Appendix D

Stormwater Management Technical Report

DILLON CONSULTING

CORPORATION OF THE CITY OF WINDSOR

Sandwich South Master Servicing Study

Stormwater Management Technical Report

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1.0 Introduction

Dillon Consulting Limited (Dillon) was retained by the City of Windsor (City) to complete the servicing requirements for the Sandwich South Master Servicing Plan (SSMSP) area to meet the growing needs of the City of Windsor. This project is aimed to serve as an important framework for the development in the Sandwich South area.

This Stormwater Management Technical Report outlines the modelling methodology, approach and functional design elements for the SSMSP area to follow the requirements of the Municipal Class Environmental Assessment (Class EA) (2000, as amended) - Approach No. 2 and the requirements of Phases 1 and 2 of the Class EA, including requirements for any Schedule B projects.

This document is to be read in conjunction with all submission documents for this study, including the Environmental Assessment Report and **Appendix F** - Municipal Servicing Functional Design Report.

1.1 Study Area

The existing SSMSP area is approximately 25.4 km^2 (2,540 ha) in size and sits within the Little River watershed along the southern region of the City. This mostly undeveloped portion of the City represents approximately 17 % of the City's municipal boundary. The area is considered one of the largest portions of undeveloped land within the City and is bound by Highway 401 to the south, Walker Road and the Canadian National (CN) Rail to the west, the Town of Tecumseh municipal boundary to the east and the EC Row Expressway to the north.

As shown in the **Figure 1**, the study area encompasses a number of Municipal Drains which are tributary to the Little River Drain. These tributaries convey runoff from a number of subwatersheds both from City of Windsor and Town of Tecumseh. The drainage takes in a mixture of both rural and urbanized areas composed of residential, industrial, commercial and agriculture lands.

1.2 Study Purpose and Scope

The purpose of the SSMSP study for stormwater management (SWM) considerations is to provide the area with a regional strategy to service the future development areas and manage flood risk. This includes providing appropriate stormwater conveyance and management on both a water quality and quantity level to current standards set out within the Windsor-Essex Region Stormwater Management Standards Manual (ERCA, December 2018).

This SWM report builds on the previous reporting developed for the upper reaches of the watershed related to SWM solutions, with consideration of updated flood plain mapping for the Little River watershed.

This technical report takes a regional approach to SWM, providing SWM approaches at two levels of detail for the study area:

1. Following Approach 2 of the Master Planning Process, a functional level of design for SWM facilities within the initial build out areas defined by the East Pelton Secondary Plan Area (East Pelton SPA) and County Road 42 Secondary Plan Area (CR42 SPA), with consideration for the future Airport employment lands, and the reconstruction of County Road 42 and Lauzon Parkway (as shown in **Figure 1**); and
2. Following Approach 1 of the Master Planning Process, a conceptual level of design for SWM requirements necessary for the remaining SSMSP study area outside the initial build out lands.

This report provides the technical modelling, analysis and documentation for the steps necessary to develop these designs. The scope overall includes the following:

- Determination of SWM Criteria to be used in the development of alternatives for the study area;
- Review of previous studies regarding SWM for the Upper Little River Watershed;
- Discussion of the Existing Conditions of the SSMSP area, including consideration for flood proofing elevations to be set by the updated flood plain mapping study of the Little River watershed;
- Future Buildout condition lumped modelling and analysis for both the initial build out areas and beyond, including consideration for climate change and the incorporation of additional important SWM details as requested by stakeholders;
- Recommendations for Municipal Drain relocations, improvements and abandonments;
- Windsor International Airport (the Airport) and Transport Canada regulations related to waterfowl mitigation for SWM facilities within the proximity to approach/takeoff surfaces and Airport Zoning Height Regulations; and
- Suggested phasing for implementation and additional considerations for an overall regional SWM approach.

Stormwater modelling to confirm the storm trunk sewer design and overland flow routing was not completed as part of this analysis. During the development planning and pre-design stage of each drainage area, it is required that the design be assessed and refined, as required, to confirm that the servicing strategy meets the design criteria at the time of implementation.

This technical report is to be considered as a guideline for all future SWM during detailed design.

1.3 Reference Reports

As part of the background review component of the SSMSP, a review of relevant reports was completed. This included review of the following that are either completed or currently ongoing:

- Little River Watershed Flood Line Mapping Study (M.M. Dillon, Completed 1977);
- Little River Flood Line Mapping (MacLaren Engineers, Completed 1985);
- Twin Oaks Business Park Class Environmental Assessment Environmental Study Report (LCBA, Completed 1997);
- Windsor International Airport Master Plan (Dillon Consulting/LPS AVIA Consulting, Completed 2010);
- Aviation Land Use In The Vicinity of Aerodromes (Transport Canada, 2013/2014);
- Lauzon Parkway Improvements Class Environmental Assessment Study Report (MMM Group, Completed 2014);
- Lauzon Parkway Improvements Class Environmental Assessment Study Report Addendum (MMM Group, Completed 2015);
- Upper Little River Watershed Master Drainage and Stormwater Management Plan Environmental Assessment Environmental Study Report (Stantec Consulting, 2023);
- Little River Watershed Flood Line Mapping Hydrologic and Hydraulic Reports and Regulated Flood Line Map Sheets (Dillon, 2023).

In addition to the above reference studies, a number of Municipal Drainage reports were collected and reviewed as part of the study throughout the SSMSP area and Little River Watershed. This included Municipal Drainage reports provided by the Town of Tecumseh, City of Windsor, Essex Region Conservation Authority (ERCA) and found internally. A representation of Municipal Drainage reports collected as part of the study are shown in **Figure 2** with direct references to each Municipal Drainage Report provided in the references section of the document.

2.0 Background Information

2.1 Upper Little River Watershed Master Drainage and Stormwater Management Plan Environmental Assessment Study

Stantec Consulting Limited completed a Master Planning and Environmental Assessment for the Upper Little River Watershed. This study, titled "Upper Little River Watershed Master Drainage and Stormwater Management Plan Environmental Assessment Study Report" (hereafter referred to as the ULRMP) was recently finalized and adopted in 2023 to satisfy Approach 1 of the Master Planning Environmental Assessment process. Through this study, both an existing and future development condition drainage review was completed for the Upper Little River watershed using a northern study limit of the EC Row Expressway. This study area (approximately 45 km^2) included the primarily undeveloped southeast area of the City of Windsor and west area of the Town of Tecumseh (as shown in Figure E1 of the report). This area was identified by both municipalities for future growth based on municipal land use planning at the time. As part of this study, consideration was given to the overall drainage impacts within the upper watershed from future development and the SWM controls necessary to protect existing resources as development continues.

The drainage assessment completed through this study took into consideration both existing and full future development buildout conditions through the development of a dynamic hydrologic and hydraulic model using the PCSWMM modelling software. Within this study, all Municipal Drains within the upper watershed were considered, with the primary focus on the Little River Drain.

As part of the Master Planning process, future development within the study area reviewed a number of potential SWM strategies to meet both regional and provincial SWM standards during this time. This included the following:

1. Do Nothing;
2. Water Quality and Erosion Control Only;
3. Communal Stormwater Facilities;
4. On-Line Quantity Control with Local Quality and Erosion Controls;
5. Distributed Off-Line SWM Controls; and
6. Grouped Off-Line SWM Controls.

Through the evaluation of initial SWM design alternatives for future development within the upper watershed, **Grouped Off-Line SWM controls** were chosen to be the preferred strategy. The grouped off-line SWM controls were identified to be the most beneficial strategy based on the evaluation of alternatives and to serve future development. The facilities were recommended to be linear facilities which shall be integrated into to the Municipal Drain system within a designated SWM corridor to support both regional SWM strategy approach, and provide for natural linkages with development areas. This regional type approach for SWM controls allows for proper Master Planning for larger development areas where individual piece-meal and interim SWM controls are discouraged and long-term cost-effective considerations are taken into account.

2.1.1 Upper Little River Watershed Release Rates

Based on the modelling analysis completed, the following allowable release rates were determined for all future development within the Upper Little River watershed:

- 1:2 Year Allowable Release Rate of 2 L/s per hectare of contributing drainage area;
- 1:5 Year Allowable Release Rate of 4 L/s per hectare of contributing drainage area;
- 1:100 Year Allowable Release Rate of 6 L/s per hectare of contributing drainage area;

This study developed a number of concepts for the grouped SWM strategy, including estimated contributing drainage areas, pond outlet considerations and water quantity and quality controls. Sufficient detail for future development considerations was completed (satisfying Approach 1 of the Master Planning process for SWM controls) to proceed with a subsequent Master Plan for the SSMSP area.

Information regarding the status of this study and final Notice of Completion can be found in the SSMSP covering report.

2.2 Little River Watershed Flood Line Study Summary

Results from the Little River Flood Line Study (Dillon, 2022) identified the recommendation of a two-zone flood plain throughout the SSMSP area. This two-zone concept is an approach to flood plain management where the flood plain is separated in two-parts; the floodway and the flood fringe. Determination of the floodway and flood fringe extents and respective levels used different modelling analysis methodologies, which is further discussed within the Little River Flood Line Study Hydrologic and Hydraulic Technical Reports (Dillon, 2022). The floodway and flood fringe are defined as follows.

Floodway Area

Inner portion of the flood plain where the majority of the flow is conveyed and represents the area required for safe passage of flood flow and/or that area where flood depth and/or velocities are considered to be such that they pose a potential threat to life and/or property damage. This area is traditionally where development and site alterations would cause danger to public health and safety or property damage.

New development within the floodway is traditionally prohibited or restricted. Should development be permitted, flood compensation measures are required to be further investigated. Generally acceptable permitted uses within the floodway include flood and/or erosion control works and minor additions or passive, non-structural uses that do not affect flood flows.

Flood Fringe Area

The Flood fridge area is defined as the outer portion of the flood plain where it could be potentially safe to develop with no adverse impacts. The flood fringe area is determined historically through a review of critical flood depths and/or velocities that could create significant hazards for developments and the magnitude of flooding. Magnitude of flooding considers both the 1:100 year regulatory event and historical events such as the Hurricane Hazel or Timmins Flood.

Based on number of provincial and federal flood hazard/flood line mapping guidelines and provincial policy statements, the present approach of determining flood fringe area is now considered to be more flexible than the rigid flood frequency criteria historically used. This new approach considers impacts both upstream and downstream on existing and proposed developments and recognizes the need to assess the impact of encroachment caused by filling and/or developing in a flood fringe area.

Based on policy considerations, the 2020 Provincial Policy Statement, Section 3.1.6 identifies that:

> *"Where the two-zone concept for flood plains is applied, development and site alteration may be permitted in the flood fringe, subject to appropriate flood proofing to the flood proofing hazard elevation or another flood hazard standard approved by the MNR."*

Development Floodproofing

It is expected that the governing 1:100 year flood fringe water levels summarized within the report and new flood plain maps will dictate new development floodproofing standards within the SSMSP. The required floodproofing standards for the SSMSP area will include the following:

- Minimum road grade to be 0.30 m below the identified 1:100 year flood fringe level; and
- Minimum building opening to be 0.30 m above the higher of either:
  - The 1:100 year flood fringe level of the watershed; or
  - The dynamic 1:100 year local road Ponding level.

The development floodproofing requirements above are to be based on the 2023 updated flood line mapping, unless otherwise indicated by ERCA. Any future updates to the Little River flood plain beyond the 2023 study may govern at the time of design. All development within the SSMSP are expected to consult with ERCA during the early stages of design process to confirm these requirements and floodproofing levels.

3.0 Sandwich South Master Plan SWM Design Alternatives

Based on the recommended SWM strategy of grouped off-line SWM controls from the final ULRMP, the following design alternatives were further considered as part of the SSMSP to meet the SWM requirements for future development.

Option 1A: Grouped Regional Wet Ponds

- Water quality treatment through end-of-pipe forebays and a permanent pool design; and
- Water quantity control through end-of-pipe active storage within a Wet Pond.

Option 1B: Grouped Regional Wet Ponds and "At-Source Controls"

- Water quality treatment through both end-of-pipe and at-source controls through Low Impact Development techniques and/or Water Quality Treatment units on both public and private property; and
- Water quantity control through both end-of-pipe active storage within the Wet Pond and at-source flow restriction and storage.

Option 2A: Grouped Regional Dry Ponds

- Water quality treatment through traditional at-source controls; and
- Water quantity control through end-of-pipe active storage within a Dry Pond.

Option 2B: Grouped Regional Dry Ponds and "At-Source Controls"

- Water quality treatment through both end-of-pipe and at-source controls through Low Impact Development techniques and/or Water Quality Treatment units on both public and private property; and
- Water quantity control through both end-of-pipe active storage within the Dry Pond and at-source flow restriction and storage.

The above SWM strategy options were evaluated based on a number of factors, including but not limited to the following:

- Flood risk management;
- Design feasibility, constructability, implementation and staging;
- Capability with municipal storm sewer servicing strategy and existing topography;
- Protection of life;
- Cost effectiveness;
- Natural environment impacts;

- Support for the creation of a complete community;
- Natural linkages to development;
- Protection of health and safety;
- Alignment with regional design standards and existing infrastructure; and
- Consideration for flexible staging.

Based on the evaluation of alternatives discussed in the SSMSP covering report it was identified that **Option 1A: Grouped Regional Wet Ponds** is the preferred alternative. Subsequently, based on further discussions with the Airport and Transport Canada relating to waterfowl mitigation and land use acceptability within Hazard Zones, the recommended solution has been modified to follow a hybrid approach which is a combination of **Option 1A: Grouped Regional Wet Ponds** and **Option 2A: Grouped Regional Dry Ponds**. This Hybrid approach recommend that SWM ponds that are proposed within or partially within the Zone of No Confidence, shall be dry ponds to aid in mitigation of waterfowl in those critical areas.

3.1 Consideration of Preferred SWM Design and Waterfowl Mitigation

The mixture of Regional SWM Wet and Dry Ponds throughout the SSMSP was determined to be preferred due to a number of future SWM facilities being located within the Primary Airport Zone for approach/takeoff surfaces. This Primary Hazard Zone is identified where airline collisions with birds have the potential to result in the greatest damage. This design guidance was taken from Table 1: Hazardous land-use acceptability by hazard zone within the Aviation Land Use in The Vicinity of Aerodromes *(Transport Canada, 2013/2014)*. This guidance document states that although SWM Ponds are identified as a potentially low level of risk, they are not permitted within the Primary Hazard Zone where airlines are flying below an elevation of 1500 feet (457 meters) above ground level. The use of wet ponds, however, are identified to be acceptable beyond the primary zone in secondary and special zones where airlines are flying above 1500 feet and bird movements are more variable around specific land uses.

4.0 Stormwater Management Design Events and Criteria

The SWM strategy for the SSMSP area has been developed to meet the following design requirement guidelines:

- Windsor/Essex Region Stormwater Management Standards Manual (December 2018); and
- Ministry of the Environment Stormwater Management Planning and Design Manual (2003).

This SWM requirements for any proposed development lands within the SSMSP area are to be based on the regional and provincial guidelines at the time. Design requirements outlined throughout this report are subject to change based on future research and guideline changes by the Municipality, ERCA, and Ministry of the Environment Conservation and Park (MECP). This includes potential future requirements to account for water balance, volumetric control and/or the capture and treatment of runoff generated from the 90th percentile precipitation event, increased climate change considerations and the use of lot level Low Impact Development measures.

During future studies within the SSMSP area, including detail design of future development lands, the most current guidelines (both Regional and Provincial) must be considered even if they differ from those discussed within this document.

4.1 Design Storm Events

A number of synthetic design storms were simulated to determine both water quantity and quality control considerations for the SSMSP area under future development conditions. The hydrologic analysis for the SSMSP study was completed using the following synthetic design storms shown below and sourced from the Windsor/Essex Region Stormwater Management Standards Manual (December 2018).

Table 4-1: Dynamic Modelling Synthetic Design Storms

4 Hour Chicago Storms:	24 Hour Storms
• 32 mm Water Quality Storm	• SCS Type II 1:100 Year Storm
• 1:2 year Storm	• Chicago 1:100 Year Storm
• 1:5 year Storm	• 150 mm Urban Stress Test (UST)
• 1:10 Year Storm	
• 1:25 Year Storm	
• 1:50 Year Storm	
• 1:100 year Storm	

The Chicago 1:100 year 24 hour storm event was identified as the governing event for the watershed through the work completed for the Little River Watershed Flood Line Mapping Hydrologic and Hydraulic Study (Little River Flood Line Study). This design storm was therefore used to assess peak flow changes and Hydraulic Grade Line (HGL) impacts within the SSMSP area municipal drainage system as development proceeds.

4.2 Design Criteria

Based on discussions with the City and local governing authorities, the following SWM criteria was used in the development of the overall SWM strategy for the SSMSP area at this time. For a more detailed description of the storm sewer and SWM Pond functional design criteria, refer to the **Appendix F -** Municipal Servicing Functional Design Report.

4.2.1 Minor System Conveyance

- Future storm trunk sewers are to be sized for a 1:10 year level of service conveyance;
- Future local storm sewers are to be sized for a 1:5 year level of service conveyance; and
- Although storm sewers are traditionally sized under a free flow condition within the pipe system, as per the Windsor/Essex Region Stormwater Management Standards Manual, consideration must be made on the impact of backwater conditions against the proposed system and respective minor losses. The HGL within the minor system conveyance system therefore must not exceed a depth of 0.30 metres below the proposed ground surface elevation during the design level of service event.

The proposed development area will be served via a network of arterial and collector roadways that will also act to provide the corridors for the proposed storm trunk sewers and overland flood routes. The storm sewer trunk locations can be found in the **Appendix F** - Municipal Servicing Functional Design Report.

4.2.2 Major System/Overland Flow Conveyance

- Future roadways and parking lot areas are to allow no more than 0.30 m of dynamic surface Ponding within all proposed development lands for storms up to and including the governing 1:100 year event;
- Detailed grading shall provide overland flow routes during large storm events to their respective ponds. Refer to the minimum overland flow route grades provided in **Appendix F** - Municipal Servicing Functional Design Report;
- One (1) dry lane access shall be provided, where possible, for events up to and including the governing 1:100 year event in both directions along ingress/egress points at institutional or hospital entrances or where required by regional and provincial governing authorities; and

- Roadways identified by the region for emergency vehicle routes are to provide dry lanes in each direction during the governing 1:100 year event.

Providing adequate overland flow routes and maintaining dry lanes shall be completed at the developer's expense and demonstrated via the required stormwater modelling design analysis required for each drainage area during the next step of design.

4.2.3 Allowable Release Rates

Based on the findings taken from the final ULRMP (Section 6.1.1 of the ULRMP), the following allowable release rates are to be met under future development conditions within the SSMSP for all development areas. These rates represent the rates that the proposed regional SWM facility pumping stations are permitted to discharge into the downstream municipal drain watercourses.

- 1:2 Year Allowable Release Rate of 3 L/s per hectare of contributing drainage area;
- 1:5 Year Allowable Release Rate of 4 L/s per hectare of contributing drainage area;
- 1:100 Year Allowable Release Rate of 6 L/s per hectare of contributing drainage area.

In addition to these release rates, the implementation of an emergency overflow, were feasible, at the SWM pond outlets shall be considered. The purpose of this overflow is to provide resiliency in the event of outlet failure. Each pump station outlet is also recommended to be equipped with stand-by power generator to avoid flood risk associated with power outages.

Each development, subdivision and/or non-residential site shall be designed such that the discharge conditions do not exceed the estimated flows from these areas. Design criteria used to establish minor system flows is detailed in Section 11.2.2. The stormwater system shall also accept overland flow from development areas.

For each pond and storm sewer system, the City will require the sizing and operation of the system.

4.2.4 Water Quantity Control

- Regional Ponds are to provide water quantity control to the permitted release rates noted in **Section 4.2.3** for all synthetic design storm events, up to and including the governing 1:100 year and Urban Stress Test (UST) event;
- Regional Ponds are to be designed with a minimum 0.30 m of freeboard from the 1:100 year water level to the top of bank; and
- To assess the resiliency of each Regional Pond, the 150mm UST design storm event is to be considered with levels required to be fully maintained within the system.

4.2.5 Water Quality Control

- Regional Ponds are to provide a minimum standard of water quality based on a normal level of treatment (70% TSS) removal through settling and filtration;
- Quality control is to be provided at a Regional scale to the best of its ability depending on the Airport requirements for either a Wet Pond or Dry Pond design. This is to include, but not limited to the following:
  - For **Wet Ponds**, quality control treatment is to be provided through a combination of sediment forebays and permanent pools;
  - For **Dry Ponds**, the most functional quality control treatment is to be considered at either the source or at the end of the storm system. At-Source treatment has the potential to reduce sizing requirements downstream at the regional level.
- Quality treatment efficiency is to be designed based on the regional 32mm water quality storm event and regional requirements for long-term average suspended solids removal.

4.2.6 Safety and Flood Risk Mitigation

The proposed regional facilities range in depths from X to x and therefore could pose safety risks to the public. It is recommended that a buffer be provided between the proposed pond top of bank and the proposed active transportation corridor. In addition, regular pond access lanes shall be provided at regular intervals.

The pumping stations and top of bank elevation of the ponds shall be set above the Little River Regulatory flood protection elevations to avoid inflows from adjacent municipal drains and recirculation effects from flooding.

5.0 Modelling Methodology

The hydrologic and hydraulic modelling completed for the Little River Flood Line Study for the Little River Watershed and SSMSP area was undertaken using the PCSWMM software distributed by CHI. PCSWMM is a modelling software for stormwater, wastewater, and watershed systems which provides a graphic user interface (GUI) for the United States Environment Protection Agency's SWM Model (EPA SWMM). This software allows for the integration of appropriate hydrologic inputs for catchment areas (area, imperviousness, catchment slope, flowpath length, infiltration parameters, depression storage etc.), while also allowing for the integration of drain conduits to represent conveyance networks to convey runoff throughout the watershed. The software also is enabled with 2-dimensional modelling capabilities to more accurately assess overland flow routing and flood inundation.

At the onset of the SSMSP, the Chicago 1:100 year 24 hour flood line elevations determined through dynamic modeling as part of the Little River Flood Line Study was set as the baseline existing condition. This includes reporting peak flows and levels through the Municipal Drains and identifying flood inundation extents beyond their respective banks.

In addition, findings from the Little River Flood Line Study are to be considered where future development lands have the potential to be constructed within designated flood fringe areas.

5.1 Existing Condition Modelling Analysis

The SSMSP area is situated within the Little River watershed, which is approximately 62.7 km^2 in size and is drained primary through the Little River Drain which runs south to north through the full length of the watershed and ultimately into the Detroit River. The existing condition Little River Flood Line Study model consolidated a number of hydrologic and hydraulic models recently completed for the watershed to develop an initial baseline model for the watershed. The existing models integrated into the baseline model include the following:

- Upper Little River Watershed: PCSWMM model completed for the ULRMP; and
- Lower Little River Watershed: Calibrated InfoWorks ICM model developed as part of the City of Windsor Sewer and Coastal Flood protection Master Plan (City SMP) (Dillon, 2020) for the City's urbanized area contributing flows to the Little River watershed.

5.1.1 Hydrologic and Hydraulic Modelling

The Little River Flood Line Study model was calibrated and validated to determine the extent of floodway and flood fringe extents and HGL levels through the Little River watershed. The hydraulic analysis considered all primary Municipal Drains and major in-drain structures and was developed using a 1-Dimensional (1D)/2-Dimensional (2D) approach. A structure inventory for all primary in-drain structures incorporated in the hydrologic/hydraulic PCSWMM model is provided in **Appendix D-1**.

Further model development information for the existing condition hydrology and hydraulics for the Little River watershed is detailed within the Little River Flood Line Study Hydrologic and Hydraulic technical reports. The PCSWMM model schematic for existing conditions is provided in **Appendix D-1**.

5.1.2 Topography

As part of the SSMSP, Ministry of Natural Resources (MNRF) 2019 Airborne Topographic LiDAR was used to assess existing topographic conditions for both the Little River Watershed and SSMSP area. This topographic LiDAR was used to develop the 1D-2D existing conditions model for the Little River watershed and SSMSP area.

The topographic LiDAR was initially provided in the vertical datum CGVD2013 and later transferred by ERCA into the more regionally accepted datum of CGVD28:78. A vertical accuracy check of the topographic LiDAR was completed by the team and was considered accurate for the purposes of this study. Further details of the conversion of the vertical datum and vertical accuracy check was provided to the City of Windsor and ERCA as part of the Data Acquisition Report for the Little River Flood Line Study.

The existing topography for both the Little River watershed and the SSMSP area, represented through a topographic elevation heat map in **Figure 3** and **Figure 3A** respectively, has a fall from south to north and west to east. The following approximate elevation changes have been identified:

- South to North grade change from 186.8 m to 183.3 m (3.5 meter fall) from Highway 401 to County Road 42;
- Southwest to Northeast grade change from 189.5 m to 183.2 m (6.3 meter fall) from 7th Concession Road/Walker Road intersection to the Lauzon Road/ County Road 42 intersection; and
- South to North grade change from 183.3 m to 181.3 m (2 meter fall) from County Road 42 to the CP Rail Line.

As per the Windsor/Essex Region Stormwater Management Standards Manual (December 2018), the following depression storage depths were initially used within the existing condition model for the respective land covers:

- Paved Areas = 2.5 mm
- Flat Roofs = 2.5 mm
- Lawn = 7.5 mm
- Wooded Area = 10.0 mm
- Open Field = 10 mm

These values were further reviewed based on local topography and adjusted accordingly as part of the calibration and validation of the Little River Flood Line Study hydrologic model.

5.1.3 Soil Conditions

A desktop soils investigation was completed using the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) provincial data soil information. The soil maps, and their respective classifications of soil and land attributes, have been digitized and electronically assembled to produce a single digital file for the region. The digital version of this map was provided by Land Information Ontario and used in determining the hydrologic properties of the study area.

Based on a review of the OMAFRA soil classifications, as shown in **Figure 4**, the majority of the SSMSP is primarily Brookston Clay and Brookston Clay Loam. These soils are traditionally considered Hydrologic "Type D" soils with very limited permeability to promote infiltration into the subsurface system. Pockets of Brookston Clay Sand spots have been identified within the central and eastern portion of the SSMSP, but seem to be isolated in nature.

As per the Windsor/Essex Region Stormwater Management Standards Manual (December 2018), the Green-Ampt method was used within the SSMSP models using the following initial hydrologic parameters:

- Su = 180 mm
- Ks – Clay = 0.5 mm/hr
- IMD, Normal = 0.10

5.1.4 Land Use

The existing SSMSP area is primarily composed of undeveloped agriculture, with small mixtures of commercial/industrial corridors along both County Road 42 and 7th Concession Road. Pockets of residential areas exist along a number of the County Roads, including Ray and Joy Road, Baseline Road, County Road 42, and the 7th, 8th, 9th and 10th Concession Roadways, as well as along Lauzon Road. The Windsor International Airport which is composed of airport runways, a solar farm and a number of airport run buildings is also within the SSMSP area.

Existing condition modelling for the study are took into consideration 2019 aerial mapping to approximate impervious values.

5.1.5 Municipal Drainage

Within the Little River watershed sits a number of Municipal Drainage tributaries which collect runoff from both the City of Windsor and Town of Tecumseh. A list of Municipal Drains conveying through the SSMSP into the Little River Drain are provided in **Table 5-1**:

Table 5-1: SSMSP Municipal Drain List

Municipal Drains	Municipal Drains
6th Concession Drain	Langlois Drain
7th Concession Drain	Lappan Drain
7th Street Drain	Little 10th Concession Drain
8th Concession Drain	Little River Drain
9th Concession Drain	McGill Drain
Baseline Road Drain	North Townline Drain
Desjardins Drain	Reicher Drain
Gouin Drain	Russette Drain
Hayes Drain	Soulliere Drain
Hurley Drain	Watson Drain
Lachance Drain	

Historical drainage reports were used to confirm subwatershed boundaries for each drain based on subwatershed delineations provided within the ULRMP and drainage area shapefiles provided by the City, Town and ERCA. Municipal Drainage cross sections and in-drain structures incorporated in the model were developed based on the detailed in-drain survey completed as part of the Little River Flood Line study. The existing condition Municipal Drainage map for the overall Little River Watershed and SSMSP area is provided in **Figure 5** and **Figure 5A** respectively.

5.2 Future Conditions Modelling and Methodology

To consider future development within the SSMSP area and impacts on the watershed as a whole, the existing condition 1D/2D PCSWMM model developed for the Little River Flood Line Study model was updated based on proposed land use conditions within the study area and the preferred SWM controls. The 2D components of the model (existing lands outside of the primary Municipal Drain banks) and necessary 1D Municipal Drains were adjusted to reflect the full buildout of both the initial and ultimate buildout conditions. This included the removal of 2D flood inundation areas adjacent to drains where development or SWM corridors are proposed. The future condition modelling also considered the incorporation of new Municipal Drains, as well as the requirements for the abandonment, improvements/enhancements and relocation of drains to accommodate each level of development.

The future condition model development and analysis for this study was completed under two full buildout conditions:

- **Initial Buildout Conditions** *(Full buildout of the East Pelton SPA, CR42 SPA, CR42 Improvements & Airport Employment Lands, Lauzon Parkway Improvements and West Hamlet SPA)*; and
- **Ultimate Buildout Conditions** *(Full SSMSP Buildout, including development of the West Hamlet SPA)*.

The initial buildout condition allowed the team to assess the impacts on the watershed based on the complete buildout of known initial stages of development expected within the SSMSP area and the necessary Municipal Drainage improvements required.

Details of the modelling for both the initial and ultimate buildout conditions are further provided in **Section 5.2.3** and **Section 5.2.4**.

5.2.1 Land Use Zoning

The City of Windsor identified the SSMSP area for significant growth in the coming years. The development growth at this time is expected to include a variety of land uses, as shown in **Figure 6**. The proposed condition modelling for the SSMSP area took into consideration the following land uses and respective impervious values.

Table 5-2: Proposed Condition Percent Impervious Values

Proposed Land Use	Percent Impervious Value (%)
Natural Heritage/Recreation/Open Space	0 %
Residential (Low / Medium Density) *	70% / 80%
Business Park/Commercial/Employment/Institutional/Mixed Use*	90 %

** Impervious values taken from the Windsor/Essex Region Stormwater Management Standards Manual (December 2018)*

5.2.2 Development Buildout Condition Models

The target for the SSMSP area SWM strategy was to provide a regional approach to support the future development communities. The Regional SWM solution was recommended to manage flood risk for both the initial and future buildout conditions, while causing no adverse impacts to the existing lands throughout the watershed.

5.2.3 Initial Development Condition Model

Within the SSMSP area, a number of proposed development lands within the study limits were identified as initial buildout areas within the City of Windsor. This includes the East Pelton SPA and CR42 SPA. In addition to these future development lands, the following projects were also considered for the SWM

Approach during initial build out conditions within the City:

- The reconstruction of CR42 from Walker Road to the Windsor/Tecumseh City Limits;
- Initial phase of reconstruction for Lauzon Parkway from Service Road B to CR42; and
- Future drainage considerations for the proposed employment lands east of the Airport.

By request of the Town of Tecumseh, the West Hamlet SPA was included in the initial development modelling condition, as drainage from these lands contribute to Little River Drain along the northeastern boundary of the SSMSP. A number of completed studies, including environmental assessments for these

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lands have commenced and developed the SWM strategy for the area, including allowable release rates into the downstream watercourses and required water quantity and quality control measures. A Secondary Planning Area update is currently ongoing and expected to be completed in 2023, with master servicing and functional design to follow. Specific details of the SWM design for this area may be subject to change in the future during more detailed studies, however the Regional design approach is not expected to change, thus not affecting this current watershed analysis.

Based on the findings of the completed ULRMP and further review of the initial buildout areas through the SSMSP study, the initial buildout development scenario considered a number of Municipal Drain improvements, relocations and introduction of new Municipal Drains. This included the following:

- Enhancement of the 6th Concession Drain directly south of Baseline Road from Walker Road to the Little River Drain. Improvements required to accommodate the future urbanization of the Baseline Road right of way area as follows:
  - Flattened side slopes to improve safety in areas adjacent to future pathways and municipal right of way areas;
  - Shifting of the drain alignment within the proposed SWM corridor;
  - Drain cross-sections where enhancements are required to consider the loss of floodplain storage beyond the southern banks due to development; and
  - Accommodate future controlled flows from the initial buildout area SWM facilities.
- Introduction of the E-W Arterial Drain from the 7th Concession Drain to the Little River Drain to collect and convey upstream existing drainage from the 7th Concession Drain, 7th Street Drain, 8th Concession Drain, Hayes Drain, 9th Concession Drain and controlled flows from respective initial buildout development lands;
- Consideration for the loss of controlled in-drain flow and ultimately less available floodplain storage due to the diversion of a number of southern drains from their current outlet into the 6th Concession Drain and into the E-W Arterial Road Drain;
- Realignment of the Lachance Drain; and
- Upon construction of the E-W Arterial Roadway, consideration of the future realignment of the Hurley Relief Drain to divert the Hurley Relief Drain and 9th Concession Drain to the Little River Drain upstream of the E-W Arterial Roadway.

The approximate initial future buildout areas considered to each Regional Pond within the SSMSP area and West Hamlet SPA lands are provided in **Table 5-3**. These development areas were advanced to a more functional level of modelling detail than what was originally assessed as part of the ULRMP. The Model Storage IDs for each Regional Pond are consistent with the design references and figures throughout as well as those provided within the **Appendix F** - Municipal Servicing Functional Design Report.

Table 5-3: Initial Buildout Area Proposed Condition Model Parameters

Area ID	Approximate Area (ha)	Model Storage ID	Proposed Land Use	Approximate Weighted Impervious (%)
EP_NORTH	124.1 ha	P1	Low to Medium Density Residential, Mixed Use, Open Space	74 %
EP_SOUTH	52.0 ha	P2	Commercial Centre, Mixed Use	90 %
CR42SPA_SW	151.1 ha*	P3	Low Density Residential, Open Space	70 %
CR42SPA_ NW	99.5 ha	P4	Low to Medium Density Residential, Business Park, Major Institutional, Mixed Use, Neighbourhood Commercial, Open Space	83 %
CR42_N_2[1]	91.9 ha	P4/P8	Employment Lands, Open Space	90 %
CR42SPA_ NE	60.8 ha	P5	Business Park, Open Space	85 %
CR42SPA_ SE	40.8 ha*	P6	Low Density Residential, Open Space	70 %
LAUZ_CR42	7.7 ha	P7	Municipal Right-of-Way, Open Space	23 %
CR42_N_4	117.8 ha	P8	Employment Lands, Open Space	85 %
Ham_1A/1B	67.1 ha**	Tec_Hamlet1	Single Residential	71 %
Ham_2	31.8 ha**	Tec_Hamlet2	Single Residential/Hydro Corridor	55 %
Ham_3	69.4 ha**	Tec_Hamlet3a	Single Residential/Forested Area	60 %
Ham4A/4B	43.8 ha	Tec_Hamlet3b	Single Residential	70 %

**Area represents only initial buildout lands within the CR42 SPA and the southern extension of service areas outside of the CR42 SPA to be consistent with 2022 property ownership land parcel boundaries.*

*** Area represents future Tecumseh West Hamlet SPA lands only, with the SWM facility design considering all existing residential developed lands east and Institutional Lands south of the SPA.*

[1] Minor & Major system split between Ponds P4 and P8

Within the East Pelton SPA, two existing sites had special consideration for existing discharge conditions. The existing Windsor Christian Fellowship lands are expected to continue to convey to the 7th Street Drain Outlet Diversion and site's SWM facility, but the outflow will be redirected east into the E-W Arterial Drain. The Southwest Detention Centre property is also expected to maintain its existing on-site SWM controls and continue to discharge into the 8th Concession Municipal Drain. These two existing sites were considered within the watershed model to continue to discharge to their respective proposed outlets without further restriction.

Provided in **Figure 7** is the initial development buildout area map for the modelling of the SSMSP Area and West Hamlet SPA lands, including the drain modifications required at this time. The Initial buildout development condition PCSWMM model schematic is provided in **Appendix D- 2**.

5.2.4 Ultimate Development Condition Model

Expanding on the initial buildout condition model, the remaining future development areas within the SSMSP area were incorporated into the model to complete a modelling assessment for ultimate buildout conditions. The development areas outside of the initial buildout SPA's are generally consistent with what was shown in the ULRMP. Minor refinements were made to catchments where future development areas were contributing runoff to lumped drainage area boundaries, as well as updates to the hydrologic model parameters based on the updated land use plan and updated modelling parameters taken from the Windsor/Essex Region Stormwater Management Standards Manual (December 2018). These development areas, outside of the initial buildout SPA's, shall continue to follow the recommended SWM strategy for the SSMSP of Regional Ponds. Functional design of the Ponds beyond the initial buildout areas have not been completed as part of this study.

The proposed land use modelling parameters used under this ultimate buildout condition are presented in **Table 5-4**. The same strategy for modelling of the existing Windsor Christian Fellowship and Southwest Detention Centre properties as initial buildout conditions was maintained under ultimate buildout condition.

Table 5-4: Ultimate Buildout Area Proposed Condition Model Parameters

Area ID	Approximate Area (ha)	Model Storage ID	Proposed Land Use	Approximate Weighted Impervious (%)
EP_NORTH	124.1 ha	P1	Low to Medium Density Residential, Mixed Use, Open Space	74 %
EP_SOUTH	52.0 ha	P2	Commercial Centre, Mixed Use	90 %
CR42SPA_SW/SSMP12	112.1 ha	P3	Low Density Residential, Future Urban, Open Space	75 %
CR42SPA_ NW	99.5 ha	P4	Low to Medium Density Residential, Business Park, Major Institutional, Mixed Use, Neighbourhood Commercial, Open Space	83 %
CR42_N_2[1]	91.9 ha	P4/P8[1]	Employment Lands, Open Space	90 %
CR42SPA_ NE	60.8 ha	P5	Business Park, Open Space	85 %
CR42SPA_ SE	63.2 ha	P6	Low Density Residential, Open Space	83 %
LAUZ_CR42	7.7 ha	P7	Municipal Right-of-Way, Open Space	23 %

Area ID	Approximate Area (ha)	Model Storage ID	Proposed Land Use	Approximate Weighted Impervious (%)
CR42_N_4	117.8 ha	P8	Employment Lands, Open Space	85 %
Ham_1A/1B	67.6 ha*	Tec_Hamlet1	Single Residential	71 %
Ham_2	31.8 ha*	Tec_Hamlet2	Single Residential/Hydro Corridor	55 %
Ham_3	69.4 ha*	Tec_Hamlet3a	Single Residential/Forested Area	60 %
Ham4A/4B	43.8 ha	Tec_Hamlet3b	Single Residential	70 %
***Catchments Outside of Initial Buildout Area*s**				
SSMP1	23.5 ha	SU1	Future Employment	90 %
SSMP2	82.0 ha	SU2	Future Employment/Open Space	80 %
SSMP3	698.8 ha	SU3	Future Employment/Open Space	73 %
SSMP4	67.6 ha	SU4	Future Employment/Neighbourhood Commercial	90 %
SSMP5	116.2 ha	SU5	Future Urban	80 %
SSMP6	52.5 ha	SU6	Future Urban/Mixed Commercial	85 %
SSMP7	93.7 ha	SU7	Future Urban	80 %
SSMP8	61.3 ha	SU8	Future Urban/Employment	85 %
SSMP9	89.4 ha	SU9	Future Employment	90 %
SSMP10	82.8 ha	SU10	Future Employment	90 %
SSMP11	210.5 ha	SU11	Future Employment	90 %

** Area represents future Tecumseh West Hamlet SPA lands only, with the SWM facility design considering all existing residential developed lands east and Institutional Lands south of the SPA*

[1] Minor & Major system split between Ponds P4 and P8

Changes and necessary refinements to Municipal Drainage paths within the SSMSP area were further reviewed based on recommendations from the ULRMP. These include the following:

- Abandonment of a number of municipal drains throughout the SSMSP area to accommodate future development; and
- Realignment of the Little 10th Concession Drain and Watson Drain (through an E-W Arterial Drain extension) along the eastern boundary of the SSMSP south of CR42.

The ultimate development buildout area map considered within the modelling for the SSMSP Area, Town of Tecumseh, and ultimate Municipal Drainage considerations are shown in **Figure 8**. The ultimate buildout development condition PCSWMM model schematic is provided in **Appendix D- 3**.

6.0 Existing Condition Modelling Results

The following sections of this report summarize the existing condition hydrologic and hydraulic model results for the Little River Watershed within the SSMSP area. As identified previously, this is based on the PCSWMM dynamic hydrologic/hydraulic model developed as part of the Little River Flood Line Study. The analysis points summarizing both existing condition peak flows and HGL levels are to be read in conjunction with **Figure 9**, which show each analysis point with their respective ID.

Recommendations from the Little River Flood Line Study regulated mapping of floodway and flood fringe areas are also summarized to assess existing flood inundation extents within the SSMSP area from a regulated flood plain mapping standpoint.

6.1 Estimated Peak Flow Results

Table 6-1 presents a summary of in-drain peak flows at the noted analysis points and primary in-drain crossings throughout the SSMSP. As part of the dynamic modelling analysis, in-drain crossings considered within the Little River Flood Line Study have been included in the model. The flow results have been taken as follows:

- Directly downstream of in-drain structure locations along the SSMSP outer boundary where contributing runoff is coming from external areas;
- Directly upstream of all in-drain structures at the roadway crossings locations within the SSMSP study area; and
- At primary confluence locations with other tributary Municipal Drains.

Table 6-1: Little River Watershed Existing Condition In-Drain Flow Summary

Analysis Location ID	Analysis Location	Chicago 4hr Distribution					Chicago 24hr Distribution
		1:2yr (m^3/s)	1:5yr (m^3/s)	1:10yr (m^3/s)	1:25yr (m^3/s)	1:50yr (m^3/s)	1:100yr (m^3/s)
7th Concession Drain							
7C-1	D/S of Highway 401 Crossing	1.55	2.17	2.55	2.99	3.30	3.57
8th Concession Drain							
8C-1	D/S of Highway 401 Crossing	1.67	2.36	2.60	2.79	2.91	3.03
Hurley Relief Drain							
HR-1	D/S of Highway 401 Crossing	2.44	3.15	3.53	4.17	4.80	5.03

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Analysis Location ID	Analysis Location	Chicago 4hr Distribution					Chicago 24hr Distribution
		1:2yr (m^3/s)	1:5yr (m^3/s)	1:10yr (m^3/s)	1:25yr (m^3/s)	1:50yr (m^3/s)	1:100yr (m^3/s)
9th Concession Drain							
9C-1	D/S of Highway 401 Crossing	4.08	5.31	6.03	7.10	7.58	7.89
9C-2	U/S of 6th Concession Drain Confluence	4.64	6.59	7.77	9.17	14.36	17.06
6th Concession Drain							
6C-1	D/S of 7th Concession Road Crossing	8.22	11.93	14.36	17.87	20.39	22.93
6C-2	U/S of 8th Concession Road Crossing	16.12	20.78	22.70	23.32	24.23	25.68
6C-3	U/S of 9th Concession Road Crossing	21.78	27.68	28.05	28.17	29.89	31.71
6C-4	U/S of Little River Confluence	15.92	18.62	18.72	18.75	19.30	19.98
Watson Drain							
W-1	D/S of Highway 401 Crossing	0.88	1.21	1.45	1.82	2.10	2.34
W-2	U/S of Baseline Road Crossing	2.54	3.64	4.42	5.47	6.26	7.06
W-3	U/S of County Road 42 Crossing	3.14	4.58	5.61	7.02	8.07	9.22
W-4	U/S of Little River Drain Confluence	3.13	4.42	5.40	7.26	8.56	9.83
Little 10th Concession Drain							
10C-1	U/S of County Road 42 Crossing	1.86	2.71	3.32	4.14	4.92	5.64

Analysis Location ID	Analysis Location	Chicago 4hr Distribution					Chicago 24hr Distribution
		1:2yr (m^3/s)	1:5yr (m^3/s)	1:10yr (m^3/s)	1:25yr (m^3/s)	1:50yr (m^3/s)	1:100yr (m^3/s)
Former Rivard Drain							
R-1	U/S of Lauzon Parkway Crossing	0.52	0.80	1.01	1.38	1.43	1.47
McGill Drain							
M-1	U/S of Lauzon Parkway Crossing	5.82	6.69	6.72	6.84	7.62	7.92
Soulliere Drain							
S-1	U/S of Little River Drain Confluence	0.44	2.32	4.52	5.83	6.82	7.45
Desjardins Drain							
D-1	D/S of SSMP Study Area Limit	1.66	2.38	2.93	3.84	4.56	5.34
D-2	U/S of Little River Drain Confluence	1.65	2.37	2.97	3.77	4.39	5.12
Lachance Drain							
L-1	D/S of Banwell Road Crossing	1.46	1.98	2.32	2.76	3.09	3.27
L-2	U/S of Little River Drain Confluence	1.74	2.31	2.64	3.02	3.24	3.38
Little River Drain							
LR-1	D/S of Highway 401 Crossing	1.17	1.43	1.59	1.81	2.03	2.34
LR-2	U/S of Baseline Road Crossing	20.72	25.57	27.18	29.10	30.51	31.94
LR-3	U/S of County Road 42 Crossing	28.44	37.03	38.00	39.18	40.40	41.14
LR-4	U/S of Lauzon Parkway Crossing	28.39	36.93	37.76	38.80	39.87	40.65

Analysis Location ID	Analysis Location	Chicago 4hr Distribution					Chicago 24hr Distribution
		1:2yr (m^3/s)	1:5yr (m^3/s)	1:10yr (m^3/s)	1:25yr (m^3/s)	1:50yr (m^3/s)	1:100yr (m^3/s)
LR-5	U/S of Lauzon Road Crossing	31.16	40.49	41.80	42.90	43.40	43.63
LR-6	U/S of CP Railway Crossing	34.13	42.54	44.02	45.12	45.64	46.16
LR-7	U/S of EC Row Expressway Crossing	43.65	55.04	58.79	61.65	62.54	63.86

The existing summary table above identifies a slight reduction of in-drain flow from upstream to downstream along the drains at a number of flow analysis locations. The reductions in flow are a result of the following:

- Refinement of channel modelling parameters including in-drain roughness, length of channelized flow between junctions and cross section details resulting in attenuation in the Little River Drain;
- More refined understanding of the flow behaviour at the 6th Concession and 9th Concession confluence. Partial flows continue north under CR42 along the 9th Concession Drain towards North Townline Drain; and
- Dampening of flows due to tailwater conditions and peak timing on the tributary drains at the confluence with the Little River Drain.

Based on the summary of flows through the SSMSP Municipal Drainage system above, the maximum 1:100 year peak flow leaving the SSMSP area drainage system, upstream of the EC Row Expressway structure crossing is 63.86 m^3/s.

6.2 Estimated Municipal Drain Hydraulic Level Results

Table 6-2 summarizes in-drain water elevations at the noted analysis points and primary in-drain crossings throughout the study area. Similar to the peak flow results, the model accounts for the in-drain crossings considered within the Little River Flood Line Study.

Table 6-2: Little River Watershed Existing Condition In-Drain Water Elevation Summary

Analysis Location ID	Analysis Location	Chicago 4hr Distribution					Chicago 24hr Distribution
		1:2yr (m)	1:5yr (m)	1:10yr (m)	1:25yr (m)	1:50yr (m)	1:100yr (m)
7th Concession Drain							
7C-1	D/S of Highway 401 Crossing	188.14	188.25	188.31	188.38	188.43	188.48
8th Concession Drain							
8C-1	D/S of Highway 401 Crossing	188.63	188.74	188.77	188.80	188.82	188.84
Hurley Relief Drain							
HR-1	D/S of Highway 401 Crossing	187.11	187.21	187.26	187.32	187.40	187.42
9th Concession Drain							
9C-1	D/S of Highway 401 Crossing	186.51	186.65	186.73	186.81	186.86	186.89
9C-2	U/S of 6th Concession Drain Confluence	184.47	184.79	184.83	184.84	184.94	185.05
6th Concession Drain							
6C-1	D/S of 7th Concession Road Crossing	188.25	188.53	188.73	188.95	189.11	189.26
6C-2	U/S of 8th Concession Road Crossing	186.45	186.83	186.95	187.03	187.07	187.10
6C-3	U/S of 9th Concession Road Crossing	184.46	184.78	184.82	184.84	184.93	185.02
6C-4	U/S of Little River Confluence	183.12	183.49	183.58	183.66	183.72	183.79
Watson Drain							
W-1	D/S of Highway 401 Crossing	185.14	185.22	185.27	185.34	185.40	185.60
W-2	U/S of Baseline Road Crossing	183.30	183.53	183.68	183.89	184.04	184.22

Analysis Location ID	Analysis Location	Chicago 4hr Distribution					Chicago 24hr Distribution
		1:2yr (m)	1:5yr (m)	1:10yr (m)	1:25yr (m)	1:50yr (m)	1:100yr (m)
W-3	U/S of County Road 42 Crossing	181.85	182.04	182.17	182.36	182.50	182.65
W-4	U/S of Little River Drain Confluence	181.38	181.83	181.88	181.93	181.95	181.97
Little 10th Concession Drain							
10C-1	U/S of County Road 42 Crossing	181.95	182.11	182.23	182.39	182.48	182.56
Former Rivard Drain							
R-1	U/S of Lauzon Parkway Crossing	181.58	182.01	182.10	182.25	182.29	182.33
McGill Drain							
M-1	U/S of Lauzon Parkway Crossing	181.07	181.16	181.18	181.21	181.27	181.38
Soulliere Drain							
S-1	U/S of Little River Drain Confluence	180.53	180.99	181.12	181.20	181.25	181.29
Desjardins Drain							
D-1	D/S of SSMP Study Area Limit	181.30	181.44	181.52	181.65	181.74	181.83
D-2	U/S of Little River Drain Confluence	180.39	180.87	181.00	181.10	181.16	181.21
Lachance Drain							
L-1	D/S of Banwell Road Crossing	180.54	180.65	180.78	180.90	180.98	181.06
L-2	U/S of Little River Drain Confluence	180.03	180.58	180.74	180.85	180.91	180.98

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Analysis Location ID	Analysis Location	Chicago 4hr Distribution					Chicago 24hr Distribution
		1:2yr (m)	1:5yr (m)	1:10yr (m)	1:25yr (m)	1:50yr (m)	1:100yr (m)
Little River Drain							
LR-1	D/S of Highway 401 Crossing	185.76	185.80	185.82	185.85	185.87	185.91
LR-2	U/S of Baseline Road Crossing	183.05	183.44	183.53	183.62	183.68	183.76
LR-3	U/S of County Road 42 Crossing	182.18	182.72	182.78	182.85	182.90	182.93
LR-4	U/S of Lauzon Parkway Crossing	181.72	182.16	182.21	182.26	182.29	182.32
LR-5	U/S of Lauzon Road Crossing	181.11	181.56	181.63	181.66	181.68	181.70
LR-6	U/S of CP Railway Crossing	180.19	180.71	180.86	180.97	181.02	181.08
LR-7	U/S of EC Row Expressway Crossing	179.32	179.83	179.99	180.10	180.17	180.23

Based on the existing condition water elevations through the primary Municipal Drains modelled, a number of drains are shown to be overtopping sections of their respective banks and inundating adjacent flood plain areas. This is expected, as Municipal Drains are traditionally sized to convey flows ranging from a 1:2 to 1:5 year event.

6.3 Flood Inundation Extents and Updated Flood Line Mapping

Regulated flood line maps were developed and/or updated for the Little River Drain watershed as part of the Little River Flood Line Study. These maps took into consideration the two-zone flood plain concept where critical flow velocities and depths were considered when determining the extent of floodway and flood fringe limits and establishing floodproofing level requirements for future development. Provided in **Figure 10** is a representation of the existing condition flood line extents within the SSMSP of both the floodway and flood fringe areas. Further information on how the floodway and flood fringe extents were determined are further detailed within the Little River Flood Line Study Hydrologic and Hydraulic Technical Reports (Dillon, 2022).

7.0 Initial Buildout Area SWM Modelling Results and Pond Design

With consideration for the design of Regional Ponds within the initial buildout development areas of the SSMSP, the following was completed to satisfy functional design:

- Determination of minimum water quantity requirements to attenuate flows to the acceptable maximum release rates noted in **Section 2.1.1**;
- Determination of requirements for water quality control using both Wet and Dry Ponds to satisfy the Windsor/Essex Region Stormwater Management Standards Manual;
- Coordination with the civil team to functionally review development design constraints impacting each Regional Pond design such as:
    - Existing topography surrounding the Pond locations;
    - Pond development service areas options and storm sewer pipe cover requirements;
    - For preferred Wet Ponds, determination of required permanent pool volumes, normal water levels (NWL) with consideration of upstream storm trunk sewers and functional forebay designs; and
    - For preferred Dry Ponds, determination of alternative means for regional TSS removal and both regional and at-source Oil and Grit treatment.
- Evaluation of subsurface soil and groundwater conditions within the study area based on existing geotechnical information completed by Golder Associates found in **Appendix F-1** of the **Appendix F** - Municipal Servicing Functional Design Report;
- Functional initial development area roadway grades to meet floodproofing requirements and general overland flow routes (Refer to SSMSP Appendix F for Suggested Minimum Road Grades);
- Requirements for environmental features and waterfowl mitigation within SWM corridors;
- Existing and future roadway crossings;
- Potential conflicts with Municipal Drains and existing or proposed sanitary trunk sewers; and
- Regional pump station locations.

Through the functional design process, Regional Pond active storage area tables for water quantity control were developed and incorporated into the PCSWMM model for each Regional SWM facility within the initial buildout areas. Functional maximum Pond water surface elevations were then determined for all synthetic storm events.

Provided within this section are the functional design details for each Regional Pond within the initial buildout areas to support Approach 2 of the Master Planning Process.

Functional design details for the storm trunk sewer design are provided in **Appendix F**: Storm Design Details

7.1 East Pelton Development Secondary Planning Area

The East Pelton SPA storm servicing is to be directed to two (2) Regional Ponds. A modelling schematic showing the contributing drainage area extents discussed for both Pond P1 and Pond P2 for the East Pelton SPA is provided in **Appendix D-2**.

Provided in the below sections are the functional design details for each Regional Facility. Where the Regional Facility is located within the Airport Hazard Zone and in the vicinity of the approach/takeoff surfaces, future coordination is required with the Airport and/or Transport Canada during detail design to determine the acceptability of a Wet Pond at each location. If a Wet Pond with proper waterfowl mitigation measures is not considered acceptable by the Airport and City due to the potential attraction of migratory birds, a Dry Pond is to be considered. At this time, the following Regional Solutions are preferred:

- **Pond P1** to be designed as a Dry Pond due to the location being within the Airport Hazard Zone;
- **Pond P2** to be designed as a Wet Pond due to being outside of the Airport Hazard Zone, with consideration for Waterfowl Mitigation.

7.1.1 Regional Pond P1

Pond P1 will provide both water quality and quantity SWM controls for the northern portion of the East Pelton SPA development area bound by 7th Concession Road to the west, 8th Concession Road to the east, the proposed E-W Arterial Road to the south and 6th Concession Drain to the north. This Pond is to be constructed within the 6th Concession Drain SWM corridor along the northern boundary of the development area with a regional pump station Pond outlet into the 6th Concession Drain.

Based on the currently known roadway layout for the development area, the development is expected to have three (3) storm inlets to the Pond. Both the minor (storm sewer) and major (overland) system runoff is expected to convey to this facility during all storm events.

At this time, Pond P1 has been identified to be within the current Airport Hazard Zone for the approach/takeoff surfaces where Wet Ponds are not permitted. Therefore, a **Regional Dry Pond has been preferred** through the master planning process.

During detail design, further coordination is recommended with the Airport to confirm all details of the preferred design and whether a Wet Pond can be considered. If a Wet Pond is decided to be acceptable by the City and Airport in the future, provided below are alternative details of a Functional Wet Pond:

- Each Pond cell would be designed with a permanent pool with each inlet discharging into a forebay for water quality treatment;
- Based on the longitudinal extent of the Pond, natural topography of the lands from west to east and consideration for each storm trunk sewer inlet elevation into the facility, Pond P1 would be designed with varying NWL elevations. This would be desired to minimize excavation of the facility and be designed similar to the proposed Pond bottom elevations identified for the Dry Pond design.
- To facilitate differences in NWL and maintain permanent pools levels at each stage, the design would consist of three (3) permanent pool cells. An earth berm with a top elevation of the upstream NWL would be required to separate each cell to limit any permanent pool water level changes through the Pond.
- The top of the earth berm would be required to be reinforced with rip rap along the banks and top of Pond to limit any erosion concerns.

7.1.2 Regional Pond P2

Pond P2 will provide both water quality and quantity SWM controls for the southern portion of the East Pelton SPA development area bound by 7th Concession Road to the west, 8th Concession Road to the east, Highway 401 to the south and the proposed E-W Arterial Road to the north. This Pond is to be constructed within the E-W Arterial SWM corridor directly south of the new E-W Arterial Drain with a regional pump station Pond outlet into the E-W Arterial Drain.

At this time, Pond P2 has been identified to be outside of the current Airport Hazard Zone for the approach/takeoff surfaces. Therefore, a **Regional Wet Pond has been preferred** through the master planning process.

Based on the currently proposed roadway layout within the development area and proposed length of Pond P2, the development is expected to have one (1) storm inlet into a Pond forebay for water quality treatment with one set NWL elevation. Both the minor (storm sewer) and major (overland) system runoff is expected to convey to this facility during all storm events

7.2 County Road 42 Development Secondary Planning Area and CR42/Lauzon Parkway Improvements

As part of the modelling for the CR42 SPA, the reconstruction of CR42 from Walker Road to County Road 17 and the initial phase of reconstruction for Lauzon Parkway from Service Road B to the north to CR42 were considered. This includes limitations of overland flow routing along CR42 during large storm events with respect to requirements for dry lane emergency access due to the proposed new Windsor Regional Hospital.

Through the functional review of all drainage considerations, the storm servicing for these lands are to be directed to six (6) Regional Ponds. A modelling schematic showing the contributing drainage area extents and model setup discussed for P3, P4, P5, P6, P7 and P8 are provided in **Appendix D-2**.

Provided in the below sections are the functional designs for each Regional Facility. Where the Regional Facility is located within the Airport Hazard Zone and in the vicinity of the approach/takeoff surfaces, future coordination is required with the Airport and/or Transport Canada during detail design to determine the feasibility of a Wet Pond at each location. If a Wet Pond with proper waterfowl mitigation measures is not considered acceptable due to the potential attraction of migratory birds, a Dry Pond is to be considered. At this time, the following Regional Solutions are preferred:

- **Pond P3** and **Pond P6** to be designed as a Dry Pond due to the location being within the Airport Hazard Zone;
- **Pond P4, P5, P7, P8** to be designed as a Wet Pond due to being outside of the Airport Hazard Zone, with consideration for Waterfowl Mitigation.

7.2.1 Regional Pond P3

Pond P3 will provide both water quality and quantity SWM controls for the southern portion of the CR42 SPA development area bound by 8th Concession Road to the west, Little River Drain to the east, the southern limit of the CR42 SPA to the south and Baseline Road to the north.

Due to topographic constraints and existing/future roadway barriers, future development lands outside of the CR42 SPA south of Joy Road between the 8th Concession Road, 9th Concession Road and E-W Arterial Road are expected to contribute to Pond P3. The estimated 73 hectares of future development outside of the CR42 SPA is considered as an undeveloped condition during initial buildout to the proposed Pond P3, and fully developed under ultimate buildout condition modelling within the functional design of this Pond. This Pond is to be constructed within the 6th Concession Drain SWM corridor directly south of the 6th Concession Drain with regional pump station Pond outlet into the Little River Drain at the confluence of Little River Drain and the 6th Concession Drain.

Based on the currently proposed roadway layout within the development area, the development is expected to have four (4) storm inlets to the Pond. Both the minor (storm sewer) and major (overland) system runoff is expected to convey to this facility during all storm events.

At this time, Pond P3 has been identified to be within the current Airport Hazard Zone for the approach/takeoff surfaces where Wet Ponds are not permitted. Therefore, a **Regional Dry Pond has been preferred** through the master planning process.

During detail design, further coordination is recommended with the Airport to confirm all details of the preferred design and whether a Wet Pond can be considered. If a Wet Pond is decided to be acceptable by the City and Airport in the future, provided below are alternative details of a Functional Wet Pond:

- Each Pond cell would be designed with a permanent pool with each inlet discharging into a forebay for water quality treatment;
- Based on the longitudinal extent of the Pond, natural topography of the lands from west to east and consideration for each storm trunk sewer inlet elevation into the facility, Pond P3 would be designed with varying NWL elevations. This would be desired to minimize excavation of the facility and be designed similar to the proposed Pond bottom elevations identified for the Dry Pond design.
- To facilitate the differences in NWL and maintain permanent pools levels at each stage, the design would consist of three (3) permanent pool cells. An earth berm with a top elevation of the upstream NWL is proposed to separate each cell to limit any permanent pool water level changes through the Pond.
- The top of the earth berm would be required to be reinforced with rip rap along the banks and top of Pond to limit any erosion concerns.

7.2.2 Regional Pond P4 & P8

Through a review of the natural topography of the lands, and following the existing Municipal Drainage boundary of the existing North Townline Road, the CR42 SPA north of Baseline Road and west of Little River was split between two (2) Regional Ponds; P4 & P8. Pond P4 will be constructed along the western Little River Drain SWM corridor bound by Baseline Road to the south and CR42 to the north with a regional pump station Pond outlet into the Little River. Pond P8 will be constructed as a twin-cell Pond system with a gravity connection between the two directly north of CR42 and west of Little River Drain within the City of Windsor owned lands. This Pond will have a regional pump station Pond outlet into the Little River Drain.

At this time, both Pond P4 & P8 have been identified to be outside of the current Airport Hazard Zone for the approach/takeoff surfaces. Therefore, a **Regional Wet Pond has been preferred** through the master planning process.

Based on the orientation of the twin-cell Pond P8 with a centralized gravity interconnection, the storm trunk sewer inlets are to enter the facility at different elevations along the east and west of the facility. The recommendation for this Pond is to maintain with one NWL elevation with storm inlets coming in slightly higher than the permanent pool. The future commercial development with the Pond P8 drainage area is not expected to commence in the near future and that the construction of this Pond will need to be staged. Additional details regarding the staging and construction of Pond P8 as it relates to the initial phasing of development and road reconstruction are included in the Implementation section of **Appendix F** - Municipal Servicing Functional Design Report.

Taking into consideration the CR42 roadway improvements, storm trunk sewer drainage strategy above and the requirement for dry lanes along CR42 during larger storm events, the following storm drainage strategy was developed for these two (2) Ponds:

- Lands within the existing North Townline Drain watershed fronting CR42 and the CR42 SPA development lands (91.9 ha) are to convey minor system flows (1:10 year) through the proposed CR42 storm trunk sewer to Pond P8; and
- To limit overland flow entering the CR42 right-of-way during larger storm events, major system overland flow from the 91.9 ha area is to be directed to Pond P4 through the future development local roadway and overland flow network.

Based on the storm runoff conveyance routing strategy for Ponds P4 & P8, the following flow split was considered in the modelling for the subject CR42 SPA development area and upstream existing North Townline watershed contributing to the CR42 storm trunk sewer:

- 1:10 year flow of 7.6 m^3/s contributing to Pond P8; and
- 1:100 year flow of 6.61 m^3/s contributing to Pond P4.

The modelling setup of the minor/major system split for the drainage areas noted above are shown in the PCSWMM model schematic in **Appendix D-2**.

The remaining CR42 development area (99.5 ha) bound by 8th Concession Road to the west, Little River Drain to the east, Baseline Road to the south and future storm drainage area limits for the CR42 storm trunk sewer to the north are to convey all runoff (minor and major) to Pond P4.

Beyond the initial buildout area drainage contributions to these two Ponds, under ultimate buildout conditions, portions of the City of Windsor/Airport employment development lands, natural heritage and open space areas north of CR42, as well as the Lauzon Parkway right-of-way from Service Road B to the Little River Drain crossing (117.8 ha) will convey all runoff (minor and major) to Pond P8.

Based on the currently proposed roadway layout within the development areas, Pond P4 and P8 are expected to have two (2) storm inlets and three (3) storm inlets to the Ponds respectively. Each Pond at this time as has been designed with one (1) NWL. Each storm inlet will discharge into a forebay for water quality treatment.

7.2.3 Regional Pond P5

Pond P5 will provide both water quality and quantity SWM controls for the northeastern portion of the development area bound by the Little River Drain to the west, County Road 17 to the east, Baseline Road to the south and CR42 to the north. This Pond is to be constructed along the eastern Little River Drain SWM corridor between Baseline Road and CR42 with a regional pump station Pond outlet into the Little River Drain.

At this time, Pond P5 has been identified to be outside of the current Airport Hazard Zone for the approach/takeoff surfaces. Therefore, a **Regional Wet Pond has been preferred** through the master planning process.

Based on the currently proposed roadway layout within the CR42 SPA development area, the development is expected to have one (1) storm inlet into the Pond forebay for water quality treatment with one set NWL elevation. Both the minor (storm sewer) and major (overland) system runoff is expected to convey to this facility during all storm events.

7.2.4 Regional Pond P6

Pond P6 will provide both water quality and quantity SWM controls for the southeastern portion of the CR42 SPA development area bound by the Little River Drain to the east, County Road 17 to the west, the new E-W Arterial Road to the south and Baseline Road to the north. This Pond is to be constructed along the SWM corridor directly south of Baseline Road, east of the future roadway and west of County Road 17. Due to topographic constraints and existing/future roadway barriers, under ultimate buildout conditions, future development lands south of the CR42 SPA boundary and north of the new E-W Arterial Road are to contribute runoff to this Pond. The estimated 20.6 hectares of future development outside of the CR42 SPA is considered within the functional design of this Pond.

Based on the currently proposed roadway layout within the CR42 SPA development area, the development is expected to have one (1) storm inlet into the Pond. Both the minor (storm sewer) and major (overland) system runoff is expected to convey to this facility during all storm events.

At this time, Pond P6 has been identified to be within the current Airport Hazard Zone for the approach/takeoff surfaces where Wet Ponds are not permitted. Therefore, a **Regional Dry Pond has been preferred** through the master planning process.

During detail design, further coordination is recommended with the Airport to confirm all details of the preferred design and whether a Wet Pond can be considered. If a Wet Pond is decided to be acceptable by the City and Airport in the future, provided below are alternative details of a Functional Wet Pond:

- The Pond cell would be designed with a permanent pool with the inlet discharging into a forebay for water quality treatment; and
- Based on the longitudinal extent of the Pond, natural topography of the lands from west to east and consideration for each storm trunk sewer inlet elevation into the facility, Pond P6 would be designed with one (1) set NWL elevation similar to the proposed Pond bottom elevation identified for the Dry Pond design.

7.2.5 Regional Wet Pond P7

Pond P7 will provide both water quality and quantity SWM controls for the Lauzon Parkway and CR42 intersection right-of-way improvements, as well as greenspace between the Little River Drain and the future Lauzon Parkway extension. This Pond is to be constructed at the northwest corner of the proposed CR42/Lauzon Parkway intersection within the eastern Little River Drain SWM corridor with a regional pump station Pond outlet into the Little River Drain.

At this time, Pond P7 has been identified to be outside of the current Airport Hazard Zone for the approach/takeoff surfaces. Therefore, a **Regional Wet Pond has been preferred** through the master planning process.

Based on the currently proposed roadway layout within the CR42 SPA development area, the development is expected to have one (1) storm inlet into the Pond forebay for water quality treatment with one set NWL elevation. Both the minor (storm sewer) and major (overland) system runoff is expected to convey to this facility during all storm events.

7.3 Initial Buildout Area SWM Facility Functional Design Details

The Regional Ponds within the initial buildout areas are proposed to consist of several linear facilities to support development. Due to the proximity to the Windsor Regional Airport, a number of Ponds through the master planning process have been recommended to be Dry, opposed to a Wet Pond due to hazard zoning outlined by the Airport and Transport Canada.

Provided below are considerations which are to be reviewed where a Dry Pond is the preferred regional solution.

Dry Pond Quantity and Quality Design Considerations:

A Dry Pond design would be constructed similar to the Wet Pond design for water quantity treatment, however the proposed Pond bottom would be based on the elevation of the lowest NWL elevation determined for the Wet Pond alternative.

Consideration for water quality treatment is to be completed based on the most feasible and cost effective solution at the time of detail design. This includes investigation of the following:

- Review the feasibility and cost effectiveness to provide full water quality control (70 % TSS and Oil and Grit) through an end-of-pipe treatment unit;
- Review alternative forms of linear water quality TSS removal solutions such as:
  - Enhanced grass swales through the dry Pond.
  - Manufactured end-of-pipe TSS treatment units (Ex. Stormtech Isolator Row PLUS units or approved equivalent).

- Consideration of at-source oil and grit separation throughout the service area such as the use of basic level of protection quality control units within private residential/ commercial/ industrial lands and goss gully traps within catchbasins for roadway treatment.

In addition to the recommended Dry Ponds, waterfowl mitigation measures for both Wet and Dry Ponds are to be considered during detail design to be consistent with the Waterfowl Mitigation Report development as part of the SSMSP study located in Supplementary Waterfowl Adaptive Mitigation Plan for SWM included in **Appendix F-10** of the Municipal Servicing Design Report. This includes a linear orientation for all Ponds and recommended vegetative planting to deter geese and bird migration.

Provided below in **Table 7-1** are the functional design summaries for each Regional Pond design for the initial buildout areas including permanent pool requirements if Wet Ponds are considered acceptable through this master plan or in the future. Additional details of the Pond designs for Pond P1 through Pond P8, including water quality and quantity design calculations, functional stage- storage tables based on the proposed layout of each Pond, water surface elevations and active storage volumes for all other design storm events are provided in **Appendix D-4**.

A plan view showing the layout for each Regional Pond P1 through P8 through the designated SWM corridors required for the initial buildout condition areas are shown in **Figures 11A** through **Figure 11C** of this report.

Table 7-1: SSMSP Initial Buildout Area Functional SWMF Design Details

Pond ID	Ultimate Service Area (ha)	Weighted Impervious Value (%)	Water Quality Design							Water Quantity Design				
			[1]Required Permanent Pool Volume (m^3)	[1]Provided Permanent Pool Volume (m^3)	[1]Provided Permanent Pool Depth (m)	[2]Design NWL(s) or Dry Pond Bottom (m)	32 mm Water Quality Inflow (m^3/s)	[1]32 mm Water Quality WSEL (m)	[1]32 mm Water Quality Volume (m^3)	Maximum Release Rate (m^3/s)	Maximum 1:100 Year WSEL (m)	Maximum 1:100 Year Active Storage Volume (m^3)	Maximum UST WSEL (m)	Maximum UST Active Storage Volume (m^3)
P1	*124.10*	*74*	*16,754*	*23,841*	*2.0*	***183.00***/*183.20/183.50*	*7.15*	*183.94*	*19,970*	*0.745*	*185.71*	*86,850*	*186.32*	*117,800*
P2	51.97	90	8,159	8,645	2.0	183.90	3.84	184.98	10,230	0.312	186.77	39,750	187.36	52,900
P3	*224.15*	*73*	*30,260*	*40,770*	*2.0*	***180.20***/*180.70/181.20*	*12.47*	*181.52*	*33,330*	*1.345*	*183.59*	*153,300*	*184.25*	*206,100*
P4	99.51 & 91.9*	83	14,628	18,036	2.0	179.00	3.24	179.85	14,990	0.597	181.92	81,200	182.61	111,800
P5	60.82	85	9,123	10,249	2.0	178.00	4.84	179.04	11,700	0.365	180.83	45,900	181.41	61,100
P6	*63.24*	*83*	*9,290*	*10,800*	*2.0*	*179.30*	*5.34*	*180.56*	*11,870*	*0.379*	*182.66*	*47,250*	*183.31*	*62,400*
P7	7.73	23	603	2,727	2.0	179.10	0.34	179.53	860	0.046	180.76	4,700	181.16	6,500
P8	117.8 & 91.9**	87	24,895	32,076	2.0	178.00	8.90	179.26	34,100	1.258	181.47	141,200	182.21	190,400

Bolded Pond ID: Dry Pond preferred where Pond Bottom to be the lowest elevation shown

1 Required Water Quality Permanent Pool Design if a Wet Pond is confirmed acceptable during detail design.

2 Design NWL if Wet Pond is preferred. Pond Bottom if Dry Pond is preferred.

** Major System Only to Pond from 91.9 ha Catchment.*

*** Minor System Only to Pond from 91.9 ha Catchment.*

7.4 Initial Buildout Area Forebay Design Summary

Based on the functional design of the initial buildout areas Ponds where Wet Ponds are considered acceptable, functional forebay requirements were computed for each storm sewer inlet. Each forebay length considered future development areas outside of the SSMSP initial buildout condition where additional future development areas would contribute to initial buildout storm trunk sewers. The contributing drainage areas were based on each storm sewer inlet's respective storm sewer design sheet provided within the **Appendix F** - Municipal Servicing Functional Design Report. The methodology in determining the initial forebay calculations from the lumped model are as follows:

- Peak outflow during the Water Quality 32mm storm event and trunk storm inlet flow based on the proposed level of service (1:10 year) for each Regional Wet Pond inlet;
- Target particle size design of 0.15mm;
- Settling velocity of 0.0003 m/s; and
- Desired forebay flow velocity of less than 0.50 m/s.

As per the Ministry of the Environment Stormwater Management Planning and Design Manual (2003), the settling distance traditionally governs forebay design lengths over the alternative dispersion length, unless there is a large contributing service area or pipe inflow to the Pond is beyond a traditional level of service. Based on the storm trunk sewers for development being sized for a 1:10 year event, and contributing drainage areas being significant for the majority of the Pond inlets, dispersion lengths were identified to govern a number of forebay designs throughout the initial buildout area wet Ponds.

Provided below in **Table 7-2** are the governing minimum forebay flow lengths for Wet Ponds, taking into consideration both the required settling and dispersion lengths based on the detailed Pond Inlet calculations provided in **Appendix D-4**.

Where Dry Ponds are preferred, this functional design information can be used to size a number of water quality solutions during detail design for each service area, including but not limited to the following:

- Manufactured Water Quality Units (ex. OGS units or similar) for full TSS and Oil and Grit end-of-pipe treatment;
- Longitudinal enhanced grass swales through Dry Ponds;
- Engineered end-of-pipe longitudinal TSS underground treatment units (Ex. Stormtech Isolator Row PLUS unit or approved equivalent)

Table 7-2: Initial Buildout Area Design Forebay Requirements

Regional Wet Pond ID	Pond Inlet ID	32mm Quality Event Pond Outflow (m^3/s)	Trunk Sewer 10yr Inlet Flow Rate to Pond (m^3/s)	Required Forebay Length (m)
P1	Out 1 (West)	0.103	2.72	44
	Out 2 (Central)	0.279	6.20	99
	Out 3 (East)	0.315	8.02	128
P2	**Out 1**	**0.312**	**4.85**	**102**
P3	Out 1 (8th)	0.566	10.75	172
	Out 2 (New Road)	0.298	5.81	93
	Out 3 (9th)	0.282	6.26	100
	Out 4 (New Road E)	0.203	3.86	62
P4	**Out 1 (South Trunk)**	**0.302**	**6.59**	**75**
	Out 2 (Mid Trunk)	**0.295**	**5.13**	**70**
P5	**Out 1**	**0.365**	**9.42**	**188**
P6	Out 1	0.380	9.00	180
P7	**Out 1**	**0.046**	**1.06**	**28**
P8	**Out 1 (CR42)**	**0.344**	**10.45**	**84**
	Out 2 (Airport)	**0.310**	**13.33**	**107**
	Out 3 (Lauzon)	**0.016**	**0.77**	**16**

Bolded Pond ID: Wet Pond preferred where forebay is required

Where trunk storm sewers are entering any proposed Wet Ponds at the upper limit of the Pond cell, on-line forebays are proposed. Where storm inlets are entering the facility midway through the Pond cell, off-line forebays are proposed to not cause sediment buildout midway through the Regional Pond permanent pool.

Functional forebay layouts for each initial development area Pond inlets for Wet Pond P1 through Pond P8 are provided in **Figures 11A** through **Figure 11C** of this report, with typical Pond and forebay cross sections provided within the **Appendix F** - Municipal Servicing Functional Design Report.

7.5 Dry Pond Alternative Water Quality Design Considerations

Where Dry Ponds are preferred, no permanent pool is to be incorporated in the facility design due to waterfowl concerns within Primary Hazard Zones as advised by the Airport and Transport Canada.

To provide regional water quality treatment for the service area, traditional dry Ponds have been historically identified to only provide a basic level of TSS removal (60%) and limited Oil and Grit treatment. During functional water quality treatment design for the initial buildout areas, it was determined that limited manufacturers could provide a water quality unit for regional treatment of large service areas such as what is proposed within the SSMSP area. Alternative water quality treatment measures were therefore considered for areas where Dry Ponds are preferred.

Provided below are functional alternative water quality considerations to be further assessed during detail design where water quality design is required for a final Regional Dry Pond selection. For each of these alternatives below, Goss Traps are recommended to be installed within all catchbasins or storm manholes for at-source oil and grit treatment. During detailed design for private sites, at-source water quality control may be considered acceptable in lieu of contributing to a regional water quality control strategy. This is to be confirmed with the City at the pre-consultation stage.

7.5.1 Enhanced Grass Swales

Although typical grassed swales and dry Ponds are generally used for the conveyance of storm water and quality control for basic levels of treatment (60%TSS), under the appropriate conditions they permit significant amounts of TSS removal. Enhanced grass swales, when integrated within dry Ponds, can be effective for treatment when the bottom width is maximized while the depth of flow and channel slope is minimized.

An enhanced grassed swale and dry Pond expansion design would meet guidelines from the following publications:

- *Young et. al., "Evaluation and Management of Highway Runoff Water Quality (FHWA, 1996),*
- *Stormwater Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring (FHWA, 1996),*
- *Stormwater Management Planning and Design Manual (MOE, 2003).*

Case studies on the effectiveness of enhanced grassed swales within dry Ponds for water quality control have provided variable results, which precludes the ability to precisely calculate pollutant removal efficiencies. However, the above referenced publications indicate that when properly designed, they can provide in excess of 80% long-term TSS removal, which meet the requirements for an *Enhanced* level of quality control as per the MOE guidelines. This is considered above the *Normal* level (70% TSS) of quality treatment, which is assigned as the minimum level of quality control for the region (Windsor/Essex Region Stormwater Management Standards Manual).

Both enhanced wet and dry swales demonstrate good pollutant removal, with enhanced dry swales and Ponds providing significantly better performance for metals and nitrate. Dry swales and Ponds typically remove 65 percent of total phosphorus (TP), 50 percent of total nitrogen (TN), and between 80 and 90 percent of metals. Wet swale and Pond removal rates are closer to 20 percent of TP, 40 percent of TN, and between 40 and 70 percent of metals. The TSS removal for both swale and Pond types are typically between 80 and 90 percent.[1]

For an enhanced grass swale being incorporated within the dry Pond design for water quality treatment, the swale is to provide for a continuous flow of runoff, at a low depth for water quality treatment through mature vegetative growth. Functional design parameters for consideration include the following:

- Peak outflow during the Water Quality 32mm storm event and trunk storm inlet flow based on the proposed level of service (1:10 year) for each Regional Pond inlet;
- Target particle size design of 0.15mm;
- Settling velocity of 0.0003 m/s;
- Desired enhanced swale flow velocity of less than 0.50 m/s;
- Trapezoidal enhanced grass swale cross section with a minimum bottom width of 1.0 m;
- Preferred minimum side slope of 3:1; and
- Shallow conveyance flow depth to promote sediment capture through the mature vegetation.

7.5.2 Engineered End-of-Pipe Longitudinal TSS Underground Treatment Units

Innovation in SWM water quality design has determined a number of alternatives for TSS removal where traditional water quality OGS units for a normal level of treatment (70% TSS removal) are not feasible due to the size of contributing service area and level of imperviousness. An example of such a product is the Stormtech Isolator Row PLUS unit.

The specific manufacturer uses the Stormtech Isolator Row PLUS unit for such a design. The product is Canadian Environmental Technology Verification (ETV) approved and uses a row of StormTech chambers wrapped in woven geotextile fabric (with two layers at the bottom). The woven fabric acts as a filter strip to provide enhanced (80% TSS) suspended solids and pollutant removal, while providing sufficient surface area for sediment storage, infiltration and overall peak runoff reduction.

The Isolator Row PLUS unit would be positioned at each Pond inlet below the Pond bank to provide TSS removal within storm runoff prior to entering the SWM facility. The designed length of the unit is calculated based on the upstream service area, imperviousness and storm inlet 32mm water quality flow rate. Additional notes on the sizing of this longitudinal treatment unit include the following:

- Based on the size of the contributing service area, the Isolator Row PLUS MC-7200 model chamber would be required;

[1] *Stormwater Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring* (FHWA, 1996) http://www.fhwa.dot.gov/environment/ultraurb/3fs10.html

- Design lengths and sizing for the unit is based on the ETV particle size distribution which use a more stringent Particle Size Distribution than the Windsor/Essex Region Stormwater Management Standards Manual (December 2018);
- Oil/hydrocarbons are not captured by the Isolator Row PLUS. Depending on final layout, it is recommended that either Goss Traps be installed within upstream manholes and/or catchbasins. An alternative is an FD-HC Oil and Grit Separation Unit be installed upstream of the longitudinal chamber; and
- For a system where the primary purpose is quality treatment and not quantity, it is mandated by the manufacturer that a flared end-ramp is included to ease in regular maintenance.

Technical design information and Operation/Maintenance details for the Stormtech Isolator Row PLUS unit and an example Goss Trap are provided in **Appendix D-4**.

7.6 Tecumseh West Hamlet Secondary Planning Area

As part of the SSMSP modelling assessment for initial buildout areas, the West Hamlet SPA within the Town of Tecumseh was considered. Through a separate study initiated by the Town in 2020, a SWM strategy was recommended for both water quality and water quantity control using Wet Ponds. This includes refined allowable release rates based on an outlet capacity assessment of the downstream watercourses.

Provided below is the current SWM design developed for each proposed SWM facility:

Table 7-3: Tecumseh West Hamlet SWM Design

Storage ID	Future Development Service Area (ha)	Weighted Impervious Value (%)	Proposed Drainage Outlet	Design Release Rate (m^3/s)	1:100 Year Active Storage Volume (m^3)	UST Active Storage Volume (m^3)
Tec_Hamlet1	67.6	71	Gouin	1.750	60,000	77,500
Tec_Hamlet2	31.8	55	Lachance	1.770	24,200	30,000
Tec_Hamlet3a/3b	113.2	64	Desjardins	765	90,500	124,800

During future master plan and functional servicing for the West Hamlet SPA, the facilities are to be designed to stay consistent with the overall approach of linear facilities used for the SSMSP. This includes the following:

- Coordination with the Airport and Transport Canada on the use of Wet or Dry Ponds relating the Airport Hazard Zones;
- Consideration for waterfowl mitigation measures (temporary and permanent), including longitudinal Wet Ponds (where approved) within narrow permanent pools and recommended vegetative plantings along the Pond banks;

- Recommended permanent pool depths of 1.0 m to 2.0 m for Wet Ponds;
- Incorporation of forebays for initial water quality treatment in Wet Ponds;
- Consideration for permanent pool widths to accommodate waterfowl mitigation measures within wet Pond areas;
- Consideration for appropriate quality control for lands requiring Dry Ponds;
- Maximum active storage depths of 3.0 m; and
- Minimum side slopes of 5:1.

8.0 Ultimate Buildout Area SWM Modelling Results

Beyond the modelling analysis and functional design of the Regional Ponds within the initial buildout areas, the remainder of the SSMSP area SWM quantity control requirements were also determined based on the current design criteria.

With the future development lands outside of the initial buildout condition analysis not projected to be developed for quite some time, only the water quantity control storage requirements were determined. Water quality control design (wet Pond permanent pool and forebay, dry Pond water quality requirements) are expected to follow the same strategy for the recommended Regional Pond strategy. The design for each Regional Pond is to consider all waterfowl mitigation requirements as per the supplementary Waterfowl Adaptive Mitigation Plan for SWM Facilities included in **Appendix F-10** of the Municipal Servicing Design Report and any future monitoring completed.

Provided below in **Table 8-1** are the governing quantity control modelling requirements for each development area outside of the initial buildout development and roadway reconstruction areas. The Model Storage IDs shown are consistent with the IDs shown in **Table 5-3**.

Table 8-1: SSMSP Ultimate Buildout Development Area SWM Modelling Results

Area ID	Estimated Service Area (ha)	Model Storage ID	Maximum Pump Out Rate (L/s/ha)	Maximum Pump Out Rate (m^3/s)	Governing 1:100 Year Storage Volume (m^3)	Required Urban Stress Test Storage Volume (m^3)
SSMP1	23.5	SU1	6	0.141	18,000	24,600
SSMP2	82.0	SU2	6	0.492	60,400	80,700
SSMP3	698.8	SU3	6	4.193	450,300	649,200
SSMP4	67.6	SU4	6	0.406	51,900	69,600
SSMP5	116.2	SU5	6	0.697	84,200	114,700
SSMP6	52.5	SU6	6	0.315	40,000	53,700
SSMP7	93.7	SU7	6	0.562	68,700	93,200
SSMP8	61.3	SU8	6	0.368	46,500	62,500
SSMP9	89.4	SU9	6	0.536	68,400	92,600
SSMP10	82.8	SU10	6	0.497	63,500	86,000
SSMP11	210.5	SU11	6	1.263	158,700	217,000

9.0 Municipal Drain Improvements

9.1 Little River Tributary Drain Improvements/Realignments

Based on both initial and ultimate buildout conditions (as shown in **Figure 7 & Figure 8**), a number of Municipal Drains are proposed to be improved or realigned to accommodate future development. These drains have been sized accordingly to cause no adverse impacts on the upstream and downstream system.

Provided below are further details regarding the realignments, which are generally consistent with the recommendations from the ULRMP. A summary of 1:100 year changes in both flows and levels under all buildout conditions in comparison to the existing conditions at key in-drain locations are provided in **Table 9-1** and **Table 9-2** respectively. Recommendations to increase bank heights are to be further assessed based on the water level results shown in **Table 9-2** in more detail from this master planning level assessment during detail design of the adjacent development area.

In addition to the land required to accommodate the widening and/or relocation of Municipal Drains, natural environment linkages are expected to be incorporated into the SWM Corridors, as per the established preferred strategy from the ULRMP. Municipal Drain and respective linkages are to be no less than 30 m in width. Refer to **Appendix B** - Natural Heritage Characterization Report of the SSMSP Class EA Report.

9.1.1 6th Concession Drain Realignment and Improvements

Relocation and enhancement of the 6th Concession Drain directly south of Baseline Road from Walker Road to the Little River Drain is recommended under initial buildout conditions. These improvements are aimed to provide improved safety adjacent to the Municipal Drain due to current steep side slopes and the drains close proximity to the roadway and private property

The Municipal Drain is proposed to be re-established to a flat bottom ditch and realigned further south within the East Pelton and CR42 SPA initial buildout area SWM corridor. The following design details for the drain are therefore recommended through the 6th Concession Drain from 7th Concession Road to the Little River Drain outlet:

- Flat bottom Ditch with a bottom width of 0.30 m;
- 5:1 side slopes; and
- Longitudinal slope to be brought back to the original design of 0.16% *(Consulting Engineers 1969 Survey Engineers Report*).

Based on the existing condition model results, current topographic mapping completed for the SSMSP and the proposed design, the Chicago 1:100 year 24 hour water levels in the drain are shown to exceed existing bank elevations at the following locations:

- 0.10 m to 0.20 m from 7th Concession Road to the existing confluence with the 7th Concession Drain;
- 0.20 m to 0.30 m from the existing confluence with the 7th Concession Drain to 8th Concession Road; and
- 0.10 m from 8th Concession Road to 9th Concession Road.

During detail design of the realignment, it is recommended that the future enhancements to the drain consider minimum drain bank elevations to just above the 1:100 year levels.

The design of the 6th Concession Drain, including the necessary bank improvements are sized to accommodate existing, initial buildout and ultimate buildout conditions to not cause any adverse flooding on existing adjacent properties. The bank improvements are expected to also act as a flood barrier for adjacent future development.

Through consultation with property owners along Baseline Road between 7th and 8th Concession, localized low areas experience ponding during major wet weather events. During future road reconstruction, the local storm sewer servicing the existing residential areas shall be evaluated to mitigate local flooding issues.

Modelling plan and profiles of the 6th Concession Drain showing the 1:100 year water surface elevations under existing, initial and ultimate buildout conditions are provided in **Appendix D-5**.

9.1.2 Hurley Relief Drain Realignment

The Hurley Relief drain is located within the south portion of the SSMPS area. The drain currently intercepts drainage from Town of Tecumseh, Oldcastle area, crosses the Hwy 401 and 9th Concession Drain, eventually discharging to Little River, approximately 420 m north of Hwy 401. Through recommendations from the ULRMP, the Hurley Relief Drain is recommended to be realigned to an alignment north of the Highway 401 right-of-way. The realignment is expected to redirect runoff from Hurley Relief Drain and 9th Concession Drain sub-watersheds to accommodate Future Employment development area between the E-W Arterial Road and Hwy 401.

As this 1,300 m realignment is outside the initial build out areas, the previously completed ULRMP study proposed drain design was generally maintained, however the longitudinal slope was adjusted to accommodate the conveyance of upstream Municipal Drains. The Hurley Relief Drain realignment is expected to have the following design properties:

- Flat bottom Ditch with a bottom width of 3.0 m;
- 3:1 side slopes; and
- Longitudinal slope of 0.15 %.

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The conceptual design of the realignment is shown to maintain flows within the banks of the Municipal Drain realignment. Further analysis is expected to be required during detail design of the realignment to confirm that the design is adequate to existing conditions at that time.

9.1.3 Little 10th Concession Drain Realignment

Through recommendations from the ULRMP, the Little 10th Concession Drain is recommended to be realigned to a similar length south of CR42 along the outer eastern boundary of the SSMSP to accommodate ultimate buildout development.

The latest Municipal Drainage report *(Dillon, 2013)* shows that the current drain design is adequate to maintain existing levels and therefore the design details are proposed to be maintained through the realignment under ultimate buildout conditions. This design is expected to be further reviewed as development requires the realignment.

9.1.4 Lachance Drain Realignment

To accommodate an automotive battery manufacturing facility that us currently being constructed south of the EC Row Expressway, directly west of Banwell Road, the Lachance Drain is proposed to be realigned around the industrial development from directly downstream of the existing Banwell Road crossing to its existing drain alignment north of the CN Railway.

For further details on the Lachance Drain Realignment, please refer to the Drainage Report for the New Drain Alignment of a Portion of the Lachance Drain. Dated March 25th, 2022.

9.2 East-West Arterial Drain (7th Concession Drain Realignment)

A future E-W Arterial Road is to be constructed, connecting Walker Road along the western boundary of the SSMSP with the future Lauzon Parkway extension and extending further east to connect with 10th Concession Road/County Road 17 at the SSMSP eastern limits. This E-W Arterial Road alignment was finalized as part of the Lauzon Parkway Improvements Class EA ESR *(MRC, 2014)* which consisted of a 2-lane cross section with provisions for an ultimate 4-lane cross section.

To accommodate the ultimate development within the SSMSP area and redirection of drainage away from the initial the buildout areas (East Pelton and CR42 SPAs), the realignment of the 7th Concession Drain required (also referred to as the East-West Arterial Municipal Drain) is proposed. This drain is also necessary to provide a storm outlet for future development areas. The drain is proposed to be constructed as follows:

- **West Alignment** along the north side of the E-W Arterial Road from the 7th Concession Drain to the Little River Drain; and
- **East Alignment** along the south side of the E-W Arterial Road from the Little 10th Concession Drain to the Little River Drain.

To facilitate the West Alignment along the north side of the E-W Arterial Road, limit servicing conflicts and municipal drain structure crossings under the E-W Arterial Road from the existing southern Municipal Drains, either of the following is recommended at the time of roadway construction:

- **Scenario 1:** Construction of the SWM Pond proposed along the south of the E-W Arterial Drain within the designated SWM corridor to convey upstream municipal drain flows from the Hayes Drain and 9th Concession Drain; or
- **Scenario 2:** Capture of the Hayes Drain within the E-W Arterial Road storm trunk sewer and construct the Hurley Relief Drain realignment directly north of the Highway 401 to redirect municipal drain flows south of the Highway 401 into the Little River Drain from the existing Hurley Drain and 9th Concession Drain.

These two scenarios are recommended to be further assessed prior to detailed design of the E-W Arterial Road and a preferred drainage solution determined. This includes the feasibility of allowing the E-W Arterial Road to convey uncontrolled into the Little River Drain until such time where the Regional Wet Pond within the E-W Arterial SWM corridor is ready to be implemented.

9.2.1 Initial Development Buildout Conditions

Modelling analysis was completed to confirm the required drain cross-sections, drain slope, drain bottoms, future in-drain structure considerations and drain bottom elevations to accommodate both initial and ultimate buildout conditions. The drains shall be sized to maintain 1:100 year water levels within the drain banks. Under existing conditions, this analysis has shown that surface flooding does not occur due to overtopping of nearby drain banks.

Upon initial buildout of the East Pelton SPA and CR42 SPA, the West Alignment of the E-W Arterial Drain is to be constructed from the 7th Concession/7th Street Drain to the Little River Drain. As part of this initial Municipal Drain design phase (as shown in **Figure 7**), a number of existing upstream Municipal Drains south of the E-W Arterial Drain are required to be redirected into the E-W Arterial Drain. The upstream sections of these drains will require abandonment and local storm system will need to direct the drainage to the assigned SWM Pond. This includes the following:

- 7th Street Drain;
- 7th Concession Drain;
- 8th Concession Drain;
- Hayes Drain; and
- 9th Concession Drain.

As part of this analysis, a scenario in which the construction of the E-W Arterial Drain as a first stage prior to development was evaluated. This scenario would allow drainage to be diverted away from the initial build out areas within the two secondary plans (East Pelton and CR42 SPAs) and subsequently as necessary abandon the upper reaches of the north-south drains as described above. It was found that under existing conditions, with no buildout of the initial buildout areas, implementation of the E-W Arterial Drain will result in a reduction of flow conveying within the 6th Concession Drain and ultimately, a reduction of flooding beyond the existing banks. Conversely, higher flooding levels along the Little River would result as much of the flows would be directed upstream of their current inlet areas. This scenario is not acceptable and therefore it is recommended that the implementation of the E-W Arterial Drain be scheduled after much of the initial buildout area have been serviced via stormwater management ponds which will attenuate the runoff of those areas to the maximum allowable release rates included in Section 4.2.3. Alternatively, additional modelling will need to be completed to determine an interim design solution to allow the E-W Arterial to be constructed and the increase in floodplain mitigated along Little River.

Under existing conditions, the 7th Street Drain conveys flow through a 7th Street Drain Outlet Diversion directly south of the existing Windsor Christian Fellowship lands. As part of the 7th Street Drain Outlet Diversion Design *(Dillon, 2006)*, a Stormwater Overflow Area was implemented to reduce flooding within the 6th Concession Drain watershed. A 900 mm diameter CSP control structure was implemented at the downstream end of the Overflow Area to maximize storage and restrict flow into the 7th Concession Drain. Open construction of the E-W Arterial Drain, considerations for the abandonment of the 7th Concession Drain within the East Pelton SPA downstream of this control structure shall be reviewed, flows from the 7th Street Drain control structure are proposed to be redirected into the E-W Arterial Drain.

The E-W Arterial Drain has been sized to accommodate drainage, including the above contributing drainage redirections and the controlled pump station outlet from Wet Pond P2. This initial design is under the condition where the E-W Arterial Road is not yet constructed and the Hayes Drain and 9th Concession Drain is considered to convey into the E-W Arterial Drain. This design philosophy was identified to govern the design in regards to contributing runoff.

The cross-sectional design for the West Alignment of the E-W Arterial Drain considers both existing roadway crossings and currently known future roadway crossings within the East Pelton SPA. The following functional design has therefore been proposed, with the location extents of each cross section presented in **Figure 12**. This cross section reflects the initial build-out scenario development pattern. As development proceeds the timing of this drain shall be established. At that time the drain design shall be confirmed and the size of the drain and cross section shall be revised accordingly. The below information may be used to ensure that the appropriate land requirements to accommodate this drain are reserved.

1. **Cross Section 1 (7th Concession Drain to 8th Concession Drain)**
    - Flat bottom Ditch with a bottom width of 4.5 m;
    - 3:1 side slopes;
    - Longitudinal slope of 0.11 %; and
      Drain Depth Range from 3.27 m to 3.54 m.
2. **Cross Section 2 (8th Concession Road to Hayes Drain)**
    - Flat bottom Ditch with a bottom width of 5.5 m;
    - 3:1 side slopes;

- Longitudinal slope of 0.11 %; and
- Drain Depth Range from 2.0 m to 3.61 m

3. **Cross Section 3 (Hayes Drain to 9th Concession Drain)**
    - Flat bottom Ditch with a bottom width of 8.0 m;
    - 3:1 side slopes;
    - Longitudinal slope of 0.11 %; and
    - Drain Depth Range from 1.71 m to 2.10 m

4. **Cross Section 4 (9th Concession Drain to Little River)**
    - Flat bottom Ditch with a bottom width of 11.0 m;
    - 3:1 side slopes;
    - Longitudinal slope of 0.10 %; and
    - Drain Depth Range from 1.84 m to 2.13 m

The following future in-drain structures throughout the E-W Arterial Drain have been designed to a functional level of detail to not cause any adverse impacts to water elevations throughout the drain and adjacent properties:

1. **Future E-W Arterial Road Crossing from the 7th Street Drain Outlet Diversion**
    - 1.50 m Diameter Concrete Culvert
    - Longitudinal slope of 0.10 %

2. **Future East Pelton SPA Road Crossing**
    - 1.950 m Diameter Concrete Culvert
    - Longitudinal slope of 0.10 %

3. **8th Concession Road Crossing**
    - 2.10 m Diameter Concrete Culvert
    - Longitudinal slope of 0.10 %

4. **9th Concession Road Crossing**
    - 1.20 m High x 8.0 m Wide Concrete Box Structure
    - Longitudinal slope of 0.10 %

9.2.2 Ultimate Development Buildout Condition

Under ultimate buildout conditions, the East Alignment of the E-W Arterial Drain is proposed to be constructed to convey flows from the upstream segment of Watson Drain to the Little River Drain. Under this condition, the Watson Drain downstream of the E-W Arterial Road is proposed to be abandoned to accommodate future development, therefore eliminating the existing drainage outlet for upstream lands.

The following functional design has therefore been proposed, with the location extents of each cross section presented in **Figure 12**. This cross section reflects the ultimate build-out scenario development pattern. As development proceeds the timing of this drain shall be established. At that time the drain design shall be confirmed and the size of the drain and cross section shall be revised accordingly. The below information may be used to ensure that the appropriate land requirements to accommodate this drain are reserved.

- Flat bottom Ditch with a bottom width of 5.0 m;
- 3:1 side slopes;
- Longitudinal slope of 0.10 %;
- Minimum Drain Depth of 1.80 m at confluence with Watson Drain; and
- Minimum Drain Depth of 2.10 m at confluence with Watson Drain.

9.3 Little River Drain

Based on the existing condition analysis completed for the Little River watershed, flood inundation beyond the banks of the drain are shown to occur during the Chicago 1:100 year 24 hour event. This is expected as Municipal Drains are traditionally not sized for these major system events, with in-drain structures being designed to a lower level of service, thus causing a restriction through the watercourse.

Provided in **Appendix D-5** is a comparison of 1:100 year HGL profiles between existing, initial buildout and ultimate buildout conditions throughout the SSMSP area under a worst case scenario for peak flows within the Little River Drain where the Hurley Relief Drain realignment is implemented and the previously noted drains are re-routed upstream within the Little River Drain. The following 1:100 year HGL elevation results are identified within the Little River Drain based on the realignment of the Hurley Relief Drain and initial buildout conditions:

- Little River Drain water surface elevations exceed existing conditions from Highway 401 to the Lauzon Parkway Crossing; and
- Initial and Ultimate condition water elevations are lower than existing conditions downstream of Lauzon Parkway.

9.3.1 Initial Buildout Condition

Based on initial buildout conditions (as shown in **Figure 7**) for the East Pelton SPA and CR42 SPA, a number of Municipal Drains require abandonment. To accommodate the abandonment under this development scenario, the proposed E-W Arterial Drain are to redirect flows upstream of the SPA lands, as identified in **Section 9.2**.

The subwatershed flows from the upstream 7th Concession/7th Street Drain, 8th Concession Drain, Hayes Drain and 9th Concession Drain are to enter the Little River Drain, approximately 1 km south of their current outlet into the 6th Concession Drain, and ultimately into the Little River Drain. Under a condition where the Hurley Relief Drain realignment is implemented during the construction of the E-W Arterial Road, the upstream flows from the Hurley Relief Drain and 9th Concession Drain are to enter the Little River Drain approximately 300 m and 2.2 km upstream of their current outlets respectively. Due to the above noted drainage redirections, in-drain Little River flows and respective drain water levels are increased.

To maintain the existing naturalization of the Little River throughout the SSMSP area, it is proposed that no major enhancements or widening of the Little River Drain be completed. Based on current topographic mapping completed for the SSMSP, the following approximate bank height improvements in Table 9-1 are recommended under the two Scenarios discussed in **Section 9.2**.

Initial Buildout Condition Scenario 1

- Hurley Relief Drain maintained to convey existing flows from the U/S Hayes Drain and 9th Concession Drain.
- Hayes and 9th Concession Drain directed into the E-W Arterial SWM Corridor Wet Pond, with a controlled discharge into the Little River.

Initial Buildout Condition Scenario 2

- Hurley Relief Drain realignment constructed to divert the existing Hurley Relief Drain and 9th Concession Drain U/S of SSMSP area to Little River.
- Hayes Drain between the Highway 401 and the E-W Arterial Drain brought into the proposed E-W Arterial Road storm trunk sewer.

Table 9-1: Little River Drain Bank Improvements

Scenario Description	Little Drain Bank Improvement Extent	Initial Buildout Condition Scenario 1	Initial Buildout Condition Scenario 2
Highway 401 Crossing to Existing Hurley Relief Drain Confluence	400 meters	None	Drain bank rise of 0.10 m - 0.15 m
Existing Hurley Relief Drain to Proposed E-W	900 meters	None	None

Scenario Description	Little Drain Bank Improvement Extent	Initial Buildout Condition Scenario 1	Initial Buildout Condition Scenario 2
Arterial Drain Confluence			
Proposed E-W Arterial Drain Confluence to Baseline Road Crossing	870 meters	Drain bank rise of 0.10 m - 0.30 m	Drain bank rise of 0.10 m - 0.30 m
Baseline Road Crossing to CR42 Crossing	1,240 meters	Drain bank rise of 0.20 m - 0.30 m	Drain bank rise of 0.20 m - 0.30 m
CR42 Crossing to Lauzon Parkway Crossing	400 meters	Drain bank rise of 0.20 m - 0.30 m	Drain bank rise of 0.20 m - 0.30 m

The above noted bank improvements are expected to be accommodated within the existing Little River drainage corridor and proposed environmental buffer area and further confirmed during detail design.

9.3.2 Ultimate Buildout Condition

Based on ultimate buildout conditions (as shown in **Figure 8**) for the SSMSP area, a number of Municipal Drains are to be abandoned/redirected south of the E-W Arterial Drain.

Based on the improvements proposed to the banks of the Little River Drain discussed in **Section 9.3.1**, under ultimate buildout conditions, the Little River Drain has ample capacity to convey the proposed development runoff.

9.4 Watershed Municipal Drain Peak Flow and Water Level Comparison

Provided below is a summary of 1:100 year changes in both flows and levels under existing, initial buildout and ultimate buildout conditions, as well as within the E- W Arterial Drain under the two buildout scenarios.

Only the analysis points where drains are to be maintained under developed conditions are compared.

Table 9-2: In-Drain Flow Comparison - Existing vs Initial vs Ultimate Build Conditions

Analysis Location ID	Analysis Location	1:100 Year Chicago 24hr Distribution Peak Flow (m^3/s)		
		Existing Conditions	Initial Buildout Conditions	Ultimate Buildout Conditions
Hurley Relief Drain				
HR-1	D/S of Highway 401 Crossing	5.07	5.18	5.35
9th Concession Drain				
9C-1	D/S of Highway 401 Crossing	7.95	8.24	7.75

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Analysis Location ID	Analysis Location	1:100 Year Chicago 24hr Distribution Peak Flow (m^3/s)		
		Existing Conditions	Initial Buildout Conditions	Ultimate Buildout Conditions
East-West Arterial Drain *(7th Concession Drain Realignment)*				
E-W-1	D/S of Confluence with 7th Concession Drain	-	5.46*	5.46
E-W-2	U/S of 8th Concession Road Crossing	-	8.78*	8.77
E-W-3	Confluence with Hayes Drain	-	10.27*	8.62
E-W-4	U/S of 9th Concession Road Crossing	-	12.32*	8.44
E-W-5	U/S of Confluence with Little River Drain	-	12.27*	8.41
E-W-6	D/S of County Road 17 Crossing	-	-	2.90
6th Concession Drain				
6C-2	U/S of 8th Concession Road Crossing	25.86	19.69	19.80
6C-3	U/S of 9th Concession Road Crossing	31.71	17.20	17.61
6C-4	U/S of Confluence with Little River Drain	19.98	15.90	16.43
Little 10th Concession Drain				
10C-1	U/S of County Road 42 Crossing	5.74	4.46	3.39
Soulliere Drain				
S-1	U/S of Little River Drain Confluence	7.57	5.30	0.93
Desjardins Drain				
D-2	U/S of Little River Drain Confluence	5.18	2.32	1.08
Lachance Drain				
L-2	U/S of Little River Drain Confluence	3.46	2.84	2.50
Little River Drain				
LR-1	D/S of Highway 401 Crossing	2.34	13.00**	13.84
LR-2	U/S of Baseline Road Crossing	31.94	43.33**	41.04
LR-3	U/S of County Road 42 Crossing	41.14	44.05**	41.17

Analysis Location ID	Analysis Location	1:100 Year Chicago 24hr Distribution Peak Flow (m^3/s)		
		Existing Conditions	Initial Buildout Conditions	Ultimate Buildout Conditions
LR-4	U/S of Lauzon Parkway Crossing	40.65	44.93**	42.15
LR-5	U/S of Lauzon Road Crossing	43.73	44.78**	41.56
LR-6	U/S of CP Railway Crossing	46.17	44.35**	45.21
LR-7	U/S of EC Row Expressway Crossing	63.86	61.97**	56.06

** Based on an E-W Arterial Drain design condition where all upstream municipal drains in conflict with the alignment are routed through the Drain to the Little River.*

*** Based on an initial buildout condition where the Hurley Relief Drain Realignment is constructed and routes the Hurley Relief and 9th Concession Drains to the Little River.*

Table 9-3: In-Drain Water Elevation Comparison - Existing vs Initial vs Ultimate Build Conditions

Analysis Location ID	Analysis Location	1:100 Year Chicago 24hr Distribution Peak HGL (m ASL)		
		Existing Conditions	Initial Buildout Conditions	Ultimate Buildout Conditions
Hurley Relief Drain				
HR-1	D/S of Highway 401 Crossing	187.42	187.04	187.05
9th Concession Drain				
9C-1	D/S of Highway 401 Crossing	186.89	186.89	186.89
East-West Arterial Drain *(7th Concession Drain Realignment)*				
E-W-1	D/S of Confluence with 7th Concession Drain	-	187.90*	187.91
E-W-2	U/S of 8th Concession Road Crossing	-	187.14*	187.14
E-W-3	Confluence with Hayes Drain	-	185.85*	185.71
E-W-4	U/S of 9th Concession Road Crossing	-	185.26*	185.01
E-W-5	U/S of Confluence with Little River Drain	-	185.06*	184.91
E-W-6	D/S of County Road 17 Crossing	-	-	185.05
6th Concession Drain				
6C-2	U/S of 8th Concession Road Crossing	187.10	186.83	186.83

Analysis Location ID	Analysis Location	1:100 Year Chicago 24hr Distribution Peak HGL (m ASL)		
		Existing Conditions	Initial Buildout Conditions	Ultimate Buildout Conditions
6C-3	U/S of 9th Concession Road Crossing	185.02	185.05	184.99
6C-4	U/S of Confluence with Little River Drain	183.79	184.31	184.12
Little 10th Concession Drain				
10C-1	U/S of County Road 42 Crossing	182.56	182.44	182.23
Soulliere Drain				
S-1	U/S of Little River Drain Confluence	181.29	181.22	181.13
Desjardins Drain				
D-2	U/S of Little River Drain Confluence	181.21	181.12	181.01
Lachance Drain				
L-2	U/S of Little River Drain Confluence	180.97	180.88	180.73
Little River Drain				
LR-1	D/S of Highway 401 Crossing	185.91	186.62**	186.66
LR-2	U/S of Baseline Road Crossing	183.76	184.29**	184.10
LR-3	U/S of County Road 42 Crossing	182.93	183.07**	182.94
LR-4	U/S of Lauzon Parkway Crossing	182.32	182.37**	182.30
LR-5	U/S of Lauzon Road Crossing	181.70	181.67**	181.71
LR-6	U/S of CP Railway Crossing	181.08	180.99**	180.86
LR-7	U/S of EC Row Expressway Crossing	180.23	180.15**	179.90

** Based on an E-W Arterial Drain design condition where all upstream municipal drains in conflict with the alignment are routed through the Drain to the Little River.*

*** Based on an initial buildout condition where the Hurley Relief Drain Realignment is constructed and routes the Hurley Relief and 9th Concession Drains to the Little River.*

A summary of these 1:100 year flow and level changes at the key analysis points throughout the SSMSP area are provided in **Figures 13A, 13B, 14A and 14B.**

10.0 Study Modelling Limitations and Assumptions

Through the SWM analysis and design completed for the SSMSP, a number of modelling limitations and design assumptions were required to functionally assess the proposed design of initial buildout and ultimate buildout development conditions. This assessment also included the review of development impacts on the municipal drainage system throughout the watershed.

Provided below are model limitations identified at this time and assumptions made throughout the study's modelling analysis:

Limitations

- Modelling uses a lumped catchment area approach to identify overall storage requirements for water quantity and quality control within designated SWM corridors based on known roadway layouts (initial buildout areas only), and existing topography;
- Future Development modelling scenarios limited to two conditions; initial buildout conditions and ultimate buildout conditions. Buildout of individual development phasing within SPA's were not assessed and are expected to be completed during further design;
- Modelling did not consider proposed structure connections and/or entry and exit losses between Regional Pond cells under future roadways;
- Modelling did not consider future roadway structure crossings within municipal drains other than along the proposed E-W Arterial Drain where future crossing are currently known;
- Modelling developed to a lumped master planning level with no hydrodynamic analysis of proposed sizing and design of storm sewers (minor) and overland flow (major) routing systems;
- Modelling has no consideration of interim SWM measures and on-site controls such as parking lot and/or roadway surface storage, and catchbasin inlet capacity constraints; and
- Development area Regional Ponds outside of the initial buildout lands were not assessed to a functional level of detail and only represent the overall water quantity requirements for the large development areas to Satisfy Approach 1 of the Master Planning Process.

Assumptions

- SWM requirements for all buildout conditions are assessed based on current regional and provincial SWM guidelines. Future studies will need to consider any and all SWM water quality and quantity control requirements at that time and the feasibility of Wet or Dry Ponds based on coordination with the Airport;
- Regional Pond design considers that all runoff (storm sewer and overland flow) can be safely conveyed through the future development areas and into the designated Ponds; and

- Development land use considerations are taken from the SSMSP land use plan discussed within this document and all other supporting reports for this study. Any changes to proposed land uses in the future are to consider further requirements for both water quality and water quantity control measures and may require additional SWM measures on private property to mitigate impacts to the downstream system.

Aside from the Limitations and Assumptions identified at this time, development and municipal drainage improvement phasing, staging and implementation recommendations have been developed, as shown in the **Appendix F** - Municipal Servicing Functional Design Report.

11.0 SWM Technical Design Summary and Next Steps

11.1 Scope of Work

The Stormwater Management (SWM) Technical Report outlines the modelling methodology, approach and functional design elements for the development areas within the SSMSP to follow the requirements of the Municipal Class Environmental Assessment (Class EA) - Approach No. 2 and the requirements of Phases 1 and 2 of the Class EA, including requirements for any Schedule B projects.

This study took into consideration a regional approach to SWM, providing design and analysis methods at two levels of detail for sections of the study area:

1. A functional level of design for SWM measures necessary in the initial build out areas defined by the East Pelton Secondary Plan Area (East Pelton SPA) and County Road 42 Secondary Plan Area (CR42 SPA) with considerations for the Airport employment lands and the reconstruction of County Road 42 and Lauzon Parkway; and
2. A conceptual level of design for SWM quantity requirements necessary in the remaining SSMSP study area outside the initial build out.

The SWM technical report is considered as a guideline for all future SWM Pond designs during detailed design.

11.2 SWM Design Criteria

Based on the findings of previously completed background studies, specifically the Upper Little River Watershed Master Drainage and Stormwater Management Plan Environmental Assessment Environmental Study Report (Stantec Consulting, 2017, **Approved in 2022**), a number of SWM alternatives were considered for future development within the SSMSP.

Through the evaluation of these alternatives, **Grouped Off-Line SWM controls** were chosen to be the preferred strategy.

11.2.1 Water Quantity and Quality Control

The SWM strategy for the SSMSP was developed to meet the following design requirement guidelines:

- Windsor/Essex Region Stormwater Management Standards Manual (December 2018); and
- Ministry of the Environment Stormwater Management Planning and Design Manual (2003).

Linear Regional Ponds are required to provide water quality (for dry ponds) and water quantity control to the permitted release rates for all synthetic design storm events, up to and including the governing 1:100 year and Urban Stress Test.

Allowable Release Rates

The following allowable release rates are to be adhered to for all future development regional SWM facilities within the Upper Little River watershed:

- 1:2 Year Allowable Release Rate of 3 L/s per hectare of contributing drainage area;
- 1:5 Year Allowable Release Rate of 4 L/s per hectare of contributing drainage area; and
- 1:100 Year Allowable Release Rate of 6 L/s per hectare of contributing drainage area.

Water Quantity Control

- Ponds are to be designed with a minimum 0.30 m of freeboard from the 1:100 year water level to the top of bank; and
- To assess the resiliency of each Regional Pond, the 150mm Urban Stress Test (UST) design storm event is to be considered with levels required to be fully maintained within the Pond system.

Water Quality Control

- Regional Ponds are to provide a minimum standard of water quality based on a normal level of treatment (70% TSS) removal through settling and filtration;
- To be provided at a Regional scale to the best of its ability depending on the Airport requirements for either a Wet Pond or Dry Pond design. This is to include, but not be limited to the following:
    - For **Wet Ponds**, quality control treatment is to be provided through a combination of sediment forebays and permanent pools;
    - For **Dry Ponds**, the most functional quality control treatment is to be considered at either the source or at the end of the storm system. Measures such as undergrounds stormwater quality treatment facilities such as oil and grit separators, underground detention units such as the Storm Tech Isolator Row Plus or similar system, Goss Gully traps on catchbasins.
- Quality treatment efficiency is to be designed based on the regional 32mm water quality storm event and regional requirements for long-term average suspended solids removal.

11.2.2 Stormwater Conveyance

Minor System

- Storm trunk sewers are to be sized for a 1:10 year level of service conveyance;
- Local storm sewers are to be sized for a 1:5 year level of service conveyance;
- The hydraulic gradeline elevations shall not concede a depth of 0.30 m below the proposed ground surface; and
- Considerations should be had for the effect on backwater conditions against the proposed storm sewer system and minor losses.

Major System

- Roadways and parking lot areas are to allow no more than 0.30 m of dynamic surface ponding within all proposed development lands for storms up to and including the governing 1:100 year event;
- Detailed grading is to allow for acceptable overland flow routes during large storm events to their respective Regional Wet Ponds;
- Dry lane access during the governing 1:100 year event in both directions along arterial and collector, roads including ingress/egress points at institutional or hospital entrances, are required where possible; and
- Roadways identified for emergency vehicle routes are to provide dry lanes in each direction during the governing 1:100 year event.
- The above stormwater conveyance design measures are to be assessed and satisfied through dual drainage SWM modelling during the next stage of design for the developments.

11.3 Future Development Buildout Scenarios

Regional Ponds are required to manage flood risk for all future buildout condition areas within the SSMSP, while causing no adverse impacts to the existing developments throughout the watershed.

Future condition model analysis for this study was completed under two buildout conditions:

- **Initial Buildout Conditions**; and
- **Ultimate Buildout Conditions**.

11.3.1 Initial Buildout Development Conditions

A number of proposed development lands within the study limits were identified as initial buildout areas within the SSMSP area. This includes:

- East Pelton Secondary Planning Area (East Pelton SPA); and
- County Road 42 Secondary Planning Area (CR42 SPA).

The following projects were also considered as initial build out areas within the SSMSP:

- The reconstruction of CR42 from Walker Road to the Windsor/Tecumseh City Limits;
- Initial phase of reconstruction for Lauzon Parkway from Service Road B to CR42; and
- Future drainage considerations for the proposed employment lands east of the Windsor International Airport.

By request of the Town of Tecumseh, the West Hamlet SPA was also considered in the initial development condition, as drainage from these lands contribute to the Little River Drain along the northeastern boundary of the SSMSP.

11.3.2 Ultimate Buildout Development Conditions

Expanding on the initial buildout condition model, the remaining future development areas within the SSMSP area were incorporated into the model. The development areas outside of the initial buildout SPA's are generally consistent with what was shown in the ULRMP.

11.4 Initial Buildout Area SWM Functional Design

The Regional Ponds within the initial buildout areas are to consist of several linear facilities within the designated SWM corridors. Due to the proximity to the Windsor Regional Airport, Waterfowl mitigation measures need to be considered in the design, as specified within **Appendix F-10** of the Municipal Servicing Design Report and/or consideration for the use of Dry Ponds.

The Pond design is to consider a linear arrangement with narrow permanent pool widths (if Wet Ponds are acceptable) to allow for vegetative planting coverage from the banks of the Pond and shade the proposed permanent pool, thus deterring geese and bird migration.

Based on discussion with the Airport during the master planning process, **Initial Buildout Ponds P1, P3 and P6** have been identified at this time to be within the current Airport Hazard Zone for the approach/takeoff surfaces where Wet Ponds are not permitted. Therefore, a **Regional Dry Pond has been preferred** for these locations through the master planning process, unless otherwise agreed upon through future discussions with the Airport during further design. At this time, the remaining Ponds within the initial buildout areas as permitted to be Wet Ponds.

A plan view showing the layout for each Regional Pond P1 through P8 through the designated SWM corridors required for the initial buildout condition areas are shown in **Figures 11A** through **Figure 11C** of this report. Based on the findings of the SSMSP technical modelling developed for this study, water quantity and quality controls requirements for each Pond were determined. A summary of the Pond design details, including consideration for the most feasible water quality control design is provided in **Table 7-1** and **Table 7-2**.

11.5 Ultimate Buildout Area SWM Quantity Control Storage

With lands outside of the East Pelton SPA and CR42 SPA not projected to be developed for quite some time, only the water quantity control storage requirements were determined for the ultimate buildout condition scenario. Water quality control (Wet or Dry Pond) is expected to follow the same strategy of Regional Ponds with consideration for waterfowl mitigation. Provided in **Table 8-1** show the quantity control modelling results for each development area outside of the initial buildout SPA's and governing quantity control volume requirements.

11.6 Municipal Drain Improvements and Implementation Staging

Through the development stages within the SSMSP, a number of municipal drains are required to be enhanced, improved or abandoned to accommodate future development within the SSMSP. The improvements shown below are in order of importance for staging of development to proceed.

Details for each municipal drain improvement are provided in **Section 9.1**, **Section 9.2** and **Section 9.3**.

<u>Initial Buildout Condition Drain Improvements</u>

- Realignment and Improvements to the 6th Concession Drain;
- Construction of the West Alignment of the E-W Arterial Drain (7th Concession Drain Realignment) from the 7th Concession Drain to the Little River Drain;
- Re-routing of the Hayes Drain, Hurley Relief Drain and 9th Concession Drain either through E-W Arterial SWM Corridor Wet Ponds (Scenario 1) or through construction of the Hurley Relief Drain Realignment (Scenario 2) and E-W Arterial storm trunk sewer (Hayes Drain only);
- Realignment of the Lachance Drain to accommodate the Stellantis EV Battery Plant;
- Municipal Drainage abandonments within the East Pelton SPA and CR42 SPA as development commences; and
- Abandonment of the North Townline Drain during the CR42 Road reconstruction.

Figure 7 illustrates all required municipal drain modifications required under initial buildout conditions.

<u>Ultimate Buildout Condition Drain Improvements</u>

- Construction of the East Alignment of the E-W Arterial Drain from County Road 17/Watson Drain to Little River along the south side of the proposed E-W Arterial Road;
- Realignment of the Little 10th Concession Drain to accommodate future buildout area along the eastern SSMSP boundary south of CR42; and
- Municipal Drainage abandonments within all other future development areas.

Figure 8 illustrates all required municipal drain modifications required under ultimate buildout conditions.

11.6.1 Little River Drain Bank Improvements

Initial Buildout Conditions

Prior to the E-W Arterial Road being constructed, 1:100 year flood inundation beyond the banks of the Little River Drain within the upper reaches of the watercourse are noted to occur in a number of locations. This includes from the future confluence with the E-W Arterial Drain and Little River Drain to the Little River Drain/Lauzon Parkway crossing. This is primarily due to the change in peak timing and dynamic flows within the Little River, as well as upstream Municipal Drains being routed through the proposed E-W Arterial Drain and discharging into the Little River Drain further south than its current outlet location to the 6th Concession Drain where existing floodplain storage was utilized. Once the future E-W Arterial Road is constructed, either Scenario 1 or Scenario 2 above is required. Details of each drain redirection scenario is provided in **Section 9.3**.

To provide proper flood protection for adjacent lands within this area, improvements along the west bank of the Little River from Highway 401 to the Lauzon Parkway crossing is required. The bank improvements along the Little River Drain are expected to range from, 0.10 m– 0.30 m depending on which Scenario is chosen by the City prior to detail design of the E-W Arterial Road. Further details of the required bank improvements are provided in **Table 9-1**.

Ultimate Buildout Conditions

Based on the modelling analysis under ultimate buildout conditions, a number of Municipal Drains are to be abandoned/redirected south of the E-W Arterial Drain.

Based on the improvements proposed to the banks of the Little River Drain under initial buildout conditions and the control of post-development runoff from future development lands, municipal drainage flows are shown to be maintained within the Little River banks. The Little River Drain is therefore expected to have ample capacity to convey the ultimate buildout condition runoff.

11.7 Next Steps

During future studies and detail design of any elements related to the SWM discussed within this technical report, any updates to regional and provincial guidelines at that time are to be considered. Any changes to standards have the potential to impact the quality and quantity control requirements for the regional Ponds and are required to be re-assessed if necessary. This includes further discussions with the Airport to confirm the incorporation of a Wet or Dry Pond within proximity to the airport and the noted Hazard Zones.

During detail design of individual phasing within buildout areas, an assessment of any development being proposed within the current flood fringe is to be confirmed in detail to have no adverse impacts to adjacent lands and the overall watershed. Consultation with the City and ERCA is recommended to be undertaken at the early stages of design to identify if additional floodproofing measures and/or interim flood plain compensation is required until full buildout of the development or SWM corridors is constructed.

Future development areas outside of the initial buildout areas are to follow similar minimum design requirements for both water quality and quantity control, including the implementation of a Wet or Dry Pond. These Regional Ponds are expected to be constructed within the originally proposed SWM corridors, as recommended within the ULRMP, unless otherwise analyzed through future Environmental Assessment and Master Plans. Future studies for development lands outside of the initial buildout areas, the estimated service areas to each Regional Pond are recommended to be further investigated through a more functional review of the SWM corridor locations and extent of Pond cell locations. This includes a review of the functionality of full storm drainage conveyance to their respective SWM corridors based on development roadway layouts in relation to proposed storm trunk sewer alignments and overland flow routing during larger storm events.

The allowable release rates and water quantity control storage values provided within this technical report may be subject to change based on refinements to contributing services areas and consideration for updated regional and provincial SWM requirements.

During future municipal drainage design related to bank improvements along both the Little River and 6th Concession Drain, a more detailed investigation of required bank heights are to be assessed. This includes confirmation of the required bank enhancements, including but not limited to:

- Determination of exact locations where bank heights are lower than the proposed 1:100 year WSEL's; and
- Consultation with ERCA on any requirements for freeboard from 1:100 year drain levels to the proposed top of bank.

In the future, dual drainage modelling is required to verify that the final design of the proposed storm sewer trunks and overland flow routes are adequate per the level of service criteria. These models are to confirm that the storm sewer servicing meets the design criteria including considerations for but not limited to:

- Final storm sewer (local and trunk) design based on the design criteria outlined within this study;
- Confirm that an adequate overland flow route is achieved to the regional pond through the development roadways;
- Ensure that no more than 0.30 meters of surface ponding is occurring along local roadways during the governing 1:100 year event;
- Consideration of future upstream development flow contributing to the subject development areas storm and overland flow system; and
- Wherever possible, provide dry access along arterial and collector roadways in each direction during the 1:100 year event.

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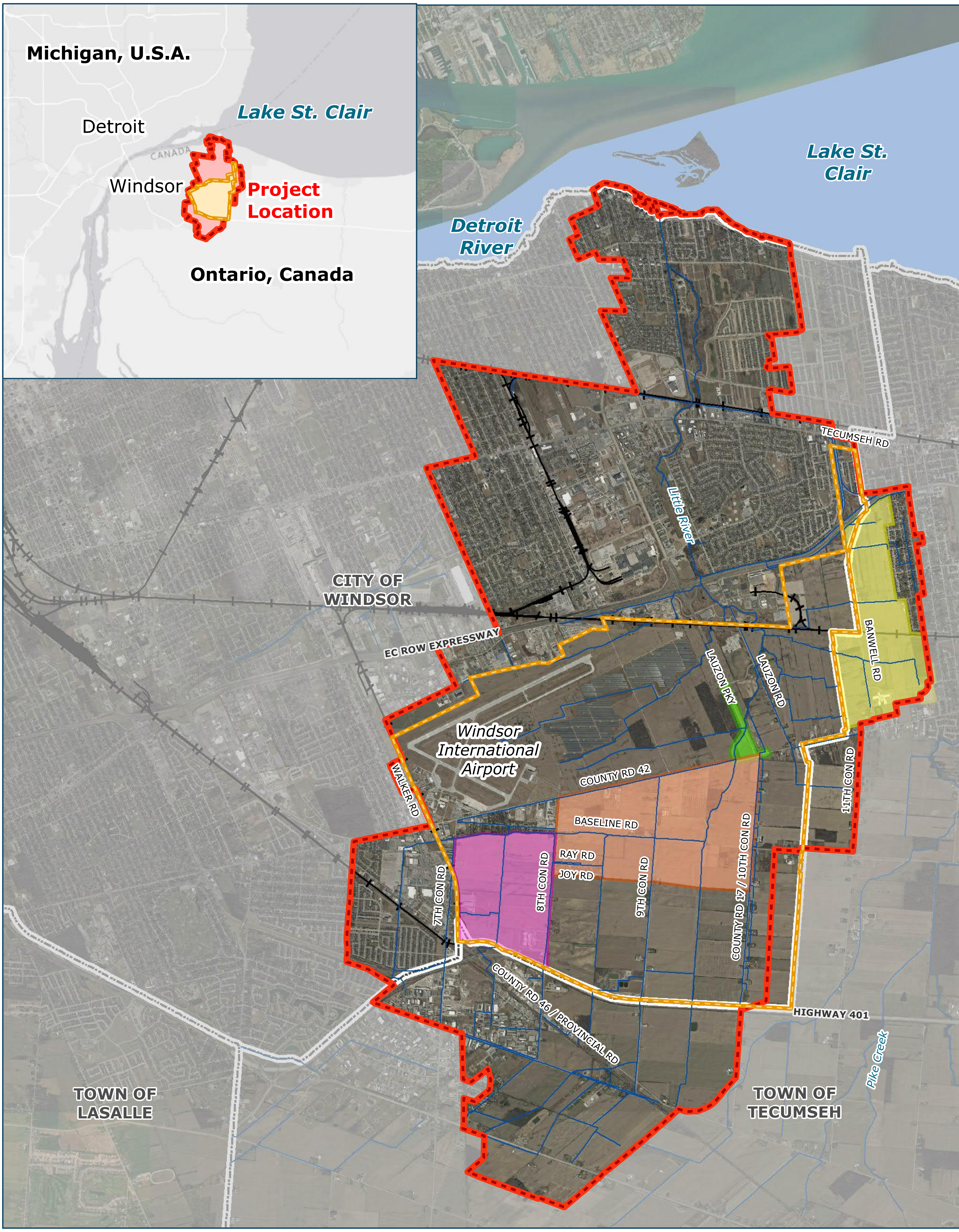
Figures



SANDWICH SOUTH MASTER SERVICING PLAN

- Sandwich South Master Planning Area
- Little River Watershed
- Railway
- Municipal Drain / Watercourse
- Municipal Boundary
- West Tecumseh Hamlet Secondary Planning Area
- East Pelton Secondary Planning Area
- County Road 42 Secondary Planning Area
- County Road 42/Lauzon Road Phase 1

LITTLE RIVER WATERSHED MAP AND STUDY AREA MAP

FIGURE 1

THE CITY OF WINDSOR ONTARIO, CANADA

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX 2019 ESRI, HERE, GARMIN, (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

MAP CREATED BY: LK/LMM
MAP CHECKED BY: -
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

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SCALE 1:50,000

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N W E S

STATUS: FINAL
PROJECT: 19-9817
DATE: 2023-04-30

File Path: K:\2019\199817-Sandwich_S_LittleRiver\GIS\MXDs\SandwichSouth\Reporting\Report_WR_SWM\199817_Fig1_Study_Area_Map.mxd

SANDWICH SOUTH MASTER SERVICING PLAN

- Sandwich South Master Planning Area
- Railway
- Municipal Drain / Watercourse
- Municipal Boundary

Report Source

- Municipal Drain: Drain Status Unknown
- Municipal Drain: Reports Found Internally
- Municipal Drain: Report Provided from City

MUNICIPAL DRAINAGE REPORT REFERENCE MAP

FIGURE 2

THE CITY OF WINDSOR ONTARIO, CANADA

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STATUS: FINAL
PROJECT: 19-9817
DATE: 2023-04-30

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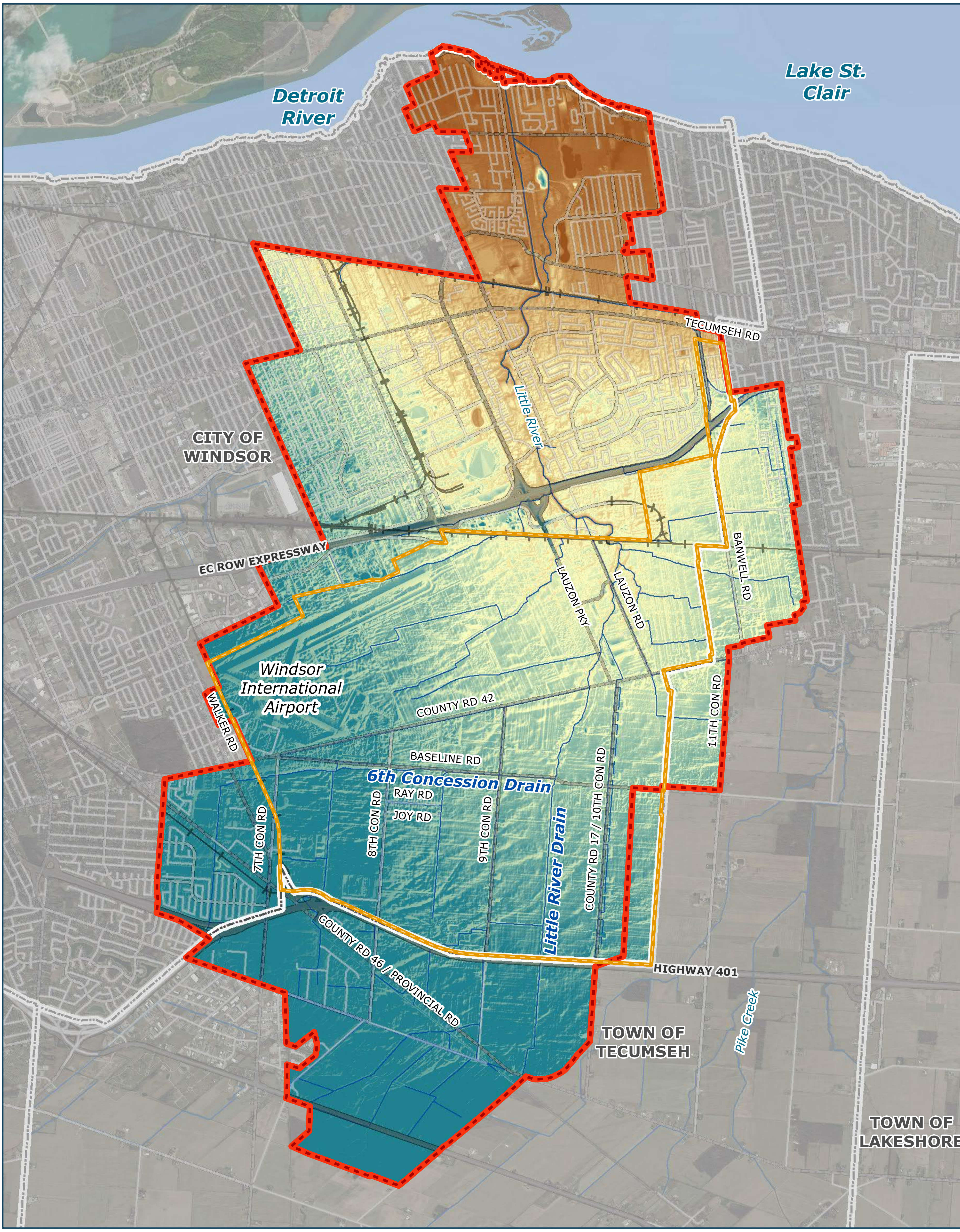

SANDWICH SOUTH MASTER SERVICING PLAN

Sandwich South Master Planning Area
Little River Watershed
Railway
Municipal Drain / Watercourse
Municipal Boundary

DEM Value (masl)
High : 207
Mid: 188
Low : 169

LITTLE RIVER TOPOGRAPHIC MAP

FIGURE 3

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019,
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SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

MAP CREATED BY: LK/LMM
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STATUS: FINAL
PROJECT: 19-9817
DATE: 2023-04-30

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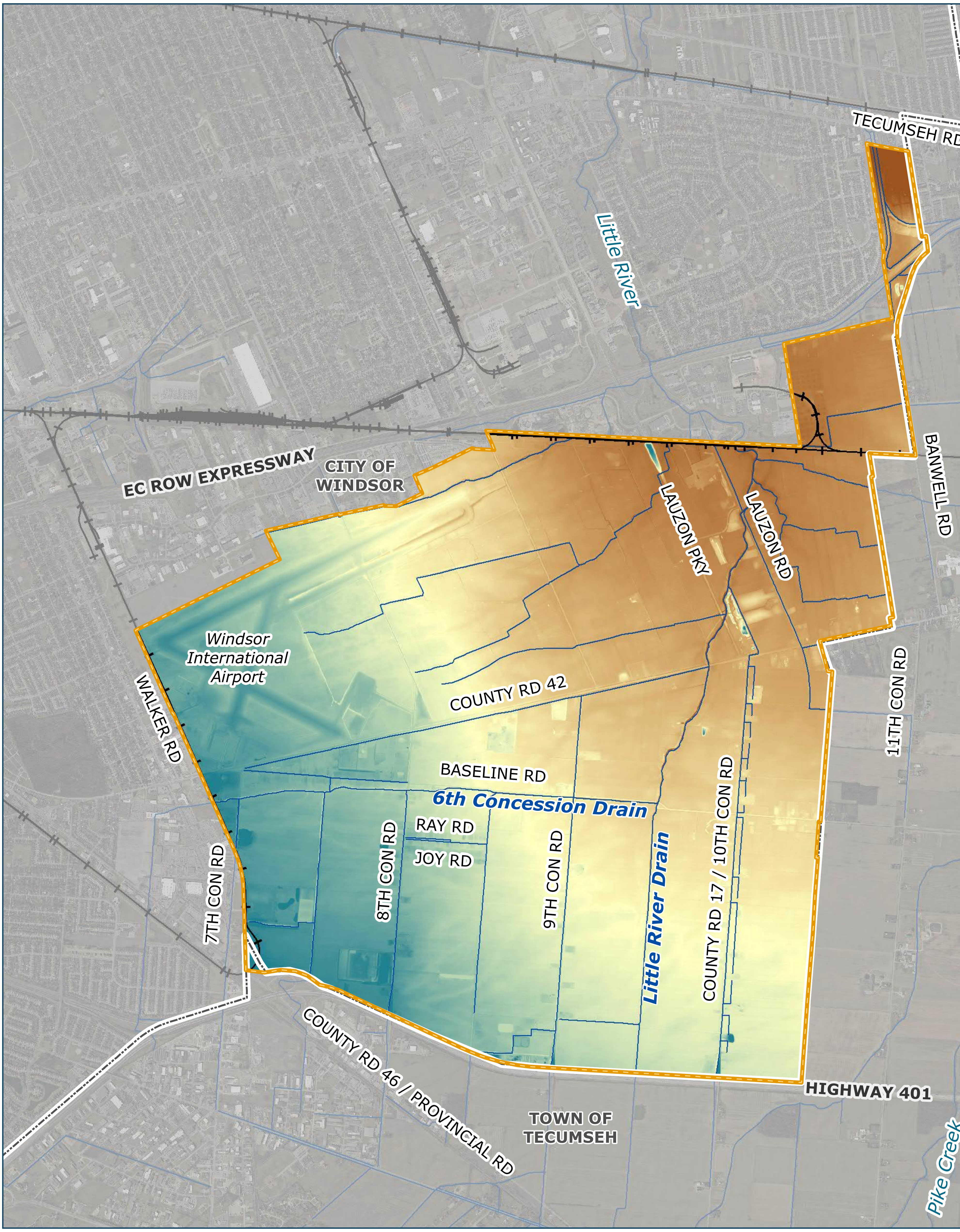

Sandwich South Master Planning Area
Railway
Municipal Drain / Watercourse
Municipal Boundary

DEM Value (masl)
High : 199
Mid: 188
Low : 176

SANDWICH SOUTH MASTER SERVICING PLAN

SANDWICH SOUTH MASTER PLANNING AREA TOPOGRAPHIC MAP

FIGURE 3A

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX 2019

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MAP COORDINATE SYSTEM: NAD 1983 UTM Zone 17N

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SCALE 1:30,000
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STATUS: FINAL
PROJECT: 19-9817
DATE: 2023-04-30

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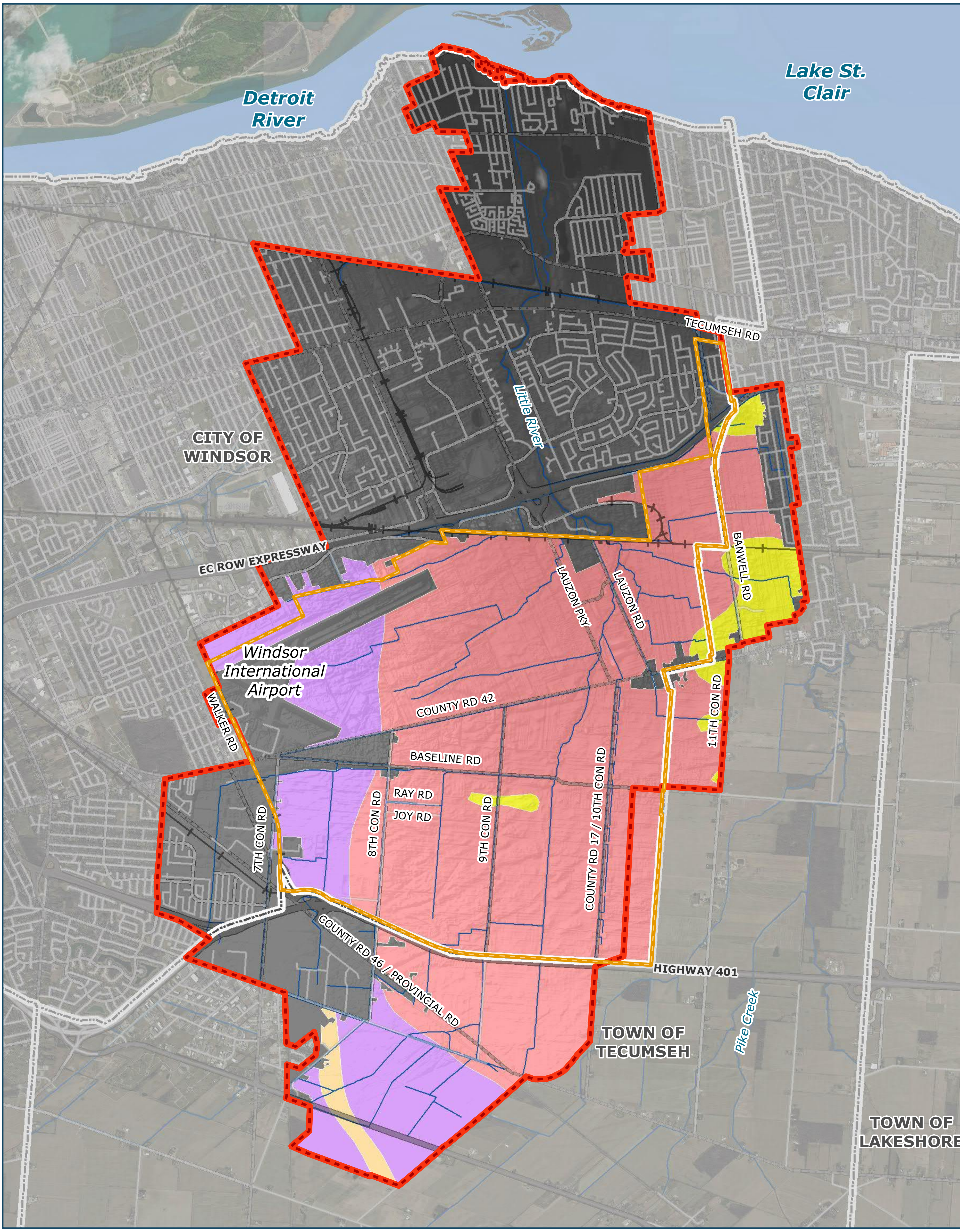

Sandwich South Master Planning Area
Little River Watershed
Railway
Municipal Drain / Watercourse
Municipal Boundary

Soil Survey Complex
Brookston Clay
Brookston Clay - Sand Spot Phase
Brookston Clay Loam
Burford Loam - Shallow Phase
Built Up Area

SANDWICH SOUTH MASTER SERVICING PLAN

LITTER RIVER WATERSHED SOILS MAP

FIGURE 4

THE CITY OF WINDSOR ONTARIO, CANADA

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MAP DRAWING INFORMATION:
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SCALE 1:45,080

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N W E S

STATUS: FINAL
PROJECT: 19-9817
DATE: 2023-04-30

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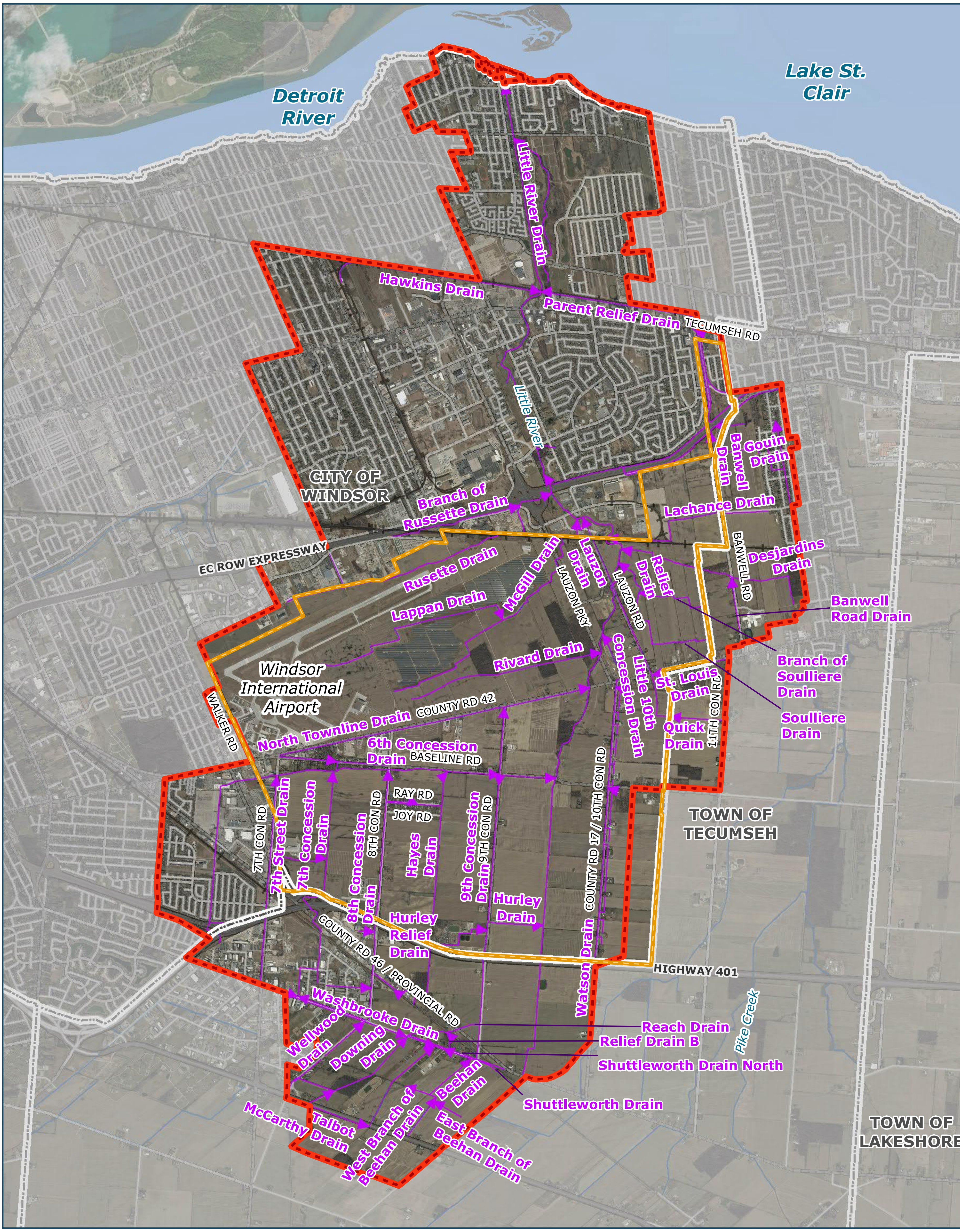

- Sandwich South Master Planning Area
- Little River Watershed
- Railway
- Municipal Drain / Watercourse
- Project Modelled Municipal Drain

SANDWICH SOUTH MASTER SERVICING PLAN

LITTLE RIVER WATERSHED MUNICIPAL DRAINAGE MAP

FIGURE 5

MAP DRAWING INFORMATION:
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SCALE 1:45,000

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N E S W

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PROJECT: 19-9817
DATE: 2023-04-30

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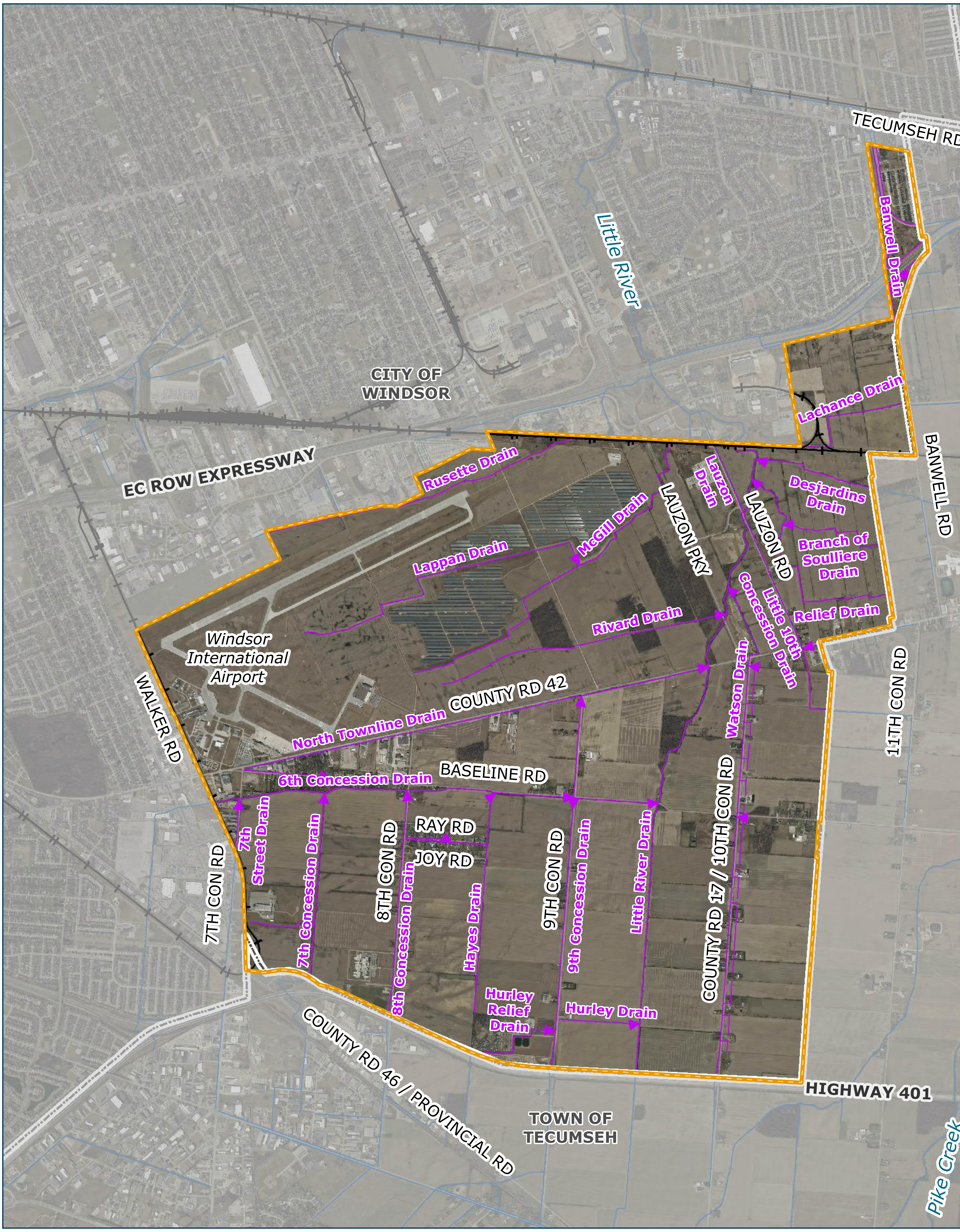

SANDWICH SOUTH MASTER SERVICING PLAN

- Sandwich South Master Planning Area
- Railway
- Municipal Drain / Watercourse
- Project Modelled Municipal Drain
- Municipal Boundary

SANDWICH SOUTH MASTER PLANNING AREA MUNICIPAL DRAINAGE MAP

FIGURE 5A

THE CITY OF WINDSOR ONTARIO, CANADA

DILLON CONSULTING

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SCALE 1:30,000

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N W E S

STATUS: FINAL
PROJECT: 19-9817
DATE: 2023-04-30

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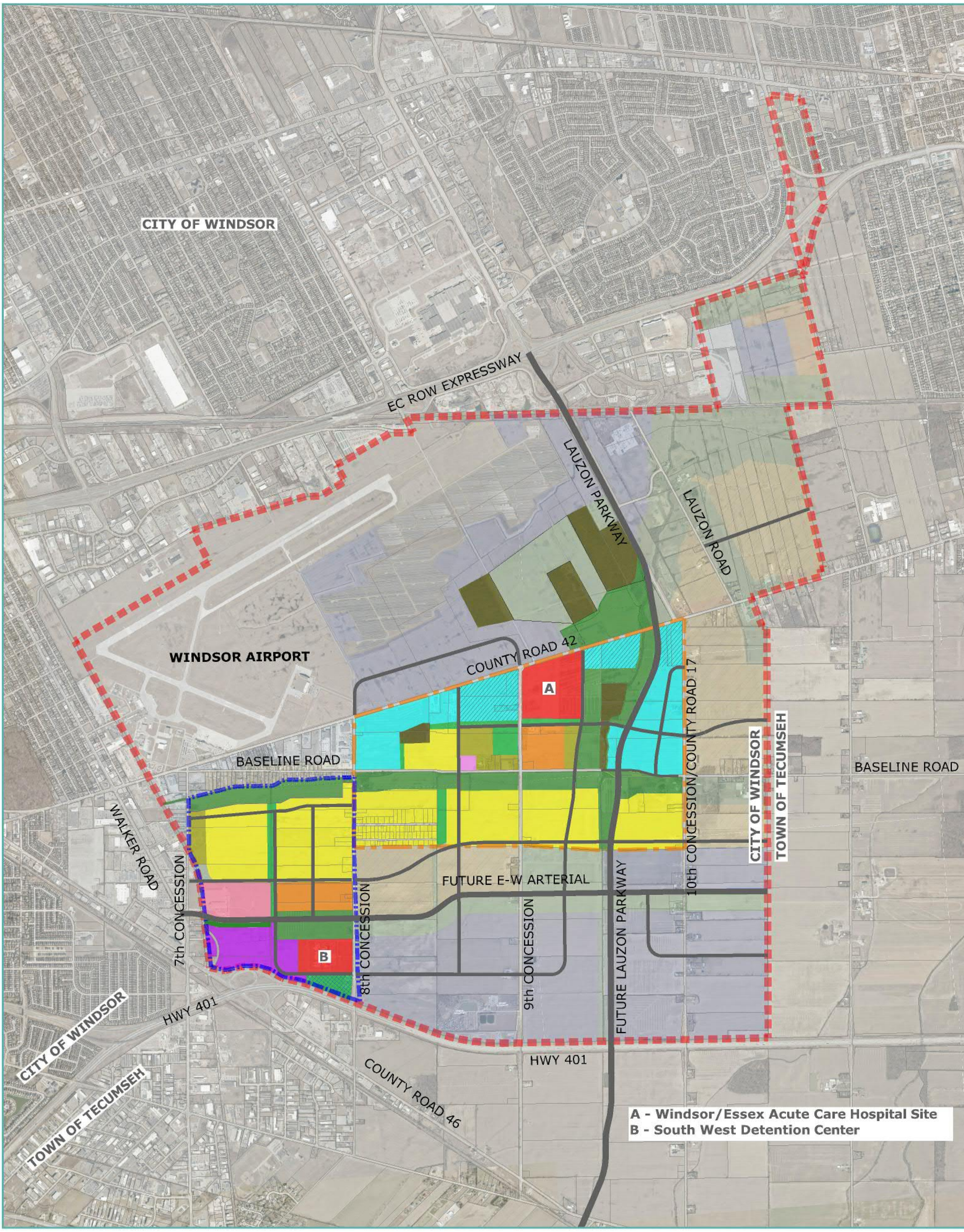

SANDWICH SOUTH MASTER SERVICING PLAN

STUDY AREA MAP
PROPOSED LAND USE

FIGURE 6

LEGEND

- Sandwich South Project Boundary
- County Road 42 Secondary Plan Area
- East Pelton Secondary Plan Area
- Low Density Residential
- Medium Density Residential
- Business Park Type I
- Business Park Type II
- Major Institutional
- Existing Employment
- Existing Residential
- Private Recreation
- Minor Institutional
- Mixed Use
- Natural Heritage
- Neighbourhood Commercial
- Open Space/Park
- Commercial Centre
- SWM Corridor
- Airport Solar Farm
- Future Employment
- Future Urban
- Proposed Collector/ Arterial Roads

THE CITY OF WINDSOR ONTARIO, CANADA

DILLON CONSULTING

MAP DRAWING INFORMATION:
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MAP CREATED BY: RBH
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SCALE: 1:15000
STATUS: FINAL
PROJECT: 19-9817

DATE: May 03, 2023

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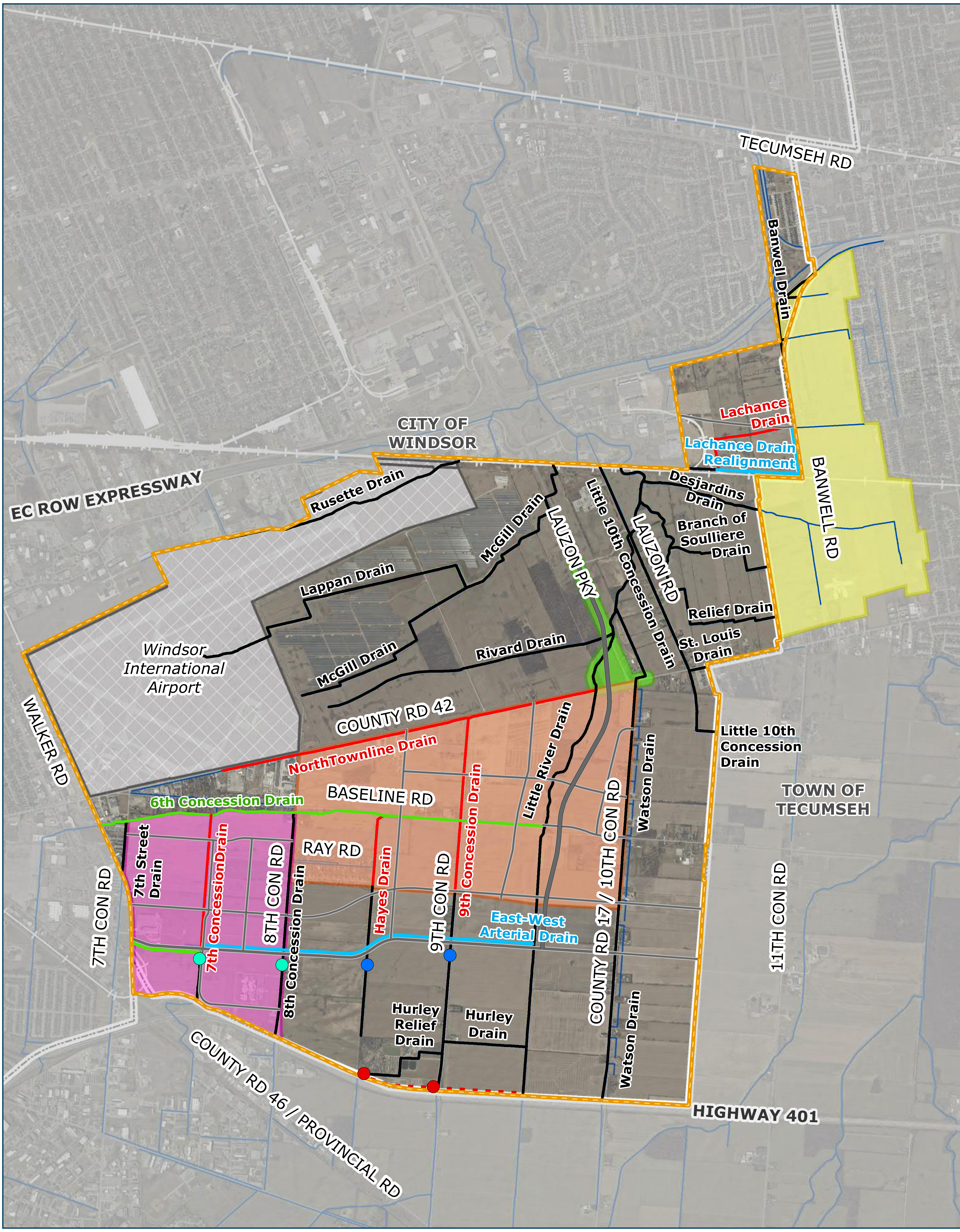

Sandwich South Master Planning Area
Railway
Municipal Drain / Watercourse
Municipal
Airport
Proposed Arterial/Collector Road

Location of Upstream Drain Re-Direction to New Drain
Scenario 1 of Upstream Drainage Re-Directed to Future SWM Wet Pond
Scenario 2 of Upstream Drainage Re-Directed to Little River through Hurley Relief Drain Realignment

Proposed Drain Plan
Proposed New Drain
To Be Abandoned
To Be Enhanced
Realignment
No Change

West Tecumseh Hamlet Secondary Planning Area
East Pelton Secondary Planning Area
County Road 42 Secondary Planning Study Area
County Road 42/Lauzon Road Phase 1

SANDWICH SOUTH MASTER SERVICING PLAN

INITIAL DEVELOPMENT AREA MAP AND MUNICIPAL DRAIN MODIFICATIONS

FIGURE 7

MAP DRAWING INFORMATION:
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MAP CREATED BY: LK/LMM
MAP CHECKED BY: -
MAP COORDINATE SYSTEM: NAD 1983 UTM Zone 17N

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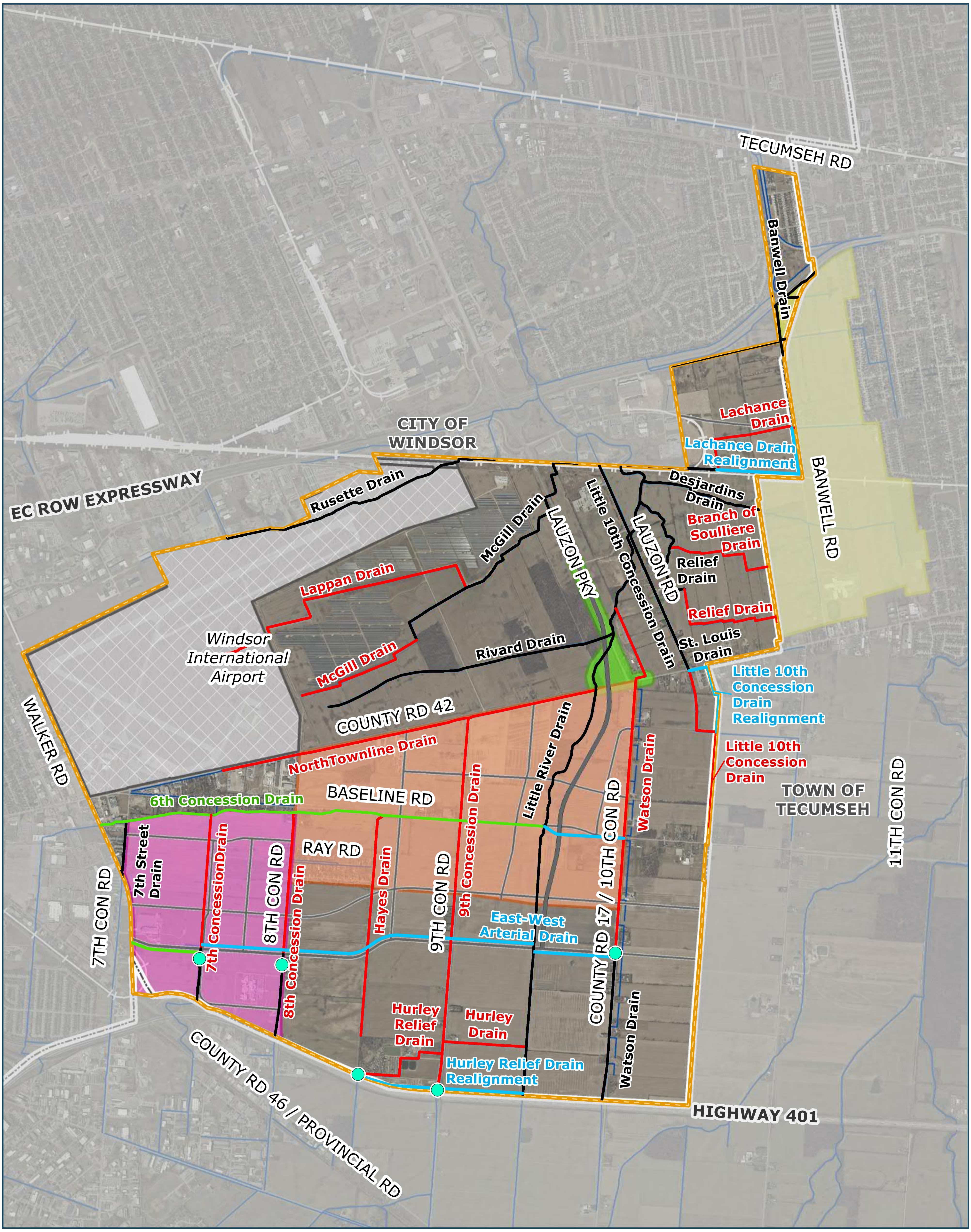
SCALE 1:30,000
0 0.25 0.5 1 km

STATUS: FINAL
PROJECT: 19-9817
DATE: 2023-04-21

File Path: K:\2019\199817-Sandwich_S_LittleRiver\GIS\MXDs\SandwichSouth\Reporting\Report_WR_SWM\199817_Fig7ap2_IntialDevArea_MunicipalDrainModifications.mxd



SANDWICH SOUTH MASTER SERVICING PLAN

- Sandwich South Master Planning Area
- Railway
- Municipal Drain / Watercourse
- Municipal Boundary
- Airport
- Proposed Arterial/Collector Road

Proposed Drain Plan

- Location of Upstream Drain Re-Direction to New Drain
- Proposed New Drain
- To Be Abandoned
- To Be Enhanced
- No Change

- West Tecumseh Hamlet Secondary Planning Area
- East Pelton Secondary Planning Area
- County Road 42 Secondary Planning Study Area
- County Road 42/Lauzon Road Phase 1

ULTIMATE BUILDOUT CONDITION MUNICIPAL DRAIN MODIFICATIONS MAP

FIGURE 8

THE CITY OF WINDSOR ONTARIO, CANADA

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX 2019

MAP CREATED BY: LK/LMM
MAP CHECKED BY: -
MAP COORDINATE SYSTEM: NAD 1983 UTM Zone 17N

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SCALE 1:30,000

0 0.25 0.5 1 km

N W E S

STATUS: FINAL
PROJECT: 19-9817
DATE: 2023-04-22

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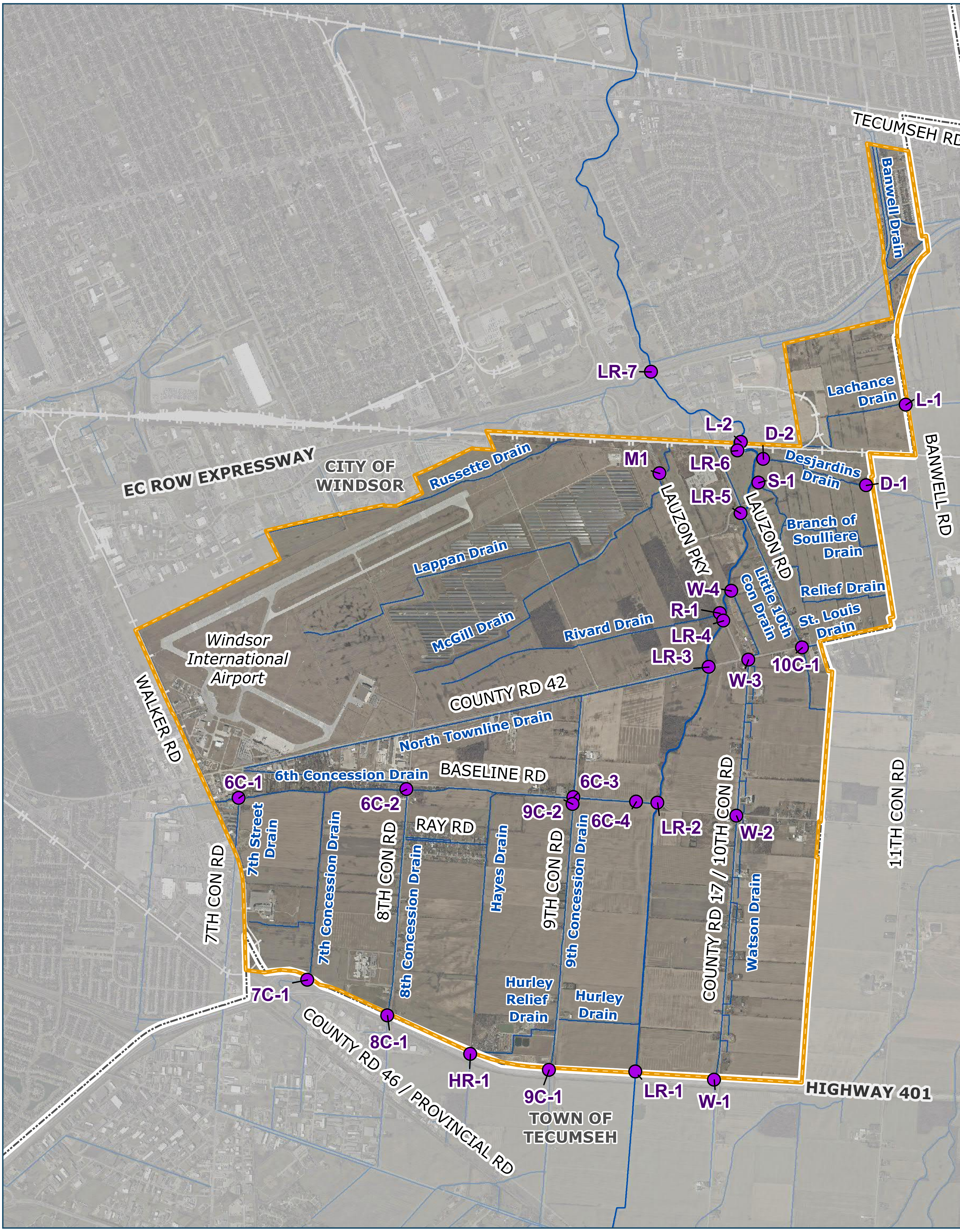

Sandwich South Master Planning Area

Railway

Municipal Drain / Watercourse

Municipal Boundary

Analysis Location

SANDWICH SOUTH MASTER SERVICING PLAN

EXISTING CONDITION FLOW AND LEVEL ANALYSIS POINTS

FIGURE 9

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX 2019

MAP CREATED BY: LK/LM/ZB
MAP CHECKED BY: -
MAP COORDINATE SYSTEM: NAD 1983 UTM Zone 17N

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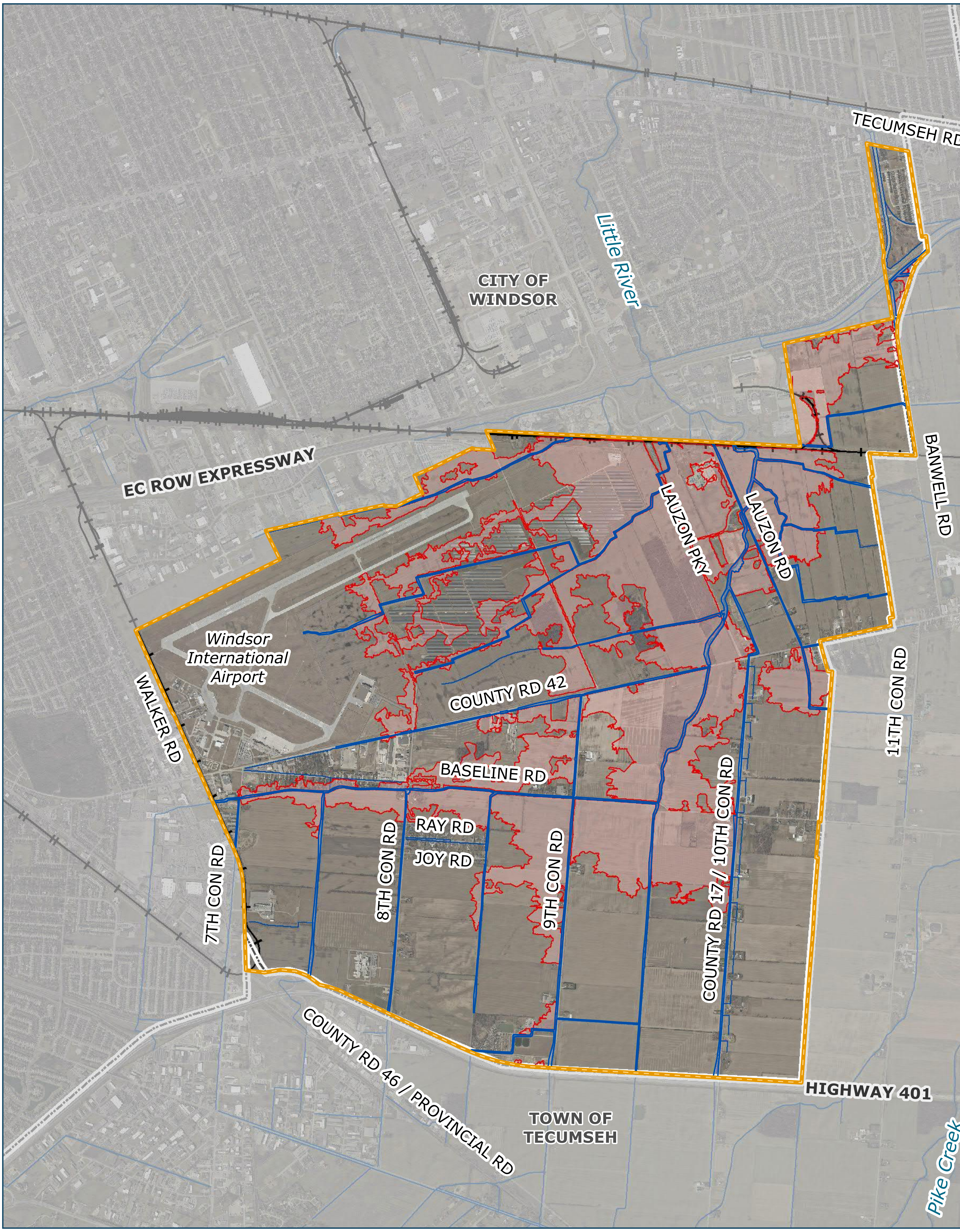
SCALE 1:30,000

0 0.25 0.5 1 km

N W E S

STATUS: FINAL
PROJECT: 19-9817
DATE: 2023-04-30

File Path: K:\2019\199817-Sandwich_S_LittleRiver\GIS\MXDs\SandwichSouth\Reporting\Report_WR_SWM\199817_Fig9ap2_ExistingConditionFlowandLevelAnalysisPoints.mxd



SANDWICH SOUTH MASTER SERVICING PLAN

- Sandwich South Master Planning Area
- Railway
- Municipal Drain / Watercourse
- Floodway Limit
- Flood Fringe Limit

EXISTING CONDITION REGULATED 1:100 YEAR FLOODWAY AND FLOOD FRINGE EXTENT SUMMARY

FIGURE 10

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX 2019

MAP CREATED BY: LK/LMM
MAP CHECKED BY: -
MAP COORDINATE SYSTEM: NAD 1983 UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR – DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – ONTARIO. (WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO

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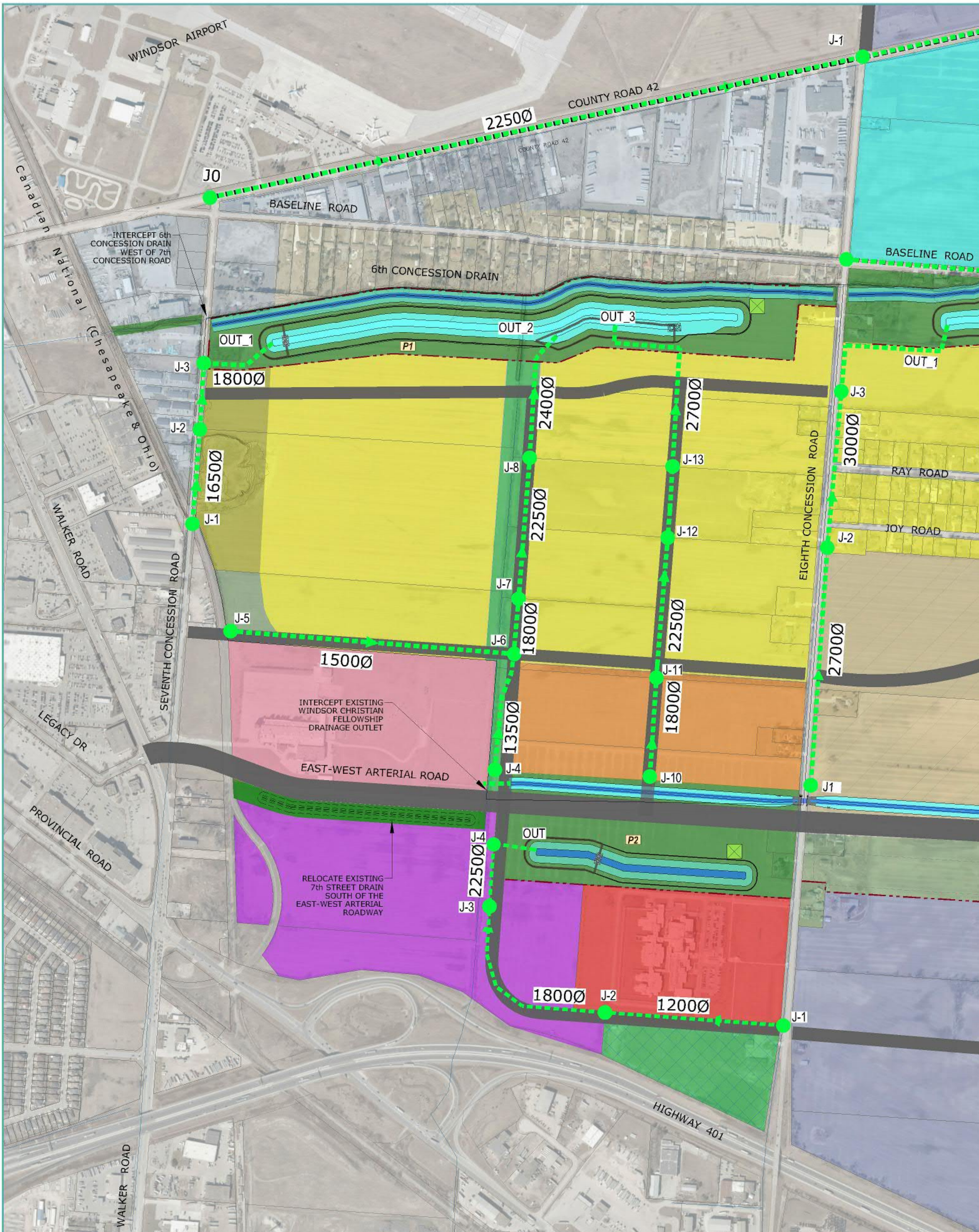
SCALE 1:30,000

0 0.25 0.5 1 km

STATUS: FINAL
PROJECT: 19-9817
DATE: 2023-04-30

File Path: K:\2019\199817-Sandwich_S_LittleRiver\GIS\MXDs\SandwichSouth\Reporting\Report_WR_SWM\199817_Fig10_Floodwayandfloodfringe.mxd



SANDWICH SOUTH MASTER SERVICING PLAN

TRUNK STORM SEWER	
PROPERTY ACQUISITION BOUNDARY	
FUTURE COLLECTOR AND ARTERIAL ROADS	
NATURAL HERITAGE	
EXISITING DRAINS	
2400Ø	STORM SEWER SIZE
OPEN SPACE / STORMWATER MANAGEMENT CORRIDOR (FUTURE)	
PROPOSED STORM SEWER DRAINAGE	
STORMWATER PUMP STATION	
STORMWATER MANAGEMENT POND- PERMANENT POOL	
STORMWATER MANAGEMENT POND - ACTIVE STORAGE	
MUNICIPAL DRAIN RELOCATION OR NEW DRAIN	

LEGEND

- Low Density Residential
- Medium Density Residential
- Business Park Type I
- Business Park Type II
- Major Institutional
- Existing Employment
- Existing Residential
- Private Recreation
- Minor Institutional
- Mixed Use
- Natural Heritage
- Neighbourhood Commercial
- Open Space/Park
- Commercial Centre
- SWM Corridor
- Airport Solar Farm
- Future Employment
- Future Urban

STORMWATER MANAGEMENT STRATEGY

EAST PELTON SPA

FIGURE 11A

THE CITY OF WINDSOR ONTARIO, CANADA

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX 2019

MAP CREATED BY: RBH
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

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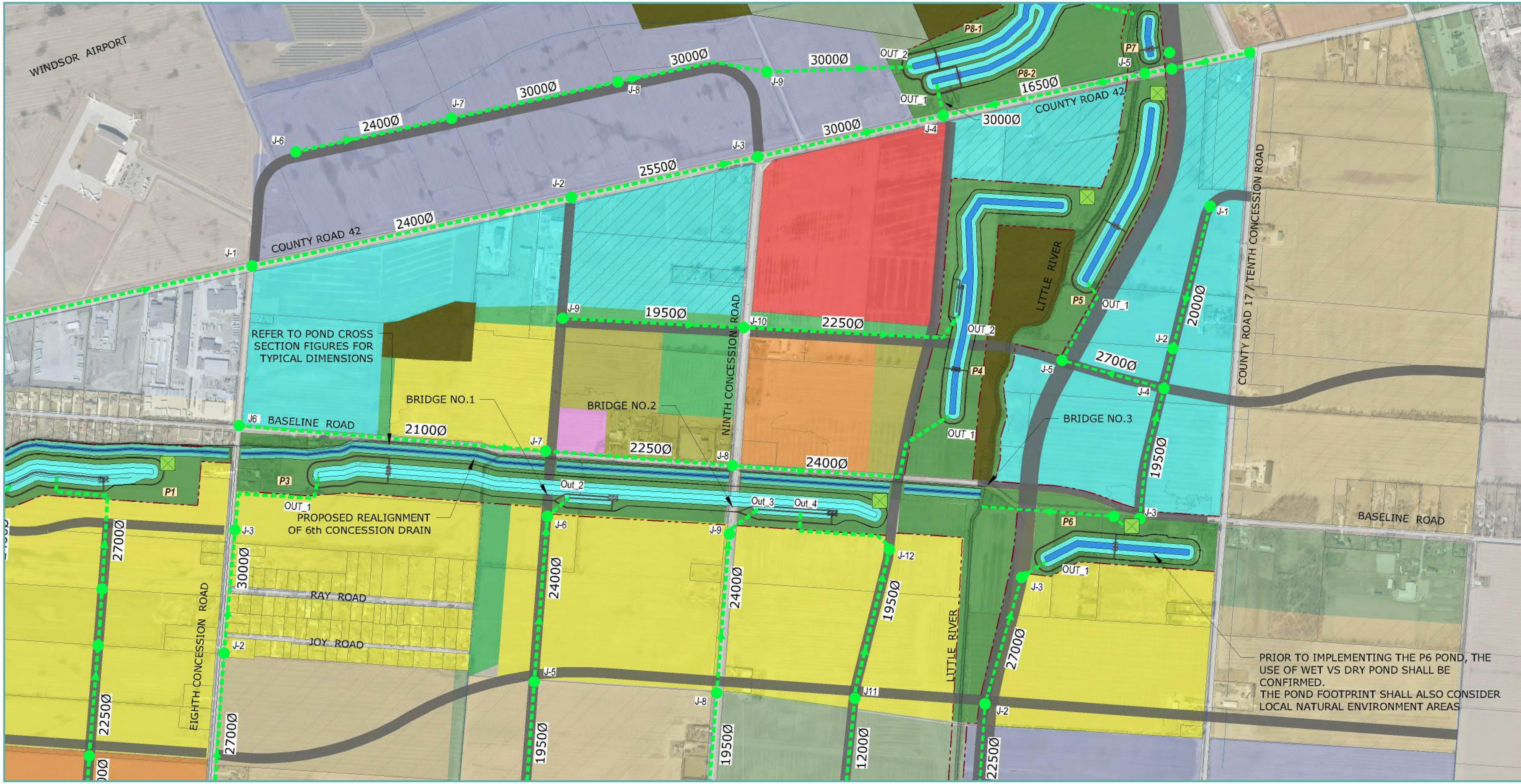
N W E S

SCALE: 1:4000
STATUS: FINAL
PROJECT: 19-9817

DATE: April 28, 2023

File Location: c:\pw working directory\projects 2019\dillon_32ed\dms90713\199817-02-swm-ponds.dwg April. 28, 2023 8:43 AM



TRUNK STORM SEWER	FUTURE COLLECTOR AND ARTERIAL ROADS
EXISTING DRAINS	NATURAL HERITAGE
PROPERTY ACQUISITION BOUNDARY	OPEN SPACE / STORMWATER MANAGEMENT CORRIDOR
2400Ø STORM SEWER SIZE	PROPOSED STORM SEWER DRAINAGE ARROW
STORMWATER PUMP STATION	STORMWATER MANAGEMENT POND- PERMANENT POOL
STORMWATER MANAGEMENT POND - ACTIVE STORAGE	MUNICIPAL DRAIN RELOCATION OR NEW DRAIN

LEGEND

Low Density Residential	Major Institutional	Open Space/Park
Medium Density Residential	Existing Employment	Commercial Centre
Business Park Type I	Existing Residential	SWM Corridor
Business Park Type II	Private Recreation	Airport Solar Farm
	Minor Institutional	Future Employment
	Mixed Use	Future Urban
	Natural Heritage	
	Neighbourhood Commercial	

SANDWICH SOUTH MASTER SERVICING PLAN

STORMWATER MANAGEMENT STRATEGY

CR42 SPA

FIGURE 11B

THE CITY OF WINDSOR ONTARIO, CANADA

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX

MAP CREATED BY: RBH
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

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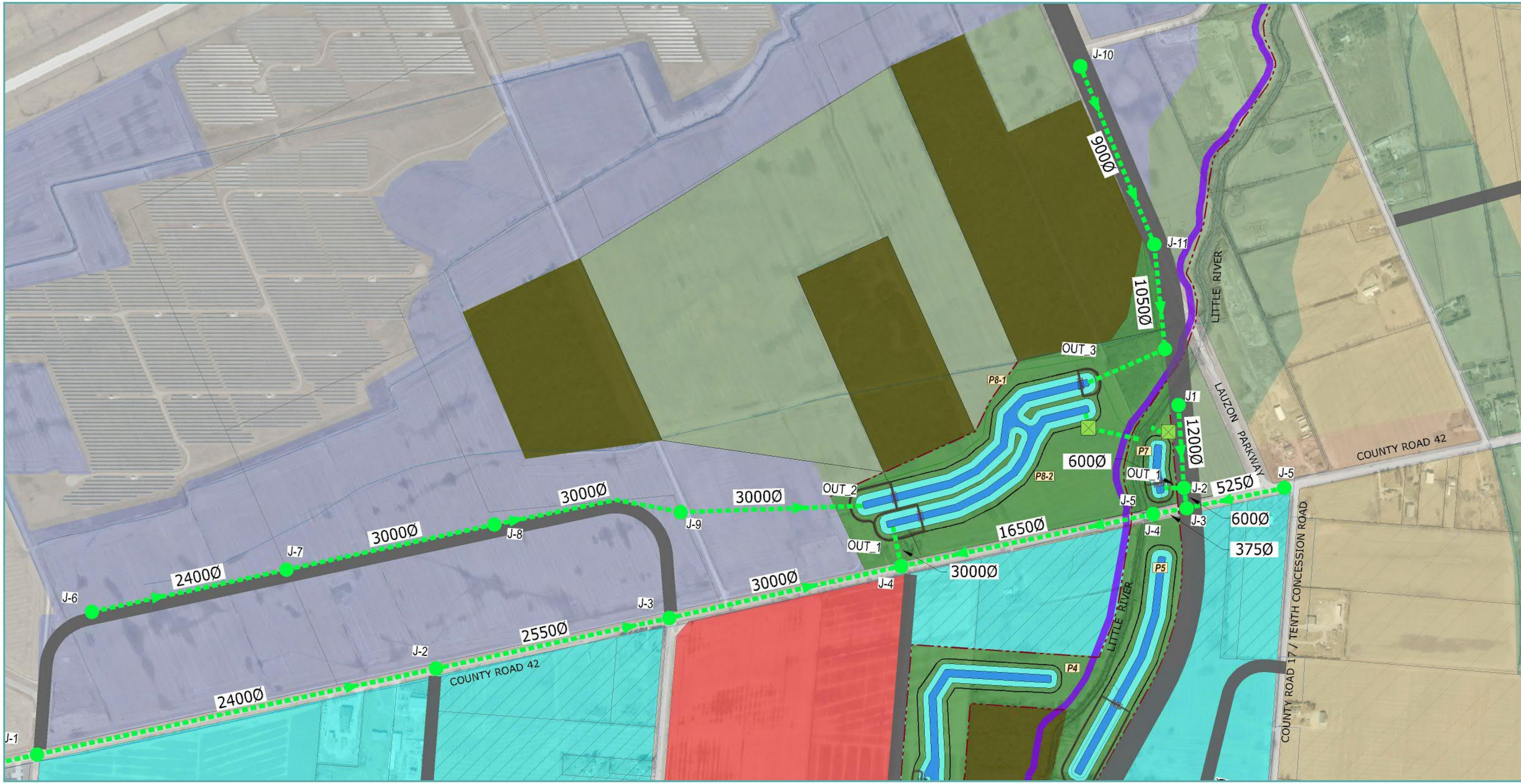
STATUS: FINAL   SCALE: 1:5000   PROJECT: 19-9817   DATE: April 28, 2023

File Location: c:\pw working directory\projects 2019\dillon_32edr\dms90713\199617-02-swm-ponds.dwg April, 28, 2023 8:41 AM



SANDWICH SOUTH MASTER SERVICING PLAN

- TRUNK STORM SEWER
- EXISTING DRAINS
- PROPERTY ACQUISITION BOUNDARY
- 2400Ø STORM SEWER SIZE
- FUTURE COLLECTOR AND ARTERIAL ROADS
- NATURAL HERITAGE
- OPEN SPACE / STORMWATER MANAGEMENT CORRIDOR
- PROPOSED STORM SEWER DRAINAGE ARROW
- STORMWATER PUMP STATION
- STORMWATER MANAGEMENT POND- PERMANENT POOL
- STORMWATER MANAGEMENT POND - ACTIVE STORAGE
- MUNICIPAL DRAIN RELOCATION OR NEW DRAIN

LEGEND

- Low Density Residential
- Medium Density Residential
- Business Park Type I
- Business Park Type II
- Major Institutional
- Existing Employment
- Existing Residential
- Private Recreation
- Minor Institutional
- Mixed Use
- Natural Heritage
- Neighbourhood Commercial
- Open Space/Park
- Commercial Centre
- SWM Corridor
- Airport Solar Farm
- Future Employment
- Future Urban

STORMWATER MANAGEMENT STRATEGY

LAUZON PARKWAY AND CR42 INTERSECTION

FIGURE 11C

THE CITY OF WINDSOR ONTARIO, CANADA

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX

MAP CREATED BY: RBH
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

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N W E S

STATUS: FINAL SCALE: 1:4000 PROJECT: 19-9817 DATE: April 28, 2023

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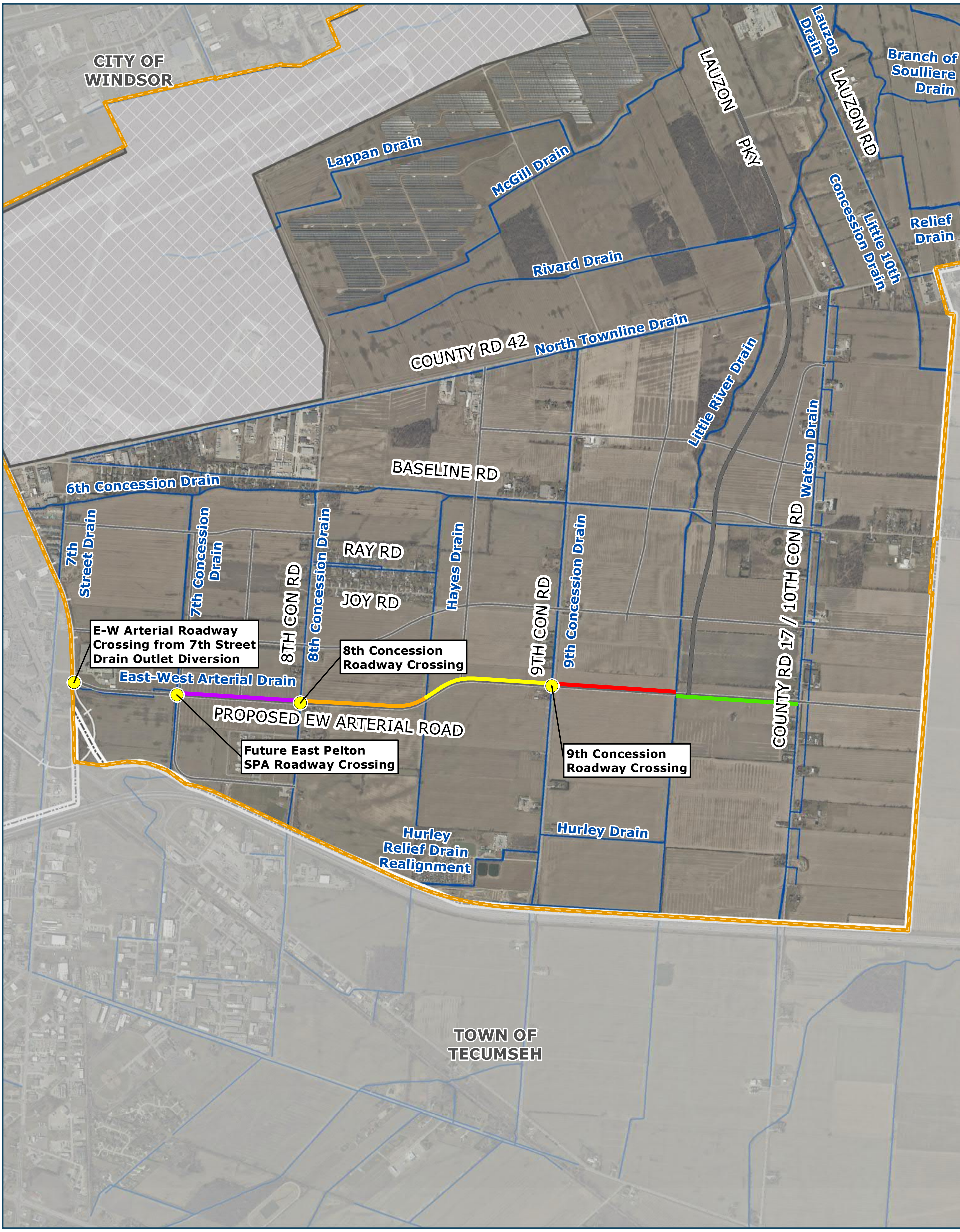

SANDWICH SOUTH MASTER SERVICING PLAN

Sandwich South Master Planning Area
Railway
Municipal Drain / Watercourse
Municipal Boundary
Airport
Proposed Arterial/Collector Road

Proposed Drain Plan
EW-Arterial Crossing Locations
EW-Arterial Cross Section 1
EW-Arterial Cross Section 2
EW-Arterial Cross Section 3
EW-Arterial Cross Section 4
EW-Arterial Cross Section 5

E-W ARTERIAL DRAIN ALIGNMENT AND STATIONING

FIGURE 12

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX 2019

MAP CREATED BY: LK/LMM
MAP CHECKED BY: -
MAP COORDINATE SYSTEM: NAD 1983 UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR – DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – ONTARIO. (WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO

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SCALE 1:20,000

0 0.15 0.3 0.6 km

N W E S

STATUS: FINAL
PROJECT: 19-9817
DATE: 2023-04-21

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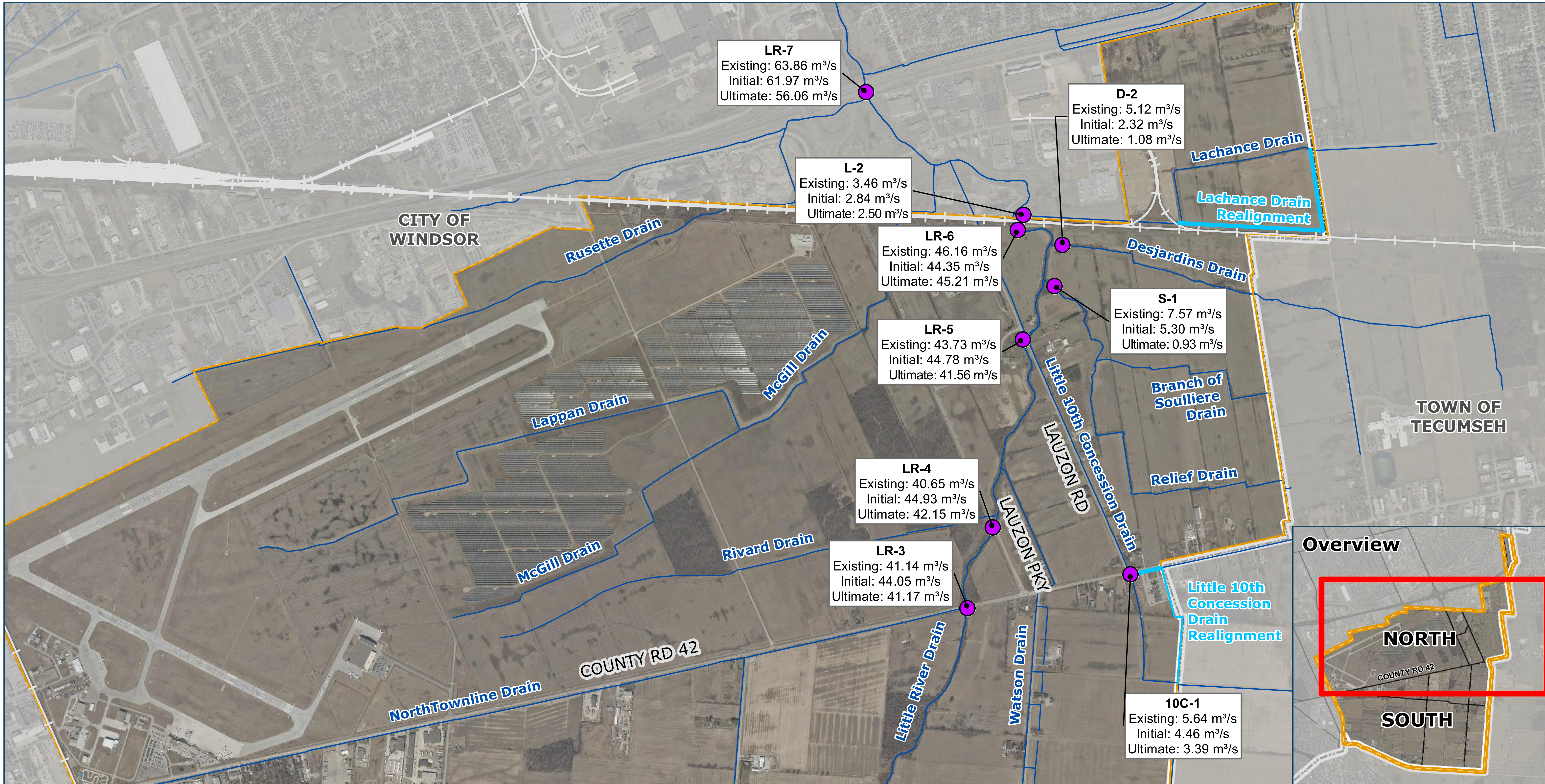

SANDWICH SOUTH MASTER SERVICING PLAN

DEVELOPMENT PHASING 1:100 YEAR FLOW COMPARISON SUMMARY (NORTH)

FIGURE 13A

- Sandwich South Master Planning Area
- Railway
- Municipal Drain / Watercourse
- Municipal Boundary
- Analysis Location
- Proposed New Drain

SCALE 1:17,500

0 0.2 0.4 0.8 km

MAP DRAWING INFORMATION:
DATA PROVIDED BY City of Windsor 2019, MNRF 2019, Town of Tecumseh 2019, *Essex Region Conservation Authority 2019, **County of Essex 2019

MAP CREATED BY: -ZJB
MAP CHECKED BY: -RL
MAP PROJECTION: NAD 1983 UTM Zone 17N

PROJECT: 19-9817 STATUS: FINAL DATE: 2023-04-14

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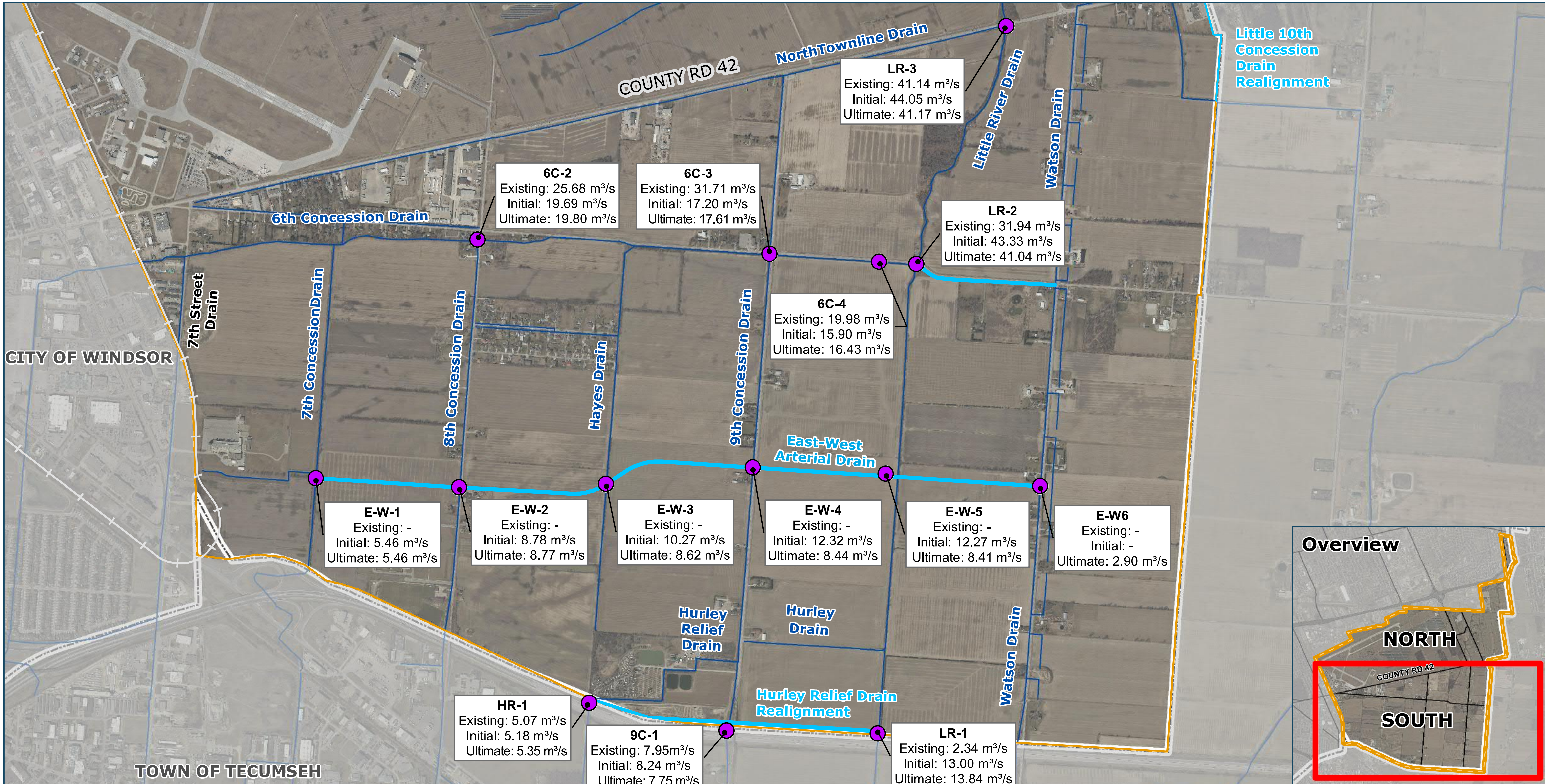


SANDWICH SOUTH MASTER SERVICING PLAN

DEVELOPMENT PHASING 1:100 YEAR FLOW COMPARISON SUMMARY (SOUTH)

FIGURE 13B

- Sandwich South Master Planning Area
- Railway
- Municipal Drain / Watercourse
- Municipal Boundary
- Analysis Location
- Proposed New Drain

SCALE 1:17,500

0 0.2 0.4 0.8 km

N S E W

MAP DRAWING INFORMATION:
DATA PROVIDED BY City of Windsor 2019, MNRF 2019, Town of Tecumseh 2019, *Essex Region Conservation Authority 2019, **County of Essex 2019

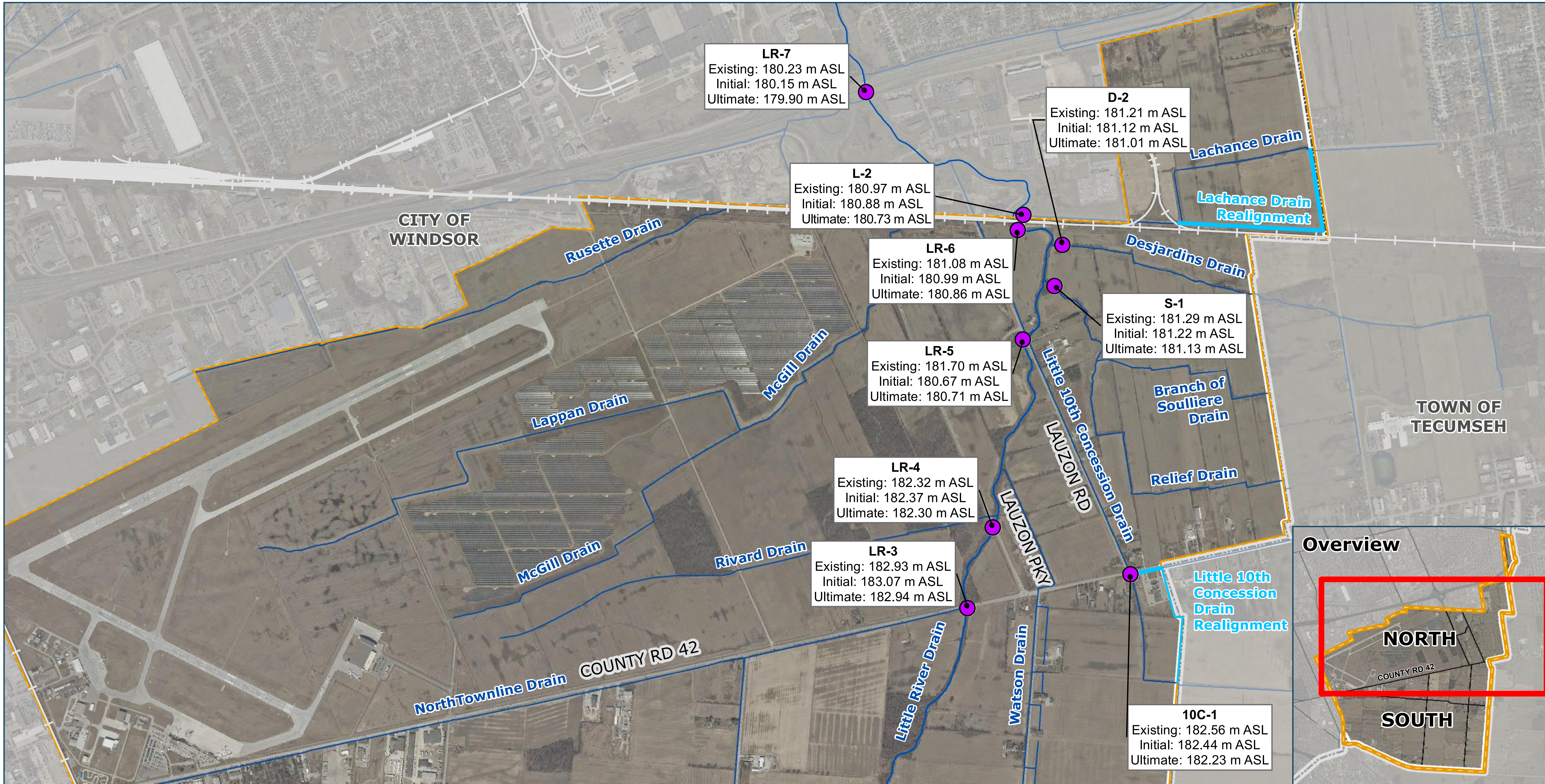
MAP CREATED BY: -ZJB
MAP CHECKED BY: -RL
MAP PROJECTION: NAD 1983 UTM Zone 17N

THE CITY OF WINDSOR ONTARIO, CANADA

DILLON CONSULTING

PROJECT: 19-9817 STATUS: FINAL DATE: 2023-04-14

FILE LOCATION: K:\2019\199817-Sandwich_S_LittleRiver\GIS\MXDs\SandwichSouth\Reporting\Report_WR_SWM\199817_Fig13aii_FlowAnalysis.mxd



SANDWICH SOUTH MASTER SERVICING PLAN

DEVELOPMENT PHASING 1:100 YEAR LEVEL COMPARISON SUMMARY (NORTH)

FIGURE 14A

- Sandwich South Master Planning Area
- Railway
- Municipal Drain / Watercourse
- Municipal Boundary
- Analysis Location
- Proposed New Drain

SCALE 1:17,500

0 0.2 0.4 0.8 km

MAP DRAWING INFORMATION:
DATA PROVIDED BY City of Windsor 2019, MNRF 2019, Town of Tecumseh 2019, *Essex Region Conservation Authority 2019, **County of Essex 2019

MAP CREATED BY: -ZJB
MAP CHECKED BY: -RL
MAP PROJECTION: NAD 1983 UTM Zone 17N

PROJECT: 19-9817 STATUS: FINAL DATE: 2023-04-14

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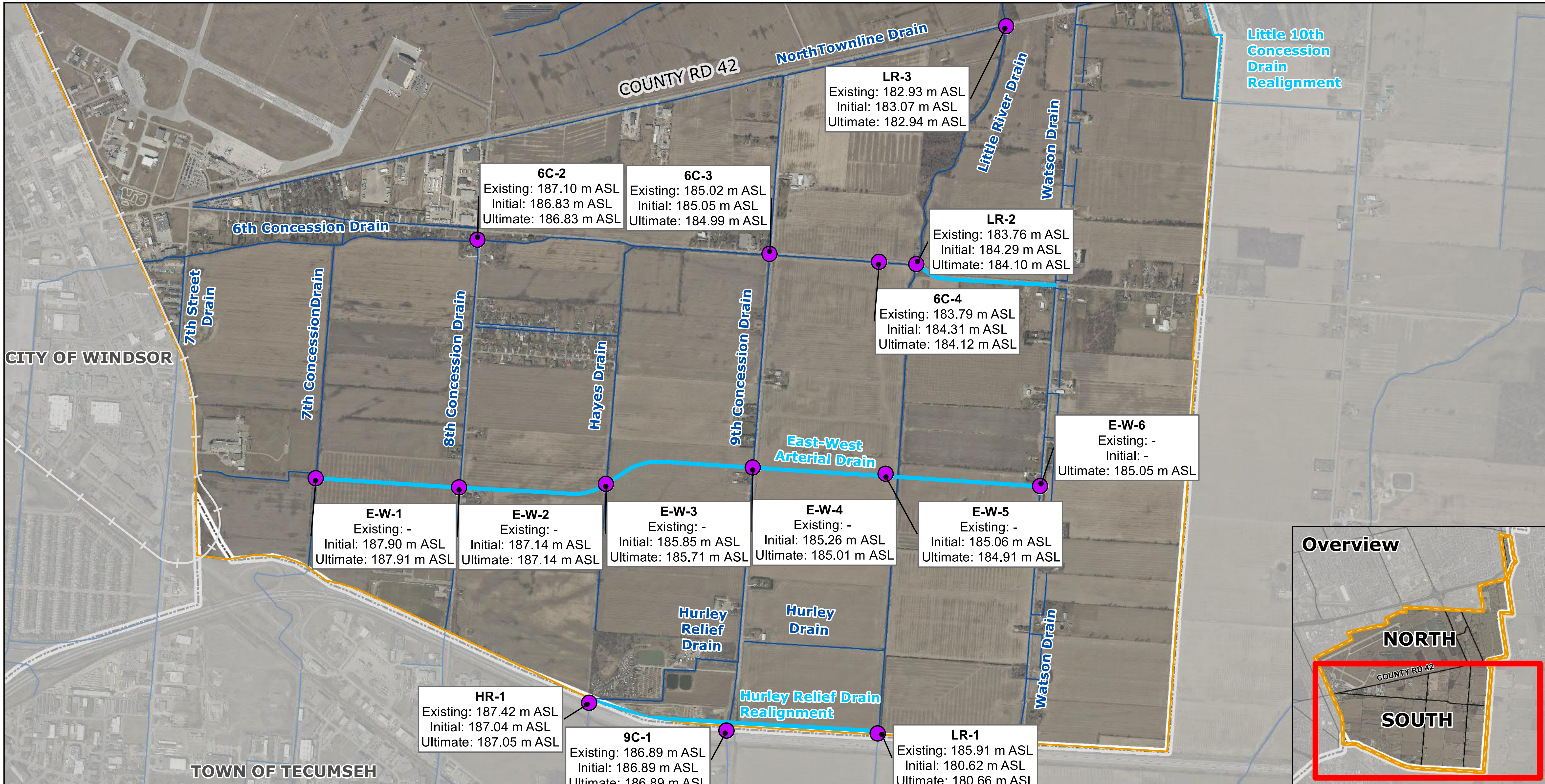


SANDWICH SOUTH MASTER SERVICING PLAN

DEVELOPMENT PHASING 1:100 YEAR LEVEL COMPARISON SUMMARY (SOUTH)

FIGURE 14B

- Sandwich South Master Planning Area
- Railway
- Municipal Drain / Watercourse
- Municipal Boundary
- Analysis Location
- Proposed New Drain

SCALE 1:17,500

0 0.2 0.4 0.8 km

N E S W

MAP DRAWING INFORMATION:
DATA PROVIDED BY City of Windsor 2019, MNRF 2019, Town of Tecumseh 2019, *Essex Region Conservation Authority 2019, **County of Essex 2019

MAP CREATED BY: -ZJB
MAP CHECKED BY: -RL
MAP PROJECTION: NAD 1983 UTM Zone 17N

PROJECT: 19-9817 STATUS: FINAL DATE: 2023-04-14

FILE LOCATION: K:\2019\199817-Sandwich_S_LittleRiver\GIS\MXDs\SandwichSouth\Reporting\Report_WR_SWM\199817_Fig14Aii_LevelAnalysis.mxd

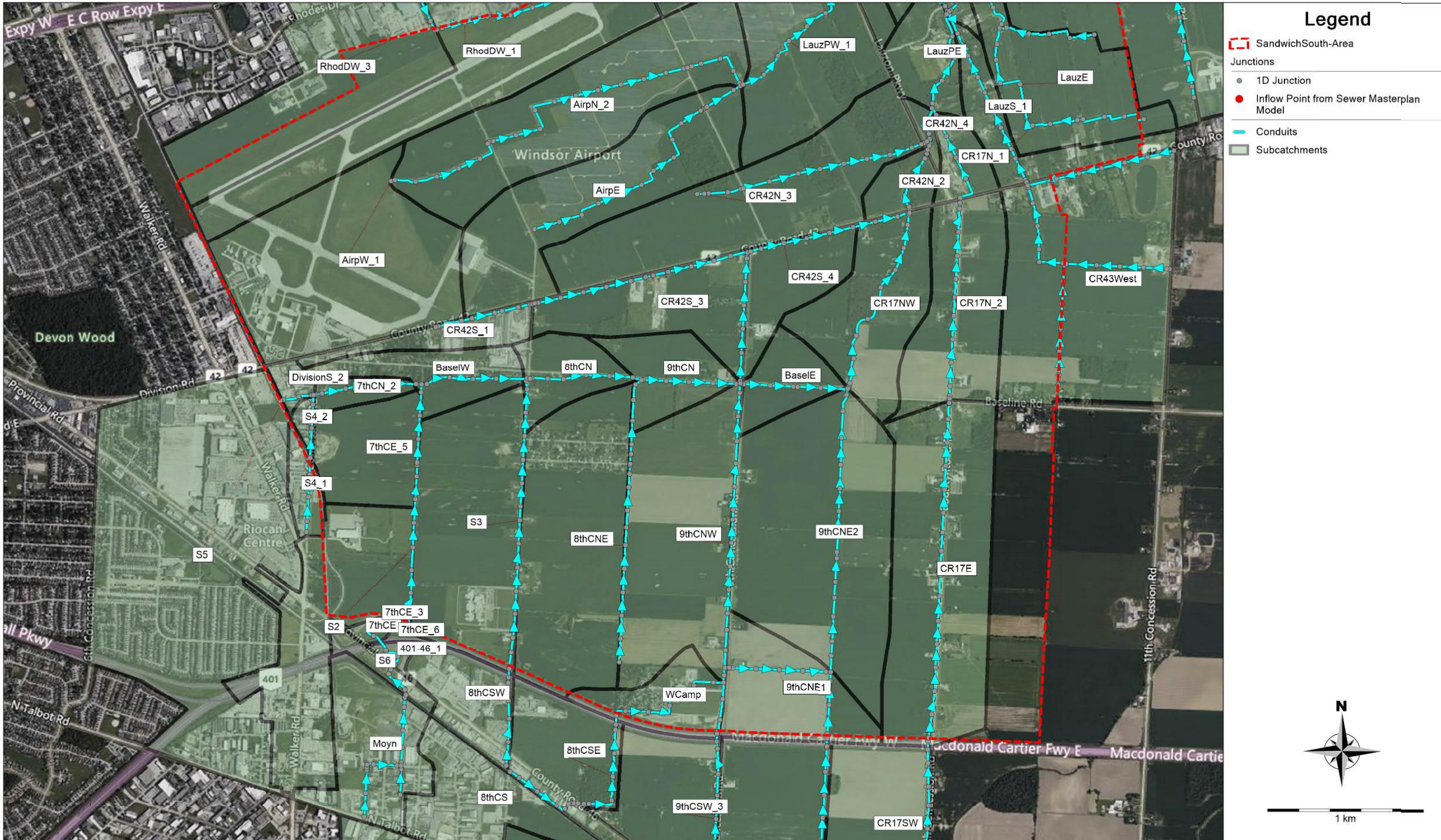
Appendix D-1

Existing Condition Model Schematics and In-Drain Structure Inventory

DILLON CONSULTING

Sandwich South Master Plan - Existing Condition Model Layout

Sandwich South Master Plan - Existing Condition Model Layout



Sandwich South Master Plan - Existing Condition Model Layout

ESSEX REGION CONSERVATION AUTHORITY
LITTLE RIVER WATERSHED FLOOD LINE MAPPING HYDRAULIC REPORT

STRUCTURE INVENTORY SHEET
FIGURE D-1A

▲ Structures
Municipal Boundaries
Little River Study Area
1D Conduit

DILLON CONSULTING

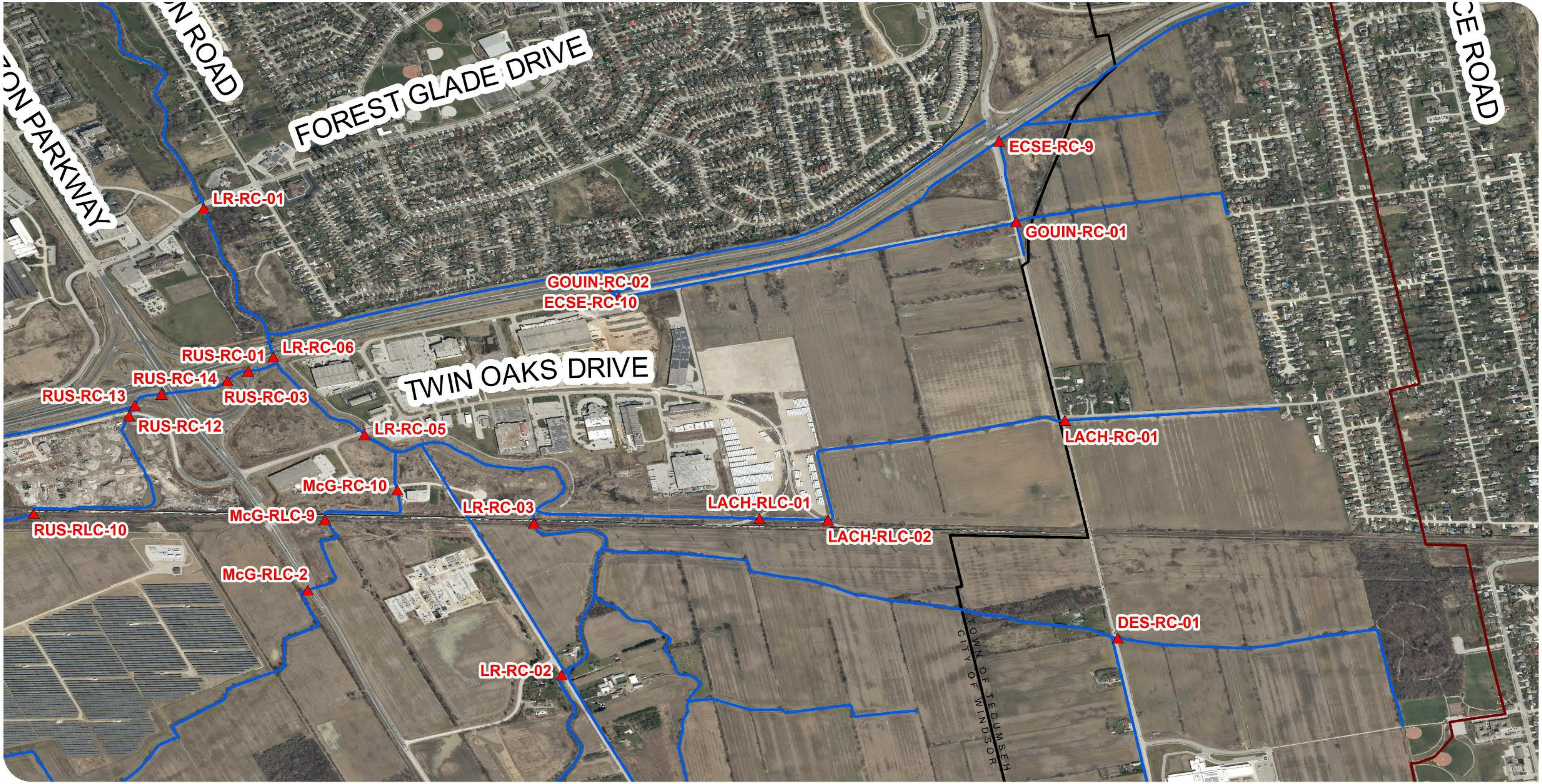
MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019,
TOWN OF TECUMSEH 2019,*ESSEX REGION CONSERVATION AUTHORITY 2019,
**COUNTY OF ESSEX 2019* DEM-CGVD28:78 DEM SURFACE DERIVED BY
ERCA BASED ON MNRF LIDAR-DIGITAL TERRAIN MODEL (2016-18).

750 375 0 750 Meters

N W E S

MAP CREATED BY: ARC
MAP CHECKED BY: RL
MAP PROJECTION: NAD 1983 UTM Zone 17N

PROJECT: 19-9817 STATUS: FINAL DATE: 2023-03-27



ESSEX REGION CONSERVATION AUTHORITY
LITTLE RIVER WATERSHED FLOOD LINE MAPPING HYDRAULIC REPORT

STRUCTURE INVENTORY SHEET
FIGURE D-1B

Structures
Municipal Boundaries
Little River Study Area
1D Conduit

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019,
TOWN OF TECUMSEH 2019,*ESSEX REGION CONSERVATION AUTHORITY 2019,
**COUNTY OF ESSEX 2019* DEM-OGVD28:78 DEM SURFACE DERIVED BY
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OPEN GOVERNMENT LICENCE - ONTARIO.
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375 187.5 0 375 Meters

N W E S

MAP CREATED BY: ARC
MAP CHECKED BY: RL
MAP PROJECTION: NAD 1983 UTM Zone 17N

PROJECT: 19-9817 STATUS: FINAL DATE: 2023-03-27

ESSEX REGION CONSERVATION AUTHORITY

LITTLE RIVER WATERSHED FLOOD LINE MAPPING HYDRAULIC REPORT

STRUCTURE INVENTORY SHEET

FIGURE D-1C

- Structures
- Municipal Boundaries
- Little River Study Area
- 1D Conduit

DILLON CONSULTING

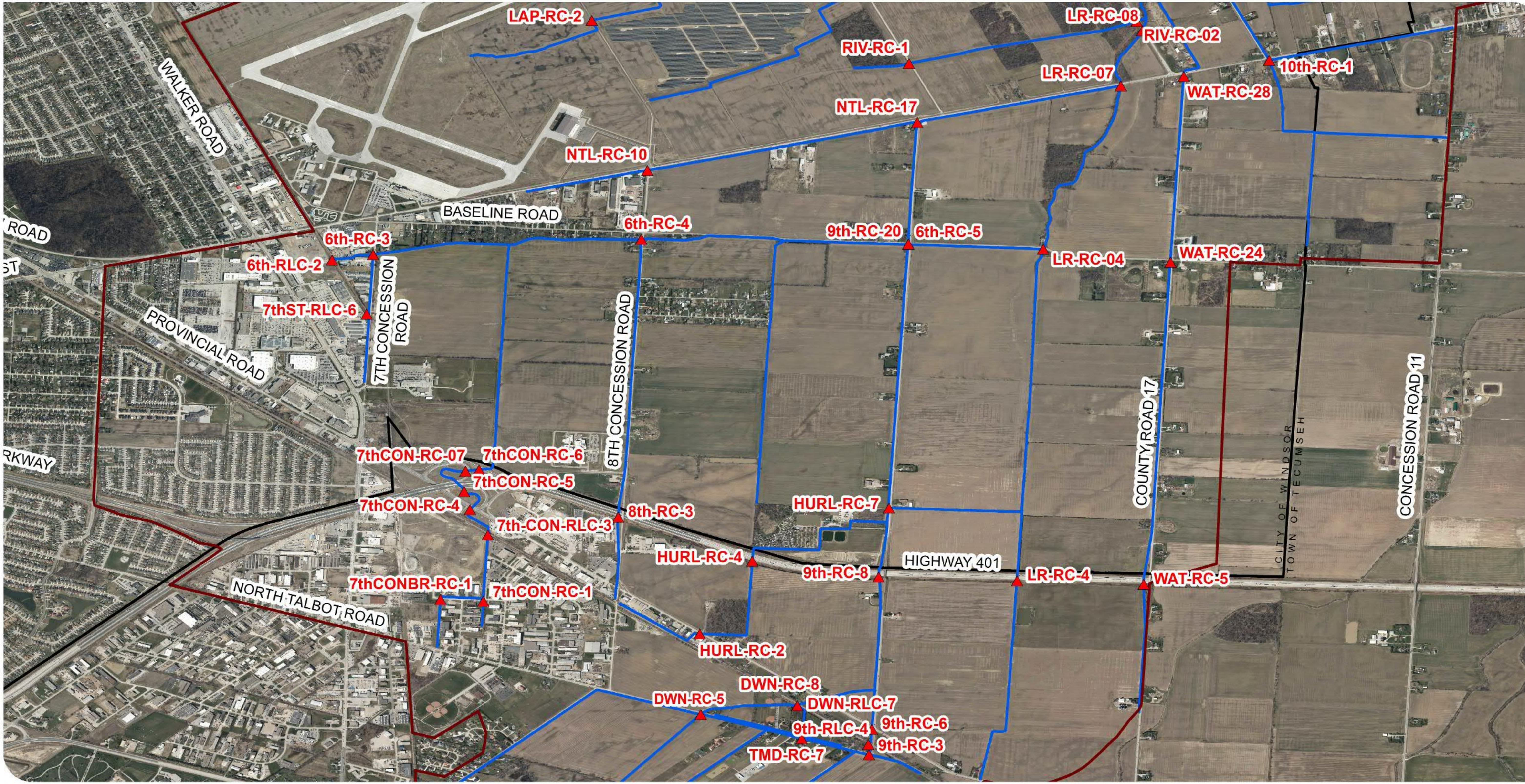
MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019,
TOWN OF TECUMSEH 2019,*ESSEX REGION CONSERVATION AUTHORITY 2019,
**COUNTY OF ESSEX 2019* DEM-CGVD28:78 DEM SURFACE DERIVED BY
ERCA BASED ON MNRF LIDAR-DIGITAL TERRAIN MODEL (2016-18).

450 225 0 450 Meters

N E S W

MAP CREATED BY: ARC
MAP CHECKED BY: RL
MAP PROJECTION: NAD 1983 UTM Zone 17N

PROJECT: 19-9817 STATUS: FINAL DATE: 2023-03-27



ESSEX REGION CONSERVATION AUTHORITY
LITTLE RIVER WATERSHED FLOOD LINE MAPPING HYDRAULIC REPORT

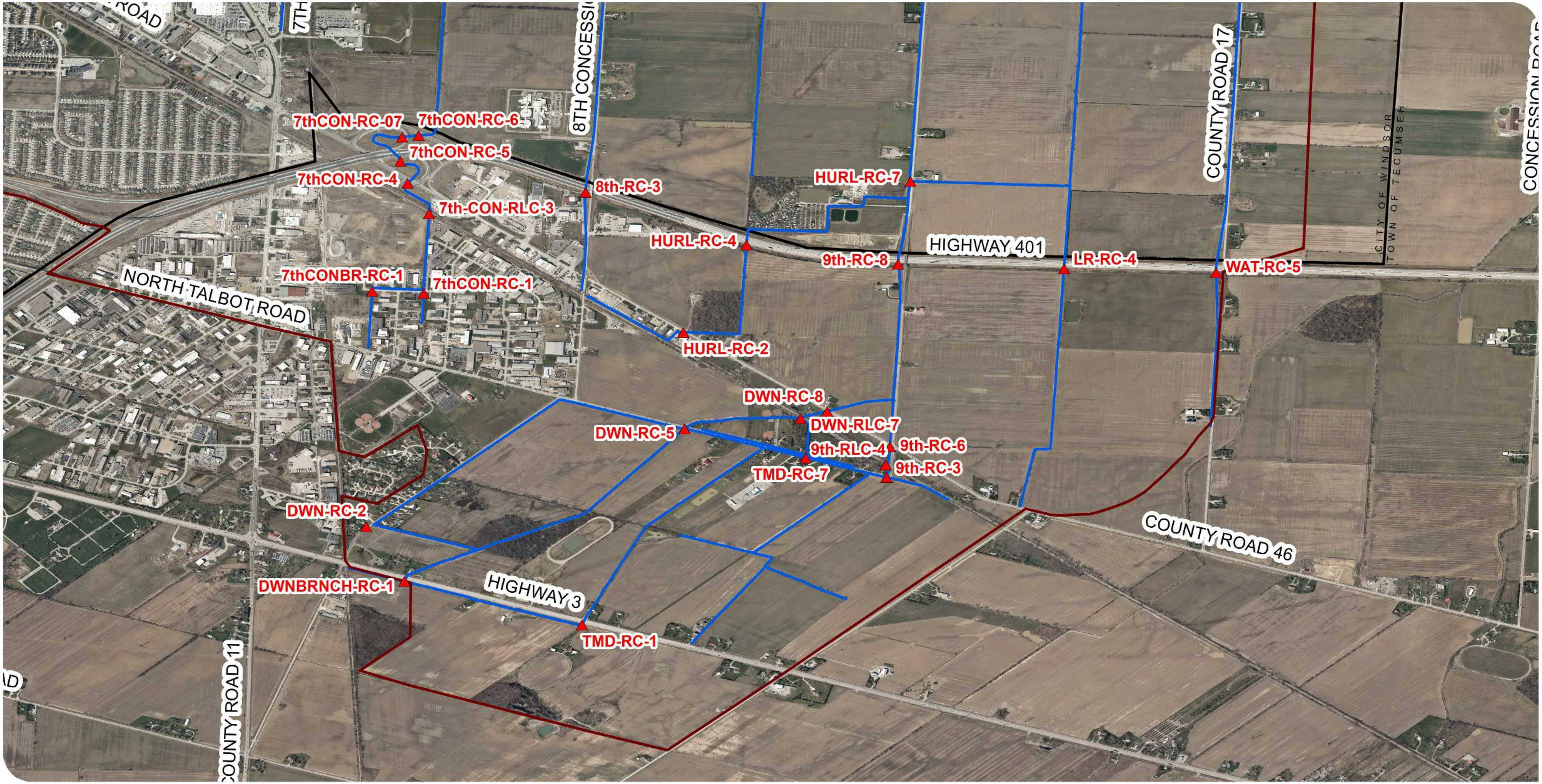
STRUCTURE INVENTORY SHEET
FIGURE D-1D

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019,
TOWN OF TECUMSEH 2019,*ESSEX REGION CONSERVATION AUTHORITY 2019,
**COUNTY OF ESSEX 2019* DEM-CGVD28:78 DEM SURFACE DERIVED BY
ERCA BASED ON MNRF LIDAR-DIGITAL TERRAIN MODEL (2016-18).

MAP CREATED BY: ARC
MAP CHECKED BY: RL
MAP PROJECTION: NAD 1983 UTM Zone 17N

PROJECT: 19-9817 STATUS: FINAL DATE: 2023-03-27



ESSEX REGION CONSERVATION AUTHORITY
LITTLE RIVER WATERSHED FLOOD LINE MAPPING HYDRAULIC REPORT

STRUCTURE INVENTORY SHEET
FIGURE D-1E

Structures
Municipal Boundaries
Little River Study Area
1D Conduit

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019,
TOWN OF TECUMSEH 2019,*ESSEX REGION CONSERVATION AUTHORITY 2019,
**COUNTY OF ESSEX 2019* DEM-CGVD28:78 DEM SURFACE DERIVED BY
ERCA BASED ON MNRF LIDAR-DIGITAL TERRAIN MODEL (2016-18).

600 300 0 600 Meters

N
W E
S

MAP CREATED BY: ARC
MAP CHECKED BY: RL
MAP PROJECTION: NAD 1983 UTM Zone 17N

PROJECT: 19-9817 STATUS: FINAL DATE: 2023-03-27

Drain Name	Structure ID	Geoprocess Survey and Dillon Survey										Drainage Reports					As-built Drawings						X-Coordinate	Y-Coordinate
		Invert mASL	Obvert mASL	Diameter (Height) m	Width m	Structure Type	Inlet Invert mASL	Outlet Invert mASL	Flow Direction	General Comments	Barrels (if more than 1)	Diameter (Height) m	Width (Span) m	Length m	Structure Type	Comments	Diameter (Height) m	Width (Span) m	Length m	Structure Type	Soffit ELEV mASL	Top of Deck mASL		
10th Concession Drain	10th-RC-1	181.2	182.14	0.94	3.1	Box culvert	181.2	181.17	S to N	Sedimentation at upstream end of Culvert						Concession Road 42 - Mentioned in Little 10th Concession Drainage Report - no details							342774.027	4681966.304
6th Concession Drain	6th-RC-3	186.77	188.88	2.11	3.6	Box culvert	186.77	186.87	W to E							Concession Road 7 - Mentioned in 6th Concession Drainage Report - No Details							338162.35	4680732.315
	6th-RC-4	184.35	186.31	1.96	3.6	Box culvert	184.35	184.4	W to E							Concession Road 8 - Mentioned in 6th Concession Drainage Report - No Details							339535.996	4680806.12
	6th-RC-5	182.25	184.68	2.43	2.1	Box Culvert	182.25	182.12	W to E							Concession Road 9 - Mentioned in 6th Concession Drainage Report - No Details							340903.235	4680739.826
7th Concession Drain	7thCONBR-RC-1	189.43	190.49	1.06	-	CP	189.45	189.43	S to N														338452.373	4678351.569
	7thCON-RC-07	-	-	-	-	-	-	-	W to E	Not Surveyed. AsBuilt Information Used in Model.		1.8		45	CSP	7th Concession Drainage Report - 401 On Ramp	1.8	1.8	41	CP			338600.797	4679232.034
	7thCON-RC-1	189.36	189.91	0.55	-	CSP	189.23	189.36	S to N														338671.601	4678333.974
	7thCON-RC-4	187.96	189.16	1.2	-	CP	187.96	187.93	S to N		2												338617.498	4678966.603
	7thCON-RC-5	187.6	189.38	1.78	-	CP	187.6	187.53	S to N								1.8	1.8	133	CP			338589.933	4679092.211
	7thCON-RC-6	187.27	189.06	1.79	-	CP	187.29	187.27	W to E			1.8		52	CSP	7th Concession - 401 Off Ramp	1.8	1.8	52	CP			338670.686	4679239.635
	7th-CON-RLC-3	188.41	190.05	1.64	-	CSP	188.41	188.27	S to N							Mentioned in 7th Concession Drainage Report - No details							338705.269	4678790.213
	7thST-RLC-6	187.98	189.09	1.11	-	CP	187.98	187.84	W to E							Mentioned in 7th Street Drainage Report - No details							338120.445	4680324.404
8th Concession Drain	8th-RC-3	188.21	189.32	1.11	1.9	Box culvert	188.21	188.1	S to N			1.52	1.22	54.5	Box Culvert	Mentioned in 8th Concession Drainage Report	1.22	1.52	55	Box Culvert			339374.266	4678897.929
9th Concession Drain	9th-RC-20	182.77	184.61	1.84	3.2	Box Culvert	182.77	182.68	S to N	Lowest SFIT 184.61													340902.323	4680743.622
	9th-RC-3	187.86	188.85	0.99	4.2	Box culvert	187.86	187.82	S to N														340621.289	4677233.168
	9th-RC-6	187.11	188.61	1.5	1.9	CSPA	187.11	187.3	S to N														340640.403	4677409.118
	9th-RC-8	185.31	186.94	1.63	3.1	Box Culvert	185.31	185.49	S to N									~2.4					340698.287	4678455.549
	9th-RLC-4	187.66	188.96	1.3	-	CP	187.66	187.65	S to N														340619.7	4677304.066
Desjardins Drain	DES-RC-01	180.83	182.22	1.39	-	HDPE	181.27	181.1	E to W														343761.258	4683170.425
Branch of Downing Drain	DWNBRNCH-RC-1	189.42	190.28	0.86	1.25	Box Culvert	189.16	189.4	S to N														338551.273	4676684.317
Washbrooke drain	DWN-RC-5	187.68	188.7	1.02	-	CSP	187.46	187.68	W to E														339765.618	4677530.511
	DWN-RC-8	186.52	188.22	1.7	2.2	CSPA	186.52	186.62	W to E														340376.164	4677616.571
	DWN-RLC-7	187.29	188.44	1.15	-	CP	187.29	187.1	W to E			1.2		15.7	CSP	CNR - mentioned in Talbot McGarthy drainage report							340262.641	4677579.396
-	ECSE-RC-10	179.08	180.63	1.55	2.9	Box Culvert	179.08	178.88	S to N		2	1.8	3.05		Box culvert	E.C. Row Expressway - Mentioned in Gouin Drainage Report							342435.727	4684463.228
Gouin Drain	ECSE-RC-9	180.68	181.53	0.85	-	CSP	180.79	180.68	E to W														343485.736	4684960.597
	GOUIN-RC-01	179.67	181.41	1.74	2.28	CSPA	180.5	180.5	E to W			1.7	2.23	15.6	CSPA	Banwell Road - Mentioned in Gouin Drainage Report							343524.499	4684670.36
	GOUIN-RC-02	179.15	180.7	1.55	-	CSP	179.15	179.23	S to N		2	1.5		19		E.C. Row Avenue - Mentioned in Gouin Drainage Report							342460.463	4684421.02
Hurley Drain	HURL-RC-2	187.16	188.35	1.19	2.4	CSPA	187.16	186.94	W to E	Sedimentation at upstream end of Culvert, 2.4 m is skew width						County Road 46 - Mentioned in Hurley Relief and Branch Drainage Report - no details							339773.266	4678084.374
	HURL-RC-4	186.46	187.7	1.24	2.5	Box Culvert	186.46	186.5	S to N							401 - Mentioned in Hurley Relief and Branch Drainage Report - no details							340053.67	4678579.611
	HURL-RC-7	185.54	186.83	1.29	3	Box Culvert	185.54	185.41	W to E	Width measured based on TOPCONC													340761.815	4678928.975
Hawkins Drain	HWK-RC-1	176.63	178.2	1.57	2.9	Box Culvert	176.63	176.57	W to E	width calculated based on CV-EDGE													340189.378	4686869.008
	HWK-RC-2	175.88	177.59	1.71	3	Box Culvert	175.88	175.34	W to E	width calculated based on CV-EDGE													340636.133	4686801.87
Lachance Drain	LACH-RC-01	179.61	181.49	1.88	1.26	CSPA	179.61	179.61	E to W	Dillon survey identified as 1800 CSP wide.		1.26	1.88	13.9	CSPA	Banwell Road - Mentioned in Lachance drainage report							343638.327	4683954.595
	LACH-RLC-01	178.97	180.77	1.8	-	RCP	178.97	178.83	E to W	Dillon survey identified as RCP 1800													342817.554	4683621.146
	LACH-RLC-02	178.94	180.74	1.8	-	RCP	178.94	178.98	E to W	Dillon survey identified as RCP 1800													342999.927	4683611.729
Lappan Drain	LAP-RC-2	183.78	185.61	1.83	1.7	Box Culvert	183.78	183.74	W to E														339317.893	4682318.459
	LAP-RC-3	181.01	182.9	1.89	3	Box Culvert	181.01	181.32	E to W														340591.194	4682765.258

Drain Name	Structure ID	Geoprocess Survey and Dillon Survey										Drainage Reports					As-built Drawings						X-Coordinate	Y-Coordinate
		Invert mASL	Obvert mASL	Diameter (Height) m	Width m	Structure Type	Inlet Invert mASL	Outlet Invert mASL	Flow Direction	General Comments	Barrels (if more than 1)	Diameter (Height) m	Width (Span) m	Length m	Structure Type	Comments	Diameter (Height) m	Width (Span) m	Length m	Structure Type	Soffit ELEV mASL	Top of Deck mASL		
Little River	LR-CNR_US.1n	174.68	178.26	3.58	16.6	Bridge	174.68	174.74	S to N	Modeled as 2 barrels with a middle pier, hydraulic opening is 15.1 m, total span is 16.6 m	2												341411.232	4686692.037
	LR-McHugh_US.1n	174.13	179	4.87	38.7	Bridge	174.09	174.13	S to N	Deck Bridge; lowest soffit 179							4.2	38.81	20.9	Bridge	178.751		341321.22	4687128.748
	LR-Lauz_US.1n	175.38	177.72	2.34	15.6	Bridge	175.2	175.38	W to E	No Soffit survey data; Abutment elevation of 177.72 used							6	15.24	12.5	Bridge			341012.014	4685959.994
	LR-Little_US.1n	174.15	176.62	2.47	16.7	Bridge	174.15	173.91	S to N	Deck Bridge; Lowest SFIT 176.62							2.82	15.21	9.65	Bridge	176.64		341197.595	4687910.405
	LR-RC-01	176.07	180.95	4.88	14.7	Bridge	176.05	176.07	S to N	Lowest SFIT 180.95							4.13	13.72	20.42	Box			341363.05	4684767.285
	LR-RC-02	178.62	181.45	2.83	10.8	Bridge	178.62	178.6	SW to NE	Lowest SFIT 181.45							2.7	9.315	9.14	Bridge	181.602	182.15	342277.771	4683073.07
	LR-RC-03	177.79	181.4	3.61	14.8	Box culvert	177.79	177.74	S to N	Lowest SFIT 181.4													342216.193	4683618.015
	LR-RC-04	181.02	183.91	2.89	5.8	Box Culvert	180.75	181.02	S to N	Lowest SFIT 183.91						Baseline Road Bridge - mentioned in 6th Concession Drainage Report - no details							341590.118	4680693.194
	LR-RC-05	176.75	181.51	4.76	18	Box Culvert	176.58	176.75	SE to NW	Lowest SFIT 181.51								17.875			181.8		341772.521	4683945.826
	LR-RC-06	177.09	181.69	4.6	11.8	Bridge	177.09	176.81	S to N	Model used asbuilt drawing height		~6	~12	~48	Bridge	From Culvert Structure drawings from the City of Windsor	4.3	12.19	51	Bridge	181.69		341535.822	4684229.501
	LR-RC-07	179.74	182.13	2.39	6.4	Box Culvert	179.73	179.74	S TO N	Lowest SFIT 182.13													342011.723	4681807.15
	LR-RC-08	179.42	182.87	3.45	10.7	Box Culvert	179.33	179.42	SW to NE	Lowest SFIT 182.87													342130.654	4682184.452
	LR-RC-09	173.2	176.93	3.73	29	Bridge	173.2	173.12	S TO N	Deck bridge; Lowest SFIT 176.93													341070.106	4688603.468
	LR-RC-10	172.55	176.29	3.74	15.8	Bridge	172.55	172.52	S TO N	Deck arch bridge; lowest SFIT 176.29							3.96	22.86		Bridge			340969.993	4689220.898
	LR-RC-4	185.35	186.55	1.2	1.8	Box Culvert	185.35	185.29	S to N								1.52	1.83	50.7	Box Culvert			341404.812	4678413.264
	LR-Tec_US.1n	174.87	177.79	2.92	15.3	Bridge	174.87	174.81	W to E	Lowest SFIT 177.79								15.24	21.23	Bridge	177.62		341173.732	4686461.931
	C76_1	172.805	176.805	4	20.1	Box Culvert	172.805	172.796	S to N														340974.902	4689187.869
McGill Drain	McG-RC-10	177.95	179.82	1.87	2.4	Box Culvert	177.95	177.86	S to N							Concession Road 8 - mentioned in North Townline Drainage Report - no details							341855.407	4683745.561
	McG-RC-7	181.68	183	1.32	1.5	Box Culvert	181.68	181.77	W to E							Lauzon Parkway - mentioned in McGill Drainage Report - no details							340706.011	4682503.768
	McG-RLC-2	179.57	182.79	3.22	3.4	Box Culvert	179.57	179.63	W to E														341608.379	4683391.696
	McG-RLC-9	179.37	181.256	1.8	-	CSP	179.52	179.37	S to N	Inlet is a Box culvert / Outlet is CSP, Modelled as the CSP outlet pipe (governing restriction).													341660.297	4683643.328
North Townline Drain	NTL-RC-10	185.11	186.05	0.94	-	CP	185.11	184.99	W to E														339578.204	4681280.75
	NTL-RC-17	182.09	183.46	1.37	6.9	Box Culvert	182.09	182.02	W to E	Sedimentation at upstream end of Culvert, Lowest SFIT 183.46													340966.913	4681577.649
Parent Relief Drain	PRD-RC-1	176.27	177.67	1.35	-	CP	176.27	176.27	E to W														342553.689	4686496.744
Rivard Drain	RIV-RC-02	180.7	181.75	1.05	-	HDPE	180.7	180.6	W to E							Lauzon Parkway - Mentioned in Rivard Drainage Report - no details							342103.143	4682247.34
	RIV-RC-1	182.08	183.15	1.07	1.6	Box Culvert	182.08	182.1	W to E	Sedimentation at upstream end of Culvert													340933.761	4681985.326
Russette Drain Branch	RUSB-RC-02	181.25	182.54	1.29	1.8	Box Culvert	181.25	181.2															340356.127	4683826.879
	RUSBR-RC-1	181.53	182.82	1.29	1.8	Box Culvert	181.53	181.44	W to E														340129.511	4683798.649
Russette Drain	RUS-RC-01	178.4	180.28	1.88	1.7	Box Culvert	178.4	178.35				2.1	3.8		Box Culvert	E.C. Row Expressway Eastbound on-ramp - mentioned in Russette Drainage report							341468.383	4684180.126
	RUS-RC-03	178.6	180.48	1.88	1.7	Box Culvert	178.6	178.55			2	2.2	4		Box Culvert	E.C. Row Expressway Northbound off-ramp - mentioned in Russette Drainage report							341412.061	4684147.193
	RUS-RC-12	179.58	181.38	1.8	3	Box Culvert	179.58	179.49	S to N			1.8	3		Box Culvert	South Service Road - mentioned in Russette drainage report							341147.06	4684027.074
	RUS-RC-13	179.36	181.26	1.9	3.8	Box Culvert	179.36	179.28	S to N		2	1.9	3.8		Box Culvert	E.C. Row Expressway Southbound off-ramp - Mentioned in Russette drainage report							341163.611	4684064.512
	RUS-RC-14	179.15	181.03	1.88	1.7	Box Culvert	179.15	179.1	W to E		2	2	3.8		Box Culvert	Lauzon Parkway - mentioned in Russette Drainage Report	3.66	5.79	20	Bridge	183.23	183.78	341235.576	4684102.909
	RUS-RC-2	184.18	185.98	1.8	3	Box Culvert	184.18	184.44	E to W	Sedimentation at downstream end of culvert		1.8	3		Box Culvert	South Service Road - mentioned in Russette drainage report							338996.405	4683048.552
	RUS-RC-5	181.65	183.45	1.8	3	Box Culvert	181.65	181.55	W to E	Dense vegetation at both structure inlet and outlet.		1.8	3		Box Culvert	South Service Road - mentioned in Russette drainage report							340302.683	4683421.412
	RUS-RLC-10	180.2	181.9	1.7	3	Box Culvert	180.2	180.25	S to N			1.7	3		Box Culvert	CNR - mentioned in Russette Drainage report							340885.653	4683682.407
Talbot McCarthy	TMD-RC-1	189.02	190.21	1.19	1.4	Box Culvert	189.02	189.35	S to N														339303.345	4676417.588
	TMD-RC-7	187.37	188.57	1.2	-	CSP	187.37	187.46	S to N			1.2		13.4	CSP	North Talbot Road - mentioned in Talbot McCarthy Road							340280.028	4677353.239
Watson Drain	WAT-RC-24	182.29	184.29	1.9	1.99	CSPA	182.29	182.25	S to N	Bottom rusted out		2		28	CSP	Concession Road 10 / Baseline Road 10 (No. 23) - mentioned in Watson drainage report							342238.207	4680587.873
	WAT-RC-28	180.98	182.41	1.43	2.9	Box Culvert	180.98	181.02	S to N			1.8	3	30	Box Culvert	Concession Road 10 / County Road 42 (No. 27) - mentioned in Watson drainage report	1.27	3.05	21	Box Culvert			342334.851	4681864.869
	WAT-RC-5	184.75	186.3	1.55	1.8	Box Culvert	184.75	184.69	S to N			1.5	1.5	50	Box Culvert	Concession Road 10 / Highway 401 (No. 5) - mentioned in Watson drainage report							342051.784	4678375.731

Appendix D-2

Initial Buildout Condition Model Schematics

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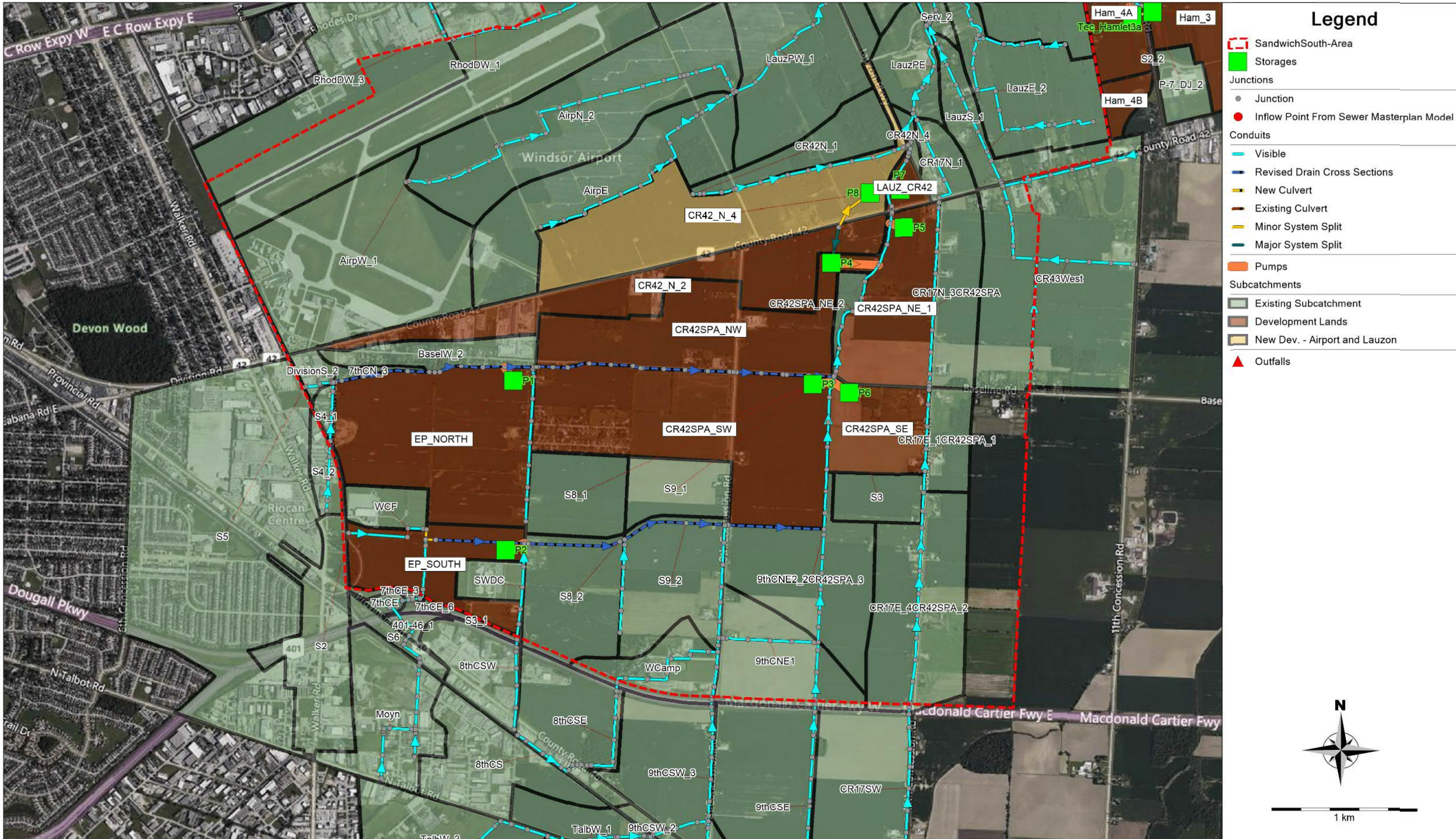
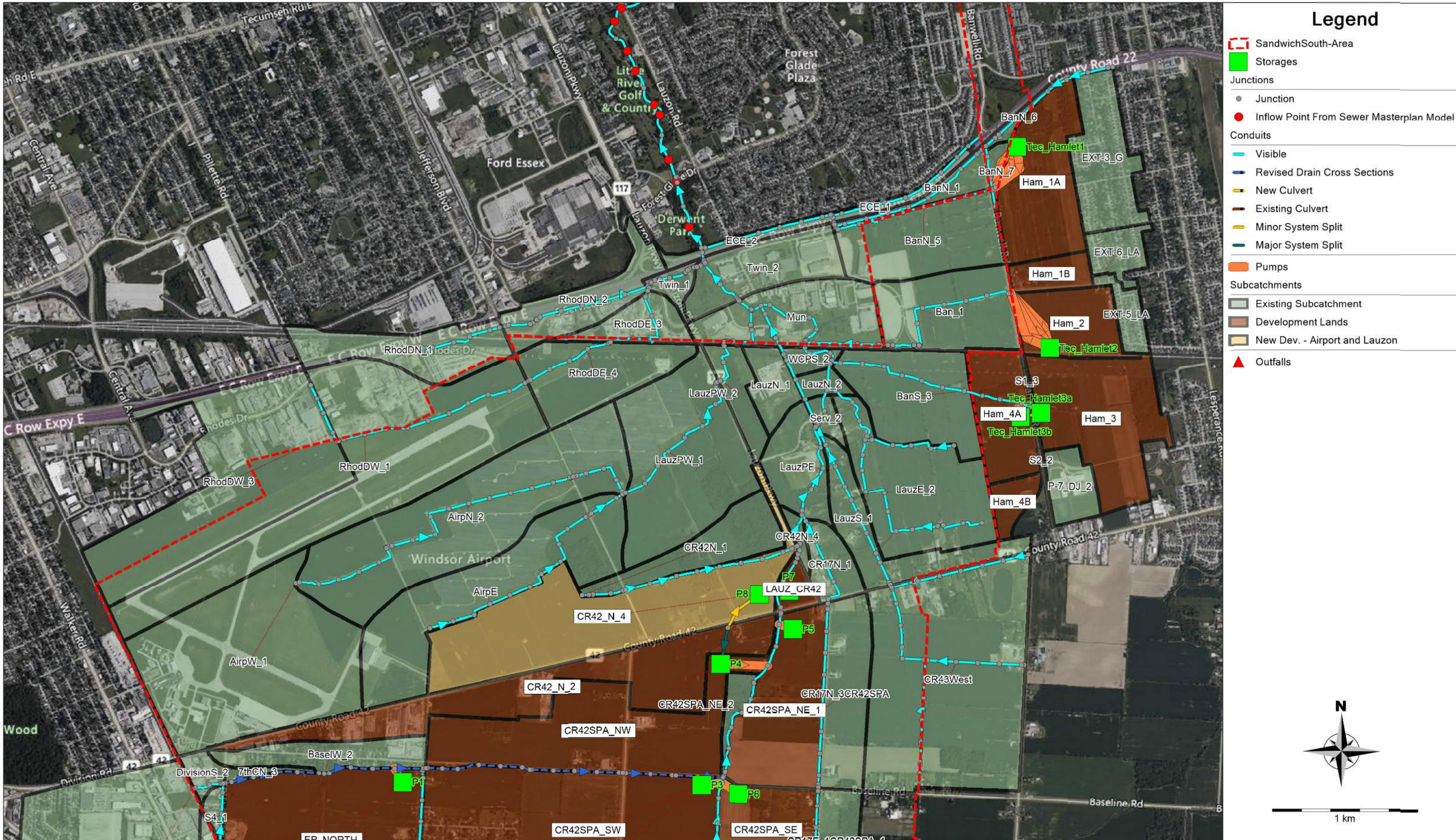
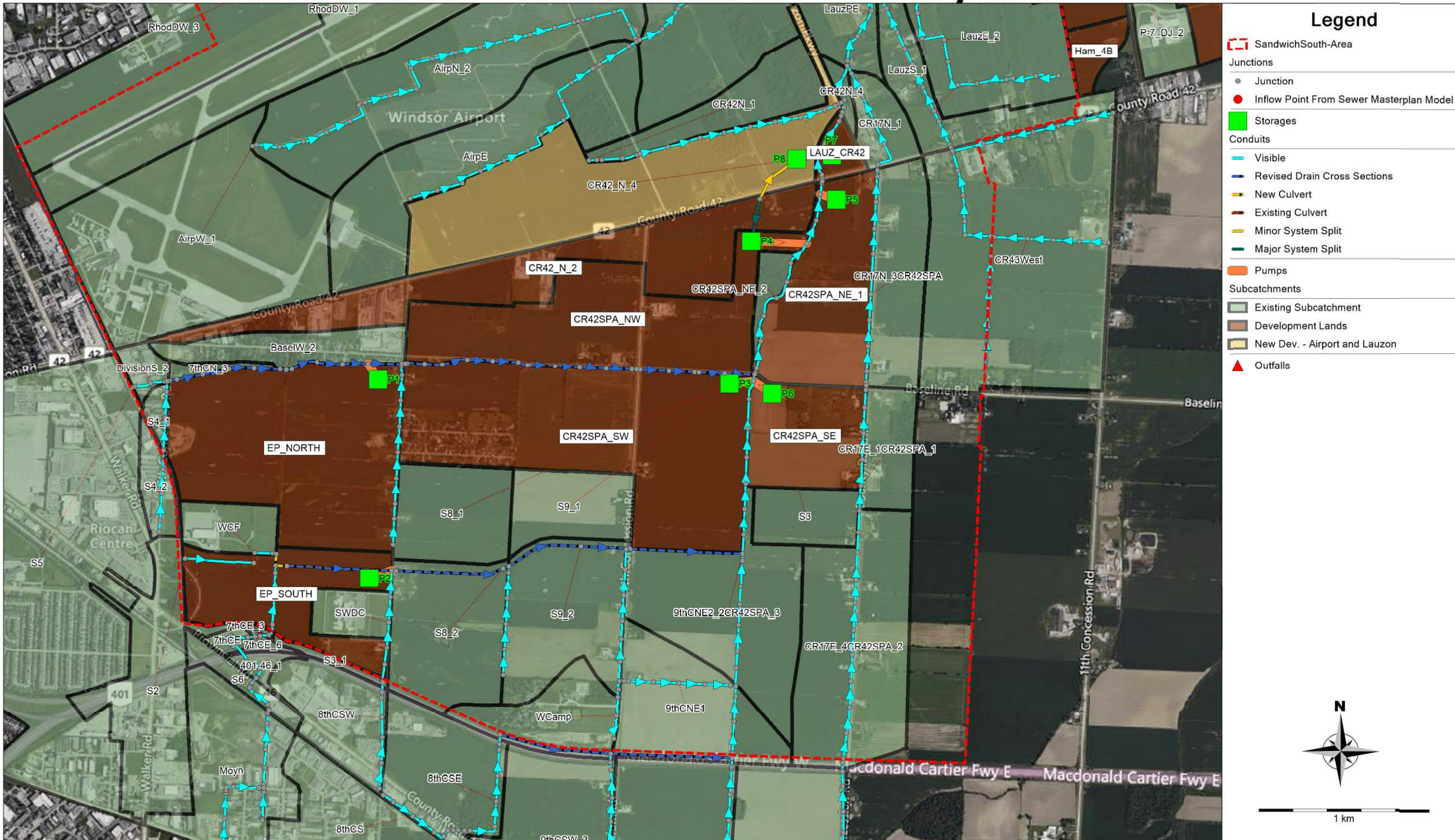
Sandwich South Master Plan - Initial Buildout Condition Model Layout



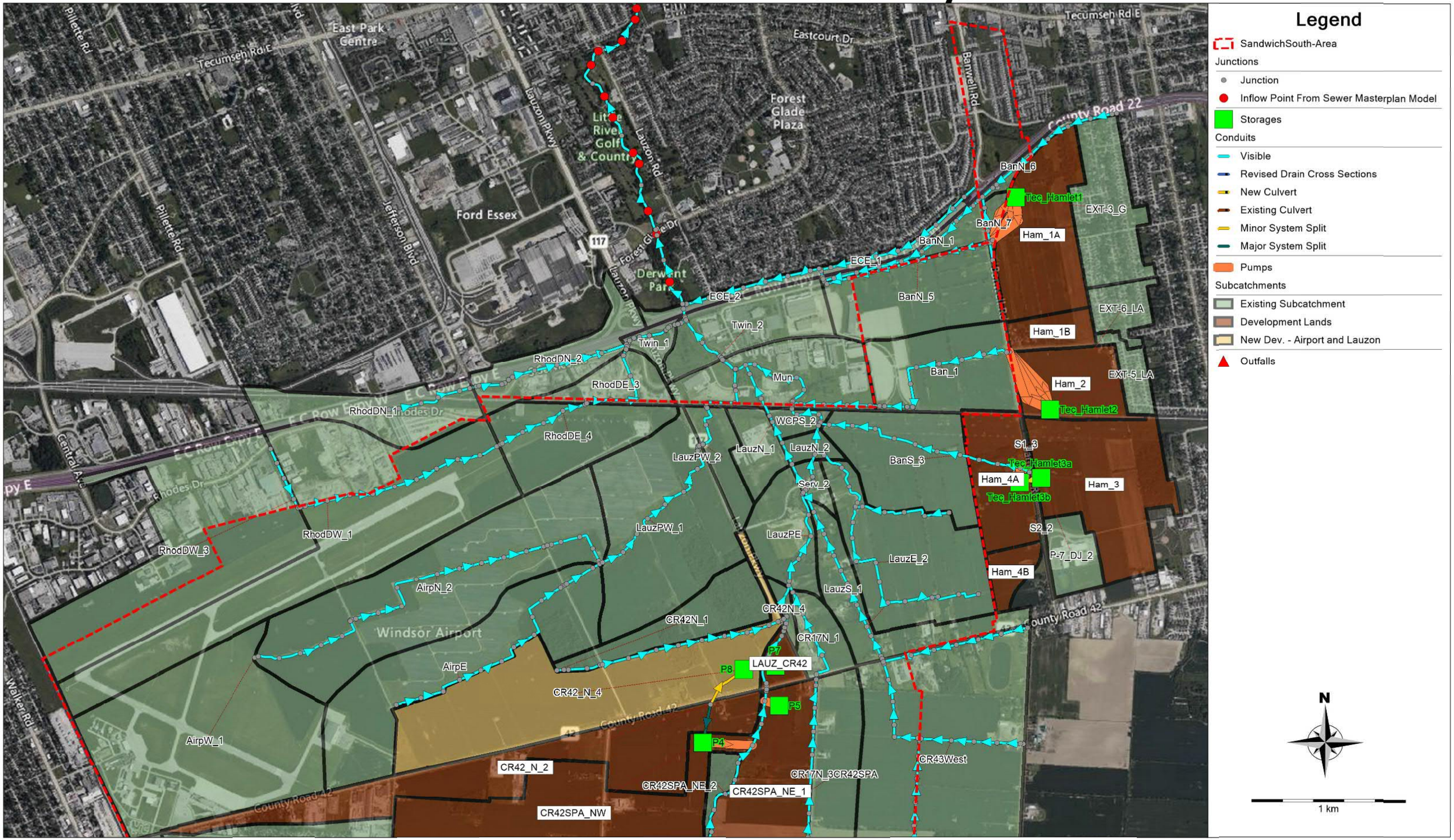
Sandwich South Master Plan - Initial Buildout Condition Model Layout



Sandwich South Master Plan - Initial Buildout Condition with Hurley Relief Drain Redirection Model Layout



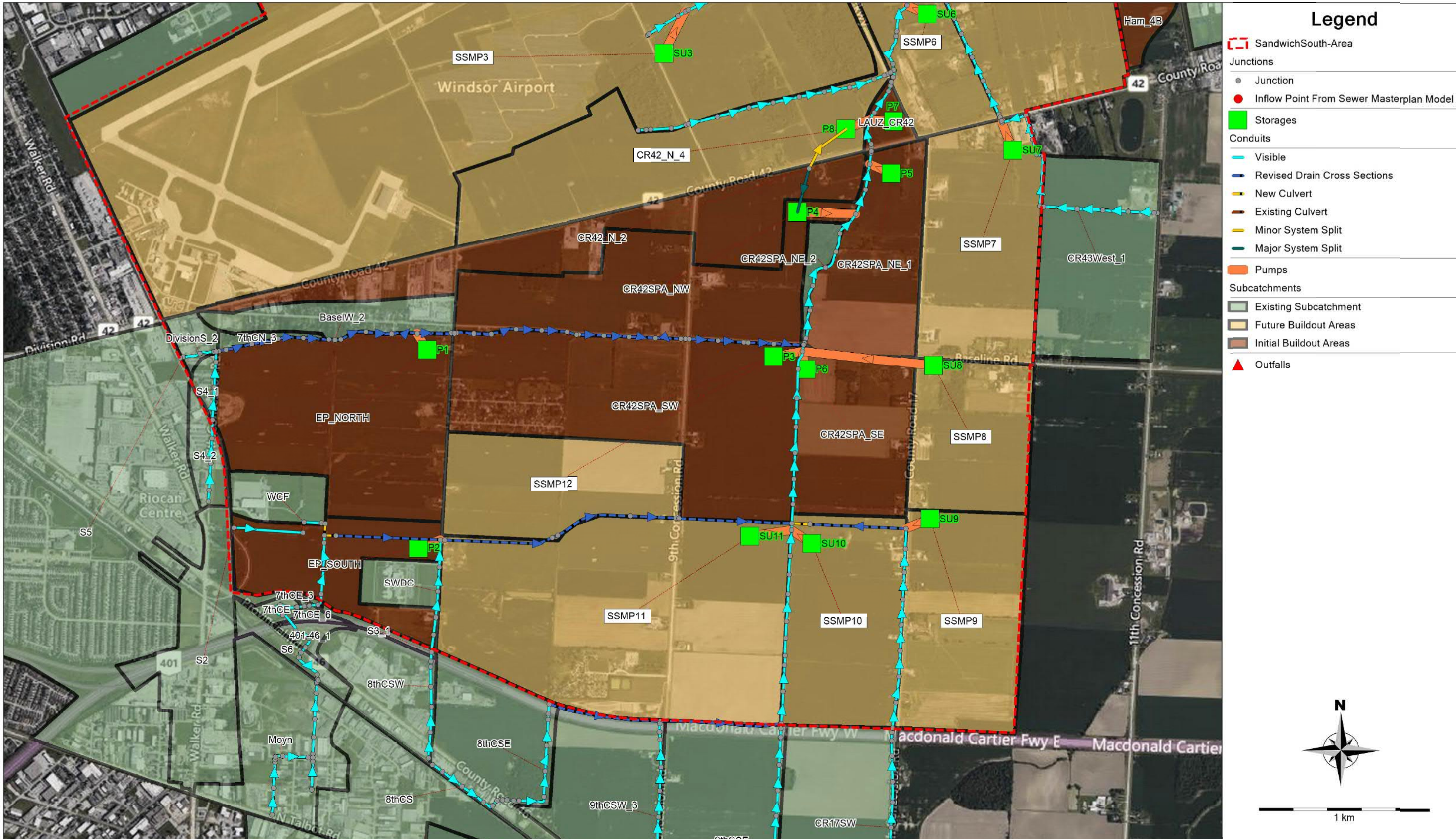
Sandwich South Master Plan - Initial Buildout Condition with Hurley Relief Drain Redirection Model Layout



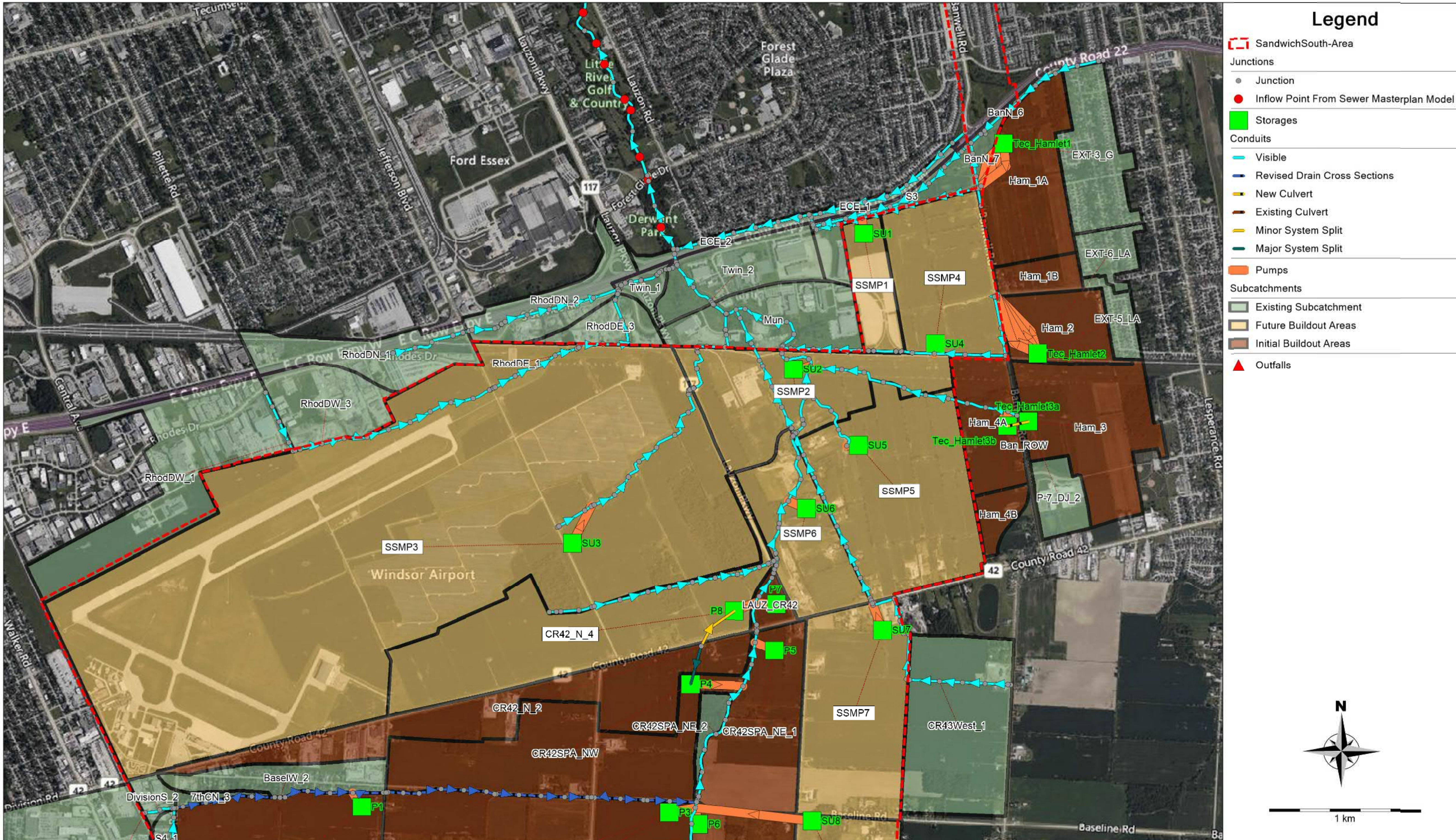
Appendix D-3

Ultimate Buildout Condition Model Schematics

Sandwich South Master Plan - Ultimate Buildout Condition Model Layout



Sandwich South Master Plan - Ultimate Buildout Condition Model Layout



Appendix D-4

Initial Buildout Area Water Quality and Quantity Design Considerations

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Sandwich South Master Planning Area - Initial Buildout Area SWM Facility Design Model Results								
Design Event	Design Water Level (m)							
	P1	P2	P3	P4	P5	P6	P7	P8
	E-Pelton North	E-Pelton South	CR42 SPA SW	CR42 SPA NW	CR42 SPA NE	CR42 SPA SE	LAUZON INTERSECTION	CR42SPA N, CR42-LAUZON ROW, AIRPORT
Minimum Pond NWL*	183.00	183.90	180.20	179.00	178.00	179.30	179.10	178.00
32mm Quality Event	183.94	184.98	181.52	179.85	179.04	180.56	179.53	179.26
2YR 4h Chicago	184.11	185.18	181.74	180.02	179.23	180.81	179.66	179.53
5YR 4h Chicago	184.49	185.6	182.21	180.39	179.64	181.3	179.93	180.07
10YR 4h Chicago	184.73	185.83	182.49	180.62	179.88	181.58	180.09	180.38
25YR 4h Chicago	185.03	186.13	182.84	180.98	180.18	181.93	180.3	180.74
50YR 4h Chicago	185.23	186.32	183.07	181.26	180.38	182.16	180.45	180.94
100YR 4h Chicago	185.44	186.53	183.3	181.56	180.58	182.4	180.6	181.15
100YR 24h SCS	185.54	186.62	183.37	181.5	180.67	182.46	180.64	181.45
100YR 24h Chicago	185.71	186.77	183.59	181.92	180.83	182.66	180.76	181.47
Urban Stress Test	186.32	187.36	184.25	182.61	181.41	183.31	181.16	182.21
Max Pond Level and Active Storage	187.50	189.30	184.50	183.50	183.00	184.50	182.60	183.00
Freeboard from Governing 100YR WSEL	*1.79*	*2.53*	*0.91*	*1.58*	*2.17*	*1.84*	*1.84*	*1.53*
Freeboard from UST WSEL	*1.18*	*1.94*	*0.25*	*0.89*	*1.59*	*1.19*	*1.44*	*0.79*

Design Event	Volume (m^3)							
	P1	P2	P3	P4	P5	P6	P7	P8
	E-Pelton North	E-Pelton South	CR42 SPA SW	CR42 SPA NW	CR42 SPA NE	CR42 SPA SE	LAUZON INTERSECTION	CR42SPA N_AIRPORT
32mm Quality Event	19,969	10,226	33,323	15,625	11,699	11,865	860	34,112
2YR 4h Chicago	24,929	12,739	43,077	19,403	14,576	14,935	1,179	43,831
5YR 4h Chicago	37,448	18,499	65,967	29,047	21,265	21,951	1,889	66,156
10YR 4h Chicago	45,758	22,200	80,942	35,620	25,577	26,447	2,351	80,685
25YR 4h Chicago	57,380	27,293	101,838	46,950	31,519	32,635	3,038	98,412
50YR 4h Chicago	65,474	30,807	116,373	56,379	35,622	36,901	3,534	109,377
100YR 4h Chicago	74,475	34,692	132,530	67,320	40,159	41,615	4,089	121,102
100YR 24h SCS	79,224	36,563	137,337	65,062	42,115	42,914	4,240	139,730
100YR 24h Chicago	86,850	39,750	153,300	81,199	45,900	47,250	4,700	141,157
Urban Stress Test	117,800	52,900	206,100	111,804	61,100	62,400	6,500	190,404
Max Pond Level and Active Storage	187,461	110,953	223,741	156,960	112,085	95,185	14,673	247,240

** P1 and P3, NWL (Normal Water Level) values represent the bottom of those dry ponds.*

East Pelton SPA - Dry Pond P1				
Stage	Elevation (m)	Area (m^2)		
		East Cell	Central Cell	West Cell
DRY POND BOTTOM	183.00	12,990	0	0
	183.20	14,148	4,575	0
	183.50	15,313	5,494	0
	183.80	16,487	6,255	3,881
	184.00	17,653	7,013	4,414
	184.50	20,014	8,547	5,763
	185.00	22,395	10,069	7,130
	185.50	24,794	11,591	8,524
	186.00	27,215	13,116	9,922
	186.50	29,654	14,642	11,349
	187.00	32,111	16,170	12,791
TOP OF BANK	187.50	34,590	17,691	14,252

CR 42 SPA/CR 42 Road (Major System Only) - Wet Pond P4		
Stage	Elevation (m)	Area (m^2)
NWL	179.00	14,193
	179.50	18,888
	180.00	24,122
	180.50	28,430
	181.00	32,775
	181.50	37,160
	182.00	41,582
	182.50	46,043
	183.00	50,543
TOP OF BANK	183.50	55,081

Lauzon Parkway/CR 42 Road Intersection - Wet Pond P7		
Stage	Elevation (m)	Area (m^2)
NWL	179.10	1,752
	179.60	2,376
	180.10	3,040
	180.60	3,743
	181.10	4,485
	181.60	5,266
	182.10	6,087
TOP OF BANK	182.60	6,947

East Pelton SPA/E-W Arterial Road West - Wet Pond P2		
Stage	Elevation (m)	Area (m^2)
NWL	183.90	6,850
	184.40	9,219
	184.90	11,628
	185.40	14,076
	185.90	16,564
	186.40	19,090
	186.90	21,656
	187.40	24,261
	187.90	26,906
	188.40	29,589
	188.90	32,312
TOP OF BANK	189.34	34,741

CR42 SPA/Lauzon Parkway - Wet Pond P5		
Stage	Elevation (m)	Area (m^2)
NWL	178.00	8,515
	178.50	11,187
	179.00	13,898
	179.50	16,649
	180.00	19,438
	180.50	22,267
	181.00	25,136
	181.50	28,043
	182.00	30,990
	182.50	33,976
TOP OF BANK	183.00	37,001

CR 42 SPA/CR 42 Road (Minor system Only)/Lauzon Parkway/Airport - Wet Pond P8		
Stage	Elevation (m)	Area (m^2)
NWL	178.00	19,477
	178.50	25,453
	179.00	31,467
	179.50	37,521
	180.00	43,613
	180.50	49,743
	181.00	55,913
	181.50	64,362
	182.00	67,915
	182.50	71,512
TOP OF BANK	183.00	75,152

CR42 SPA/E-W Arterial Road Central - Dry Pond P3				
Stage	Elevation (m)	Area (m^2)		
		East Cell	Central Cell	West Cell
DRY POND BOTTOM	180.20	10,728	0	0
	180.70	13,090	10,374	0
	181.20	15,466	13,035	0
	181.40	16,661	14,360	9,102
	181.70	17,864	15,693	10,784
	182.20	20,282	18,347	13,600
	182.70	22,721	21,007	16,439
	183.20	25,177	23,666	19,297
	183.70	27,653	26,325	22,170
	184.20	30,152	28,974	25,070
TOP OF BANK	184.50	31,657	30,574	26,816

CR42 SPA/Lauzon Parkway - Wet Pond P6		
Stage	Elevation (m)	Area (m^2)
NWL	179.30	6,691
	179.80	8,810
	180.30	10,969
	180.80	13,166
	181.30	15,403
	181.80	17,679
	182.30	19,994
	182.80	22,348
	183.30	24,741
	183.80	27,174
	184.30	29,646
TOP OF BANK	184.50	30,645

Sandwich South Master Planning Area - Initial Buildout Area SWM Facility Permanent Pool Design Calculations

Table 3.2 Water Quality Storage Requirements based on Receiving Waters [1], [2]

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level: 35%	Storage Volume (m^3/ha) for Impervious Level: 55%	Storage Volume (m^3/ha) for Impervious Level: 70%	Storage Volume (m^3/ha) for Impervious Level: 85%
Enhanced 80% long-term S.S. removal	Infiltration	25	30	35	40
Enhanced 80% long-term S.S. removal	Wetlands	80	105	120	140
Enhanced 80% long-term S.S. removal	Hybrid Wet Pond/Wetland	110	150	175	195
Enhanced 80% long-term S.S. removal	Wet Pond	140	190	225	250
Normal 70% long-term S.S. removal	Infiltration	20	20	25	30
Normal 70% long-term S.S. removal	Wetlands	60	70	80	90
Normal 70% long-term S.S. removal	Hybrid Wet Pond/Wetland	75	90	105	120
Normal 70% long-term S.S. removal	Wet Pond	90	110	130	150
Basic 60% long-term S.S. removal	Infiltration	20	20	20	20
Basic 60% long-term S.S. removal	Wetlands	60	60	60	60
Basic 60% long-term S.S. removal	Hybrid Wet Pond/Wetland	60	70	75	80
Basic 60% long-term S.S. removal	Wet Pond	60	70	85	95
Basic 60% long-term S.S. removal	Dry Pond (Continuous Flow)	90	150	200	240

Note: Ponds P1 and P3 are recommended to be dry ponds, therefore, stormwater quality control shall be provided using other measures. The Storm Tech Isolator Row Plus System is an example of an underground chamber unit that can be designed to address treatment needs.

Dry Pond P1	
Contributing Area (ha):	124.1
Weighted Impervious (%):	74
Treatment Volume (m^3/ha):	135

Wet Pond P2	
Contributing Area (ha):	52.0
Weighted Impervious (%):	90
Treatment Volume (m^3/ha):	157
Required Permanent Pool (m^3):	**8,159**

Dry Pond P3	
Contributing Area (ha):	224.2
Weighted Impervious (%):	73
Treatment Volume (m^3/ha):	135

Wet Pond P4	
Contributing Area (ha):	99.5
Weighted Impervious (%):	83
Treatment Volume (m^3/ha):	147
Required Permanent Pool (m^3):	**14,628**

Wet Pond P5	
Contributing Area (ha):	60.8
Weighted Impervious (%):	85
Treatment Volume (m^3/ha):	150
Required Permanent Pool (m^3):	**9,123**

Wet Pond P6	
Contributing Area (ha):	63.2
Weighted Impervious (%):	83
Treatment Volume (m^3/ha):	147
Required Permanent Pool (m^3):	**9,290**

Wet Pond P7	
Contributing Area (ha):	7.7
Weighted Impervious (%):	23
Treatment Volume (m^3/ha):	78
Required Permanent Pool (m^3):	**603**

Wet Pond P8	
Contributing Area (ha):	179.1
Weighted Impervious (%):	77
Treatment Volume (m^3/ha):	139
Required Permanent Pool (m^3):	**24,895**

INITIAL BUILDOUT AREA

Wet Pond P2

Drainage Area	52.0 ha
% Impervious:	**90**

REPORTING AT OUT 1

East Pelton - Required Forebay Length

Parameters:

Length to width ratio of forebay, r =	10.0:1	
Peak outflow (32 mm storm), Q_p =	0.312	m^3/s (24hr ext. det)
Target particle size =	0.15	mm
Settling velocity, V_s =	0.0003	m/s

Forebay Settling Length, Dist

$$Dist = \sqrt{\frac{rQ_P}{V_S}}$$

= 102 m

Check Dispersion Length, $Dist_2$

Desired velocity in forebay, V_f =	0.25	m/s
Inlet flowrate , Q_{10} =	4.850	m^3/s
Depth in forebay, d =	2.0	m

$$Dist_2 = \frac{8Q}{dV_f}$$

= 78 m

Therefore, the settling length of 102 m governs the design.

Forebay Length =	2.0 metres/ha

Provided Length:	**= 102 m**
Required Width at Spillover from Forebay to Main Pond Cell:	10.2 m

INITIAL BUILDOUT AREA

Wet Pond P4

Drainage Area	99.5 ha
% Impervious:	**83**

REPORTING AS OUT 1 (SOUTH TRUNK)

CR42 SPA - Required Forebay Length

Parameters:

Length to width ratio of forebay, *r* = 5.0:1

Peak outflow (32 mm storm), Q_p = 0.302 m^3/s (24hr ext. det)

Target particle size = 0.15 mm

Settling velocity, V_s = 0.0003 m/s

Forebay Settling Length, Dist

$$Dist = \sqrt{\frac{rQ_P}{V_S}}$$

= 71 m

Check Dispersion Length, $Dist_2$

Desired velocity in forebay, V_f = 0.35 m/s

Inlet flowrate , Q_{10} = 6.590 m^3/s

Depth in forebay, *d* = 2.0 m

$$Dist_2 = \frac{8Q}{dV_f}$$

= 75 m

Therefore, the dispersion length of 75 m governs the design.

Forebay Length = 0.8 metres/ha

Provided Length: = 75 m

Required Width at Spillover from Forebay to Main Pond Cell: 15.1 m

REPORTING AS OUT 2 (MID TRUNK)

CR42 SPA - Required Forebay Length

Parameters:

Length to width ratio of forebay, *r* = 5.0:1

Peak outflow (32 mm storm), Q_p = 0.295 m^3/s (24hr ext. det)

Target particle size = 0.15 mm

Settling velocity, V_s = 0.0003 m/s

Forebay Settling Length, Dist

$$Dist = \sqrt{\frac{rQ_P}{V_S}}$$

= 70 m

Check Dispersion Length, $Dist_2$

Desired velocity in forebay, V_f = 0.35 m/s

Inlet flowrate , Q_{10} = 5.130 m^3/s

Depth in forebay, *d* = 2.0 m

$$Dist_2 = \frac{8Q}{dV_f}$$

= 59 m

Therefore, the settling length of 70 m governs the design.

Provided Length: = 70 m

Required Width at Spillover from Forebay to Main Pond Cell: 14.0 m

INITIAL BUILDOUT AREA

Wet Pond P5

Drainage Area	60.8 ha
% Impervious:	**85**

REPORTING AT OUT 1

CR42 SPA - Required Forebay Length

Parameters:

Length to width ratio of forebay, *r* =	13.0:1
Peak outflow (32 mm storm), Q_p =	0.365 m^3/s (24hr ext. det)
Target particle size =	0.15 mm
Settling velocity, V_s =	0.0003 m/s

Forebay Settling Length, Dist

$$Dist = \sqrt{\frac{rQ_P}{V_S}}$$

= 126 m

Check Dispersion Length, $Dist_2$

Desired velocity in forebay, V_f =	0.2 m/s
Inlet flowrate , Q_{10} =	9.420 m^3/s
Depth in forebay, *d* =	2.0 m

$$Dist_2 = \frac{8Q}{dV_f}$$

= 188 m

Therefore, the dispersion length of 188 m governs the design.

Forebay Length =	3.1 metres/ha

Provided Length:	**= 188 m**
Required Width at Spillover from Forebay to Main Pond Cell:	14.5 m

INITIAL BUILDOUT AREA

Wet Pond P6

Drainage Area	63.2	ha
% Impervious:	**83**	

REPORTING AT OUT 1

CR42 SPA - Required Forebay Length

Parameters:

Length to width ratio of forebay, r =	14.0:1	
Peak outflow (32 mm storm), Q_p =	0.380	m^3/s (24hr ext. det)
Target particle size =	0.15	mm
Settling velocity, V_s =	0.0003	m/s

Forebay Settling Length, Dist

$$Dist = \sqrt{\frac{rQ_P}{V_S}}$$

= 133 m

Check Dispersion Length, Dist $_2$

Desired velocity in forebay, V_f =	0.2	m/s
Inlet flowrate , Q_{10} =	8.997	m^3/s
Depth in forebay, d =	2.0	m

$$Dist_2 = \frac{8Q}{dV_f}$$

= 180 m

Therefore, the dispersion length of 180 m governs the design.

Forebay Length =	2.8	metres/ha

Provided Length:	**= 180 m**
Required Width at Spillover from Forebay to Main Pond Cell:	12.9 m

Sandwich South Master Planning Area - Initial Buildout Area SWM Facility Forebay Design Calculations

INITIAL BUILDOUT AREA

Wet Pond P7

Drainage Area	7.7	ha
% Impervious:	**23**	

REPORTING AT OUT 1

Lauzon/CR42 Intersection - Required Forebay Length

Parameters:

Length to width ratio of forebay, r =	5.0:1	
Peak outflow (32 mm storm), Q_p =	0.046	m^3/s (24hr ext. det)
Target particle size =	0.15	mm
Settling velocity, V_s =	0.0003	m/s

Forebay Settling Length, Dist

$$Dist = \sqrt{\frac{rQ_P}{V_S}}$$

= 28 m

Check Dispersion Length, $Dist_2$

Desired velocity in forebay, V_f =	0.2	m/s
Inlet flowrate , Q_{10} =	1.059	m^3/s
Depth in forebay, d =	2.0	m

$$Dist_2 = \frac{8Q}{dV_f}$$

= 21 m

Therefore, the settling length of 28 m governs the design.

Forebay Length =	3.6 metres/ha

Provided Length:	**= 28 m**
Required Width at Spillover from Forebay to Main Pond Cell:	5.5 m

INITIAL BUILDOUT AREA
Wet Pond P8

Drainage Area*	179.1 ha
% Impervious:	**77**

* Drainage area considers no qualtiy control required for greenspace area within Airport Lands

Forebay Length =	0.6 metres/ha

Out 2_AIRPORT
REPORTING AT INLET 2
CR42/CR42 SPA - Required Forebay Length

Drainage Area 83 ha

Parameters:

- Length to width ratio of forebay, r = 5.0:1
- Peak outflow (32 mm storm), Q_p = 0.310 m^3/s (24hr ext. det)
- Target particle size = 0.15 mm
- Settling velocity, V_s = 0.0003 m/s

Forebay Settling Length, Dist

$$Dist = \sqrt{\frac{rQ_P}{V_S}}$$

= 72 m

Check Dispersion Length, Dist$_2$

- Desired velocity in forebay, V_f = 0.5 m/s
- Inlet flowrate , Q_{10} = 13.330 m^3/s
- Depth in forebay, d = 2.0 m

$$Dist_2 = \frac{8Q}{dV_f}$$

= 107 m

Therefore, the dispersion length of 107 m governs the design.

Provided Length: = 107 m

Out 1_CR42
REPORTING AT INLET 1
CR42/CR42 SPA - Required Forebay Length

Drainage Area 91.9 ha

Parameters:

- Length to width ratio of forebay, r = 5.0:1
- Peak outflow (32 mm storm), Q_p = 0.344 m^3/s (24hr ext. det)
- Target particle size = 0.15 mm
- Settling velocity, V_s = 0.0003 m/s

Forebay Settling Length, Dist

$$Dist = \sqrt{\frac{rQ_P}{V_S}}$$

= 76 m

Check Dispersion Length, Dist$_2$

- Desired velocity in forebay, V_f = 0.5 m/s
- Inlet flowrate , Q_{10} = 10.450 m^3/s
- Depth in forebay, d = 2.0 m

$$Dist_2 = \frac{8Q}{dV_f}$$

= 84 m

Therefore, the dispersion length of 84 m governs the design.

Provided Length: = 84 m

Out 3_LAUZON
REPORTING AT INLET 3
CR42/CR42 SPA - Required Forebay Length

Drainage Area 4.2 ha

Parameters:

- Length to width ratio of forebay, r = 5.0:1
- Peak outflow (32 mm storm), Q_p = 0.016 m^3/s (24hr ext. det)
- Target particle size = 0.15 mm
- Settling velocity, V_s = 0.0003 m/s

Forebay Settling Length, Dist

$$Dist = \sqrt{\frac{rQ_P}{V_S}}$$

= 16 m

Check Dispersion Length, Dist$_2$

- Desired velocity in forebay, V_f = 0.2 m/s
- Inlet flowrate , Q_{10} = 0.768 m^3/s
- Depth in forebay, d = 2.0 m

$$Dist_2 = \frac{8Q}{dV_f}$$

= 15 m

Therefore, the settling length of 16 m governs the design.

Provided Length: = 16 m

Summary of Testing

StormTech® Isolator® Row Plus – Pollutant Removal

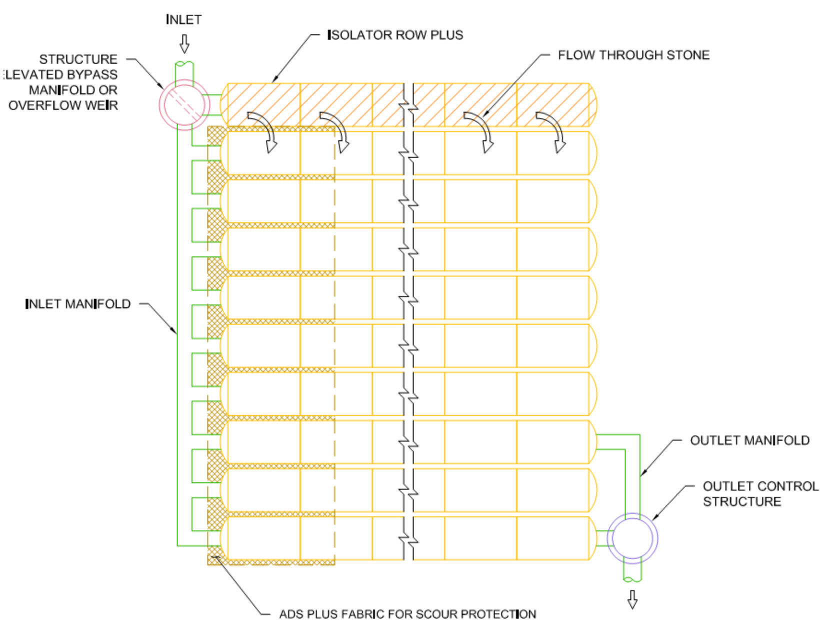
The following information is intended to provide a general overview of the pollutant removal capability of the StormTech Isolator Row Plus, which is a patented filtration type BMP manufactured by StormTech, LLC. The StormTech Isolator Row Plus is covered under several US and International patents.

I. Description:

The StormTech Isolator Row Plus is a row or rows of thermoplastic chambers that sit on a layer of ADS Plus fabric and are connected to a closely located structure for easy access. The chambers provide for settling and filtration of sediment and other contaminants as stormwater rises in the Isolator Row Plus and ultimately passes through the fabric. The open-bottom chambers allow stormwater to flow out of the chambers. Sediment is captured in the Isolator Row Plus, protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

The StormTech Isolator Row Plus is designed to capture the "first flush" and offers the versatility to be sized on a volume basis or a flow-rate basis. An upstream manhole not only provides access to the Isolator Row but includes a high low/concept such that stormwater flow rates or volumes that exceed the capacity of the Isolator Row bypass through a manifold to the other chambers. This is achieved with either a high-flow weir or an elevated manifold. This creates a differential between the Isolator Row Plus and the manifold, thus allowing for settlement time in the Isolator Row Plus.

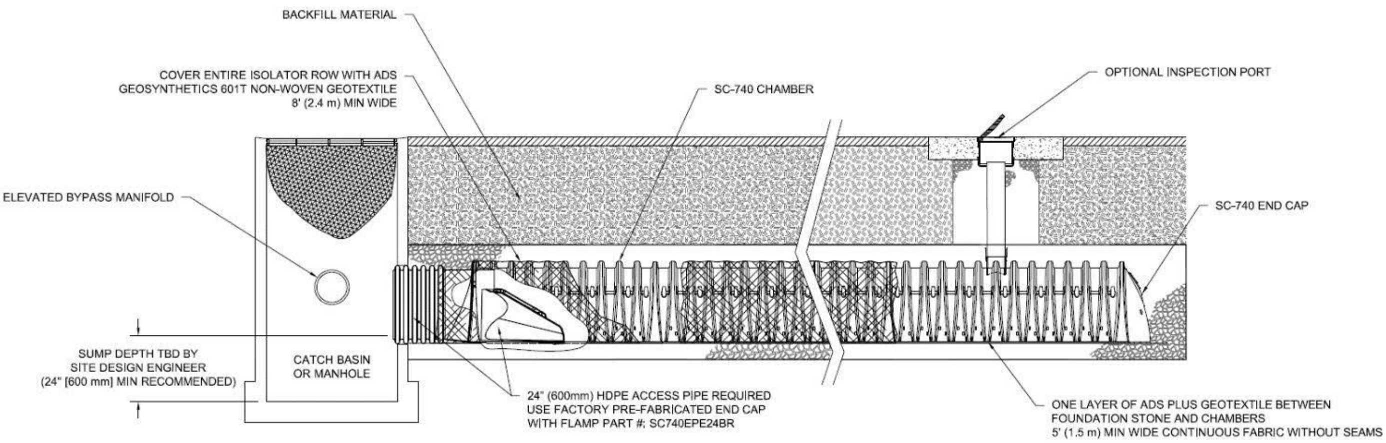
Figure 1: Schematic of the StormTech Isolator Row Plus System



Some of the unique features of the Isolator Row that contribute to its effectiveness and practicality include:

- Vast filtration surface area
- Large sediment storage volume
- Easily maintainable by most pipe and sewer maintenance companies
- Large network of ADS personnel that can help with designs and provide onsite guidance
- A state-of-the-art structural design that meets ASTM standards and incorporates AASHTO safety factors for both live loads and permanent dead loads

Figure 2: Isolator Row Plus Cross Section Detail



II. Applicable Sites:

The Isolator Row Plus can be effectively used for essentially all developed sites. The most common applications are highly impervious sites such as paved parking areas, roads as well as developed sites that include grassy or other landscaped areas. It is not intended to be used for construction sediments.

III. StormTech System & Isolator Row Testing:

October 2006 – Tennessee Tech University's Civil and Environmental Department prepared the "Performance Evaluation of Sediment Removal Efficiency – StormTech Isolator Row". Testing on a full-scale Isolator Row in a laboratory was done to determine the sediment removal efficiency with two different silica-water slurries in accordance with NJCAT protocols. In August of 2007, the technology was verified by NJCAT. Results are shown in Table 1.

September 2010 – The University of New Hampshire Stormwater Center released the "Final Report on Field Verification Testing of the StormTech Isolator Row Treatment Unit". Testing consisted of determining the water quality performance for multiple stormwater pollutants in accordance with TARP Tier II protocol. Testing was done for a system only consisting of the StormTech Isolator Row. Data was recorded for 23 storm events. Results are shown in Table 1.

January 2020 – BaySaver Technologies prepared the "NJCAT Technology Verification of Isolator Row Plus". Testing on a full-scale Isolator Row Plus in a laboratory was done to determine the sediment removal efficiency with a silica-water slurry in accordance with the updated NJCAT protocols. In July of 2020, the technology was verified by NJCAT. Results are shown in Table 1.

June 2020 – North Carolina State University Department of Biological and Agricultural Engineering prepared the technical report "An Evaluation of the StormTech Isolator Row and Subsurface Stormwater Management System at Capital Oaks Retirement Resort, Raleigh, North Carolina". 14 months of monitoring and over 73 precipitation events were completed to study the hydrologic and water quality performance of a StormTech MC-4500 system in Raleigh, NC. Results are shown in Table 1.

Table 1: StormTech Isolator Row 3rd Party Pollutant Removal Efficiency Data

Pollutant	University of New Hampshire (Isolator Row Only) Median	Raleigh, North Carolina (StormTech system with Isolator Row)	Tennessee Tech University (Isolator Row Only)	NJCAT Verification (Isolator Row Plus only)
Total Suspended Solids	83%*	91%*	84%*	81%**
Total Phosphorus	33%	68%	Not Tested	Not Tested
Total Nitrogen	Not Tested	35%	Not Tested	Not Tested
Total Zinc	81%	Not Tested	Not Tested	Not Tested
Total Petroleum Hydrocarbons	91%	Not Tested	Not Tested	Not Tested

*Based on a flow rate of 2.5 gpm/sf (1.70 L/s/m^2) (Isolator Row)
** Based on a flow rate of 4.1 gpm/sf (2.78 L/s/m^2) (Isolator Row Plus)

IV. Product Performance and Design:

Minimum 80% TSS removal is achieved by sizing the Isolator Row PLUS to treat the water quality at a specific flow rate per chamber floor area using a single layer of ADS Plus fabric. The design flow rates for each chamber size are listed below.

Model	Specific Flow Rate	Bottom Area	Flow Per Model
StormTech SC-160LP	4.1 gpm/sf (2.78 L/s/m^2)	11.45 sf (1.06 m^2)	0.11 cfs (3.11 L/s)
StormTech SC-310	4.1 gpm/sf (2.78 L/s/m^2)	17.7 sf (1.64 m^2)	0.16 cfs (4.53 L/s)
StormTech SC-740	4.1 gpm/sf (2.78 L/s/m^2)	27.8 sf (2.58 m^2)	0.26 cfs (7.36 L/s)
StormTech DC-780	4.1 gpm/sf (2.78 L/s/m^2)	27.8 sf (2.58 m^2)	0.26 cfs (7.36 L/s)
StormTech MC-3500	4.1 gpm/sf (2.78 L/s/m^2)	42.9 sf (3.99 m^2)	0.40 cfs (11.33 L/s)
StormTech MC-4500	4.1 gpm/sf (2.78 L/s/m^2)	30.1 sf (2.80 m^2)	0.28 cfs (7.93 L/s)
StormTech MC-7200	4.1 gpm/sf (2.78 L/s/m^2)	50.0 sf (4.65 m^2)	0.45 cfs (12.74 L/s)

V. StormTech Isolator Row Approvals:

The StormTech Isolator Row and Isolator Row Plus have been approved on a project by project basis for tens of thousands of projects around the world. Following are some examples:

- The Isolator Row Plus is a verified filtration manufactured treatment device by the New Jersey Corporation for Advanced Testing (NJCAT) in accordance with NJDEP Filter Protocols.
- In Ohio, the Isolator Row is approved per the Ohio EPA as a pretreatment to underground storage and can be used for both storage volume and pretreatment as the water quality volume all passes through the Isolator Row.
- The Metropolitan St. Louis Sewer District (MSD) has approved the StormTech Isolator Row as a standalone post-construction stormwater Best Management Practice.
- In Massachusetts, approvals for the State DEP requirement of 80% TSS removal on an annual load basis are issued at the Conservation Commission level, and the Isolator Row is commonly used to meet these criteria.
- In Oregon, the Rogue Valley Storm Water Advisory Team (SWAT) has incorporated the StormTech Isolator Row into their Stormwater Design Manual as a pre-approved proprietary device for stormwater quality treatment.
- The Kansas City Metro Chapter of the American Public Works have included the StormTech Isolator Row wit a value rating of 3.0 in their Manual of Best Management Practices for Stormwater Quality.
- Maine DEP has approved the Isolator Row pollutant removal efficiency based on laboratory testing of 110 micron (US Silica OK-110) particle size
- In Texas, the City of Houston PWE as well as Harris county, has recognized the Isolator Row as an official water quality device.
- Under the New Environmental Technology Evaluation program, the Ontario (Canada) Ministry of the Environment has evaluated the Isolator row and issued a Certificate of Technology Assessment
- The Isolator Row Plus has been evaluated and approved for Canadian Environment Technology Verification (ETV) by VerifiGlobal.

V. Isolator Row Maintenance:

The frequency of Inspection and Maintenance varies by location. A routine inspection schedule needs to be established for each individual location, based upon site-specific variables. The type of land use (i.e. industrial, commercial, public, residential), anticipated pollutant load, percent imperviousness, climate, rainfall data, etc., all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection schedule should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If, upon visual inspection, it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

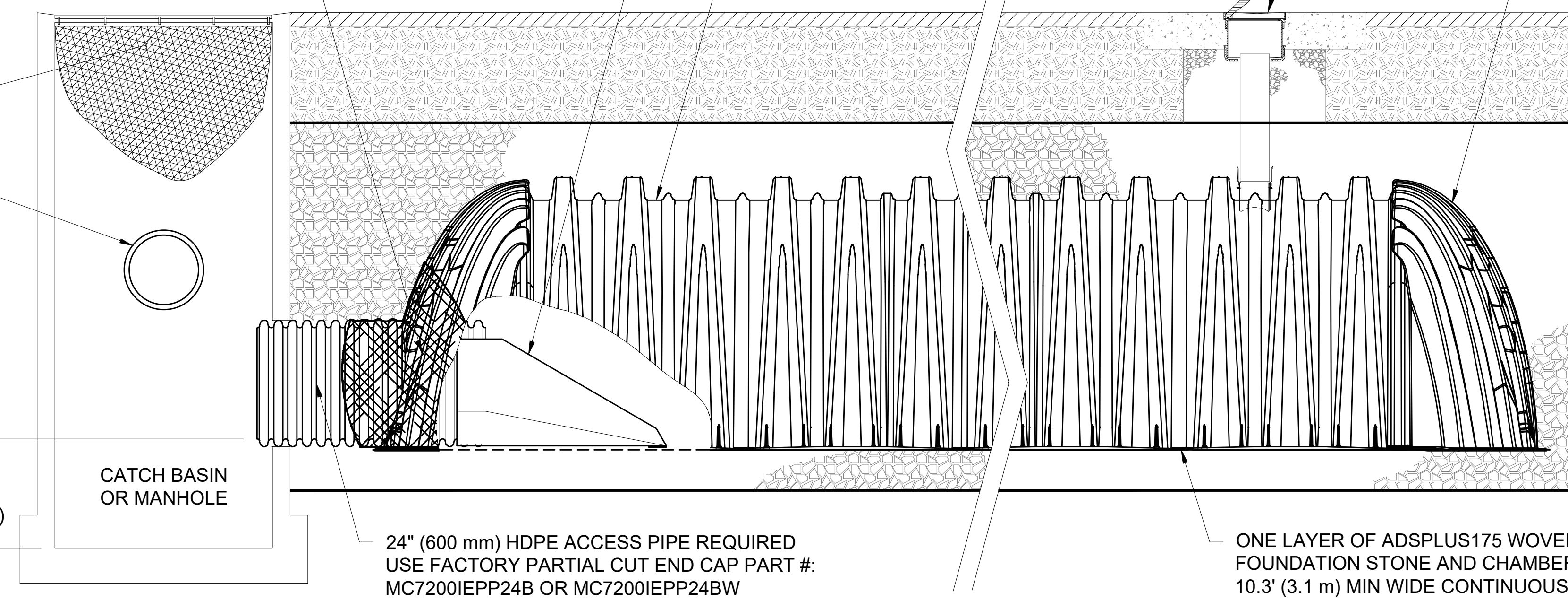
The Isolator Row was designed to reduce the cost of periodic maintenance. By “isolating” sediment to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout.

Maintenance is accomplished with the jetvac process. The jetvac process utilizes a high-pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediment. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/jetvac combination vehicles. Selection of an appropriate jetvac nozzle will improve maintenance efficiency.

Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear-facing jets with an effective spread of at least 45" are best. Most jetvac reels have 200 feet of hose, allowing maintenance of an Isolator Row up to 50 chambers long. The jetvac process shall only be performed on StormTech Isolator Rows that have fabric specified by StormTech over their angular base stone.

Complete details of the design, operation, and maintenance of the Isolator Row Plus can be found in the StormTech Isolator Row and Isolator Row Plus O&M Manuals.

adspipe.com
1-800-821-6710



MC-7200 ISOLATOR ROW PLUS DETAIL

NTS

INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW PLUS FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW PLUS FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR PLUS ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW PLUS
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW PLUS THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

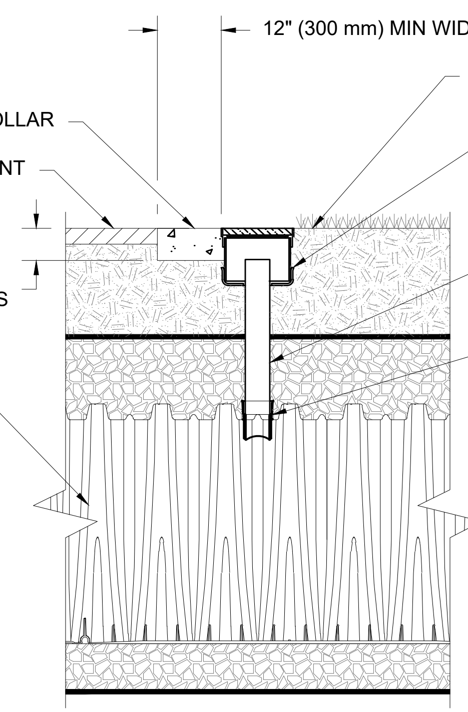
STEP 2) CLEAN OUT ISOLATOR ROW PLUS USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH WATER ELEVATIONS.
2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.



NOTE:
INSPECTION PORTS MAY BE CONNECTED THROUGH ANY CHAMBER CORRUGATION VALLEY.

4" PVC INSPECTION PORT DETAIL (MC SERIES CHAMBER)

NTS

MC-7200
ISOLATOR ROW PLUS DETAILS
DATE: 9/13/22 DRAWN: KLJ
PROJECT #: CHECKED: KLJ

DATE	DRWN	CHKD	DESCRIPTION

StormTech® Chamber System
888-892-2694 | WWW.STORMTECH.COM

ADS
4640 TRUEMAN BLVD HILLIARD, OH 43026

SHEET 1 OF 1

Isolator® Row Plus
O&M Manual

ADS
StormTech™

The Isolator® Row Plus

Introduction

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row Plus is a technique to inexpensively enhance Total Suspended Solids (TSS) and Total Phosphorus (TP) removal with easy access for inspection and maintenance.

The Isolator Row Plus

The Isolator Row Plus is a row of StormTech chambers, either SC-160, SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-4500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for sediment settling and filtration as stormwater rises in the Isolator Row Plus and passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC- 310-3 and SC-740 models) allow stormwater to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row Plus protecting the adjacent stone and chambers storage areas from sediment accumulation.

ADS geotextile fabric is placed between the stone and the Isolator Row Plus chambers. The woven geotextile provides a media for stormwater filtration, a durable surface for maintenance, prevents scour of the underlying stone and remains intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the chamber's sidewall. The non-woven fabric is not required over the SC-160, DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

The Isolator Row Plus is designed to capture the "first flush" runoff and offers the versatility to be sized on a volume basis or a flow-rate basis. An upstream manhole provides access to the Isolator Row Plus and includes a high/low concept such that stormwater flow rates or volumes that exceed the capacity of the Isolator Row Plus bypass through a manifold to the other chambers. This is achieved with an elevated bypass manifold or a high-flow weir. This creates a differential between the Isolator Row Plus row of chambers and the manifold to the rest of the system, thus allowing for settlement time in the Isolator Row Plus. After Stormwater flows through the Isolator Row Plus and into the rest of the chamber system it is either exfiltrated into the soils below or passed at a controlled rate through an outlet manifold and outlet control structure.

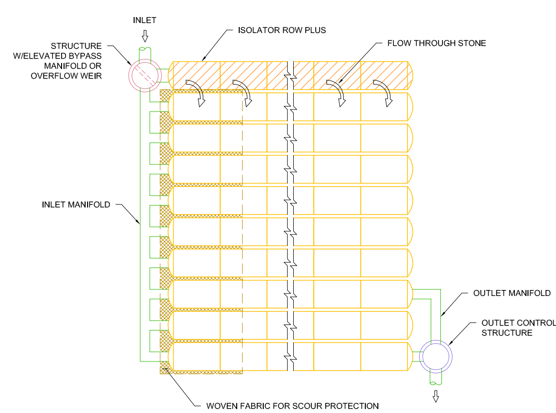
The Isolator Row FLAMP™ (patent pending) is a flared end ramp apparatus attached to the inlet pipe on the inside of the chamber end cap. The FLAMP provides a smooth transition from pipe invert to fabric bottom. It is configured to improve chamber function performance by enhancing outflow of solid debris that would otherwise collect at the chamber's end. It also serves to improve the fluid and solid flow into the access pipe during maintenance and cleaning and to guide cleaning and inspection equipment back into the inlet pipe when complete.

The Isolator Row Plus may be part of a treatment train system. The treatment train design and pretreatment device selection by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, StormTech recommend using the Isolator Row Plus to minimize maintenance requirements and maintenance costs.

Note: *See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row Plus.*

Looking down the Isolator Row PLUS from the manhole opening, ADS PLUS Fabric is shown between the chamber and stone base.

StormTech Isolator Row PLUS with Overflow Spillway (not to scale)



Isolator Row Plus Inspection/Maintenance

Inspection

The frequency of inspection and maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row Plus should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

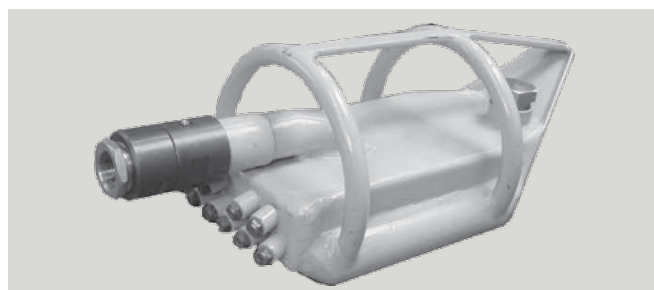
The Isolator Row Plus incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row Plus, clean-out should be performed.

Maintenance

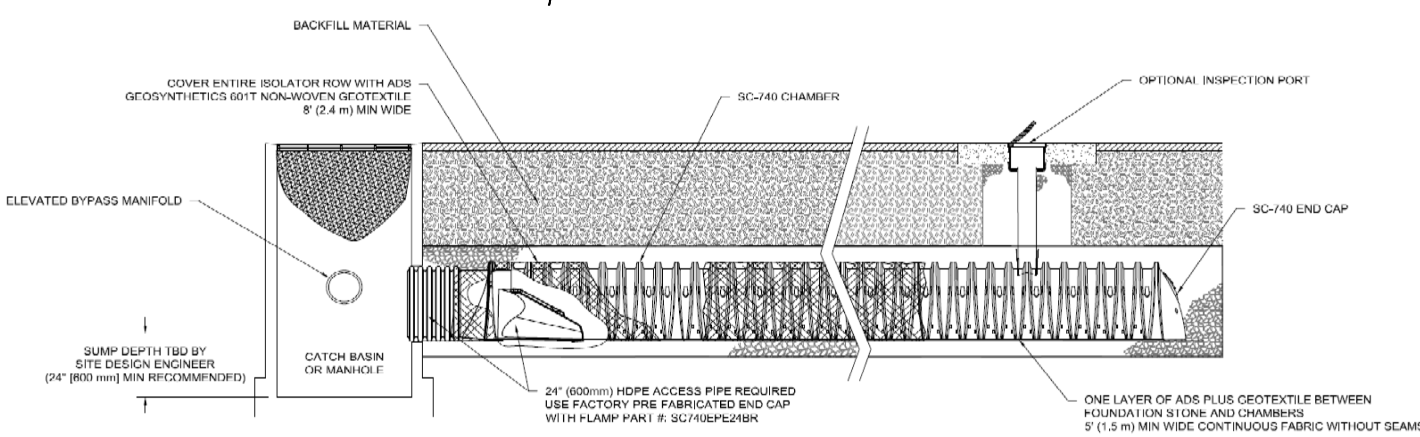
The Isolator Row Plus was designed to reduce the cost of periodic maintenance. By “isolating” sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row Plus while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45” are best. StormTech recommends a maximum nozzle pressure of 2000 psi be utilized during cleaning. JetVac reels can vary in length. For ease of maintenance, ADS recommends Isolator Row Plus lengths up to 200' (61 m). **The JetVac process shall only be performed on StormTech Isolator Row Plus that have ADS Plus Fabric (as specified by StormTech) over their angular base stone.**



StormTech Isolator Row PLUS (*not to scale*)

***Note:** Non-woven fabric is only required over the inlet pipe connection into the end cap for SC-160LP, DC-780, MC-3500 and MC-4500 chamber models and is not required over the entire Isolator Row PLUS.*



Isolator Row Plus Step By Step Maintenance Procedures

Step 1

Inspect Isolator Row Plus for sediment.

A) Inspection ports (if present)
  i. Remove lid from floor box frame
  ii. Remove cap from inspection riser
  iii. Using a flashlight and stadia rod,measure depth of sediment and record results on maintenance log.
  iv. If sediment is at or above 3 inch depth, proceed to Step 2. If not, proceed to Step 3.

B) All Isolator Row Plus
  i. Remove cover from manhole at upstream end of Isolator Row Plus
  ii. Using a flashlight, inspect down Isolator Row Plus through outlet pipe
    1. Mirrors on poles or cameras may be used to avoid a confined space entry
    2. Follow OSHA regulations for confined space entry if entering manhole
  iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches), proceed to Step 2.
  If not, proceed to Step 3.

Step 2

Clean out Isolator Row Plus using the JetVac process.

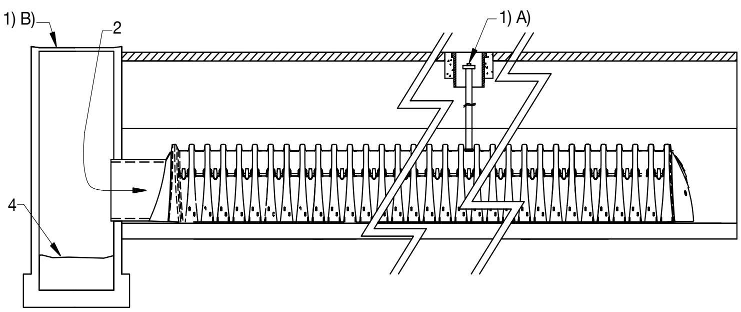
A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
B) Apply multiple passes of JetVac until backflush water is clean
C) Vacuum manhole sump as required

Step 3

Replace all caps, lids and covers, record observations and actions.

Step 4

Inspect & clean catch basins and manholes upstream of the StormTech system.



Sample Maintenance Log

Date	Stadia Rod Readings		Sedi-ment Depth (1)–(2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/11	6.3 ft	none		New installation. Fixed point is CI frame at grade	DJM
9/24/11		6.2	0.1 ft	Some grit felt	SM
6/20/13		5.8	0.5 ft	Mucky feel, debris visible in manhole and in Isolator Row PLUS, maintenance due	NV
7/7/13	6.3 ft		0	System jetted and vacuumed	DJM

adspipe.com
800-821-6710

EnviroHood™

ENVIROHOOD STRUCTURE

The Nyloplast® EnviroHood™ is an innovative stormwater management device attached to the inside of a catch basin or manhole designed to prevent the outflow of floating debris and oil.

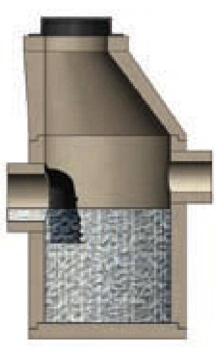
The need for cleaner stormwater has caused municipal leaders to demand forward-thinking solutions to improve their overall water quality. The EnviroHood offers lower installed costs and less intrusive installations than competitive devices.

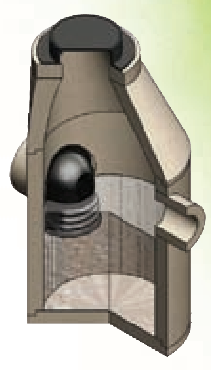
ENGINEERED FOR OPTIMAL PERFORMANCE

The innovative design incorporates the same proven corrugation technology used on ADS N-12® pipe products. This delivers maximum strength to weight ratio and ensures the structure is capable of supporting the hydraulic forces of a rainfall event.

FEATURES & BENEFITS:

- Molded from High Density Polyethylene (HDPE) for lightweight and sturdy design
- Corrugated design eliminates flat surfaces and provides increased structural capacity
- Effective low-cost solution for storm water treatment
- Easy to clean
- Highly corrosion-resistant for long service life





ADS Service: ADS representatives are committed to providing you with the answers to all your questions, including specifications, installation and more.

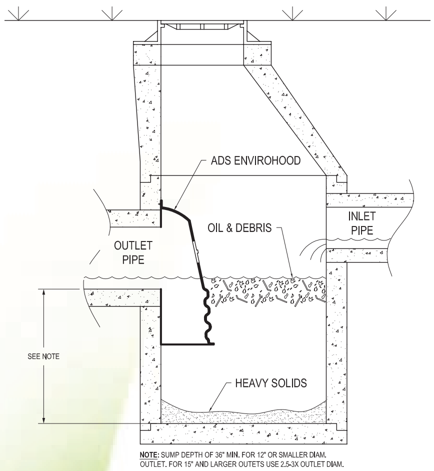
NYLOPLAST ENVIROHOOD SPECIFICATION

SCOPE

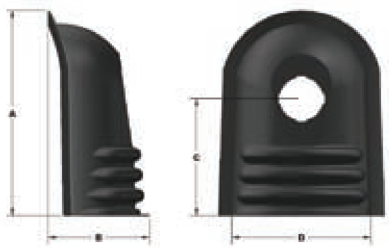
This specification describes the EnviroHood for use in stormwater conveyance systems.

REQUIREMENTS

- All hoods shall be constructed of polyethylene.
- The size and position of the hood shall be determined by the outlet pipe size as per manufacturer's recommendation.
- The bottom of the hood shall extend downward a minimum distance of 6" (15 cm) for pipes < 12" (30 cm).
- Installation hardware and instructions shall be provided by manufacturer.
- Installation shall be in accordance with Nyloplast installation procedures and those issues by local building/construction regulations.



TYPICAL INSTALLATION



STRUCTURE TYPE	OUTLET COVERED	PART NUMBER*	GENERAL DIMENSIONS in. (cm) A	B	C	D
48" (120 cm) Round Concrete	up to 18" (45 cm)	5818AGR	30.2 (75)	14.9 (35)	17.2 (45)	20.5 (50)
48"–54" (120–135 cm) Round Concrete	up to 24" (60 cm)	5824AGR	41.7 (105)	18.0 (45)	26.9 (70)	26.9 (70)
54"–60" (135–150 cm)Round Concrete	up to 30" (75 cm)	5830AGR	48.7 (120)	20.5 (50)	30.5 (75)	33.1 (85)
Flat Concrete	up to 18" (45 cm)	5818AGF	30.2 (75)	11.8 (30)	17.2 (45)	20.4 (50)
Flat Concrete	up to 24" (60 cm)	5824AGF	41.8 (105)	15.3 (40)	26.9 (70)	27.0 (70)
Flat Concrete	up to 30" (75 cm)	5830AGF	48.8 (120)	18.3 (45)	30.5 (75)	34.0 (85)
18" (45 cm) Nyloplast	up to 12" (30 cm)	5818AG0412	19.4 (50)	9.8 (25)	12.3 (30)	13.8 (35)
24" (60 cm)Nyloplast	up to 15" (40 cm)	5824AG0415	26.5 (65)	12.8 (30)	14.5 (35)	20.0 (50)
30"(75 cm) Nyloplast	up to 18" (45 cm)	5830AG0418	32.8 (85)	15.4 (40)	18.7 (45)	26.0 (65)

*Includes installation hardware

For more information on EnviroHood and other ADS products, please contact our Customer Service Representatives at 1-800-821-6710

BRO 10853 07/12

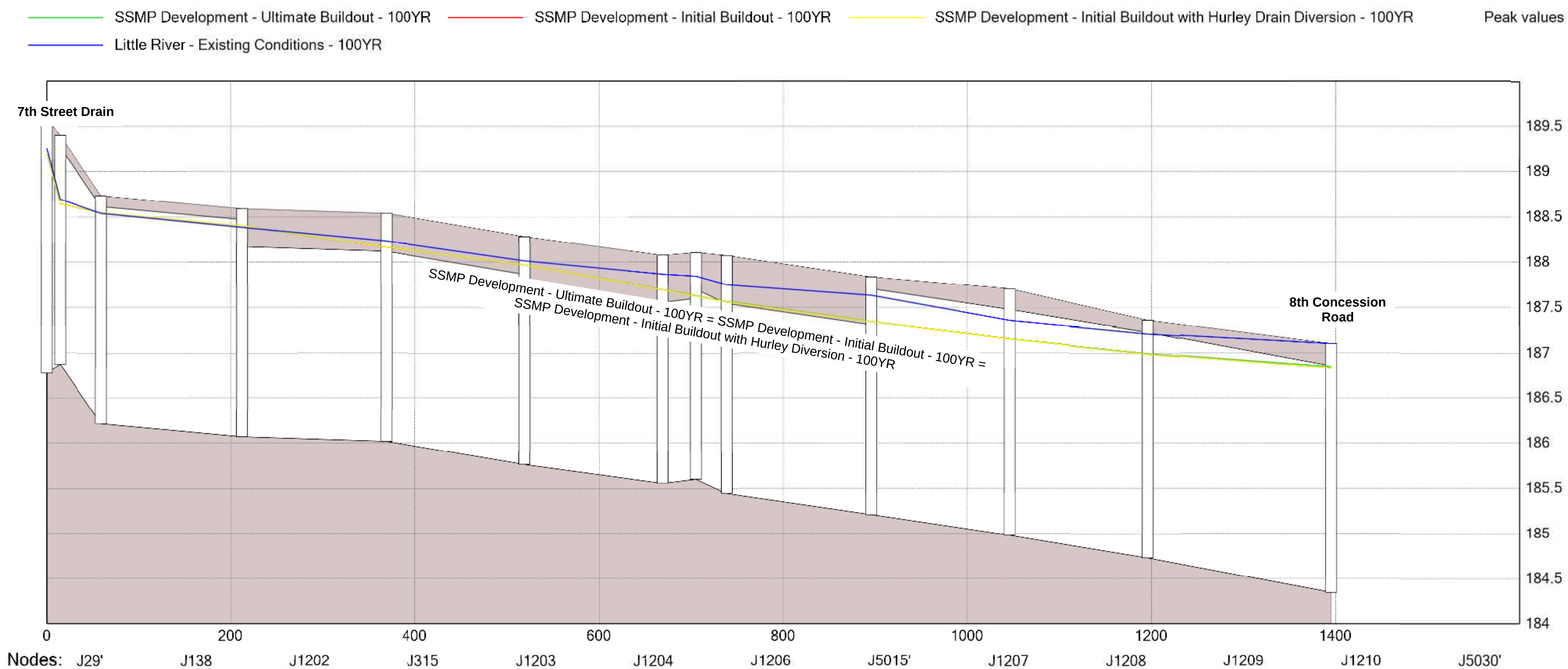
Advanced Drainage Systems, Inc.
4640 Trueman Blvd., Hilliard, OH 43026
1-800-821-6710 www.ads-pipe.com

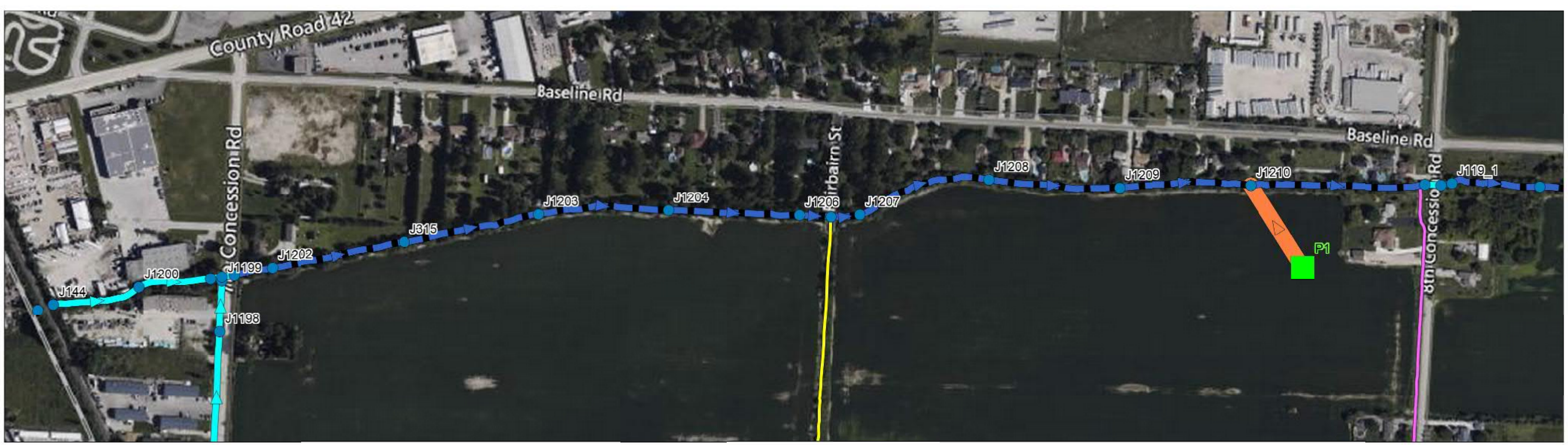
Appendix D-5

Little River Watershed Primary Municipal Drains - Development Phasing HGL Profiles

6th Concession Drain Profile

7th Street Drain to 8th Concession Road

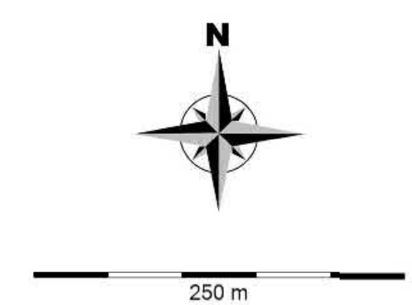




Legend

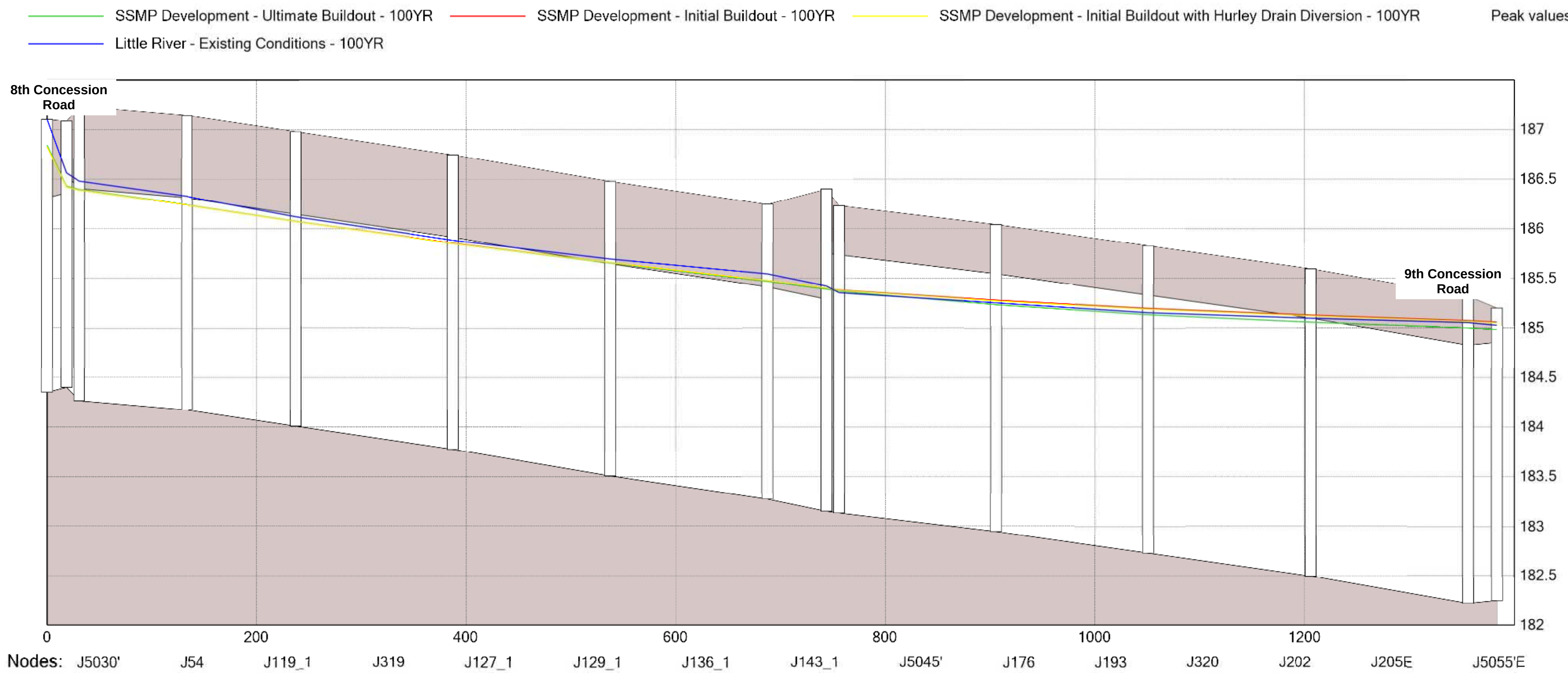
Junctions
- Visible
- Little River Junction

Conduits
- Existing Drains to Remain
- Revised Drain Cross Sections
- New Culverts
- Existing Culverts
- Little River
- Storages
- Pumps
- Drain to Remain Under Initial Buildout, but Abandoned Under Future Buildout
- Abandoned Drains Under Initial Buildout Condition



6th Concession Drain Profile

8th Concession Road to 9th Concession Road



Legend

Junctions

- Visible
- Little River Junction

Conduits

- Existing Drains to Remain
- Revised Drain Cross Sections
- New Culverts
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- Little River
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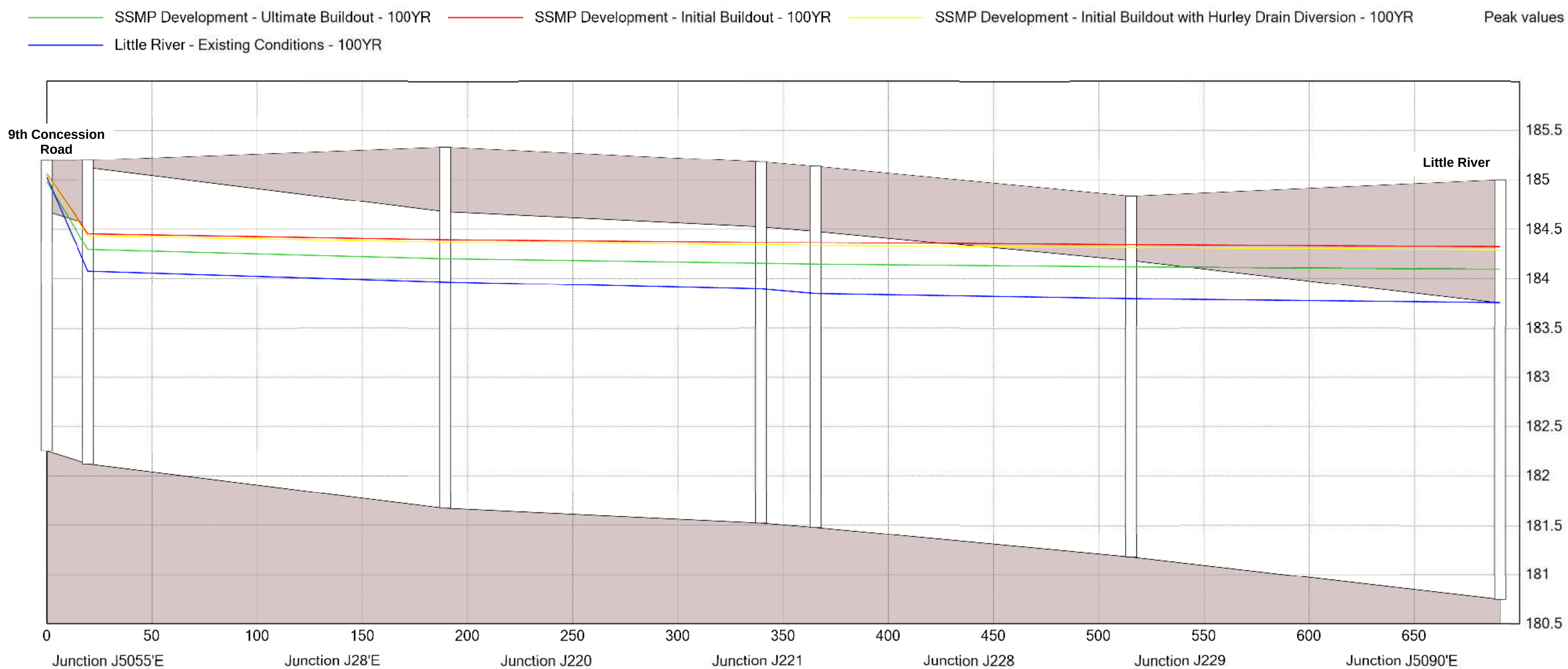
- Pumps
- Drain to Remain Under Initial Buildout, but Abandoned Under Future Buildout
- Abandoned Drains Under Initial Buildout Condition

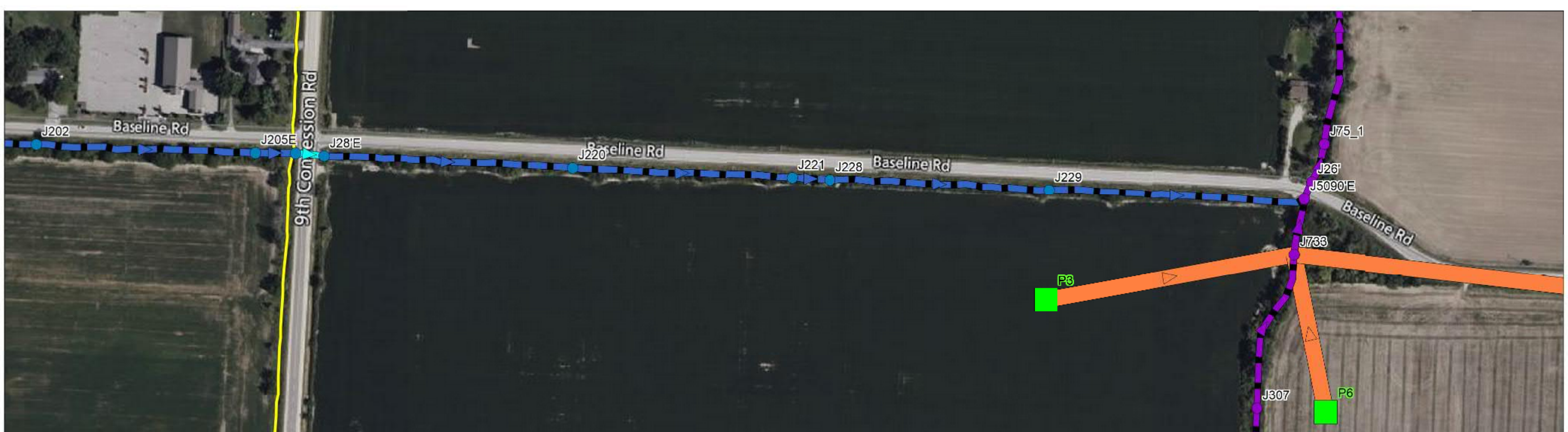
N

250 m

6th Concession Drain Profile

9th Concession Road to Liittle River Drain





Legend

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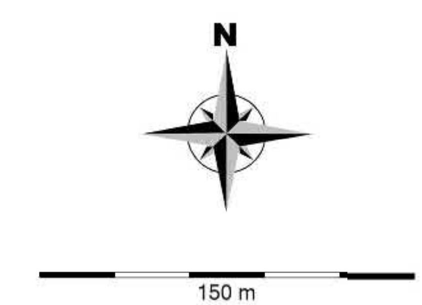
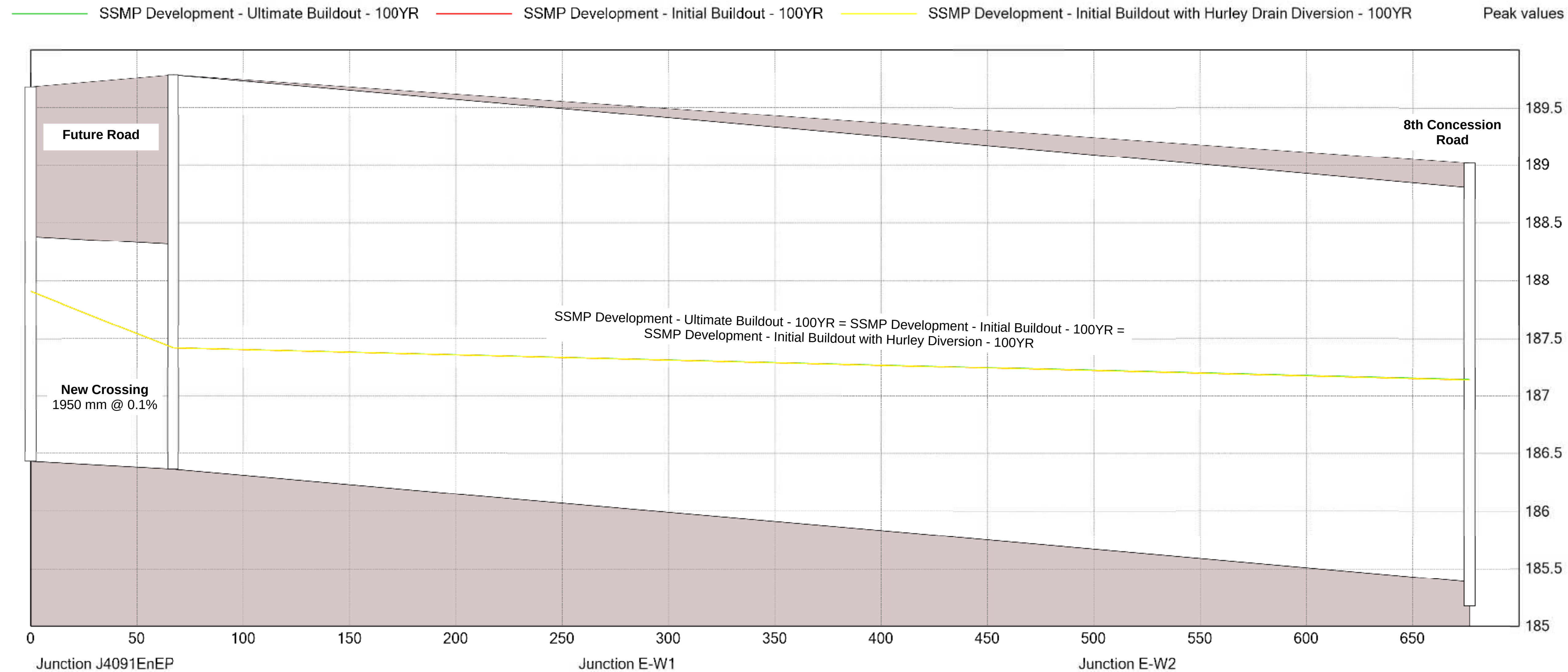


E-W Arterial Drain Profile

7th Concession Drain to 8th Concession Road



Legend

Junctions
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Conduits
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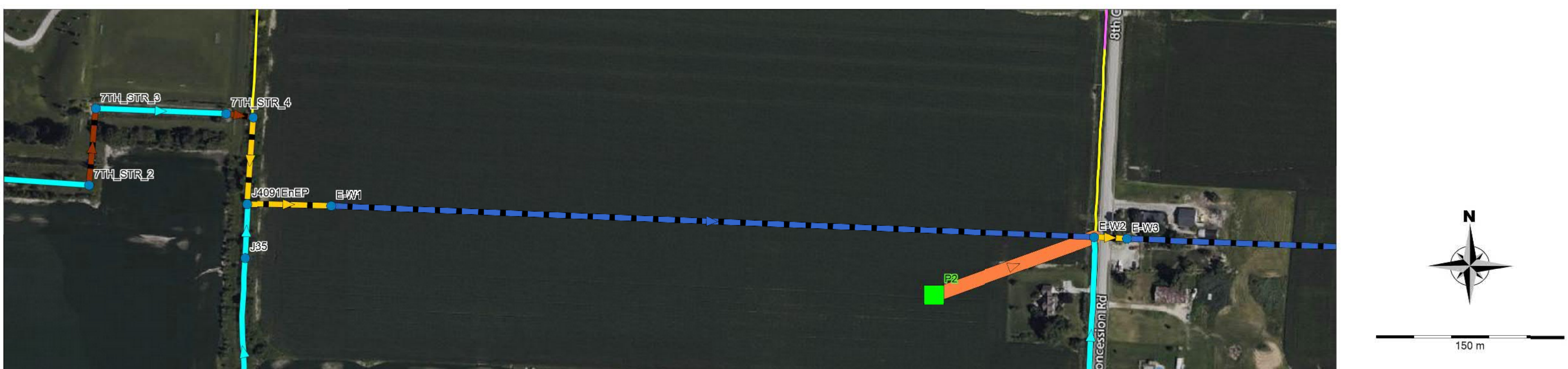
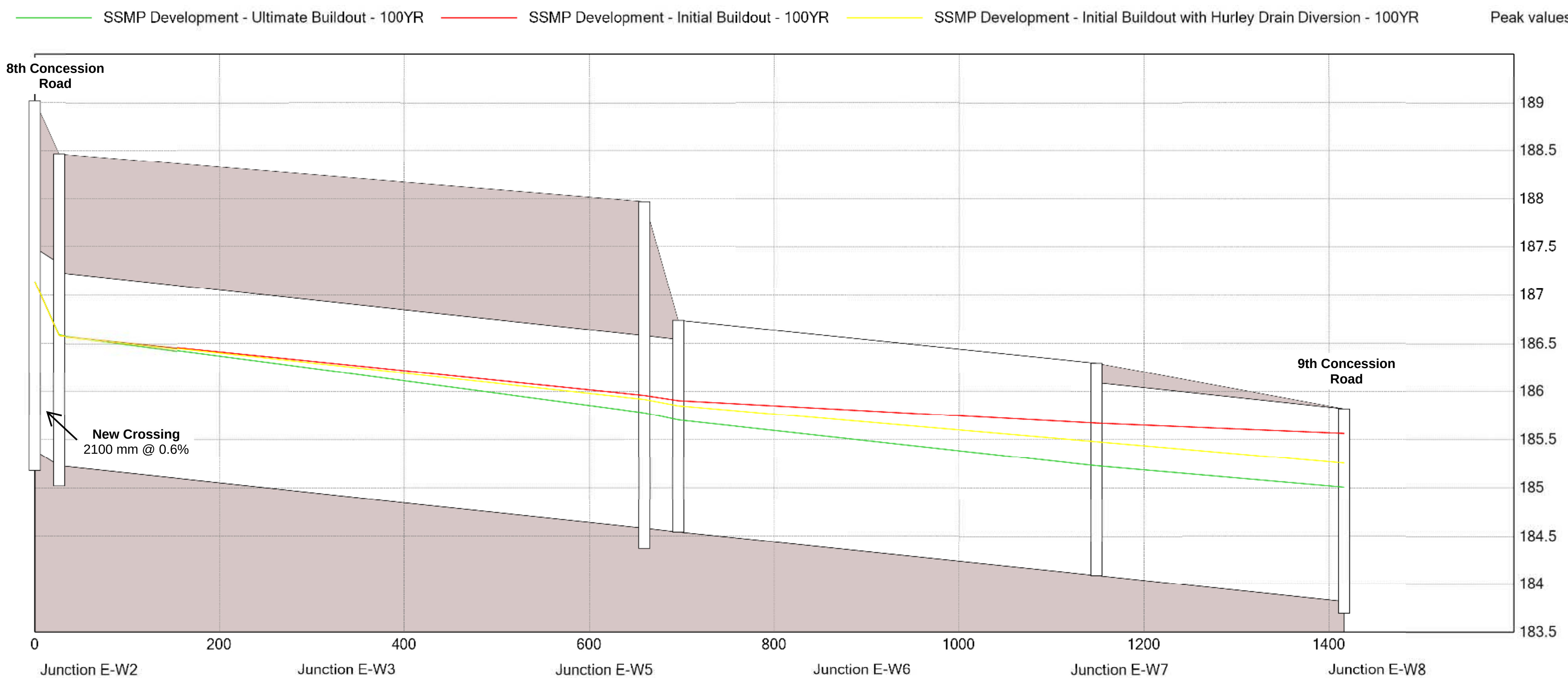
- Abandoned Drains Under Initial Buildout Condition



E-W Arterial Drain Profile

8th Concession Road to 9th Concession Road



Legend

Junctions

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Conduits

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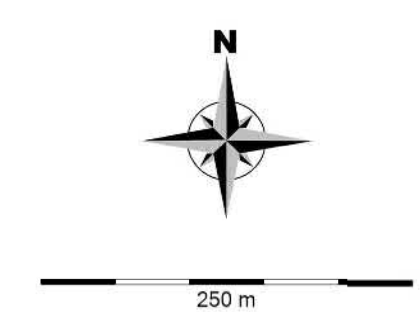
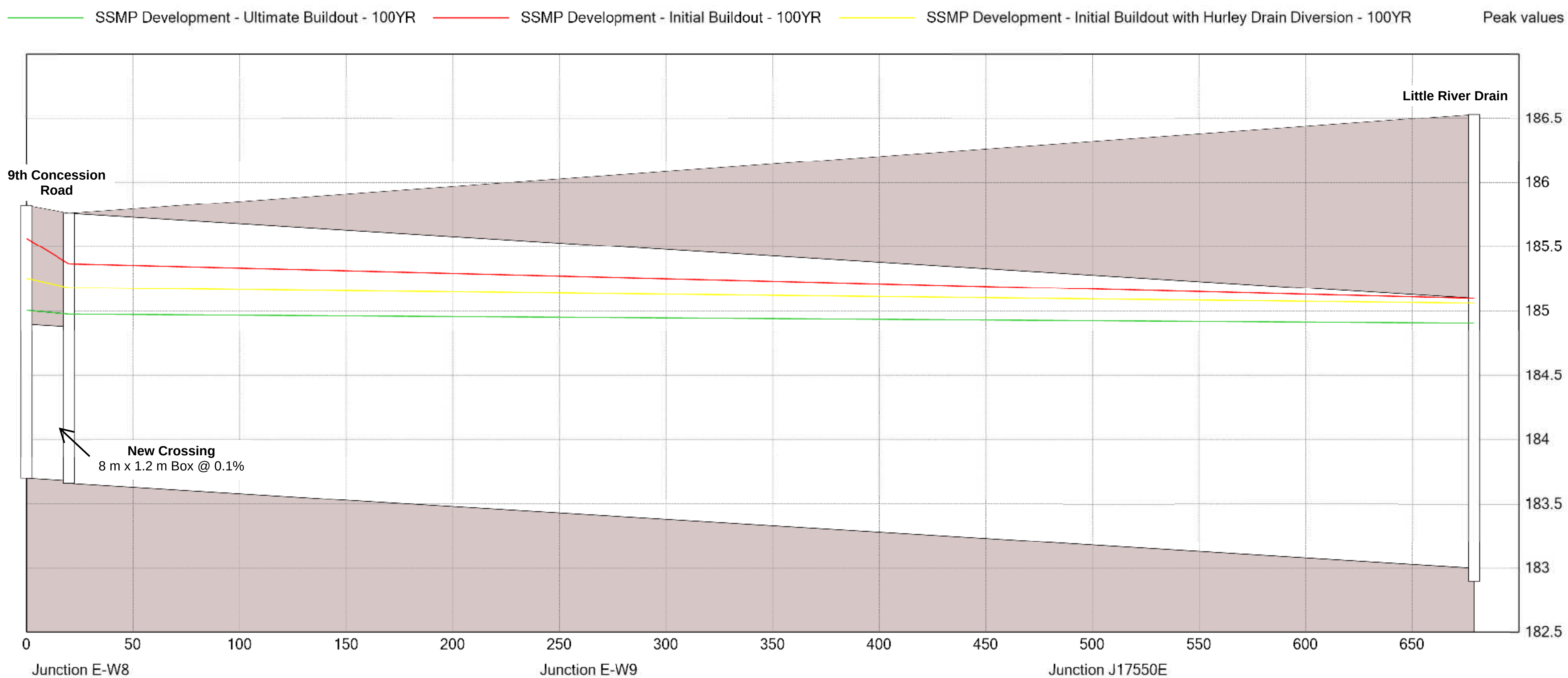


E-W Arterial Drain Profile

9th Concession Road to Little River Drain



Legend

Junctions
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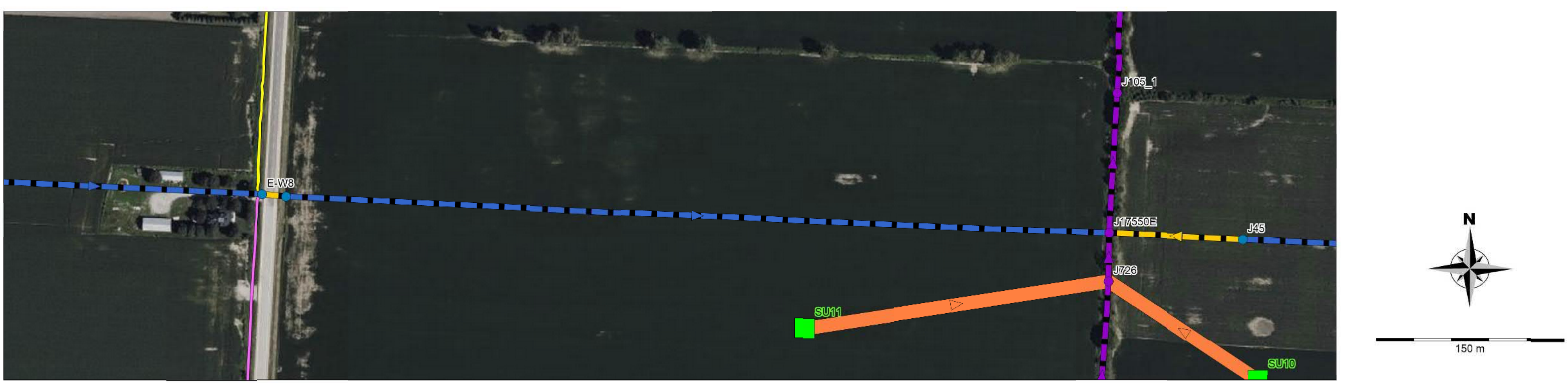
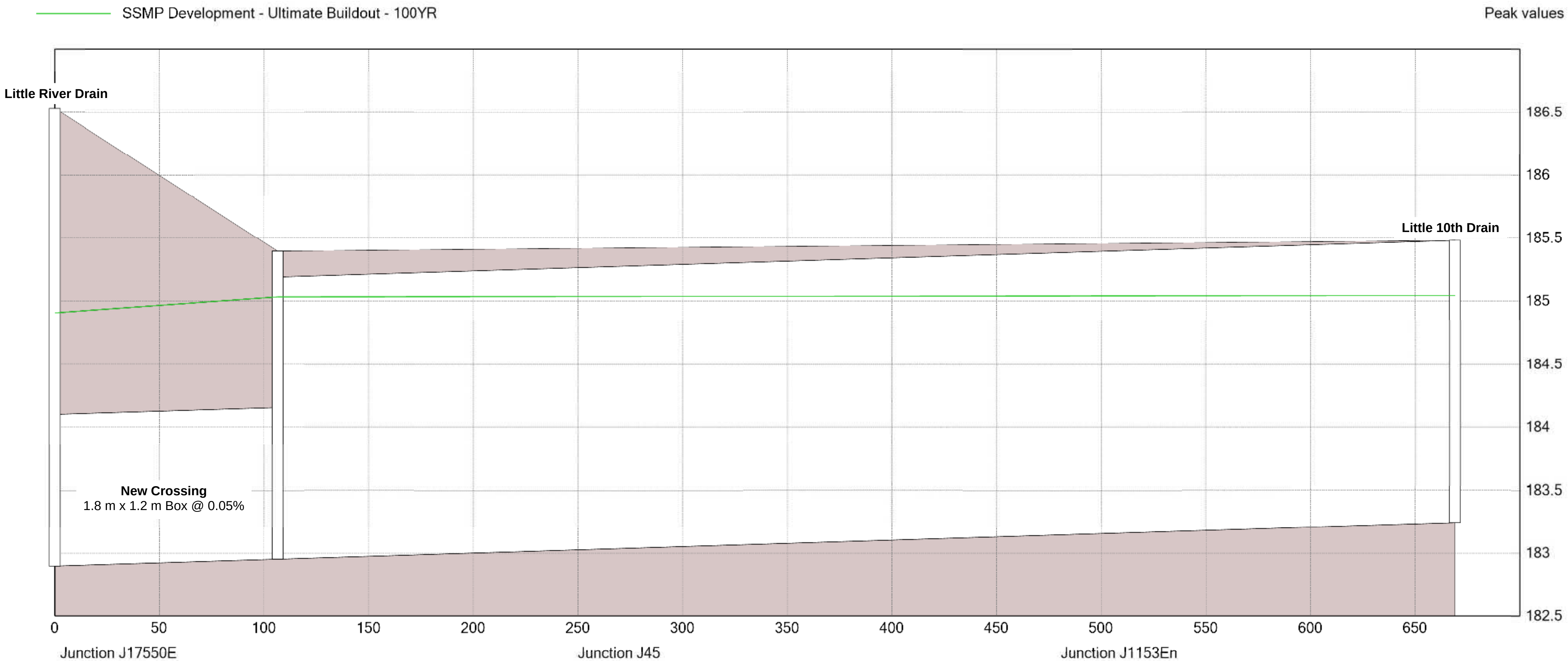


E-W Arterial Drain Profile

Little 10th Drain to Little River Drain



Legend

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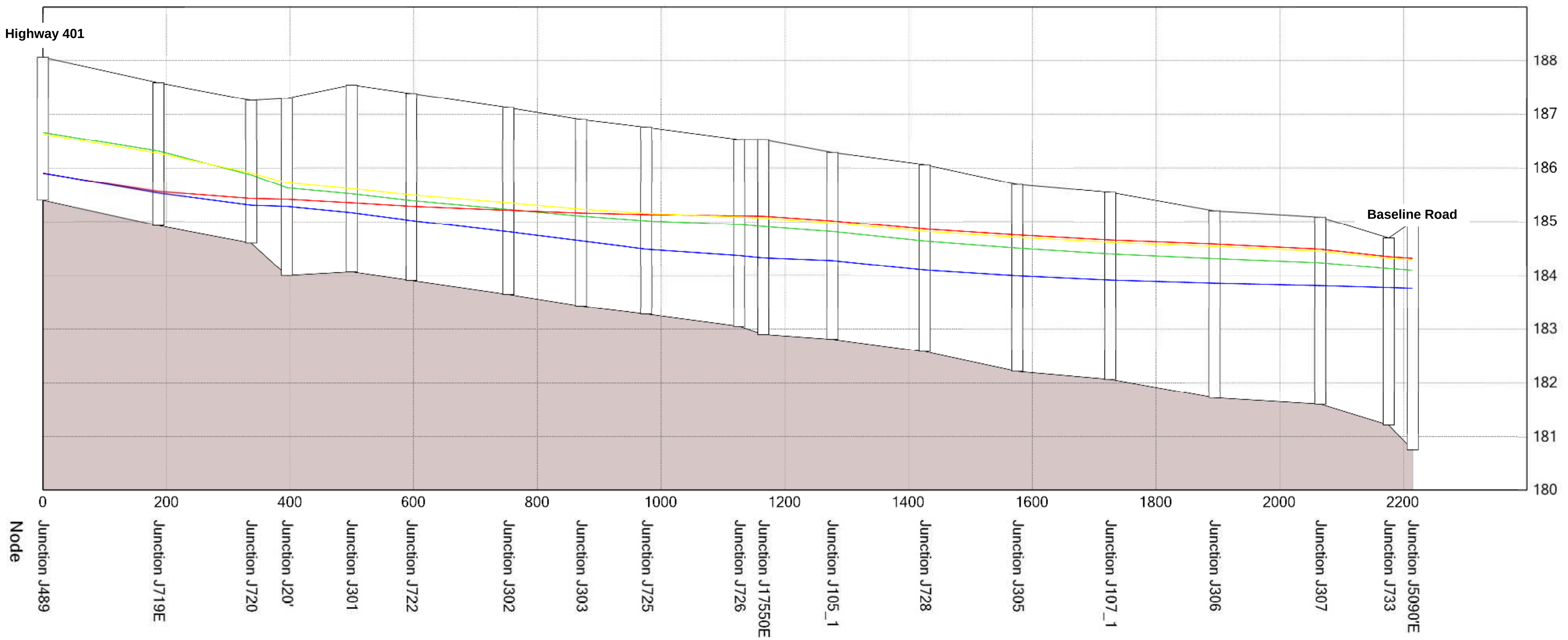
- Abandoned Drains Under Initial Buildout Condition

Little River Drain Profile

Highway 401 to Baseline Road

SSMP Development - Ultimate Buildout - 100YR
SSMP Development - Initial Buildout - 100YR
SSMP Development - Initial Buildout with Hurley Drain Diversion - 100YR
Peak values
Little River - Existing Conditions - 100YR



Legend

Junctions

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Conduits

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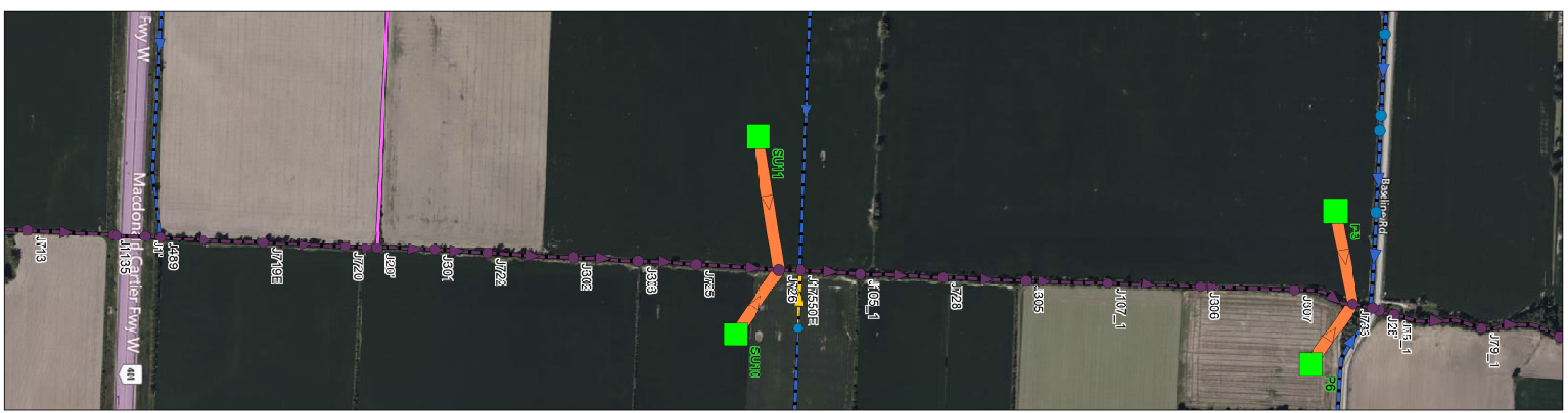
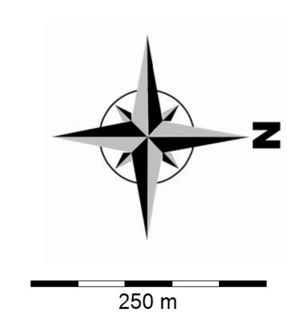
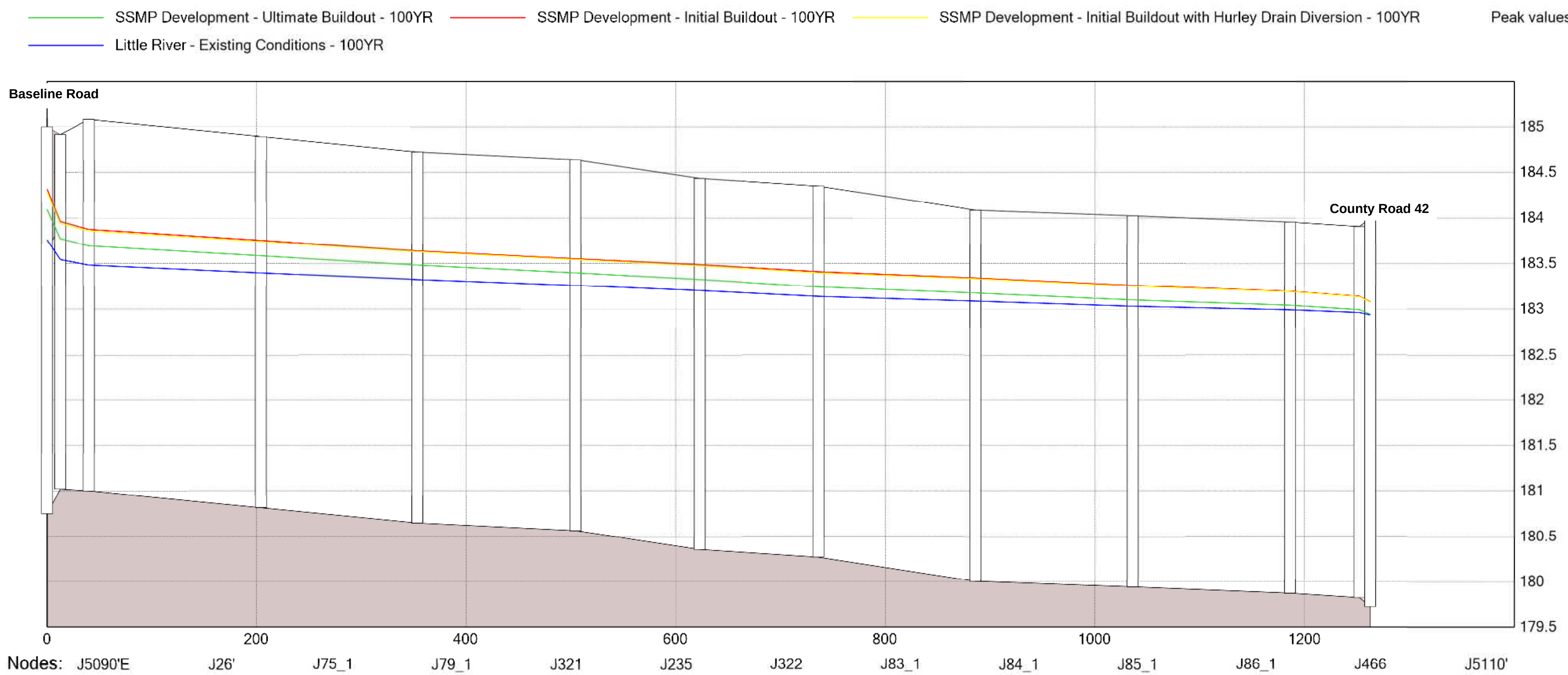
- Abandoned Drains Under Initial Buildout Condition





Little River Drain Profile

Baseline Road to County Road 42



Legend

Junctions
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- Little River Junction

Conduits
- Existing Drains to Remain
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- New Culverts
- Existing Culverts
- Little River
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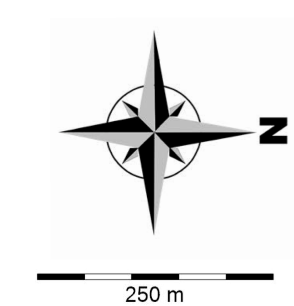
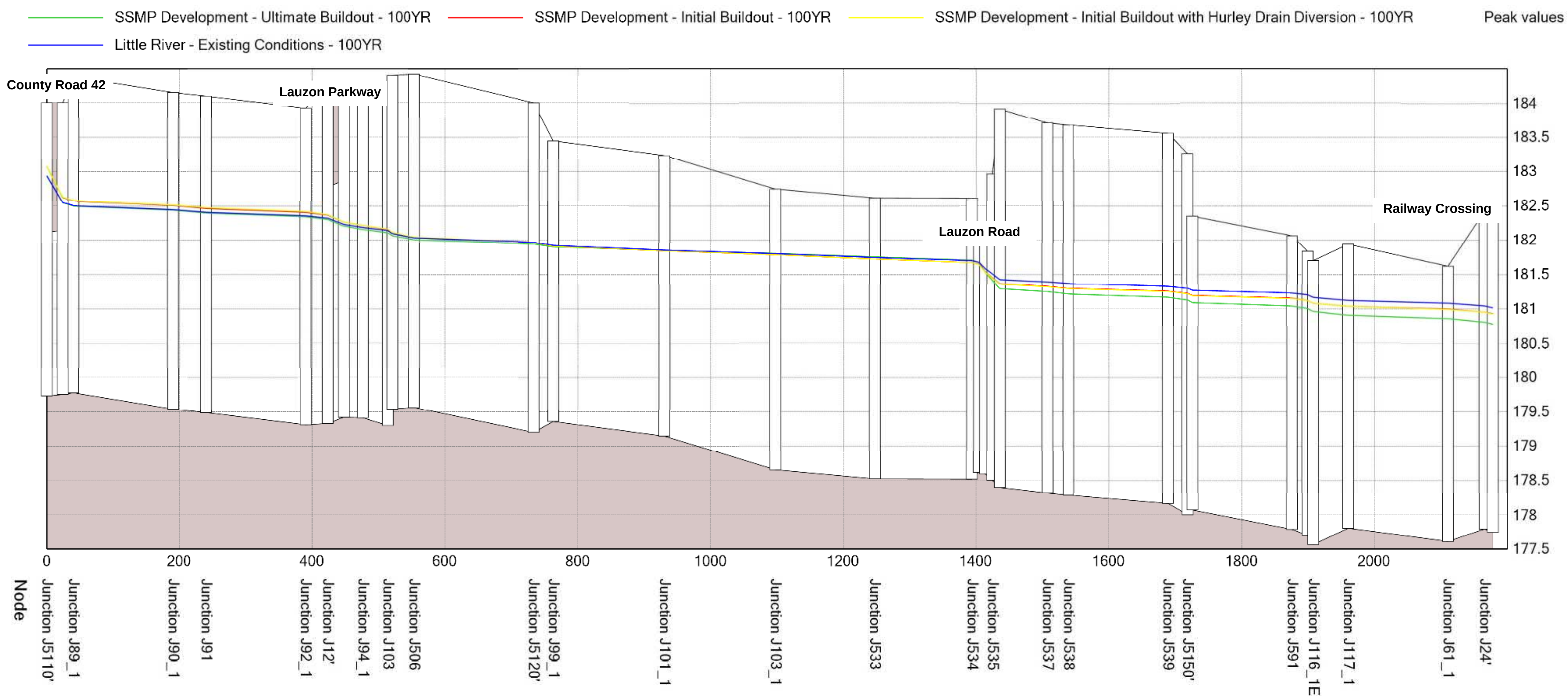
- Abandoned Drains Under Initial Buildout Condition



Little River Drain Profile

County Road 42 to Railway Crossing



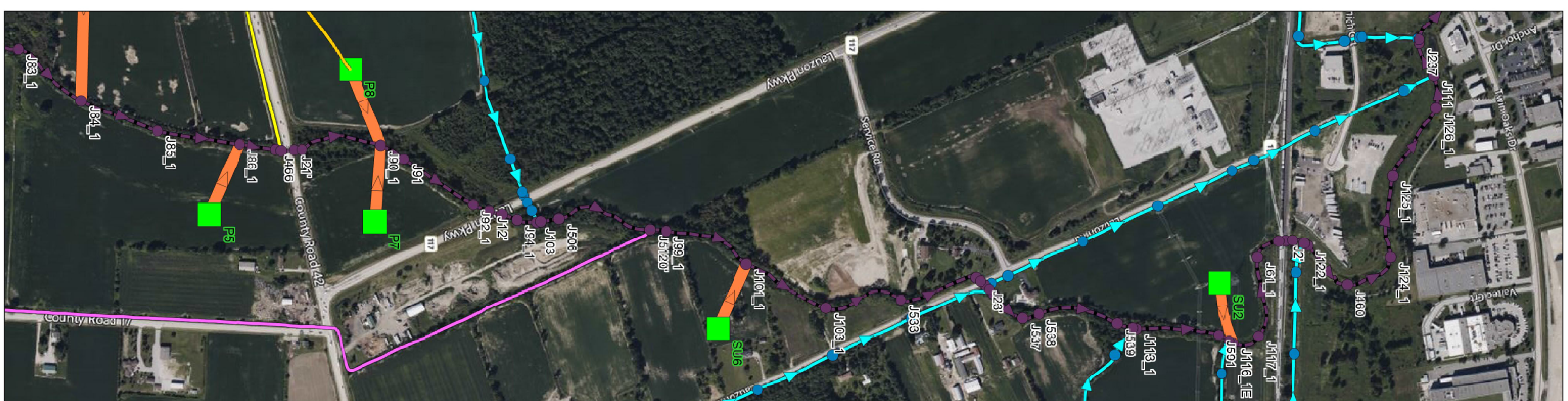
Legend

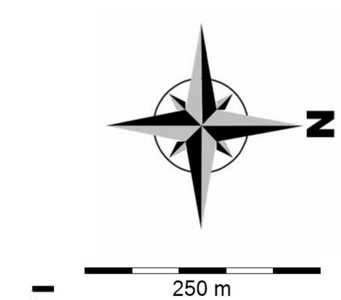
Junctions

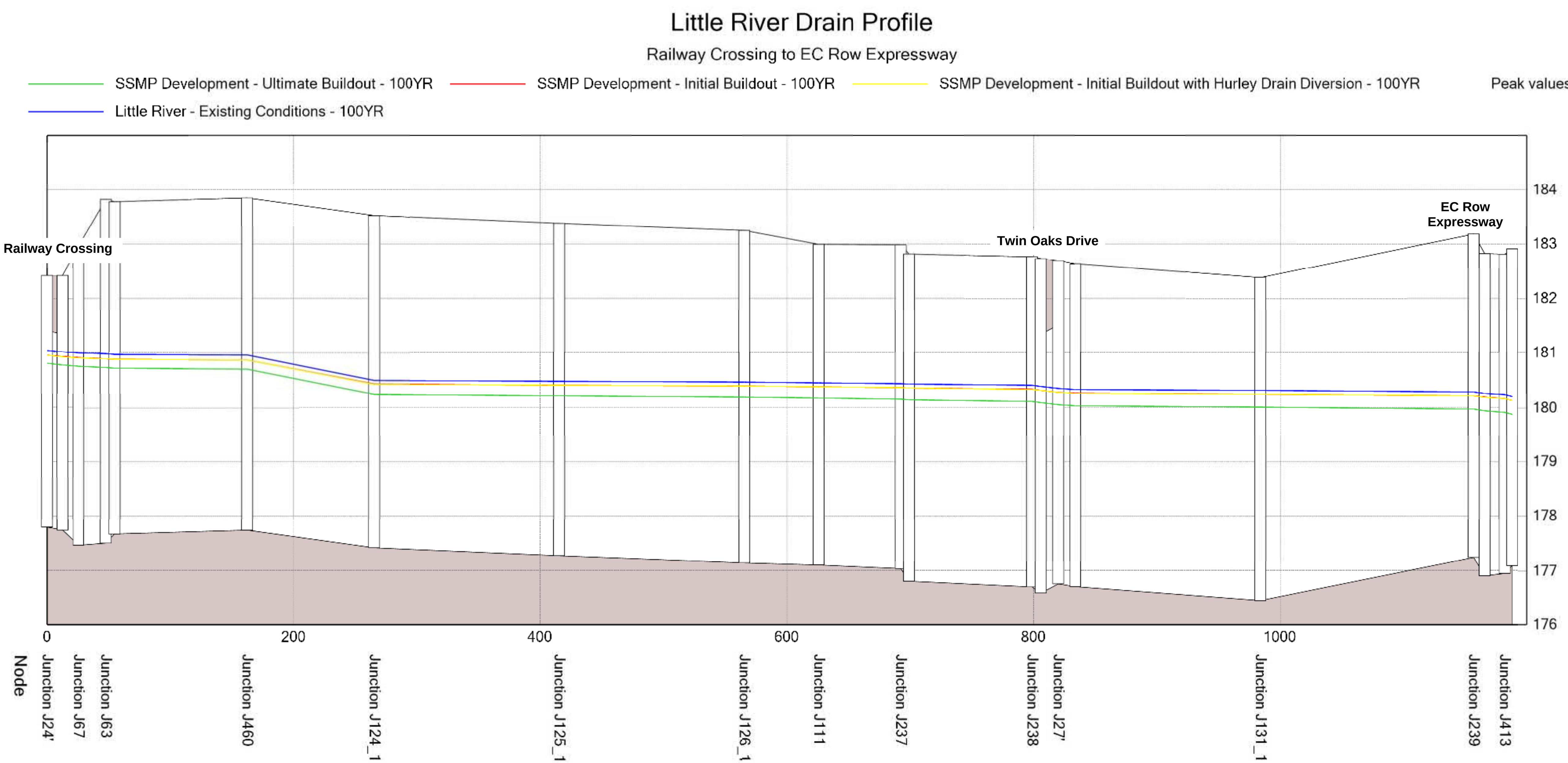
- Visible
- Little River Junction

Conduits

- Existing Drains to Remain
- Revised Drain Cross Sections
- New Culverts
- Existing Culverts
- Little River
- Storages
- Pumps
- Drain to Remain Under Initial Buildout, but Abandoned Under Future Buildout
- Abandoned Drains Under Initial Buildout Condition







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