:00
MH35	2.31	4.03	179.78	0	08:32	0	0	0:00:00
MH36	0.55	2.00	179.78	0	08:31	0	0	0:00:00
MH38	0.42	1.84	179.79	0	08:31	0	0	0:00:00
MH40	0.30	1.66	179.78	0	08:30	0	0	0:00:00
MH43	0.17	1.45	179.79	0	08:32	0	0	0:00:00
MH46	0.08	1.26	179.79	0	08:31	0	0	0:00:00
MH5	0.00	0.00	179.76	0	00:00	0	0	0:00:00
MH50	2.17	4.23	180.19	0	08:32	0	0	0:00:00
MH51	1.05	3.03	180.30	0	08:31	0	0	0:00:00
MH52	0.95	2.99	180.40	0	08:31	0	0	0:00:00
MH53	0.85	2.95	180.50	0	08:31	0	0	0:00:00
MH54	0.66	2.75	180.50	0	08:30	0	0	0:00:00
MH55	0.49	2.52	180.50	0	08:31	0	0	0:00:00
MH58	1.91	4.02	180.27	0	08:34	0	0	0:00:00
MH59	1.68	3.81	180.34	0	08:36	0	0	0:00:00
MH61	1.53	3.69	180.41	0	08:37	0	0	0:00:00
MH62	1.31	3.52	180.53	0	08:39	0	0	0:00:00
MH63	1.00	3.20	180.53	0	08:40	0	0	0:00:00
MH64	0.83	2.99	180.53	0	08:39	0	0	0:00:00
MH67	1.49	3.69	180.46	0	08:37	0	0	0:00:00
MH69	1.25	3.60	180.69	0	08:39	0	0	0:00:00
MH7	0.00	0.00	180.11	0	00:00	0	0	0:00:00
MH71	1.02	3.37	180.69	0	08:39	0	0	0:00:00
MH72	0.84	3.16	180.69	0	08:39	0	0	0:00:00
MH76	2.01	4.22	180.39	0	08:31	0	0	0:00:00
MH77	1.77	4.16	180.64	0	08:33	0	0	0:00:00
MH78	1.68	4.15	180.75	0	08:33	0	0	0:00:00
MH79	1.58	4.14	180.88	0	08:34	0	0	0:00:00
MH8	0.00	0.00	180.12	0	00:00	0	0	0:00:00
MH80	1.49	4.04	180.89	0	08:36	0	0	0:00:00

MH82	1.38	3.91	180.89	0	08:36	0	0	0:00:00
MH85	1.25	3.77	180.91	0	08:37	0	0	0:00:00
MH86	1.13	3.62	180.92	0	08:40	0	0	0:00:00
MH89	1.01	3.49	180.92	0	08:40	0	0	0:00:00
MH90	0.86	3.30	180.92	0	08:41	0	0	0:00:00
MH93	0.72	3.10	180.86	0	09:04	0	0	0:00:00
MH94	0.59	2.94	180.86	0	09:11	0	0	0:00:00
MH95	0.19	1.86	180.87	0	09:10	0	0	0:00:00
MH97	0.70	3.24	181.04	0	08:36	0	0	0:00:00
MH99	0.56	3.17	181.22	0	08:37	0	0	0:00:00
MH-A	0.33	2.85	181.97	0	08:41	0	0	0:00:00
MH-C	0.31	2.73	182.73	0	08:36	0	0	0:00:00
SPA Pond_130360m3	3.04	4.12	178.62	0	21:53	0	0	0:00:00
Stor-02	0.00	0.00	173.50	0	00:00	0	0	0:00:00
Stor-SPA1	0.13	1.58	181.93	0	08:16	0	0	0:00:00
Stor-SPA100	0.18	1.59	181.54	0	08:19	0	0	0:00:00
Stor-SPA106	0.19	1.66	181.26	0	08:24	0	0	0:00:00
Stor-SPA14	0.15	1.55	182.00	0	08:16	0	0	0:00:00
Stor-SPA21	0.15	1.52	182.12	0	08:16	0	0	0:00:00
Stor-SPA35	0.19	1.58	181.78	0	08:26	0	0	0:00:00
Stor-SPA50	0.18	1.56	181.86	0	08:23	0	0	0:00:00
Stor-SPA51	0.15	1.60	180.80	0	08:20	0	0	0:00:00
Stor-SPA52	0.27	1.60	181.65	0	08:28	0	0	0:00:00
Stor-SPA62	0.15	1.57	181.47	0	08:26	0	0	0:00:00
Stor-SPA69	0.16	1.58	181.33	0	08:30	0	0	0:00:00
Stor-SPA79	0.17	1.57	181.52	0	08:16	0	0	0:00:00
Stor-SPA86	0.17	1.60	181.15	0	08:22	0	0	0:00:00
Stor-Spa86a	0.11	1.63	181.64	0	08:10	0	0	0:00:00

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Node Flow Summary
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Node ID	Element Type	Maximum Lateral Inflow cms	Peak Inflow cms	Time of Peak Inflow Occurrence days	hh:mm	Maximum Flooding Overflow cms	Time of Peak Flooding Occurrence days	hh:mm
15	JUNCTION	0.458	0.458	0	08:00	0.00		
77a	JUNCTION	0.000	4.977	0	08:09	0.00		
77b	JUNCTION	0.000	3.258	0	08:01	0.00		
Jun-01	JUNCTION	0.000	0.000	0	00:00	0.00		
Jun-02	JUNCTION	0.506	6.690	0	08:31	0.00		
Jun-03	JUNCTION	0.000	5.781	0	08:13	0.00		
Jun-04	JUNCTION	1.174	7.498	0	08:30	0.00		
Jun-05	JUNCTION	0.000	6.716	0	08:30	0.00		
Jun-06	JUNCTION	1.042	6.735	0	08:30	0.00		
Jun-109	JUNCTION	0.000	2.016	0	08:38	0.00		
Jun-11	JUNCTION	0.000	6.046	0	08:25	0.00		

Jun-16	JUNCTION	0.000	5.695	0	08:14	0.00
Jun-17	JUNCTION	0.000	5.661	0	08:14	0.00
Jun-18	JUNCTION	0.000	5.596	0	08:30	0.00
Jun-19	JUNCTION	0.000	5.579	0	08:32	0.00
Jun-20	JUNCTION	0.000	5.576	0	08:33	0.00
Jun-21	JUNCTION	0.000	5.575	0	08:34	0.00
Jun-22	JUNCTION	0.000	5.574	0	08:35	0.00
Jun-23	JUNCTION	0.000	5.574	0	08:36	0.00
Jun-24	JUNCTION	0.000	5.574	0	08:36	0.00
Jun-25	JUNCTION	0.000	5.575	0	08:36	0.00
Jun-26	JUNCTION	0.000	5.575	0	08:37	0.00
Jun-27	JUNCTION	0.000	5.576	0	08:37	0.00
Jun-28	JUNCTION	0.000	5.576	0	08:37	0.00
Jun-29	JUNCTION	0.000	5.577	0	08:37	0.00
Jun-30	JUNCTION	0.000	5.578	0	08:37	0.00
Jun-31	JUNCTION	0.000	5.578	0	08:37	0.00
Jun-32	JUNCTION	0.000	5.579	0	08:37	0.00
Jun-33	JUNCTION	1.303	6.370	0	08:32	0.00
Jun-34	JUNCTION	0.000	6.370	0	08:32	0.00
Jun-35	JUNCTION	0.000	6.370	0	08:32	0.00
Jun-36	JUNCTION	0.000	6.370	0	08:32	0.00
Jun-37	JUNCTION	0.000	6.370	0	08:32	0.00
Jun-38	JUNCTION	0.000	6.370	0	08:32	0.00
Jun-47	JUNCTION	0.000	6.370	0	08:33	0.00
Jun-49	JUNCTION	0.000	2.179	0	09:04	0.00
Jun-50	JUNCTION	0.000	2.230	0	09:05	0.00
Jun-51	JUNCTION	0.000	2.272	0	09:06	0.00
Jun-52	JUNCTION	2.345	4.182	0	08:56	0.00
Jun-53	JUNCTION	0.000	4.196	0	08:56	0.00
Jun-54	JUNCTION	0.000	4.200	0	08:56	0.00
Jun-55	JUNCTION	3.355	6.566	0	08:15	0.00
Jun-56	JUNCTION	0.000	6.495	0	08:14	0.00
Jun-57	JUNCTION	0.000	6.416	0	08:14	0.00
Jun-58	JUNCTION	0.000	6.268	0	08:13	0.00
Jun-59	JUNCTION	0.000	6.071	0	08:12	0.00
STA0+775	JUNCTION	0.321	0.321	0	08:00	0.00
STA0+925	JUNCTION	0.000	0.309	0	08:00	0.00
STA1+025	JUNCTION	0.000	1.543	0	08:22	0.00
STA1+150	JUNCTION	0.000	1.537	0	08:24	0.00
STA1+178	JUNCTION	0.000	1.729	0	08:24	0.00
STA1+200	JUNCTION	0.000	1.730	0	08:24	0.00
STA1+325	JUNCTION	0.000	1.739	0	08:25	0.00
STA1+450	JUNCTION	0.495	2.069	0	08:30	0.00
STA1+700	JUNCTION	0.000	2.022	0	08:36	0.00
ETLD-1	OUTFALL	0.000	0.060	0	08:26	0.00
ETLD-2a	OUTFALL	0.000	0.885	0	08:20	0.00
ETLD-2b	OUTFALL	0.000	0.178	0	08:28	0.00
ETLD-3	OUTFALL	0.000	0.057	0	08:26	0.00
ETLD-4	OUTFALL	0.000	0.083	0	08:30	0.00
Out-01	OUTFALL	0.000	7.476	0	00:00	0.00
Out-02	OUTFALL	0.000	1.858	0	08:34	0.00

Out-03	OUTFALL	0.000	0.000	0	00:00	0.00
Out-04	OUTFALL	0.000	0.000	0	00:00	0.00
Out-11	OUTFALL	2.341	5.473	0	08:00	0.00
CR22 Pond 19900m3	STORAGE	0.609	6.689	0	08:15	0.00
EX0	STORAGE	0.000	0.448	0	08:00	0.00
EX1	STORAGE	0.000	0.930	0	08:19	0.00
EX3	STORAGE	0.000	0.922	0	08:17	0.00
EX3868	STORAGE	0.924	2.962	0	08:00	0.00
EX3869	STORAGE	0.000	1.838	0	08:00	0.00
EX3870	STORAGE	0.000	1.622	0	07:56	0.00
EX3877(MHD)	STORAGE	2.200	2.200	0	08:00	0.00
EX4	STORAGE	0.848	3.259	0	08:01	0.00
EX4322	STORAGE	0.000	0.399	0	07:58	0.00
EX4351	STORAGE	0.000	1.383	0	08:00	0.00
EX4373	STORAGE	0.000	0.315	0	07:57	0.00
EX4374	STORAGE	0.000	0.239	0	08:46	0.00
EX4375	STORAGE	0.000	0.240	0	08:46	0.00
EX4389	STORAGE	0.480	0.480	0	08:00	0.00
EX4390	STORAGE	0.000	0.348	0	12:49	0.00
EX4419	STORAGE	0.000	0.604	0	12:03	0.00
EX4422	STORAGE	0.823	1.088	0	08:00	0.00
EX4469	STORAGE	1.973	1.973	0	08:00	0.00
EX4518	STORAGE	0.000	0.327	0	07:55	0.00
EX4528	STORAGE	0.622	0.651	0	08:02	0.00
EX4615	STORAGE	0.659	0.659	0	08:00	0.00
EX4650	STORAGE	0.000	0.614	0	11:41	0.00
EX4654	STORAGE	0.000	0.813	0	11:40	0.00
EX4658	STORAGE	0.000	0.395	0	12:04	0.00
EX4659	STORAGE	0.000	0.225	0	12:35	0.00
EX4668	STORAGE	0.000	0.347	0	07:51	0.00
EX4672	STORAGE	0.589	0.589	0	08:00	0.00
EX4678	STORAGE	0.000	0.283	0	07:50	0.00
EX4682	STORAGE	0.000	0.290	0	13:38	0.00
EX4686	STORAGE	0.000	0.288	0	13:38	0.00
EX4690	STORAGE	0.731	0.731	0	08:00	0.00
EX4694	STORAGE	0.000	0.171	0	07:55	0.00
EX4695	STORAGE	0.000	0.087	0	07:52	0.00
EX4702	STORAGE	0.000	0.168	0	08:03	0.00
EX4709	STORAGE	0.000	0.361	0	13:13	0.00
EX4710	STORAGE	0.000	0.360	0	13:12	0.00
EX4711	STORAGE	0.000	0.463	0	08:01	0.00
EX4712	STORAGE	0.000	0.498	0	07:50	0.00
EX4717	STORAGE	0.000	0.082	0	07:50	0.00
EX4719	STORAGE	0.845	0.845	0	08:00	0.00
EX4720	STORAGE	0.000	0.553	0	07:51	0.00
EX4721	STORAGE	0.000	0.322	0	08:00	0.00
EX4722	STORAGE	0.268	0.268	0	08:00	0.00
EX4725	STORAGE	0.000	0.252	0	14:57	0.00
EX4729	STORAGE	0.000	0.290	0	08:00	0.00
EX4737	STORAGE	0.475	0.475	0	08:00	0.00
EX4755	STORAGE	0.000	0.086	0	07:50	0.00

EX4809	STORAGE	0.336	0.502	0	07:59	0.00
EX4810	STORAGE	0.000	0.345	0	09:32	0.00
EX5	STORAGE	0.000	2.142	0	11:09	0.00
EX5069	STORAGE	0.000	0.347	0	09:34	0.00
EX5070	STORAGE	0.523	0.523	0	08:00	0.00
EX5077	STORAGE	0.000	0.296	0	07:55	0.00
EX5081	STORAGE	0.000	0.249	0	09:51	0.00
EX5085	STORAGE	0.000	0.088	0	07:55	0.00
Jun-1	STORAGE	3.163	3.163	0	08:00	0.00
Jun-300	STORAGE	0.000	0.545	0	07:48	0.00
Jun-310	STORAGE	0.000	0.683	0	08:01	0.00
Jun-315	STORAGE	2.940	3.315	0	08:15	0.00
Jun-320	STORAGE	3.227	5.992	0	08:15	0.00
Jun-95	STORAGE	0.000	2.000	0	07:50	0.00
MH1	STORAGE	1.472	9.852	0	08:20	0.00
MH100	STORAGE	0.000	1.961	0	07:57	0.00
MH102	STORAGE	0.000	0.657	0	07:57	0.00
MH103	STORAGE	0.000	0.375	0	10:16	0.00
MH105	STORAGE	0.000	0.369	0	10:16	0.00
MH106	STORAGE	0.000	0.472	0	07:52	0.00
MH107	STORAGE	0.000	0.165	0	07:53	0.00
MH108	STORAGE	0.000	0.087	0	07:54	0.00
MH11	STORAGE	0.000	8.285	0	08:39	0.00
MH14	STORAGE	0.000	8.282	0	08:38	0.00
MH15	STORAGE	0.000	0.000	0	00:00	0.00
MH16	STORAGE	0.000	0.000	0	00:00	0.00
MH20	STORAGE	0.000	0.000	0	00:00	0.00
MH21	STORAGE	0.000	7.866	0	08:38	0.00
MH22	STORAGE	0.000	0.040	0	08:16	0.00
MH23	STORAGE	0.000	0.007	0	08:22	0.00
MH25	STORAGE	0.000	0.000	0	00:00	0.00
MH28	STORAGE	0.000	0.000	0	00:00	0.00
MH3	STORAGE	0.000	0.000	0	00:00	0.00
MH31	STORAGE	0.000	7.311	0	08:59	0.00
MH35	STORAGE	0.000	7.295	0	09:00	0.00
MH36	STORAGE	0.000	0.380	0	08:01	0.00
MH38	STORAGE	0.000	0.325	0	08:03	0.00
MH40	STORAGE	0.000	0.248	0	08:03	0.00
MH43	STORAGE	0.000	0.188	0	08:06	0.00
MH46	STORAGE	0.000	0.098	0	08:07	0.00
MH5	STORAGE	0.000	0.000	0	00:00	0.00
MH50	STORAGE	0.000	6.519	0	08:59	0.00
MH51	STORAGE	0.000	1.219	0	07:55	0.00
MH52	STORAGE	0.000	1.191	0	07:56	0.00
MH53	STORAGE	0.000	1.264	0	08:01	0.00
MH54	STORAGE	0.000	0.160	0	07:50	0.00
MH55	STORAGE	0.000	0.068	0	07:50	0.00
MH58	STORAGE	0.000	0.479	0	07:58	0.00
MH59	STORAGE	0.000	0.442	0	09:28	0.00
MH61	STORAGE	0.000	0.180	0	07:52	0.00
MH62	STORAGE	0.000	0.254	0	08:00	0.00

MH63	STORAGE	0.000	0.174	0	08:00	0.00
MH64	STORAGE	0.000	0.098	0	08:01	0.00
MH67	STORAGE	0.000	0.260	0	09:39	0.00
MH69	STORAGE	0.000	0.291	0	08:09	0.00
MH7	STORAGE	0.000	0.000	0	00:00	0.00
MH71	STORAGE	0.000	0.142	0	07:58	0.00
MH72	STORAGE	0.000	0.076	0	07:57	0.00
MH76	STORAGE	0.000	4.975	0	08:09	0.00
MH77	STORAGE	0.000	2.024	0	09:40	0.00
MH78	STORAGE	0.000	2.010	0	09:40	0.00
MH79	STORAGE	0.000	2.290	0	07:56	0.00
MH8	STORAGE	0.000	0.000	0	00:00	0.00
MH80	STORAGE	0.000	0.545	0	10:08	0.00
MH82	STORAGE	0.000	0.534	0	10:08	0.00
MH85	STORAGE	0.000	0.564	0	07:52	0.00
MH86	STORAGE	0.000	0.630	0	07:53	0.00
MH89	STORAGE	0.000	0.372	0	10:07	0.00
MH90	STORAGE	0.000	0.367	0	10:06	0.00
MH93	STORAGE	0.000	0.331	0	08:19	0.00
MH94	STORAGE	0.000	0.206	0	08:01	0.00
MH95	STORAGE	0.000	0.133	0	08:01	0.00
MH97	STORAGE	0.000	1.769	0	07:56	0.00
MH99	STORAGE	0.000	1.848	0	07:56	0.00
MH-A	STORAGE	0.000	1.516	0	07:58	0.00
MH-C	STORAGE	0.000	1.614	0	07:58	0.00
SPA Pond_130360m3	STORAGE	0.000	10.166	0	08:18	0.00
Stor-02	STORAGE	0.000	0.000	0	00:00	0.00
Stor-SPA1	STORAGE	1.287	1.304	0	08:00	0.00
Stor-SPA100	STORAGE	0.924	0.924	0	08:00	0.00
Stor-SPA106	STORAGE	0.820	1.030	0	08:15	0.00
Stor-SPA14	STORAGE	0.719	0.719	0	08:00	0.00
Stor-SPA21	STORAGE	1.057	1.057	0	08:00	0.00
Stor-SPA35	STORAGE	1.324	1.324	0	08:00	0.00
Stor-SPA50	STORAGE	1.071	1.071	0	08:00	0.00
Stor-SPA51	STORAGE	2.453	2.453	0	08:00	0.00
Stor-SPA52	STORAGE	0.229	0.241	0	08:21	0.00
Stor-SPA62	STORAGE	0.295	0.295	0	08:00	0.00
Stor-SPA69	STORAGE	0.492	0.492	0	08:00	0.00
Stor-SPA79	STORAGE	1.028	1.028	0	08:00	0.00
Stor-SPA86	STORAGE	0.685	0.848	0	08:00	0.00
Stor-Spa86a	STORAGE	0.576	0.576	0	08:00	0.00

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Storage Node Summary
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Storage Node ID	Maximum Ponded Volume	Maximum Ponded Volume	Time of Max Ponded Volume	Average Ponded Volume	Average Ponded Volume	Maximum Storage Node Outflow	Maximum Exfiltration Rate	Time of Max. Exfiltration Rate	Total Exfiltrated Volume

	1000 m^3	(%)	days	hh:mm	1000 m^3	(%)	cms	cmm	hh:mm:ss	1000 m^3
CR22 Pond 19900m3	25.108	37	0	11:03	5.626	8	2.00	0.00	0:00:00	0.000
EX0	0.002	0	0	08:03	0.000	0	0.40	0.00	0:00:00	0.000
EX1	0.003	0	0	08:03	0.000	0	0.92	0.00	0:00:00	0.000
EX3	0.002	0	0	08:02	0.000	0	0.92	0.00	0:00:00	0.000
EX3868	3.014	10	0	09:12	0.206	1	2.14	0.00	0:00:00	0.000
EX3869	0.192	1	0	08:17	0.003	0	1.62	0.00	0:00:00	0.000
EX3870	0.002	0	0	08:34	0.000	0	1.62	0.00	0:00:00	0.000
EX3877 (MHD)	0.392	1	0	08:28	0.008	0	2.01	0.00	0:00:00	0.000
EX4	0.002	0	0	08:01	0.001	0	3.26	0.00	0:00:00	0.000
EX4322	0.001	0	0	08:03	0.000	0	0.31	0.00	0:00:00	0.000
EX4351	0.002	0	0	08:11	0.000	0	1.38	0.00	0:00:00	0.000
EX4373	0.031	0	0	08:28	0.000	0	0.24	0.00	0:00:00	0.000
EX4374	0.001	0	0	08:02	0.000	0	0.24	0.00	0:00:00	0.000
EX4375	0.002	0	0	08:02	0.000	0	0.24	0.00	0:00:00	0.000
EX4389	1.612	5	0	10:48	0.164	1	0.35	0.00	0:00:00	0.000
EX4390	0.942	3	0	09:04	0.057	0	0.35	0.00	0:00:00	0.000
EX4419	0.002	0	0	07:54	0.000	0	0.61	0.00	0:00:00	0.000
EX4422	1.122	4	0	09:07	0.083	0	0.60	0.00	0:00:00	0.000
EX4469	0.054	0	0	08:02	0.001	0	1.69	0.00	0:00:00	0.000
EX4518	0.035	0	0	08:16	0.000	0	0.26	0.00	0:00:00	0.000
EX4528	0.002	0	0	08:02	0.000	0	0.65	0.00	0:00:00	0.000
EX4615	0.003	0	0	08:00	0.000	0	0.65	0.00	0:00:00	0.000
EX4650	0.705	2	0	11:09	0.048	0	0.81	0.00	0:00:00	0.000
EX4654	0.002	0	0	09:19	0.000	0	0.81	0.00	0:00:00	0.000
EX4658	0.412	1	0	11:12	0.029	0	0.35	0.00	0:00:00	0.000
EX4659	0.963	3	0	10:12	0.089	0	0.40	0.00	0:00:00	0.000
EX4668	0.001	0	0	07:55	0.000	0	0.28	0.00	0:00:00	0.000
EX4672	0.502	2	0	08:41	0.024	0	0.35	0.00	0:00:00	0.000
EX4678	0.002	0	0	07:54	0.000	0	0.23	0.00	0:00:00	0.000
EX4682	0.024	0	0	07:55	0.000	0	0.29	0.00	0:00:00	0.000
EX4686	0.002	0	0	07:54	0.000	0	0.29	0.00	0:00:00	0.000
EX4690	0.195	1	0	08:17	0.004	0	0.48	0.00	0:00:00	0.000
EX4694	0.447	1	0	08:51	0.024	0	0.11	0.00	0:00:00	0.000
EX4695	0.001	0	0	07:54	0.000	0	0.06	0.00	0:00:00	0.000
EX4702	1.311	4	0	11:28	0.152	1	0.26	0.00	0:00:00	0.000
EX4709	0.002	0	0	07:56	0.000	0	0.36	0.00	0:00:00	0.000
EX4710	0.002	0	0	07:56	0.000	0	0.36	0.00	0:00:00	0.000
EX4711	0.976	3	0	09:58	0.118	0	0.36	0.00	0:00:00	0.000
EX4712	0.002	0	0	07:57	0.000	0	0.40	0.00	0:00:00	0.000
EX4717	0.002	0	0	07:56	0.000	0	0.03	0.00	0:00:00	0.000
EX4719	0.002	0	0	08:00	0.000	0	0.84	0.00	0:00:00	0.000
EX4720	0.037	0	0	08:05	0.001	0	0.50	0.00	0:00:00	0.000
EX4721	0.643	2	0	09:14	0.060	0	0.14	0.00	0:00:00	0.000
EX4722	0.736	2	0	10:45	0.116	0	0.14	0.00	0:00:00	0.000
EX4725	0.002	0	0	08:00	0.000	0	0.25	0.00	0:00:00	0.000
EX4729	1.418	5	0	10:22	0.217	1	0.25	0.00	0:00:00	0.000
EX4737	0.464	2	0	08:38	0.024	0	0.22	0.00	0:00:00	0.000
EX4755	0.509	2	0	12:25	0.049	0	0.23	0.00	0:00:00	0.000
EX4809	0.018	0	0	08:06	0.000	0	0.45	0.00	0:00:00	0.000

EX4810	0.015	0	0	08:17	0.000	0	0.35	0.00	0:00:00	0.000
EX5	0.002	0	0	08:01	0.001	0	2.14	0.00	0:00:00	0.000
EX5069	0.016	0	0	08:22	0.000	0	0.34	0.00	0:00:00	0.000
EX5070	0.498	2	0	08:37	0.016	0	0.44	0.00	0:00:00	0.000
EX5077	0.167	1	0	09:18	0.006	0	0.28	0.00	0:00:00	0.000
EX5081	0.103	0	0	09:40	0.004	0	0.26	0.00	0:00:00	0.000
EX5085	0.092	0	0	09:50	0.004	0	0.25	0.00	0:00:00	0.000
Jun-1	0.002	0	0	08:00	0.001	0	3.14	0.00	0:00:00	0.000
Jun-300	0.016	18	0	08:00	0.013	15	0.55	0.00	0:00:00	0.000
Jun-310	0.002	0	0	08:20	0.001	0	0.58	0.00	0:00:00	0.000
Jun-315	0.002	0	0	08:15	0.001	0	3.29	0.00	0:00:00	0.000
Jun-320	0.002	0	0	08:15	0.000	0	5.98	0.00	0:00:00	0.000
Jun-95	1.016	0	0	08:43	0.297	0	2.18	0.00	0:00:00	0.000
MH1	0.004	49	0	21:50	0.003	37	9.85	0.00	0:00:00	0.000
MH100	0.004	82	0	08:43	0.001	13	1.85	0.00	0:00:00	0.000
MH102	0.003	86	0	08:44	0.000	12	0.60	0.00	0:00:00	0.000
MH103	0.019	2	0	08:49	0.001	0	0.38	0.00	0:00:00	0.000
MH105	0.050	5	0	08:58	0.001	0	0.37	0.00	0:00:00	0.000
MH106	0.115	15	0	09:01	0.003	0	0.44	0.00	0:00:00	0.000
MH107	0.151	14	0	09:11	0.004	0	0.15	0.00	0:00:00	0.000
MH108	0.304	29	0	09:27	0.012	1	0.14	0.00	0:00:00	0.000
MH11	0.004	48	0	21:45	0.003	36	8.29	0.00	0:00:00	0.000
MH14	0.004	48	0	21:41	0.003	37	8.29	0.00	0:00:00	0.000
MH15	0.000	0	0	00:00	0.000	0	0.00	0.00	0:00:00	0.000
MH16	0.000	0	0	00:00	0.000	0	0.00	0.00	0:00:00	0.000
MH20	0.000	0	0	00:00	0.000	0	0.00	0.00	0:00:00	0.000
MH21	0.004	51	0	08:30	0.003	36	7.87	0.00	0:00:00	0.000
MH22	0.000	10	0	08:30	0.000	2	0.04	0.00	0:00:00	0.000
MH23	0.000	6	0	08:29	0.000	3	0.00	0.00	0:00:00	0.000
MH25	0.000	0	0	00:00	0.000	0	0.00	0.00	0:00:00	0.000
MH28	0.000	0	0	00:00	0.000	0	0.00	0.00	0:00:00	0.000
MH3	0.000	0	0	00:00	0.000	0	0.00	0.00	0:00:00	0.000
MH31	0.004	51	0	08:32	0.003	33	7.33	0.00	0:00:00	0.000
MH35	0.005	60	0	08:32	0.003	34	7.31	0.00	0:00:00	0.000
MH36	0.002	44	0	08:31	0.001	12	0.32	0.00	0:00:00	0.000
MH38	0.002	46	0	08:31	0.000	11	0.25	0.00	0:00:00	0.000
MH40	0.002	39	0	08:30	0.000	7	0.19	0.00	0:00:00	0.000
MH43	0.002	37	0	08:32	0.000	4	0.10	0.00	0:00:00	0.000
MH46	0.001	37	0	08:31	0.000	2	0.02	0.00	0:00:00	0.000
MH5	0.000	0	0	00:00	0.000	0	0.00	0.00	0:00:00	0.000
MH50	0.005	66	0	08:32	0.002	34	6.55	0.00	0:00:00	0.000
MH51	0.003	63	0	08:31	0.001	22	1.20	0.00	0:00:00	0.000
MH52	0.003	68	0	08:31	0.001	22	1.16	0.00	0:00:00	0.000
MH53	0.003	75	0	08:31	0.001	22	1.21	0.00	0:00:00	0.000
MH54	0.003	80	0	08:30	0.001	19	0.13	0.00	0:00:00	0.000
MH55	0.003	81	0	08:31	0.001	16	0.05	0.00	0:00:00	0.000
MH58	0.005	67	0	08:34	0.002	32	0.48	0.00	0:00:00	0.000
MH59	0.004	68	0	08:36	0.002	30	0.46	0.00	0:00:00	0.000
MH61	0.004	71	0	08:37	0.002	29	0.19	0.00	0:00:00	0.000
MH62	0.004	73	0	08:39	0.001	27	0.18	0.00	0:00:00	0.000
MH63	0.004	72	0	08:40	0.001	23	0.10	0.00	0:00:00	0.000

MH64	0.003	79	0	08:39	0.001	22	0.02	0.00	0:00:00	0.000
MH67	0.004	72	0	08:37	0.002	29	0.27	0.00	0:00:00	0.000
MH69	0.004	76	0	08:39	0.001	26	0.27	0.00	0:00:00	0.000
MH7	0.000	0	0	00:00	0.000	0	0.00	0.00	0:00:00	0.000
MH71	0.004	77	0	08:39	0.001	23	0.08	0.00	0:00:00	0.000
MH72	0.004	77	0	08:39	0.001	20	0.04	0.00	0:00:00	0.000
MH76	0.005	66	0	08:31	0.002	32	4.91	0.00	0:00:00	0.000
MH77	0.005	69	0	08:33	0.002	29	2.04	0.00	0:00:00	0.000
MH78	0.005	72	0	08:33	0.002	29	2.02	0.00	0:00:00	0.000
MH79	0.005	74	0	08:34	0.002	28	2.08	0.00	0:00:00	0.000
MH8	0.000	0	0	00:00	0.000	0	0.00	0.00	0:00:00	0.000
MH80	0.005	82	0	08:36	0.002	30	0.56	0.00	0:00:00	0.000
MH82	0.004	85	0	08:36	0.002	30	0.55	0.00	0:00:00	0.000
MH85	0.004	86	0	08:37	0.001	29	0.53	0.00	0:00:00	0.000
MH86	0.004	88	0	08:40	0.001	27	0.56	0.00	0:00:00	0.000
MH89	0.004	1	0	08:40	0.001	0	0.38	0.00	0:00:00	0.000
MH90	0.004	0	0	08:41	0.001	0	0.37	0.00	0:00:00	0.000
MH93	0.567	27	0	09:04	0.027	1	0.36	0.00	0:00:00	0.000
MH94	0.228	30	0	09:11	0.008	1	0.19	0.00	0:00:00	0.000
MH95	0.002	79	0	09:10	0.000	8	0.10	0.00	0:00:00	0.000
MH97	0.004	69	0	08:36	0.001	15	1.70	0.00	0:00:00	0.000
MH99	0.004	75	0	08:37	0.001	13	1.77	0.00	0:00:00	0.000
MH-A	0.003	0	0	08:41	0.000	0	1.41	0.00	0:00:00	0.000
MH-C	0.003	0	0	08:36	0.000	0	1.52	0.00	0:00:00	0.000
SPA Pond_130360m3	122.671	61	0	21:53	88.003	44	0.55	0.00	0:00:00	0.000
Stor-02	0.000	0	0	00:00	0.000	0	0.00	0.00	0:00:00	0.000
Stor-SPA1	0.334	32	0	08:16	0.006	1	1.06	0.00	0:00:00	0.000
Stor-SPA100	0.267	34	0	08:19	0.010	1	0.63	0.00	0:00:00	0.000
Stor-SPA106	0.474	70	0	08:24	0.020	3	0.91	0.00	0:00:00	0.000
Stor-SPA14	0.173	20	0	08:16	0.004	0	0.58	0.00	0:00:00	0.000
Stor-SPA21	0.206	17	0	08:16	0.003	0	0.78	0.00	0:00:00	0.000
Stor-SPA35	0.593	38	0	08:26	0.018	1	0.80	0.00	0:00:00	0.000
Stor-SPA50	0.419	33	0	08:23	0.012	1	0.69	0.00	0:00:00	0.000
Stor-SPA51	0.818	48	0	08:20	0.020	1	1.64	0.00	0:00:00	0.000
Stor-SPA52	0.142	42	0	08:28	0.011	3	0.23	0.00	0:00:00	0.000
Stor-SPA62	0.108	31	0	08:26	0.004	1	0.20	0.00	0:00:00	0.000
Stor-SPA69	0.190	36	0	08:30	0.007	1	0.29	0.00	0:00:00	0.000
Stor-SPA79	0.150	22	0	08:16	0.004	1	0.86	0.00	0:00:00	0.000
Stor-SPA86	0.275	38	0	08:22	0.009	1	0.68	0.00	0:00:00	0.000
Stor-Spa86a	0.122	56	0	08:10	0.002	1	0.40	0.00	0:00:00	0.000

****
Outfall Loading Summary
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Outfall Node ID	Flow Frequency (%)	Average Flow cms	Peak Inflow cms

ETLD-1	2.60	0.035	0.060
ETLD-2a	4.02	0.513	0.885
ETLD-2b	9.15	0.070	0.178
ETLD-3	2.58	0.031	0.057
ETLD-4	3.33	0.046	0.083
Out-01	100.00	1.751	7.476
Out-02	6.48	0.993	1.858
Out-03	0.00	0.000	0.000
Out-04	0.00	0.000	0.000
Out-11	99.73	0.287	5.473
System	22.79	3.725	12.641

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Link Flow Summary
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Link ID	Element Type	Time of Peak Flow Occurrence days hh:mm	Maximum Velocity Attained m/sec	Length Factor	Peak Flow during Analysis cms	Design Flow Capacity cms	Ratio of Maximum /Design Flow	Ratio of Maximum Flow Depth	Total Time Surcharged minutes	Reported Condition
1	CONDUIT	0 08:00	2.05	1.00	3.137	3.766	0.83	0.81	0	Calculated
Culvert D10	CONDUIT	0 08:36	0.92	1.00	5.574	1.961	2.84	0.93	0	> CAPACITY
Culvert D11	CONDUIT	0 08:52	0.56	1.00	5.185	58.206	0.09	1.00	0	Calculated
Culvert D12	CONDUIT	0 08:37	1.04	1.00	5.576	17.268	0.32	0.89	0	Calculated
Culvert D13	CONDUIT	0 08:37	0.92	1.00	5.577	23.990	0.23	0.84	0	Calculated
Culvert D14	CONDUIT	0 08:37	1.11	1.00	5.578	31.021	0.18	0.83	0	Calculated
Culvert D15	CONDUIT	0 08:38	1.05	1.00	5.579	30.653	0.18	0.79	0	Calculated
Culvert D16	CONDUIT	0 08:32	1.53	1.00	6.370	33.465	0.19	0.73	0	Calculated
Culvert D17	CONDUIT	0 08:32	1.07	1.00	6.370	4.421	1.44	0.55	0	> CAPACITY
Culvert D7	CONDUIT	0 08:14	1.07	1.00	5.661	84.130	0.07	1.00	38	SURCHARGED
Culvert D8	CONDUIT	0 08:32	0.89	1.00	5.579	33.017	0.17	0.95	0	Calculated
Culvert D9	CONDUIT	0 08:34	0.88	1.00	5.575	16.263	0.34	0.95	0	Calculated
Culvert R1	CONDUIT	0 08:30	0.70	1.00	6.716	26.948	0.25	1.00	23	SURCHARGED
Culvert R2	CONDUIT	0 08:09	0.73	1.00	5.314	9.320	0.57	1.00	280	SURCHARGED
Cyr Drain	CHANNEL	0 09:02	0.74	1.00	1.614	50.008	0.03	0.21	0	Calculated
CYR-1	CHANNEL	0 08:00	0.51	1.00	0.309	10.887	0.03	0.22	0	Calculated
CYR-2	CHANNEL	0 08:01	0.54	1.00	0.294	25.524	0.01	0.31	0	Calculated
CYR-3	CHANNEL	0 08:24	0.72	1.00	1.537	13.325	0.12	0.39	0	Calculated
CYR-4	CHANNEL	0 08:26	0.80	1.00	1.539	14.919	0.10	0.40	0	Calculated
CYR-5	CHANNEL	0 08:24	0.96	1.00	1.730	14.696	0.12	0.39	0	Calculated
CYR-6	CHANNEL	0 08:25	0.71	1.00	1.739	17.768	0.10	0.35	0	Calculated
CYR-7	CHANNEL	0 08:32	0.26	1.00	1.668	110.612	0.02	0.41	0	Calculated
CYR-8	CHANNEL	0 08:36	0.90	1.00	2.022	17.630	0.11	0.41	0	Calculated
CYR-9	CHANNEL	0 08:38	0.85	1.00	2.016	28.754	0.07	0.57	0	Calculated
Drain R1	CHANNEL	0 08:32	0.75	1.00	6.014	9.834	0.61	0.76	0	Calculated
Drain R2	CHANNEL	0 08:32	0.75	1.00	6.691	11.455	0.58	0.88	0	Calculated
Drain R3	CHANNEL	0 08:14	0.71	1.00	3.149	24.381	0.13	0.90	0	Calculated

Enclosed_ETLD1	CONDUIT	0	08:01	1.19	1.00	0.549	0.606	0.91	0.87	0	Calculated
EX14a	CONDUIT	0	11:40	1.14	1.00	0.407	0.299	1.36	1.00	361	SURCHARGED
EX14b	CONDUIT	0	11:40	1.14	1.00	0.407	0.299	1.36	1.00	361	SURCHARGED
EX15b	CONDUIT	0	11:40	1.14	1.00	0.407	0.293	1.39	1.00	369	SURCHARGED
EXB1	CONDUIT	0	07:52	0.41	1.00	0.087	0.140	0.62	1.00	345	SURCHARGED
EXB10	CONDUIT	0	12:04	1.10	1.00	0.395	0.302	1.31	1.00	305	SURCHARGED
EXB11	CONDUIT	0	12:03	0.99	1.00	0.355	0.174	2.04	1.00	321	SURCHARGED
EXB12a	CONDUIT	0	12:03	0.84	1.00	0.302	0.299	1.01	1.00	350	SURCHARGED
EXB12b	CONDUIT	0	12:03	0.84	1.00	0.302	0.299	1.01	1.00	350	SURCHARGED
EXB13a	CONDUIT	0	11:41	0.86	1.00	0.307	0.391	0.79	1.00	353	SURCHARGED
EXB13b	CONDUIT	0	11:41	0.86	1.00	0.307	0.391	0.79	1.00	353	SURCHARGED
EXB15a	CONDUIT	0	11:40	1.14	1.00	0.407	0.293	1.39	1.00	369	SURCHARGED
EXB2	CONDUIT	0	07:52	0.75	1.00	0.162	0.162	1.00	1.00	348	SURCHARGED
EXB3	CONDUIT	0	13:38	0.88	1.00	0.288	0.262	1.10	1.00	348	SURCHARGED
EXB4	CONDUIT	0	13:38	0.81	1.00	0.290	0.309	0.94	1.00	349	SURCHARGED
EXB5	CONDUIT	0	13:38	0.82	1.00	0.292	0.256	1.14	1.00	349	SURCHARGED
EXB6	CONDUIT	0	13:38	1.19	1.00	0.257	0.139	1.84	1.00	347	SURCHARGED
EXB7	CONDUIT	0	07:51	1.24	1.00	0.347	0.228	1.53	1.00	285	SURCHARGED
EXB8	CONDUIT	0	07:50	0.98	1.00	0.283	0.377	0.75	1.00	286	SURCHARGED
EXB9	CONDUIT	0	12:35	0.87	1.00	0.225	0.224	1.01	1.00	290	SURCHARGED
EXG1	CONDUIT	0	09:51	0.56	1.00	0.249	0.305	0.81	1.00	124	SURCHARGED
EXG2	CONDUIT	0	09:52	0.57	1.00	0.251	0.280	0.90	1.00	125	SURCHARGED
EXG3	CONDUIT	0	07:55	0.68	1.00	0.296	0.309	0.96	1.00	127	SURCHARGED
EXG4	CONDUIT	0	09:34	0.78	1.00	0.347	0.290	1.19	1.00	133	SURCHARGED
EXG5	CONDUIT	0	09:32	0.78	1.00	0.345	0.323	1.07	1.00	140	SURCHARGED
EXG6	CONDUIT	0	09:33	0.78	1.00	0.345	0.277	1.25	1.00	159	SURCHARGED
EXG7	CONDUIT	0	08:00	0.70	1.00	0.448	1.220	0.37	1.00	152	SURCHARGED
EXG8	CONDUIT	0	09:33	0.62	1.00	0.398	0.418	0.95	1.00	271	SURCHARGED
EXO1	CONDUIT	0	07:50	0.30	1.00	0.082	0.166	0.49	1.00	430	SURCHARGED
EXO10	CONDUIT	0	11:09	1.89	1.00	2.142	0.882	2.43	1.00	205	SURCHARGED
EXO11	CONDUIT	0	08:01	2.49	1.00	3.258	1.195	2.73	0.88	0	> CAPACITY
EXO12	CONDUIT	0	13:25	1.06	1.00	0.230	0.135	1.71	1.00	335	SURCHARGED
EXO13	CONDUIT	0	12:49	1.23	1.00	0.348	0.172	2.02	1.00	337	SURCHARGED
EXO14	CONDUIT	0	12:49	1.25	1.00	0.349	0.176	1.99	1.00	292	SURCHARGED
EXO15	CONDUIT	0	08:00	1.60	1.00	1.383	0.646	2.14	1.00	234	SURCHARGED
EXO16	CONDUIT	0	08:00	1.22	1.00	1.383	1.784	0.78	1.00	221	SURCHARGED
EXO2	CONDUIT	0	14:18	1.15	1.00	0.326	0.259	1.26	1.00	433	SURCHARGED
EXO3	CONDUIT	0	13:12	1.01	1.00	0.360	0.243	1.48	1.00	432	SURCHARGED
EXO4	CONDUIT	0	13:13	1.01	1.00	0.361	0.259	1.39	1.00	412	SURCHARGED
EXO5	CONDUIT	0	13:13	1.01	1.00	0.361	0.258	1.40	1.00	398	SURCHARGED
EXO6	CONDUIT	0	08:00	1.27	1.00	0.455	0.228	2.00	1.00	343	SURCHARGED
EXO7	CONDUIT	0	07:56	1.43	1.00	1.622	7.926	0.20	1.00	280	SURCHARGED
EXO8	CONDUIT	0	07:56	1.43	1.00	1.622	1.313	1.24	1.00	292	SURCHARGED
EXO9	CONDUIT	0	11:09	1.89	1.00	2.142	1.346	1.59	1.00	259	SURCHARGED
EXPK10	CONDUIT	0	08:19	1.01	1.00	0.646	0.359	1.80	1.00	135	SURCHARGED
EXPK11	CONDUIT	0	08:17	1.45	1.00	0.922	0.395	2.34	1.00	304	SURCHARGED
EXPK12	CONDUIT	0	08:18	1.07	1.00	0.924	0.978	0.94	1.00	262	SURCHARGED
EXPK4	CONDUIT	0	07:58	1.41	1.00	0.399	0.200	2.00	1.00	62	SURCHARGED
EXPK5	CONDUIT	0	07:57	1.14	1.00	0.315	0.194	1.62	1.00	62	SURCHARGED
EXPK6	CONDUIT	0	08:46	0.84	1.00	0.239	0.166	1.44	1.00	68	SURCHARGED
EXPK7	CONDUIT	0	08:46	0.85	1.00	0.240	0.168	1.43	1.00	79	SURCHARGED

EXPK8	CONDUIT	0	08:46	0.47	1.00	0.241	0.706	0.34	1.00	67	SURCHARGED
EXPK9	CONDUIT	0	07:55	0.57	1.00	0.327	0.738	0.44	1.00	86	SURCHARGED
EXY1	CONDUIT	0	07:50	1.04	1.00	0.225	0.136	1.65	1.00	431	SURCHARGED
EXY2	CONDUIT	0	14:57	1.16	1.00	0.252	0.144	1.74	1.00	433	SURCHARGED
EXY3	CONDUIT	0	14:57	0.89	1.00	0.252	0.192	1.31	1.00	433	SURCHARGED
EXY4	CONDUIT	0	07:51	1.25	1.00	0.553	0.300	1.84	1.00	430	SURCHARGED
EXY5	CONDUIT	0	14:23	0.66	1.00	0.144	0.147	0.98	1.00	431	SURCHARGED
EXY6	CONDUIT	0	08:00	1.10	1.00	0.312	0.197	1.58	1.00	433	SURCHARGED
EXY7	CONDUIT	0	07:50	1.13	1.00	0.498	0.302	1.65	1.00	430	SURCHARGED
Link-01	CONDUIT	0	08:09	1.44	1.00	4.975	5.419	0.92	1.00	1473	SURCHARGED
Link-04	CONDUIT	0	07:59	2.22	1.00	1.412	0.906	1.56	1.00	149	SURCHARGED
Link-109	CONDUIT	0	08:42	1.26	1.00	0.575	0.608	0.95	1.00	68	SURCHARGED
Link-110	CONDUIT	0	08:15	1.92	1.00	3.291	2.732	1.20	0.93	0	> CAPACITY
Link-111	CONDUIT	0	08:15	2.32	1.00	5.983	8.212	0.73	0.60	0	Calculated
Link-12	CHANNEL	0	08:30	0.55	1.00	5.596	11.610	0.48	0.97	0	Calculated
Link-14	CHANNEL	0	08:33	0.66	1.00	5.576	6.816	0.82	0.92	0	Calculated
Link-16	CHANNEL	0	08:35	0.63	1.00	5.574	1.608	3.47	0.85	0	> CAPACITY
Link-18	CHANNEL	0	08:36	0.64	1.00	5.574	18.603	0.30	0.87	0	Calculated
Link-20	CHANNEL	0	08:37	0.64	1.00	5.575	24.695	0.23	0.86	0	Calculated
Link-22	CHANNEL	0	08:37	0.69	1.00	5.576	15.310	0.36	0.85	0	Calculated
Link-23	CONDUIT	0	08:01	2.45	1.00	3.239	2.534	1.28	1.00	118	SURCHARGED
Link-24	CHANNEL	0	08:37	0.72	1.00	5.578	52.989	0.11	0.66	0	Calculated
Link-26	CHANNEL	0	08:37	0.71	1.00	5.579	79.596	0.07	0.63	0	Calculated
Link-28	CHANNEL	0	08:32	0.84	1.00	6.370	28.828	0.22	0.62	0	Calculated
Link-30	CHANNEL	0	08:32	1.09	1.00	6.370	19.120	0.33	0.58	0	Calculated
Link-32	CHANNEL	0	08:32	1.65	1.00	6.370	32.829	0.19	0.42	0	Calculated
Link-33	CONDUIT	0	08:00	0.51	1.00	0.442	1.328	0.33	0.87	0	Calculated
Link-38	CHANNEL	0	08:20	0.47	1.00	2.646	1.042	2.54	0.86	0	> CAPACITY
Link-42	CONDUIT	0	08:33	1.35	1.00	6.370	9.180	0.69	0.87	0	Calculated
Link-43	CONDUIT	0	08:34	1.48	1.00	6.372	10.583	0.60	0.85	0	Calculated
Link-44	CONDUIT	0	00:00	0.00	1.00	0.000	202.438	0.00	0.00	0	Calculated
Link-45	CONDUIT	0	00:00	0.00	1.00	0.000	0.740	0.00	0.00	0	Calculated
Link-46	CONDUIT	0	00:00	0.00	1.00	0.000	0.737	0.00	0.00	0	Calculated
Link-48	CONDUIT	0	00:00	0.00	1.00	0.000	0.826	0.00	0.00	0	Calculated
Link-49	CONDUIT	0	00:00	0.00	1.00	0.000	0.721	0.00	0.00	0	Calculated
Link-51	CONDUIT	0	09:04	1.05	1.00	2.179	5.984	0.36	0.85	0	Calculated
Link-52	CONDUIT	0	09:05	0.85	1.00	2.230	5.796	0.38	0.94	0	Calculated
Link-53	CONDUIT	0	09:06	0.79	1.00	2.272	8.827	0.26	1.00	0	Calculated
Link-54	CONDUIT	0	09:06	0.83	1.00	2.294	4.838	0.47	0.99	0	Calculated
Link-55	CONDUIT	0	08:56	1.08	1.00	4.196	1.781	2.36	0.87	0	> CAPACITY
Link-56	CONDUIT	0	08:56	2.38	1.00	4.200	4.680	0.90	1.00	31	SURCHARGED
Link-57	CONDUIT	0	08:55	1.43	1.00	4.214	10.377	0.41	0.88	0	Calculated
Link-58	CONDUIT	0	08:14	1.90	1.00	6.495	8.600	0.76	0.98	0	Calculated
Link-59	CONDUIT	0	08:14	0.97	1.00	6.416	20.115	0.32	0.99	0	Calculated
Link-60	CONDUIT	0	08:13	1.46	1.00	6.268	8.654	0.72	1.00	14	SURCHARGED
Link-61	CONDUIT	0	00:00	0.00	1.00	0.000	0.903	0.00	0.00	0	Calculated
Link-63	CONDUIT	0	08:12	0.84	1.00	6.071	20.979	0.29	1.00	44	SURCHARGED
Link-64	CONDUIT	0	08:25	1.16	1.00	6.046	9.294	0.65	1.00	56	SURCHARGED
Link-C-A	CONDUIT	0	07:58	2.38	1.00	1.516	0.784	1.93	1.00	116	SURCHARGED
LinkD-C	CONDUIT	0	07:58	2.54	1.00	1.614	0.468	3.45	1.00	92	SURCHARGED
PipeA	CONDUIT	0	08:10	1.42	1.00	4.910	5.614	0.87	1.00	1596	SURCHARGED

Pipe-B	CONDUIT	0	08:59	1.89	1.00	6.547	5.821	1.12	1.00	1874	SURCHARGED
Pipe-C	CONDUIT	0	08:59	2.11	1.00	7.311	5.202	1.41	1.00	2147	SURCHARGED
Pipe-D	CONDUIT	0	08:59	2.11	1.00	7.325	5.211	1.41	1.00	2315	SURCHARGED
Pipe-E	CONDUIT	0	08:38	2.27	1.00	7.872	5.419	1.45	1.00	2403	SURCHARGED
Pipe-F	CONDUIT	0	08:39	2.39	1.00	8.285	5.628	1.47	1.00	2400	SURCHARGED
Pipe-G	CONDUIT	0	08:39	2.39	1.00	8.289	5.619	1.48	1.00	2336	SURCHARGED
PipeTo-Pond	CONDUIT	0	08:20	3.11	1.00	9.852	5.419	1.82	1.00	2271	SURCHARGED
SPAB1	CONDUIT	0	00:00	0.00	1.00	0.000	0.219	0.00	0.00	0	Calculated
SPAB2	CONDUIT	0	00:00	0.00	1.00	0.000	0.255	0.00	0.06	0	Calculated
SPAB3	CONDUIT	0	08:22	0.11	1.00	0.007	0.326	0.02	0.28	0	Calculated
SPAB4	CONDUIT	0	08:16	0.26	1.00	0.040	0.432	0.09	0.56	0	Calculated
SPABL1	CONDUIT	0	00:00	0.00	1.00	0.000	0.208	0.00	0.00	0	Calculated
SPABL2	CONDUIT	0	00:00	0.00	1.00	0.000	0.238	0.00	0.00	0	Calculated
SPABL3	CONDUIT	0	00:00	0.00	1.00	0.000	0.342	0.00	0.00	0	Calculated
SPAG1	CONDUIT	0	08:01	0.55	1.00	0.133	0.213	0.62	1.00	141	SURCHARGED
SPAG2	CONDUIT	0	08:01	0.58	1.00	0.206	0.334	0.62	1.00	222	SURCHARGED
SPAG3	CONDUIT	0	10:06	0.76	1.00	0.337	0.376	0.90	1.00	1036	SURCHARGED
SPAG4	CONDUIT	0	10:07	0.84	1.00	0.372	0.433	0.86	1.00	1362	SURCHARGED
SPAG5	CONDUIT	0	10:10	0.59	1.00	0.378	0.568	0.67	1.00	1420	SURCHARGED
SPAG6	CONDUIT	0	07:52	0.99	1.00	0.564	0.567	0.99	1.00	1607	SURCHARGED
SPAG8	CONDUIT	0	10:08	0.63	1.00	0.545	0.749	0.73	1.00	1830	SURCHARGED
SPAG9	CONDUIT	0	10:08	0.64	1.00	0.557	0.755	0.74	1.00	2054	SURCHARGED
SPAO1	CONDUIT	0	07:57	0.41	1.00	0.076	0.171	0.44	1.00	1709	SURCHARGED
SPAO2	CONDUIT	0	07:58	0.51	1.00	0.142	0.206	0.69	1.00	1929	SURCHARGED
SPAO3	CONDUIT	0	09:39	1.06	1.00	0.260	0.266	0.98	1.00	2158	SURCHARGED
SPAO4	CONDUIT	0	09:38	0.76	1.00	0.272	0.326	0.84	1.00	2407	SURCHARGED
SPAO5	CONDUIT	0	09:28	0.73	1.00	0.464	0.647	0.72	1.00	2407	SURCHARGED
SPAO6	CONDUIT	0	09:28	0.76	1.00	0.485	0.666	0.73	1.00	2409	SURCHARGED
SPAPK1	CONDUIT	0	08:01	0.52	1.00	0.098	0.158	0.62	1.00	1429	SURCHARGED
SPAPK2	CONDUIT	0	08:00	0.83	1.00	0.174	0.187	0.93	1.00	1726	SURCHARGED
SPAPK3	CONDUIT	0	09:27	0.90	1.00	0.176	0.266	0.66	1.00	2152	SURCHARGED
SPAPK4	CONDUIT	0	09:28	0.66	1.00	0.187	0.266	0.70	1.00	2407	SURCHARGED
SPAPL1	CONDUIT	0	00:00	0.00	1.00	0.000	0.154	0.00	0.00	0	Calculated
SPAPL2	CONDUIT	0	00:00	0.00	1.00	0.000	0.167	0.00	0.00	0	Calculated
SPAPL3	CONDUIT	0	00:00	0.00	1.00	0.000	0.301	0.00	0.00	0	Calculated
SPAPL4	CONDUIT	0	00:00	0.00	1.00	0.000	0.342	0.00	0.00	0	Calculated
SPAR1	CONDUIT	0	08:07	0.52	1.00	0.098	0.154	0.64	1.00	86	SURCHARGED
SPAR2	CONDUIT	0	08:06	0.77	1.00	0.188	0.238	0.79	1.00	99	SURCHARGED
SPAR3	CONDUIT	0	08:03	0.80	1.00	0.248	0.397	0.62	1.00	107	SURCHARGED
SPAR4	CONDUIT	0	08:03	0.79	1.00	0.325	0.483	0.67	1.00	122	SURCHARGED
SPAR5	CONDUIT	0	08:01	0.78	1.00	0.380	0.556	0.68	1.00	556	SURCHARGED
SPAY1	CONDUIT	0	07:50	0.37	1.00	0.068	0.167	0.41	1.00	184	SURCHARGED
SPAY2	CONDUIT	0	07:50	0.40	1.00	0.160	0.374	0.43	1.00	186	SURCHARGED
SPAY3	CONDUIT	0	07:56	1.37	1.00	1.191	1.006	1.18	1.00	167	SURCHARGED
SPAY4	CONDUIT	0	07:55	1.36	1.00	1.162	1.005	1.16	1.00	777	SURCHARGED
SPAY5	CONDUIT	0	07:54	1.68	1.00	1.199	1.003	1.19	1.00	1420	SURCHARGED
SPG7	CONDUIT	0	10:08	0.86	1.00	0.534	0.565	0.95	1.00	1822	SURCHARGED
Z1	CONDUIT	0	09:37	1.15	1.00	2.039	2.212	0.92	1.00	1984	SURCHARGED
Z10	CONDUIT	0	10:16	0.95	1.00	0.369	0.362	1.02	1.00	158	SURCHARGED
Z11	CONDUIT	0	07:53	0.59	1.00	0.165	0.206	0.80	1.00	156	SURCHARGED
Z12	CONDUIT	0	10:13	0.66	1.00	0.144	0.154	0.94	1.00	152	SURCHARGED

Z2	CONDUIT	0	09:40	1.15	1.00	2.024	2.211	0.92	1.00	1832	SURCHARGED
Z3	CONDUIT	0	09:40	1.14	1.00	2.010	2.031	0.99	1.00	1621	SURCHARGED
Z4	CONDUIT	0	07:55	1.79	1.00	1.697	1.434	1.18	1.00	176	SURCHARGED
Z5	CONDUIT	0	07:56	1.59	1.00	1.769	1.393	1.27	1.00	164	SURCHARGED
Z6	CONDUIT	0	07:56	1.63	1.00	1.848	1.394	1.33	1.00	160	SURCHARGED
Z7	CONDUIT	0	07:56	0.94	1.00	0.595	0.647	0.92	1.00	171	SURCHARGED
Z8	CONDUIT	0	10:17	0.72	1.00	0.382	0.584	0.65	1.00	163	SURCHARGED
Z9	CONDUIT	0	10:16	0.93	1.00	0.375	0.386	0.97	1.00	162	SURCHARGED
LowFlowPump	PUMP	0	04:11			0.045		1.00		473	
Pump-02	PUMP	0	07:48			0.500		1.00		2412	
Pump-03	PUMP	0	07:50			2.000		1.00		2868	
16	ORIFICE	0	08:04			0.351			1.00		
SPA1	ORIFICE	0	08:16			0.738			1.00		
SPA100	ORIFICE	0	07:56			0.525			1.00		
SPA106	ORIFICE	0	07:52			0.472			1.00		
SPA14	ORIFICE	0	08:16			0.417			1.00		
SPA21	ORIFICE	0	08:16			0.722			1.00		
SPA35	ORIFICE	0	08:26			0.739			1.00		
SPA50	ORIFICE	0	08:23			0.636			1.00		
SPA51	ORIFICE	0	08:01			1.264			1.00		
SPA52	ORIFICE	0	08:15			0.059			1.00		
SPA62	ORIFICE	0	08:13			0.173			1.00		
SPA69	ORIFICE	0	08:09			0.291			1.00		
SPA79	ORIFICE	0	08:04			0.613			1.00		
SPA86	ORIFICE	0	08:01			0.490			1.00		
01	WEIR	0	08:16			0.165			0.17		
02	WEIR	0	08:16			0.325			0.26		
03	WEIR	0	08:20			0.885			0.51		
04	WEIR	0	08:16			0.055			0.08		
05	WEIR	0	08:26			0.060			0.11		
06	WEIR	0	08:28			0.178			0.18		
07	WEIR	0	08:23			0.025			0.05		
08	WEIR	0	08:16			0.274			0.23		
09	WEIR	0	08:19			0.423			0.31		
10	WEIR	0	08:26			0.057			0.08		
11	WEIR	0	08:30			0.083			0.11		
12	WEIR	0	08:24			0.906			0.52		
13	WEIR	0	08:22			0.452			0.33		
14	WEIR	0	08:23			0.025			0.05		
15	WEIR	0	08:10			0.063			0.09		
Weir-01	WEIR	0	00:00			0.000			0.00		
Weir-02	WEIR	0	08:32			2.149			0.96		
Weir-03	WEIR	0	00:00			0.000			0.00		
Weir-04	WEIR	0	00:00			0.000			0.00		
Weir-05	WEIR	0	00:00			0.000			0.00		
Weir-07	WEIR	0	00:00			0.000			0.00		
Weir-08	WEIR	0	00:00			0.000			0.00		
Weir-09	WEIR	0	00:00			0.000			0.00		
Weir-10	WEIR	0	08:34			1.157			0.48		
Weir-11	WEIR	0	08:35			0.397			0.39		
Weir-12	WEIR	0	00:00			0.000			0.00		

Weir-15	WEIR	0	00:00	0.000	0.00
Weir-16	WEIR	0	00:00	0.000	0.00
Weir-17	WEIR	0	00:00	0.000	0.00
Weir-19	WEIR	0	08:34	1.858	0.95
Weir-20	WEIR	0	00:00	0.000	0.00
Weir-39	WEIR	0	00:00	0.000	0.00
Outlet-01	OUTLET	0	00:00	7.476	

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Flow Classification Summary
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Link	--- Fraction of Time in Flow Class ---- Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
1	0.00	0.03	0.00	0.00	0.00	0.97	0.00	0.17	0.0000
Culvert D10	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.18	0.0000
Culvert D11	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.11	0.0000
Culvert D12	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.19	0.0000
Culvert D13	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.19	0.0000
Culvert D14	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.19	0.0000
Culvert D15	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.20	0.0000
Culvert D16	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.27	0.0000
Culvert D17	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.18	0.0000
Culvert D7	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.14	0.0001
Culvert D8	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.16	0.0000
Culvert D9	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.17	0.0000
Culvert R1	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.11	0.0000
Culvert R2	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.12	0.0000
Cyr Drain	0.05	0.00	0.00	0.00	0.00	0.00	0.95	0.20	0.0000
CYR-1	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.22	0.0000
CYR-2	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.21	0.0000
CYR-3	0.02	0.00	0.00	0.98	0.00	0.00	0.00	0.19	0.0000
CYR-4	0.04	0.00	0.00	0.88	0.00	0.00	0.08	0.20	0.0000
CYR-5	0.12	0.00	0.00	0.88	0.00	0.00	0.00	0.16	0.0000
CYR-6	0.12	0.00	0.00	0.88	0.00	0.00	0.00	0.24	0.0000
CYR-7	0.00	0.12	0.00	0.88	0.00	0.00	0.00	0.04	0.0000
CYR-8	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.29	0.0000
CYR-9	0.03	0.00	0.00	0.97	0.00	0.00	0.00	0.15	0.0000
Drain R1	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.19	0.0000
Drain R2	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.23	0.0000
Drain R3	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.16	0.0000
Enclosed_ETLD1	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.48	0.0000
EX14a	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.27	0.0000
EX14b	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.27	0.0000
EX15b	0.00	0.00	0.00	0.96	0.00	0.00	0.04	0.22	0.0000
EXB1	0.13	0.01	0.00	0.21	0.00	0.00	0.65	0.02	0.0001
EXB10	0.00	0.00	0.00	0.27	0.00	0.00	0.72	0.48	0.0000

EXB11	0.01	0.00	0.00	0.44	0.00	0.00	0.55	0.23	0.0000
EXB12a	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.37	0.0000
EXB12b	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.37	0.0000
EXB13a	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.38	0.0000
EXB13b	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.38	0.0000
EXB15a	0.00	0.00	0.00	0.96	0.00	0.00	0.04	0.22	0.0000
EXB2	0.09	0.56	0.00	0.35	0.00	0.00	0.00	0.00	0.0000
EXB3	0.00	0.00	0.00	0.29	0.00	0.00	0.71	0.35	0.0000
EXB4	0.00	0.00	0.00	0.98	0.00	0.00	0.02	0.36	0.0000
EXB5	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.22	0.0000
EXB6	0.06	0.54	0.00	0.41	0.00	0.00	0.00	0.00	0.0001
EXB7	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.36	0.0000
EXB8	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.22	0.0000
EXB9	0.00	0.00	0.00	0.19	0.00	0.00	0.80	0.30	0.0000
EXG1	0.14	0.00	0.00	0.21	0.00	0.00	0.65	0.00	0.0000
EXG2	0.58	0.14	0.00	0.28	0.00	0.00	0.00	0.01	0.0000
EXG3	0.04	0.54	0.00	0.42	0.00	0.00	0.00	0.01	0.0000
EXG4	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.28	0.0000
EXG5	0.00	0.00	0.00	0.95	0.00	0.00	0.05	0.27	0.0000
EXG6	0.00	0.00	0.00	0.25	0.00	0.00	0.75	0.29	0.0000
EXG7	0.00	0.00	0.00	0.54	0.10	0.00	0.36	0.59	0.0000
EXG8	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.09	0.0000
EXO1	0.00	0.49	0.00	0.51	0.00	0.00	0.00	0.00	0.0000
EXO10	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.27	0.0000
EXO11	0.01	0.00	0.00	0.02	0.00	0.00	0.97	0.54	0.0000
EXO12	0.01	0.57	0.00	0.43	0.00	0.00	0.00	0.00	0.0000
EXO13	0.00	0.00	0.00	0.98	0.00	0.00	0.02	0.25	0.0000
EXO14	0.00	0.00	0.00	0.22	0.00	0.00	0.78	0.36	0.0001
EXO15	0.00	0.00	0.00	0.41	0.00	0.00	0.59	0.39	0.0000
EXO16	0.00	0.00	0.00	0.25	0.00	0.00	0.75	0.70	0.0000
EXO2	0.00	0.00	0.00	0.26	0.00	0.00	0.74	0.44	0.0000
EXO3	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.22	0.0000
EXO4	0.02	0.00	0.00	0.95	0.00	0.00	0.04	0.30	0.0000
EXO5	0.01	0.01	0.00	0.98	0.00	0.00	0.00	0.22	0.0000
EXO6	0.00	0.00	0.00	0.25	0.00	0.00	0.75	0.33	0.0000
EXO7	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.67	0.0000
EXO8	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.29	0.0000
EXO9	0.00	0.00	0.00	0.64	0.00	0.00	0.36	0.43	0.0000
EXPK10	0.00	0.00	0.00	0.25	0.00	0.00	0.75	0.29	0.0000
EXPK11	0.00	0.00	0.00	0.97	0.00	0.00	0.02	0.13	0.0000
EXPK12	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.04	0.0000
EXPK4	0.15	0.79	0.00	0.05	0.00	0.01	0.00	0.01	0.0000
EXPK5	0.15	0.00	0.00	0.08	0.00	0.00	0.77	0.03	0.0000
EXPK6	0.15	0.00	0.00	0.11	0.00	0.00	0.74	0.03	0.0000
EXPK7	0.15	0.00	0.00	0.12	0.00	0.00	0.74	0.04	0.0000
EXPK8	0.14	0.01	0.00	0.20	0.00	0.00	0.65	0.02	0.0000
EXPK9	0.01	0.66	0.00	0.32	0.00	0.00	0.00	0.00	0.0000
EXY1	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.25	0.0000
EXY2	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.25	0.0000
EXY3	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.08	0.0000
EXY4	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.26	0.0000

EXY5	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.24	0.0000
EXY6	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.06	0.0000
EXY7	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.24	0.0000
Link-01	0.01	0.00	0.00	0.93	0.00	0.00	0.06	0.09	0.0000
Link-04	0.01	0.00	0.00	0.09	0.00	0.00	0.90	0.77	0.0000
Link-109	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.49	0.0000
Link-110	0.00	0.00	0.00	0.70	0.30	0.00	0.00	0.88	0.0000
Link-111	0.00	0.00	0.00	0.08	0.00	0.00	0.92	0.69	0.0000
Link-12	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.12	0.0000
Link-14	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.21	0.0000
Link-16	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.20	0.0000
Link-18	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.20	0.0000
Link-20	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.20	0.0000
Link-22	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.22	0.0000
Link-23	0.02	0.00	0.00	0.57	0.00	0.00	0.42	0.50	0.0000
Link-24	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.23	0.0000
Link-26	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.20	0.0000
Link-28	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.23	0.0000
Link-30	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.27	0.0000
Link-32	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.49	0.0000
Link-33	0.00	0.05	0.00	0.95	0.00	0.00	0.00	0.01	0.0000
Link-38	0.00	0.00	0.00	0.92	0.00	0.00	0.08	0.13	0.0003
Link-42	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.40	0.0000
Link-43	0.00	0.00	0.00	0.36	0.00	0.00	0.64	0.58	0.0000
Link-44	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-45	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-46	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-48	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-49	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-51	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.34	0.0000
Link-52	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.26	0.0000
Link-53	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.19	0.0000
Link-54	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.20	0.0000
Link-55	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.29	0.0000
Link-56	0.00	0.00	0.00	0.47	0.53	0.00	0.00	0.90	0.0000
Link-57	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.57	0.0000
Link-58	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.59	0.0000
Link-59	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.30	0.0000
Link-60	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.39	0.0000
Link-61	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-63	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.21	0.0000
Link-64	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.18	0.0000
Link-C-A	0.01	0.00	0.00	0.08	0.00	0.00	0.91	0.67	0.0000
LinkD-C	0.00	0.00	0.00	0.06	0.00	0.00	0.94	0.54	0.0000
PipeA	0.01	0.00	0.00	0.94	0.00	0.00	0.06	0.07	0.0000
Pipe-B	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.07	0.0000
Pipe-C	0.00	0.00	0.00	0.98	0.00	0.00	0.02	0.07	0.0000
Pipe-D	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.06	0.0000
Pipe-E	0.00	0.00	0.00	0.98	0.00	0.00	0.01	0.07	0.0000
Pipe-F	0.00	0.00	0.00	0.98	0.00	0.00	0.02	0.07	0.0000
Pipe-G	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.07	0.0000

PipeTo-Pond	0.00	0.00	0.00	0.81	0.00	0.00	0.19	0.15	0.0000
SPAB1	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
SPAB2	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
SPAB3	0.60	0.07	0.00	0.04	0.00	0.00	0.29	0.01	0.0000
SPAB4	0.45	0.15	0.00	0.29	0.00	0.01	0.11	0.02	0.0000
SPABL1	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
SPABL2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
SPABL3	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
SPAG1	0.15	0.00	0.00	0.10	0.00	0.00	0.75	0.02	0.0000
SPAG2	0.22	0.02	0.00	0.77	0.00	0.00	0.00	0.00	0.0000
SPAG3	0.04	0.12	0.00	0.84	0.00	0.00	0.00	0.00	0.0000
SPAG4	0.01	0.00	0.00	0.91	0.00	0.00	0.08	0.07	0.0000
SPAG5	0.02	0.00	0.00	0.98	0.00	0.00	0.00	0.04	0.0000
SPAG6	0.01	0.00	0.00	0.97	0.00	0.00	0.02	0.06	0.0000
SPAG8	0.02	0.00	0.00	0.96	0.00	0.00	0.02	0.05	0.0000
SPAG9	0.02	0.01	0.00	0.97	0.00	0.00	0.00	0.02	0.0000
SPAO1	0.14	0.01	0.00	0.85	0.00	0.00	0.00	0.00	0.0000
SPAO2	0.02	0.12	0.00	0.86	0.00	0.00	0.00	0.00	0.0000
SPAO3	0.01	0.00	0.00	0.88	0.00	0.00	0.11	0.08	0.0000
SPAO4	0.02	0.00	0.00	0.96	0.00	0.00	0.02	0.06	0.0000
SPAO5	0.02	0.00	0.00	0.90	0.00	0.00	0.08	0.06	0.0000
SPAO6	0.02	0.00	0.00	0.98	0.00	0.00	0.00	0.01	0.0000
SPAPK1	0.15	0.00	0.00	0.84	0.00	0.00	0.01	0.00	0.0000
SPAPK2	0.03	0.11	0.00	0.85	0.00	0.00	0.00	0.00	0.0000
SPAPK3	0.02	0.00	0.00	0.85	0.00	0.00	0.13	0.07	0.0000
SPAPK4	0.03	0.00	0.00	0.87	0.00	0.00	0.09	0.07	0.0000
SPAPL1	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
SPAPL2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
SPAPL3	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
SPAPL4	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
SPAR1	0.44	0.00	0.00	0.56	0.00	0.00	0.00	0.00	0.0000
SPAR2	0.34	0.01	0.00	0.65	0.00	0.00	0.00	0.00	0.0000
SPAR3	0.27	0.01	0.00	0.72	0.00	0.00	0.00	0.00	0.0000
SPAR4	0.21	0.00	0.00	0.79	0.00	0.00	0.00	0.00	0.0000
SPAR5	0.15	0.01	0.00	0.84	0.00	0.00	0.00	0.00	0.0000
SPAY1	0.24	0.01	0.00	0.74	0.00	0.00	0.00	0.00	0.0000
SPAY2	0.05	0.11	0.00	0.83	0.00	0.00	0.00	0.00	0.0000
SPAY3	0.01	0.00	0.00	0.98	0.00	0.00	0.01	0.08	0.0000
SPAY4	0.01	0.00	0.00	0.98	0.00	0.00	0.01	0.07	0.0000
SPAY5	0.01	0.00	0.00	0.85	0.00	0.00	0.13	0.08	0.0000
SPG7	0.02	0.00	0.00	0.97	0.00	0.00	0.02	0.06	0.0000
Z1	0.00	0.00	0.00	0.89	0.00	0.00	0.11	0.06	0.0000
Z10	0.01	0.00	0.00	0.92	0.00	0.00	0.07	0.40	0.0000
Z11	0.03	0.62	0.00	0.34	0.00	0.00	0.00	0.00	0.0000
Z12	0.14	0.01	0.00	0.14	0.00	0.00	0.72	0.01	0.0000
Z2	0.00	0.00	0.00	0.98	0.00	0.00	0.02	0.06	0.0000
Z3	0.00	0.00	0.00	0.98	0.00	0.00	0.02	0.06	0.0000
Z4	0.02	0.00	0.00	0.84	0.00	0.00	0.13	0.12	0.0000
Z5	0.02	0.00	0.00	0.77	0.00	0.00	0.21	0.19	0.0000
Z6	0.02	0.00	0.00	0.97	0.00	0.00	0.01	0.29	0.0000
Z7	0.01	0.00	0.00	0.98	0.00	0.00	0.01	0.34	0.0000

Z8	0.02	0.01	0.00	0.97	0.00	0.00	0.00	0.38	0.0000
Z9	0.02	0.00	0.00	0.40	0.00	0.00	0.58	0.46	0.0000

****
****
Routing Time Step Summary
****

```
Minimum Time Step           :     0.50 sec
Average Time Step           :     0.88 sec
Maximum Time Step           :     1.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.01
```

Analysis began on: Wed Apr 08 08:15:30 2015
Analysis ended on: Wed Apr 08 08:16:52 2015
Total elapsed time: 00:01:22

APPENDIX D

FINAL CORRESPONDENCE

DILLON CONSULTING

Langlois, Ryan <rlanglois@dillon.ca>

MRSPA Modelling Memo

John Henderson <JHenderson@erca.org> Wed, Apr 8, 2015 at 10:01 AM
To: "Forest, Flavio" <fforest@dillon.ca>
Cc: "Langlois, Ryan" <rlanglois@dillon.ca>, Phil Bartnik <pbartnik@tecumseh.ca>, Tim Byrne <TByrne@erca.org>, Mike Nelson <MNelson@erca.org>

Good morning Flavio,

As per our phone conversation yesterday, we have reviewed your revised Functional Servicing Modelling Memo for the MRSPA in the Town of Tecumseh dated March 2015. The revised report was provided in response to questions/comments that ERCA provided regarding the original memo. In general, the revised information appears to address our previously submitted questions/comments. Based on the revised submission, however, clarification is required on the following additional items:

1. In Table 2, the lowest proposed MRSPA surface elevation is noted as 180.750 m. On Figure 3 the lowest surface elevation appears to be 180.700 m and on Figure 9 it appears to be 180.650 m. Please confirm. In addition, the road elevations shown on Figures 7 and 8 are not readable. Please confirm that all road elevations used in the modelling and shown on the Figures are consistent.

2. Sections 6.2 and 6.2.2 discuss the pumping rates for the quality storm event. Based on this information, it appears that the pumping rate starts at 45 l/s and increases to 545 l/s when the active storage depth of 0.190 m is reached. Do the small quality pumps shut off at elevation 174.920 m (0.420m active depth) or do they remain on until the pond is pumped to the normal water level. Based on the rest of the report, it was our understanding that the maximum release rate from the pond was 500 l/s. Please clarify.

3. Section 7.3.2 identifies that improvements are required to the Jamsyl Drive/Sylvestre Drive intersection and the Jamsyl Drive/Manning Road intersection. Who will be responsible for completing this improvements when they are required for development to proceed?

4. It appears there is a minor typo in Section 8.0. Section 4.1.1 is referred to in the text. It appears it should be Section 4.2.1.

5. Based on the HGL plots in Appendix A, the HGL at MH 108 is approximately 181.300 m. The proposed road elevation immediately east of MH108 at MH94 is 180.700 m. What is the HGL at MH94?

6. General information about the pond (ie. volumes, water levels, etc.) is provided in text and tables within the report. It is our understanding that the actual pond will be designed by others when the first development proceeds. It is recommended that a plan be included showing the configuration of the pond that was used in this study. It is further recommended that the plan include typical cross-sections and dimensions that can be finalized as part of the detailed design that will be completed by others.

7. The storm sewer layout and pipe diameters used in the analysis are shown in Figure 11.0. To ensure consistency as development proceeds in this area, the storm sewer slopes and inverts used in the analysis should also be included. We recommend that your preliminary storm sewer design sheets be included to be used as a guide for future design of the individual developments.

8. It is our understanding that the preliminary proposals for future improvements to Manning Road include the enclosure of the East Townline Drain. As part of the MRSPA proposal, 1:100 year overland flow routes are proposed to direct water to the East Townline Drain. How will these overland routes be maintained when the East Townline Drain is enclosed in the future?

9. Modeling input parameters are included in Appendix B. A developed CN value of 90 has been considered for the residential areas. Based on the historic soil mapping, the majority of this area appears to be brookston clay. Please provide your supporting information your curve number selection.

10. In general the report provides a lot of information/criteria that will need to be implemented at different stages of the future buildout of this area. How will this information/criteria be tracked to ensure that all future works recommended in this report are implemented as development proceeds?

11. As per our previous comments, we recommend that, due to the complexities of this development area, the Town of Tecumseh should engage Dillon Consulting Ltd. to review the future individual development submissions to ensure they are in compliance with the functional design study.

If you have any questions, please contact our office.

John Henderson, P. Eng.

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DILLON CONSULTING

Langlois, Ryan <rlanglois@dillon.ca>

MRSPA Modelling Memo

Forest, Flavio <fforest@dillon.ca> Thu, Apr 9, 2015 at 9:33 AM
To: John Henderson <JHenderson@erca.org>
Cc: "Langlois, Ryan" <rlanglois@dillon.ca>, Phil Bartnik <pbartnik@tecumseh.ca>, Tim Byrne <TByrne@erca.org>, Mike Nelson <MNelson@erca.org>

John, thanks for your timely review and comments. As discussed, we understand that ERCA is satisfied that the Modelling Memo has now addressed your comments to date. The final corrections and clarifications, as outlined below, will be incorporated into the final Modelling Memo (where appropriate) that will be included as an Appendix to the Addendum report and that will form the basis for the functional servicing report that will serve to guide the detailed design of the MRSPA drainage solution. You will receive a copy of the updated Addendum Report, as well as a copy of the Functional Servicing Report (once it is finalized with the Town). Our responses to your comments are as follows:

1. In Table 2, the lowest proposed MRSPA surface elevation is noted as 180.750 m. On Figure 3 the lowest surface elevation appears to be 180.700 m and on Figure 9 it appears to be 180.650 m. Please confirm. In addition, the road elevations shown on Figures 7 and 8 are not readable. Please confirm that all road elevations used in the modelling and shown on the Figures are consistent.

- We will update the tables and figures for consistency.

2. Sections 6.2 and 6.2.2 discuss the pumping rates for the quality storm event. Based on this information, it appears that the pumping rate starts at 45 l/s and increases to 545 l/s when the active storage depth of 0.190 m is reached. Do the small quality pumps shut off at elevation 174.920 m (0.420m active depth) or do they remain on until the pond is pumped to the normal water level. Based on the rest of the report, it was our understanding that the maximum release rate from the pond was 500 l/s. Please clarify.

- We will include a clarification in the report confirming that during the initial 25mm event, the active storage volume between a 0.19m to 0.34m depth will be discharged with both the low flow and high flow pumps operating simultaneously, resulting in a discharge rate of 545 L/s. This will result in a water quality drawdown time of 24-48 hours. Above an active storage depth of 0.34m, the discharge rate will be 500 L/s.

3. Section 7.3.2 identifies that improvements are required to the Jamsyl Drive/Sylvestre Drive intersection and the Jamsyl Drive/Manning Road intersection. Who will be responsible for completing this improvements when they are required for development to proceed?

- We have confirmed with the Town that the modifications to Jamsyl Drive required to accommodate overland flows to the ETLD will be the responsibility of the developers.

4. It appears there is a minor typo in Section 8.0. Section 4.1.1 is referred to in the text. It appears it should be Section 4.2.1.

- We will update the report, as noted.

5. Based on the HGL plots in Appendix A, the HGL at MH 108 is approximately 181.300 m. The proposed road elevation immediately east of MH108 at MH94 is 180.700 m. What is the HGL at

MH94?

- The SSA modelling for the MRSPA area provides the following Hydraulic Gradeline Elevations during the Chicago 1:100yr-24 event at the corresponding Manholes for your information:
  - HGL @ MH 108 = 181.26
  - HGL @ MH 94 = 180.87

6. General information about the pond (ie. volumes, water levels, etc.) is provided in text and tables within the report. It is our understanding that the actual pond will be designed by others when the first development proceeds. It is recommended that a plan be included showing the configuration of the pond that was used in this study. It is further recommended that the plan include typical cross-sections and dimensions that can be finalized as part of the detailed design that will be completed by others.

- Drawings of the pond geometry, including dimensions and typical cross sections are provided within Figure 15 & Figure 16 of the MRSPA Class EA Study Report (April 2010), which has been referenced in our Addendum report. No changes to the proposed MRSPA pond have been identified as part of this Addendum report.

7. The storm sewer layout and pipe diameters used in the analysis are shown in Figure 11.0. To ensure consistency as development proceeds in this area, the storm sewer slopes and inverts used in the analysis should also be included. We recommend that your preliminary storm sewer design sheets be included to be used as a guide for future design of the individual developments.

- The storm sewer slopes and inverts,including preliminary storm sewer design sheets, will be included within Appendix B of the Functional Servicing Report for the MRSPA.

8. It is our understanding that the preliminary proposals for future improvements to Manning Road include the enclosure of the East Townline Drain. As part of the MRSPA proposal, 1:100 year overland flow routes are proposed to direct water to the East Townline Drain. How will these overland routes be maintained when the East Townline Drain is enclosed in the future?

- Once detailed design of the enclosure of the East Townline Drain commences, the overland flows from the MRSPA are to be included within the design. It is expected that future overland flows will be captured through the use of ditch inlet catchbasins to convey flows into the future enclosure. The County of Essex is currently considering a proposal from Dillon Consulting Limited to update the Preliminary Design Report for the CR 19/22 Improvements as it relates to drainage, which is expected to incorporate these overland drainage requirements.

9. Modeling input parameters are included in Appendix B. A developed CN value of 90 has been considered for the residential areas. Based on the historic soil mapping, the majority of this area appears to be brookston clay. Please provide your supporting information your curve number selection.

- The developed CN value of 90 was used for residential areas with Type D soils (Brookston Clay). This value is consistent with the curve numbers used for residential districts by average lot sizes ranging from 500 m^2 to 1000m^2. *(Urban Hydrology for Small Watersheds TR-55, USDA).* A CN value of 90 is considered conservative within the design of the MRSPA as an impervious value is also being used within the model.

10. In general the report provides a lot of information/criteria that will need to be implemented at

different stages of the future buildout of this area. How will this information/criteria be tracked to ensure that all future works recommended in this report are implemented as development proceeds?

- The information and stormwater management criteria outlined is identified within the main body of the MRSPA Functional Servicing Report. The detailed designers for each stage of development will be required to review the Functional Servicing Report prior to any detailed design of the lands commence (ie. grading, storm servicing etc.).

11. As per our previous comments, we recommend that, due to the complexities of this development area, the Town of Tecumseh should engage Dillon Consulting Ltd. to review the future individual development submissions to ensure they are in compliance with the functional design study.

- We have confirmed with the Town that it is their intention to continue having Dillon involved in the review of the drainage design for all individual development submissions to ensure the proper stormwater management criteria has been met.

At this time, the Town is proceeding to table the Addendum Report at the April 14 Council meeting, including the updates outlined herein.
We appreciate your time and input into this process, and the valuable feedback that you provided. As a result of this collaborative effort, we believe that the resulting report will provide a valuable reference for the effective implementation of this drainage solution in the Town of Tecumseh.
Sincerely,

DILLON CONSULTING

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Our File: 11-5366 (Corr.)

February 11, 2015

Essex Region Conservation Authority
360 Fairview Avenue West, Suite 311
Essex, ON
N8M 1Y6

Attention: Mr. John Henderson, P.Eng.

Manning Road Secondary Plan Area Stormwater Management
Class Environmental Assessment Addendum
Response to ERCA Comments

Further to your email dated January 19, 2015 in response to the Notice of Addendum for the noted project, including subsequent discussions, emails and our recent meeting of February 3, 2015, we are hereby confirming our approach for addressing your comments and the additional information that will form part of the preferred stormwater management solution that has been identified for this area.

The following were in attendance during our meeting of February 3, 2015:

John Henderson, P.Eng .	-	Essex Region Conservation Authority
Phil Roberts	-	Windsor International Airport
Brian Hillman	-	Town of Tecumseh
Daniel Piescic	-	Town of Tecumseh
Flavio Forest	-	Dillon Consulting Limited
Ryan Langlois	-	Dillon Consulting Limited

At this meeting, the following matters were addressed:

1.0 WINDSOR INTERNATIONAL AIRPORT

It was confirmed that the proposed MRSPA pond is not located within the runway approach and outer surface limits affecting the Windsor Airport.

The Windsor Airport offered suggestions to limit waterfowl attraction, which may present a nuisance to local area residents in the future, including allowing grass in buffer areas to grow taller, planting trees and naturalized treatments in the embankment areas, and use of coarse shrubs in lower lying areas of the pond.

...continued

2.0 OVERLAND DRAINAGE SYSTEM CHARACTERISTICS

2.1 MRSPA

It was agreed that more specific stormwater management (SWM) design criteria would be included as part of the SWM and functional servicing reports for the MRSPA, particularly surface storage and runoff control requirements.

The opportunities to direct overland flow to the proposed MRSPA SWM pond are limited based on the existing topography. It has been recommended that inlet control devices be incorporated within roadway catchbasins to provide an appropriate balance between runoff being conveyed by the minor storm sewer system and the temporary surface storage required within roadways for more significant storm events.

In order to determine the surface storage that could be accommodated within the right-of-way, a representative roadway surface storage calculation was completed based on the proposed site grades with a 0.3m maximum ponding depth. It was determined that the maximum average roadway surface storage volume would be approximately 91 m^3/ha. The preliminary modeling results will be updated based on other aspects of our discussion presented herein, though it would appear that this surface storage capacity would address more than 50 percent of, but not all of the 1:100 year requirements.

Due to the benefits of modifications in the watershed boundaries and the over-restricted release rate from the MRSPA SWM pond, it was proposed that overland flows exceeding the available roadway surface storage capacity be permitted to overflow to the Cyr Drain and to the East Townline Drain. It was agreed that this would be acceptable, subject to confirmation of the following:

- That the rate of overflow would not exceed the 1:2 year existing conditions runoff rate (assumed to represent the existing outlet drain capacity); and
- That these overflow rates were accounted for in the design of the East Townline Drain pump station outlet at Lake St. Clair.

Furthermore, there were challenges identified with the ability to fully implement these overland flow outlets based on the phased approach to development in the MRSPA. In particular, a continuous overland flow outlet to the Cyr Drain may not be possible due to land ownership constraints, which may only be resolved once a fuller extent of development takes place in the north part of the MRSPA. As requested, we will give consideration to the opportunities and related limitations of overland flow solutions under interim development conditions in the MRSPA.

...continued

2.2 Baillargeon Drain Area

As noted in the December 2014 modeling memo, the Baillargeon Drain area generally slopes easterly towards the MRSPA and northerly towards County Road 22. The drainage characteristics of the Baillargeon Drain area under major storm events were determined based on a review of existing grades along its boundary with MRSPA. It was observed that there may be two locations that provide potential overland flow to the MRSPA, which were found to exhibit the following characteristics:

- An emergency overland flood route was previously designated within an easement that was established between existing homes on Charlene Lane:
  - The existing grades within the existing overland flow easement appear to be at least 0.3 m higher than the existing roadway elevations.

- A lower lying area on Candlewood Drive, directly south of the Agnes Drive intersection at the location of the Baillargeon Drain:
  - The lot grading of the existing properties are approximately 0.5 m higher than the existing roadway elevations.

There are no alterations being proposed to the existing grading along this boundary that would result in an increase to overland flow contributions between the Baillargeon Drain area and the MRSPA.

Accordingly, the Baillargeon Drain area was modeled based on surface storage of overland flows being temporarily contained within the existing drainage area under major storm events, with conveyance by the minor storm sewer system (1:2 year level of service). The complete 1:100 runoff volume was considered in assessing the operation of the proposed MRSPA SWM pond.

It was agreed that in cases of more extreme events exceeding the 1:100 year condition, that the following measures would be appropriate:

- Extension of the existing overland flow easement, interconnecting Charlene Lane with the MRSPA roadway network and the proposed overland flow network that would be available for overland flow relief to the East Townline Drain and the proposed MRSPA pond.

- Incorporating a new ditch inlet catchbasin at the downstream end of the overland flow easement that would be directly connected into the proposed MRSPA storm sewer system.

...continued

3.0 BAILLARGEON DRAIN AREA RUNOFF CHARACTERISTICS AND DRAINAGE SYSTEM PERFORMANCE

3.1 Modeling Approach and Runoff Parameters

The modeling approach for the Baillargeon Drain included discretizing the watershed into a total of 19 sub-catchments and incorporating existing storm sewers exceeding 600 mm diameter. Each sub-catchment was assigned a percent impervious value based on an evaluation of aerial images.

The modeled peak flows for the 1:2 year storm event were initially found to exceed the existing storm sewer capacities. Adjustments were made to percent impervious values for select sub-catchment areas to calibrate the model to the existing storm sewer capacities. The percentage impervious values for the sub-catchment areas vary from 25% to 40%.

3.2 Drainage System Performance

The hydraulic performance of the Baillargeon Drain will improve as a result of being redirected to the proposed MRSPA storm sewer system and pond facility. Furthermore, the controlled outlet from the proposed MRSPA pond will provide considerable relief to the East Townline Drain.

The outlet conditions at the confluence of the 1350 mm diameter Baillargeon Drain storm sewer with the proposed MRSPA storm sewer will consist of a drop of approximately 1.8 m, while the northern portion of the area will be separately served by extending an existing 900 mm diameter storm sewer stub on Gouin Street to the MRSPA storm sewer. In addition, the tailwater conditions at the proposed MRSPA pond are considerably lower than the available hydraulic conditions in the East Townline Drain.

A comparison of the hydraulic grade lines under existing and future conditions for MH EX4, located directly upstream of the Baillargeon Drain, is outlined below in Table 1.

Table 1: Hydraulic Grade Line Comparison

Storm Event (12 hr)	Existing Conditions HGL @ U/S MH EX4 (m)	Future Conditions HGL @ U/S MH EX4 (m)
1:2	181.53	180.64
1:5	181.70	180.75
1:100	181.82	181.78

...continued

3.3 Runoff Quality Treatment

Incorporating the Baillargeon Drain into the proposed MRSPA SWM pond provides an opportunity to improve runoff quality for this drainage area that currently has no such measures in place. The criteria used in the model included the 25 mm, 4 hour Chicago storm, which resulted in the following:

- 25 mm water surface elevation in MRSPA pond = 174.87
- Water quality drawdown time = 37 hours

4.0 MRSPA RUNOFF CHARACTERISTICS

A slightly reduced runoff coefficient of 0.35 for the residential portion of the MRSPA was originally selected as the basis for the proposed storm sewer design to account for the beneficial effects of the required disconnection of roof leaders and sump pumps.

Upon further review, it has been agreed to increase the runoff coefficient for the design of storm sewers in residential areas to 0.4, which may be considered to provide an added buffer in the level of service. The hydrodynamic model will also be updated accordingly.

5.0 MRSPA POND DRAWDOWN TIME

In order to address the comments related to the increased 1:100 year pond drawdown time of approximately 100 hours, a risk analysis was completed to confirm the resiliency of the MRSPA pond to accommodate subsequent storm events within the drawdown period. The following Table 2 summarizes the incremental storage available (up to an extreme high water surface elevation of 180.50 m) during the drawdown period following a 1:100 year storm, and the corresponding storm event that could be accommodated at each interval of time:

Table 2: MRSPA Pond Drawdown Summary

Drawdown Time (hrs)	WSEL (m)	Active Storage Available (m^3)	Active Storage Needed for Storm Event (m^3)	Storm Event Capacity in MRSPA Pond @ Time
24	178.84	73,517	54,959	1:5 year
48	177.91	107,935	106,079	1:25 year
72	176.67	148,050	130,928	1:100 year
96	175.13	189,854	130,928	1:100 year
120	174.6	202,048	130,928	1:100 year

...continued

These preliminary results will be reconfirmed, but it was suggested that on the basis of the storage volume available up to an extreme water surface elevation of 180.5 m, that the MRSPA SWM pond would provide a reasonable level of service to address the risk of storm events occurring shortly following a major 1:100 year storm.

6.0 CLIMATE CHANGE CONSIDERATIONS

While the Provincial Policy Statement references the need to consider the potential impacts of climate change while accommodating projected needs, there is a lack of direction on the degree of increases/decreases and frequency of climatic changes that should be used for such assessments. It was agreed that the adaptability of the proposed solution to potential changes in climate would be addressed, both in terms of the solution as currently proposed and the potential opportunities for future modifications.

7.0 MODELING MEMO CLARIFICATIONS AND UPDATES

It was agreed that the modeling memo would be updated as outlined herein, including the additional functional design information that will facilitate the detailed design for each phase of development in the MRSPA. In addition, the report figures will be updated and additional descriptions will be included for clarity.

8.0 CLOSURE

We trust that we have confirmed the manner in which we are proceeding to address your comments, as discussed during our meeting of February 3, 2015. The modeling memo will be updated accordingly, and a final copy will be provided to you, based on which we would be pleased to meet with you to present our findings and address any remaining questions you might have.

Yours sincerely,

DILLON CONSULTING LIMITED

Flavio R. Forest, P.Eng.,
Project Manager

FRF:d
Cc: Mr. Brian Hillman, Town of Tecumseh
Mr. Daniel Piescic, P.Eng., Town of Tecumseh

---------- Forwarded message ----------
From: **John Henderson** <JHenderson@erca.org>
Date: Fri, Jan 23, 2015 at 11:44 AM
Subject: FW: Addendum to MRSPA
To: "Forest, Flavio" <fforest@dillon.ca>
Cc: Phil Bartnik <pbartnik@tecumseh.ca>, Daniel Piescic <dpiescic@tecumseh.ca>, Tim Byrne <TByrne@erca.org>, Mike Nelson <MNelson@erca.org>

Hi Flavio,

Thank you for calling to discuss the comments that we provided in our January 19, 2015 e-mail. As per our call, the following additional items were discussed:

a. It is identified that, during a major storm event, temporary on-site storage will be required for each development within the MRSPA to allow the minor system time to drain water to the pond. A chart showing temporary on-site storage requirement for each catchment area would be helpful. Also, with the natural fall of these lands being from south to north, will it be possible for the individual developments to actually provide the required on-site storage. The potential storage available on a typical roadway, with the existing south to north fall, should be analysed to see if the on-site storage requirements can be achieved. Please note that on-site storage should only include storage that is available within the municipally owned road right of way.

b. Potential climate change considerations were discussed. Your initial thoughts were that the pond outlet could be reviewed and that the pond has not been design to minimum storage requirements. Due to the uniqueness of the MRSPA and lack of overland routing, the minimum temporary on-site storage for each individual development may also need to be considered.

c. Numerous figures/plots are provided in Appendix B. Tabular presentation of some of this information would be helpful.

d. The proposed road grade elevation shown at the north end of the site in Figure 3 (low elevation = 180.650 m) does not appear to match the existing grade elevations shown on the truck sewer profile plots in Appendix A. In addition, the plotted HGL appears to be above the proposed road grade elevation.

If you have any questions, please do not hesitate to contact our office.

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519-776-5209 ext. 246
Fax: 519-776-8688

---------- Forwarded message ----------
From: **John Henderson** <JHenderson@erca.org>
Date: Mon, Jan 19, 2015 at 5:23 PM
Subject: Addendum to MRSPA
To: Phil Bartnik <pbartnik@tecumseh.ca>
Cc: Tim Byrne <TByrne@erca.org>, Mike Nelson <MNelson@erca.org>, "Forest, Flavio" <fforest@dillon.ca>

Good afternoon Mr. Bartnik,

We received the Town of Tecumseh MRSPA SWM Environmental Study Report Addendum date December 2104. Due to time constraints we have only completed a preliminary/screening review of this document.

As per our discussions during the original EA preparation, it remains our position that the best location for the pond to service these lands is at the north end of the development area near County Road No. 22 due to the significant fall on these lands from south to north. Through the original EA process, however, the preferred solution was to have the pond at the south end of the development. As a result, it is not possible to have direct overland flow routes to the pond for major storm events. Instead, each portion of the development will be required to be designed with temporary on-site storage to detain water until the minor storm sewer system can convey the runoff to the proposed pond. Control/provision of the temporary on-site storage in each development is critical in order for the drainage from this entire planning area to function as designed. All future development designs must consider the functional servicing modelling that was prepared by Dillon Consulting Ltd. for this addendum. We recommend that the Town of Tecumseh clearly outline the modelling requirements and parameters for each development within this planning area to ensure that the site drainage will function as proposed in the functional servicing study. We further recommend that the Town of Tecumseh engage Dillon Consulting Ltd. to review the individual development submissions to ensure that they meet the intent of their functional design study.

Based on our current screening review, the following comments are provided:

MRSPA SWM Environmental Study Report Addendum (December 2014)

1. Section 5.0 Public and Agency Consultation – It is identified that no significant concerns were identified at our August 15, 2014 meeting. During this meeting ERCA raised concerns about the lack of overland flow routes to the pond and the potential challenges of having to temporarily manage major storm events within individual developments. There was also substantial discussion regarding how the existing Baillargeon drainage area functions during a major storm event under existing conditions and how it would be provided for in the proposal to direct it into the MRSPA pond.

Functional Servicing Modelling Memo (December 2014)

2. Section 4.1.2 Baillargeon Drainage Area and Section 4.2 Assumptions - The following comments from these sections are noted:

a. "It appears that surface runoff for major storm events are generally contained within the Baillargeon Drain drainage area boundaries, with limited overflow to the MRSPA".

b. It is assumed that "sufficient temporary surface storage exists within the Baillargeon drainage area".

c. It is assumed that "All runoff volumes are contained within each drainage area boundary with no losses from overland drainage outside of those boundaries."

These issues were the focus of some of the discussions during our August 15, 2014 meeting. The exact functioning of the Baillargeon drainage area during minor and major events must be completely understood in order to determine if the development of the MRSPA will adversely impact these existing lands. Based on the statements contained in the report, it does not appear that a complete review of the existing drainage patterns/conditions within the Baillargeon drainage area has been completed. It appears that bulk areas have be used in the current modelling to account for flows from this area. We would suggest that a more detailed assessment is required to determine how this area functions under both minor and major events and if sufficient on-site temporary storage is available for all storms up to and including the 1:100 year event. If temporary on-site storage is not available, where does the major event go? How do the hydraulic gradelines within the Baillargeon drainage area compare before and after the development of the MRSPA?

3. As per table 2, the proposed pond drawdown time for Scenario 3 is 98 hours. This is significantly higher than the typical maximum drawdown time of 48 hours. What was the rationale for determining that a 98 hour drawdown time is acceptable? Has another storm within the 98 hour drawdown time been considered? Is there any safety factor in the existing pond freeboard? Does the Windsor Airport have concerns with the proposed 98 hour drawdown time?

4. In Table 3 it is noted that the quality requirements are based on Table 3.2 of the MOECC manual for 'normal' protection. Was the 25 mm 4 hour Chicago storm also considered.

5. In section 6.2 it is identified that the % impervious was reduced because the MRSPA is zoned low density residential. In section 6.1 of the addendum report, the MRSPA is identified as low density residential, medium density residential, general commercial, neighbourhood commercial, community facility and recreational. Please clarify. In addition, in Table 3 of the functional servicing modeling memo the % impervious is estimated as 33% for the MRSPA and 25 % for the Baillargeon Drain area. These estimates seem low. Based on a quick review of a few random properties within the Baillargeon drainage area, it would appear that the % impervious may be well above 25%. In addition, we do not know the proposed lot size within the MRSPA, however, with smaller lots that are typically proposed within many new developments, an estimate of 33% impervious may also be low. Additional consideration should be given to the estimates of the % impervious.

6. In Appendix A, hydraulic gradeline (HGL) profiles are shown for the 100 year storm for Scenarios 2 and 3 from MH 108 to the SPA Pond. It was anticipated that Scenario 3 would have a slightly lower HGL because the normal and high water elevations in the pond are lower. In review of the two HGL plots, however, it appears that the HGL for Scenario 2 is slightly lower. Please clarify.

7. Summary figures are provided in Appendix B. Additional clarification would be helpful on some of these figures.

8. It does not appear that the potential impact of climate change have been considered in the assessment for these lands.

As noted above, we did not have time to undertake a complete review of the entire document. The comments provided above relate to our preliminary/screening review of the document. We would suggest that a meeting may be beneficial with the Town and Dillon to review the above information.

If you have any questions, please do not hesitate to contact our office.

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