Lauzon Parkway
Class EA Study

G.W.P. 3117-09-00

DRAINAGE AND STORM WATER MANAGEMENT REPORT

FINAL

MRC, A MEMBER OF MMM GROUP

January 2014

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1.0 INTRODUCTION

1.1 Project Description

On behalf of the Ontario Ministry of Transportation, the City of Windsor and the County of Essex, MRC is undertaking a Class Environmental Assessment Study to address the future requirements for Lauzon Parkway, County Road 42 and the future East West (E-W) Arterial. The study includes the following main components:

- The environmental assessment study for Lauzon Parkway's extension to Highway 401 and further extension to Highway 3;
- The environmental assessment study for Essex County Road 42 from Walker Road to Essex County Road 25;
- The environmental assessment study for future east/west arterial from Walker Road to Essex County Road 17; and
- preparation and approval of a Secondary Plan for the remainder of the lands transferred to the City of Windsor in 2003 (lands are generally bounded by the CPR mainline north of the Windsor Airport, Lauzon Road and the 8th Concession, and the City of Windsor boundary).

The purpose of this report is to characterize the existing drainage system within the study area, as well as outline the proposed design aspects pertaining to drainage and Storm Water Management (SWM). The details discussed in this report include:

- Descriptions of the existing and future drainage patterns for the study area;
- Hydrologic assessments for existing and future conditions;
- Hydraulic assessments of existing and future major watercourse crossings within the study area; and
- Storm water management measures proposed for mitigating the effects of the proposed works.

The study area is presented on Exhibit 1 (back of the report). There are a total of 43 transverse and 14 entrance culverts, as well as three bridges (Little River, Pike Creek, and Puce River) within the study area. The Culvert Inspection Report prepared by MRC is appended to this report in Appendix A.

1.2 Study Data

The background information provided for this study includes:

- 1:10,000 Ontario Base Maps (OBM) for the study area;
- Aerial photographs;
- Existing drainage condition information obtained from the site reconnaissance;
- Numerous reports prepared for other studies (including the Upper Little River Watershed Master Drainage Plan and Stormwater Management Plan initiated by ERCA, City of Windsor and Town of Tecumseh);
- Hydrologic and hydraulic model and output data for other drainage studies within the study area; and

- Municipal Drain reports for various drains within the study area.

Various background information was provided by the Essex Region Conservation Authority (ERCA), the City of Windsor, Town of Tecumseh, and the County of Essex, mainly in the form of various reports and some historic construction drawings. Municipal Drain reports were part of this information and included reports for:

- North Townline Road Drain;
- Baseline Drain;
- Watson Drain;
- St. Louis Drain;
- Little 10th Concession Drain;
- Little River Drain;
- 9th Concession Drain (Kerr Drain);
- Lesperance Road Drain West;
- Lappan and McGill Drain;
- 8th Concession Drain and Demonte Branch;
- Rivard Drain;
- Gouin Drain;
- Ray Road Drain;
- Quick Drain;
- Soulliere Drain;
- Riecher Drain;
- Langlois Drain;
- Hayes Drain;
- Hurley Drain;
- Lachance Drain;
- 6th Concession Drain;
- 7th Concession Drain;
- 7th Street Drain; and
- Desjardins Drain.

Not all of the above municipal drains fall within the study area, therefore only some of the reports were referenced. It should be noted that many of the reports referenced were dated, or contained limited design information (i.e. crossing and channel design parameters) for the purposes of this study.

It was originally intended that The Upper Little River Master Plan Class Environmental Assessment (ULR Class EA) would be completed prior to the Lauzon Parkway Class EA Study and would provide a drainage and storm water management conceptual design for the study area. The ULR Class EA is now being prepared concurrently with this Class EA. Information available at the time of writing this report includes conceptual pond and channel configurations and locations, which have been included in this report. The ULR Class EA will ultimately be incorporated at the detailed design stage, including but not limited to drainage and storm water management recommendations and locations.

2.0 EXISTING DRAINAGE CONDITIONS

The existing drainage system for the study area is depicted on Exhibit 2 through Exhibit 10. These exhibits show the existing drainage features within the study area, the location of existing culverts and the municipal drains. The drainage features were obtained from 1:10,000 Ontario Base Mapping (OBM) and from information provided within the municipal drain reports. The Town of Lakeshore also provided MRC with access to their Municipal Drain mapping, which was used to update the mapping.

The study area drainage basin is primarily comprised of agricultural areas. The topography of the study area consists of very flat terrain with an average slope of less than 0.5 percent, with overland flow conveyed mainly via municipal drains and roadside ditches.

The major crossings include the Little River crossing at Highway 401, the Little River crossing of County Road 42, the Pike Creek crossing of County Road 42, the Puce River crossing of County Road 42, and the Kerr Drain crossing of County Road 42.

2.1 Site Reconnaissance

A site reconnaissance was carried out in May 2011 to confirm existing culvert locations and sizes, to assess the physical condition of each culvert, and to record characteristics of significant drainage features within the study area, such as roadway drains.

The following is a list of the field tasks completed during the site reconnaissance:

- Confirmed local drainage patterns and drainage divides;
- Confirmed size, type, location, material, physical condition, and approximate cover depth of each road culvert crossing;
- Documented channel characteristics upstream and downstream of each culvert; and
- Noted sediment accumulation, and checked for signs of erosion.

It should be noted that entrance culverts were not investigated or assessed as part of the site reconnaissance. Prior to the site visit, MRC contacted the MTO Maintenance Supervisor, ERCA, and the City of Windsor to gain further understanding of drainage related issues within the study area. A photographic inventory and condition summary are presented in the Culvert Inspection Report completed by MRC in August 2011, which is included in Appendix A.

2.2 Existing Culvert Locations and Characteristics

The locations and characteristics of the existing culverts within the study area are summarized in Table 1. This table provides the following information:

- Culvert identification number;
- Approximate location;
- Municipal drain conveyed by culvert;
- Culvert size;
- Culvert Type;

- Upstream invert (estimated where not provided in drainage report);
- Downstream invert (estimated where not provided in drainage report);
- Length (if available from existing drainage report);
- Slope (if available);
- Municipal drain report from which the information was obtained;
- Station (from Municipal Drain reports); and
- Additional information or descriptions from Municipal Drain reports.

The physical condition assessment of the culverts is included in the Culvert Inspection Report (MRC, August 2011, revised November 2013), and as noted therein, the majority of the inspected culverts are in good condition. Of the culverts assessed during the site reconnaissance, ten were found to be in poor or fair condition:

- LC2 was corroded at the downstream end, and the culvert barrel was in poor condition;
- LC3 was deformed/crushed at the upstream and downstream ends;
- LC9 was crushed, cracked, and the pipe barrel was rusty where visible;
- LC15 was corroded at the downstream end on the culvert bottom;
- LC16 was corroded at the downstream end on the culvert bottom;
- LC17 was broken and corroded at the upstream end. The downstream end had a hole through the bottom of the culvert and was angled upwards;
- DC4 had scaling, cracking and spalling at upstream end;
- DC5 had scaling and spalling at the upstream end;
- DC6 had exposed rebar and spalling at the upstream end; and
- XC8 had culvert barrels found to be in poor to fair condition.

The above culverts found to be in poor condition are recommended to be replaced. A detailed hydraulic analysis and sizing will be provided at the detailed design stage. Culvert DC2 was found to be in fair condition. The remaining culverts were found to be in good condition.

Table 1: Existing Culvert Characteristics

LAUZON PARKWAY (COUNTY ROAD 17 AND COUNTY ROAD 117) – From CN Rail to EC Row Expressway - Centreline Culverts												
No.	**Culvert. I.D.**	**Location**	**Drain**	**Culvert Size (mm)**	**Culvert Type**	**Estimated Upstream Invert (m)**	**Estimated Downstream Invert (m)**	**Length (m)**	**Slope (%)**	**Report Name**	**Station (from Municipal Drain reports)**	**Description from Municipal Drain Report**
1	XC1	Middle Road	Sullivan Drain	Twin-2000	CSP (With headwalls)	N/A	N/A	N/A	N/A	-	N/A	N/A
2	LC1	County Road 17 (10th Concession Road)	Sullivan Drain	3600 x 1500	Concrete (Open Footing)	N/A	N/A	N/A	N/A	-	N/A	N/A
3	XC2	Highway 401 (West side of County Road 17)	Watson Drain	1500 x 1670	Concrete	184.825	184.74	50	0.17	Watson Municipal Drain Report (2009)	4+201	1500 x 1500 concrete box, 50m long ("to be cleaned")
4	LC2	County Road 17 (10th Concession Road)	Watson Drain	450	CSP	N/A	N/A	N/A	N/A	-	N/A	N/A
5	LC3	County Road 17 (10th Concession Road)	Watson Drain	400	CSP	N/A	N/A	N/A	N/A	-	N/A	N/A
6	LC4	County Road 17 (10th Concession Road)	Watson Drain	450	CSP	184.3	N/A	N/A	N/A	Watson Municipal Drain Report (2009)	3+310	450 CSP (Langlois Drain)
7	LC5	County Road 17 (10th Concession Road)	Watson Drain	350	CSP	184.00	N/A	N/A	N/A	Watson Municipal Drain Report (2009)	3+031.5	300 CSP
8	LC6	County Road 17 (10th Concession Road)	Watson Drain	200	HDPE	183.85	N/A	N/A	N/A	Watson Municipal Drain Report (2009)	2+889	250mm dia HDPE from East (Langlois Drain)
9	LC7	County Road 17 (10th Concession Road)	Watson Drain	600	CSP	183.50	N/A	N/A	N/A	Watson Municipal Drain Report (2009)	2+750.5	600 CSP (listed as Langlois Drain)
10	LC8	County Road 17 (10th Concession Road)	Watson Drain	1600 x 1900	Concrete	182.38	182.38	6.00	0.1	Watson Municipal Drain Report (2009)	2+026.1?	1800 x 1260 CSP ("To be removed")?
11	LC9	County Road 17 (10th Concession Road)	Watson Drain	500	CSP	N/A	N/A	N/A	N/A	-	N/A	N/A
12	XC3	Baseline road on west side of County Road 17	Watson Drain	1970	CSP	182.35	182.33	28.00	0.1	Watson Municipal Drain Report (2009)	1+991.2	2000 CSP, 28m, ("to be cleaned"), Bridge No. 23
13	LC10	County Road 17 (10th Concession Road)	Watson Drain	400	CSP	182.10	N/A	N/A	N/A	Watson Municipal Drain Report (2009)	1+685.8	375 dia CSP, "new 3m long tile end"
14	LC11	County Road 17 (10th Concession Road)	Watson Drain	450	CSP	182.20	N/A	N/A	N/A	Watson Municipal Drain Report (2009)	1+533.8	450 CSP, "new 3m long end", (listed as Reicher Drain)
15	LC12	County Road 17 (10th Concession Road)	Watson Drain	400	CSP	182.40	N/A	N/A	N/A	Watson Municipal Drain Report (2009)	1+232	375 CSP
16	LC13	County Road 17 (10th Concession Road)	Watson Drain	300	PVC	182.40	N/A	N/A	N/A	Watson Municipal Drain Report (2009)	1+226	300 CSP
17	LC14	County Road 17 (10th Concession Road)	Watson Drain	300 & 450 (from CB)	CSPs	181.80	N/A	N/A	N/A	Watson Municipal Drain Report (2009)	1+060 (1+065)	300 CSP ("repair"), (listed as Reicher Drain)
18	LC15	County Road 17 (10th Concession Road)	Watson Drain	450	CSP	181.50	N/A	N/A	N/A	Watson Municipal Drain Report (2009)	0+775	450 CSP ("repair"), (listed as Reicher Drain)
19	LC16	County Road 17 (10th Concession Road)	Watson Drain	250	CSP	181.95	N/A	N/A	N/A	Watson Municipal Drain Report (2009)	0+748	250
20	LB1	Bridge Structure at Little River	Little River	n/a	n/a	179.00	N/A	N/A	N/A	Little River Municipal Drain Report (1993)	N/A	Size not specified, 1983 report, Drain Slope = 0.09%, invert = 179m
21	LC17	County Road 117 (Lauzon Parkway)	Little River	1350	CSP	N/A	N/A	N/A	N/A	-	N/A	N/A
22	LC18	County Road 117 (Lauzon Parkway)	McGill Drain	3100 x 3100	Concrete (wing walls)	N/A	N/A	N/A	N/A	-	N/A	N/A
23	R1	EC Row Expressway -W-S Ramp	Russette Drain	Twin-1800 x 1850	Concrete (wing walls)	N/A	N/A	N/A	N/A	-	N/A	N/A
24	LC19	County Road 117 (Lauzon Parkway)	Russette Drain	Twin-1800 x 1900	Concrete (wing walls)	N/A	N/A	N/A	N/A	-	N/A	N/A
25	R2	EC Row Expressway-W-N Ramp	Russette Drain	Twin-1800 x 1830	Concrete (wing walls)	N/A	N/A	N/A	N/A	-	N/A	N/A
26	R3	EC Row Expressway-S-E Ramp	Russette Drain	Twin-1800 x 1830	Concrete (wing walls)	N/A	N/A	N/A	N/A	-	N/A	N/A

COUNTY ROAD 42 (DIVISION ROAD) – Walker Road to Puce Road (County Road 25) - Centreline Culverts												
No.	**Culvert. I.D.**	**Location**	**Drain**	**Culvert Size (mm)**	**Culvert Type**							
27	XC4	Concession Road 8	North Townline Highway Drain	900	Concrete pipe	186.70	N/A	N/A	N/A	North Townline Road Drain (1960)	N/A	Profile only, no culvert info in report, values estimated from profile
28	XC5	Concession Road 9	North Townline Highway Drain	6300 x 1300	Concrete	N/A	N/A	N/A	N/A	North Townline Road Drain (1960)	N/A	Profile only, no culvert info in report, profile does not extend to culvert XC5
29	DC1	County Road 42	Little River	6100 x 2450	Concrete (wing walls)	179.80	N/A	N/A	N/A	Little River Municipal Drain Report (1993)	N/A	Size not specified. 1983 report, Drain Slope = 0.09%, inv = 179.8m
30	DC2	County Road 42	Watson Drain	3300 x 1500	Concrete	180.93	180.89	30.00	0.12	Watson Municipal Drain Report (2009)	0+709	30m long, 3000 x 1800mm concr. culvert, ("to be cleaned"), Bridge No. 27
31	XC6	private entrance	Watson Drain	2100 x 1500	CSP Arch	180.84	180.82	18.00	0.12	Watson Municipal Drain Report (2009)	0+643.4	18m long, 2240 x 1630 CSP Arch, ("to be cleaned"), Bridge No. 28
32	DC3	County Road 42	Little 10th Concession Drain	3200 x 900	Concrete box	175.10	175.05	9.50	0.53	Little 10th Conc. Drain Report (2010)	1+214	9.5m long, Inv. 175.05ds (175.1 u/s, approximated from profile), Bridge No. 10
33	XC7	Was not found in field	Local Flow	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	N/A
34	XC8	Banwell Road	Local Flow	500	CSP	N/A	N/A	N/A	N/A	-	N/A	N/A
35	DB1	Bridge Structure at Pike Creek	Pike Creek	n/a	n/a	N/A	N/A	N/A	N/A	-	N/A	N/A
36	XC9	Lakeshore Road 101	9th Concession Centreline Drain (Kerr Drain)	900	CSP	N/A	N/A	N/A	N/A	-	N/A	N/A
37	DC4	County Road 42	9th Concession Centreline Drain (Kerr Drain)	3700 x 2500	Concrete	N/A	N/A	N/A	N/A	-	N/A	N/A
38	DC5	County Road 42	8th Concession Centreline Drain	5500 x 2850	Concrete	N/A	N/A	N/A	N/A	-	N/A	N/A
39	DC6	County Road 42	8th Concession Centreline Drain	915		N/A	N/A	N/A	N/A	-	N/A	N/A
40	XC10	Concession Road 8W (Lakeshore Road 103)	Local Flow	400	HDPE	N/A	N/A	N/A	N/A	-	N/A	N/A
41	XC11	Concession Road 7W (Lakeshore Road 105)	Baseline Drain	1500	CSP	N/A	N/A	N/A	N/A	-	N/A	N/A
42	XC12	Concession Road 6W (Lakeshore Road 107)	Baseline Drain	2050	CSP	N/A	N/A	N/A	N/A	-	N/A	N/A
43	DC7	County Road 42	Local Flow	200	HDPE	N/A	N/A	N/A	N/A	-	N/A	N/A
44	DB2	Bridge Structure at Puce River	Puce River	n/a	n/a	N/A	N/A	N/A	N/A	-	N/A	N/A
45	XC13	County Road 25	Puce River "lower portion of the Standish Drain"	4500 x 1650	Concrete	N/A	N/A	N/A	N/A	-	N/A	N/A
46	R4	E.C. ROW Expressway (Highway 2)	Little River	12100 x 5400	Concrete	N/A	N/A	N/A	N/A	-	N/A	-Structure not assessed in field, information from hydraulic model provided by ERCA

LAUZON PARKWAY (COUNTY ROAD 17 AND COUNTY ROAD 117) – From CN Rail to EC Row Expressway - ENTRANCE CULVERTS												
No.	**Culvert. I.D.**	**Location**	**Drain**	**Culvert Size (mm)**	**Culvert Type**	**Estimated Upstream Invert (m)**	**Estimated Downstream Invert (m)**	**Length (m)**	**Slope (%)**	**Report Name**	**Station (from Municipal Drain reports)**	**Description from Municipal Drain Report**
47	DW1	County Road 42-East of 7th Concession Road	North Townline Road Drain	600	CSP	N/A	N/A	N/A	N/A	North Townline Road Drain Report (1960)	N/A	N/A
48	DW2	County Road 42-East of 7th Concession Road	North Townline Road Drain	760	CSP	N/A	N/A	N/A	N/A	North Townline Road Drain Report (1960)	(~134m from 7th Concession Road)	N/A
49	DW3	County Road 42-East of 7th Concession Road	North Townline Road Drain	915	CSP	N/A	N/A	N/A	N/A	North Townline Road Drain Report (1960)	(~210m from 7th Concession Road)	N/A
50	DW4	County Road 42-East of 7th Concession Road	North Townline Road Drain	915	CSP	N/A	N/A	N/A	N/A	North Townline Road Drain Report (1960)	(~226m from 7th Concession Road)	N/A
51	DW5	County Road 42 between Lauzon Rd and Conc. 11	St. Louis Drain	760	CSP	N/A	N/A	N/A	N/A	St. Louis Drain Report (2006)	(~870m from 11th Concession Road)	N/A
52	DW6	County Road 42 between Lauzon Rd and Conc. 12	St. Louis Drain	600	CSP	N/A	N/A	N/A	N/A	St. Louis Drain Report (2006)	(~793m from 11th Concession Road)	N/A
53	DW7	County Road 42 between Lauzon Rd and Conc. 13	St. Louis Drain	600	CSP	N/A	N/A	N/A	N/A	St. Louis Drain Report (2006)	(~733m from 11th Concession Road)	N/A
54	DW8	County Road 42 between Lauzon Rd and Conc. 14	St. Louis Drain	600	CSP	N/A	N/A	N/A	N/A	St. Louis Drain Report (2006)	(~717m from 11th Concession Road)	N/A
55	DW9	County Road 42 between Lauzon Rd and Conc. 15	St. Louis Drain	600	CSP	N/A	N/A	N/A	N/A	St. Louis Drain Report (2006)	(~672m from 11th Concession Road)	N/A
56	DW10	County Road 42 between Lauzon Rd and Conc. 16	St. Louis Drain	600	CSP	N/A	N/A	N/A	N/A	St. Louis Drain Report (2006)	(~561m from 11th Concession Road)	N/A
57	DW11	County Road 42 between Lauzon Rd and Conc. 17	St. Louis Drain	450	CSP	N/A	N/A	N/A	N/A	St. Louis Drain Report (2006)	(~460m from 11th Concession Road)	N/A
58	DW12	County Road 42 between Lauzon Rd and Conc. 18	St. Louis Drain	600	CSP	N/A	N/A	N/A	N/A	St. Louis Drain Report (2006)	(~386m from 11th Concession Road)	N/A
59	DW13	County Road 42 between Lauzon Rd and Conc. 19	St. Louis Drain	600	CSP	N/A	N/A	N/A	N/A	St. Louis Drain Report (2006)	(~353m from 11th Concession Road)	N/A
60	DW14	County Road 42 between Lauzon Rd and Conc. 20	St. Louis Drain	600	CSP	N/A	N/A	N/A	N/A	St. Louis Drain Report (2006)	(~50m from 11th Concession Road)	N/A

Note: All inverts, slopes estimated from Municipal Drain reports where available.

3.0 DESIGN CRITERIA

The design criteria from the City of Windsor Development Manual and the 2008 MTO Highway Drainage Design Standards were reviewed and used to outline the drainage and storm water management criteria and are summarized in Table 2.

3.1 MTO Highway Drainage Design Criteria

WC-1: Design Flows for Bridges and Culverts: This standard identifies the minimum design flows that should be used for the sizing of roadway bridges and culverts. For an urban arterial roadway (for culvert spans less than or equal to 6.0 m) the flow generated by the 50-year storm is used as the design flow. For structures with a span greater than 6.0 m the 100-year storm is used as the design flow. Additionally, there should be no highway overtopping during the overtopping check flow event (100-year storm).

WC-7: Culvert Crossings on a Watercourse: This standard identifies the minimum freeboard and the maximum flood depth at culvert crossings. The desirable freeboard (**Freeboard Criterion**) is measured vertically from the Energy Grade Line (EGL) elevation for the design flow to the edge of the travelled lane at the lowest point in the road profile adjacent to the culvert (spill point). For example, for culverts located at or near a highway sag, the spill elevation would be the lowest edge of travelled lane elevation at the sag. In cases where a culvert is not located at highway sag, the spill point is considered to be the edge of travelled lane elevation at the point at which flows would spill to an adjacent culvert (highpoint along the highway ditch). For design of culverts under freeways this standard indicates the minimum freeboard is 1.0 m (using the design flows, 50-year storm) and that the water level generated by the 100-year design flow should not exceed the edge of the travelled lane at the lowest point in the road profile adjacent to the culvert (spill point). For culverts with a diameter or rise less than 3.0 m, this standard specifies the ratio of headwater depth to diameter (HW/D) ratio should be less than 1.5m.

WC-8: Minimum Culvert Size: This standard identifies minimum culvert sizes for various road types based on maintenance considerations. The minimum culvert size for freeways, urban arterial road transverse culverts, and ramp culverts include an 800 mm diameter round culvert and a box culvert with a minimum rise of 900 mm.

3.2 City of Windsor Design Criteria

The City of Windsor design criteria includes minimum longitudinal road slopes, roadway flood overtopping depths, culvert size and slopes, recommended storm sewer cover, and storm sewer criteria as specified in Table 2.

Table 2: City of Windsor and MTO Design Criteria

Design Parameter	City of Windsor Criteria	MTO Criteria	Comments
Road Grades			
- Minimum Longitudinal Slope for Curbed Roads	0.40%	0.30% Minimum Standard 0.50% Desirable Standard	
- Minimum Longitudinal Slope for Uncurbed Roads	-	0.0%	
Flood Overtopping	5 year – no overtopping 100 year – max. 0.3 m overtopping	The maximum depth of flow on the roadway shall not exceed 0.3m; and the product of the velocity and depth on the roadway shall not exceed $0.8m^2/s$.	
Storm Sewers			
Sewer Design Storm	5 year minor system		
Minimum Depth of Cover	1.0 m	The Minimum Cover is dictated by design loads and the depth of frost penetration.	Alternatives where min. cover cannot be met: - Insulated Pipe - Specialized Pavement Design - Twinned Smaller Diameter Storm Sewers
Minimum Slope	**Sewer Size** / **Minimum Slope (%)** 300mm / 0.30 375mm / 0.23 400mm / 0.21 450mm / 0.18 525mm / 0.14 600mm / 0.12 675mm / 0.10 750mm / 0.09 825mm / 0.08 900mm / 0.07	No criteria – See velocity Criteria	

Design Parameter	City of Windsor Criteria	MTO Criteria	Comments
Minimum Velocity	The minimum velocity for full flow shall be 0.76 m/x and the maximum shall be 3.00 m/s.	Desirable Standard - the Minimum Allowable Velocity in a Trunk Sewer shall be 0.75 m/s for smooth walled pipes, and 0.9 m/s for corrugated pipes. The Minimum Allowable Velocity in a Lateral Sewer shall be 1.5 m/s. Minimum Standard - the Minimum Allowable Velocity in a Trunk Sewer shall be 0.5 m/s where the pipe can be flushed	
Minimum Sewer Size	300 mm	The Minimum Pipe Diameter of the trunk and lateral storm sewers shall be 300 mm in order to facilitate maintenance	

3.3 Bridge Assessment Criteria

The hydraulic criteria for the structures are based on the MTO Highway Drainage Design Standards (HDDS) for water crossings. The MTO HDDS for the watercourse and water body crossings are based on the criteria from the Canadian Highway Bridge Design Code. The following performance standards were utilized for this study:

Performance Criteria for Structures

- Design storms used to calculate flood elevations and perform scour calculations;
- Desired and minimum top of road freeboard;
- Minimum soffit clearance;
- Bridge deck drainage;
- Maximum depth and velocity of relief flow over the road;
- Navigable clearance;
- Allowable increase in the flood elevation upstream of the structure, ;and
- Temporary works during construction.

Design Storms for Bridges

MTO HDDS Standard WC-1 specifies the 50-year storm as the design storm for bridges with spans greater than 6.0 m that are located on rural arterials. The same standard specifies the check flow for scour calculations to be 115% of the 100-year storm.

Top of Road Freeboard

MTO HDDS Standard WC-2 specifies that the freeboard at bridge crossings shall be greater than or equal to 1.0 m for freeways, arterials and collectors. The desirable freeboard is measured vertically from the energy grade line elevation for the design flow to the edge of the travelled lane. The minimum freeboard is measured vertically from the high water level for the design flow to the edge of the travelled lane.

Soffit Clearance

MTO HDDS Standard WC-2 specifies the bridge clearance for freeways, arterials and collector roads shall be greater than or equal to 1.0 m for the design flow, in this case 50-year return event for culverts equal to or less than 6.0 m, and the 100-year event for structures greater than 6.0 m. The clearance is measured vertically from the high water level for the design flow to the lowest point on the soffit.

Standard WC-2 also states that “where the structure is required to convey the regulatory flow, clearance shall be based on the design flow...Zero clearance is required for the regulatory flow… The freeboard for the regulatory flow may be less than the minimum required for the design flow”.

Bridge Deck Drainage – Spread

MTO HDDS Standard WC-4 specifies the maximum spread for bridges. This standard specifies the following:

- A Design Storm with a minimum Return Period of 10 years shall be used to calculate Flow Spread. This standard shall be used in conjunction with Standard WC-5: Bridge Deck Drains; and;
- For arterial roads the Maximum Lateral Spread Distance shall be such that a minimum of 2.5 m of the lane adjacent to the median barrier or curb remains clear of any flooding.

Relief Flow

MTO HDDS Standard WC-13 specifies that the regulatory flow shall be used for defining the relief flow. Where relief flow is provided, the following parameters shall not be exceeded at the cross section of the road for the regulatory flood:

- The maximum depth of flow on the roadway shall not exceed 0.3 m, and
- The product of the velocity and depth on the roadway shall not exceed 0.8 m^2/s.

Navigable Clearance

The MTO HDDS state "the vertical and horizontal Navigational Clearances shall be determined in accordance with the Navigable Waters Protection Act".

Changes in Upstream Water Levels

The MTO HDDS do not quantify a maximum increase in flood elevations. However the Commentary Section in Standard WC-1 states: *"…any risk to public safety or potential damage to adjacent properties as a result of impact on the flood elevations associated with the Regulatory Flow …shall be determined in consultation with the Municipality, Conservation Authority or the Ministry of Natural Resources given their responsibilities under the Conservation Authorities Act and Lakes and Rivers Improvement Act."*

3.4 Storm Water Management Criteria

The City of Windsor specifies a flood overtopping criteria of 0.3 m for the 100-year event, and no overtopping for the 5-year event.

The Stormwater Management Criteria presented in the 2008 MTO Highway Drainage Design Standards (HDSS) identifies the level of control requirements for the design of storm water management facilities for highways. The HDSS references the 2003 MOE Stormwater Management Planning and Design Manual.

The HDSS specifies that the SWM facilities are to be designed to control the design flows to the more stringent of either; the capacity of the receiving system; or to any criteria that has been set through a watershed, subwatershed, or master drainage plan that has been endorsed by the MTO (as per the requirements of Directive B-237).

For storm water quality criteria, the HDSS defers to previous subwatershed studies, and the MOE Stormwater Management Planning and Design Manual. Specific design standards for SWM ponds are again deferred to the MOE Stormwater Management Planning and Design Manual.

3.5 Storm Sewer Criteria

The storm sewer criteria for the City of Windsor are presented in Table 2. The criteria include a specified slope dependent on sewer diameter and a minimum 1.0 m cover depth. The design storm for storm sewers is the 5-year event.

The MTO criteria for storm sewers include a minimum 300 mm pipe diameter to facilitate maintenance, and a minimum allowable velocity in a trunk sewer of 0.75 m/s for smooth walled pipes, and 0.9 m/s for corrugated pipes. The minimum allowable velocity in a lateral sewer shall be 1.5 m/s. The minimum allowable velocity in a trunk sewer shall be 0.5 m/s where the pipe can be flushed. The minimum pipe diameter of the trunk and lateral storm sewers shall be 300 mm in order to facilitate maintenance.

4.0 EXISTING CONDITIONS HYDRAULIC ANALYSIS

As noted in the previous sections, limited information was available to assess the existing hydraulic conditions of the culverts within the study area and along future alignments. The most detailed information was provided for the existing culverts along the Watson Drain along the 10th Concession Road. This drain is no longer on the current proposed alignment, and as such, these culverts were not hydraulically assessed. Limited culvert information was provided for the culverts along County Road 42, specifically on the North Townline Road Drain and the St. Louis Drain. The available information was deemed insufficient to perform a hydraulic assessment for the culverts within the proposed work limits. Limited information was available for three culverts (culverts DC2, DC3, and XC6), however the information, including inverts and slopes, was estimated only and a hydraulic analysis was therefore deemed not feasible at this time. The information provided was limited to culvert size, material, and length for only some of the culverts. Detailed invert and slope information was unavailable. At the detailed design stage, a detailed survey will be required to obtain the required culvert information to perform a comprehensive hydraulic assessment.

4.1 Hydraulic Modeling of Major Watercourse Crossings

Hydraulic modeling of the Little River, Pike Creek, Kerr Drain, Puce River, and 8th Concession Drain was provided by ERCA in PDF format. Table 3 provides a summary of the existing structure characteristics for those bridges and culverts with hydraulic models available.

The HEC-2 hard copy printouts were first compared to the available floodplain mapping elevations. Based on this comparison, the model for the 8th Concession Drain in Lakeshore Municipality appeared to be inconsistent with the floodplain mapping as the elevations did not match; however, a hydraulic model for this watercourse was generated, assuming the hard copy output was correct. The HEC-2 hard copy information for each major watercourse was scanned and formatted into HEC-2 to create a working model. The HEC-2 model was in turn used to generate HEC-RAS models for the five major crossings. The final HEC-RAS model for each creek system was then compared to the floodline elevations provided on the floodplain mapping as a check, to ensure the models were correct. The differences in the 100-year flood elevations were negligible (with the exception of the 8th Concession Drain), and the converted models were thereby confirmed to be converted correctly. Table 4 through Table 8 provide a summary of the comparisons of the 100-year flood elevations of the various stages of the model conversion from PDF format to HEC-RAS format. Table 4 presents the Little River model comparison, Table 5 presents the comparison for the Pike Creek, Table 6 for the Kerr Drain, Table 7 presents the Puce River model comparison, and Table 8 presents the 8th Concession Drain model comparison.

The integrity of the sections in the model (i.e., elevations and general geometry of the sections) was not evaluated. Assumptions were made for some of the station information and flow data provided, and some modifications were made to the original data to correspond to modeling input required by HEC-RAS. Discrepancies in the floodplain mapping flood elevations and the PDF flood elevations were noted, and it was assumed that the PDF elevations were correct and were used as boundary conditions, as illustrated in Table 4 to Table 8. Exhibit 11 provides a schematic of the floodplain mapping and the HEC-RAS information. Hydraulic modeling output is included in Appendix B.

As presented in Table 3, there are no cases of road overtopping for the hydraulically assessed major crossings under existing conditions for the 100-year storm. Only one culvert (DB1-Pike Creek) currently meets the 1.0 m freeboard criteria. Only 3 of the culverts (R4-Little River, LB1-Little River, and DB1-Pike Creek) currently meet the soffit clearance criteria.

Table 3: Existing Structure Characteristics

Structure Number	Watercourse Name	Road Crossing	Structure Size		Upstream WSEL (50yr) (m)	Upstream WSEL (100yr) (m)	Top of Road Elev. (m)	Top of Road Freeboard (1) (m)	Road Overtopping (2) Yes/No	Soffit Elev. (3) (m)	Soffit Clearance (m)
			HEC-2 Model (m)	Field Measurement (m)							
R4	Little River	E.C. Row Expy	12.1x5.4	na	180.47	180.83	181.40	0.57	No	182.60	1.77
LB1	Little River	Lauzon Pkwy	10.7x3.7	na	181.97	182.19	182.40	0.21	No	183.60	1.41
DC1	Little River	County Rd 42	6.9x2.5	6.1x2.45	182.23	182.65	183.10	0.45	No	182.40	-0.25
DB1	Pike Creek	County Rd 42	18.3x4.9	na	-	179.22	181.78	2.56	No	181.20	1.98
DC4	Kerr Drain	County Rd 42	4.3x2.3	3.7x2.5	-	180.23	180.72	0.49	No	180.02	-0.21
DB2	Puce River	County Rd 42	15.8x4.1	na	-	178.76	179.68	0.92	No	179.25	0.49

Notes:

1. MTO HDDS Standard WC-2 specifies that the freeboard at bridge crossings shall be greater than or equal to 1.0 m for freeways, arterials and collectors. The Desirable Freeboard is measured vertically from the Energy Grade Line elevation for the Design Flow to the edge of the travelled lane. The Minimum Freeboard is measured vertically from the High Water Level for the Design Flow to the edge of the travelled lane.

2. MTO HDDS Standard WC-13 specifies that The Regulatory Flow (Hurricane Hazel for this project) shall be used for defining the Relief Flow. Where Relief Flow is provided, the following parameters shall not be exceeded at the cross section of the road for the Regulatory Flood:
- The maximum depth of flow on the roadway shall not exceed 0.3 m; and
- The product of the velocity and depth on the roadway shall not exceed $0.8 m^2/s$.

3. MTO HDDS Standard WC-2 specifies the Bridge Clearance for freeways, arterials and collector roads shall be greater than or equal to 1.0 m for the design flow, in this case 100 year return for structures with a span greater than 6.0 m. The Clearance is measured vertically from the High Water Level for the Design Flow to the lowest point on the soffit. Standard WC-2 also states that "where the structure is required to convey the Regulatory Flow, clearance shall be based on the Design Flow. Zero clearance is required for the Regulatory Flow. The freeboard for the Regulatory Flow may be less than the minimum required for the Design Flow".

Table 4: Hydraulic Model Development – Flood Elevation Comparison for Little River (100yr Flood)

Section Number	HEC-2 Mapping (m)	HEC-2 Paper Copy (m)	Diff. (m)	HEC-2 Paper Copy (m)	HEC-2 Digital (m)	Diff. (m)	HEC-2 Digital (m)	HEC-RAS Converted (m)	Diff. (m)
34001	180.26	180.43	0.17	180.43	180.43	0.00	180.43	180.43	0.00
35002	180.32	180.48	0.16	180.48	180.48	0.00	180.48	180.48	0.00
35092.5	Forest Glade Drive								
35183	na	180.56	na	180.56	180.56	0.00	180.56	180.57	0.01
35404	na	108.56	na	180.56	180.56	0.00	180.56	180.57	0.01
36000	180.38	180.57	0.19	180.57	180.57	0.00	180.57	180.58	0.01
37500	na	180.62	na	180.62	180.62	0.00	180.62	180.63	0.01
39001	180.62	180.71	0.09	180.71	180.71	0.00	180.71	180.72	0.01
40302	180.72	180.82	0.10	180.82	180.82	0.00	180.82	na	na
40323	na	180.82	na	180.82	180.82	0.00	180.82	180.81	-0.01
40573.5	E.C. Row Expressway								
40824	na	180.83	na	180.83	180.83	0.00	180.83	180.83	0.00
40845	na	180.84	na	180.84	180.84	0.00	180.84	na	na
41106	na	180.88	na	180.88	180.88	0.00	180.88	180.86	-0.02
42000	180.86	180.97	0.11	180.97	180.97	0.00	180.97	180.96	-0.01
43501	180.89	181.00	0.11	181.00	181.00	0.00	181.00	180.98	-0.02
44302	180.91	181.01	0.10	181.01	181.01	0.00	181.01	181.00	-0.01
44323	na	181.01	na	181.01	181.01	0.00	181.01	181.00	-0.01
44704	na	181.02	na	181.02	181.02	0.00	181.02	181.01	-0.01
45100	na	181.02	na	181.02	181.02	0.00	181.02	181.01	-0.01
45601	na	181.07	na	181.07	181.07	0.00	181.07	181.06	-0.01
46102	180.99	181.07	0.08	181.07	181.07	0.00	181.07	181.05	-0.02
46152.5	Lauzon Road (may no longer exist)								
46203	na	181.51	na	181.51	181.51	0.00	181.51	181.50	-0.01
46304	na	181.52	na	181.52	181.52	0.00	181.52	181.51	-0.01
47100	na	181.53	na	181.53	181.53	0.00	181.53	181.52	-0.01
48000	181.36	181.53	0.17	181.53	181.53	0.00	181.53	181.52	-0.01
48500	na	181.56	na	181.56	181.56	0.00	181.56	181.56	0.00
49000	na	181.57	na	181.57	181.57	0.00	181.57	181.57	0.00
50350	na	181.60	na	181.60	181.60	0.00	181.60	181.61	0.01
51701	181.54	181.63	0.09	181.63	181.63	0.00	181.63	181.65	0.02
52302	181.56	181.64	0.08	181.64	181.64	0.00	181.64	181.66	0.02
52352.5	Railway								
52403	na	181.65	na	181.65	181.65	0.00	181.65	181.66	0.01
52804	na	181.73	na	181.73	181.73	0.00	181.73	181.74	0.01
54000	na	181.75	na	181.75	181.75	0.00	181.75	181.76	0.01
55200	181.67	181.77	0.10	181.77	181.77	0.00	181.77	181.78	0.01
56150	na	181.78	na	181.78	181.78	0.00	181.78	181.79	0.01
57100	na	181.78	na	181.78	181.78	0.00	181.78	181.79	0.01
59000	181.70	181.79	0.09	181.79	181.79	0.00	181.79	181.80	0.01
59201	na	181.81	na	181.81	181.81	0.00	181.81	181.82	0.01
59602	181.72	181.81	0.09	181.81	181.81	0.00	181.81	181.82	0.01
59652.5	Lauzon Road								
59703	na	181.92	na	181.92	181.92	0.00	181.92	181.93	0.01
59804	na	181.92	na	181.92	181.92	0.00	181.92	181.93	0.01
61000	181.85	181.94	0.09	181.94	181.94	0.00	181.94	181.94	0.00
62301	na	181.98	na	181.98	181.98	0.00	181.98	181.98	0.00
62602	181.91	181.98	0.07	181.98	181.98	0.00	181.98	181.99	0.01
62622.5	Unknown Structure								
62643	na	182.02	na	182.02	181.98	-0.04	181.98	182.02	0.04
62804	na	182.02	na	182.02	182.01	-0.01	182.01	182.05	0.04
66000	182.01	182.08	0.07	182.08	182.07	-0.01	182.07	182.10	0.03
67250	na	182.10	na	182.10	182.09	-0.01	182.09	182.12	0.03
68501	182.08	182.13	0.05	182.13	182.12	-0.01	182.12	182.15	0.03
69002	182.12	182.14	0.02	182.14	182.14	0.00	182.14	na	na
69023	na	182.14	na	182.14	182.14	0.00	182.14	182.17	0.03
69118.5	Lauzon Parkway								
69214	na	182.16	na	182.16	182.16	0.00	182.16	182.19	0.03
69235	na	182.17	na	182.17	182.16	-0.01	182.16	na	na
69736	182.29	182.31	0.02	182.31	182.31	0.00	182.31	182.33	0.02
71000	182.34	182.34	0.00	182.34	182.34	0.00	182.34	182.36	0.02
72801	182.61	182.49	-0.12	182.49	182.48	-0.01	182.48	182.50	0.02
73102	182.63	182.49	-0.14	182.49	182.49	0.00	182.49	182.51	0.02
73162.5	County Road 42								
73223	na	182.88	na	182.88	182.87	-0.01	182.87	182.65	-0.22
73404	182.87	182.93	0.06	182.93	182.93	0.00	182.93	182.83	-0.10
75800	na	183.00	na	183.00	183.00	0.00	183.00	182.92	-0.08
77000	na	183.06	na	183.06	183.06	0.00	183.06	182.99	-0.07
78201	na	183.18	na	183.18	183.18	0.00	183.18	183.14	-0.04
78502	183.19	183.24	0.05	183.24	183.24	0.00	183.24	183.20	-0.04
78527.5	Unknown Structure								
78553	na	183.31	na	183.31	183.31	0.00	183.31	183.27	-0.04
78704	na	183.33	na	183.33	183.32	-0.01	183.32	183.29	-0.03
80600	na	183.51	na	183.51	183.51	0.00	183.51	183.48	-0.03
82500	183.82	183.68	-0.14	183.68	183.68	0.00	183.68	183.66	-0.02
83950	na	183.82	na	183.82	183.82	0.00	183.82	183.80	-0.02
85401	184.07	183.95	na	183.95	183.95	0.00	183.95	183.93	-0.02
85702	184.08	183.94	na	183.94	183.94	0.00	183.94	183.93	-0.01
85752.5	Baseline Road								
85803	na	184.14	na	184.14	184.14	0.00	184.14	184.19	0.05
86104	na	184.39	na	184.39	184.39	0.00	184.39	184.44	0.05
86400	184.35	184.40	0.05	184.40	184.40	0.00	184.40	184.45	0.05
87700	na	184.43	na	184.43	184.43	0.00	184.43	184.47	0.04
89500	184.54	184.52	-0.02	184.52	184.49	-0.03	184.49	184.52	0.03
94000	185.21	185.09	-0.12	185.09	185.09	0.00	185.09	185.09	0.00

Table 5: Hydraulic Model Development – Flood Elevation Comparison for Pike Creek (100yr Flood)

Section Number	HEC-2 Mapping (m)	HEC-2 Paper Copy (m)	Diff. (m)	HEC-2 Paper Copy (m)	HEC-2 Digital (m)	Diff. (m)	HEC-2 Digital (m)	HEC-RAS Converted (m)	Diff. (m)
1	586.30	586.30	0.00	586.30	586.30	0.00	178.70	178.70	0.00
3	587.90	587.90	0.00	587.90	587.87	-0.03	179.18	179.20	0.02
3.1	na	587.93	na	587.93	587.90	-0.03	179.19	179.21	0.02
3.15	County Road 42								
3.2	na	587.95	na	587.95	587.92	-0.03	179.20	179.22	0.02
3.3	588.00	587.98	-0.02	587.98	587.95	-0.03	179.21	179.22	0.01
4	588.90	588.93	0.03	588.93	588.91	-0.02	179.50	179.51	0.01
4.1	na	589.09	na	589.09	589.07	-0.02	179.55	179.56	0.01
4.15	Manning Road (County Road 19)								
4.2	na	589.24	na	589.24	589.22	-0.02	179.59	179.61	0.02
4.3	589.70	589.73	0.03	589.73	589.72	-0.01	179.75	179.76	0.01
5	592.50	592.53	0.03	592.53	592.52	-0.01	180.60	180.60	0.00
5.1	na	592.86	na	592.86	592.76	-0.10	180.67	180.68	0.01
5.15	Concession Road 12								
5.2	na	592.79	na	592.79	592.78	-0.01	180.68	180.68	0.00
5.3	592.80	592.78	-0.02	592.78	592.77	-0.01	180.68	180.68	0.00
6	596.20	596.21	0.01	596.21	596.20	-0.01	181.72	181.72	0.00
6.1		596.34	596.34	596.34	596.35	0.01	181.77	181.77	0.00
6.15	Concession Road 12								
6.2	na	596.36	na	596.36	596.37	0.01	181.77	181.77	0.00
6.3	596.40	596.37	-0.03	596.37	596.38	0.01	181.78	181.78	0.00
7	597.00	596.99	-0.01	596.99	596.99	0.00	181.96	181.97	0.01
9	599.00	599.02	0.02	599.02	599.02	0.00	182.58	182.58	0.00
9.1	na	599.07	na	599.07	599.07	0.00	182.60	182.60	0.00
9.15	Baseline Road								
9.2	599.10	599.09	-0.01	599.09	599.09	0.00	182.60	182.60	0.00
11	600.10	600.07	-0.03	600.07	599.82	-0.25	182.83	182.83	0.00
13	na	601.90	na	601.90	601.99	0.09	183.49	183.50	0.01

Table 6: Hydraulic Model Development – Flood Elevation Comparison for Kerr Drain (100yr Flood)

Section Number	HEC-2 Mapping (m)	HEC-2 Paper Copy (m)	Diff. (m)	HEC-2 Paper Copy (m)	HEC-2 Digital (m)	Diff. (m)	HEC-2 Digital (m)	HEC-RAS Converted (m)	Diff. (m)
1	585.30	585.30	0.00	585.30	585.30	0.00	178.40	178.40	0.00
2	587.50	587.53	0.03	587.53	587.53	0.00	179.08	179.17	0.09
3	590.90	590.90	0.00	590.90	590.91	0.01	180.11	180.10	-0.01
3.1	na	590.51	na	590.51	590.77	0.26	180.07	180.06	-0.01
3.15	County Road 42								
3.2	na	591.12	na	591.12	591.41	0.29	180.26	180.23	-0.03
3.3	591.80	591.77	-0.03	591.77	592.02	0.25	180.45	180.42	-0.03
4	593.30	593.28	-0.02	593.28	593.28	0.00	180.83	180.84	0.01
4.1	na	594.49	na	594.49	594.49	0.00	181.20	181.20	0.00
4.15	Concession Road 9								
4.2	na	594.83	na	594.83	594.84	0.01	181.31	181.30	-0.01
4.3	595.30	595.25	-0.05	595.25	595.25	0.00	181.43	181.43	0.00

Table 7: Hydraulic Model Development – Flood Elevation Comparison for Puce River (100yr Flood)

Section Number	HEC-2 Mapping (m)	HEC-2 Paper Copy (m)	Diff. (m)	HEC-2 Paper Copy (m)	HEC-2 Digital (m)	Diff. (m)	HEC-2 Digital (m)	HEC-RAS Converted (m)	Diff. (m)
9	na	581.50	na	581.50	581.50	0.00	177.24	177.24	0.00
10	581.90	581.87	-0.03	581.87	581.87	0.00	177.35	177.36	0.01
11	na	582.12	na	582.12	582.12	0.00	177.43	177.44	0.01
11.1	na	582.07	na	582.07	582.07	0.00	177.41	177.42	0.01
11.15	Railway								
11.2	na	582.06	na	582.06	582.06	0.00	177.41	177.42	0.01
12	581.90	582.39	0.49	582.39	582.39	0.00	177.51	177.52	0.01
13	584.30	584.30	0.00	584.30	584.31	0.01	178.10	178.10	0.00
14	586.40	586.37	-0.03	586.37	586.37	0.00	178.73	178.73	0.00
14.1	na	586.42	na	586.42	586.42		178.74	178.74	0.00
14.15	County Rd 42								
14.2	na	586.44	na	586.44	586.44	0.00	178.75	178.76	0.01
14.3		586.51	na	586.51	586.50	-0.01	178.77	178.77	0.00
14.4	586.70	586.66	-0.04	586.66	586.65	-0.01	178.81	178.81	0.00
15	590.00	589.99	-0.01	589.99	589.99	0.00	179.83	179.83	0.00
15.1	na	590.32	na	590.32	590.32	0.00	179.93	179.93	0.00
16	593.00	592.98	-0.02	592.98	592.98	0.00	180.74	180.75	0.01
16.1	594.10	594.09	-0.01	594.09	594.09	0.00	181.08	181.09	0.01
16.2	595.60	595.59	-0.01	595.59	595.59	0.00	181.54	181.54	0.00
17	597.20	597.18	-0.02	597.18	597.18	0.00	182.02	182.02	0.00
17.1	598.20	598.20	0.00	598.20	598.20	0.00	182.33	182.34	0.01
17.2	599.60	599.63	0.03	599.63	599.63	0.00	182.77	182.78	0.01
18	600.50	600.46	-0.04	600.46	600.46	0.00	183.02	183.03	0.01

Table 8: Hydraulic Model Development – Flood Elevation Comparison for 8th Concession Drain (100yr Flood)

Section Number	HEC-2 Mapping (m)	HEC-2 Paper Copy (m)	Diff. (m)	HEC-2 Paper Copy (m)	HEC-2 Digital (m)	Diff. (m)	HEC-2 Digital (m)	HEC-RAS Converted (m)	Diff. (m)
1	na	580.30	na	580.30	580.30	0.00	176.88	176.88	0.00
2	na	580.52	na	580.52	580.52	0.00	176.94	176.95	0.01
2.1	na	580.36	na	580.36	580.36	0.00	176.89	176.90	0.01
2.15	East Pike Road								
2.2	na	580.71	na	580.71	580.71	0.00	177.00	177.35	0.35
2.3	582.60	581.78	-0.82	581.78	581.78	0.00	177.33	177.61	0.28
3	583.60	583.62	0.02	583.62	583.62	0.00	177.89	177.95	0.06
3.1	na	583.44	na	583.44	583.44	0.00	177.83	177.90	0.07
3.15	Baseline Road								
3.2	na	583.61	na	583.61	583.61	0.00	177.88	177.94	0.06
3.3	na	588.84	na	588.84	588.84	0.00	179.48	179.45	-0.03
4	586.70	588.97	2.27	588.97	588.97	0.00	179.52	179.49	-0.03
4.1	na	589.13	na	589.13	589.14	0.01	179.57	179.54	-0.03
4.2	na	583.61	na	583.61	583.61	0.00	177.88	177.94	0.06
4.25									
4.3	na	589.46	na	589.46	589.46	0.00	179.67	179.87	0.20
4.4	587.20	589.60	2.40	589.60	589.61	0.01	179.71	180.00	0.29

5.0 PROPOSED CONDITIONS DRAINAGE AND DESIGN

5.1 Extension of Lauzon Parkway

Under proposed conditions, Lauzon Parkway will be extended from County Road 42 southerly for approximately 6 km, tying in at Highway 3 (Talbot Road). The newly extended portion of Lauzon Parkway will consist of an urban section with drainage provided by storm sewers for the majority of the length, with a rural section at the proposed Highway 401 interchange southerly to the tie-in at Highway 3. The proposed Lauzon Parkway drainage and SWM system is presented on Exhibits 13 through 15.

5.2 Lauzon Parkway and Highway 401 Interchange

The Lauzon Parkway extension will include a new interchange at Highway 401. The proposed interchange will consist of a rural section with road drainage discharging to roadside ditches. The ditches will convey the runoff to the existing Highway 401 conveyance system. The proposed interchange drainage system is presented on Exhibit 13.

5.3 Widening of County Road 42

County Road 42 will be widened from Walker Road easterly to the project limits at East Puce Road (County Road 25), a total distance of approximately 15.5 km. The proposed works consist of an urban section with drainage provided by storm sewers from the westerly limits of County Road 42 at Walker Road easterly to Manning Road (County Road 19). From Manning Road (County Road 19) to the easterly limits of the study area the proposed works consist of a rural section with drainage to roadside ditches and grassed swales. The profile for County Road 42 will follow the existing road profile. As shown on the attached exhibits, drainage from portions of the widened County Road 42 will be accommodated by the proposed drainage and SWM system to be designed by Stantec and provided in the future ULR Class EA.

5.4 East West Arterial

The new E-W Arterial will be located north of Highway 401 and will extend from Walker Road easterly to 10th Concession Road, a total distance of approximately 4.3 km. The E-W Arterial will consist of an urban section with drainage provided by storm sewers. The profile for the proposed E-W Arterial will approximately follow the existing ground profile, accounting for drainage to be conveyed to the proposed drainage and SWM system to be designed by Stantec and provided in the future ULR Class EA.

5.5 Proposed Drain and Channel Works

Based on the preliminary information provided by Stantec, the ULR Class EA is proposing realignments as presented on the future condition drainage maps. The channel realignments together with the new roads will result in the need for new culverts at various small drains, with more substantial crossings at the E-W Arterial crossing of the Little River. A summary of the modeled and observed water surface elevations is provided on Exhibit 24. A summary table of the Upper Little River Proposed SWM Characteristics was provided by Stantec and was used for the drainage and SWM design. The table is included in Appendix C.

6.0 PROPOSED CONDITIONS HYDRAULIC ANALYSIS

6.1 HEC-RAS Modeling of Major Watercourses

The hydraulic analysis of the major crossings on Lauzon Parkway and associated lands for the proposed conditions will be based on the proposed hydraulic modeling provided by Stantec as part of the ULR Class EA. At the time of the writing of this report, the Stantec model has not been finalized. Further detailed hydraulic analyses will be carried out during the detailed design stage of the project to include proposed conditions once the ULR Class EA has been finalized.

For the remaining roads within the study area, the major crossings include the Little River at E.C. Row Expressway, the Little River at Lauzon Parkway, the Little River at County Road 42, Pike Creek at County Road 42, Kerr Drain at County Road 42, and the Puce River at County Road 42. As presented in Table 3, the crossings are sufficient as there is no road overtopping for the 100-year storm event.

6.2 Hydraulic Analysis of Smaller Culverts

A hydraulic analysis of the proposed culverts was not carried out at this time, as the limited information available was deemed insufficient to assess the hydraulic conditions of the culverts within the study area. A detailed survey will be required to obtain the required culvert information to perform a comprehensive hydraulic assessment at the detailed design stage.

6.3 Storm Sewer Design

This report presents the proposed drainage and SWM components for the proposed works within the study area; however, a conceptual storm sewer design is also included. The storm sewer design and proposed road layout for the proposed E-W Arterial and for the proposed Lauzon Parkway extension were done in collaboration with RC Spencer Associates Inc.

Due to the flat topography of the area a conceptual storm sewer design was prepared to ensure that the drainage concept is feasible with the proposed road elevations. The intent of the storm sewer design is to meet the City of Windsor design criteria including pipe slope and minimum cover, as presented in Table 2.

The proposed road profile was minimized to reduce the amount of fill required, and to avoid having the proposed road elevations significantly higher than the adjacent existing topography. This was achieved in part with using a saw tooth pattern for the proposed longitudinal road slope. The storm sewer inverts were based on the Upper Little River Proposed SWM Characteristics provided by Stantec, and included in Appendix C. Grades for future road profiles will also be confirmed during detailed design for road drainage based on the detailed hydraulic analyses.

During the detailed design stage it may be determined that areas may have insufficient cover, so alternative methods may be proposed including twinning of smaller diameter pipes, pipe insulation, specialized pavement design, or the need for pump stations to provide drainage to the outlets. The design of the storm drainage system is to be confirmed at the time of detailed design and when construction phasing is known. This includes the size of storm sewers, pump stations, and SWM facilities.

The conceptual storm sewer design was completed using the XP-SWMM modeling software, which is capable of analyzing sewer networks under surcharged conditions. The flow contributing to each portion of storm sewer was calculated using the Rational Method and input into the hydraulic model. The area was determined by multiplying the proposed road width by the length of sewer. The 5-year rainfall intensity (78.74 mm/hr) was calculated based on the City of Windsor rain gauge. The coefficient of runoff for the roadway was assumed to be 0.85.

In locations where the storm sewers outlet to the proposed pond locations, a constant backwater condition was applied to simulate the effects of the ponds on the sewer outlets. Two scenarios were included in the model: 1) the backwater condition was set at the permanent pool elevations extracted from Stantec's Upper Little River Proposed SWM characteristics; and 2) the permanent pool elevation mentioned above plus 1.0 m. Based on the modeling results, the first scenario produces no surface flooding. The model results including hydraulic grade line elevation profiles are included in Appendix D.

The existing profile of County Road 42 was a constraint to the proposed storm sewer design for this road. Two alternatives are proposed for the long stretch of roadway from the westerly limits to the proposed SWM pond at Station 14+500. The first option is to upsize the sewer to 1500 mm. Based on the XP-SWMM modeling results, this size is appropriate.

Another alternative is to introduce another SWM pond along County Road 42 which would discharge to municipal drains. This alternative would require additional property requisition. A summary of the conceptual storm sewer design for the main road reaches is provided in Table 9 through Table 11 and in Exhibits 25 through 36. It should be noted that the SWM pond locations indicated on Exhibits 25 through 36 are for conceptual purposes only and the locations are subject to change.

Table 9: Preliminary Storm Sewer Calculations – East West Arterial

Line & Location			Pipe Size (mm)	Length (m)	Slope (%)	Capacity (m^3/s)	Full Flow Velocity (m/s)
Street	From	To					
Road Width = 14.6 m							
E-W Arterial	10+360	10+740	450	380	0.18%	0.121	0.761
	10+760	11+440	600	680	0.12%	0.213	0.752
	11+500	12+020	525	520	0.14%	0.161	0.743
	12+100	12+020	450	80	0.21%	0.095	0.759
	12+100	12+400	450	300	0.21%	0.095	0.759
	12+500	12+400	450	100	0.21%	0.095	0.759
	12+500	12+780	450	280	0.21%	0.095	0.759
	12+900	12+780	450	120	0.21%	0.095	0.759
	12+900	13+250	450	350	0.18%	0.121	0.761
	13+500	13+250	450	250	0.21%	0.095	0.759
	13+580	14+160	600	580	0.12%	0.213	0.752
Notes:							
City of Windsor 5-year intensity = 78.74 mm/hr							

Table 10: Preliminary Storm Sewer Calculations – Lauzon Parkway

Line & Location			Pipe Size (mm)	Length (m)	Slope (%)	Capacity (m^3/s)	Full Flow Velocity (m/s)
Street	From	To					
Road Width = 21.9 m							
Lauzon Parkway	10+900	11+240	900	340	0.07%	0.479	0.753
	12+360	11+350	900	1010	0.07%	0.479	0.753
	12+360	12+940	900	580	0.07%	0.479	0.753
	14+180	12+940	900	1240	0.07%	0.479	0.753
	14+980	14+250	900	730	0.07%	0.479	0.753
	16+000	15+000	900	1000	0.07%	0.479	0.753
Notes:							
City of Windsor 5-year intensity = 78.74 mm/hr							

Table 11: Preliminary Storm Sewer Calculations – County Road 42

Line & Location			Pipe Size (mm)	Length (m)	Slope (%)	Capacity (m^3/s)	Full Flow Velocity (m/s)
Street	From	To					
Road Width = 17.6 m							
County Road 42	10+000	12+220	900	2220	0.20%	0.810	1.273
	12+220	13+000	1500	780	0.20%	3.161	1.789
	13+000	14+520	1500	1520	0.04%	1.414	0.800
	14+880	14+680	450	200	0.18%	0.121	0.761
	15+320	14+990	450	330	0.20%	0.128	0.802
	16+250	16+620	675	370	0.15%	0.768	1.207
	16+620	18+540	900	1920	0.15%	1.102	0.701
Notes:							
City of Windsor 5-year intensity = 78.74 mm/hr							

7.0 PROPOSED STORM WATER MANAGEMENT

The proposed storm water management measures for the study area are presented in Exhibits 13 through 23. The ULR Class EA will provide storm water management alternatives for the majority of the study area, as presented on Exhibit 13. It will include all of the proposed Lauzon Parkway extension, all of the E-W Arterial, and the westerly portion of the County Road 42 works. Information provided by Stantec to date indicates that the proposed storm water management alternative is comprised of off-line SWM ponds to provide water quality treatment for events up to and including the 5-year storm event. In addition to the SWM ponds, on-line channels are proposed for water quantity control storage. The proposed on-line channels are intended to resemble a wide river valley, as opposed to the fairly constrained valley system present under existing conditions.

In addition to the SWM ponds, oil grit separators may be implemented in some areas to provide additional water quality where treatment in SWM ponds or grassed swales is not achievable due to physical site constraints (i.e. not enough grade for SWM pond or no area for grassed swales). Details for the storm water management plan will be provided in the ULR Class EA and subsequently for the detailed design stage of the project.

A preliminary estimate was carried out to determine the approximate SWM facility volume that would be required to accommodate the additional road areas resulting from the road widening and new roadways. The following calculations are based on the water quality sizing criteria as specified in the 2003 MOE SWM Planning and Design Manual. A 70 percent impervious level was assumed for the road right-of-way, resulting in a required wet pond volume of 225 m^3 per hectare of the roadway. Based on the additional road lengths outlined in Section 5.1 above, and taking into account the estimated additional widths, the required treatment volumes were estimated as described below.

East West Arterial

The E-W Arterial is proposed to be two lanes with an approximate road pavement width of 8.2 m, over 4.3 km. This results in an overall pavement area of 3.5 ha. At 225 m^3 per hectare, the required water quality storage volume is approximately 790 m^3.

The E-W Arterial is proposed to have an urban cross section with storm sewers along its entire length to 10^{th} Concession Road. Based on the existing flat topography of the area, it will be required to design storm sewers with several outlet locations to minimize the overall slope. There are numerous locations which will allow for discharge of the treated storm sewer flows. Preliminary outlet locations are shown on the future conditions drainage mosaic Exhibits 22 and 23.

Lauzon Parkway

The Lauzon Parkway extension is proposed to be a six lane (approximately 28 m width of paved surface, including road, sidewalk and multi-use pathway) roadway extending southerly approximately 6 km. This results in an additional pavement area of approximately 16.8 ha. At 225 m^3 per hectare, this results in an approximate required storage volume of 3,780 m^3.

The extension of the Lauzon Parkway is proposed to have an urban cross section with storm sewers from the E.C ROW Expressway to Highway 401. It will be required to design storm sewers with several outlet locations to minimize the overall slope due to the flat topography of the area. There are numerous locations which will allow for discharge of the treated storm sewer flows. Preliminary outlet locations and proposed SWM facility locations are shown on the future conditions drainage mosaic Exhibits 13 through 15.

The existing Little River will be realigned south of Highway 401 to run westerly, through the existing culvert crossing Highway 401 (existing capacity to be assessed). The realigned drain will connect to the existing alignment north of Highway 401. This realignment results in the drain averting the proposed interchange entirely.

The Lauzon Parkway at the Highway 401 interchange and south to Highway 3 will have a rural section with road drainage discharging to roadside grassed swales for treatment and conveyance. Water quality treatment at the proposed Lauzon Parkway and Highway 401 interchange will consist entirely of grassed swales.

County Road 42

The County Road 42 works propose to widen the road to four lanes, resulting in an additional 7.5 m of road pavement over the 15.5 km project length, with 5.4 km in the City of Windsor boundaries and 10.1 km in the Town of Tecumseh boundaries. This results in an additional pavement area of approximately 11.6 ha, 4.0 ha in Windsor, 7.6 ha in Tecumseh. At 225 m^3 per hectare, the required water quality storage volume is 2,610 m^3.

The widening of County Road 42 is proposed to have an urban cross section with storm sewers from Walker Road to Manning Road (County Road 19). It will be required to design storm sewers with regular outlet locations to minimize the overall slope due to the flat topography of the area and the limits of achievable cover and drop, due to the existing road and surface water elevations. There are numerous locations which will allow for discharge of the treated storm sewer flows. Preliminary outlet locations are shown on the future conditions drainage mosaic drawings. A storm sewer running from 9th Concession Road to Manning Road (County Road 19) will capture road runoff and discharge it to a proposed SWM pond located just east of Manning Road (County Road 19). Alternative location for treatment of this road runoff is a future community pond at Manning Road (County Road 19) south of CR 42. Final pond locations will be selected during detailed design. Preliminary calculations indicate that the proposed SWM pond will require a footprint of approximately 2,000 m^2 to treat the road runoff to MOE quality criteria as specified in the Stormwater Management Planning and Design Manual.

County Road 42 east of Manning Road (County Road 19) is proposed to have a rural cross section with no storm sewers. The road will be widened to the north, allowing for the relocation and redesign of portions of the drainage swales running along the north side of the road. The overland flow will be designed to outlet at various locations along County Road 42 to the redesigned north grassed swale. A small portion of the road runoff will discharge to a proposed ditch along the south of County Road 42 in the vicinity of Elmstead Road, due to constraints resulting from the existing development to the north of County Road 42. There are numerous locations which will allow for discharge of the road runoff. Treatment options will include grassed swales where feasible, depending on the final width of the north right of way and resulting area available for the swale. Rock check dams are also proposed within the grassed swales as feasible to provide additional water quality treatment. Due to the limited available swales and the flat topography, treatment in the form of oil/grit separators may be required in some areas. Preliminary swale and outlet locations are shown on the future conditions drainage mosaic Exhibits 16 through 20.

7.1 Proposed Drainage and Storm Water Management by Others

Conceptual drainage and storm water management measures have been proposed as part of the ULR Class EA now being prepared concurrently with this Lauzon Parkway Class EA. At the time of writing this report, the ULR Class EA is still ongoing. The drainage and storm water management components available to date have been incorporated in this report. “Alternative #6 Grouped Stormwater Management Controls” as presented in ULR’s May 2012 PIC materials is the preferred alternative. The proposed drainage conditions and the preferred storm water management alternative are presented on Exhibits 12 through 22.

Owing to the proximity of the study area to Windsor International Airport, the ULR Class EA Team sought design input for the SWM facilities from YQG Inc. Windsor International Airport, Director of Operations. MRC obtained the meeting minutes of the various project team meetings and a summary of the Airport’s design suggestions are summarized herein. The guidelines were in fact a working collaboration between the project team to achieve an ultimate workable solution for stormwater management for the study are while minimizing impacts to the airport lands. The overall storm water management plan in the ULR Class EA has incorporated the design suggestions provided by the airport authority.

With respect to SWM facilities as part of the airport’s strategy to minimize airplane/bird conflicts (especially large bodied waterfowl, i.e., geese and gulls) the airport aims to avoid/minimize large open water ponds and large open lawns. Generally, heavy vegetation and less open water/fetches result in fewer birds. These features make ponds less attractive to bird species as it makes entering and exiting the water and the identification of predators more difficult.

MRC has incorporated the conceptual layout of this preferred alternative in this Lauzon Parkway Class EA. At this time, no design information is available regarding the pond size or culvert sizes and elevations. For the purposes of this Class EA report, MRC is providing a conceptual drainage and storm water management plan based on the best available information to date.

8.0 SUMMARY

This report documents the existing and proposed drainage conditions for the Class Environmental Assessment Study to address the future requirements for Lauzon Parkway, County Road 42, and the proposed E-W Arterial, as prepared by MRC on behalf of the Ontario Ministry of Transportation, the City of Windsor and the County of Essex. The following section provides a summary of the key findings and recommendations.

A site reconnaissance was carried out in May 2011. As noted in the Culvert Inspection Report (MRC, 2011) included in Appendix A, the majority of the inspected culverts are in good condition. Of the 33 culverts assessed, ten were found to be in poor or fair condition:

- LC2 was corroded at the downstream end, and the culvert barrel was in poor condition;
- LC3 was deformed/crushed at the upstream and downstream ends;
- LC9 was crushed, cracked, and the pipe barrel was rusty where visible;
- LC15 was corroded at the downstream end on the culvert bottom;
- LC16 was corroded at the downstream end on the culvert bottom;
- LC17 was broken and corroded at the upstream end, and the downstream end had a hole through the bottom of the culvert and was angled upwards;
- DC4 had scaling, cracking and spalling at upstream end;
- DC5 had scaling and spalling at the upstream end;
- DC6 had exposed rebar and spalling at the upstream end; and
- XC8 had culvert barrels found to be in poor to fair condition.

Culverts DC2 was found to be in fair condition. The remaining culverts are in good condition. The above assessments are based only on the observations of the site reconnaissance. A comprehensive hydraulic assessment could not be carried out at this time due to limited available information, and as such this report does not include an assessment based on hydraulic capacities.

Hydraulic modelling for existing conditions was carried out for the relevant crossings of the Little River, Pike Creek, Kerr Drain, and Puce River within the proposed work limits. Hydraulic modelling of the Little River, Pike Creek, Kerr Drain, Puce River, and 8th Concession Drain was provided by ERCA in PDF format. The HEC-2 hard copy printouts were compared to the available floodplain mapping elevations, and were scanned and ultimately formatted into HEC-RAS working models for all five of the major crossings. Assumptions were made for some of the station information and flow data provided. Some modifications were made to the original data to correspond to modelling input required by HEC-RAS. Summaries of the comparisons of the various stages of the model conversion from PDF format to HEC-RAS format are provided in this report. Hydraulic modelling output is included in Appendix B of this report.

As presented in this report, there were no cases of road overtopping under existing conditions for the 100-year storm. Only one culvert (DB1-Pike Creek) currently meets the freeboard criteria. Only 3 of the culverts (R4-Little River, LB1-Little River, and DB1-Pike Creek) currently meet the soffit clearance criteria.

At the time of writing this report, limited information is available and as such, the proposed conditions hydraulic analysis and storm water management analysis is carried out at a preliminary level.

Under proposed conditions, Lauzon Parkway will be extended from County Road 42 southerly for approximately 6 km. The newly extended portion of Lauzon Parkway will consist of an urban section with drainage provided by storm sewers, with the road drainage to be accommodated by the proposed drainage and SWM system to be designed by Stantec and provided in the future ULR Class EA.

County Road 42 will be widened from Walker Road easterly to the project limits at East Puce Road (County Road 25), a total distance of approximately 15.5 km. The widened Road will consist of an urban section from the westerly project limits to Manning Road (County Road 19), with drainage provided by storm sewers. The road drainage to be accommodated by the proposed drainage and SWM system as presented in this report. Easterly of Manning Road (County Road 19), the proposed road will consist of a rural section. Drainage will be directed to a proposed swale predominantly located to the north of County Road 42. Storm water management will be provided in the form of grassed swales and rock check dams.

The new E-W Arterial will be located north of Highway 401 and will extend from Walker Road easterly to 10th Concession Road, a total distance of approximately 4.3 km. The E-W Arterial will consist of an urban section, with drainage provided by storm sewers, with the road drainage to be accommodated by the drainage and SWM system to be designed by Stantec and provided in the future ULR Class EA.

Based on the preliminary information provided by Stantec, the ULR Class EA is proposing realignments as presented on the future condition drainage maps. The channel realignments together with the new roads will result in the need for new culverts at various small drains, with more substantial crossings at the E-W Arterial crossing of the Little River.

Proposed drainage and storm water management measures will be identified as part of the ULR Class EA being carried out by Stantec, now being prepared concurrently with this Lauzon Parkway Class EA.

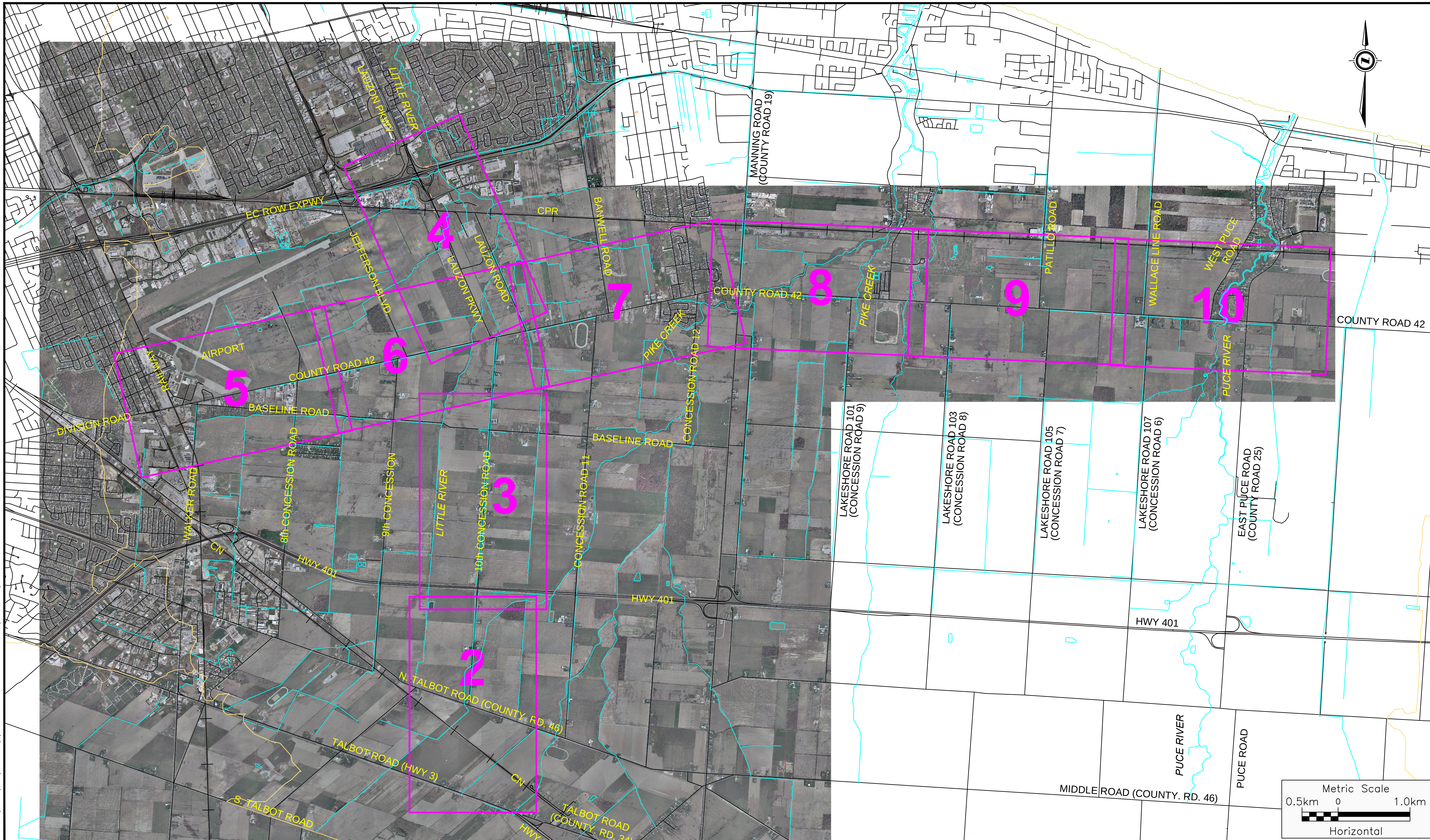
The drainage and storm water management components available to date have been incorporated in this report. From MRC's discussions with Stantec, their "Alternative #6 Grouped Stormwater Management Controls" as presented in their May 2012 PIC materials is the preferred alternative.

For the purposes of this Class EA report, MRC is providing a conceptual drainage and storm water management plan based on the best available information to date. The hydraulic analysis for the proposed conditions will ultimately be based on the proposed modeling provided by Stantec. Grades for future road profiles will be confirmed during detailed design for road drainage.

The proposed storm water management measures are based on those proposed for the ULR Class EA. The proposed Storm Water Management alternative is comprised of off-line SWM ponds to provide water quality for events up to and including the 5-year storm event. In addition to the SWM ponds, on-line channels are proposed for water quantity control storage. The proposed on-line channels are proposed to resemble a wide river valley, as opposed to the fairly constrained valley system present under existing conditions.

Details for the storm water management plan will be provided in the ULR Class EA. A detailed storm water management plan will be required for the detailed design stage of the project.

EXHIBITS



MRC McCORMICK RANKIN A member of MMM GROUP

KEY MAP

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT 1

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-KEY MAP.DWG

MODIFIED: Nov. 24, 2013 6:29 PM

MRC McCORMICK RANKIN A member of MMM GROUP

EXISTING DRAINAGE CONDITIONS

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT 2

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-EXISTING DRAINAGE MOSAIC.DWG

MODIFIED: Nov. 22, 2013 3:51 PM

MRC McCORMICK RANKIN A member of MMM GROUP

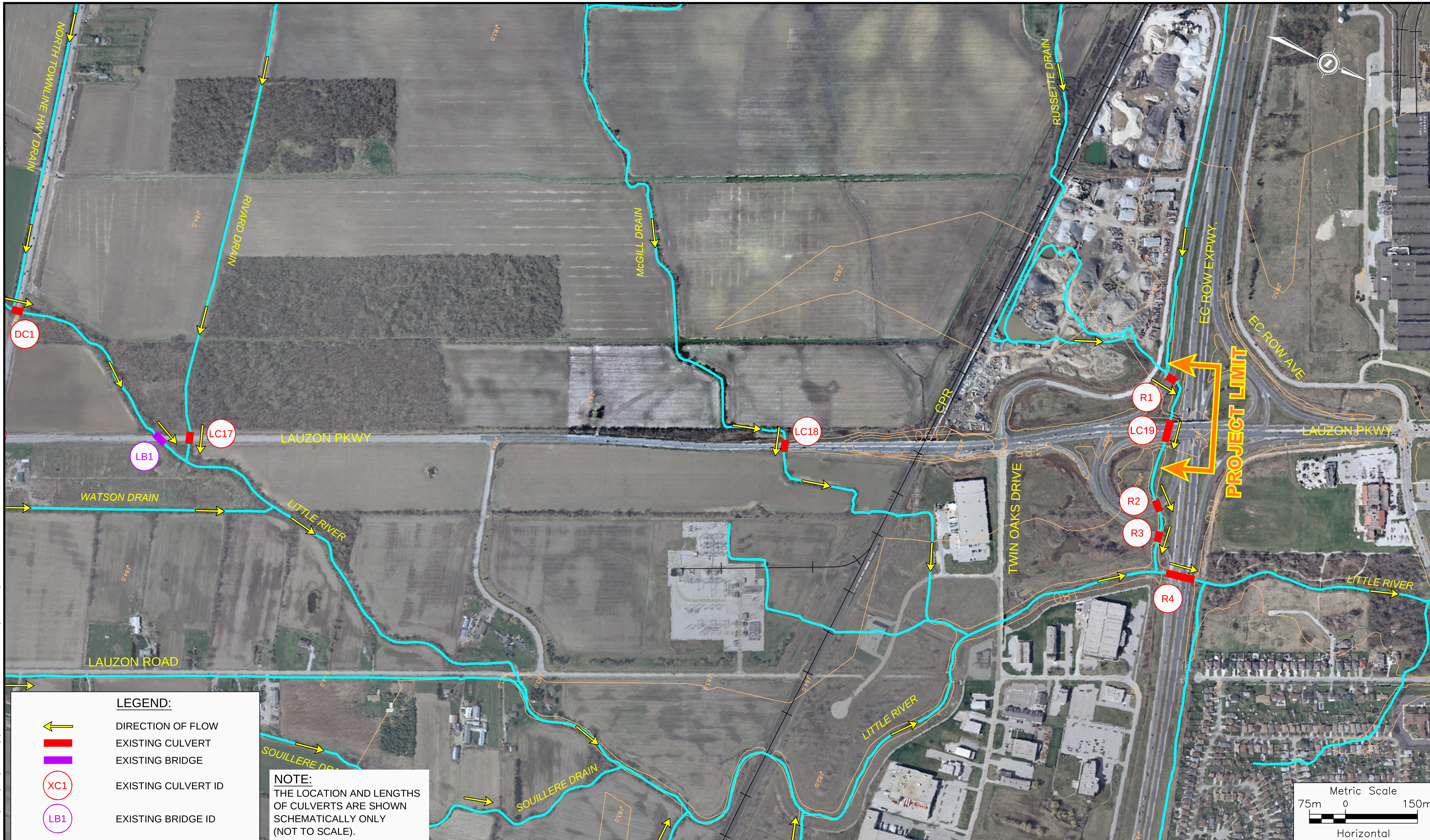
EXISTING DRAINAGE CONDITIONS

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT 3

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-EXISTING DRAINAGE MOSAIC.DWG

MODIFIED: Nov. 22, 2013 3:51 PM



LEGEND:

- DIRECTION OF FLOW
- EXISTING CULVERT
- EXISTING BRIDGE
- XC1 EXISTING CULVERT ID
- LB1 EXISTING BRIDGE ID

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS ARE SHOWN SCHEMATICALLY ONLY (NOT TO SCALE).

MRC McCORMICK RANKIN A member of MMM GROUP

EXISTING DRAINAGE CONDITIONS

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT 4

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-EXISTING DRAINAGE MOSAIC.DWG MODIFIED: Nov. 22, 2013 3:51 PM

MRC McCORMICK RANKIN A member of MMM GROUP

EXISTING DRAINAGE CONDITIONS

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT

5

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-EXISTING DRAINAGE MOSAIC.DWG

MODIFIED: Nov. 22, 2013 3:51 PM

LEGEND:

- DIRECTION OF FLOW
- EXISTING CULVERT
- EXISTING BRIDGE
- XC1 EXISTING CULVERT ID
- LB1 EXISTING BRIDGE ID

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS ARE SHOWN SCHEMATICALLY ONLY (NOT TO SCALE).

MRC McCORMICK RANKIN A member of MMM GROUP

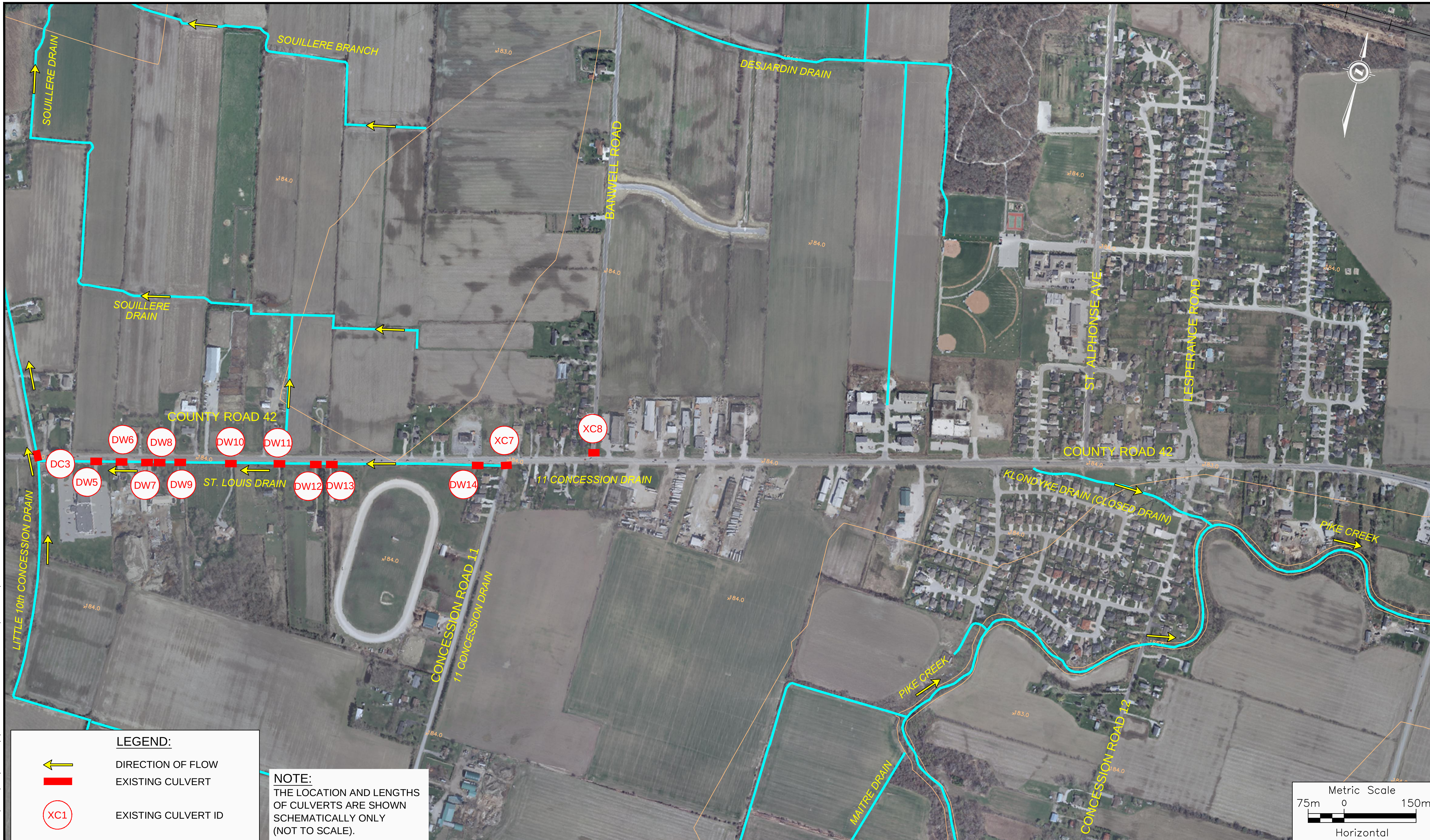
EXISTING DRAINAGE CONDITIONS

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT 6

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-EXISTING DRAINAGE MOSAIC.DWG

MODIFIED: Nov. 22, 2013 3:51 PM



LEGEND:

- DIRECTION OF FLOW
- EXISTING CULVERT
- XC1 EXISTING CULVERT ID

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS ARE SHOWN SCHEMATICALLY ONLY (NOT TO SCALE).

MRC McCORMICK RANKIN A member of MMM GROUP

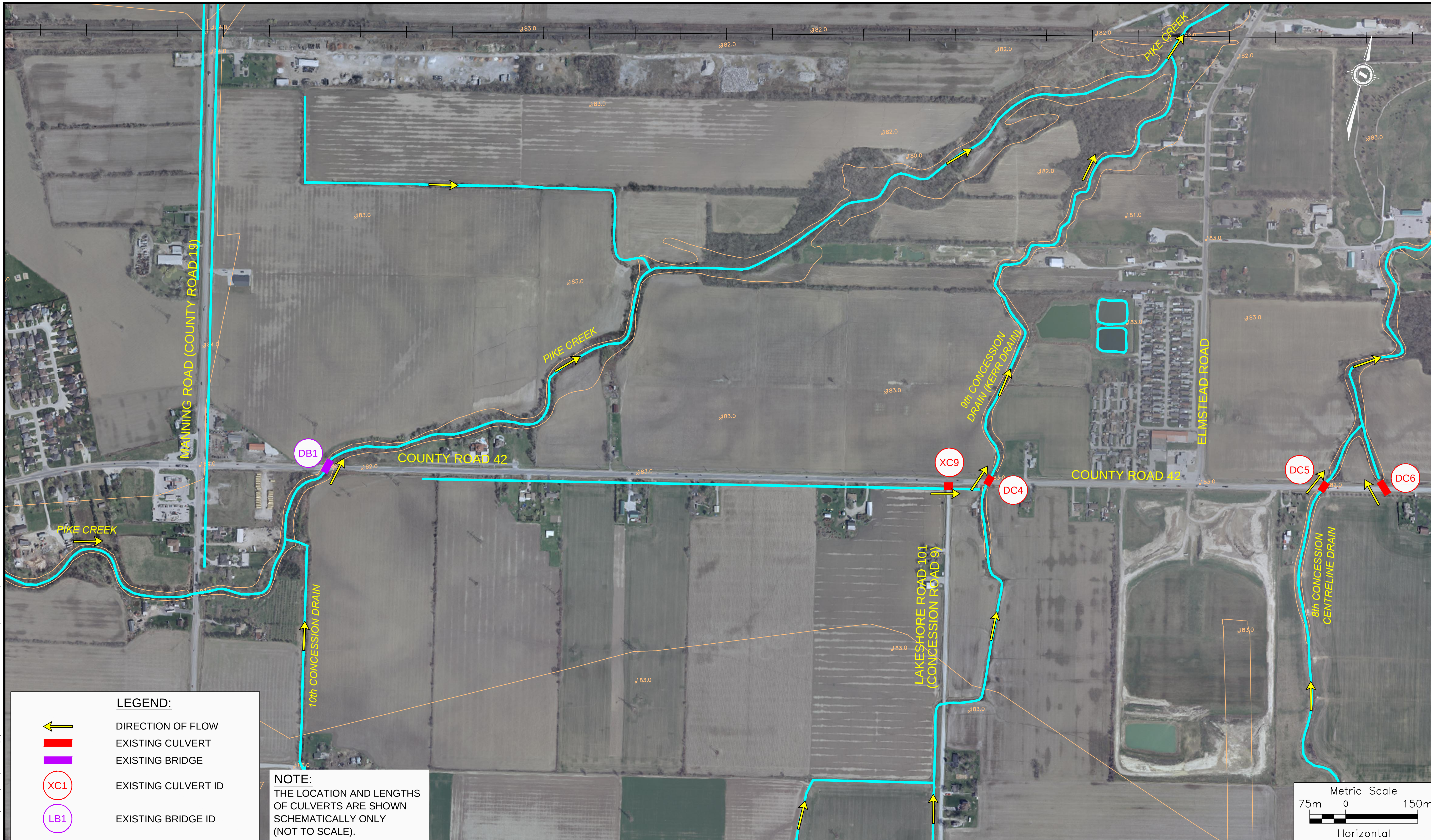
EXISTING DRAINAGE CONDITIONS

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT 7

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-EXISTING DRAINAGE MOSAIC.DWG

MODIFIED: Nov. 22, 2013 3:51 PM



MRC McCORMICK RANKIN A member of MMM GROUP

EXISTING DRAINAGE CONDITIONS

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT 8

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-EXISTING DRAINAGE MOSAIC.DWG

MODIFIED: Nov. 24, 2013 6:35 PM

LEGEND:

- DIRECTION OF FLOW
- EXISTING CULVERT
- XC1 EXISTING CULVERT ID

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS ARE SHOWN SCHEMATICALLY ONLY (NOT TO SCALE).

MRC McCORMICK RANKIN A member of MMM GROUP

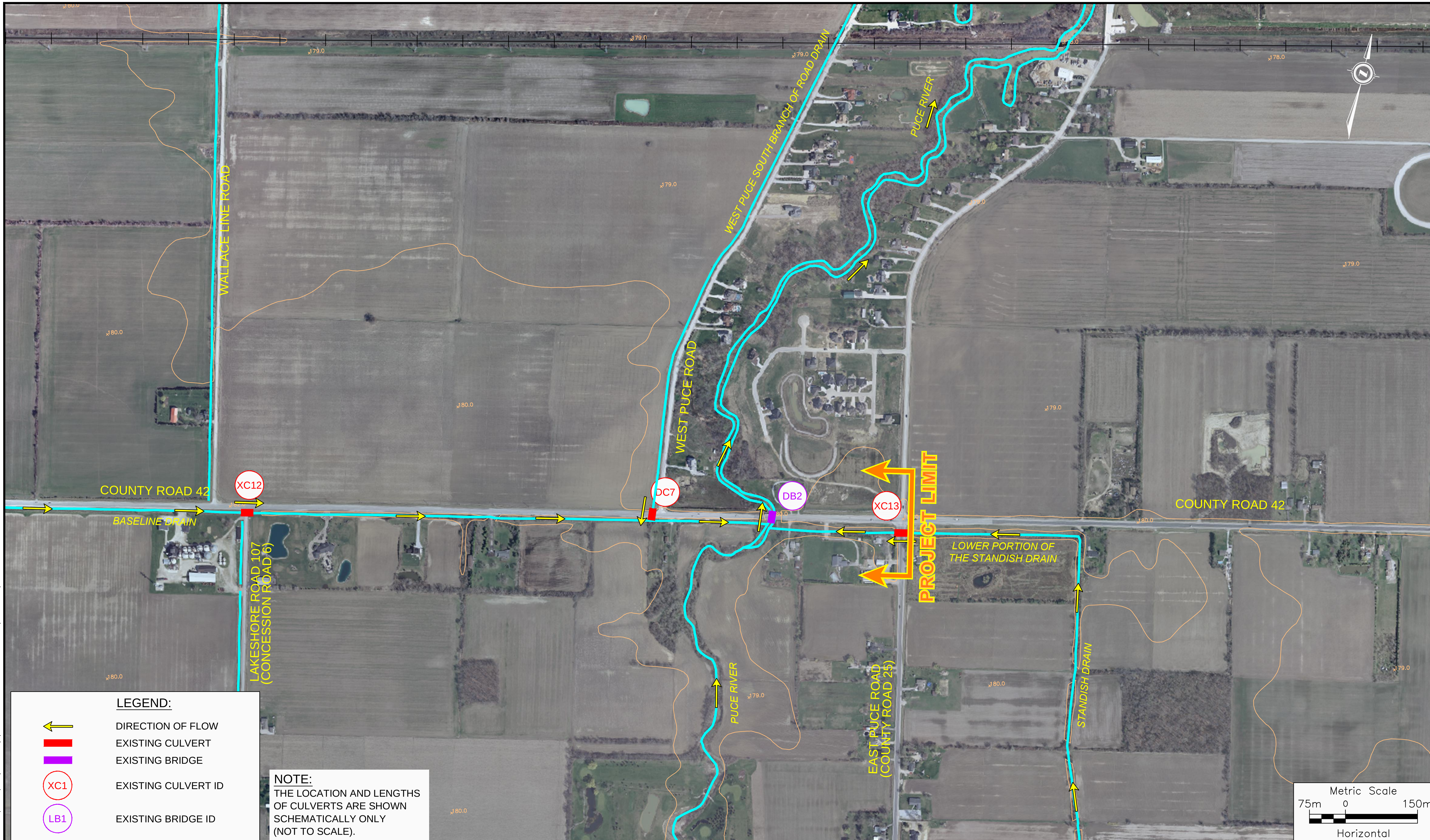
EXISTING DRAINAGE CONDITIONS

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT 9

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-EXISTING DRAINAGE MOSAIC.DWG

MODIFIED: Nov. 22, 2013 3:51 PM



EXISTING DRAINAGE CONDITIONS

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT 10

MRC McCORMICK RANKIN A member of MMM GROUP

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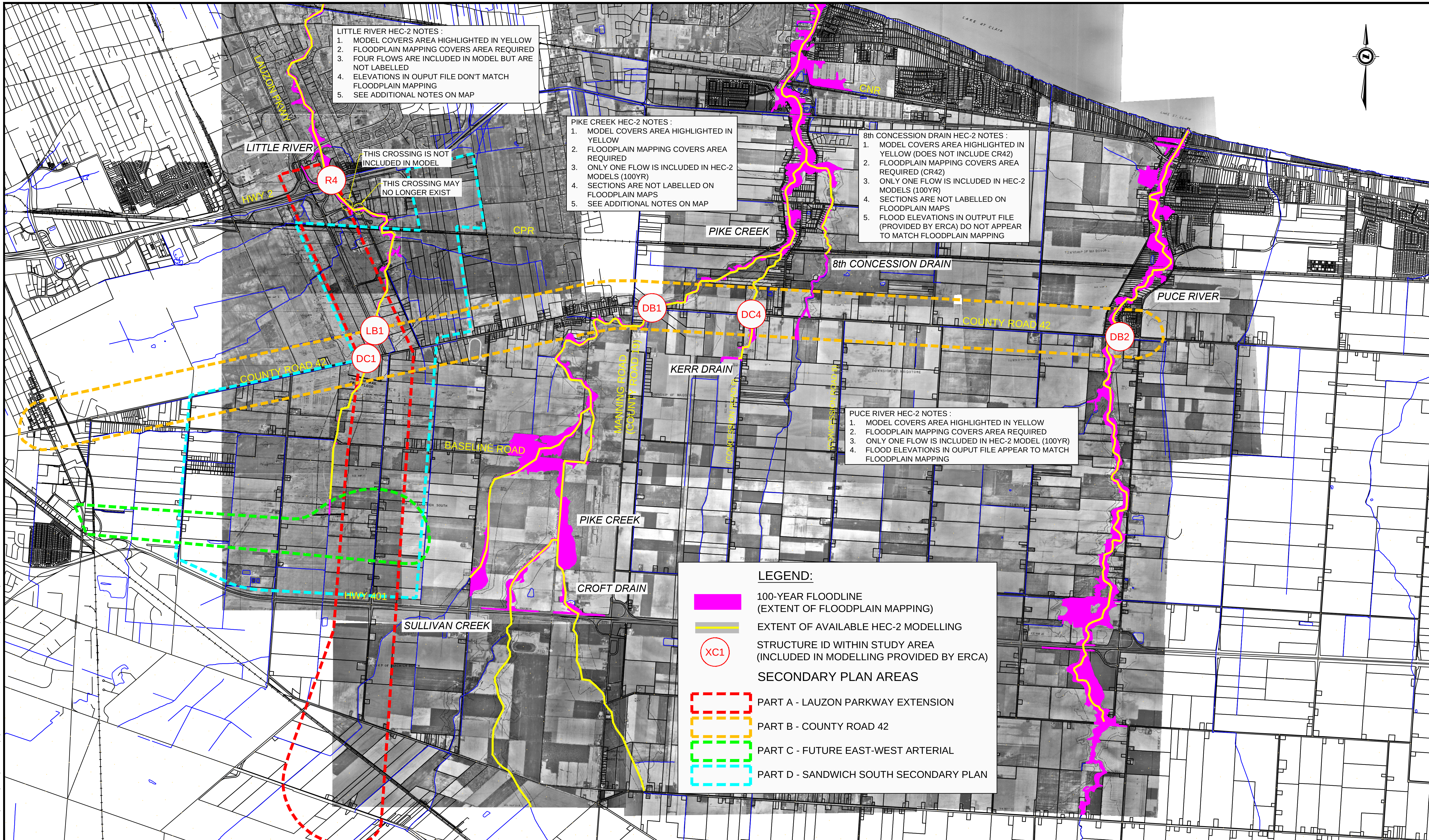

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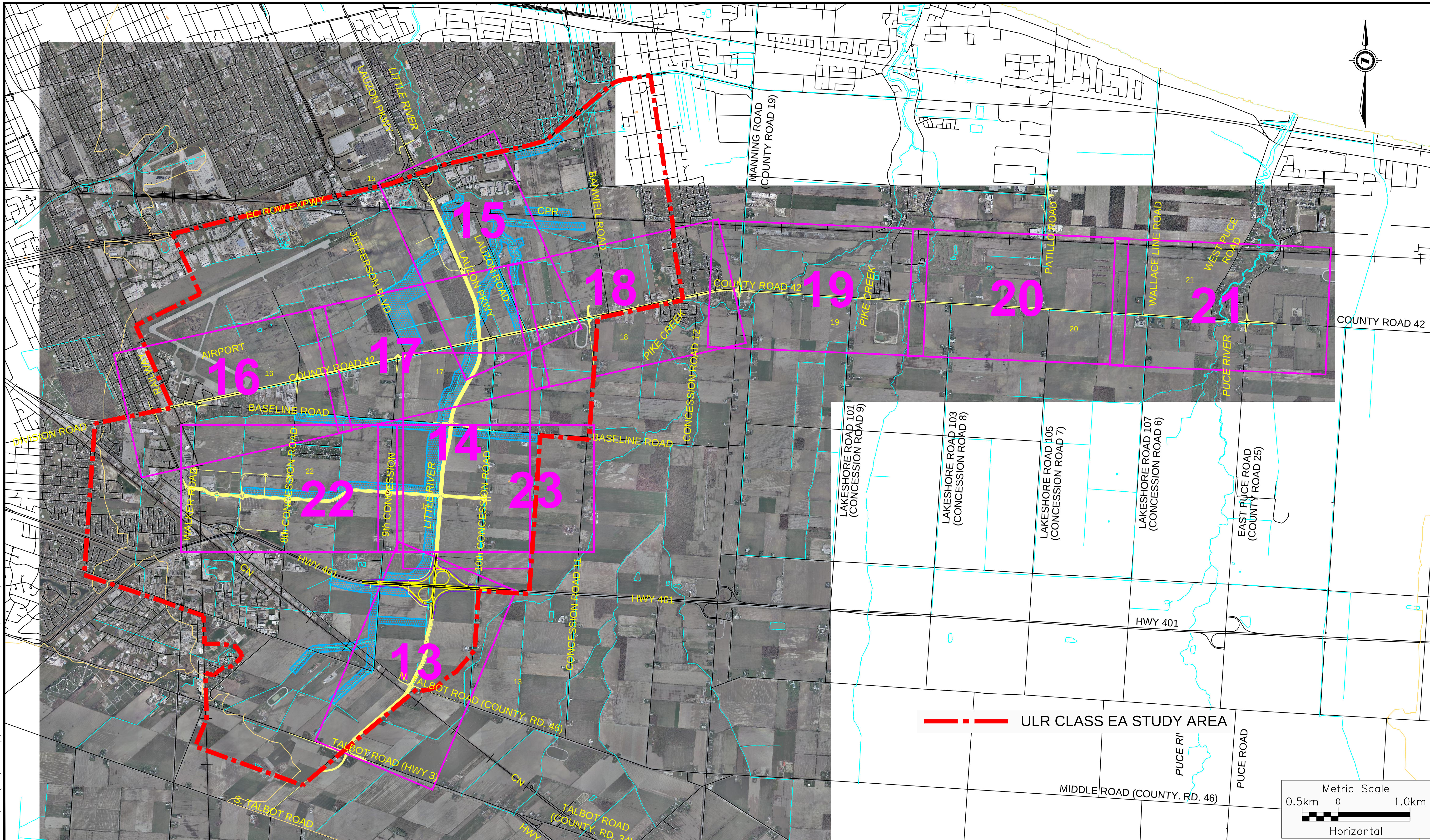
MODIFIED: Nov. 28, 2013 10:06 AM

MRC McCORMICK RANKIN A member of MMM GROUP

FLOODPLAIN MAPPING AND HEC-2 INFORMATION

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT 11



MRC McCORMICK RANKIN
A member of MMM GROUP

FUTURE DRAINAGE MOSAIC KEY MAP

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT

12

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-FUTURE DRAINAGE MOSAIC KEY MAP.DWG

MODIFIED: Nov. 28, 2013 10:24 AM

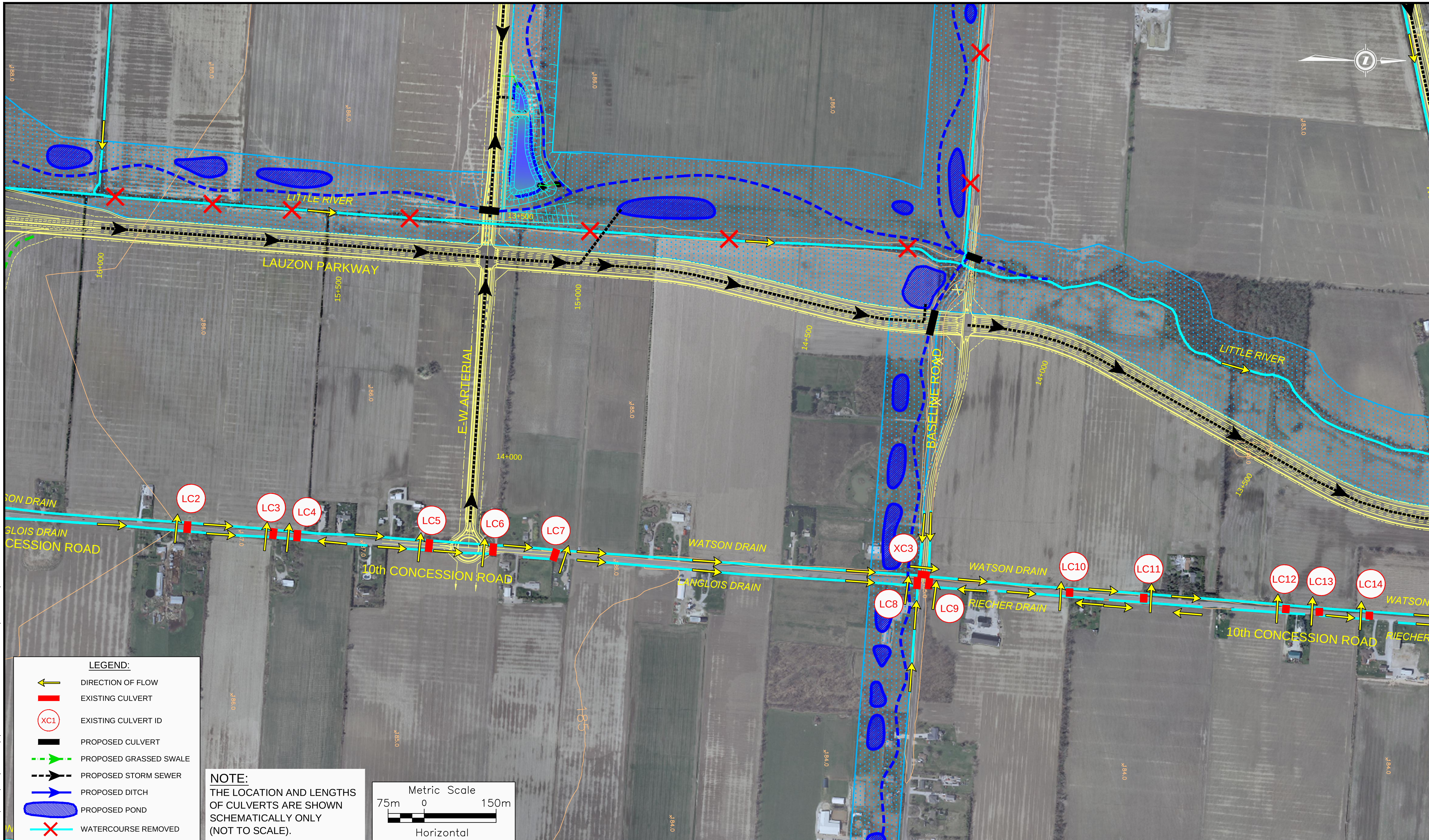
MRC McCORMICK RANKIN A member of MMM GROUP

FUTURE DRAINAGE CONDITIONS

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT 13

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-FUTURE DRAINAGE MOSAIC.DWG MODIFIED: Jan. 13, 2014 12:22 PM



MRC McCORMICK RANKIN A member of MMM GROUP

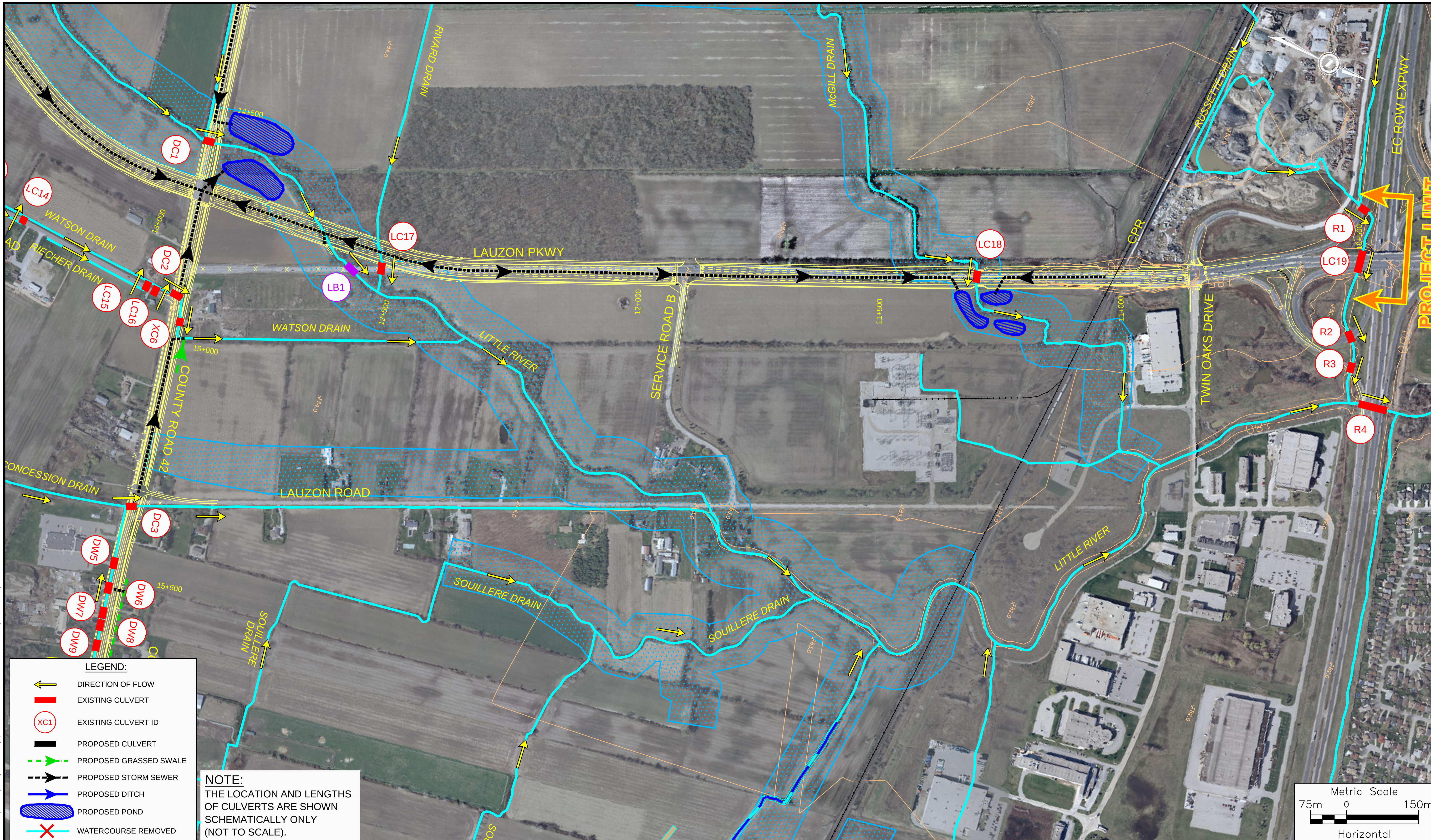
FUTURE DRAINAGE CONDITIONS

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT 14

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-FUTURE DRAINAGE MOSAIC.DWG

MODIFIED: Jan. 13, 2014 12:22 PM



MRC McCORMICK RANKIN
A member of MMM GROUP

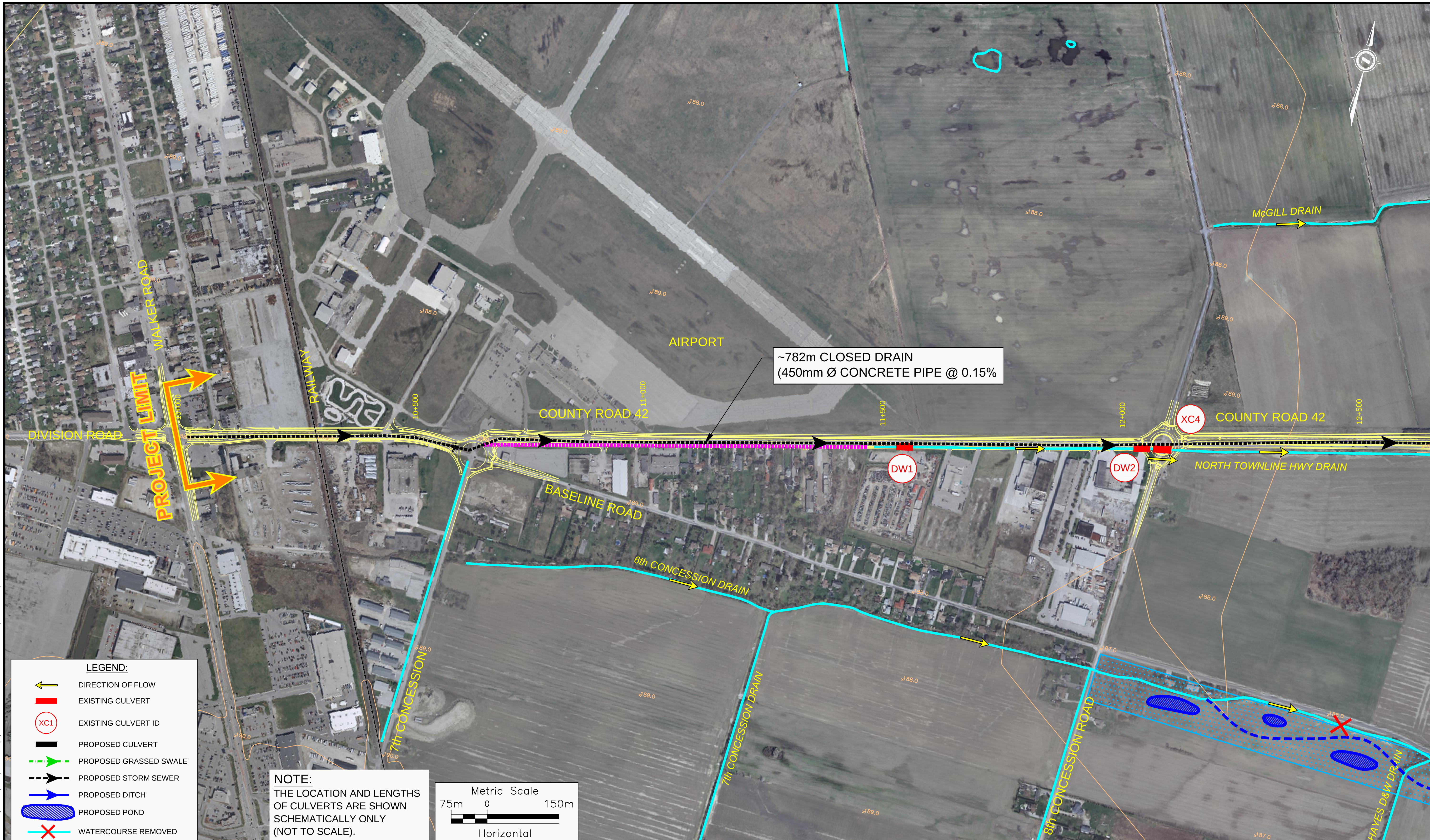
FUTURE DRAINAGE CONDITIONS

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT 15

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-FUTURE DRAINAGE MOSAIC.DWG

MODIFIED: Jan. 13, 2014 1:34 PM



MRC McCORMICK RANKIN A member of MMM GROUP

FUTURE DRAINAGE CONDITIONS

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT 16

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-FUTURE DRAINAGE MOSAIC.DWG

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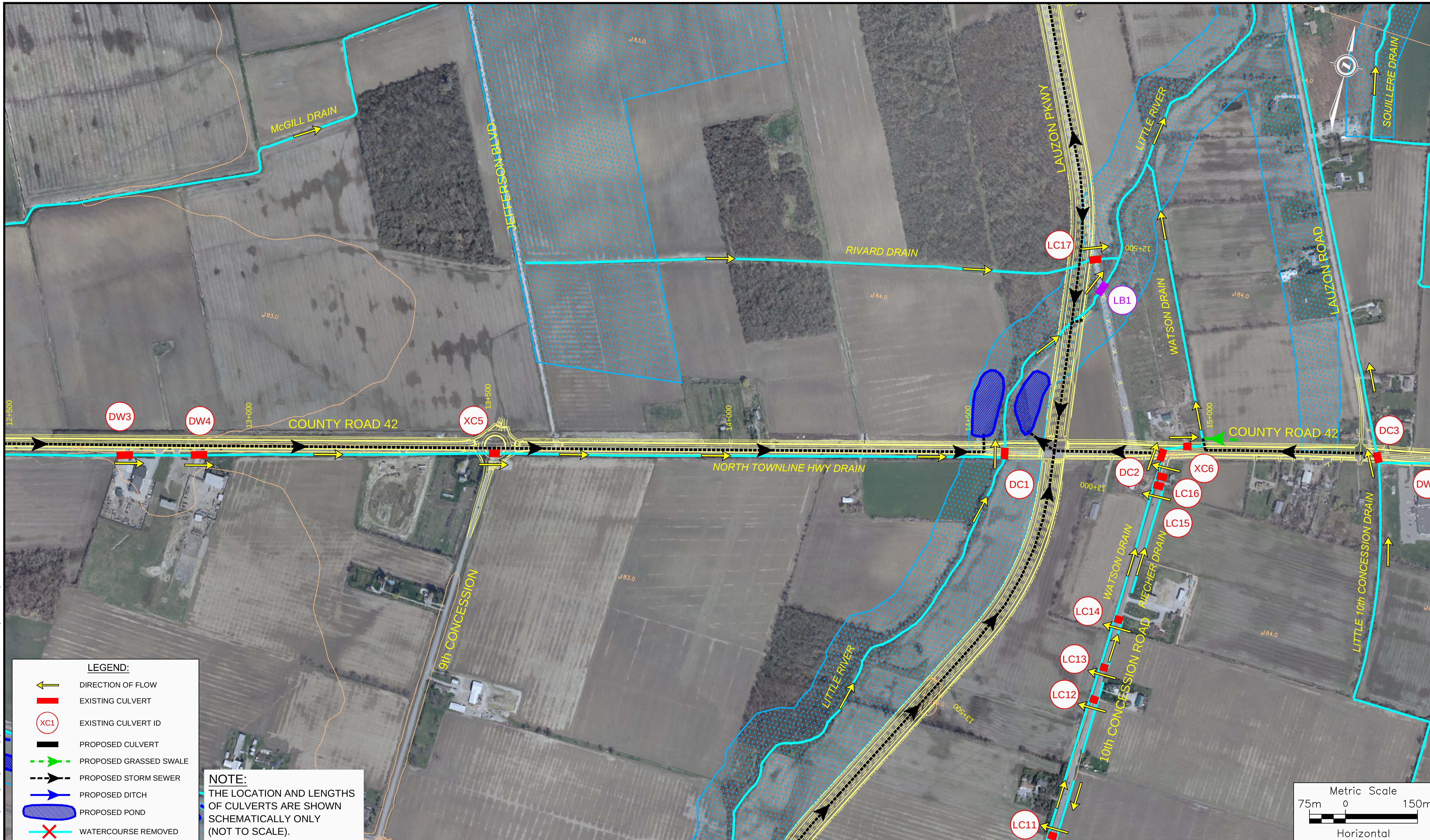


FUTURE DRAINAGE CONDITIONS

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT 17

MRC McCORMICK RANKIN A member of MMM GROUP

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-FUTURE DRAINAGE MOSAIC.DWG

MODIFIED: Jan. 13, 2014 12:22 PM

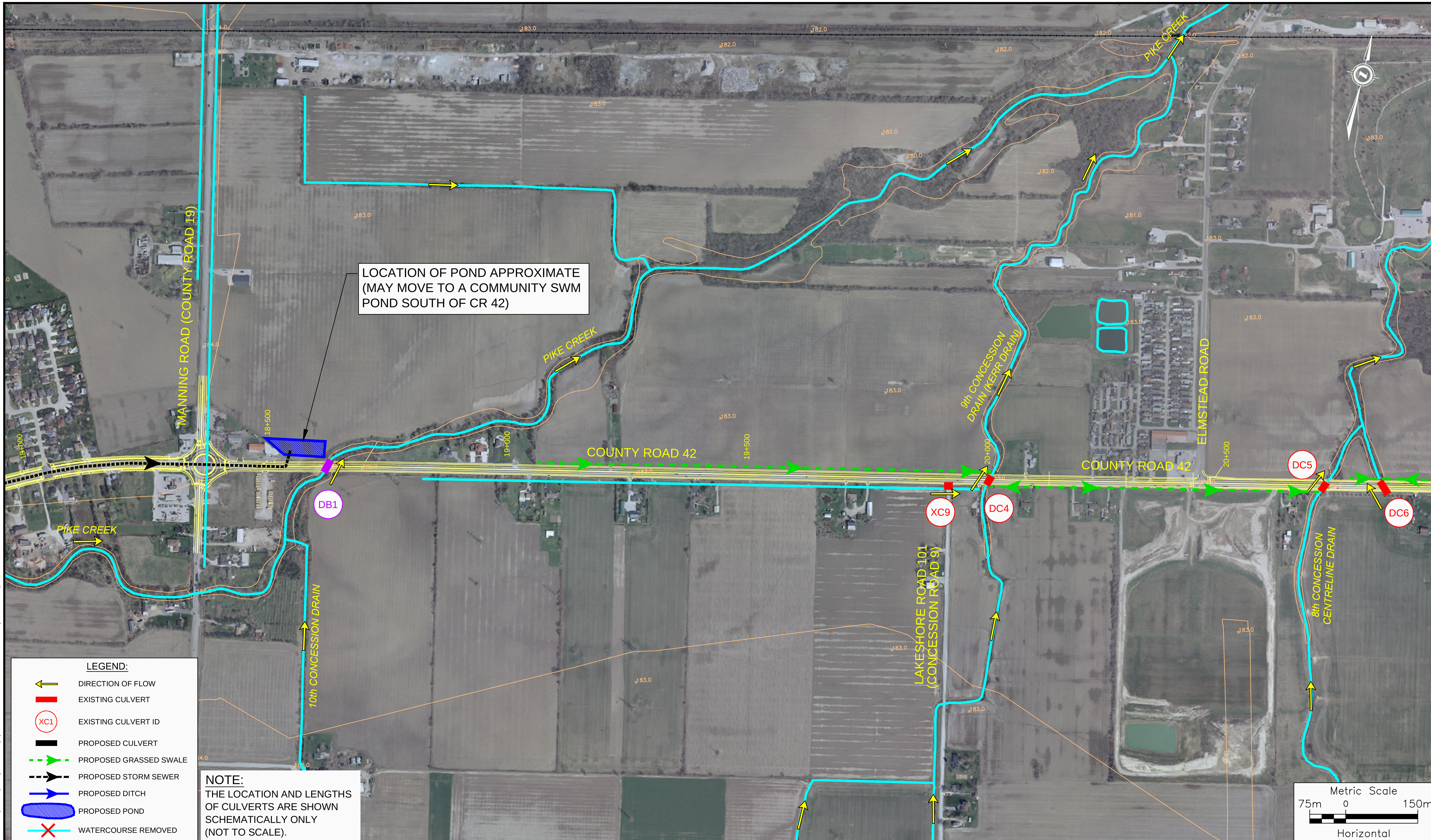
MRC McCORMICK RANKIN A member of MMM GROUP

FUTURE DRAINAGE CONDITIONS

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT 18

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-FUTURE DRAINAGE MOSAIC.DWG MODIFIED: Jan. 13, 2014 12:22 PM



MRC McCORMICK RANKIN A member of MMM GROUP

FUTURE DRAINAGE CONDITIONS

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT 19

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-FUTURE DRAINAGE MOSAIC.DWG MODIFIED: Jan. 13, 2014 12:22 PM

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS ARE SHOWN SCHEMATICALLY ONLY (NOT TO SCALE).

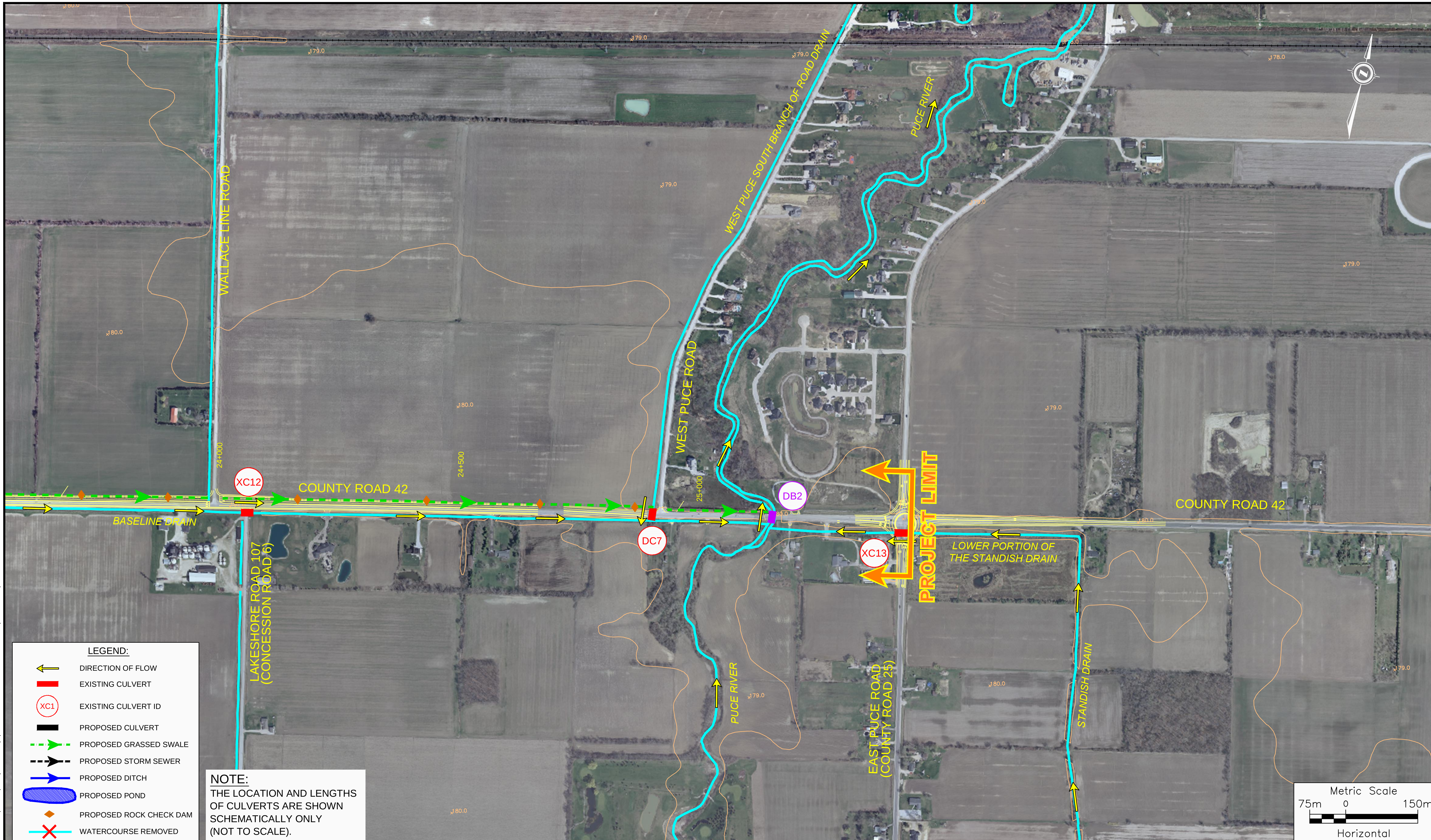
MRC McCORMICK RANKIN A member of MMM GROUP

FUTURE DRAINAGE CONDITIONS

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT 20

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-FUTURE DRAINAGE MOSAIC.DWG
MODIFIED: Jan. 13, 2014 12:22 PM



NOTE:
THE LOCATION AND LENGTHS OF CULVERTS ARE SHOWN SCHEMATICALLY ONLY (NOT TO SCALE).

MRC McCORMICK RANKIN A member of MMM GROUP

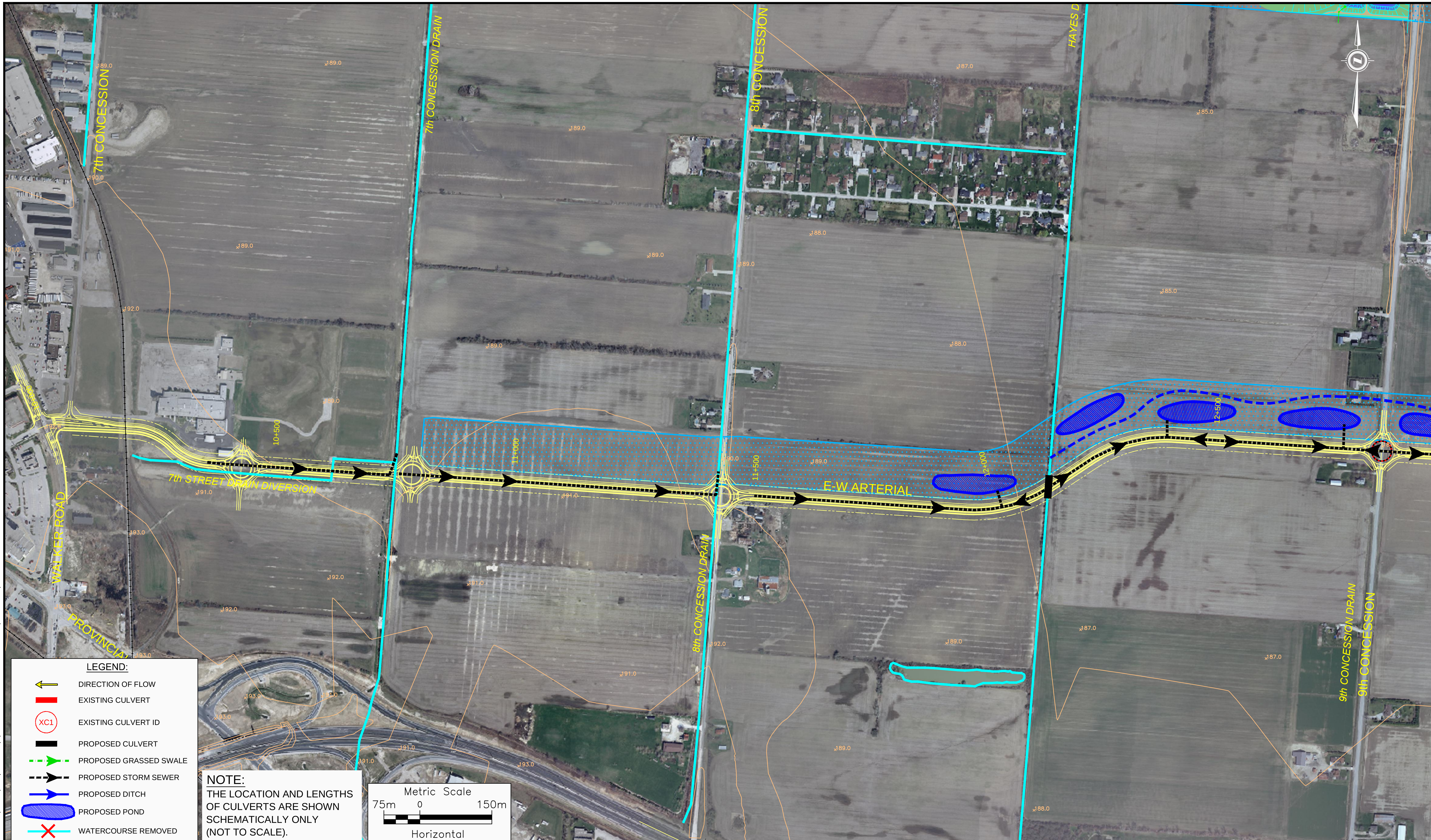
FUTURE DRAINAGE CONDITIONS

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT 21

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-FUTURE DRAINAGE MOSAIC.DWG

MODIFIED: Jan. 13, 2014 12:22 PM



MRC McCORMICK RANKIN A member of MMM GROUP

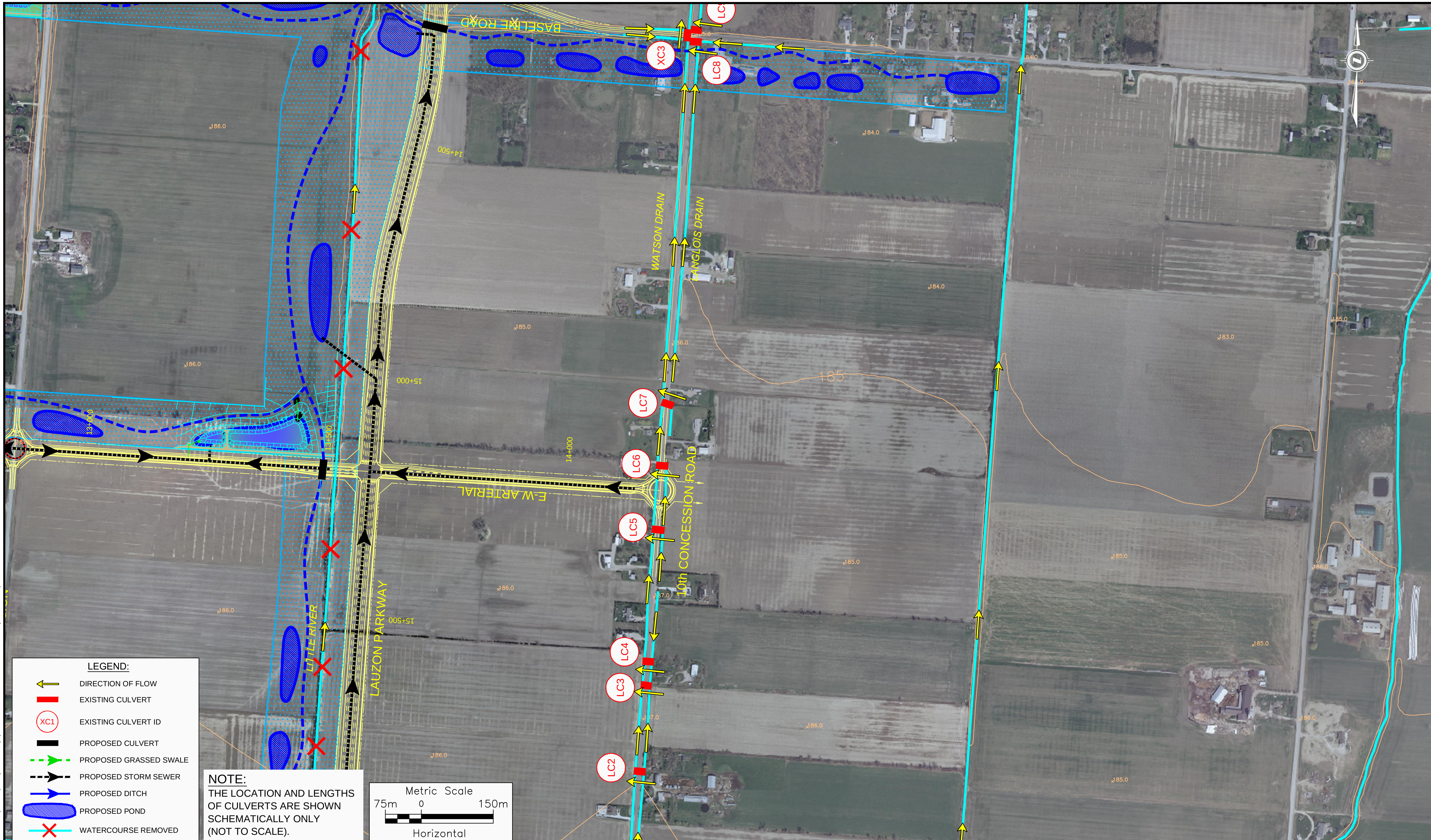
FUTURE DRAINAGE CONDITIONS

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT 22

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-FUTURE DRAINAGE MOSAIC.DWG

MODIFIED: Jan. 13, 2014 12:22 PM



MRC McCORMICK RANKIN A member of MMM GROUP

FUTURE DRAINAGE CONDITIONS

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT 23

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-FUTURE DRAINAGE MOSAIC.DWG

MODIFIED: Jan. 13, 2014 12:22 PM

MRC McCORMICK RANKIN A member of MMM GROUP

WATER ELEVATIONS

LAUZON PARKWAY EA & PRELIMINARY DESIGN

EXHIBIT 24

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-WATER ELEVATIONS.DWG

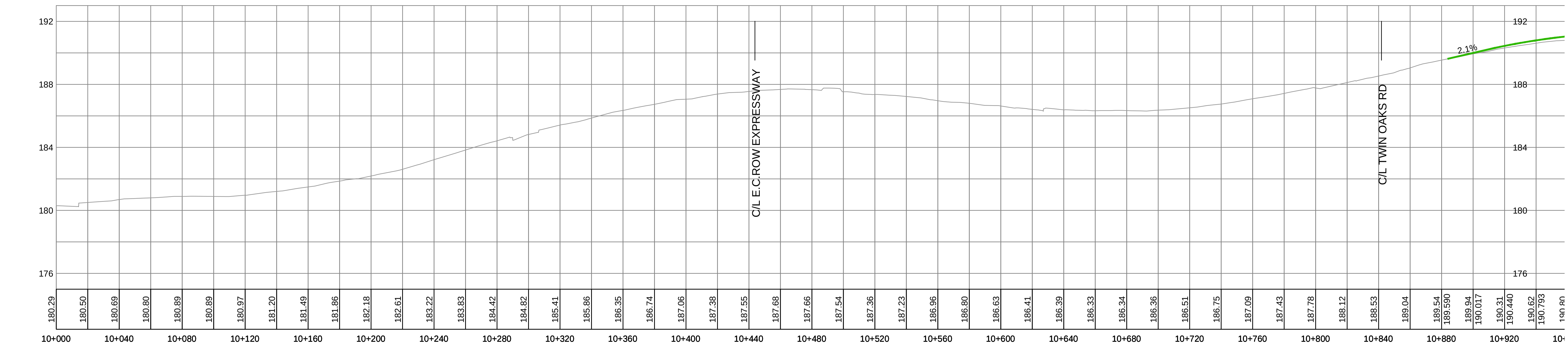
MODIFIED: Jan. 13, 2014 12:59 PM

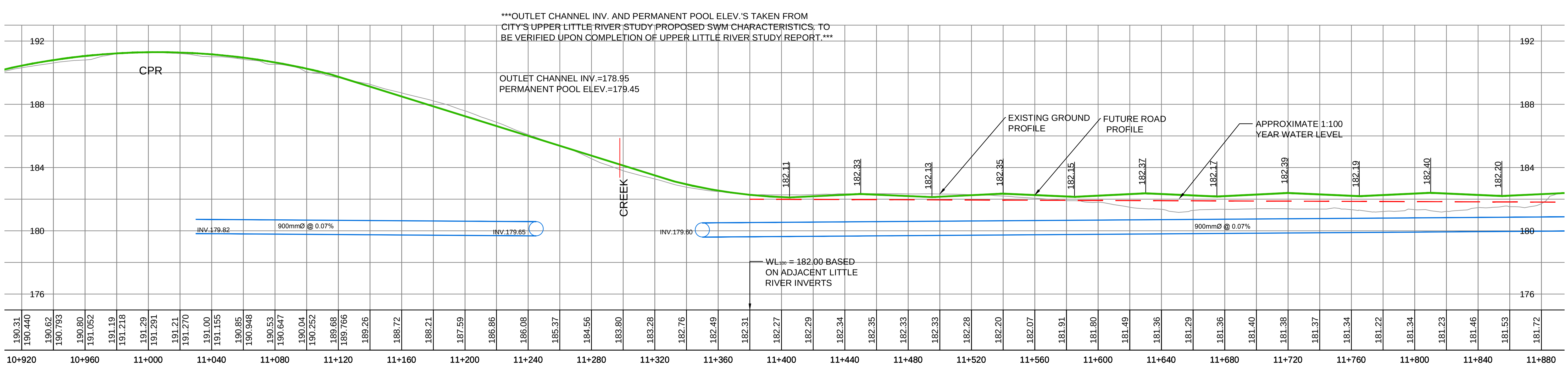
LEGEND

- PROPOSED TOP OF ROAD
- EXISTING GRADE
- PROPOSED STORM SEWER
- WL100 100 yr. WATER LEVEL
- STORM OUTLET

NOTE:

100 yr WATER LEVEL INFORMATION WAS ADDED WHERE AVAILABLE, OR WHERE REASONABLY INTERPOLATED. WATER SURFACE ELEVATIONS WERE NOT AVAILABLE FOR ALL AREAS, PARTICULARLY WHERE NOT ADJACENT TO A MAJOR WATERCOURSE.





MRC McCORMICK RANKIN A member of MMM GROUP

CONCEPTUAL STORM SEWER DESIGN LAUZON PARKWAY EXTENSION - (Sta. 10+000 - 11+880)

LAUZON PARKWAY EA

EXHIBIT

25

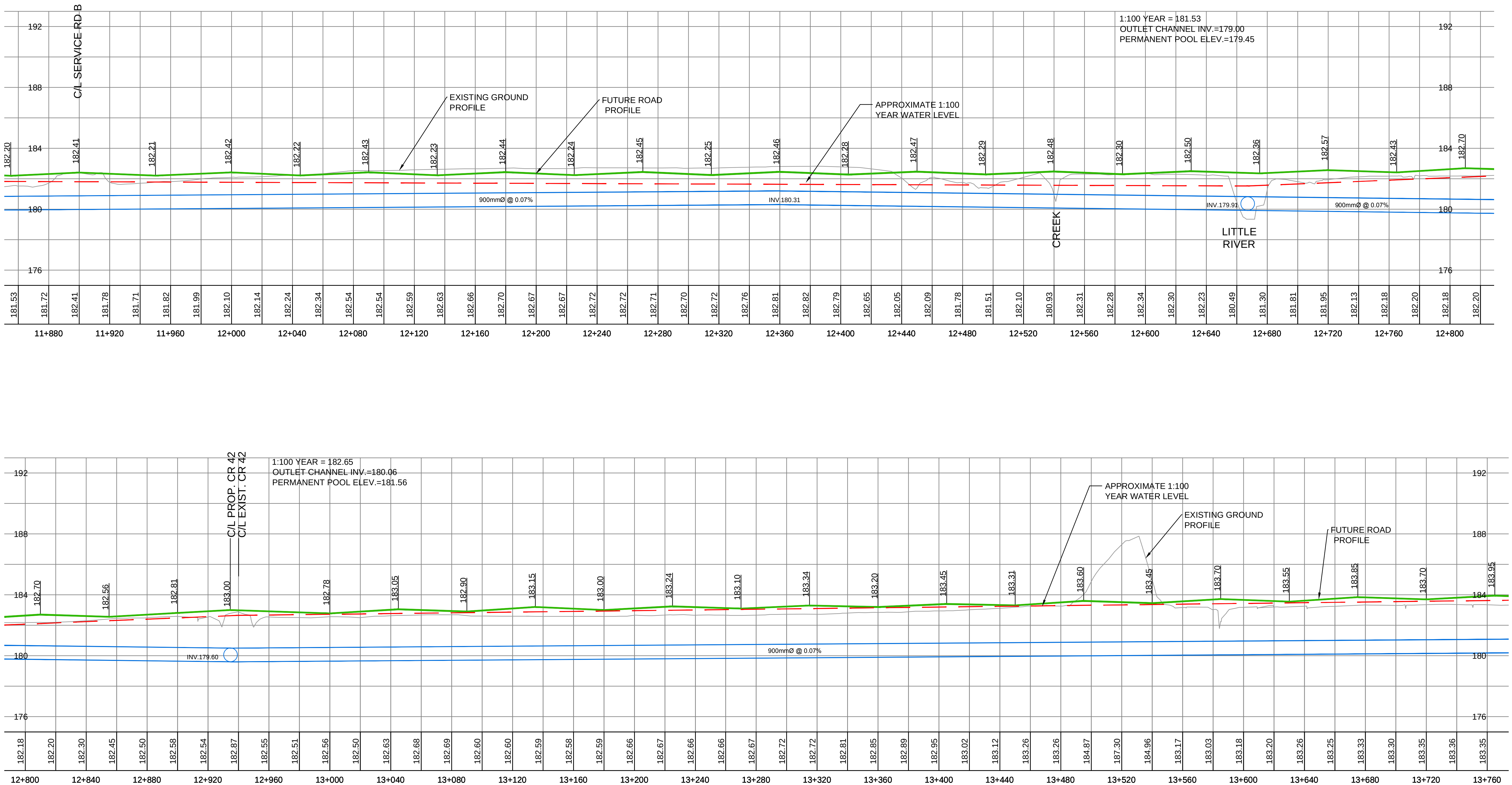
DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-PROFILE FOR STORM SEWER DESIGN.DWG
MODIFIED: Jan. 13, 2014 1:33 PM

LEGEND

- PROPOSED TOP OF ROAD
- EXISTING GRADE
- PROPOSED STORM SEWER
- WL100 100 yr. WATER LEVEL
- STORM OUTLET

NOTE:

100 yr WATER LEVEL INFORMATION WAS ADDED WHERE AVAILABLE, OR WHERE REASONABLY INTERPOLATED. WATER SURFACE ELEVATIONS WERE NOT AVAILABLE FOR ALL AREAS, PARTICULARLY WHERE NOT ADJACENT TO A MAJOR WATERCOURSE.



CONCEPTUAL STORM SEWER DESIGN LAUZON PARKWAY EXTENSION - (Sta. 11+880 - 13+760)

LAUZON PARKWAY EA

EXHIBIT 26

MRC McCORMICK RANKIN A member of MMM GROUP

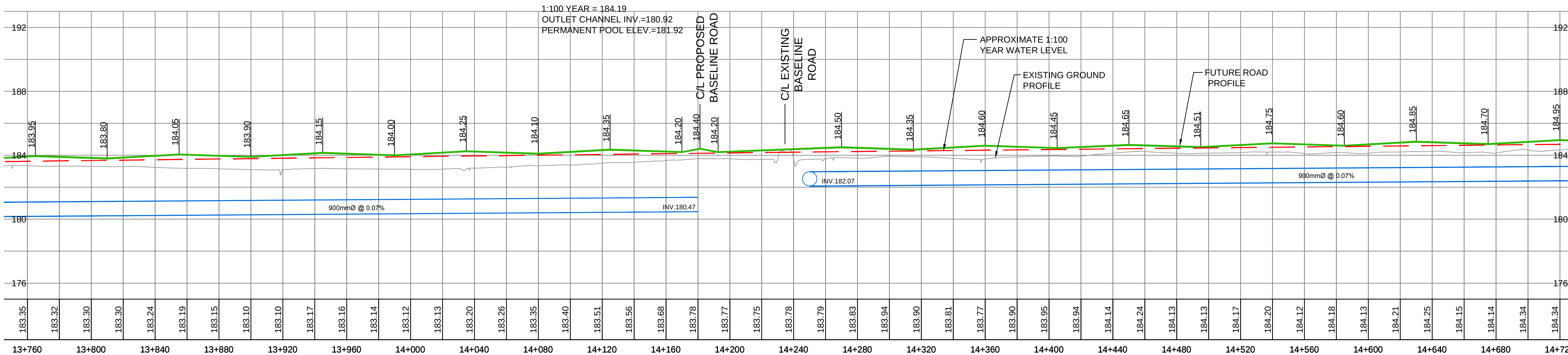
DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-PROFILE FOR STORM SEWER DESIGN.DWG
MODIFIED: Jan. 13, 2014 1:29 PM

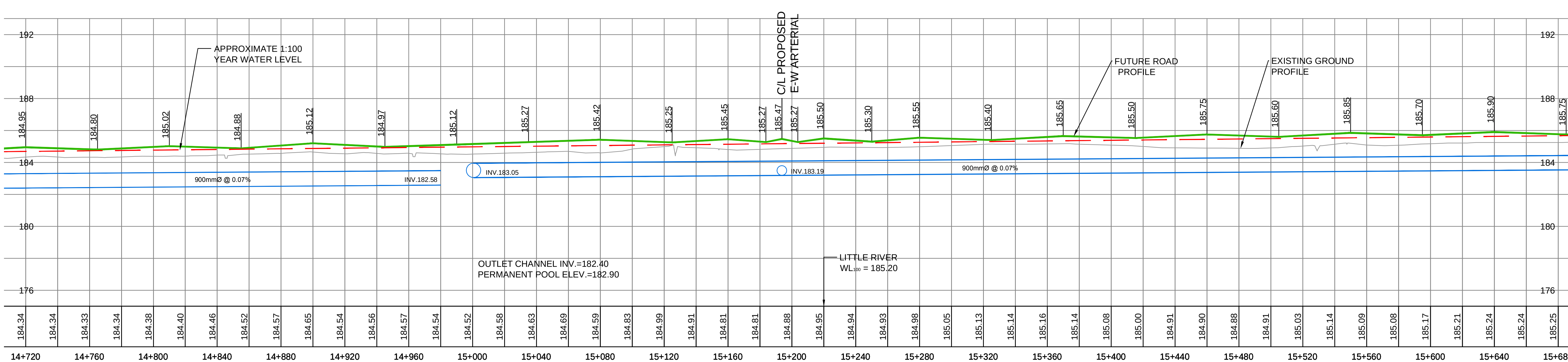
LEGEND

- PROPOSED TOP OF ROAD
- EXISTING GRADE
- PROPOSED STORM SEWER
- WL_{100} 100 yr. WATER LEVEL
- STORM OUTLET

NOTE:

100 yr WATER LEVEL INFORMATION WAS ADDED WHERE AVAILABLE, OR WHERE REASONABLY INTERPOLATED. WATER SURFACE ELEVATIONS WERE NOT AVAILABLE FOR ALL AREAS, PARTICULARLY WHERE NOT ADJACENT TO A MAJOR WATERCOURSE.





McCORMICK RANKIN
A member of MMM GROUP

CONCEPTUAL STORM SEWER DESIGN LAUZON PARKWAY EXTENSION - (Sta. 13+760 - 15+680)

LAUZON PARKWAY EA

EXHIBIT

27

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-PROFILE FOR STORM SEWER DESIGN.DWG

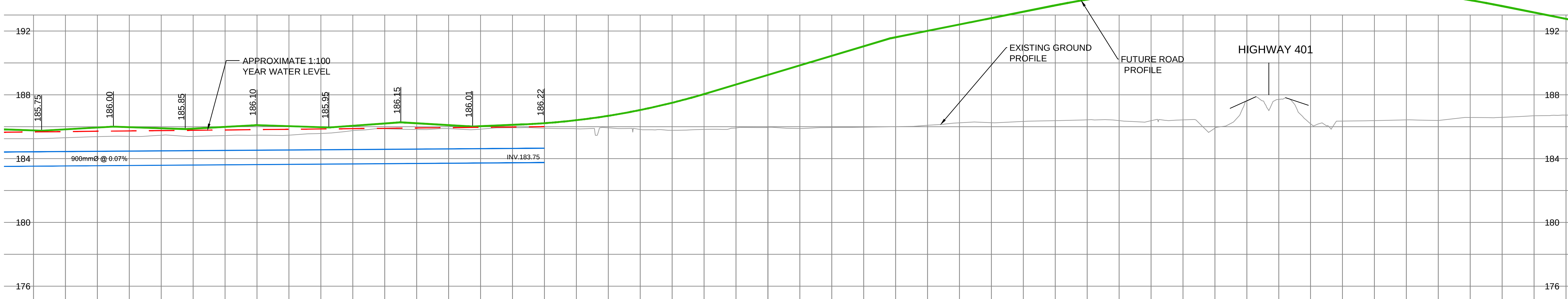
MODIFIED: Jan. 13, 2014 1:29 PM

LEGEND

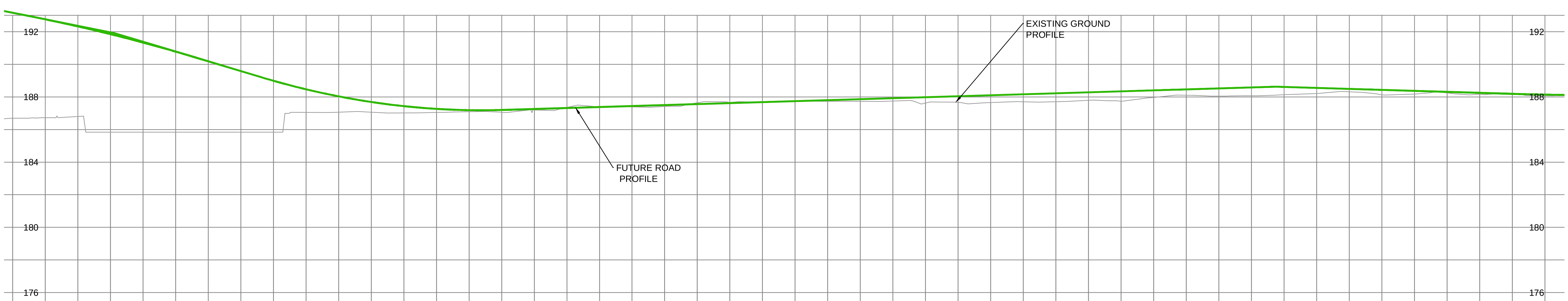
- PROPOSED TOP OF ROAD
- EXISTING GRADE
- PROPOSED STORM SEWER
- WL100 — 100 yr. WATER LEVEL
- STORM OUTLET

NOTE:

100 yr WATER LEVEL INFORMATION WAS ADDED WHERE AVAILABLE, OR WHERE REASONABLY INTERPOLATED. WATER SURFACE ELEVATIONS WERE NOT AVAILABLE FOR ALL AREAS, PARTICULARLY WHERE NOT ADJACENT TO A MAJOR WATERCOURSE.



15+680	185.25	
	185.31	
15+720	185.38	
	185.39	
15+760	185.46	
	185.39	
15+800	185.44	
	185.47	
15+840	185.47	
	185.57	
15+880	185.75	
	185.86	
15+920	185.82	
	185.88	
15+960	185.85	
	185.93	
16+000	185.90	186.219
	185.87	186.405
16+040	185.93	186.681
	185.82	187.045
16+080	185.78	187.499
	185.83	188.041
16+120	185.92	188.640
	185.96	189.240
16+160	185.88	189.840
	185.95	190.431
16+200	185.96	190.984
	186.00	191.498
16+240	186.09	191.971
	186.24	192.405
16+280	186.25	192.807
	186.33	193.207
16+320	186.38	193.607
	186.43	193.975
16+360	186.38	194.286
	186.37	194.539
16+400	186.43	194.736
	185.91	194.875
16+440	187.62	194.957
	187.71	194.982
16+480	186.18	194.950
	186.35	194.861
16+520	186.38	194.715
	186.42	194.511
16+560	186.39	194.251
	186.57	193.933
16+600	186.59	193.558
	186.69	193.158
16+640	186.73	192.755



	186.69	193.158
16+640	186.73	192.755
	186.80	192.320
16+680	185.83	191.845
	185.83	191.330
16+720	185.83	190.775
	185.83	190.183
16+760	185.83	189.583
	185.83	188.989
16+800	187.05	188.466
	187.06	188.033
16+840	187.06	187.688
	187.02	187.433
16+880	187.04	187.266
	187.09	187.188
16+920	187.05	187.199
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16+960	187.35	187.319
	187.39	187.379
17+000	187.39	187.439
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17+040	187.64	187.559
	187.67	187.619
17+080	187.70	187.679
	187.75	187.739
17+120	187.73	187.799
	187.73	187.859
17+160	187.75	187.919
	187.62	187.979
17+200	187.66	188.039
	187.65	188.099
17+240	187.70	188.159
	187.70	188.219
17+280	187.79	188.279
	187.74	188.339
17+320	187.97	188.399
	188.10	188.458
17+360	188.05	188.503
	188.07	188.528
17+400	188.14	188.533
	188.20	188.518
17+440	188.31	188.483
	188.12	188.429
17+480	188.17	188.369
	188.25	188.309
17+520	188.17	188.249
	188.23	188.189
17+560	188.08	188.139

MRC McCORMICK RANKIN A member of MMM GROUP

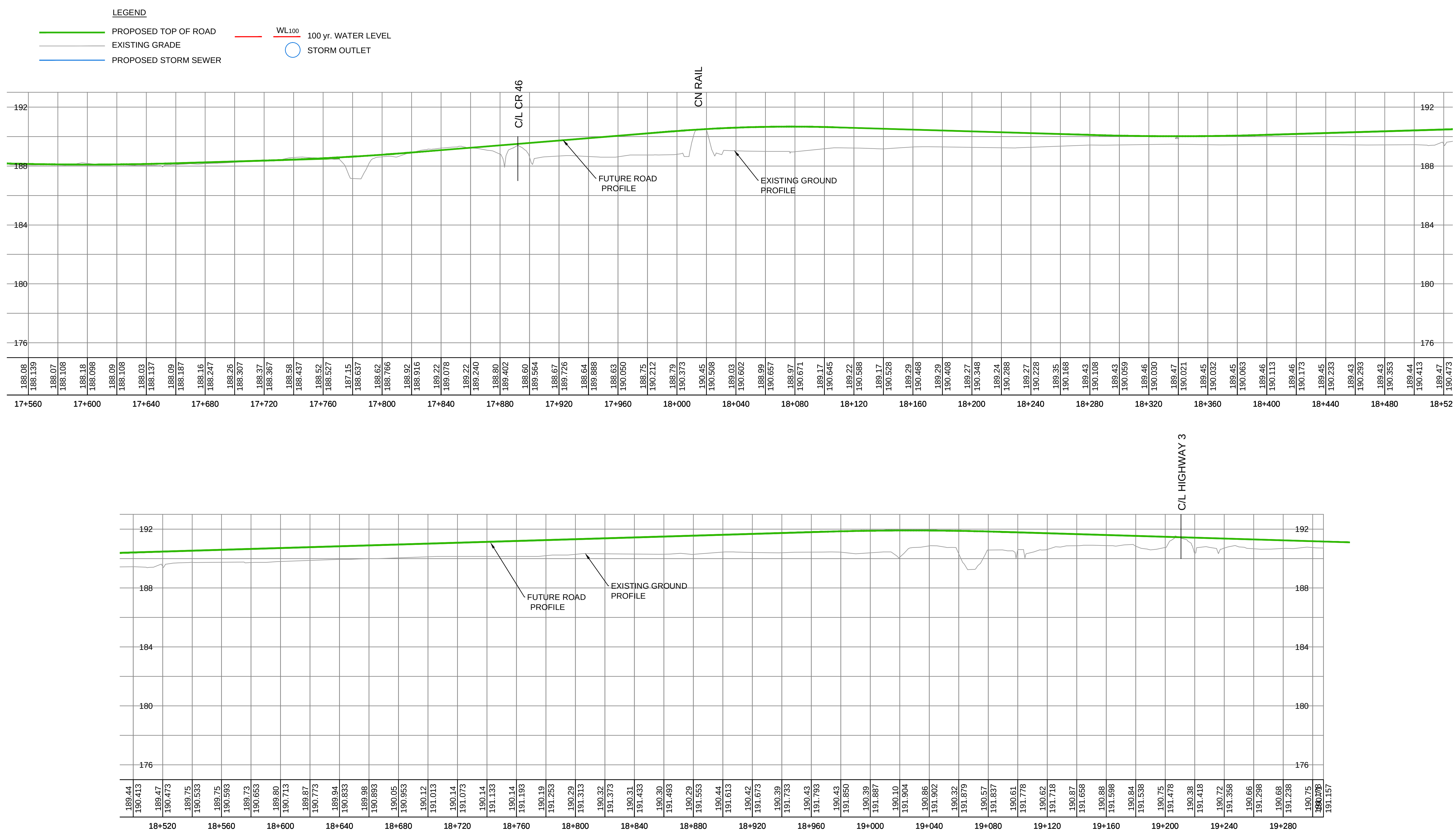
CONCEPTUAL STORM SEWER DESIGN LAUZON PARKWAY EXTENSION - (Sta. 15+680 - 17+560)

LAUZON PARKWAY EA

EXHIBIT 28

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-PROFILE FOR STORM SEWER DESIGN.DWG

MODIFIED: Jan. 13, 2014 1:29 PM



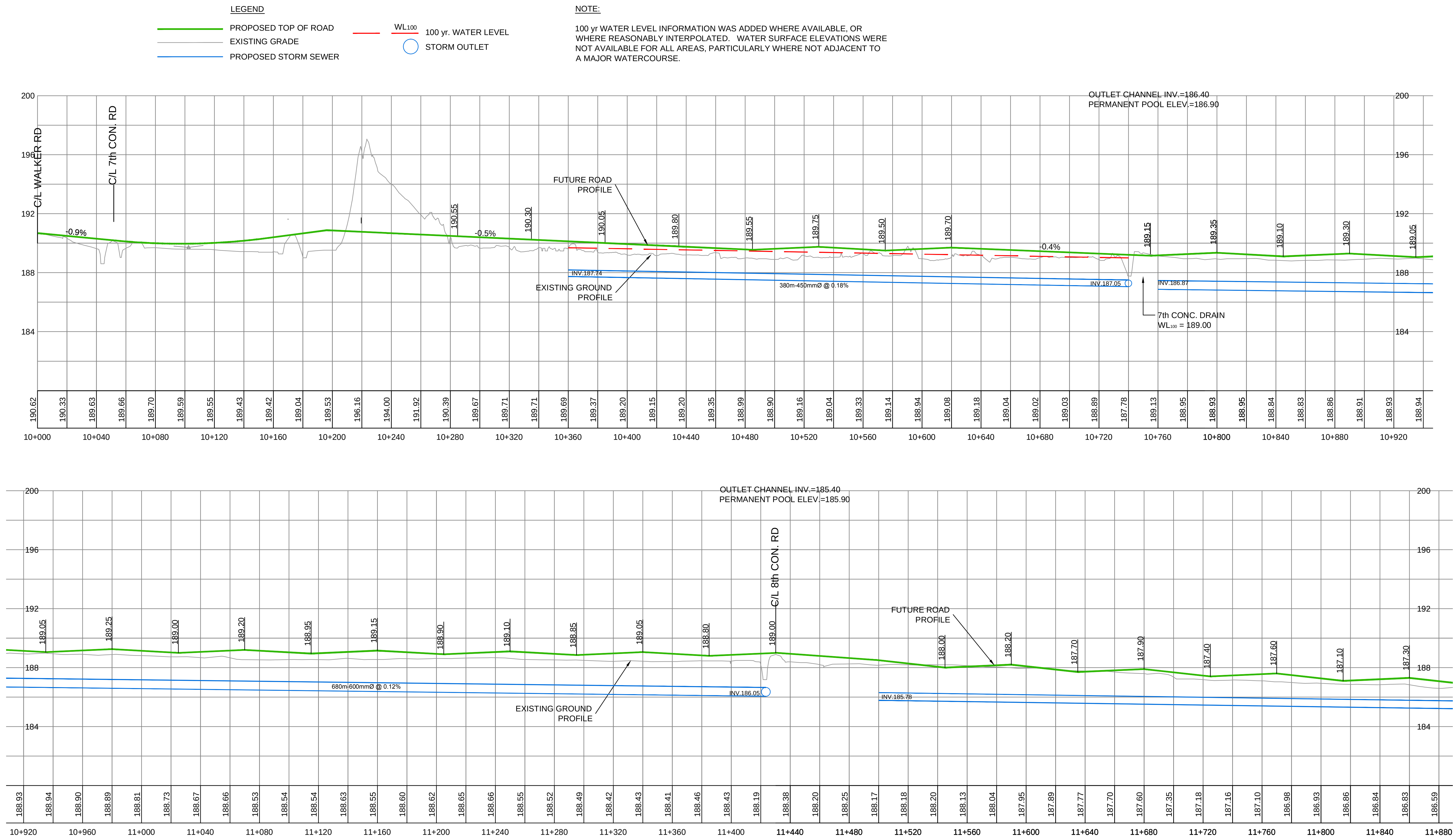
MRC McCORMICK RANKIN A member of MMM GROUP

CONCEPTUAL STORM SEWER DESIGN LAUZON PARKWAY EXTENSION - (Sta. 19+280)

LAUZON PARKWAY EA

EXHIBIT

29



NOTE:

100 yr WATER LEVEL INFORMATION WAS ADDED WHERE AVAILABLE, OR WHERE REASONABLY INTERPOLATED. WATER SURFACE ELEVATIONS WERE NOT AVAILABLE FOR ALL AREAS, PARTICULARLY WHERE NOT ADJACENT TO A MAJOR WATERCOURSE.

MRC McCORMICK RANKIN A member of MMM GROUP

CONCEPTUAL STORM SEWER DESIGN E-W ARTERIAL - (Sta. 10+000 - 11+880)

LAUZON PARKWAY EA

EXHIBIT

30

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-PROFILE FOR STORM SEWER DESIGN.DWG

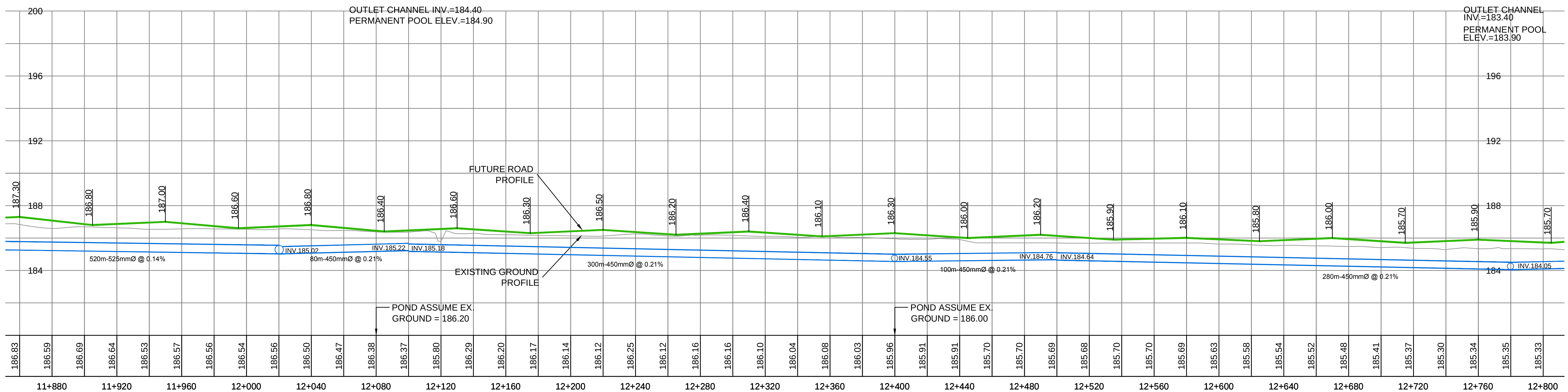
MODIFIED: Jan. 13, 2014 1:29 PM

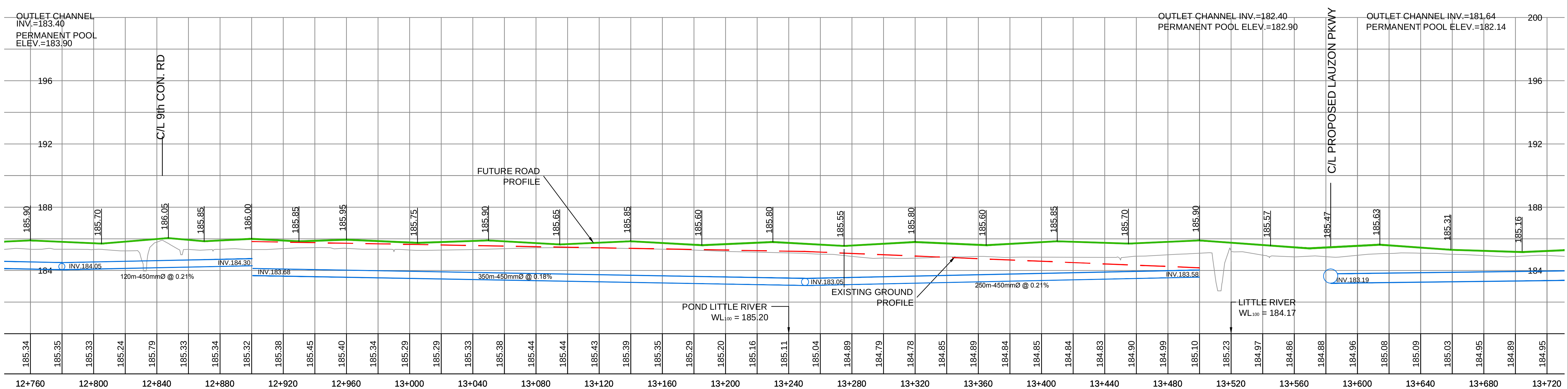
LEGEND

- PROPOSED TOP OF ROAD
- EXISTING GRADE
- PROPOSED STORM SEWER
- WL_{100} 100 yr. WATER LEVEL
- STORM OUTLET

NOTE:

100 yr WATER LEVEL INFORMATION WAS ADDED WHERE AVAILABLE, OR WHERE REASONABLY INTERPOLATED. WATER SURFACE ELEVATIONS WERE NOT AVAILABLE FOR ALL AREAS, PARTICULARLY WHERE NOT ADJACENT TO A MAJOR WATERCOURSE.





CONCEPTUAL STORM SEWER DESIGN E-W ARTERIAL - (Sta. 11+880 - 13+720)

LAUZON PARKWAY EA

EXHIBIT 31a

MRC McCORMICK RANKIN A member of MMM GROUP

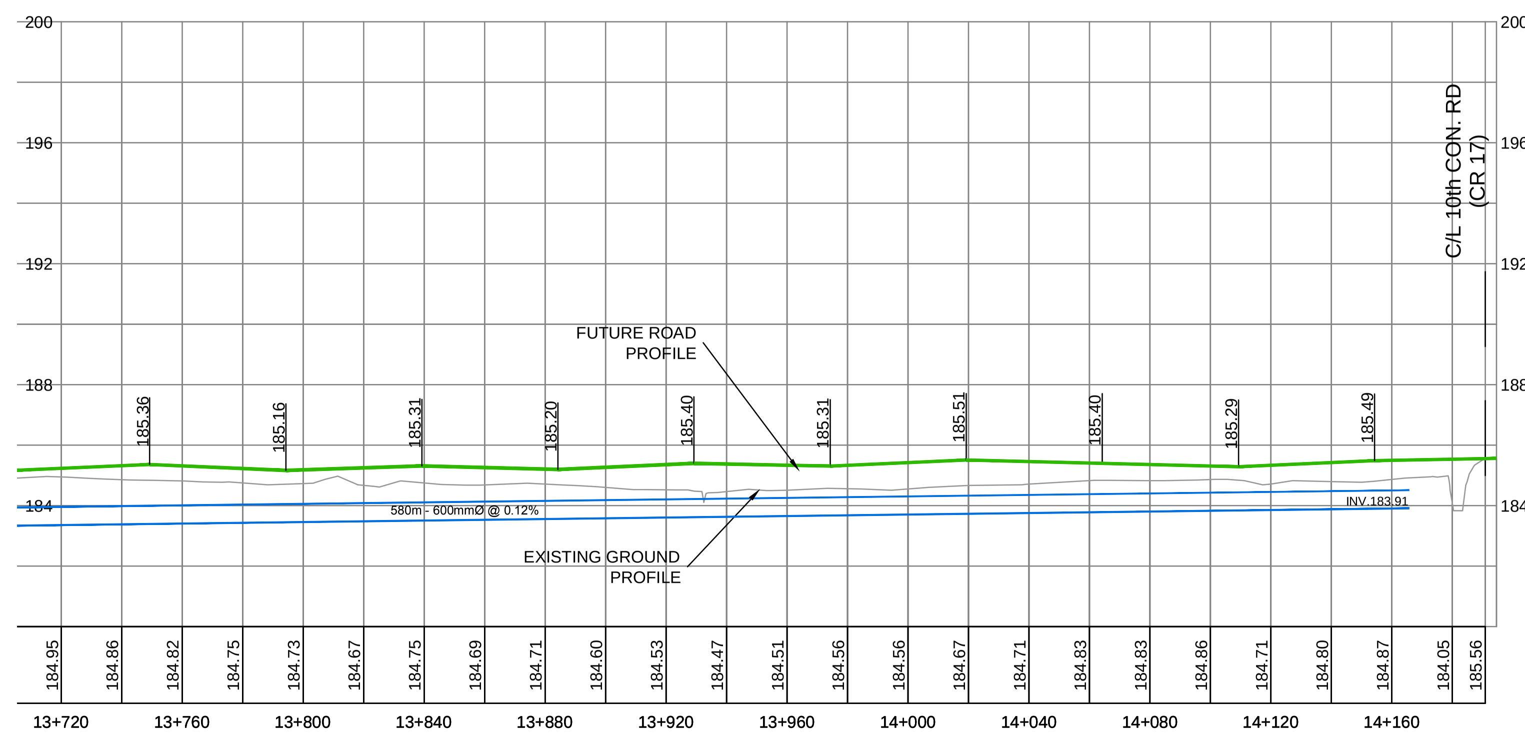
DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-PROFILE FOR STORM SEWER DESIGN.DWG
MODIFIED: Jan. 13, 2014 1:29 PM

LEGEND

- PROPOSED TOP OF ROAD
- EXISTING GRADE
- PROPOSED STORM SEWER
- WL100 100 yr. WATER LEVEL
- STORM OUTLET

NOTE:

100 yr WATER LEVEL INFORMATION WAS ADDED WHERE AVAILABLE, OR WHERE REASONABLY INTERPOLATED. WATER SURFACE ELEVATIONS WERE NOT AVAILABLE FOR ALL AREAS, PARTICULARLY WHERE NOT ADJACENT TO A MAJOR WATERCOURSE.



McCORMICK RANKIN A member of MMM GROUP

CONCEPTUAL STORM SEWER DESIGN E-W ARTERIAL - (Sta. 13+720 - 14+190)

LAUZON PARKWAY EA

EXHIBIT 31b

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-PROFILE FOR STORM SEWER DESIGN.DWG

MODIFIED: Jan. 13, 2014 1:29 PM

LEGEND

PROPOSED TOP OF ROAD

EXISTING GRADE

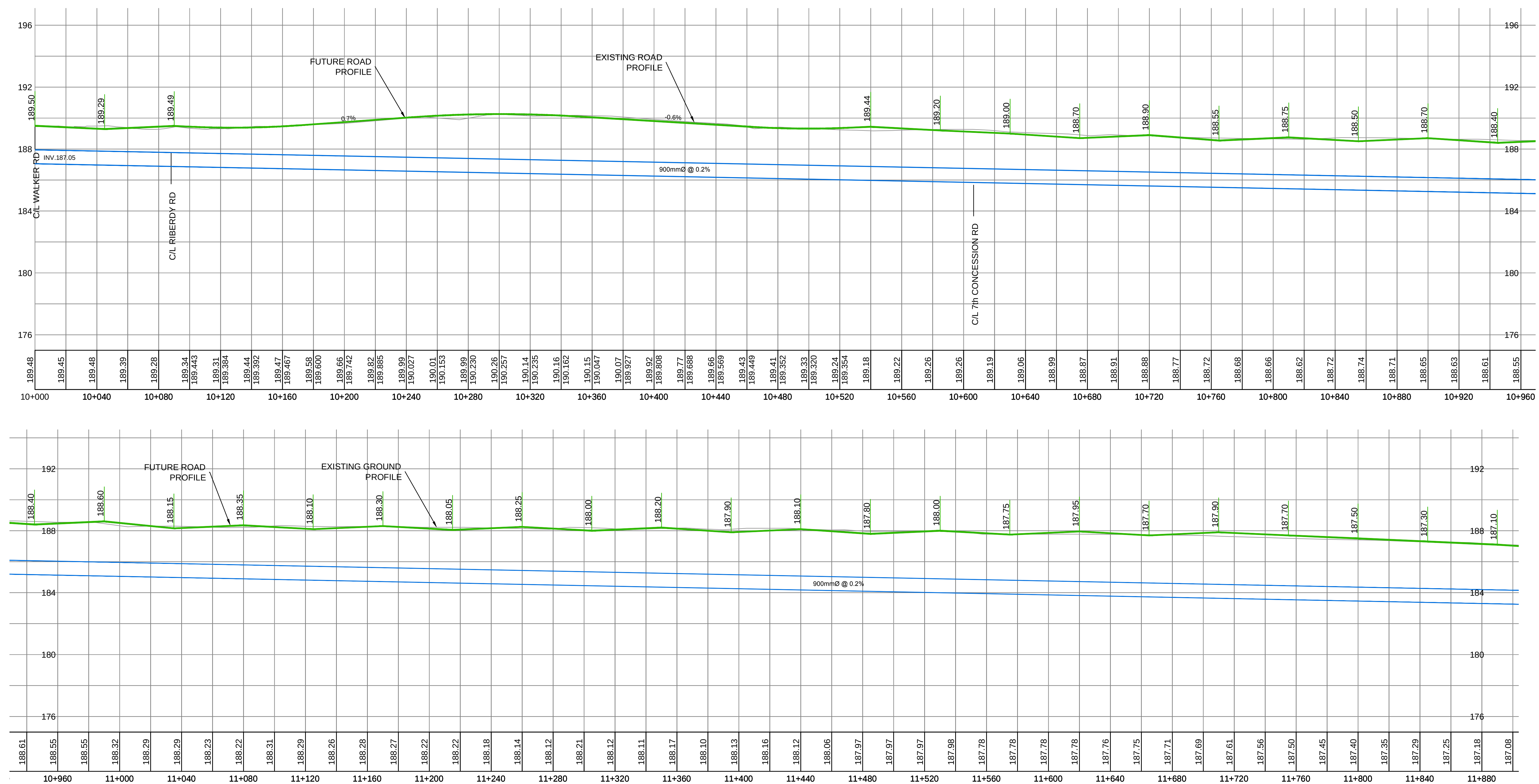
PROPOSED STORM SEWER

WL_{100} 100 yr. WATER LEVEL

STORM OUTLET

NOTE:

100 yr WATER LEVEL INFORMATION WAS ADDED WHERE AVAILABLE, OR WHERE REASONABLY INTERPOLATED. WATER SURFACE ELEVATIONS WERE NOT AVAILABLE FOR ALL AREAS, PARTICULARLY WHERE NOT ADJACENT TO A MAJOR WATERCOURSE.



CONCEPTUAL STORM SEWER DESIGN COUNTY ROAD 42 - (Sta. 10+000 - 11+880)

LAUZON PARKWAY EA

EXHIBIT 32

MRC McCORMICK RANKIN A member of MMM GROUP

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-PROFILE FOR STORM SEWER DESIGN-CR42.DWG

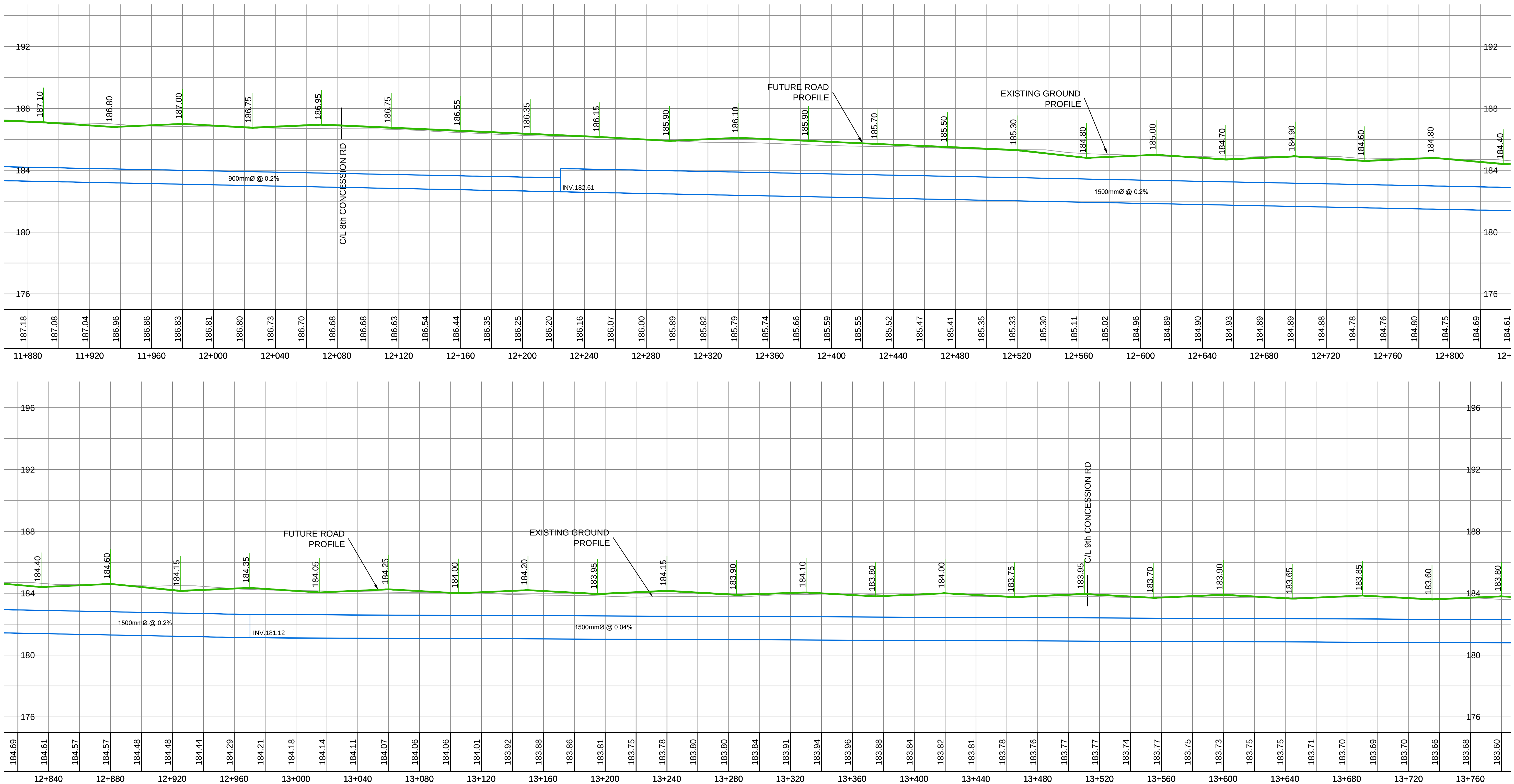
MODIFIED: Jan. 13, 2014 1:20 PM

LEGEND

- PROPOSED TOP OF ROAD
- EXISTING GRADE
- PROPOSED STORM SEWER
- WL100 100 yr. WATER LEVEL
- STORM OUTLET

NOTE:

100 yr WATER LEVEL INFORMATION WAS ADDED WHERE AVAILABLE, OR WHERE REASONABLY INTERPOLATED. WATER SURFACE ELEVATIONS WERE NOT AVAILABLE FOR ALL AREAS, PARTICULARLY WHERE NOT ADJACENT TO A MAJOR WATERCOURSE.



CONCEPTUAL STORM SEWER DESIGN COUNTY ROAD 42 - (Sta. 11+880 - 13+760)

LAUZON PARKWAY EA

EXHIBIT 33

MRC McCORMICK RANKIN A member of MMM GROUP

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-PROFILE FOR STORM SEWER DESIGN-CR42.DWG

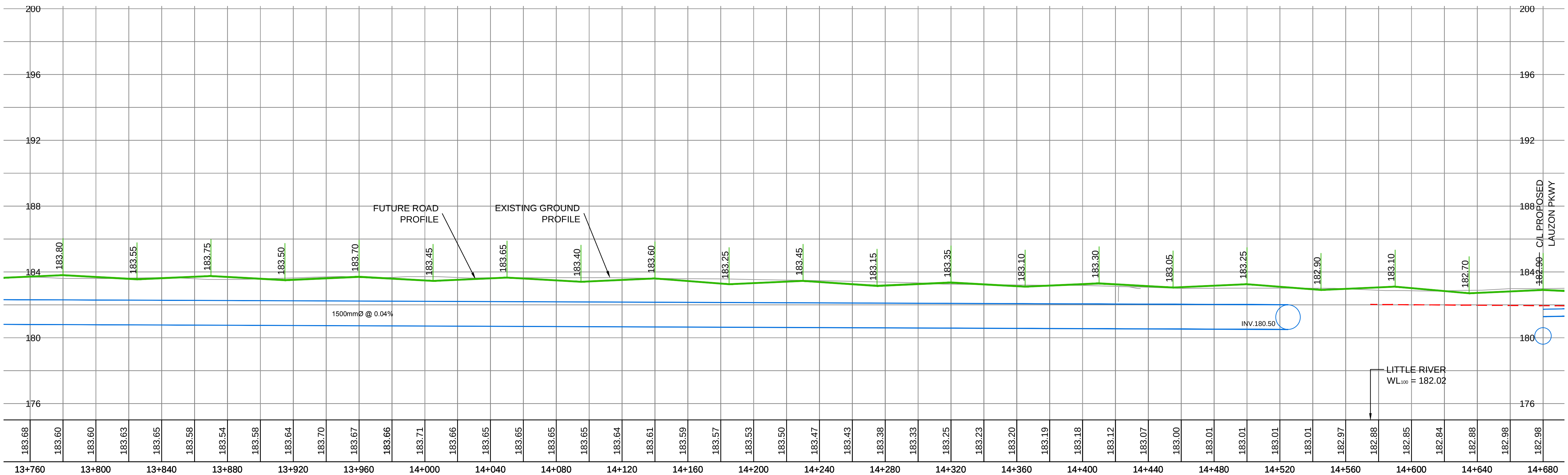
MODIFIED: Jan. 13, 2014 1:20 PM

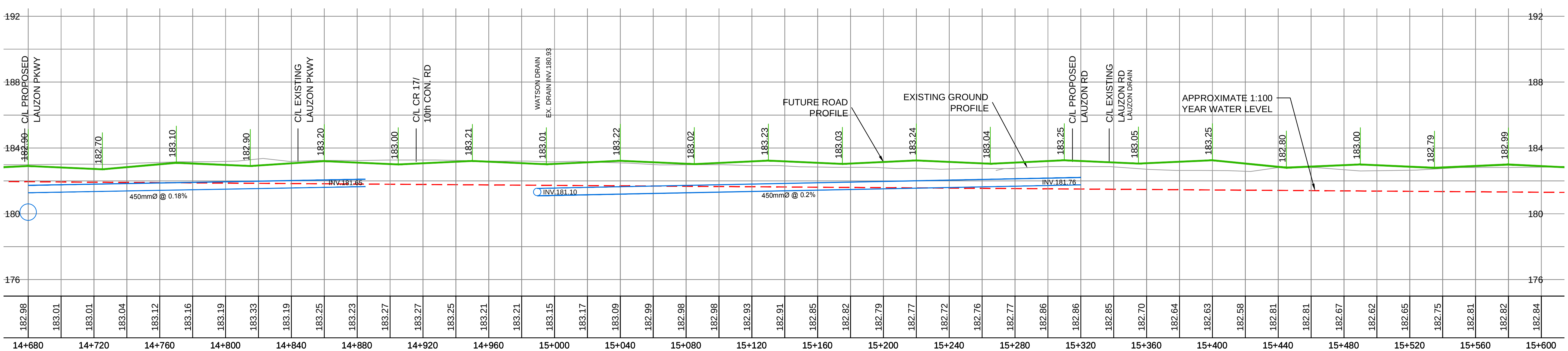
LEGEND

- PROPOSED TOP OF ROAD
- EXISTING GRADE
- PROPOSED STORM SEWER
- WL_{100} 100 yr. WATER LEVEL
- STORM OUTLET

NOTE:

100 yr WATER LEVEL INFORMATION WAS ADDED WHERE AVAILABLE, OR WHERE REASONABLY INTERPOLATED. WATER SURFACE ELEVATIONS WERE NOT AVAILABLE FOR ALL AREAS, PARTICULARLY WHERE NOT ADJACENT TO A MAJOR WATERCOURSE.





MRC McCORMICK RANKIN A member of MMM GROUP

CONCEPTUAL STORM SEWER DESIGN COUNTY ROAD 42 - (Sta. 13+760 - 15+600)

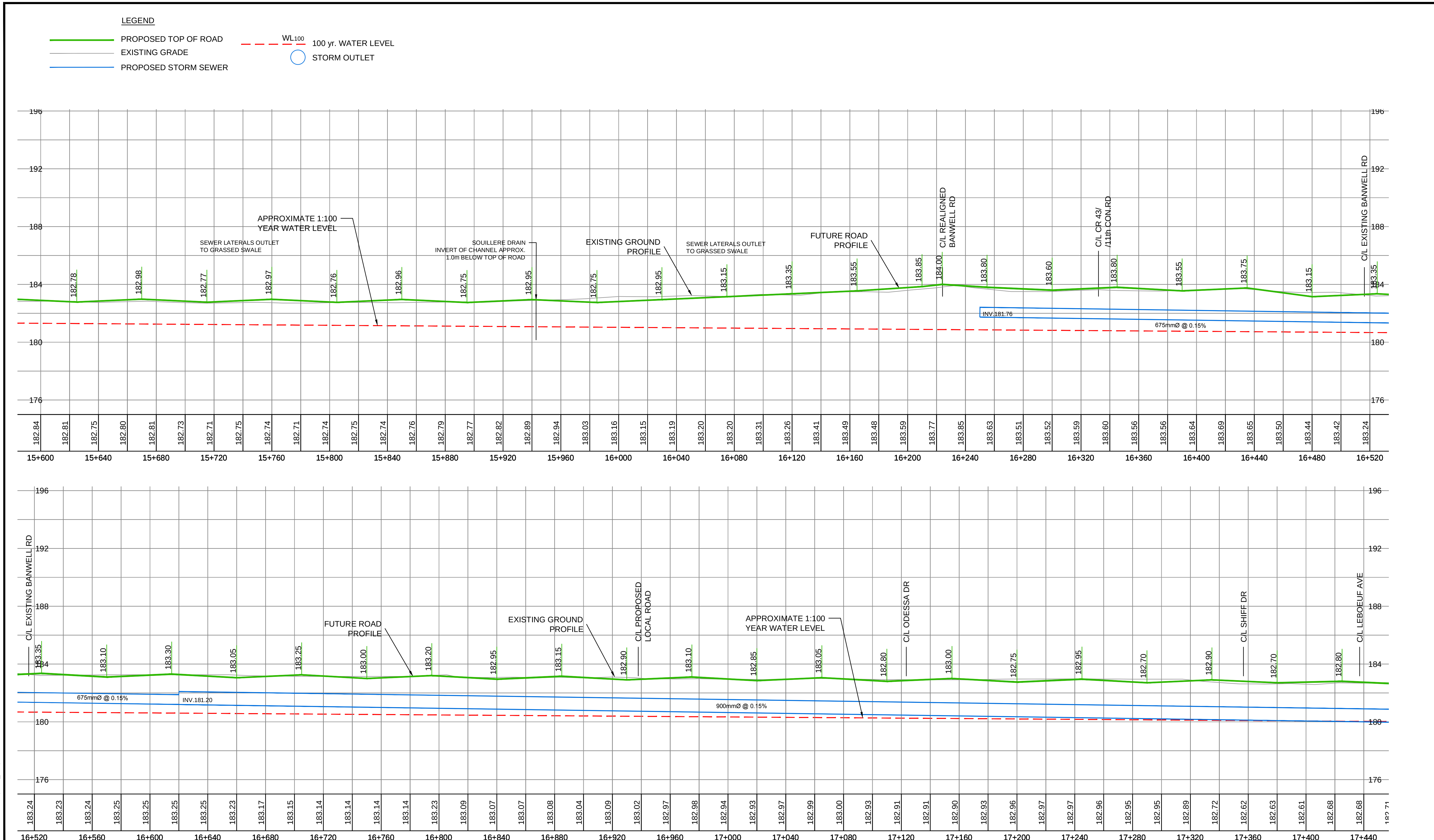
LAUZON PARKWAY EA

EXHIBIT

34

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-PROFILE FOR STORM SEWER DESIGN-CR42.DWG

MODIFIED: Jan. 13, 2014 1:20 PM

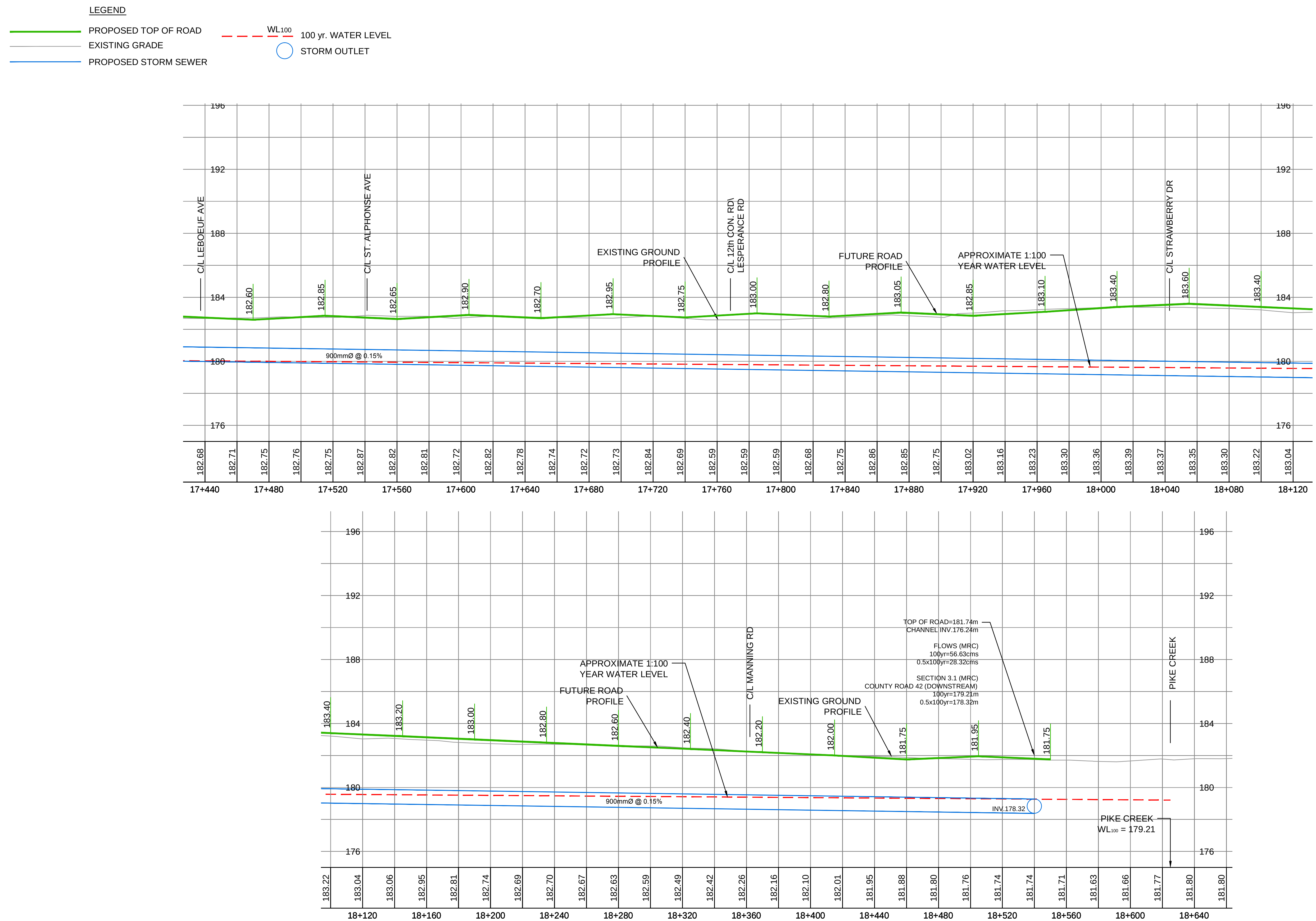


MRC McCORMICK RANKIN A member of MMM GROUP	CONCEPTUAL STORM SEWER DESIGN COUNTY ROAD 42 - (Sta. 15+600 - 17+440)
	LAUZON PARKWAY EA

EXHIBIT
35

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-PROFILE FOR STORM SEWER DESIGN-CR42.DWG

MODIFIED: Jan. 13, 2014 1:20 PM



MRC McCORMICK RANKIN A member of MMM GROUP

CONCEPTUAL STORM SEWER DESIGN COUNTY ROAD 42 - (Sta. 17+440 - 18+640)

LAUZON PARKWAY EA

EXHIBIT 36

DRAWING NAME: K:\DRAWINGS\2011\32 (MRC_MIS)\3211012 LAUZON PARKWAY EA\DRAINAGE\K3211012-LAUZON PARKWAY-PROFILE FOR STORM SEWER DESIGN-CR42.DWG

MODIFIED: Jan. 13, 2014 1:20 PM

APPENDIX A

Culvert Inspection Report

APPENDIX B

HEC-RAS Output Files for Little River, Pike Creek, Kerr Drain, and Puce River

Little River Existing Conditions HEC-RAS Summary Output

HEC-RAS Plan: LTRiv-ExCond1 River: RIVER-1 Reach: Reach-1

Reach	River Sta	Profile	W.S. Elev	Q Total	Crit W.S.	E.G. Elev	Vel Total	Vel Chnl	Flow Area	Top Width	Min Ch El	Length Chnl	Max Chl Dpth	Invert Slope	Froude # Chl	E.G. Slope
			(m)	(m3/s)	(m)	(m)	(m/s)	(m/s)	(m2)	(m)	(m)	(m)	(m)			(m/m)
Reach-1	34001	Max Observed	180.81	92.50	179.10	180.88	0.27	1.33	339.73	636.89	176.70		4.11		0.25	0.000428
Reach-1	34001	100yr	180.43	66.10	178.74	180.49	0.37	1.18	177.23	286.75	176.70		3.73		0.24	0.000412
Reach-1	34001	PF 3	179.42	37.60	178.22	179.50	1.28	1.28	29.38	17.60	176.70		2.72		0.32	0.000804
Reach-1	34001	PF 4	180.01	51.90	178.50	180.08	0.67	1.22	77.66	187.38	176.70		3.31		0.27	0.000568
Reach-1	35002	Max Observed	180.86	92.50	178.43	180.92	0.20	1.20	473.64	744.25	176.80	100.00	4.06	0.0010	0.19	0.000214
Reach-1	35002	100yr	180.48	66.10	178.10	180.53	0.26	1.04	251.10	310.27	176.80	100.00	3.68	0.0010	0.17	0.000182
Reach-1	35002	PF 3	179.52	37.60	177.71	179.56	0.95	0.95	39.68	95.98	176.80	100.00	2.72	0.0010	0.18	0.000229
Reach-1	35002	PF 4	180.07	51.90	177.92	180.13	1.09	1.09	47.76	202.05	176.80	100.00	3.27	0.0010	0.19	0.000235
Reach-1	35092.5		Bridge													
Reach-1	35183	Max Observed	180.86	92.50	178.43	180.92	0.20	1.20	473.60	744.22	176.80	0.10	4.06	0.0000	0.19	0.000214
Reach-1	35183	100yr	180.57	66.10	178.11	180.61	0.23	1.02	282.21	462.21	176.80	0.10	3.77	0.0000	0.17	0.000171
Reach-1	35183	PF 3	179.53	37.60	177.71	179.57	0.94	0.94	39.79	97.58	176.80	0.10	2.73	0.0000	0.18	0.000227
Reach-1	35183	PF 4	180.08	51.90	177.92	180.14	1.08	1.08	47.99	206.12	176.80	0.10	3.28	0.0000	0.19	0.000231
Reach-1	35404	Max Observed	180.87	92.50		180.93	0.23	1.23	406.81	700.81	176.80	22.00	4.07	0.0000	0.22	0.000314
Reach-1	35404	100yr	180.57	66.10		180.63	0.31	1.12	214.11	578.24	176.80	22.00	3.77	0.0000	0.21	0.000293
Reach-1	35404	PF 3	179.53	37.60		179.59	1.06	1.07	35.47	24.23	176.80	22.00	2.73	0.0000	0.24	0.000453
Reach-1	35404	PF 4	180.09	51.90		180.15	0.82	1.14	63.59	122.68	176.80	22.00	3.29	0.0000	0.23	0.000387
Reach-1	36000	Max Observed	180.88	92.50		180.96	0.27	1.32	348.36	666.03	176.90	60.00	3.98	0.0017	0.24	0.000373
Reach-1	36000	100yr	180.58	66.10		180.65	0.40	1.19	166.02	543.37	176.90	60.00	3.68	0.0017	0.22	0.000344
Reach-1	36000	PF 3	179.56	37.60		179.62	1.11	1.11	33.83	20.29	176.90	60.00	2.66	0.0017	0.25	0.000508
Reach-1	36000	PF 4	180.11	51.90		180.18	0.94	1.18	55.30	89.76	176.90	60.00	3.21	0.0017	0.24	0.000433
Reach-1	37500	Max Observed	180.93	92.50		181.06	0.37	1.72	251.10	515.70	177.00	150.00	3.93	0.0007	0.31	0.000678
Reach-1	37500	100yr	180.63	66.10	178.91	180.74	0.61	1.54	109.11	416.57	177.00	150.00	3.63	0.0007	0.29	0.000622
Reach-1	37500	PF 3	179.64	37.60		179.74	1.41	1.41	26.73	15.32	177.00	150.00	2.64	0.0007	0.32	0.000862
Reach-1	37500	PF 4	180.17	51.90		180.29	1.24	1.51	41.77	59.06	177.00	150.00	3.17	0.0007	0.31	0.000753
Reach-1	39001	Max Observed	181.04	92.50		181.18	0.32	1.92	288.46	743.73	177.10	150.00	3.94	0.0007	0.34	0.000888
Reach-1	39001	100yr	180.72	66.10	179.21	180.86	0.45	1.76	145.50	378.43	177.10	150.00	3.62	0.0007	0.33	0.000859
Reach-1	39001	PF 3	179.77	37.60		179.92	1.68	1.68	22.33	11.22	177.10	150.00	2.67	0.0007	0.38	0.001282
Reach-1	39001	PF 4	180.28	51.90		180.45	1.18	1.81	43.87	93.43	177.10	150.00	3.18	0.0007	0.37	0.001126
Reach-1	40323	Max Observed	181.08	92.50	179.00	181.27	1.94	1.94	47.74	580.35	177.20	132.00	3.88	0.0008	0.31	0.000246
Reach-1	40323	100yr	180.81	66.10	178.63	180.92	1.49	1.49	44.36	411.24	177.20	132.00	3.61	0.0008	0.25	0.000161
Reach-1	40323	PF 3	179.94	37.60	178.18	180.00	1.12	1.12	33.70	26.13	177.20	132.00	2.74	0.0008	0.22	0.000130
Reach-1	40323	PF 4	180.45	51.90	178.42	180.53	1.30	1.30	39.95	129.39	177.20	132.00	3.25	0.0008	0.23	0.000140
Reach-1	40573.5		Bridge													
Reach-1	40824	Max Observed	181.12	92.50	179.00	181.31	1.92	1.92	48.21	592.00	177.20	0.10	3.92	0.0000	0.31	0.000238
Reach-1	40824	100yr	180.83	66.10	178.63	180.94	1.48	1.48	44.63	418.47	177.20	0.10	3.63	0.0000	0.25	0.000157
Reach-1	40824	PF 3	179.96	37.60	178.18	180.02	1.11	1.11	33.89	29.28	177.20	0.10	2.76	0.0000	0.21	0.000127
Reach-1	40824	PF 4	180.47	51.90	178.42	180.55	1.29	1.29	40.17	133.09	177.20	0.10	3.27	0.0000	0.23	0.000138
Reach-1	41106	Max Observed	181.20	92.50	179.39	181.34	0.64	1.71	144.05	412.52	177.30	28.00	3.90	0.0036	0.30	0.000572
Reach-1	41106	100yr	180.86	66.10		180.96	0.90	1.38	73.06	66.41	177.30	28.00	3.56	0.0036	0.25	0.000429
Reach-1	41106	PF 3	179.96	37.60		180.03	1.04	1.15	36.16	28.66	177.30	28.00	2.66	0.0036	0.25	0.000483
Reach-1	41106	PF 4	180.48	51.90		180.56	0.96	1.26	54.30	40.98	177.30	28.00	3.18	0.0036	0.25	0.000429
Reach-1	42000	Max Observed	181.36	81.60		181.40	0.27	0.97	304.32	685.69	177.30	90.00	4.06	0.0000	0.16	0.000165
Reach-1	42000	100yr	180.96	59.50		181.00	0.52	0.84	114.58	112.26	177.30	90.00	3.66	0.0000	0.15	0.000146
Reach-1	42000	PF 3	180.04	32.60		180.06	0.59	0.67	55.10	43.68	177.30	90.00	2.74	0.0000	0.15	0.000150
Reach-1	42000	PF 4	180.57	46.10		180.60	0.56	0.76	82.81	61.49	177.30	90.00	3.27	0.0000	0.15	0.000142
Reach-1	43501	Max Observed	181.38	81.60		181.43	0.24	1.03	339.27	829.59	177.50	150.00	3.88	0.0013	0.18	0.000205
Reach-1	43501	100yr	180.98	59.50		181.03	0.48	0.93	123.84	176.96	177.50	150.00	3.48	0.0013	0.17	0.000197
Reach-1	43501	PF 3	180.07	32.60		180.10	0.76	0.76	42.74	23.14	177.50	150.00	2.57	0.0013	0.17	0.000218
Reach-1	43501	PF 4	180.59	46.10		180.63	0.67	0.85	69.20	100.07	177.50	150.00	3.09	0.0013	0.17	0.000202
Reach-1	44302	Max Observed	181.40	81.60		181.45	0.23	1.01	354.79	854.71	177.50	80.00	3.90	0.0000	0.18	0.000198
Reach-1	44302	100yr	181.00	59.50		181.04	0.47	0.94	126.63	360.01	177.50	80.00	3.50	0.0000	0.17	0.000200
Reach-1	44302	PF 3	180.08	32.60		180.11	0.76	0.76	43.16	23.89	177.50	80.00	2.58	0.0000	0.17	0.000212
Reach-1	44302	PF 4	180.61	46.10		180.64	0.65	0.85	70.91	103.35	177.50	80.00	3.11	0.0000	0.17	0.000198
Reach-1	44323	Max Observed	181.40	81.60		181.45	0.23	1.01	355.22	855.43	177.50	2.20	3.90	0.0000	0.18	0.000198
Reach-1	44323	100yr	181.00	59.50		181.04	0.47	0.94	126.80	360.31	177.50	2.20	3.50	0.0000	0.17	0.000200
Reach-1	44323	PF 3	180.08	32.60		180.11	0.76	0.76	43.17	23.91	177.50	2.20	2.58	0.0000	0.17	0.000212
Reach-1	44323	PF 4	180.61	46.10		180.64	0.65	0.85	70.96	103.44	177.50	2.20	3.11	0.0000	0.17	0.000197
Reach-1	44704	Max Observed	181.41	81.60		181.47	0.38	1.15	214.52	590.61	177.70	38.00	3.71	0.0053	0.21	0.000276
Reach-1	44704	100yr	181.01	59.50		181.06	0.62	1.00	95.61	142.52	177.70	38.00	3.31	0.0053	0.19	0.000250
Reach-1	44704	PF 3	180.09	32.60		180.13	0.83	0.83	39.12	20.10	177.70	38.00	2.39	0.0053	0.19	0.000281
Reach-1	44704	PF 4	180.61	46.10		180.66	0.82	0.92	55.99	54.43	177.70	38.00	2.91	0.0053	0.19	0.000258
Reach-1	45100	Max Observed	181.41	81.60		181.49	0.63	1.28	130.29	366.19	177.90	40.00	3.51	0.0050	0.23	0.000370
Reach-1	45100	100yr	181.01	59.50		181.07	0.83	1.09	71.66	104.76	177.90	40.00	3.11	0.0050	0.22	0.000326
Reach-1	45100	PF 3	180.10	32.60		180.14	0.92	0.92	35.34	19.50	177.90	40.00	2.20	0.0050	0.22	0.000378
Reach-1	45100	PF 4	180.62	46.10		180.67	0.98	1.00	47.27	36.16	177.90	40.00	2.72	0.0050	0.21	0.000342
Reach-1	45601	Max Observed	181.50	62.50		181.52	0.10	0.72	653.33	1459.88	178.20	50.00	3.30	0.0060	0.13	0.000113
Reach-1	45601	100yr	181.06	48.10		181.09	0.34	0.88	141.70	880.48	178.20	50.00	2.86	0.0060	0.18	0.000213
Reach-1	45601	PF 3	180.14	25.10		180.16	0.73	0.74	34.17	28.07	178.20	50.00	1.94	0.0060	0.19	0.000272
Reach-1	45601	PF 4	180.66	36.60		180.69	0.59	0.81	61.87	77.76	178.20	50.00	2.46	0.0060	0.18	0.000223
Reach-1	46102	Max Observed	181.51	62.50	180.03	181.53	0.08	0.96	801.81	1681.54	178.40	50.00	3.11	0.0040	0.18	0.000192
Reach-1	46102	100yr	181.05	48.10	179.79	181.20	0.46	1.72	104.38	1384.31	178.40	50.00	2.65	0.0040	0.34	0.000770
Reach-1	46102	PF 3	180.14	25.10	179.34	180.25	1.44	1.44	17.39	13.96	178.40	50.00	1.74	0.0040	0.36	0.000984
Reach-1	46102	PF 4	180.66	36.60	179.58	180.79	1.34	1.57	27.32	15.13	178.40	50.00	2.26	0.0040	0.34	0.000811
Reach-1	46152.5		Bridge													
Reach-1	46203	Max Observed	181.58	62.50	180.03	181.59	0.07	0.85	917.63	1725.95	178.40	0.10	3.18	0.0000	0.16	0.000147
Reach-1	46203	100yr	181.50	48.10	179.79	181.52	0.06	0.74	797.21	1679.75	178.40	0.10	3.10	0.0000	0.14	0.000115
Reach-1	46203	PF 3	180.17	25.10	179.34	180.27	1.42	1.42	17.64	14.01	178.40	0.10	1.77	0.0000	0.35	0.000938
Reach-1	46203	PF 4	180.86	36.60	179.58	180.96	1.46	1.46	25.00	15.57	178.40	0.10	2.46	0.0000	0.31	0.000624
Reach-1	46304	Max Observed	181.59	62.50		181.60	0.07	0.69	934.87	1732.46	178.40	10.00	3.19	0.0000	0.13	0.000135
Reach-1	46304	100yr	181.51	48.10		181.52	0.06	0.60	810.99	1685.10	178.40	10.00	3.11	0.0000	0.12	0.000106

HEC-RAS Plan: LTRiv-ExCond1 River: RIVER-1 Reach: Reach-1 (Continued)

Reach	River Sta	Profile	W.S. Elev	Q Total	Crit W.S.	E.G. Elev	Vel Total	Vel Chnl	Flow Area	Top Width	Min Ch El	Length Chnl	Max Chl Dpth	Invert Slope	Froude # Chl	E.G. Slope
			(m)	(m3/s)	(m)	(m)	(m/s)	(m/s)	(m2)	(m)	(m)	(m)	(m)			(m/m)
Reach-1	46304	PF 3	180.22	25.10		180.30	1.20	1.20	20.94	14.14	178.40	10.00	1.82	0.0000	0.31	0.000861
Reach-1	46304	PF 4	180.93	36.60		180.99	1.17	1.17	31.40	15.73	178.40	10.00	2.53	0.0000	0.26	0.000563
Reach-1	47100	Max Observed	181.60	62.50		181.61	0.08	0.79	793.61	1264.13	178.30	80.00	3.30	-0.0012	0.15	0.000191
Reach-1	47100	100yr	181.52	48.10		181.53	0.07	0.69	699.78	1229.72	178.30	80.00	3.22	-0.0012	0.13	0.000149
Reach-1	47100	PF 3	180.29	25.10		180.41	1.54	1.54	16.29	10.16	178.30	80.00	1.99	-0.0012	0.39	0.001411
Reach-1	47100	PF 4	180.96	36.60	179.72	181.07	0.44	1.49	83.40	973.88	178.30	80.00	2.66	-0.0012	0.33	0.000960
Reach-1	48000	Max Observed	181.60	62.50		181.66	0.20	1.28	306.54	1186.35	178.30	90.00	3.30	0.0000	0.26	0.000471
Reach-1	48000	100yr	181.52	48.10		181.57	0.22	1.09	220.54	1120.95	178.30	90.00	3.22	0.0000	0.22	0.000355
Reach-1	48000	PF 3	180.45	25.10		180.51	1.13	1.13	22.12	14.59	178.30	90.00	2.15	0.0000	0.29	0.000728
Reach-1	48000	PF 4	181.08	36.60		181.15	0.86	1.14	42.42	137.16	178.30	90.00	2.78	0.0000	0.26	0.000507
Reach-1	48500	Max Observed	181.65	62.50		181.69	0.12	1.02	509.57	1383.01	178.20	50.00	3.45	-0.0020	0.20	0.000277
Reach-1	48500	100yr	181.56	48.10		181.59	0.12	0.89	389.05	1269.21	178.20	50.00	3.36	-0.0020	0.18	0.000224
Reach-1	48500	PF 3	180.50	25.10		180.55	1.03	1.03	24.30	15.18	178.20	50.00	2.30	-0.0020	0.26	0.000562
Reach-1	48500	PF 4	181.12	36.60		181.17	0.52	1.04	70.68	280.65	178.20	50.00	2.92	-0.0020	0.23	0.000391
Reach-1	49000	Max Observed	181.66	62.50		181.72	0.19	1.14	322.31	1232.84	178.20	50.00	3.46	0.0000	0.23	0.000362
Reach-1	49000	100yr	181.57	48.10		181.61	0.22	0.98	215.81	1087.74	178.20	50.00	3.37	0.0000	0.20	0.000283
Reach-1	49000	PF 3	180.53	25.10		180.58	0.95	0.95	26.45	16.09	178.20	50.00	2.33	0.0000	0.24	0.000456
Reach-1	49000	PF 4	181.14	36.60		181.19	0.78	0.98	46.91	147.51	178.20	50.00	2.94	0.0000	0.22	0.000366
Reach-1	50350	Max Observed	181.71	62.50		181.76	0.16	1.06	390.20	1306.49	178.20	135.00	3.51	0.0000	0.21	0.000305
Reach-1	50350	100yr	181.61	48.10		181.65	0.18	0.93	261.93	1163.42	178.20	135.00	3.41	0.0000	0.19	0.000251
Reach-1	50350	PF 3	180.59	25.10		180.64	0.91	0.91	27.47	16.35	178.20	135.00	2.39	0.0000	0.23	0.000411
Reach-1	50350	PF 4	181.19	36.60		181.24	0.66	0.96	55.34	183.42	178.20	135.00	2.99	0.0000	0.21	0.000334
Reach-1	51701	Max Observed	181.76	62.50		181.80	0.14	1.00	447.72	1365.78	178.20	135.00	3.56	0.0000	0.19	0.000265
Reach-1	51701	100yr	181.65	48.10		181.68	0.16	0.89	304.50	1212.78	178.20	135.00	3.45	0.0000	0.18	0.000225
Reach-1	51701	PF 3	180.65	25.10		180.69	0.88	0.88	28.40	16.58	178.20	135.00	2.45	0.0000	0.22	0.000375
Reach-1	51701	PF 4	181.24	36.60		181.28	0.57	0.93	64.63	216.03	178.20	135.00	3.04	0.0000	0.20	0.000306
Reach-1	52302	Max Observed	181.76	62.50	179.99	181.87	1.44	1.44	43.49	1425.28	178.20	60.00	3.56	0.0000	0.27	0.000474
Reach-1	52302	100yr	181.66	48.10	179.77	181.72	1.15	1.15	41.86	1260.06	178.20	60.00	3.45	0.0000	0.22	0.000319
Reach-1	52302	PF 3	180.67	25.10	179.30	180.72	0.92	0.92	27.22	17.05	178.20	60.00	2.47	0.0000	0.22	0.000365
Reach-1	52302	PF 4	181.26	36.60	179.56	181.31	1.02	1.02	35.94	227.57	178.20	60.00	3.06	0.0000	0.21	0.000307
Reach-1	52352.5		Bridge													
Reach-1	52403	Max Observed	181.88	62.50	179.99	181.97	1.38	1.38	45.17	1557.14	178.20	0.10	3.68	0.0000	0.25	0.000418
Reach-1	52403	100yr	181.66	48.10	179.77	181.73	1.15	1.15	41.93	1268.82	178.20	0.10	3.46	0.0000	0.22	0.000317
Reach-1	52403	PF 3	180.68	25.10	179.30	180.72	0.92	0.92	27.26	17.06	178.20	0.10	2.47	0.0000	0.22	0.000363
Reach-1	52403	PF 4	181.26	36.60	179.56	181.31	1.02	1.02	35.99	229.95	178.20	0.10	3.06	0.0000	0.21	0.000306
Reach-1	52804	Max Observed	182.02	62.50		182.03	0.07	0.69	852.38	1730.85	178.20	40.00	3.82	0.0000	0.13	0.000111
Reach-1	52804	100yr	181.74	48.10		181.76	0.11	0.79	419.76	1337.29	178.20	40.00	3.54	0.0000	0.15	0.000168
Reach-1	52804	PF 3	180.70	25.10		180.74	0.86	0.86	29.19	16.77	178.20	40.00	2.50	0.0000	0.21	0.000348
Reach-1	52804	PF 4	181.29	36.60		181.33	0.48	0.90	76.71	252.16	178.20	40.00	3.09	0.0000	0.19	0.000278
Reach-1	54000	Max Observed	182.03	57.50		182.04	0.07	0.60	846.12	1925.61	178.30	120.00	3.73	0.0008	0.11	0.000086
Reach-1	54000	100yr	181.76	45.10		181.78	0.12	0.69	382.15	1474.52	178.30	120.00	3.46	0.0008	0.14	0.000129
Reach-1	54000	PF 3	180.75	22.90		180.77	0.67	0.67	34.06	19.89	178.30	120.00	2.45	0.0008	0.16	0.000212
Reach-1	54000	PF 4	181.34	34.00		181.36	0.44	0.72	76.61	256.15	178.30	120.00	3.04	0.0008	0.16	0.000180
Reach-1	55200	Max Observed	182.05	57.50		182.05	0.05	0.47	1189.49	1783.18	178.40	120.00	3.64	0.0008	0.09	0.000053
Reach-1	55200	100yr	181.78	45.10		181.79	0.06	0.50	790.28	1341.31	178.40	120.00	3.38	0.0008	0.10	0.000070
Reach-1	55200	PF 3	180.78	22.90		180.81	0.82	0.82	28.05	17.02	178.40	120.00	2.38	0.0008	0.20	0.000333
Reach-1	55200	PF 4	181.37	34.00		181.38	0.11	0.69	308.50	995.87	178.40	120.00	2.97	0.0008	0.15	0.000167
Reach-1	56150	Max Observed	182.05	57.50		182.05	0.05	0.47	1194.94	1789.27	178.50	95.00	3.55	0.0011	0.09	0.000054
Reach-1	56150	100yr	181.79	45.10		181.80	0.06	0.50	795.90	1346.47	178.50	95.00	3.29	0.0011	0.10	0.000071
Reach-1	56150	PF 3	180.81	22.90		180.84	0.84	0.84	27.37	17.12	178.50	95.00	2.31	0.0011	0.21	0.000363
Reach-1	56150	PF 4	181.38	34.00		181.40	0.11	0.69	321.96	1005.83	178.50	95.00	2.88	0.0011	0.15	0.000171
Reach-1	57100	Max Observed	182.05	57.50		182.06	0.05	0.46	1201.48	1795.20	178.50	95.00	3.55	0.0000	0.09	0.000054
Reach-1	57100	100yr	181.79	45.10		181.80	0.06	0.50	802.73	1351.60	178.50	95.00	3.29	0.0000	0.10	0.000070
Reach-1	57100	PF 3	180.84	22.90		180.88	0.82	0.82	27.98	17.28	178.50	95.00	2.34	0.0000	0.21	0.000341
Reach-1	57100	PF 4	181.40	34.00		181.41	0.10	0.67	337.13	1016.02	178.50	95.00	2.90	0.0000	0.15	0.000162
Reach-1	59000	Max Observed	182.06	57.50		182.08	0.08	0.74	729.81	1453.62	178.70	190.00	3.36	0.0011	0.14	0.000142
Reach-1	59000	100yr	181.80	45.10		181.83	0.12	0.86	382.78	1197.87	178.70	190.00	3.10	0.0011	0.18	0.000220
Reach-1	59000	PF 3	180.91	22.90		180.96	0.93	0.93	24.62	15.64	178.70	190.00	2.21	0.0011	0.24	0.000463
Reach-1	59000	PF 4	181.42	34.00		181.47	0.46	1.00	73.92	274.00	178.70	190.00	2.72	0.0011	0.22	0.000380
Reach-1	59201	Max Observed	182.07	47.20		182.08	0.06	0.60	743.16	1462.58	178.70	20.00	3.37	0.0000	0.12	0.000093
Reach-1	59201	100yr	181.82	37.70		181.84	0.09	0.70	402.07	1221.78	178.70	20.00	3.12	0.0000	0.14	0.000146
Reach-1	59201	PF 3	180.94	18.10		180.97	0.72	0.72	25.09	15.77	178.70	20.00	2.24	0.0000	0.18	0.000275
Reach-1	59201	PF 4	181.45	27.90		181.48	0.34	0.80	82.25	293.78	178.70	20.00	2.75	0.0000	0.18	0.000240
Reach-1	59602	Max Observed	182.07	47.20	180.09	182.09	0.06	0.73	834.26	2080.24	178.70	40.00	3.37	0.0000	0.13	0.000101
Reach-1	59602	100yr	181.82	37.70	179.91	181.85	0.09	0.84	411.32	1418.31	178.70	40.00	3.12	0.0000	0.16	0.000151
Reach-1	59602	PF 3	180.95	18.10	179.49	180.98	0.78	0.78	23.11	15.18	178.70	40.00	2.25	0.0000	0.17	0.000209
Reach-1	59602	PF 4	181.46	27.90	179.72	181.50	0.32	0.92	85.96	298.64	178.70	40.00	2.76	0.0000	0.18	0.000217
Reach-1	59652.5		Bridge													
Reach-1	59703	Max Observed	182.30	47.20	180.08	182.30	0.04	0.48	1309.50	2081.00	178.70	0.10	3.60	0.0000	0.08	0.000040
Reach-1	59703	100yr	181.93	37.70	179.91	181.94	0.07	0.71	566.31	1564.51	178.70	0.10	3.23	0.0000	0.13	0.000103
Reach-1	59703	PF 3	180.96	18.10	179.49	181.00	0.78	0.78	23.25	15.21	178.70	0.10	2.26	0.0000	0.17	0.000205
Reach-1	59703	PF 4	181.54	27.90	179.72	181.59	0.94	0.94	29.60	478.40	178.70	0.10	2.84	0.0000	0.18	0.000217
Reach-1	59804	Max Observed	182.30	47.20		182.31	0.06	0.60	731.25	1637.27	178.70	9.50	3.60	0.0000	0.11	0.000085
Reach-1	59804	100yr	181.93	37.70		181.95	0.13	0.75	296.21	620.18	178.70	9.50	3.23	0.0000	0.15	0.000159
Reach-1	59804	PF 3	180.97	18.10		181.00	0.79	0.79	22.93	14.18	178.70	9.50	2.27	0.0000	0.20	0.000329
Reach-1	59804	PF 4	181.57	27.90		181.60	0.22	0.78	125.32	345.45	178.70	9.50	2.87	0.0000	0.17	0.000214
Reach-1	61000	Max Observed	182.31	47.20		182.32	0.09	0.75	537.16	1270.42	178.80	120.00	3.51	0.0008	0.14	0.000142
Reach-1	61000	100yr	181.94	37.70		181.97	0.17	0.89	224.02	504.01	178.80	120.00	3.14	0.0008	0.18	0.000243
Reach-1	61000	PF 3	181.01	18.10		181.05	0.90	0.90	20.09	12.70	178.80	120.00	2.21	0.0008	0.23	0.000449
Reach-1	61000	PF 4	181.60	27.90		181.63	0.30	0.92	91.90	261.16	178.80	120.00	2.80	0.0008	0.20	0.000317
Reach-1	62301	Max Observed	182.33	47.20		182.34	0.06	0.57	789.24	1171.88	179.00	130.00	3.33	0.0015	0.11	0.000090

HEC-RAS Plan: LTRiv-ExCond1 River: RIVER-1 Reach: Reach-1 (Continued)

Reach	River Sta	Profile	W.S. Elev	Q Total	Crit W.S.	E.G. Elev	Vel Total	Vel Chnl	Flow Area	Top Width	Min Ch El	Length Chnl	Max Chl Dpth	Invert Slope	Froude # Chl	E.G. Slope
			(m)	(m3/s)	(m)	(m)	(m/s)	(m/s)	(m2)	(m)	(m)	(m)	(m)			(m/m)
Reach-1	62301	100yr	181.98	37.70		182.00	0.09	0.79	399.10	1062.69	179.00	130.00	2.98	0.0015	0.16	0.000207
Reach-1	62301	PF 3	181.07	18.10		181.11	0.94	0.94	19.28	11.79	179.00	130.00	2.07	0.0015	0.23	0.000487
Reach-1	62301	PF 4	181.64	27.90		181.68	0.29	1.00	95.58	610.20	179.00	130.00	2.64	0.0015	0.22	0.000400
Reach-1	62602	Max Observed	182.34	47.20	180.65	182.35	0.06	0.75	791.75	1173.27	179.00	30.00	3.34	0.0000	0.13	0.000102
Reach-1	62602	100yr	181.99	37.70	180.42	182.02	0.09	1.07	403.28	1064.41	179.00	30.00	2.99	0.0000	0.20	0.000238
Reach-1	62602	PF 3	181.08	18.10	179.87	181.15	1.23	1.23	14.74	11.81	179.00	30.00	2.08	0.0000	0.27	0.000513
Reach-1	62602	PF 4	181.64	27.90	180.16	181.73	0.28	1.37	98.63	618.97	179.00	30.00	2.64	0.0000	0.27	0.000459
Reach-1	62622.5		Bridge													
Reach-1	62643	Max Observed	182.35	47.20	180.65	182.36	0.06	0.74	806.91	1181.63	179.00	0.10	3.35	0.0000	0.13	0.000097
Reach-1	62643	100yr	182.02	37.70	180.42	182.05	0.09	1.00	440.57	1075.88	179.00	0.10	3.02	0.0000	0.18	0.000206
Reach-1	62643	PF 3	181.09	18.10	179.87	181.16	1.22	1.22	14.81	11.84	179.00	0.10	2.09	0.0000	0.27	0.000504
Reach-1	62643	PF 4	181.67	27.90	180.16	181.75	0.23	1.31	119.41	675.86	179.00	0.10	2.67	0.0000	0.26	0.000418
Reach-1	62804	Max Observed	182.36	47.20		182.36	0.06	0.56	815.50	1186.34	179.00	16.00	3.36	0.0000	0.11	0.000084
Reach-1	62804	100yr	182.05	37.70		182.06	0.08	0.71	467.31	1082.47	179.00	16.00	3.05	0.0000	0.14	0.000161
Reach-1	62804	PF 3	181.15	18.10		181.19	0.89	0.89	20.28	12.00	179.00	16.00	2.15	0.0000	0.22	0.000422
Reach-1	62804	PF 4	181.76	27.90		181.79	0.16	0.85	179.29	805.09	179.00	16.00	2.76	0.0000	0.18	0.000272
Reach-1	66000	Max Observed	182.38	47.20		182.39	0.05	0.54	885.68	1520.28	179.40	320.00	2.98	0.0013	0.12	0.000107
Reach-1	66000	100yr	182.10	37.70		182.12	0.08	0.77	474.59	1402.09	179.40	320.00	2.70	0.0013	0.18	0.000260
Reach-1	66000	PF 3	181.32	18.10		181.39	0.57	1.14	31.81	158.70	179.40	320.00	1.92	0.0013	0.30	0.000836
Reach-1	66000	PF 4	181.85	27.90		181.88	0.12	0.86	227.09	641.86	179.40	320.00	2.45	0.0013	0.21	0.000370
Reach-1	67250	Max Observed	182.39	38.70		182.40	0.06	0.58	673.44	1460.45	179.55	125.00	2.84	0.0012	0.13	0.000136
Reach-1	67250	100yr	182.12	33.10		182.14	0.11	0.85	312.87	823.84	179.55	125.00	2.57	0.0012	0.20	0.000345
Reach-1	67250	PF 3	181.44	14.20		181.48	0.54	0.93	26.44	134.15	179.55	125.00	1.89	0.0012	0.25	0.000565
Reach-1	67250	PF 4	181.89	23.70		181.92	0.15	0.87	161.70	508.91	179.55	125.00	2.34	0.0012	0.21	0.000400
Reach-1	68501	Max Observed	182.40	38.70		182.42	0.08	0.77	474.59	1401.71	179.70	125.00	2.70	0.0012	0.18	0.000262
Reach-1	68501	100yr	182.15	33.10		182.19	0.14	0.99	228.64	643.62	179.70	125.00	2.45	0.0012	0.24	0.000489
Reach-1	68501	PF 3	181.51	14.20		181.55	0.76	0.96	18.61	82.86	179.70	125.00	1.81	0.0012	0.26	0.000633
Reach-1	68501	PF 4	181.93	23.70		181.97	0.21	0.98	114.86	384.70	179.70	125.00	2.23	0.0012	0.25	0.000529
Reach-1	69023	Max Observed	182.41	38.70	181.08	182.43	0.07	0.82	529.49	1468.38	179.90	52.00	2.51	0.0038	0.17	0.000188
Reach-1	69023	100yr	182.17	33.10	180.97	182.27	1.40	1.40	23.72	882.52	179.90	52.00	2.27	0.0038	0.30	0.000632
Reach-1	69023	PF 3	181.55	14.20	180.55	181.59	0.84	0.84	16.95	17.91	179.90	52.00	1.65	0.0038	0.21	0.000356
Reach-1	69023	PF 4	181.95	23.70	180.78	182.02	1.11	1.11	21.37	518.03	179.90	52.00	2.05	0.0038	0.25	0.000459
Reach-1	69118.5		Bridge													
Reach-1	69214	Max Observed	182.58	38.70	181.08	182.59	0.05	0.58	807.56	1829.13	179.90	0.10	2.68	0.0000	0.12	0.000088
Reach-1	69214	100yr	182.19	33.10	180.97	182.29	1.38	1.38	23.98	922.83	179.90	0.10	2.29	0.0000	0.30	0.000609
Reach-1	69214	PF 3	181.56	14.20	180.55	181.60	0.83	0.83	17.07	17.97	179.90	0.10	1.66	0.0000	0.21	0.000348
Reach-1	69214	PF 4	181.97	23.70	180.78	182.03	1.10	1.10	21.54	544.25	179.90	0.10	2.07	0.0000	0.25	0.000447
Reach-1	69736	Max Observed	182.58	38.70		182.59	0.05	0.58	816.58	1831.67	179.90	52.00	2.68	0.0000	0.11	0.000086
Reach-1	69736	100yr	182.33	33.10		182.35	0.08	0.79	427.31	1256.83	179.90	52.00	2.43	0.0000	0.16	0.000182
Reach-1	69736	PF 3	181.58	14.20		181.61	0.66	0.81	21.57	18.11	179.90	52.00	1.68	0.0000	0.20	0.000320
Reach-1	69736	PF 4	182.03	23.70		182.07	0.16	0.90	147.64	648.22	179.90	52.00	2.13	0.0000	0.20	0.000284
Reach-1	71000	Max Observed	182.58	38.70		182.67	1.33	1.33	29.13	16.87	179.90	127.00	2.68	0.0000	0.31	0.000748
Reach-1	71000	100yr	182.36	33.10		182.45	1.28	1.28	25.78	14.54	179.90	127.00	2.46	0.0000	0.31	0.000780
Reach-1	71000	PF 3	181.63	14.20		181.67	0.89	0.89	16.03	12.13	179.90	127.00	1.73	0.0000	0.25	0.000539
Reach-1	71000	PF 4	182.08	23.70		182.14	1.09	1.09	21.81	13.61	179.90	127.00	2.18	0.0000	0.27	0.000636
Reach-1	72801	Max Observed	182.72	38.70	181.31	182.80	0.52	1.22	74.73	369.99	179.90	180.00	2.82	0.0000	0.27	0.000583
Reach-1	72801	100yr	182.50	33.10		182.58	1.21	1.21	27.34	16.24	179.90	180.00	2.60	0.0000	0.29	0.000668
Reach-1	72801	PF 3	181.73	14.20		181.76	0.85	0.85	16.69	12.39	179.90	180.00	1.83	0.0000	0.23	0.000484
Reach-1	72801	PF 4	182.19	23.70		182.25	1.04	1.04	22.85	13.97	179.90	180.00	2.29	0.0000	0.26	0.000562
Reach-1	73102	Max Observed	182.73	38.70	181.35	182.86	0.36	1.71	108.90	387.35	179.90	30.00	2.83	0.0000	0.32	0.000659
Reach-1	73102	100yr	182.51	33.10	181.20	182.67	1.22	1.78	27.13	351.31	179.90	30.00	2.61	0.0000	0.35	0.000796
Reach-1	73102	PF 3	181.74	14.20	180.64	181.80	1.09	1.09	13.04	10.28	179.90	30.00	1.84	0.0000	0.26	0.000475
Reach-1	73102	PF 4	182.20	23.70	180.95	182.31	1.45	1.45	16.34	11.08	179.90	30.00	2.30	0.0000	0.31	0.000623
Reach-1	73162.5		Bridge													
Reach-1	73223	Max Observed	182.96	38.70	181.35	183.13	1.78	1.78	21.75	425.51	179.90	0.10	3.06	0.0000	0.32	0.000640
Reach-1	73223	100yr	182.65	33.10	181.20	182.80	1.69	1.69	19.56	375.18	179.90	0.10	2.75	0.0000	0.33	0.000668
Reach-1	73223	PF 3	181.75	14.20	180.64	181.81	1.08	1.08	13.15	10.31	179.90	0.10	1.85	0.0000	0.25	0.000462
Reach-1	73223	PF 4	182.23	23.70	180.95	182.33	1.43	1.43	16.54	11.13	179.90	0.10	2.33	0.0000	0.30	0.000598
Reach-1	73404	Max Observed	183.19	38.70		183.22	0.11	0.78	343.61	671.83	179.90	18.00	3.29	0.0000	0.15	0.000181
Reach-1	73404	100yr	182.83	33.10		182.87	0.22	0.99	148.32	403.58	179.90	18.00	2.93	0.0000	0.20	0.000352
Reach-1	73404	PF 3	181.79	14.20		181.83	0.86	0.86	16.56	10.38	179.90	18.00	1.89	0.0000	0.22	0.000438
Reach-1	73404	PF 4	182.31	23.70		182.37	1.07	1.07	22.18	11.28	179.90	18.00	2.41	0.0000	0.24	0.000532
Reach-1	75800	Max Observed	183.24	38.70		183.28	0.20	1.03	194.93	422.00	180.20	240.00	3.04	0.0012	0.21	0.000353
Reach-1	75800	100yr	182.92	33.10	181.43	183.00	0.49	1.24	68.16	369.85	180.20	240.00	2.72	0.0012	0.27	0.000615
Reach-1	75800	PF 3	181.91	14.20		181.96	0.97	0.97	14.71	10.07	180.20	240.00	1.71	0.0012	0.25	0.000617
Reach-1	75800	PF 4	182.45	23.70		182.52	1.16	1.16	20.38	11.00	180.20	240.00	2.25	0.0012	0.27	0.000676
Reach-1	77000	Max Observed	183.28	38.70		183.36	0.28	1.36	136.13	329.87	180.30	120.00	2.98	0.0008	0.28	0.000701
Reach-1	77000	100yr	182.99	33.10	181.72	183.12	0.71	1.58	46.55	292.34	180.30	120.00	2.69	0.0008	0.34	0.001126
Reach-1	77000	PF 3	182.00	14.20		182.07	1.22	1.22	11.62	8.03	180.30	120.00	1.70	0.0008	0.32	0.001077
Reach-1	77000	PF 4	182.54	23.70		182.65	1.47	1.47	16.17	8.78	180.30	120.00	2.24	0.0008	0.34	0.001180
Reach-1	78201	Max Observed	183.36	38.70		183.50	1.66	1.66	23.30	12.24	180.40	120.00	2.96	0.0008	0.38	0.001266
Reach-1	78201	100yr	183.14	33.10		183.27	1.61	1.61	20.62	11.57	180.40	120.00	2.74	0.0008	0.38	0.001287
Reach-1	78201	PF 3	182.14	14.20		182.23	1.35	1.35	10.53	8.63	180.40	120.00	1.74	0.0008	0.39	0.001465
Reach-1	78201	PF 4	182.69	23.70		182.80	1.51	1.51	15.72	10.25	180.40	120.00	2.29	0.0008	0.39	0.001373
Reach-1	78502	Max Observed	183.42	38.70	182.17	183.55	1.54	1.55	25.06	12.55	180.40	30.00	3.02	0.0000	0.35	0.000992
Reach-1	78502	100yr	183.20	33.10	182.02	183.31	1.49	1.49	22.27	12.40	180.40	30.00	2.80	0.0000	0.35	0.001073
Reach-1	78502	PF 3	182.20	14.20	181.41	182.28	1.24	1.24	11.44	9.22	180.40	30.00	1.80	0.0000	0.36	0.001198
Reach-1	78502	PF 4	182.75	23.70	181.75	182.85	1.39	1.39	17.01	10.97	180.40	30.00	2.35	0.0000	0.36	0.001137
Reach-1	78527.5		Bridge													
Reach-1	78553	Max Observed	183.50	38.70	182.17	183.61	1.49	1.49	25.95	12.60	180.40	0.10	3.10	0.0000	0.33	0.000880

HEC-RAS Plan: LTRiv-ExCond1 River: RIVER-1 Reach: Reach-1 (Continued)

Reach	River Sta	Profile	W.S. Elev	Q Total	Crit W.S.	E.G. Elev	Vel Total	Vel Chnl	Flow Area	Top Width	Min Ch El	Length Chnl	Max Chl Dpth	Invert Slope	Froude # Chl	E.G. Slope
			(m)	(m3/s)	(m)	(m)	(m/s)	(m/s)	(m2)	(m)	(m)	(m)	(m)			(m/m)
Reach-1	78553	100yr	183.27	33.10	182.02	183.38	1.43	1.43	23.16	12.45	180.40	0.10	2.87	0.0000	0.33	0.000941
Reach-1	78553	PF 3	182.21	14.20	181.41	182.28	1.23	1.23	11.51	9.24	180.40	0.10	1.81	0.0000	0.35	0.001179
Reach-1	78553	PF 4	182.76	23.70	181.75	182.86	1.39	1.39	17.09	11.00	180.40	0.10	2.36	0.0000	0.36	0.001123
Reach-1	78704	Max Observed	183.51	38.70	182.19	183.63	1.48	1.54	26.17	97.20	180.40	15.00	3.11	0.0000	0.35	0.001009
Reach-1	78704	100yr	183.29	33.10		183.40	1.48	1.48	22.39	12.02	180.40	15.00	2.89	0.0000	0.35	0.001031
Reach-1	78704	PF 3	182.22	14.20		182.30	1.26	1.26	11.29	8.88	180.40	15.00	1.82	0.0000	0.36	0.001210
Reach-1	78704	PF 4	182.77	23.70		182.88	1.43	1.43	16.63	10.51	180.40	15.00	2.37	0.0000	0.36	0.001179
Reach-1	80600	Max Observed	183.70	38.70	182.34	183.82	1.24	1.50	31.30	145.71	180.55	190.00	3.15	0.0008	0.33	0.000937
Reach-1	80600	100yr	183.48	33.10		183.59	1.44	1.44	22.95	12.15	180.55	190.00	2.93	0.0008	0.34	0.000965
Reach-1	80600	PF 3	182.45	14.20		182.52	1.19	1.19	11.96	9.10	180.55	190.00	1.90	0.0008	0.33	0.001036
Reach-1	80600	PF 4	183.00	23.70		183.09	1.36	1.36	17.40	10.72	180.55	190.00	2.45	0.0008	0.34	0.001044
Reach-1	82500	Max Observed	183.88	38.70		183.98	0.53	1.44	72.73	256.63	180.70	190.00	3.18	0.0008	0.31	0.000790
Reach-1	82500	100yr	183.66	33.10	182.36	183.77	1.06	1.45	31.16	115.42	180.70	190.00	2.96	0.0008	0.33	0.000915
Reach-1	82500	PF 3	182.64	14.20		182.71	1.17	1.17	12.12	8.98	180.70	190.00	1.94	0.0008	0.32	0.000984
Reach-1	82500	PF 4	183.19	23.70		183.29	1.35	1.35	17.49	10.53	180.70	190.00	2.49	0.0008	0.34	0.001013
Reach-1	83950	Max Observed	184.01	38.70		184.10	0.36	1.36	108.76	331.73	180.90	145.00	3.11	0.0014	0.29	0.000683
Reach-1	83950	100yr	183.80	33.10	182.53	183.90	0.64	1.40	51.80	203.06	180.90	145.00	2.90	0.0014	0.32	0.000832
Reach-1	83950	PF 3	182.79	14.20		182.86	1.18	1.18	12.02	9.24	180.90	145.00	1.89	0.0014	0.33	0.001031
Reach-1	83950	PF 4	183.34	23.70		183.43	1.35	1.35	17.61	10.92	180.90	145.00	2.44	0.0014	0.34	0.001020
Reach-1	85401	Max Observed	184.12	38.70		184.19	0.25	1.20	153.32	473.55	181.10	145.00	3.02	0.0014	0.25	0.000491
Reach-1	85401	100yr	183.93	33.10		184.00	0.39	1.22	85.20	283.54	181.10	145.00	2.83	0.0014	0.26	0.000565
Reach-1	85401	PF 3	182.94	14.20		182.99	1.03	1.03	13.82	10.25	181.10	145.00	1.84	0.0014	0.28	0.000733
Reach-1	85401	PF 4	183.49	23.70		183.57	1.19	1.19	19.93	11.68	181.10	145.00	2.39	0.0014	0.29	0.000733
Reach-1	85702	Max Observed	184.13	38.70	182.81	184.25	0.25	1.72	155.77	483.01	181.10	30.00	3.03	0.0000	0.32	0.000648
Reach-1	85702	100yr	183.93	33.10	182.65	184.13	1.98	1.98	16.74	281.28	181.10	30.00	2.83	0.0000	0.38	0.000942
Reach-1	85702	PF 3	182.95	14.20	182.04	183.04	1.33	1.33	10.67	10.29	181.10	30.00	1.85	0.0000	0.32	0.000777
Reach-1	85702	PF 4	183.50	23.70	182.37	183.65	1.68	1.68	14.10	13.28	181.10	30.00	2.40	0.0000	0.36	0.000856
Reach-1	85752.5		Bridge													
Reach-1	85803	Max Observed	184.58	38.70	182.81	184.60	0.07	0.96	535.30	1226.42	181.10	0.10	3.48	0.0000	0.17	0.000167
Reach-1	85803	100yr	184.19	33.10	182.66	184.36	1.80	1.80	18.37	600.03	181.10	0.10	3.09	0.0000	0.33	0.000691
Reach-1	85803	PF 3	182.98	14.20	182.04	183.06	1.31	1.31	10.83	10.36	181.10	0.10	1.88	0.0000	0.32	0.000739
Reach-1	85803	PF 4	183.57	23.70	182.37	183.71	1.63	1.63	14.51	57.83	181.10	0.10	2.47	0.0000	0.34	0.000777
Reach-1	86104	Max Observed	184.60	38.70		184.61	0.07	0.68	562.51	1273.59	181.10	30.00	3.50	0.0000	0.13	0.000122
Reach-1	86104	100yr	184.44	33.10		184.45	0.09	0.71	383.14	967.32	181.10	30.00	3.34	0.0000	0.14	0.000147
Reach-1	86104	PF 3	183.06	14.20		183.11	0.94	0.94	15.16	10.58	181.10	30.00	1.96	0.0000	0.25	0.000565
Reach-1	86104	PF 4	183.72	23.70		183.77	0.62	1.03	38.24	152.39	181.10	30.00	2.62	0.0000	0.24	0.000469
Reach-1	86400	Max Observed	184.61	38.70		184.62	0.06	0.61	659.86	1176.00	181.40	30.00	3.21	0.0100	0.12	0.000126
Reach-1	86400	100yr	184.45	33.10		184.46	0.07	0.73	466.84	1176.00	181.40	30.00	3.05	0.0100	0.15	0.000196
Reach-1	86400	PF 3	183.07	14.20		183.16	1.35	1.35	10.52	7.84	181.40	30.00	1.67	0.0100	0.37	0.001392
Reach-1	86400	PF 4	183.71	23.70	182.64	183.82	1.48	1.48	15.97	9.02	181.40	30.00	2.31	0.0100	0.36	0.001215
Reach-1	87700	Max Observed	184.63	38.70		184.64	0.08	0.81	503.84	1176.00	181.60	130.00	3.03	0.0015	0.16	0.000223
Reach-1	87700	100yr	184.47	33.10		184.50	0.10	0.92	333.76	978.17	181.60	130.00	2.87	0.0015	0.19	0.000315
Reach-1	87700	PF 3	183.25	14.20		183.34	1.33	1.33	10.71	8.20	181.60	130.00	1.65	0.0015	0.37	0.001357
Reach-1	87700	PF 4	183.88	23.70	182.83	183.98	0.69	1.41	34.27	139.42	181.60	130.00	2.28	0.0015	0.34	0.001059
Reach-1	89500	Max Observed	184.66	38.70	183.46	184.76	0.31	1.45	126.20	808.65	182.00	180.00	2.66	0.0022	0.32	0.000889
Reach-1	89500	100yr	184.52	33.10	183.33	184.63	0.96	1.47	34.52	545.99	182.00	180.00	2.52	0.0022	0.34	0.000999
Reach-1	89500	PF 3	183.49	14.20		183.57	1.23	1.23	11.52	9.41	182.00	180.00	1.49	0.0022	0.36	0.001215
Reach-1	89500	PF 4	184.07	23.70		184.17	1.37	1.37	17.32	10.72	182.00	180.00	2.07	0.0022	0.34	0.001065
Reach-1	94000	Max Observed	185.17	38.70	184.48	185.31	0.26	1.78	146.18	1037.77	182.70	450.00	2.47	0.0016	0.44	0.001657
Reach-1	94000	100yr	185.09	33.10	184.33	185.25	0.45	1.80	73.52	794.63	182.70	450.00	2.39	0.0016	0.45	0.001807
Reach-1	94000	PF 3	184.21	14.20	183.71	184.35	1.61	1.61	8.84	8.18	182.70	450.00	1.51	0.0016	0.49	0.002401
Reach-1	94000	PF 4	184.71	23.70	184.06	184.87	1.79	1.79	13.24	9.70	182.70	450.00	2.01	0.0016	0.49	0.002220

Pike Creek Existing Conditions HEC-RAS Summary Output

HEC-RAS Plan: PkCkExCond1 River: RIVER-1 Reach: Reach-1 Profile: 100-Year

Reach	River Sta	Profile	W.S. Elev	Q Total	Crit W.S.	E.G. Elev	Vel Total	Vel Chnl	Flow Area	Top Width	Min Ch El	Length Chnl	Max Chl Dpth	Invert Slope	Froude # Chl	E.G. Slope
			(m)	(m3/s)	(m)	(m)	(m/s)	(m/s)	(m2)	(m)	(m)	(m)	(m)			(m/m)
Reach-1	1	100-Year	178.70	56.63	176.51	178.73	0.55	0.91	102.98	66.36	174.65		4.05		0.15	0.000218
Reach-1	3	100-Year	179.20	56.63		179.26	1.10	1.10	51.45	18.29	176.24	1554.48	2.97	0.0010	0.21	0.000570
Reach-1	3.1	100-Year	179.21	56.63	177.38	179.27	1.10	1.10	51.61	18.29	176.24	15.24	2.97	0.0000	0.21	0.000564
Reach-1	3.15		Bridge													
Reach-1	3.2	100-Year	179.22	56.63	177.41	179.28	1.11	1.11	51.17	18.29	176.27	0.10	2.95	0.0000	0.21	0.000579
Reach-1	3.3	100-Year	179.22	56.63		179.29	1.12	1.12	50.77	18.29	176.30	15.24	2.93	0.0020	0.21	0.000593
Reach-1	4	100-Year	179.51	55.78		179.62	1.44	1.44	38.66	16.81	175.93	396.24	3.58	-0.0009	0.30	0.001085
Reach-1	4.1	100-Year	179.56	55.78	178.24	179.76	1.96	1.96	28.48	10.36	175.93	60.96	3.63	0.0000	0.38	0.002227
Reach-1	4.15		Bridge													
Reach-1	4.2	100-Year	179.61	55.78	178.25	179.80	1.93	1.93	28.95	10.36	175.93	0.10	3.68	0.0000	0.37	0.002126
Reach-1	4.3	100-Year	179.76	55.78		179.84	1.32	1.32	42.30	17.51	175.96	15.24	3.80	0.0020	0.27	0.000851
Reach-1	5	100-Year	180.60	55.78		180.72	1.48	1.48	37.66	15.14	176.81	899.16	3.79	0.0009	0.30	0.001081
Reach-1	5.1	100-Year	180.68	55.78	178.79	180.75	1.22	1.22	45.68	15.24	176.85	30.48	3.83	0.0010	0.23	0.000670
Reach-1	5.15		Bridge													
Reach-1	5.2	100-Year	180.68	55.78	178.79	180.76	1.22	1.22	45.79	15.24	176.85	0.10	3.84	0.0000	0.22	0.000665
Reach-1	5.3	100-Year	180.68	55.78		180.79	1.44	1.44	38.80	15.51	176.85	15.24	3.84	0.0000	0.29	0.001006
Reach-1	6	100-Year	181.72	55.78		181.80	1.11	1.27	50.18	66.75	178.06	1167.38	3.66	0.0010	0.26	0.000754
Reach-1	6.1	100-Year	181.77	55.78	179.49	181.83	1.08	1.08	51.69	27.57	178.00	30.48	3.77	-0.0020	0.19	0.000473
Reach-1	6.15		Bridge													
Reach-1	6.2	100-Year	181.77	55.78	179.48	181.83	1.08	1.08	51.77	27.92	178.00	0.10	3.77	0.0000	0.19	0.000471
Reach-1	6.3	100-Year	181.78	55.78		181.85	1.05	1.22	53.07	67.67	178.09	15.24	3.68	0.0060	0.24	0.000665
Reach-1	7	100-Year	181.97	55.78		182.06	1.21	1.36	46.10	62.74	177.91	256.03	4.05	-0.0007	0.28	0.000917
Reach-1	9	100-Year	182.58	55.78		182.65	0.90	1.20	62.13	128.75	179.07	752.86	3.51	0.0015	0.24	0.000669
Reach-1	9.1	100-Year	182.60	55.78	180.62	182.68	1.23	1.23	45.51	142.12	179.07	30.48	3.53	0.0000	0.22	0.000642
Reach-1	9.15		Bridge													
Reach-1	9.2	100-Year	182.60	55.78	180.62	182.68	1.22	1.22	45.59	147.11	179.07	0.10	3.53	0.0000	0.22	0.000639
Reach-1	11	100-Year	182.83	55.78		182.86	0.48	0.92	115.22	217.97	179.13	310.90	3.70	0.0002	0.19	0.000437
Reach-1	13	100-Year	183.50	55.78		183.61	1.45	1.47	38.52	40.39	179.89	1066.80	3.61	0.0007	0.31	0.001135

Kerr Drain Existing Conditions HEC-RAS Summary Output

HEC-RAS Plan: KerrDrExCond1   River: RIVER-1   Reach: Reach-1   Profile: 100yr

Reach	River Sta	Profile	W.S. Elev	Q Total	Crit W.S.	E.G. Elev	Vel Total	Vel Chnl	Flow Area	Top Width	Min Ch El	Length Chnl	Max Chl Dpth	Invert Slope	Froude # Chl	E.G. Slope
			(m)	(m3/s)	(m)	(m)	(m/s)	(m/s)	(m2)	(m)	(m)	(m)	(m)			(m/m)
Reach-1	1	100yr	178.40	17.84	177.54	178.51	0.87	1.82	20.52	78.45	175.87		2.53		0.36	0.002254
Reach-1	2	100yr	179.17	17.84		179.23	0.85	1.47	20.88	34.95	177.39	316.99	1.77	0.0048	0.35	0.002150
Reach-1	3	100yr	180.10	17.84	178.96	180.13	0.40	1.02	44.30	246.92	177.67	609.60	2.43	0.0005	0.21	0.001066
Reach-1	3.1	100yr	180.06	17.84	178.96	180.23	1.81	1.81	9.84	197.66	177.67	15.24	2.39	0.0000	0.38	0.003442
Reach-1	3.15		Bridge													
Reach-1	3.2	100yr	180.23	17.84	178.96	180.37	1.69	1.69	10.56	419.30	177.67	0.10	2.56	0.0000	0.34	0.002725
Reach-1	3.3	100yr	180.42	17.84		180.42	0.11	0.31	164.69	511.85	177.70	15.24	2.72	0.0020	0.06	0.000086
Reach-1	4	100yr	180.84	17.84	180.84	181.27	2.92	2.92	6.12	7.09	179.59	505.97	1.25	0.0037	1.00	0.015922
Reach-1	4.1	100yr	181.20	17.84	180.70	181.48	2.36	2.36	7.57	4.57	179.47	15.24	1.73	-0.0080	0.58	0.007913
Reach-1	4.15		Bridge													
Reach-1	4.2	100yr	181.30	17.84	180.70	181.55	2.21	2.21	8.06	4.57	179.47	0.10	1.84	0.0000	0.53	0.006670
Reach-1	4.3	100yr	181.43	17.84		181.66	2.10	2.10	8.50	4.57	179.50	15.24	1.93	0.0020	0.49	0.005761

Puce River Existing Conditions HEC-RAS Summary Output

HEC-RAS Plan: PuceExCond1 River: RIVER-1 Reach: Reach-1 Profile: 100yr

Reach	River Sta	Profile	W.S. Elev	Q Total	Crit W.S.	E.G. Elev	Vel Total	Vel Chnl	Flow Area	Top Width	Min Ch El	Length Chnl	Max Chl Dpth	Invert Slope	Froude # Chl	E.G. Slope
			(m)	(m3/s)	(m)	(m)	(m/s)	(m/s)	(m2)	(m)	(m)	(m)	(m)			(m/m)
Reach-1	9	100yr	177.24	80.99	175.77	177.29	0.61	1.10	132.12	197.05	174.25		2.99		0.22	0.000530
Reach-1	10	100yr	177.36	80.99		177.38	0.42	0.80	194.03	246.81	174.56	213.36	2.80	0.0015	0.16	0.000285
Reach-1	11	100yr	177.44	80.99		177.47	0.57	0.93	141.80	164.52	174.62	243.84	2.82	0.0002	0.19	0.000426
Reach-1	11.1	100yr	177.42	80.99	175.91	177.51	1.29	1.29	62.64	162.39	174.62	15.24	2.80	0.0000	0.26	0.000825
Reach-1	11.15		Bridge													
Reach-1	11.2	100yr	177.42	80.99	175.98	177.52	1.40	1.40	57.89	220.09	174.62	0.10	2.80	0.0000	0.28	0.001295
Reach-1	12	100yr	177.52	80.99		177.55	0.52	0.90	155.50	174.58	174.62	15.24	2.90	0.0000	0.18	0.000376
Reach-1	13	100yr	178.10	81.84		178.24	1.57	1.70	52.02	45.94	174.89	1005.84	3.21	0.0003	0.33	0.001270
Reach-1	14	100yr	178.73	82.12		178.84	1.51	1.51	54.52	15.84	175.14	548.64	3.59	0.0005	0.26	0.000923
Reach-1	14.1	100yr	178.74	82.12	176.68	178.86	1.50	1.50	54.83	26.91	175.14	15.24	3.60	0.0000	0.26	0.000909
Reach-1	14.15		Bridge													
Reach-1	14.2	100yr	178.76	82.12	176.71	178.87	1.51	1.51	54.50	15.84	175.17	0.10	3.59	0.0000	0.26	0.000924
Reach-1	14.3	100yr	178.77	82.12		178.89	1.51	1.51	54.24	15.84	175.20	15.24	3.57	0.0020	0.26	0.000937
Reach-1	14.4	100yr	178.81	77.87		178.92	1.41	1.42	55.06	29.89	175.20	30.48	3.61	0.0000	0.24	0.000809
Reach-1	15	100yr	179.83	77.87		180.01	1.28	2.02	60.62	120.22	176.85	853.44	2.98	0.0019	0.41	0.002104
Reach-1	15.1	100yr	179.93	77.87		180.08	1.12	1.86	69.79	135.03	176.88	30.48	3.05	0.0010	0.38	0.001738
Reach-1	16	100yr	180.75	73.62		180.78	0.66	1.02	110.74	106.19	177.76	853.44	2.99	0.0010	0.20	0.000439
Reach-1	16.1	100yr	181.09	70.79		181.19	1.01	1.54	69.93	111.59	178.16	548.64	2.93	0.0007	0.33	0.001212
Reach-1	16.2	100yr	181.54	70.79		181.67	1.24	1.67	57.28	79.17	178.37	365.76	3.17	0.0006	0.35	0.001362
Reach-1	17	100yr	182.02	67.96		182.08	0.68	1.23	99.44	151.39	178.61	396.24	3.41	0.0006	0.26	0.000720
Reach-1	17.1	100yr	182.34	67.96		182.41	0.77	1.34	88.19	157.81	179.04	411.48	3.30	0.0010	0.28	0.000840
Reach-1	17.2	100yr	182.78	63.71		182.81	0.53	1.04	121.29	219.73	179.56	609.60	3.22	0.0009	0.22	0.000507
Reach-1	18	100yr	183.03	60.88		183.05	0.35	0.86	172.01	409.89	180.08	548.64	2.95	0.0009	0.18	0.000371

8th Concession Drain Existing Conditions HEC-RAS Summary Output

HEC-RAS Plan: ExCond River: RIVER-1 Reach: Reach-1 Profile: 100-Year

Reach	River Sta	Profile	W.S. Elev	Q Total	Crit W.S.	E.G. Elev	Vel Total	Vel Chnl	Flow Area	Top Width	Min Ch El	Length Chnl	Max Chl Dpth	Invert Slope	Froude # Chl	E.G. Slope
			(m)	(m3/s)	(m)	(m)	(m/s)	(m/s)	(m2)	(m)	(m)	(m)	(m)			(m/m)
Reach-1	1	100-Year	176.88	31.15	174.96	176.90	0.54	0.61	57.53	74.05	173.43		3.45		0.13	0.000202
Reach-1	2	100-Year	176.95	31.15		177.07	1.55	1.55	20.14	15.42	174.53	259.08	2.42	0.0042	0.38	0.001931
Reach-1	2.1	100-Year	176.90	31.15	176.12	177.22	2.51	2.51	12.41	5.49	174.53	15.24	2.37	0.0000	0.53	0.006312
Reach-1	2.15		Bridge													
Reach-1	2.2	100-Year	177.35	31.15	176.12	177.57	2.09	2.09	14.91	57.00	174.53	0.10	2.82	0.0000	0.40	0.003462
Reach-1	2.3	100-Year	177.61	31.15		177.65	0.58	0.88	53.57	73.78	174.56	15.24	3.05	0.0020	0.19	0.000408
Reach-1	3	100-Year	177.95	31.15		178.03	1.11	1.20	28.02	31.32	175.08	609.60	2.88	0.0009	0.27	0.000935
Reach-1	3.1	100-Year	177.90	31.15	176.74	178.13	2.15	2.15	14.49	23.62	175.11	15.24	2.79	0.0020	0.42	0.004036
Reach-1	3.15		Bridge													
Reach-1	3.2	100-Year	177.94	31.15	176.74	178.17	2.11	2.11	14.75	26.91	175.11	0.10	2.84	0.0000	0.41	0.003832
Reach-1	3.3	100-Year	178.19	31.15		178.24	0.84	1.03	36.97	57.26	175.11	15.24	3.09	0.0000	0.23	0.000620
Reach-1	4	100-Year	179.45	31.15		179.62	1.84	1.84	16.96	11.11	177.15	1115.57	2.30	0.0018	0.47	0.003047
Reach-1	4.1	100-Year	179.49	31.15		179.67	1.86	1.86	16.73	7.32	177.15	15.24	2.34	0.0000	0.39	0.002912
Reach-1	4.2	100-Year	179.54	31.15	178.43	179.71	1.82	1.82	17.12	7.32	177.15	15.24	2.39	0.0000	0.38	0.002730
Reach-1	4.25		Bridge													
Reach-1	4.3	100-Year	179.87	31.15	178.46	180.00	1.61	1.61	19.30	145.57	177.18	0.10	2.69	0.0000	0.32	0.001896
Reach-1	4.4	100-Year	180.00	31.15	178.49	180.05	0.57	1.16	54.54	184.08	177.21	15.24	2.79	0.0020	0.22	0.000945

APPENDIX C

Upper Little River Proposed SWM Characteristics Table
(Provided by Stantec)

Upper Little River
Proposed SWM Characteristics

Catchment Number	Area	Imperviousness	Outlet Channel Invert	Permanent Pool Elevation	Water Quality Volume Required	Permanent Pool Required	Extended Detention Volume Required	Active Volume Required
	(ha)	(%)	(m)	(m)	(m^3/ha)	(m^3)	(m^3)	(m^3)
2020	66.13	67%	186.40	186.90	136	5,687	2,381	40588
2030	117.58	49%	184.80	185.30	114	7,388	3,998	52069
2035	81.42	63%	185.40	185.90	130	6,595	2,931	46716
2045	63.81	43%	183.20	183.70	113	3,499	1,914	25818
2050	97.34	47%	184.40	184.90	120	5,824	2,920	41513
2055	65.11	50%	182.20	182.70	115	4,134	2,214	30108
2060	112.73	57%	183.40	183.90	121	8,267	4,058	58001
2065	116.33	55%	185.72	186.22	123	8,240	3,955	57820
2070	175.27	62%	185.72	186.22	123	13,876	6,660	95860
2075	117.69	59%	187.00	187.50	123	8,827	4,237	61781
2080	71.20	52%	187.00	187.50	123	4,747	2,278	34240
2085	100.90	65%	187.25	187.75	123	8,408	4,036	58956
2087	129.60	65%	187.25	187.75	123	10,800	5,184	75100
2090	66.37	31%	180.92	182.42	128	2,622	1,195	19896
2095	106.74	47%	182.40	182.90	140	6,404	2,562	45430
2100	58.37	56%	180.92	181.92	120	4,203	2,101	30568
2105	60.91	50%	181.90	182.40	110	3,837	2,193	28102
2110	49.11	52%	180.06	181.56	110	3,266	1,866	24244
2115	114.29	37%	180.06	181.56	119	5,410	2,743	38716
2125	93.38	55%	179.10	180.60	110	6,537	3,735	46322
2130	89.80	80%	181.64	182.14	143	9,279	3,592	64836
2133	93.08	65%	181.64	182.14	123	7,757	3,723	54558
2135	22.21	50%	178.67	180.17	110	1,399	800	11645
2140	82.09	28%	178.70	179.70	110	2,873	1,642	21594
2145	104.35	55%	179.56	180.06	110	7,305	4,174	51505
2155	75.47	50%	178.68	180.18	110	4,755	2,717	34294
2165	172.92	55%	179.70	180.20	110	12,104	6,917	83905
2175	45.65	66%	179.30	179.80	124	3,835	1,826	28084
2185	69.84	55%	178.00	179.50	110	4,912	2,794	35357
2190	81.91	55%	179.75	180.25	110	5,745	3,276	40976
2200	784.25	56%	178.95	179.45	111	55,682	31,370	378052
2210	58.24	63%	179.40	179.90	121	4,698	2,330	33912
2215	106.67	56%	180.00	180.50	112	7,659	4,267	53898

Note: This was provided to MRC by Stantec in April 2013.

APPENDIX D

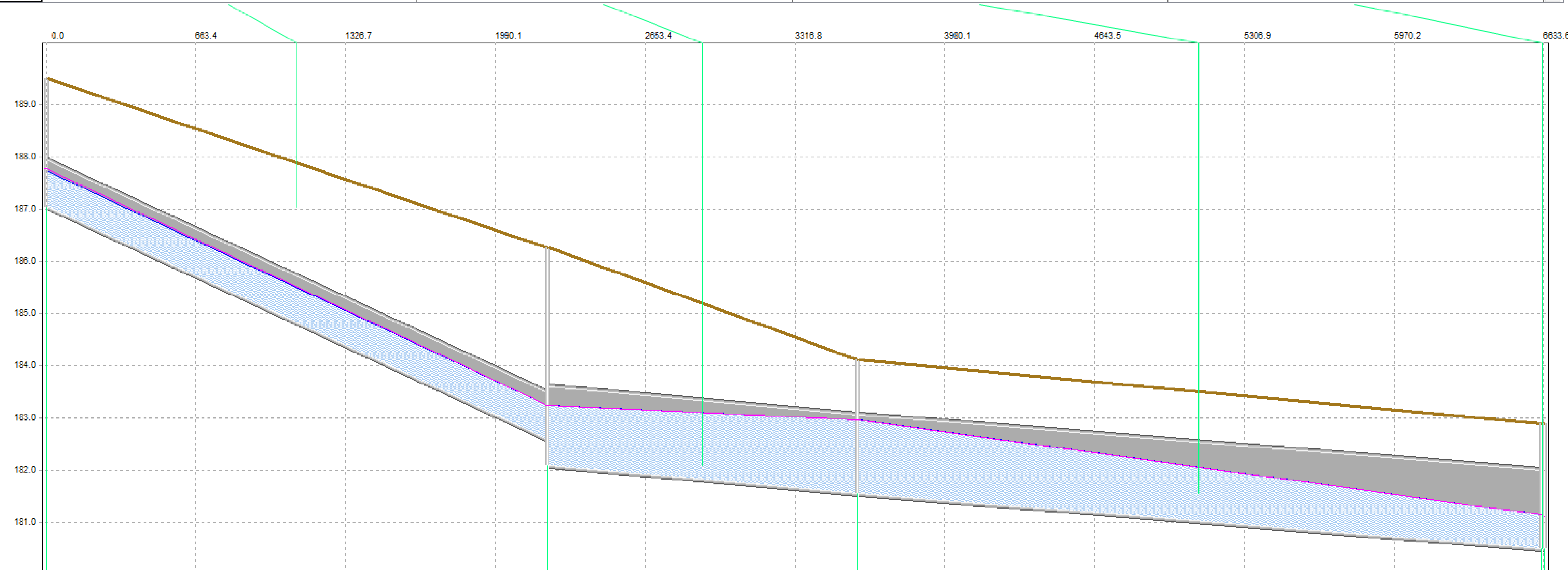
Preliminary Storm Sewer Calculations – XP-SWMM Model Output

Modeling Notes:

1. The profiles shown in the following exhibits display the peak hydraulic grade line elevation in the sewers. The blue line indicates the maximum water level in the pipe under stable conditions. Due to the nature of the model setup, there are some cases in which the pink line (which typically indicates the maximum HGL) is higher than the blue line. This is the result of model startup instability and should not be considered an accurate representation of the hydraulic grade line elevation. In these cases, the pink line should be ignored.
2. All outlets on the Lauzon Parkway extension and County Road 42 were modeled as 1000 mm diameter outlets with 0.0% slope. The outlets on the E-W arterial were modeled as 600 mm diameter outlets with 0.0% slope. The 5-year design flow from the City of Windsor rain gauge was used to generate the peak flow to each node in the model based on contributing road area and was input as a constant inflow to each node. Two scenarios were modeled to represent the outlet conditions:
    i. The backwater condition of the outlets was set at the permanent pool elevation extracted from Stantec's ULR Report. These results are depicted in Figures 1 through 22.
    ii. A conservative estimate of the permanent pool elevation plus 1.0 m was used as the backwater condition for the outlets. These results are depicted in Figures 23 through 44.

Link

	Link1	Link2	Link3	Link4
Shape	Circular	Circular	Circular	Circular
Length	2220.000	1375.000	3028.571	10.000
Conduit Slop	0.200	0.040	0.035	0.000
Diameter (He	0.900	1.500	1.500	1.500
Downstream	182.610	181.560	180.500	180.500
Upstream Inv	187.050	182.110	181.560	180.500



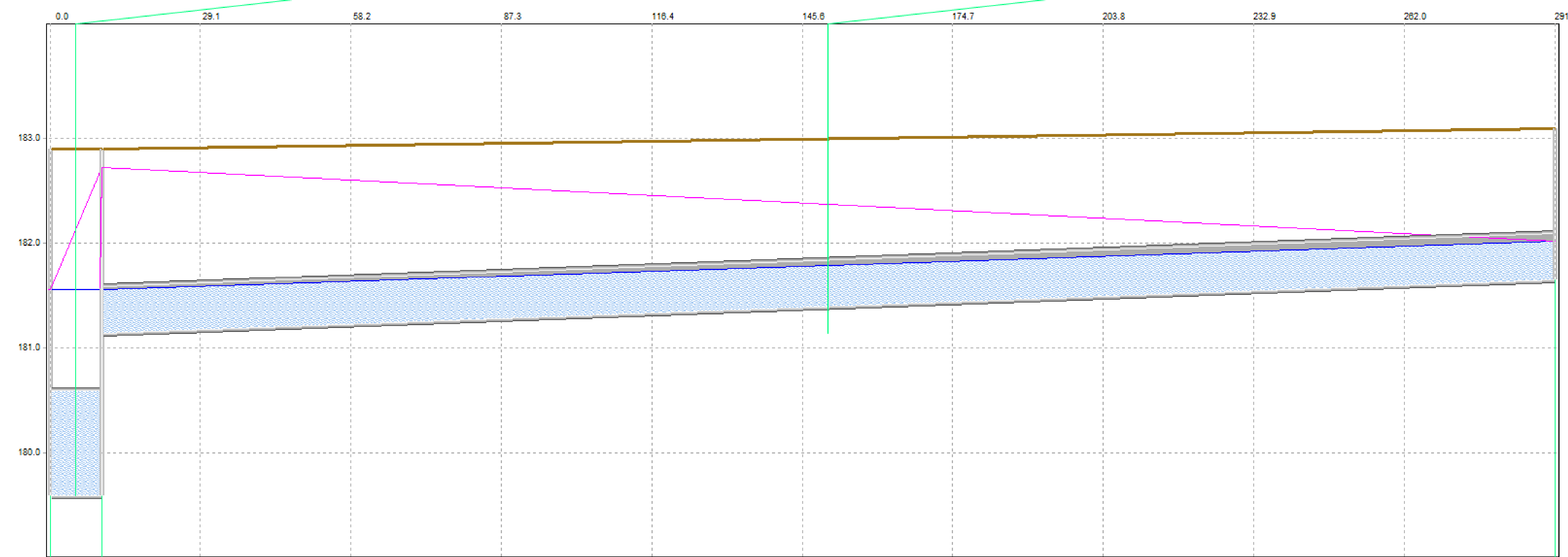
	Node1	Node2	Node3	Node4	Node32
Ground Eleva	189.500	186.268	184.119	182.900	182.900
Invert Elevati	187.050	182.110	181.560	180.500	180.500
Storage Nod	☐	☐	☐	☐	☐
Outfall Flag	☐	☐	☐	☐	☑
Outlet Contro	0.000	0.000	0.000	0.000	179.450

Node

Figure 1: County Road 42 (Sta. 10+000 - 14+520) - Permanent Pool Elevation Backwater Condition

Link

	Link41	Link40
Shape	Circular	Circular
Length	10.000	281.111
Conduit Slop	0.000	0.180
Diameter (He	1.000	0.450
Downstream	179.600	181.144
Upstream Inv	179.600	181.650



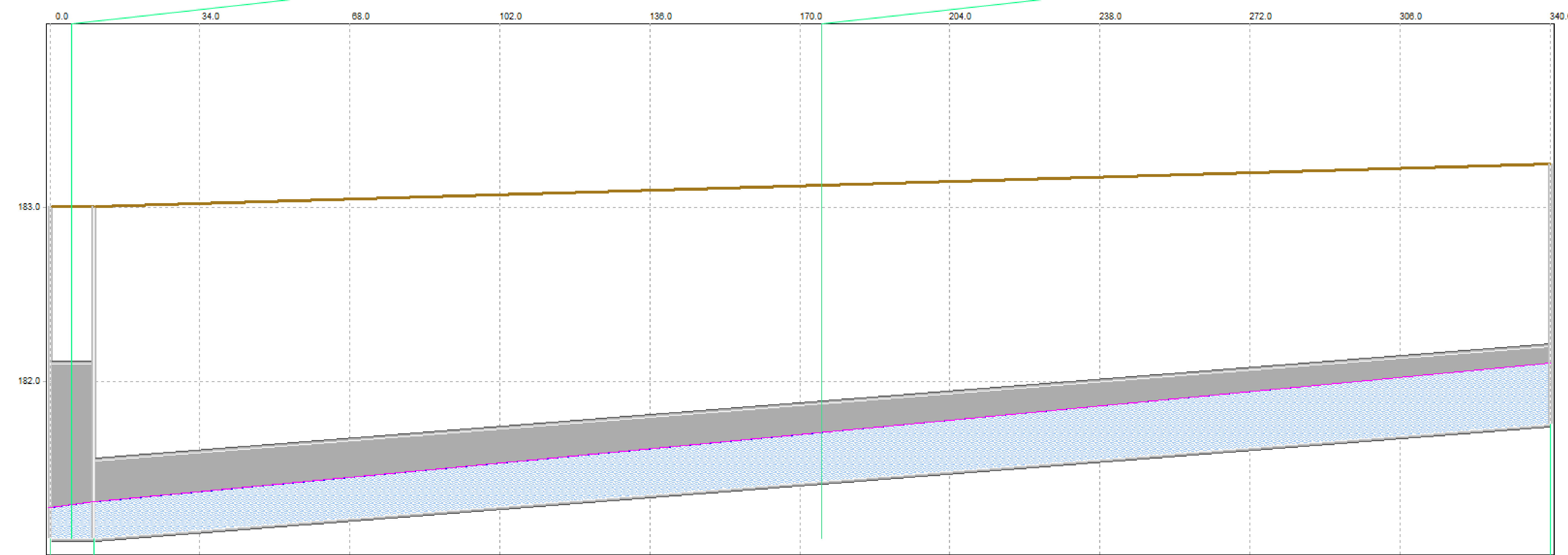
	Node49	Node13	Node33
Ground Eleva	182.900	182.900	183.100
Invert Elevati	179.600	179.600	181.650
Storage Nod	☐	☐	☐
Outfall Flag	☑	☐	☐
Outlet Contro	181.560	0.000	0.000

Node

Figure 2: County Road 42 (Sta. 14+680 - 14+880) - Permanent Pool Elevation Backwater Condition

Link

	Link7	Link6
Shape	Circular	Circular
Length	10.000	330.000
Conduit Slop	0.000	0.200
Diameter (He	1.000	0.450
Downstream	181.100	181.100
Upstream Inv	181.100	181.760



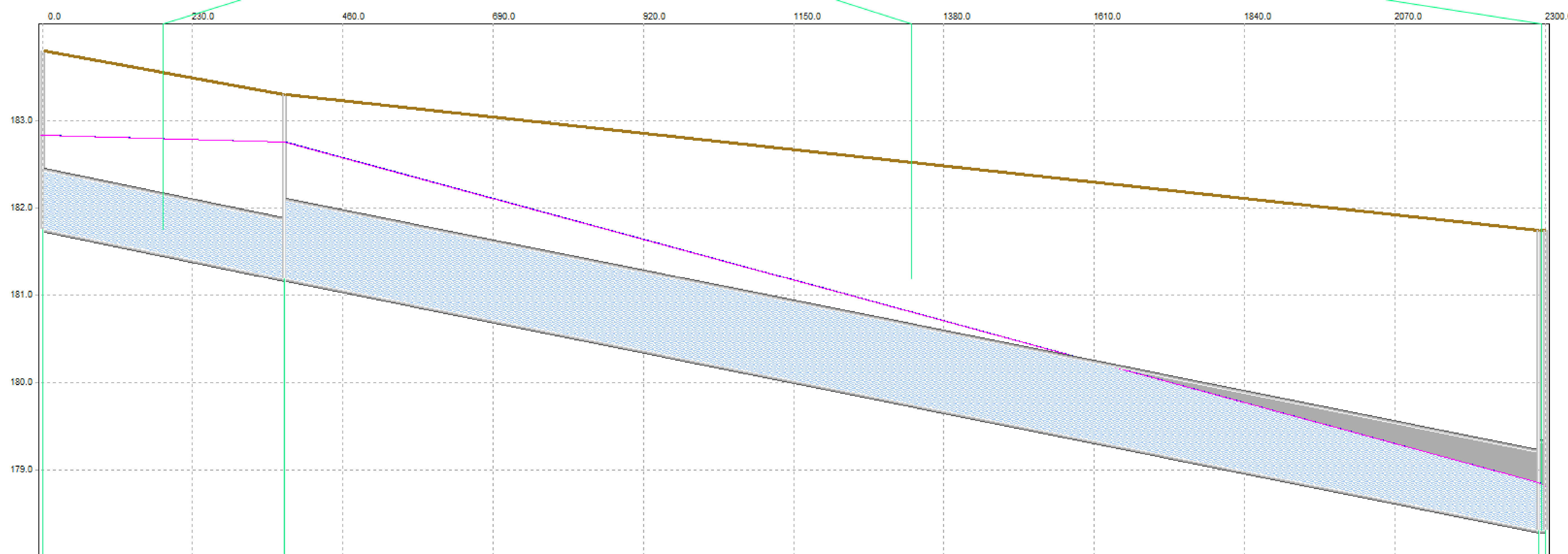
	Node34	Node5	Node6
Ground Eleva	183.010	183.010	183.250
Invert Elevati	181.100	181.100	181.760
Storage Nod	☐	☐	☐
Outfall Flag	☑	☐	☐
Outlet Contro	180.600	0.000	0.000

Node

Figure 3: County Road 42 (Sta. 15+000 - 15+320) - Permanent Pool Elevation Backwater Condition

Link

	Link8	Link11	Link12
Shape	Circular	Circular	Circular
Length	370.000	1920.000	10.000
Conduit Slop	0.151	0.150	0.000
Diameter (He	0.675	0.900	1.000
Downstream	181.200	178.320	178.320
Upstream Inv	181.760	181.200	178.320



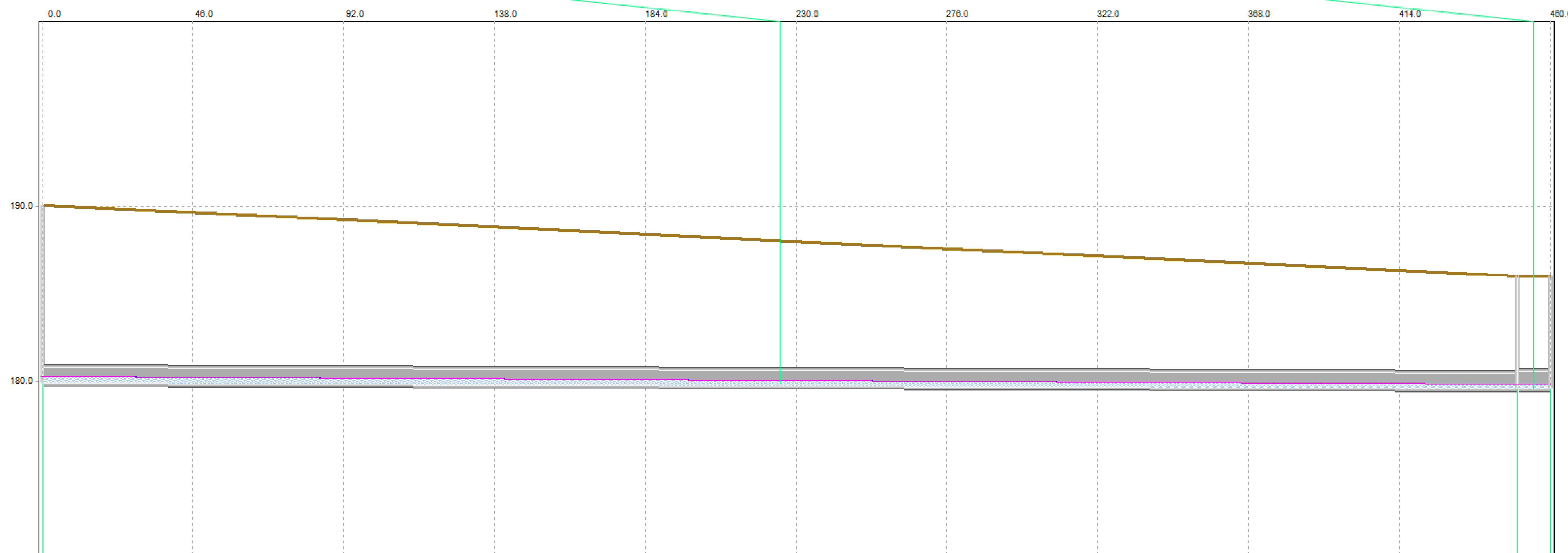
	Node7	Node8	Node9	Node37
Ground Eleva	183.800	183.300	181.750	181.750
Invert Elevati	181.760	181.200	178.320	178.320
Storage Nod	☐	☐	☐	☐
Outfall Flag	☐	☐	☐	☑
Outlet Contro	0.000	0.000	0.000	178.320

Node

Figure 4: County Road 42 (Sta. 16+240 - 18+540) - Permanent Pool Elevation Backwater Condition

Link

	Link13	Link42
Shape	Circular	Circular
Length	450.000	10.000
Conduit Slop	0.070	0.000
Diameter (He	0.900	1.000
Downstream	179.600	179.600
Upstream Inv	179.915	179.600



	Node10	Node51	Node50
Ground Eleva	190.060	186.000	186.000
Invert Elevati	179.915	179.600	179.600
Storage Nod	☐	☐	☐
Outfall Flag	☐	☐	☑
Outlet Contro	0.000	0.000	179.450

Node

Figure 5: Lauzon Parkway Extension (Sta. 10+900 - 11+350) - Permanent Pool Elevation Backwater Condition

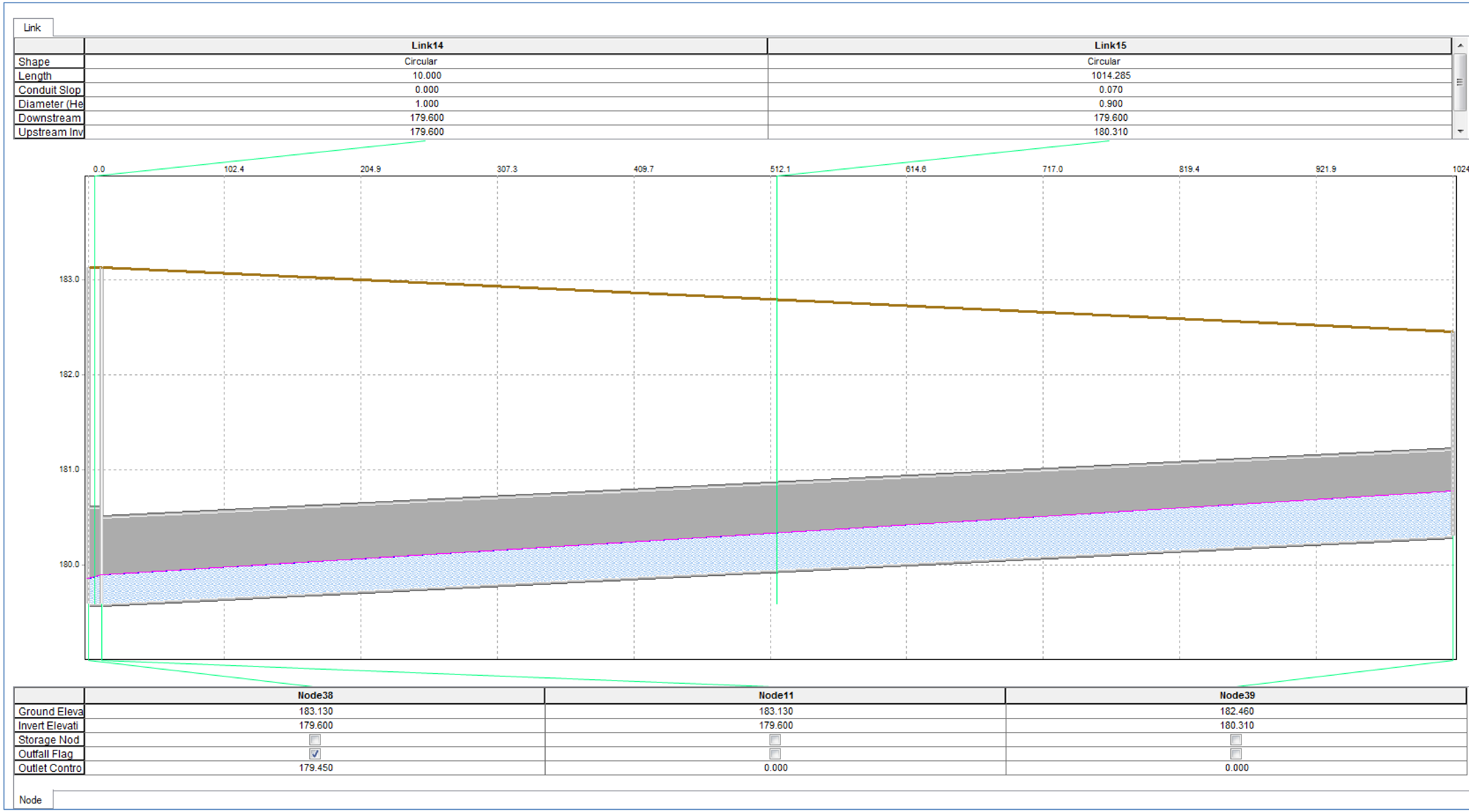
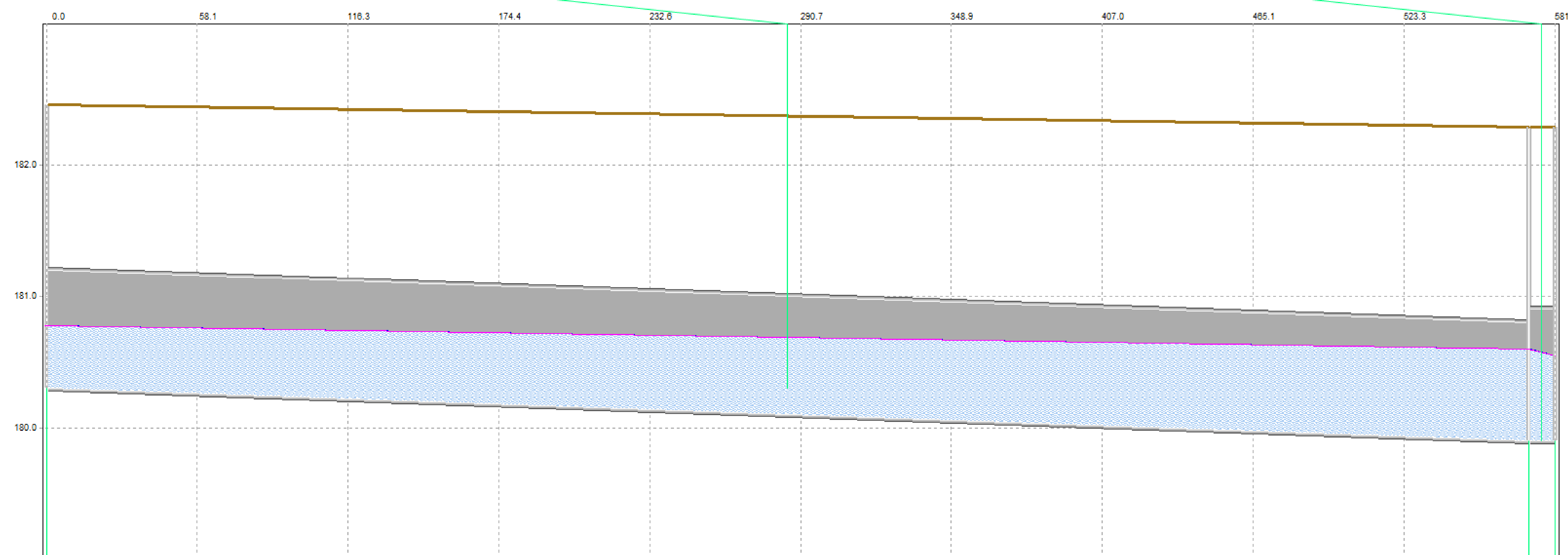


Figure 6: Lauzon Parkway Extension (Sta. 11+350 - 12+370) - Permanent Pool Elevation Backwater Condition

Link

	Link16	Link17
Shape	Circular	Circular
Length	571.428	10.000
Conduit Slop	0.070	0.000
Diameter (He	0.900	1.000
Downstream	179.910	179.910
Upstream Inv	180.310	179.910



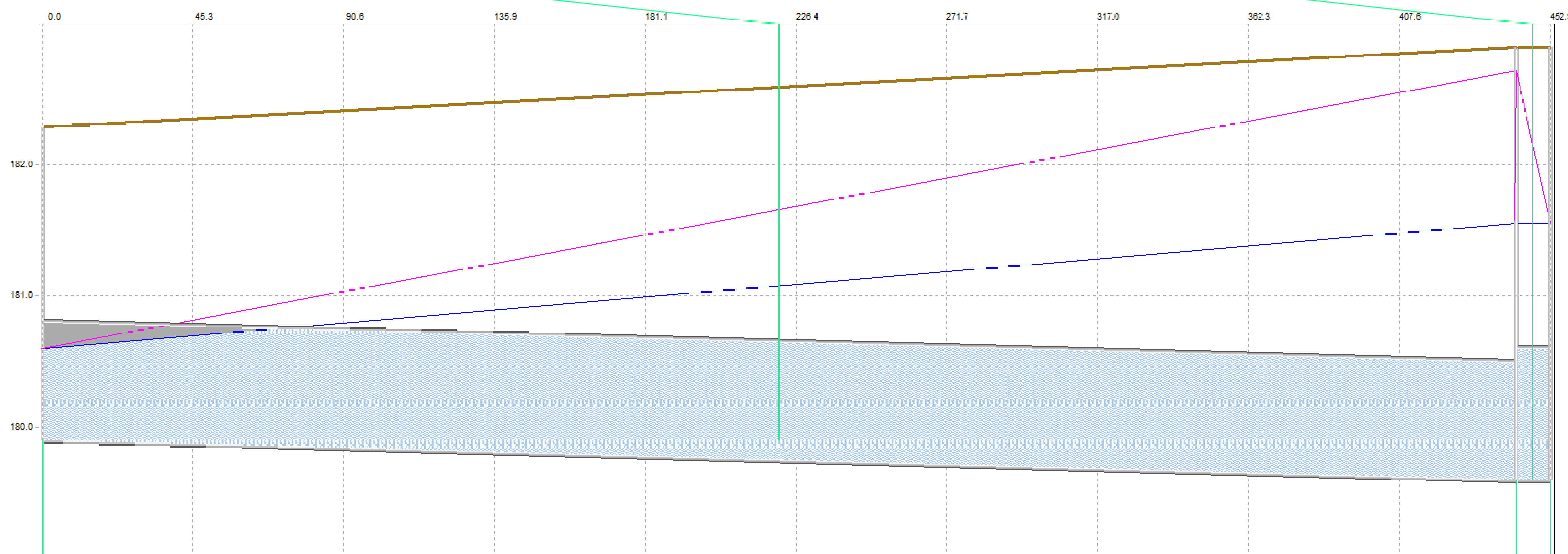
	Node39	Node12	Node40
Ground Eleva	182.460	182.290	182.290
Invert Elevati	180.310	179.910	179.910
Storage Nod	☐	☐	☐
Outfall Flag	☐	☐	☑
Outlet Contro	0.000	0.000	179.450

Node

Figure 7: Lauzon Parkway Extension (Sta. 12+370 - 12+670) - Permanent Pool Elevation Backwater Condition

Link

	Link18	Link41
Shape	Circular	Circular
Length	442.857	10.000
Conduit Slop	0.070	0.000
Diameter (He	0.900	1.000
Downstream	179.600	179.600
Upstream Inv	179.910	179.600



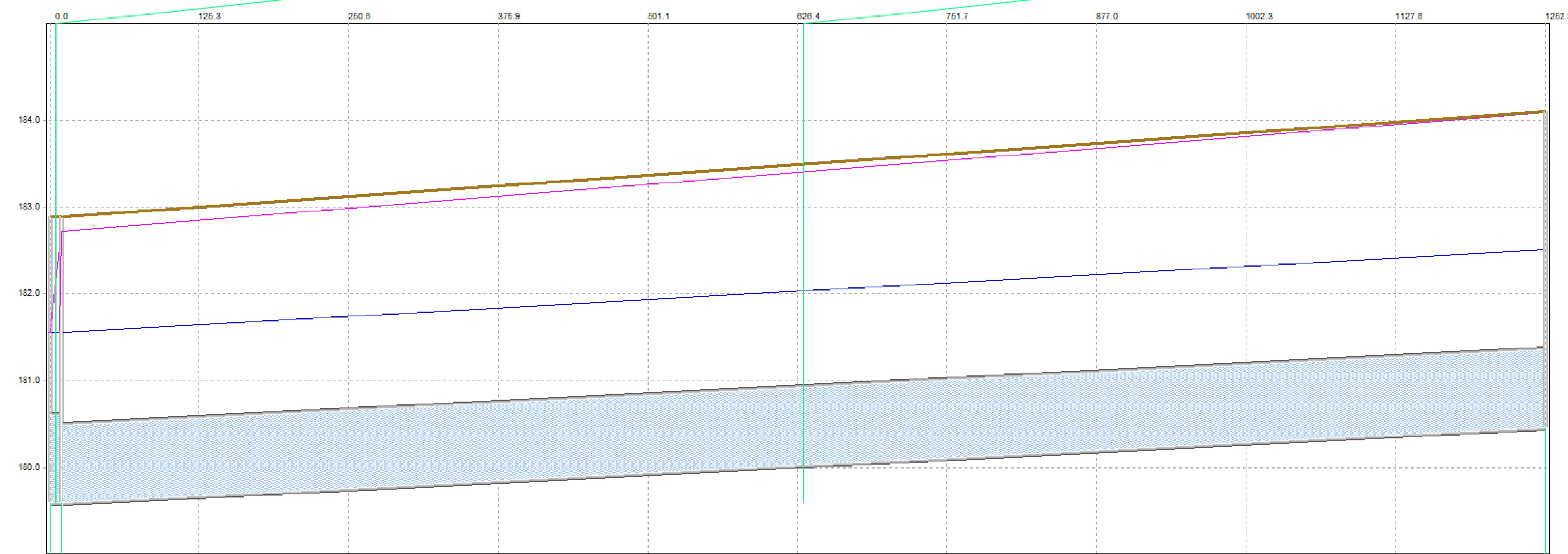
	Node12	Node13	Node49
Ground Eleva	182.290	182.900	182.900
Invert Elevati	179.910	179.600	179.600
Storage Nod	☐	☐	☐
Outfall Flag	☐	☐	☑
Outlet Contro	0.000	0.000	181.560

Node

Figure 8: Lauzon Parkway Extension (Sta. 12+670 - 12+935) - Permanent Pool Elevation Backwater Condition

Link

	Link41	Link19
Shape	Circular	Circular
Length	10.000	1242.857
Conduit Slop	0.000	0.070
Diameter (He	1.000	0.900
Downstream	179.600	179.600
Upstream Inv	179.600	180.470



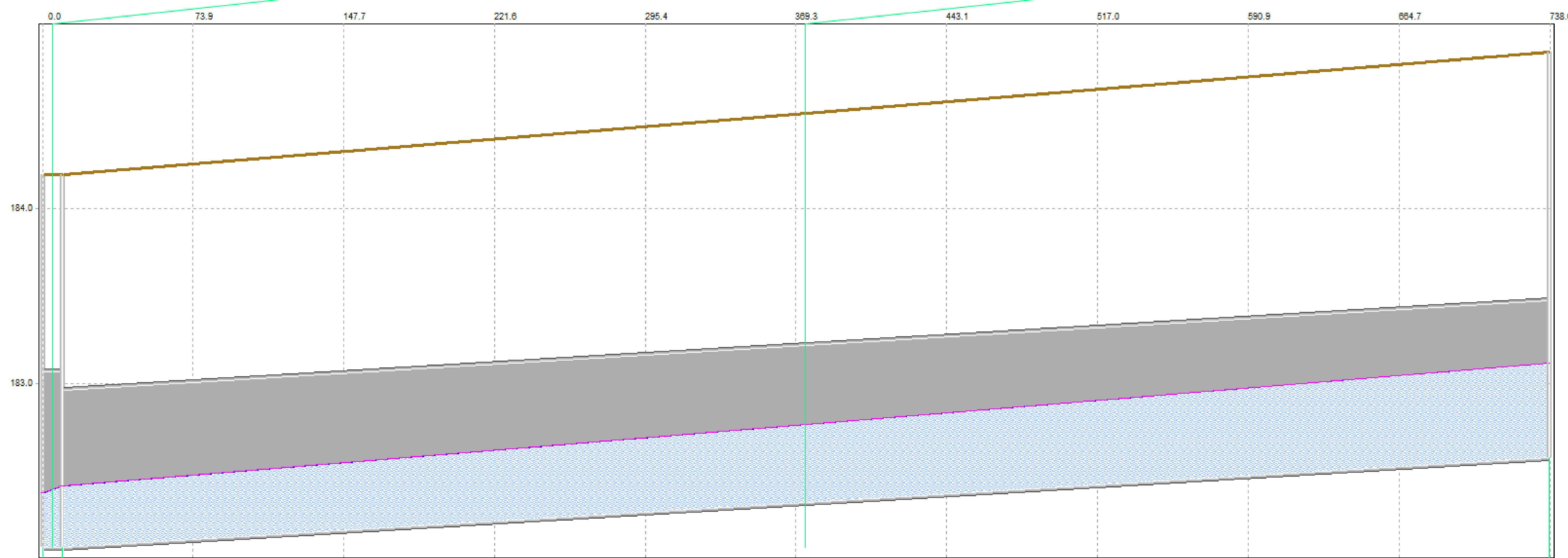
	Node49	Node13	Node14
Ground Eleva	182.900	182.900	184.100
Invert Elevati	179.600	179.600	180.470
Storage Nod	☐	☐	☐
Outfall Flag	☑	☐	☐
Outlet Contro	181.560	0.000	0.000

Node

Figure 9: Lauzon Parkway Extension (Sta. 12+935 - 14+180) - Permanent Pool Elevation Backwater Condition

Link

	Link23	Link20
Shape	Circular	Circular
Length	10.000	728.571
Conduit Slop	0.000	0.070
Diameter (He	1.000	0.900
Downstream	182.070	182.070
Upstream Inv	182.070	182.580



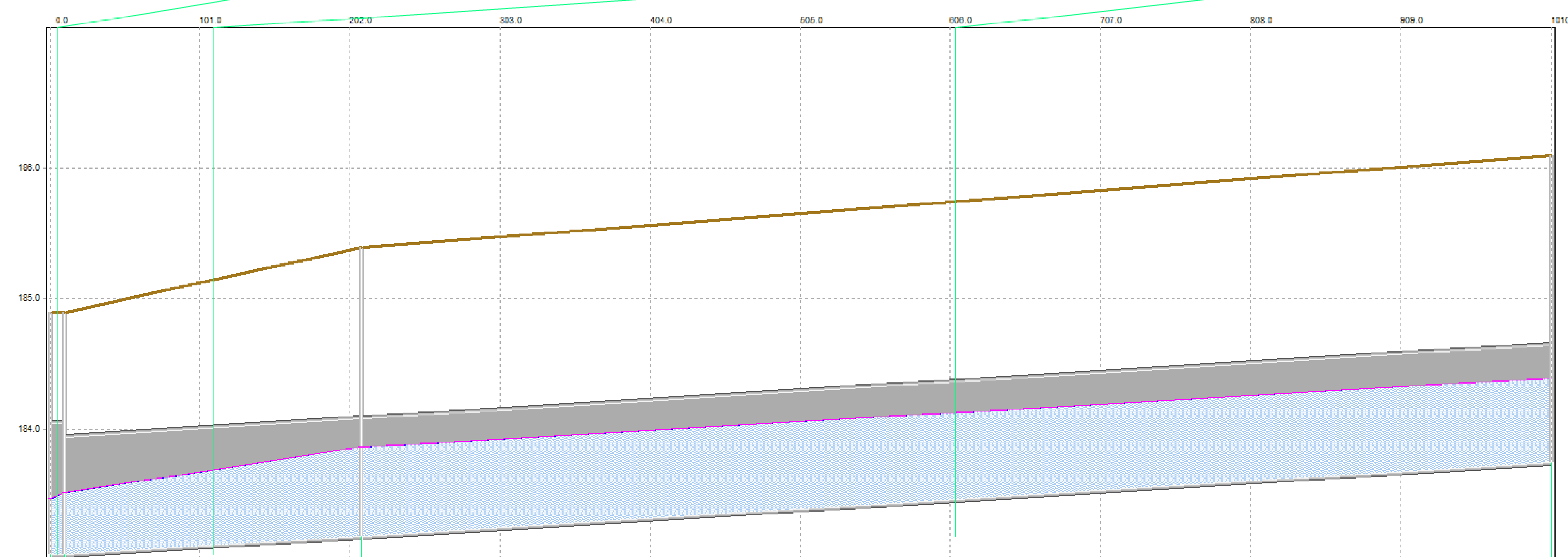
	Node42	Node15	Node16
Ground Eleva	184.200	184.200	184.900
Invert Elevati	182.070	182.070	182.580
Storage Nod	☐	☐	☐
Outfall Flag	☑	☐	☐
Outlet Contro	181.920	0.000	0.000

Node

Figure 10: Lauzon Parkway Extension (Sta. 14+250 - 14+980) - Permanent Pool Elevation Backwater Condition

Link

	Link22	Link44	Link21
Shape	Circular	Circular	Circular
Length	10.000	200.000	800.000
Conduit Slop	0.000	0.000	0.070
Diameter (He	1.000	0.900	0.900
Downstream	183.050	183.050	183.190
Upstream Inv	183.050	183.190	183.750



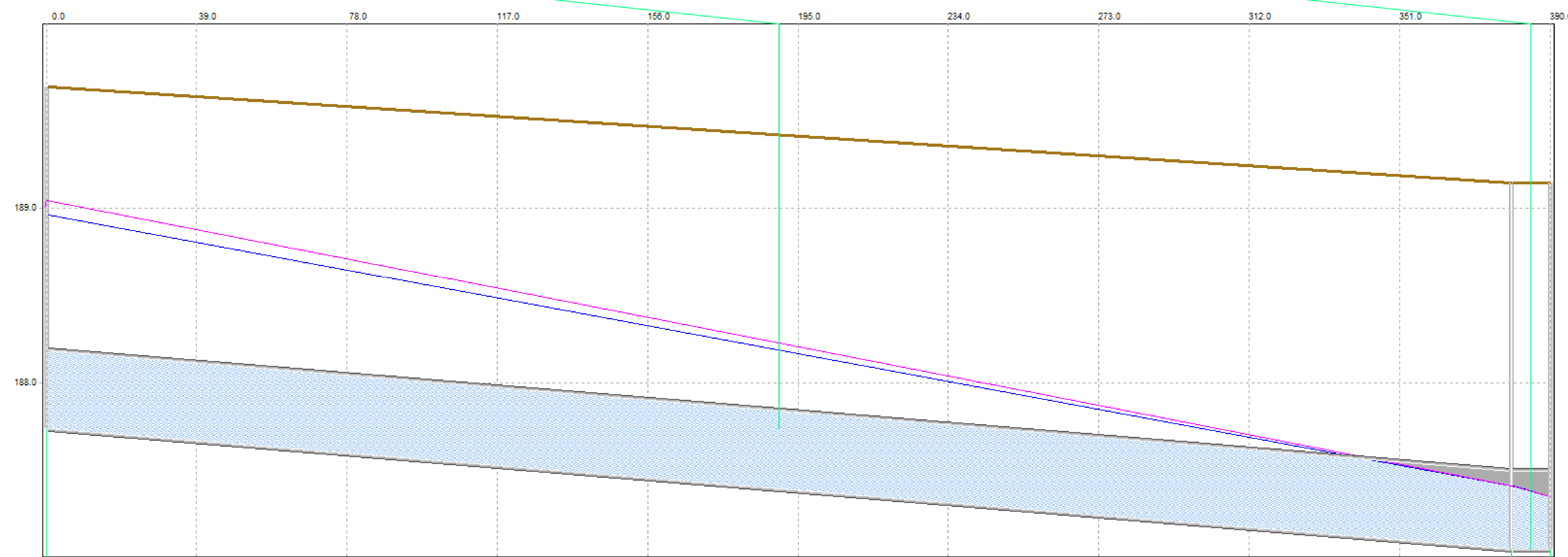
	Node41	Node17	Node52	Node18
Ground Eleva	184.900	184.900	185.400	186.100
Invert Elevati	183.050	183.050	183.190	183.750
Storage Nod	☐	☐	☐	☐
Outfall Flag	☑	☐	☐	☐
Outlet Contro	182.900	0.000	0.000	0.000

Node

Figure 11: Lauzon Parkway Extension (Sta. 15+000 - 16+000) - Permanent Pool Elevation Backwater Condition

Link

	Link24	Link25
Shape	Circular	Circular
Length	380.000	10.000
Conduit Slop	0.182	0.000
Diameter (He	0.450	0.450
Downstream	187.050	187.050
Upstream Inv	187.740	187.050



	Node19	Node20	Node43
Ground Eleva	189.700	189.150	189.150
Invert Elevati	187.740	187.050	187.050
Storage Nod	☐	☐	☐
Outfall Flag	☐	☐	☑
Outlet Contro	0.000	0.000	186.900

Node

Figure 12: E-W Arterial (Sta. 10+360 - 10+740) - Permanent Pool Elevation Backwater Condition

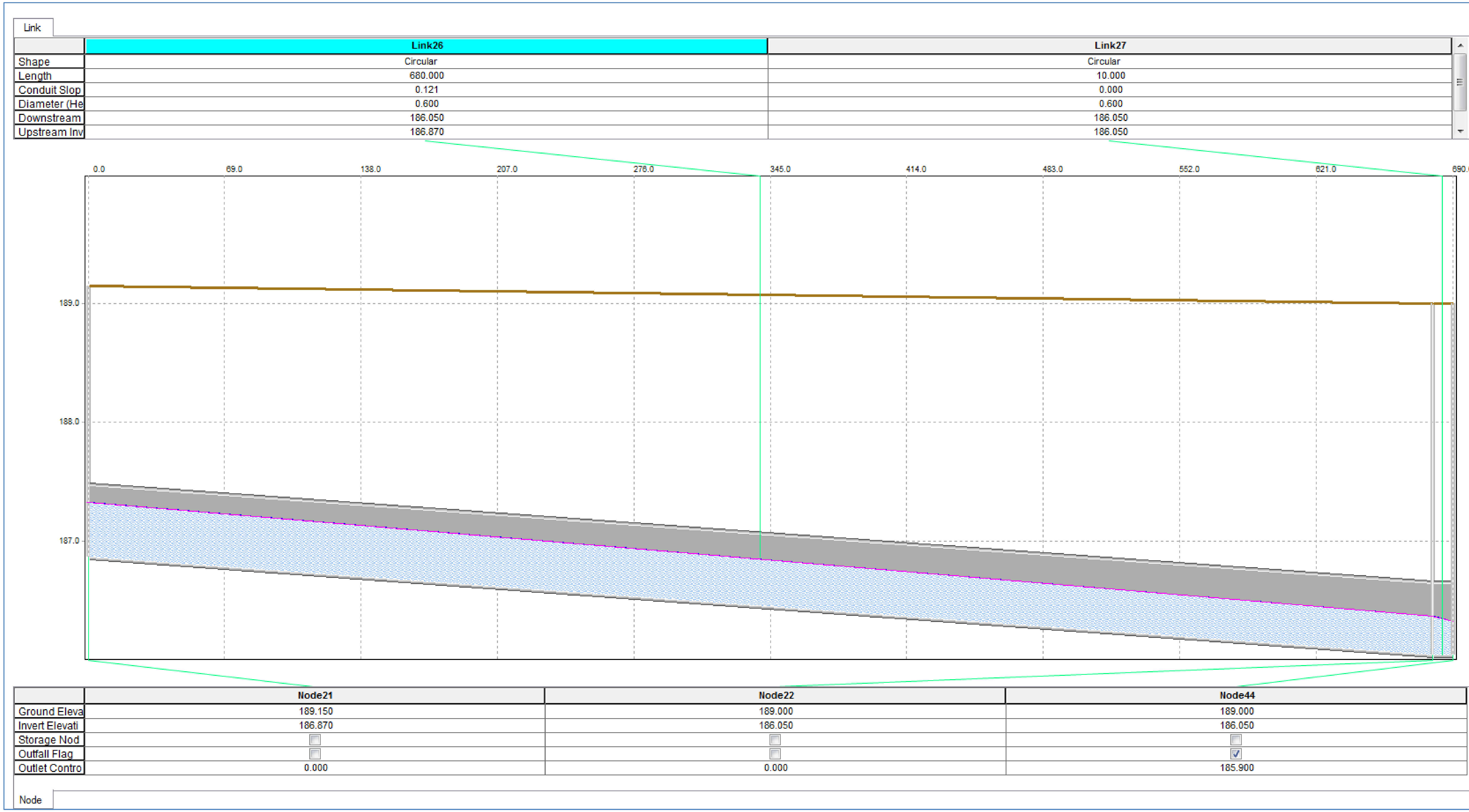
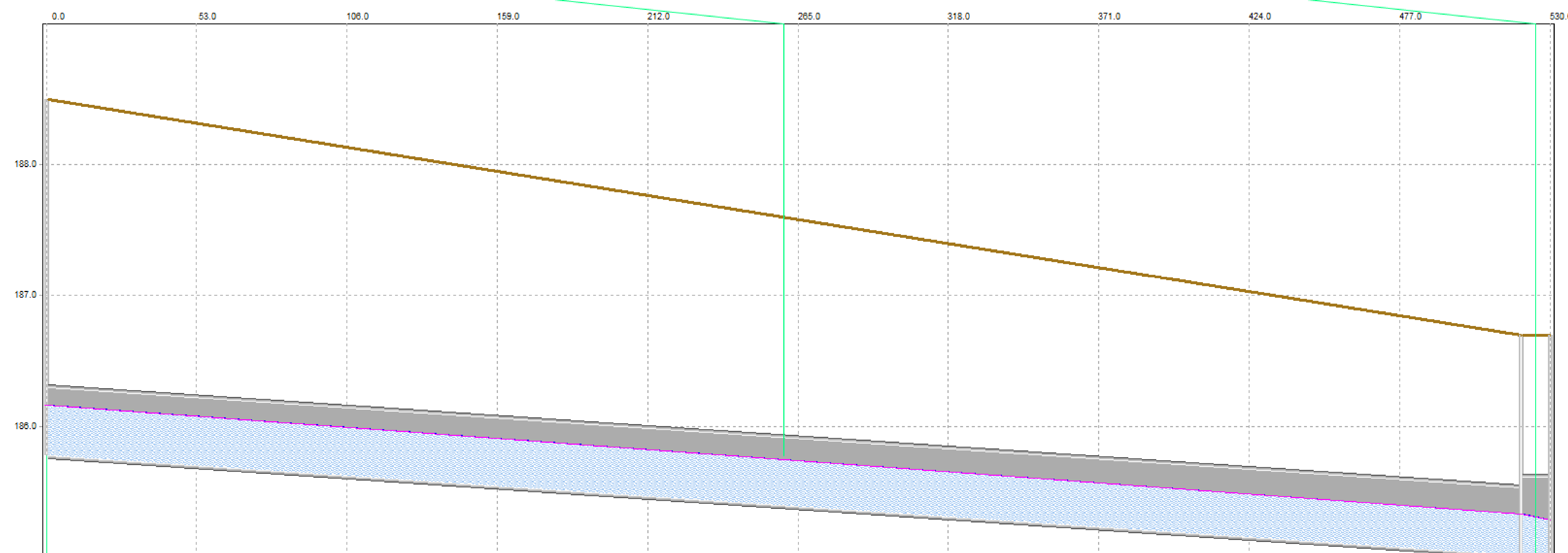


Figure 13: E-W Arterial (Sta. 10+760 - 11+425) - Permanent Pool Elevation Backwater Condition

Link

	Link28	Link29
Shape	Circular	Circular
Length	520.000	10.000
Conduit Slop	0.146	0.000
Diameter (He	0.525	0.600
Downstream	185.020	185.020
Upstream Inv	185.780	185.020



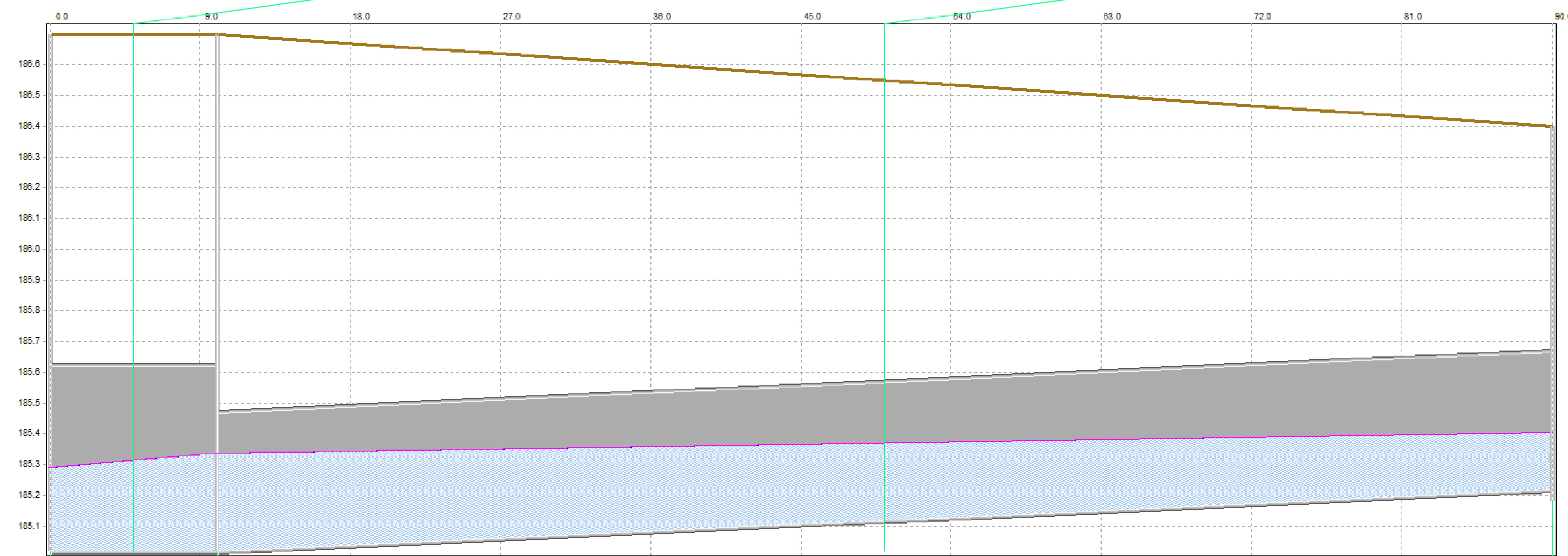
	Node23	Node24	Node45
Ground Eleva	188.500	186.700	186.700
Invert Elevati	185.780	185.020	185.020
Storage Nod	☐	☐	☐
Outfall Flag	☐	☐	☑
Outlet Contro	0.000	0.000	184.900

Node

Figure 14: E-W Arterial (Sta. 11+500 - 12+020) - Permanent Pool Elevation Backwater Condition

Link

	Link29	Link30
Shape	Circular	Circular
Length	10.000	80.000
Conduit Slop	0.000	0.250
Diameter (He	0.600	0.450
Downstream	185.020	185.020
Upstream Inv	185.020	185.220



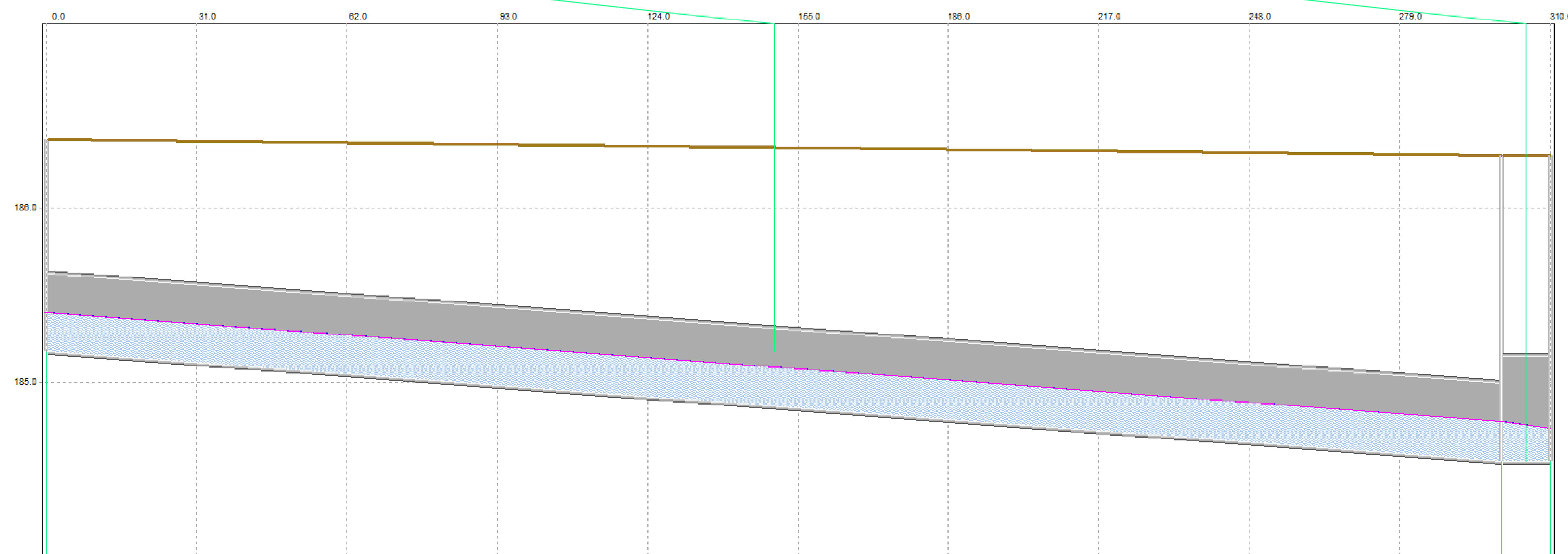
	Node45	Node24	Node25
Ground Eleva	186.700	186.700	186.400
Invert Elevati	185.020	185.020	185.180
Storage Nod	☐	☐	☐
Outfall Flag	☑	☐	☐
Outlet Contro	184.900	0.000	0.000

Node

Figure 15: E-W Arterial (Sta. 12+020 - 12+100) - Permanent Pool Elevation Backwater Condition

Link

	Link31	Link32
Shape	Circular	Circular
Length	300.000	10.000
Conduit Slop	0.210	0.000
Diameter (He	0.450	0.600
Downstream	184.550	184.550
Upstream Inv	185.180	184.550



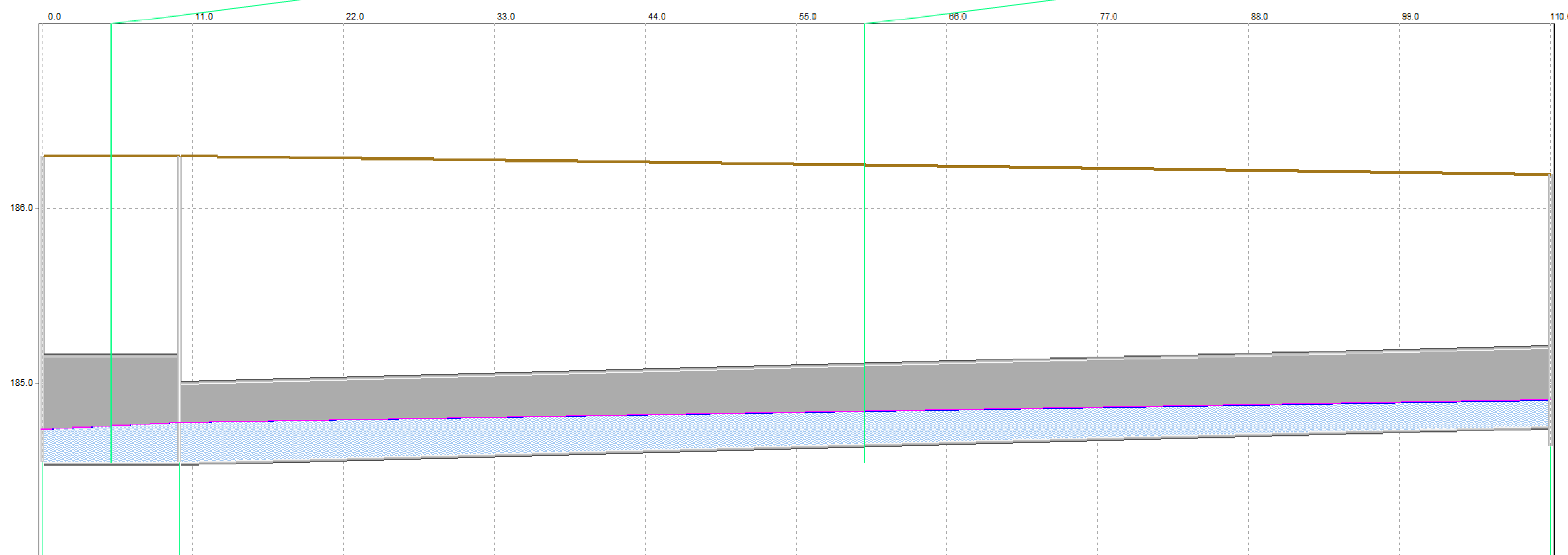
	Node25	Node26	Node46
Ground Eleva	186.400	186.300	186.300
Invert Elevati	185.180	184.550	184.550
Storage Nod	☐	☐	☐
Outfall Flag	☐	☐	☑
Outlet Contro	0.000	0.000	183.900

Node

Figure 16: E-W Arterial (Sta. 12+100 - 12+400) - Permanent Pool Elevation Backwater Condition

Link

	Link32	Link33
Shape	Circular	Circular
Length	10.000	100.000
Conduit Slop	0.000	0.210
Diameter (He	0.600	0.450
Downstream	184.550	184.550
Upstream Inv	184.550	184.760



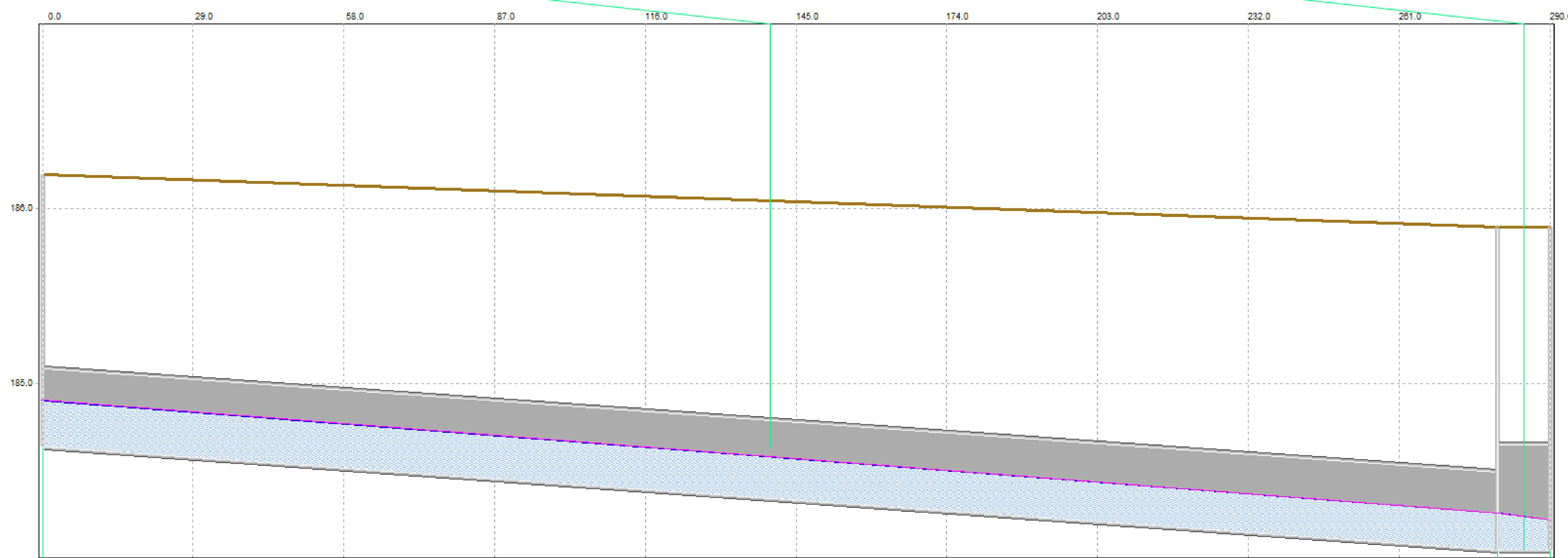
	Node46	Node26	Node27
Ground Eleva	186.300	186.300	186.200
Invert Elevati	184.550	184.550	184.640
Storage Nod	☐	☐	☐
Outfall Flag	☑	☐	☐
Outlet Contro	183.900	0.000	0.000

Node

Figure 17: E-W Arterial (Sta. 12+400 - 12+500) - Permanent Pool Elevation Backwater Condition

Link

	Link34	Link35
Shape	Circular	Circular
Length	280.000	10.000
Conduit Slop	0.211	0.000
Diameter (He	0.450	0.600
Downstream	184.050	184.050
Upstream Inv	184.640	184.050



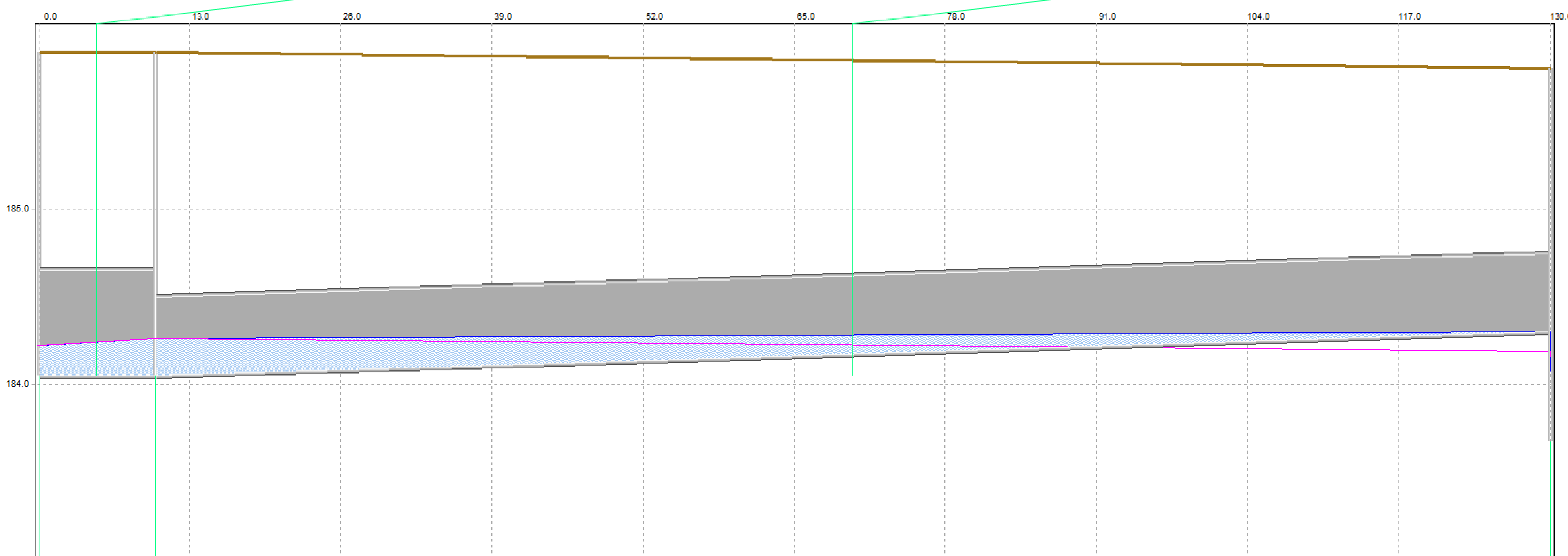
	Node27	Node28	Node47
Ground Eleva	186.200	185.900	185.900
Invert Elevati	184.640	184.050	184.050
Storage Nod	☐	☐	☐
Outfall Flag	☐	☐	☑
Outlet Contro	0.000	0.000	183.900

Node

Figure 18: E-W Arterial (Sta. 12+500 - 12+780) - Permanent Pool Elevation Backwater Condition

Link

	Link35	Link36
Shape	Circular	Circular
Length	10.000	120.000
Conduit Slop	0.000	0.208
Diameter (He	0.600	0.450
Downstream	184.050	184.050
Upstream Inv	184.050	184.300



	Node47	Node28	Node29
Ground Eleva	185.900	185.900	185.800
Invert Elevati	184.050	184.050	183.680
Storage Nod	☐	☐	☐
Outfall Flag	☑	☐	☐
Outlet Contro	183.900	0.000	0.000

Node

Figure 19: E-W Arterial (Sta. 12+780 - 12+900) - Permanent Pool Elevation Backwater Condition

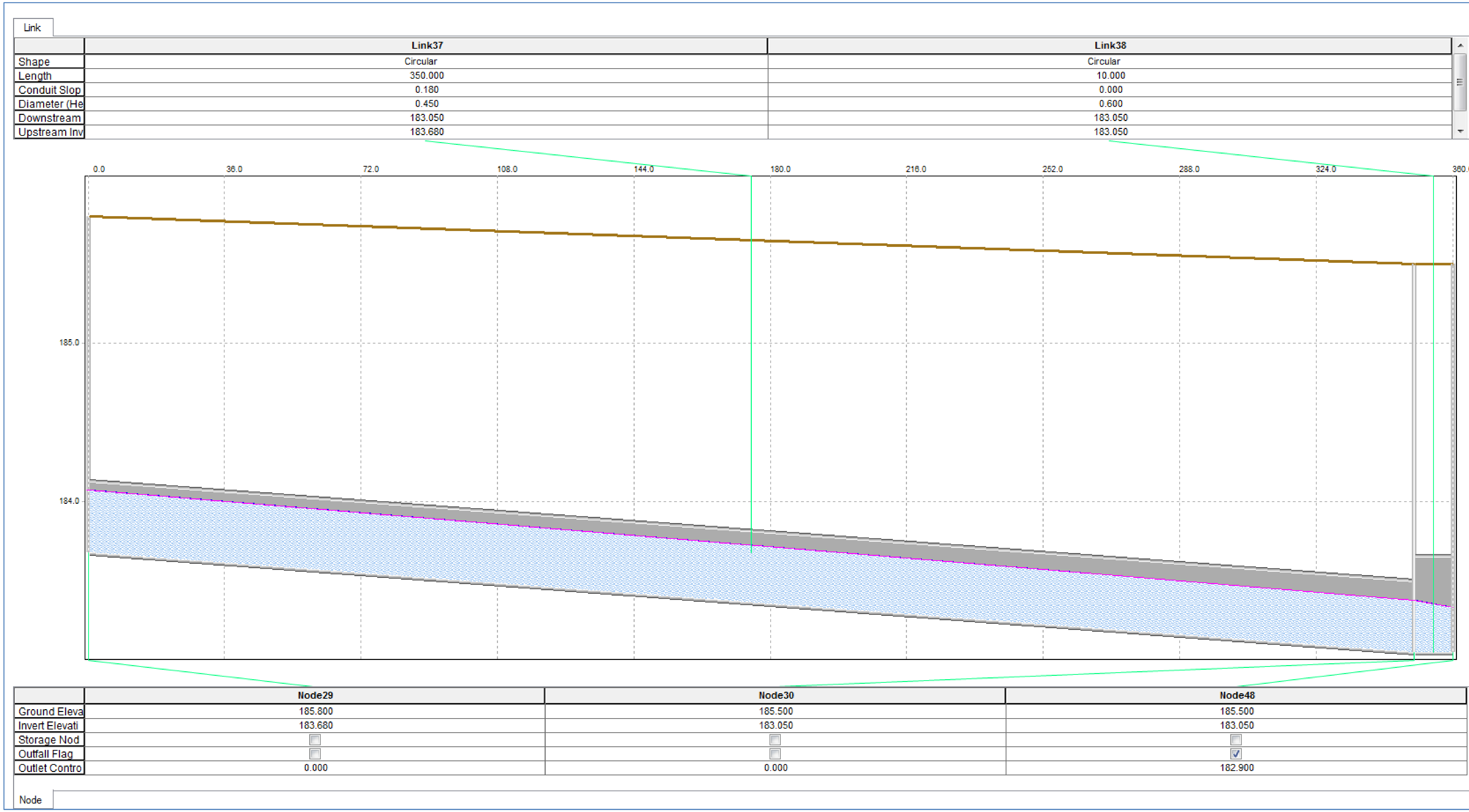
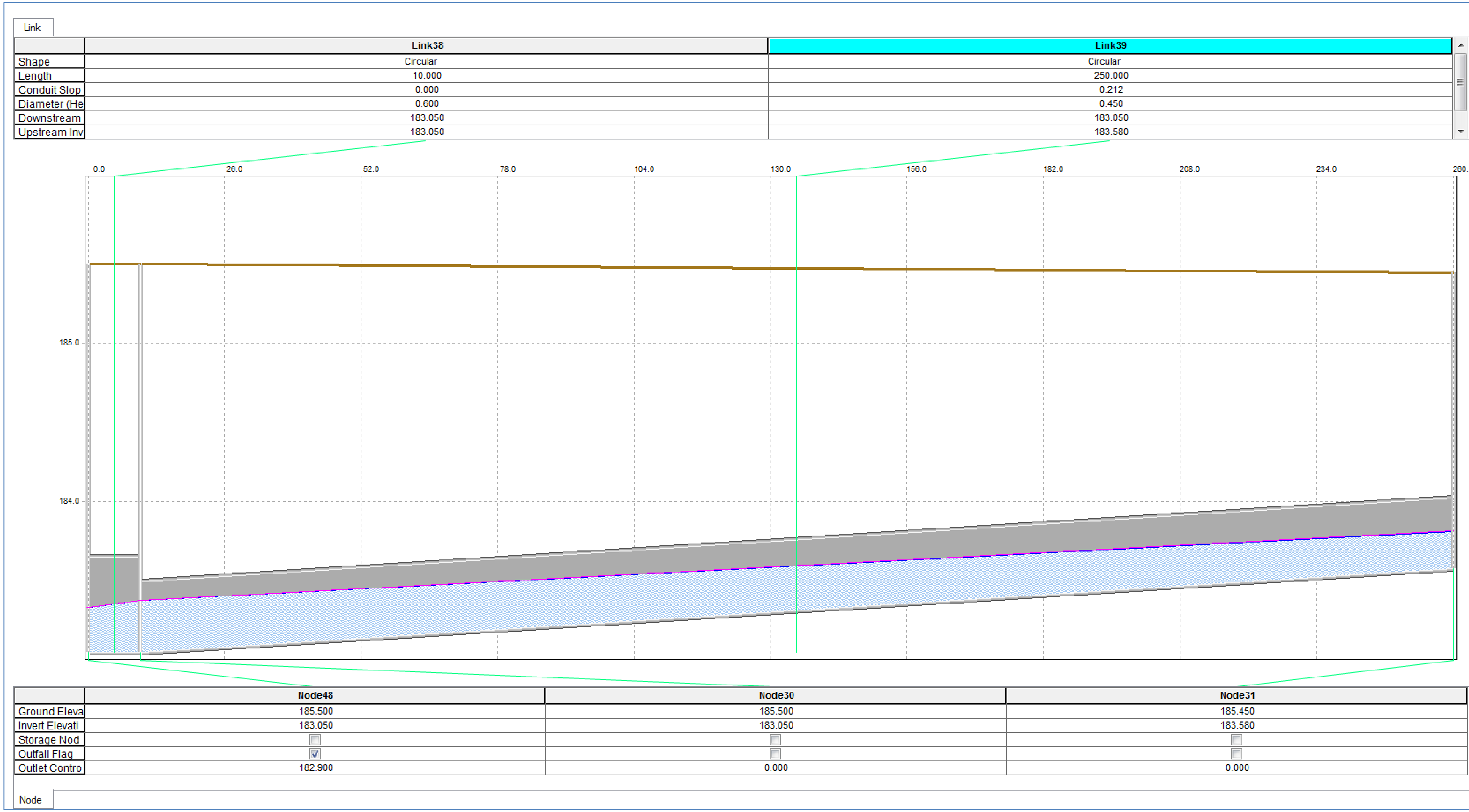


Figure 20: E-W Arterial (Sta. 12+900 - 13+250) - Permanent Pool Elevation Backwater Condition



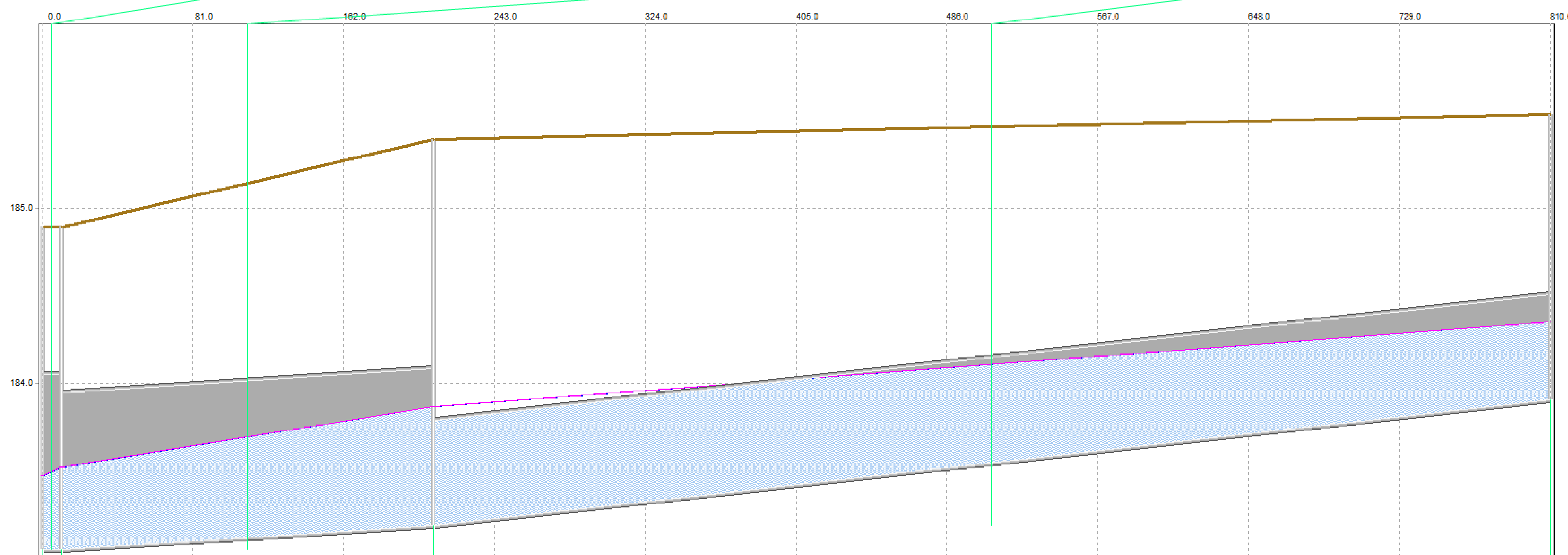
	Link38	Link39
Shape	Circular	Circular
Length	10.000	250.000
Conduit Slop	0.000	0.212
Diameter (He	0.600	0.450
Downstream	183.050	183.050
Upstream Inv	183.050	183.580

	Node48	Node30	Node31
Ground Eleva	185.500	185.500	185.450
Invert Elevati	183.050	183.050	183.580
Storage Nod	☐	☐	☐
Outfall Flag	☑	☐	☐
Outlet Contro	182.900	0.000	0.000

Figure 21: E-W Arterial (Sta. 13+250 - 13+500) - Permanent Pool Elevation Backwater Condition

Link

	Link22	Link44	Link43
Shape	Circular	Circular	Circular
Length	10.000	200.000	600.000
Conduit Slop	0.000	0.000	0.000
Diameter (He	1.000	0.900	0.600
Downstream	183.050	183.050	183.190
Upstream Inv	183.050	183.190	183.910



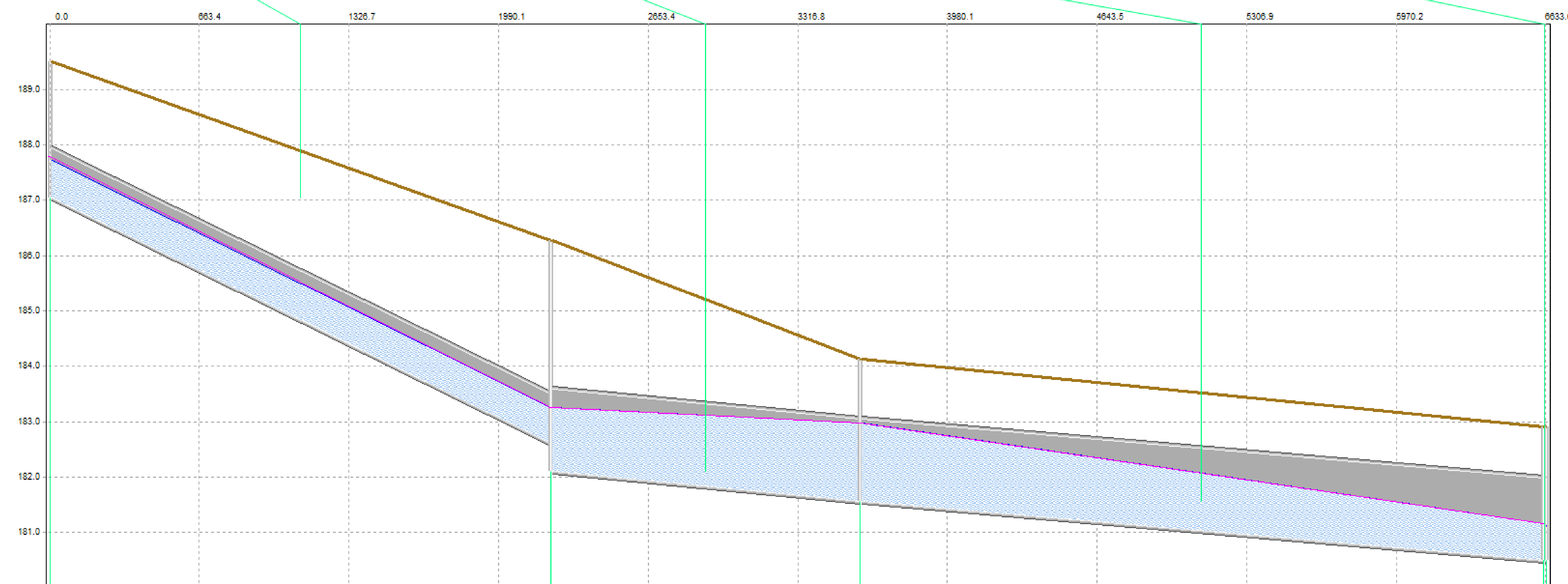
	Node41	Node17	Node52	Node53
Ground Eleva	184.900	184.900	185.400	185.540
Invert Elevati	183.050	183.050	183.190	183.910
Storage Nod	☐	☐	☐	☐
Outfall Flag	☑	☐	☐	☐
Outlet Contro	182.900	0.000	0.000	0.000

Node

Figure 22: E-W Arterial (Sta. 13+590 – 14+190) - Permanent Pool Elevation Backwater Condition

Link

	Link1	Link2	Link3	Link4
Shape	Circular	Circular	Circular	Circular
Length	2220.000	1375.000	3028.571	10.000
Conduit Slop	0.200	0.040	0.035	0.000
Diameter (He	0.900	1.500	1.500	1.500
Downstream	182.610	181.560	180.500	180.500
Upstream Inv	187.050	182.110	181.560	180.500



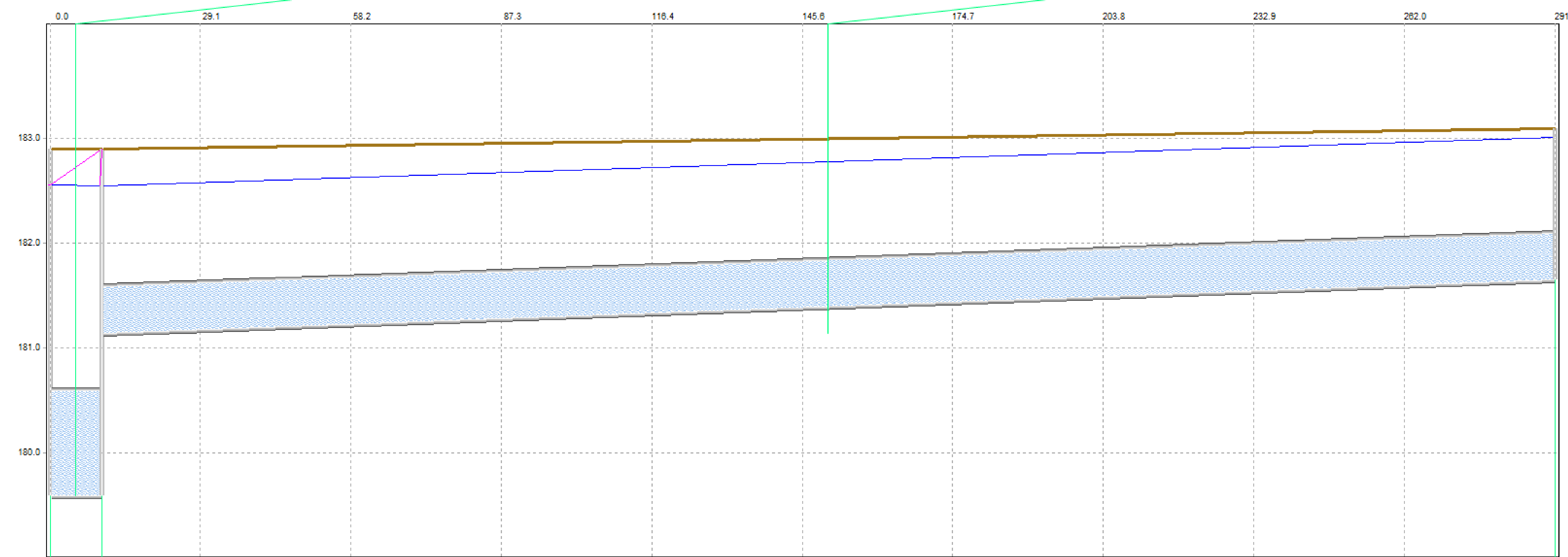
	Node1	Node2	Node3	Node4	Node32
Ground Eleva	189.500	186.268	184.119	182.900	182.900
Invert Elevati	187.050	182.110	181.560	180.500	180.500
Storage Nod	☐	☐	☐	☐	☐
Outfall Flag	☐	☐	☐	☐	☑
Outlet Contro	0.000	0.000	0.000	0.000	180.450

Node

Figure 23: County Road 42 (Sta. 10+000 - 14+520) - Permanent Pool Elevation + 1.0m Backwater Condition

Link

	Link41	Link40
Shape	Circular	Circular
Length	10.000	281.111
Conduit Slop	0.000	0.180
Diameter (He	1.000	0.450
Downstream	179.600	181.144
Upstream Inv	179.600	181.650



	Node49	Node13	Node33
Ground Eleva	182.900	182.900	183.100
Invert Elevati	179.600	179.600	181.650
Storage Nod	☐	☐	☐
Outfall Flag	☑	☐	☐
Outlet Contro	182.560	0.000	0.000

Node

Figure 24: County Road 42 (Sta. 14+680 - 14+880) - Permanent Pool Elevation + 1.0m Backwater Condition

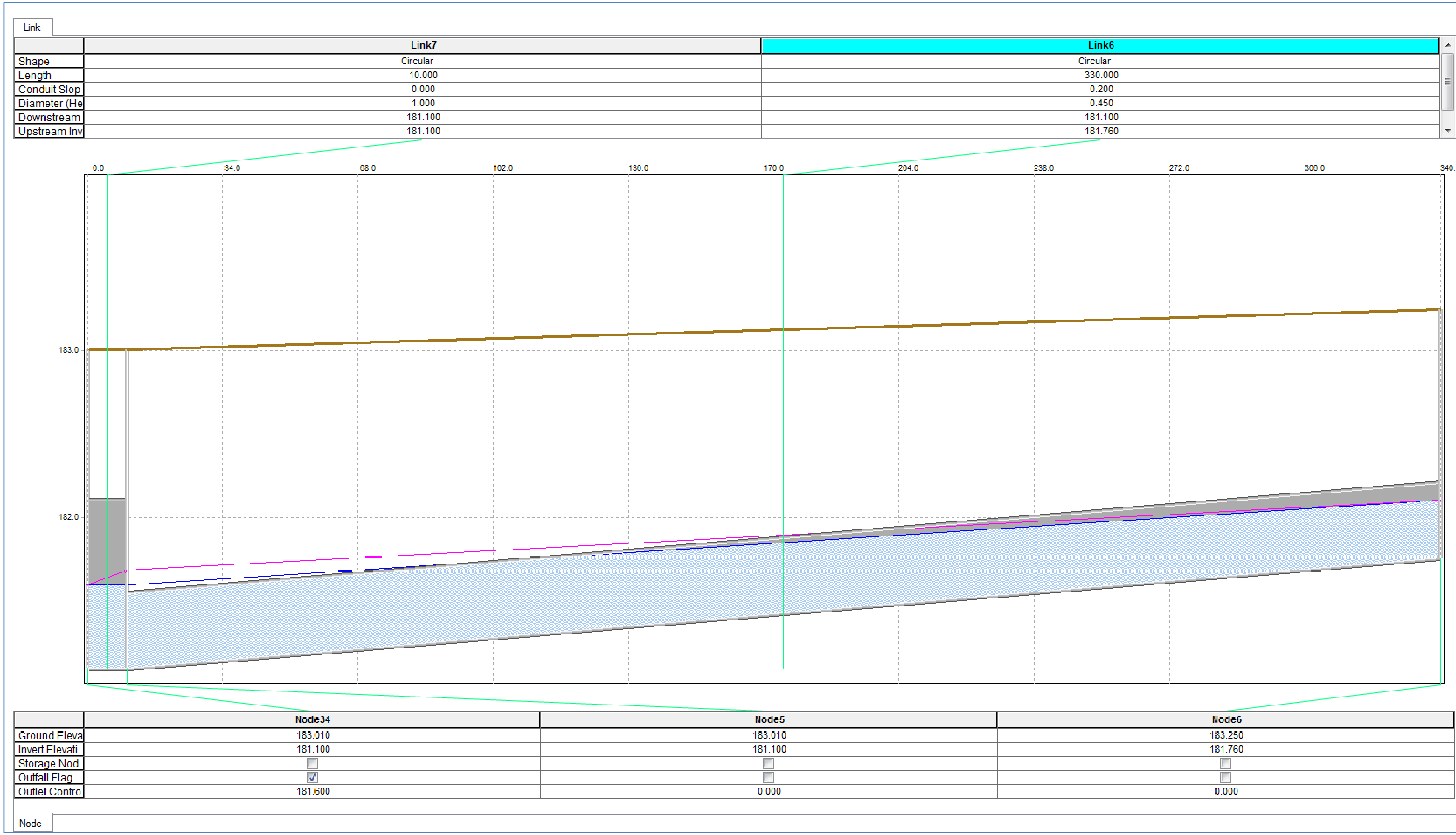
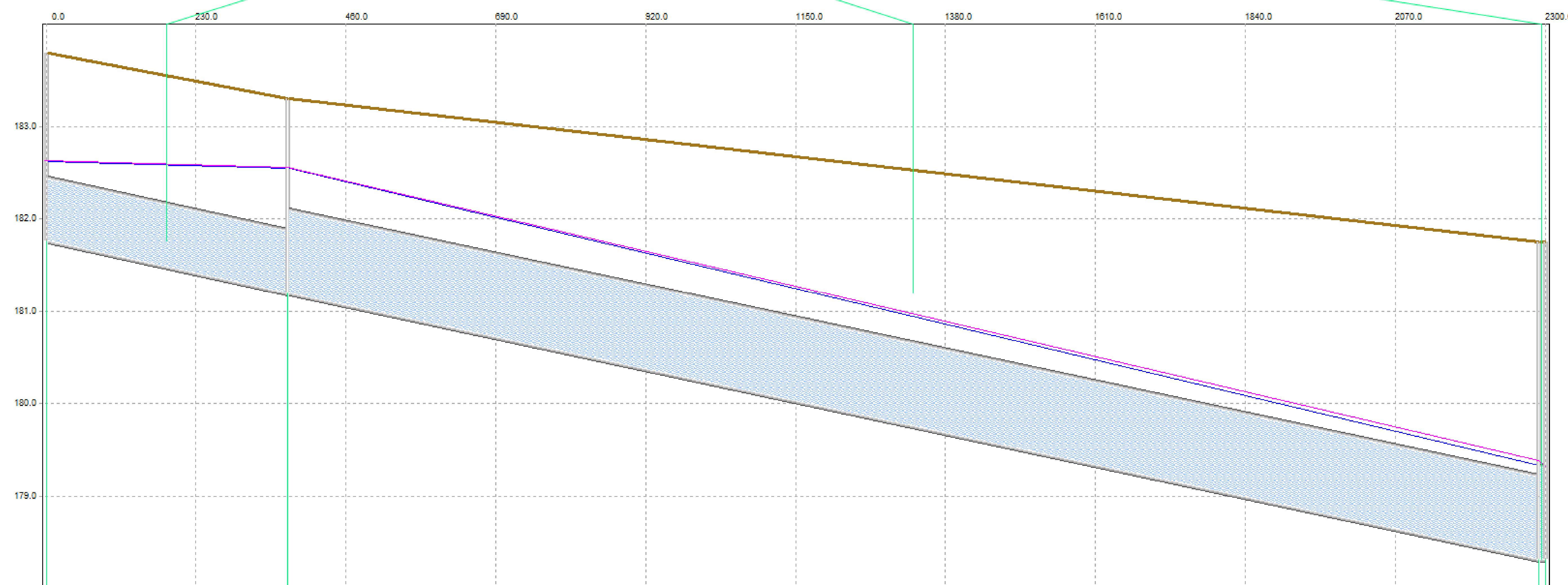


Figure 25: County Road 42 (Sta. 15+000 - 15+320) - Permanent Pool Elevation + 1.0m Backwater Condition

Link

	Link8	Link11	Link12
Shape	Circular	Circular	Circular
Length	370.000	1920.000	10.000
Conduit Slop	0.151	0.150	0.000
Diameter (He	0.675	0.900	1.000
Downstream	181.200	178.320	178.320
Upstream Inv	181.760	181.200	178.320

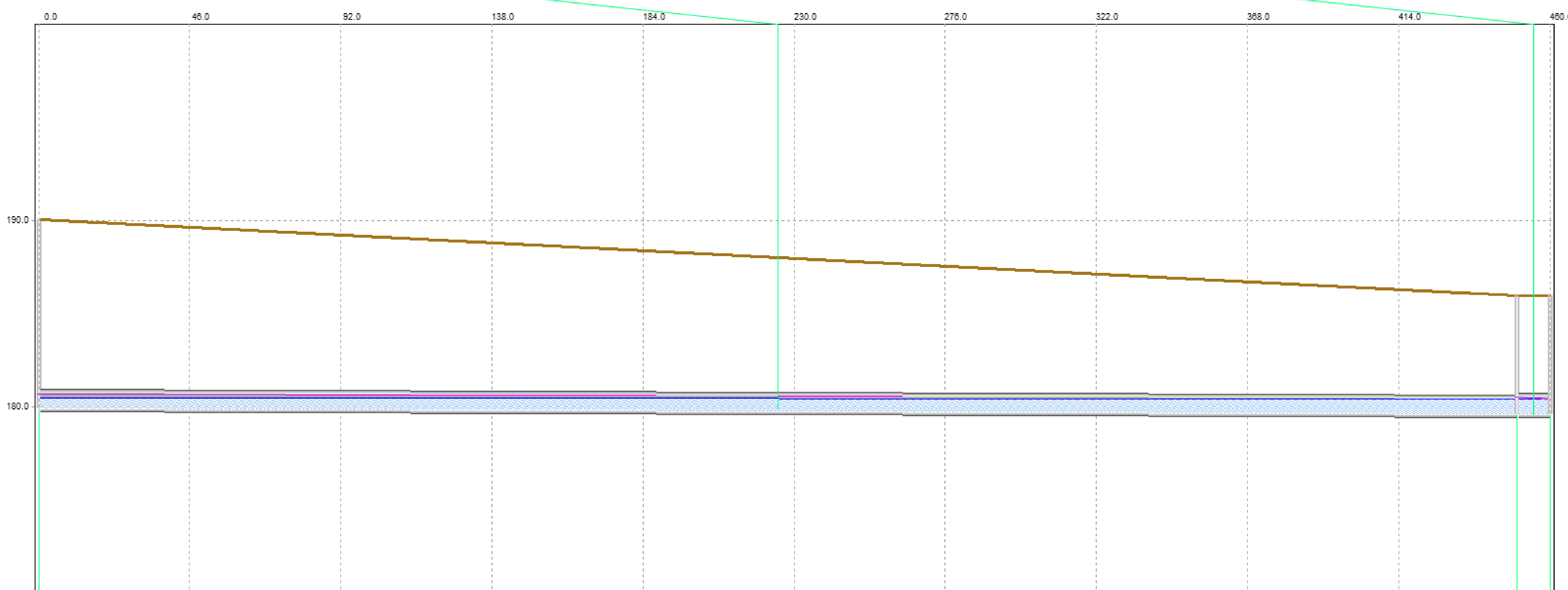


	Node7	Node8	Node9	Node37
Ground Eleva	183.800	183.300	181.750	181.750
Invert Elevati	181.760	181.200	178.320	178.320
Storage Nod	☐	☐	☐	☐
Outfall Flag	☐	☐	☐	☑
Outlet Contro	0.000	0.000	0.000	179.320

Node

Figure 26: County Road 42 (Sta. 16+240 - 18+540) - Permanent Pool Elevation + 1.0m Backwater Condition

Link	Link13	Link42
Shape	Circular	Circular
Length	450.000	10.000
Conduit Slop	0.070	0.000
Diameter (He	0.900	1.000
Downstream	179.600	179.600
Upstream Inv	179.915	179.600

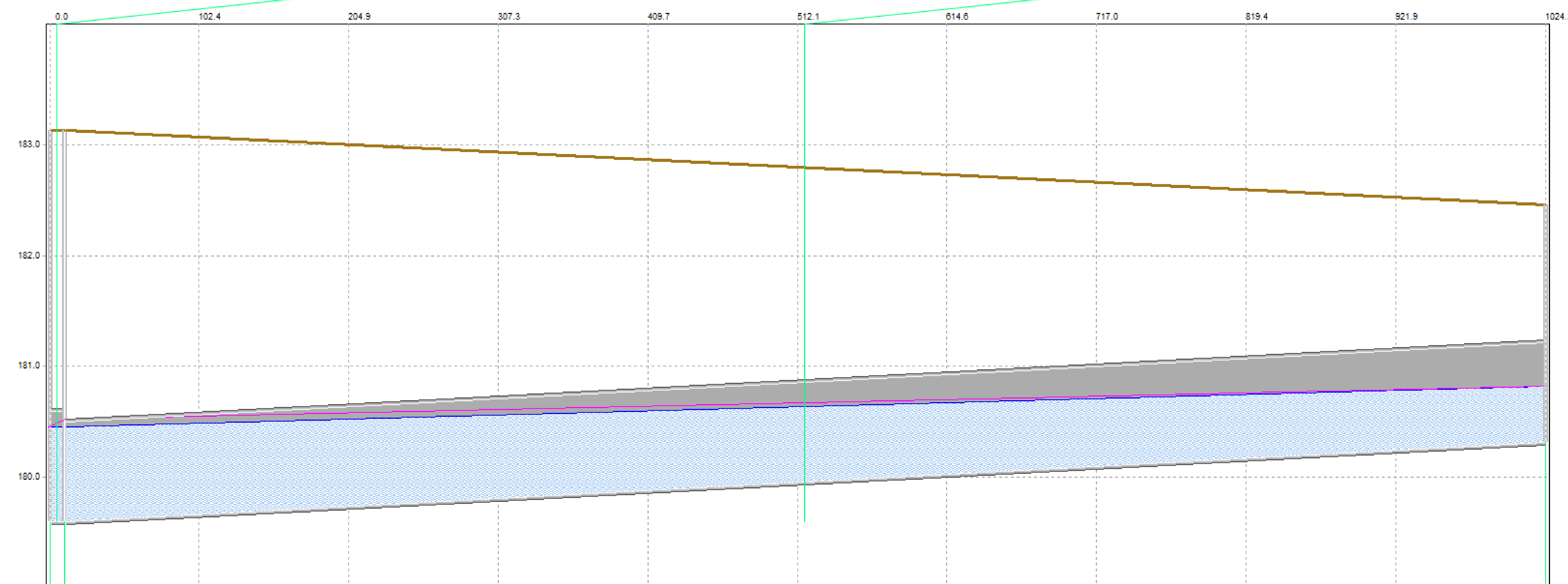


Node	Node10	Node51	Node50
Ground Eleva	190.060	186.000	186.000
Invert Elevati	179.915	179.600	179.600
Storage Nod	☐	☐	☐
Outfall Flag	☐	☐	☑
Outlet Contro	0.000	0.000	180.450

Figure 27: Lauzon Parkway Extension (Sta. 10+900 - 11+350) - Permanent Pool Elevation + 1.0m Backwater Condition

Link

	Link14	Link15
Shape	Circular	Circular
Length	10.000	1014.285
Conduit Slop	0.000	0.070
Diameter (He	1.000	0.900
Downstream	179.600	179.600
Upstream Inv	179.600	180.310



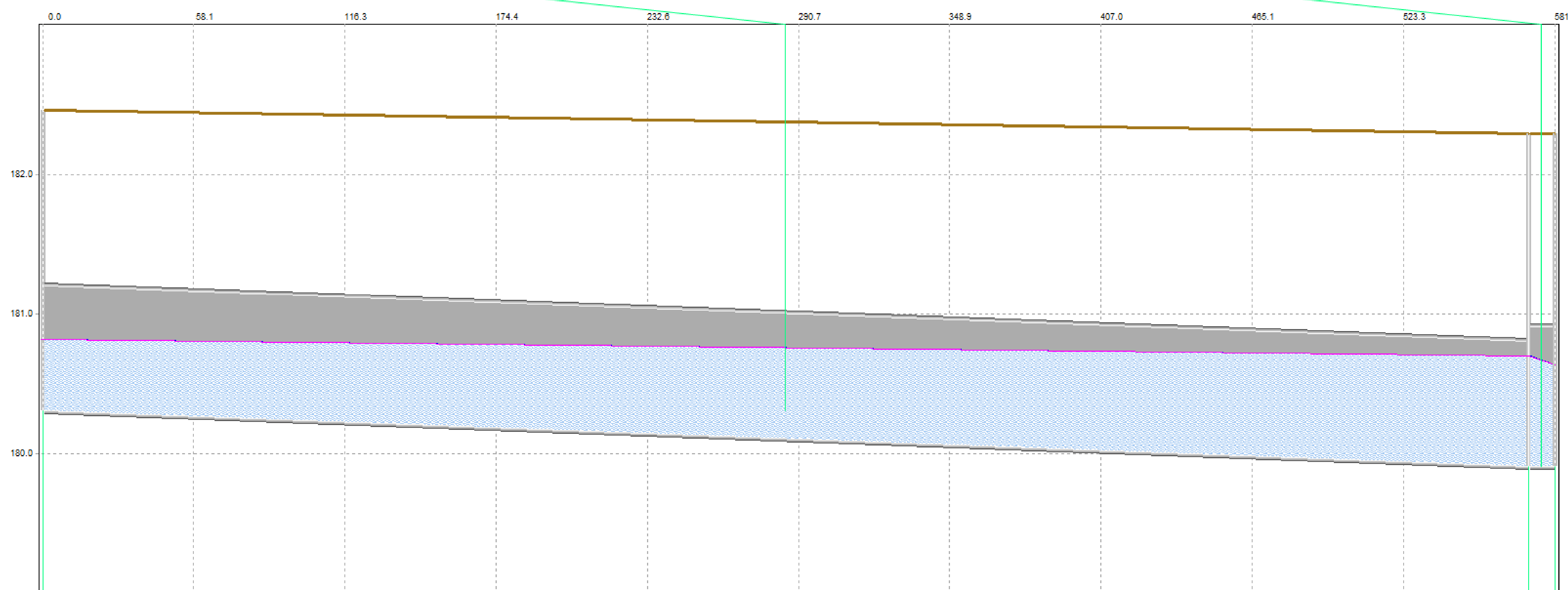
	Node38	Node11	Node39
Ground Eleva	183.130	183.130	182.460
Invert Elevati	179.600	179.600	180.310
Storage Nod	☐	☐	☐
Outfall Flag	☑	☐	☐
Outlet Contro	180.450	0.000	0.000

Node

Figure 28: Lauzon Parkway Extension (Sta. 11+350 - 12+370) - Permanent Pool Elevation + 1.0m Backwater Condition

Link

	Link16	Link17
Shape	Circular	Circular
Length	571.428	10.000
Conduit Slop	0.070	0.000
Diameter (He	0.900	1.000
Downstream	179.910	179.910
Upstream Inv	180.310	179.910



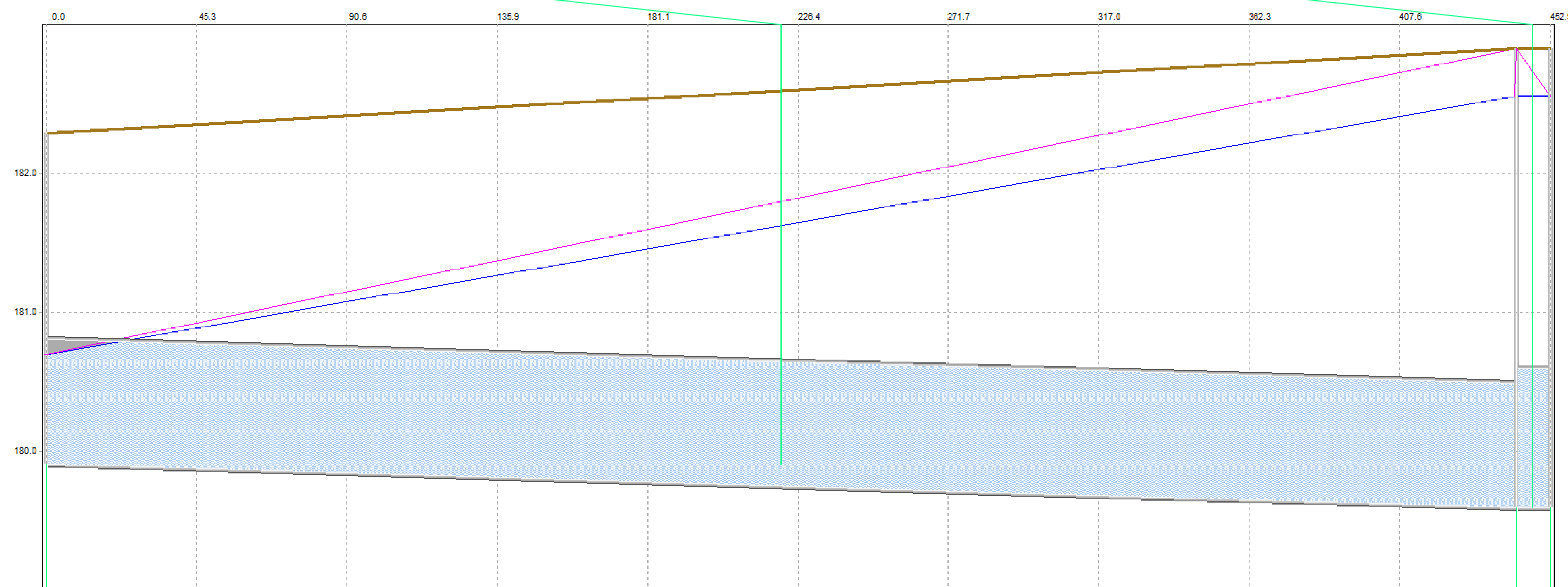
	Node39	Node12	Node40
Ground Eleva	182.460	182.290	182.290
Invert Elevati	180.310	179.910	179.910
Storage Nod	☐	☐	☐
Outfall Flag	☐	☐	☑
Outlet Contro	0.000	0.000	180.450

Node

Figure 29: Lauzon Parkway Extension (Sta. 12+370 - 12+670) - Permanent Pool Elevation + 1.0m Backwater Condition

Link

	Link18	Link41
Shape	Circular	Circular
Length	442.857	10.000
Conduit Slop	0.070	0.000
Diameter (He	0.900	1.000
Downstream	179.600	179.600
Upstream Inv	179.910	179.600



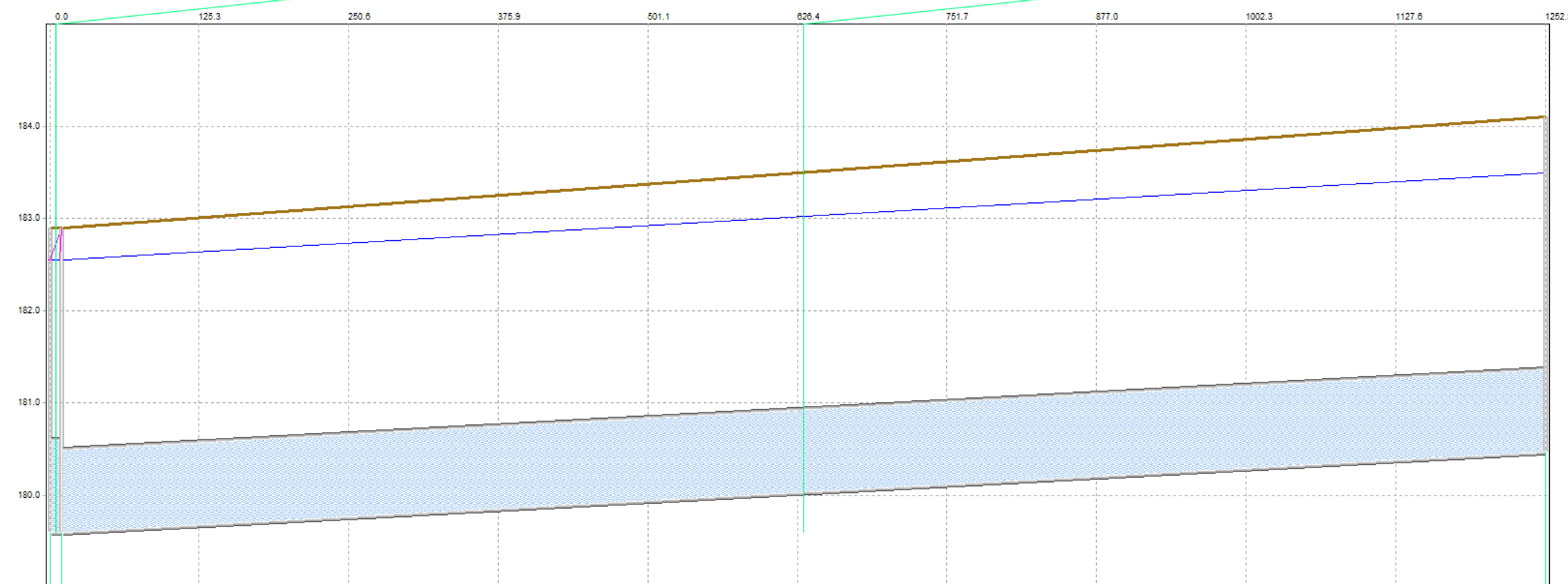
	Node12	Node13	Node49
Ground Eleva	182.290	182.900	182.900
Invert Elevati	179.910	179.600	179.600
Storage Nod	☐	☐	☐
Outfall Flag	☐	☐	☑
Outlet Contro	0.000	0.000	182.560

Node

Figure 30: Lauzon Parkway Extension (Sta. 12+670 - 12+935) - Permanent Pool Elevation + 1.0m Backwater Condition

Link

	Link41	Link19
Shape	Circular	Circular
Length	10.000	1242.857
Conduit Slop	0.000	0.070
Diameter (He	1.000	0.900
Downstream	179.600	179.600
Upstream Inv	179.600	180.470



	Node49	Node13	Node14
Ground Eleva	182.900	182.900	184.100
Invert Elevati	179.600	179.600	180.470
Storage Nod	☐	☐	☐
Outfall Flag	☑	☐	☐
Outlet Contro	182.560	0.000	0.000

Node

Figure 31: Lauzon Parkway Extension (Sta. 12+935 - 14+180) - Permanent Pool Elevation + 1.0m Backwater Condition

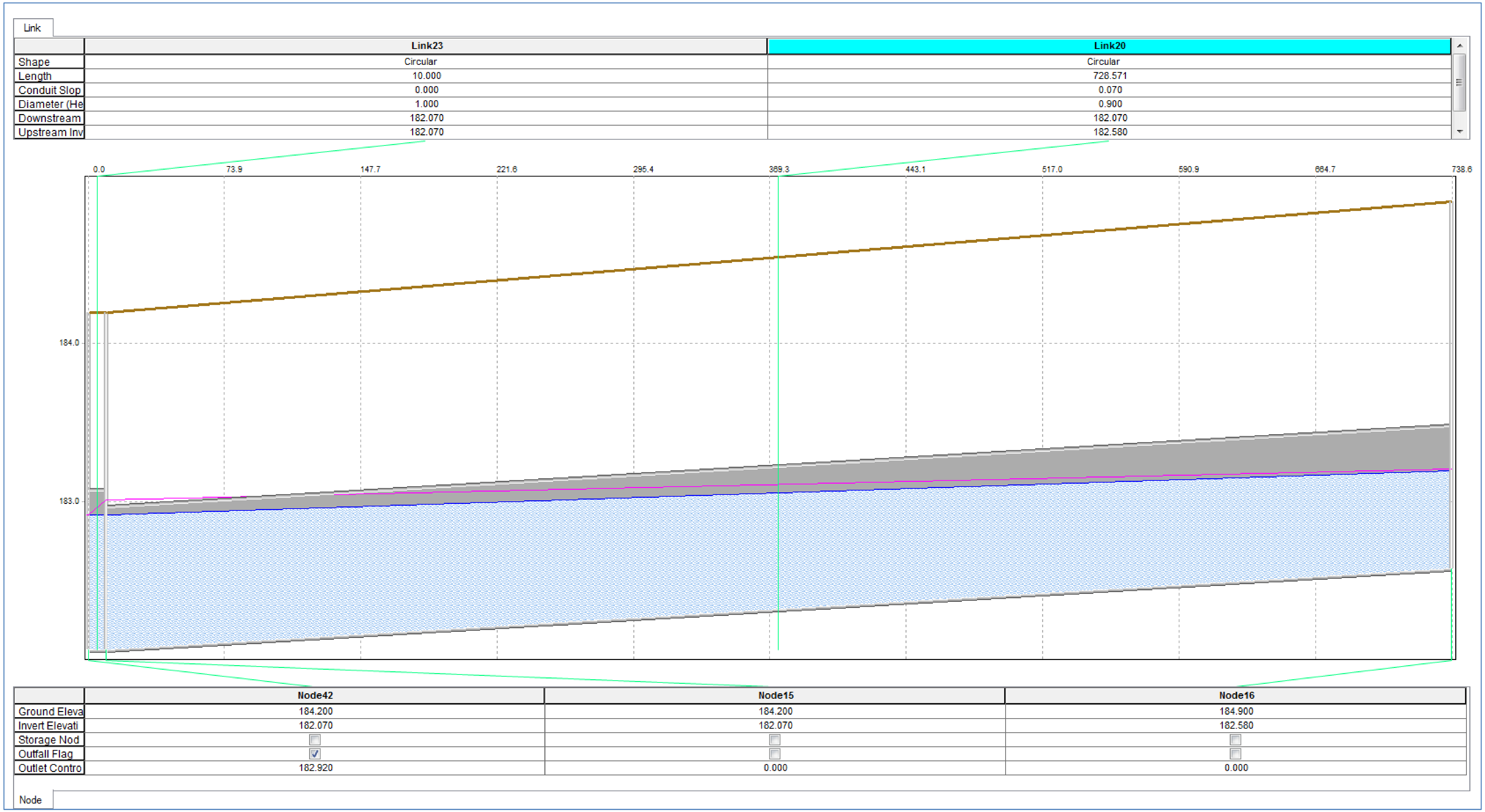
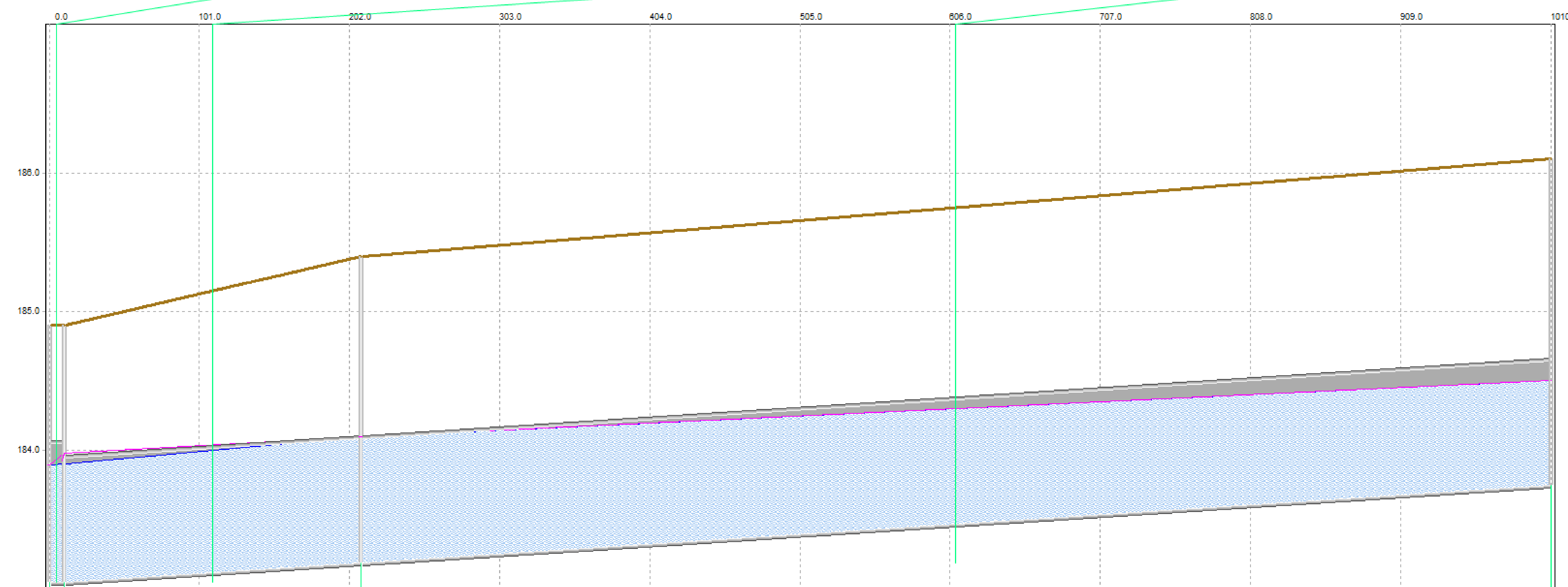


Figure 32: Lauzon Parkway Extension (Sta. 14+250 - 14+980) - Permanent Pool Elevation + 1.0m Backwater Condition

Untitled
Day [0] Time 05:00:00 Step 300

Link

	Link22	Link44	Link21
Shape	Circular	Circular	Circular
Length	10.000	200.000	800.000
Conduit Slop	0.000	0.000	0.070
Diameter (He	1.000	0.900	0.900
Downstream	183.050	183.050	183.190
Upstream Inv	183.050	183.190	183.750



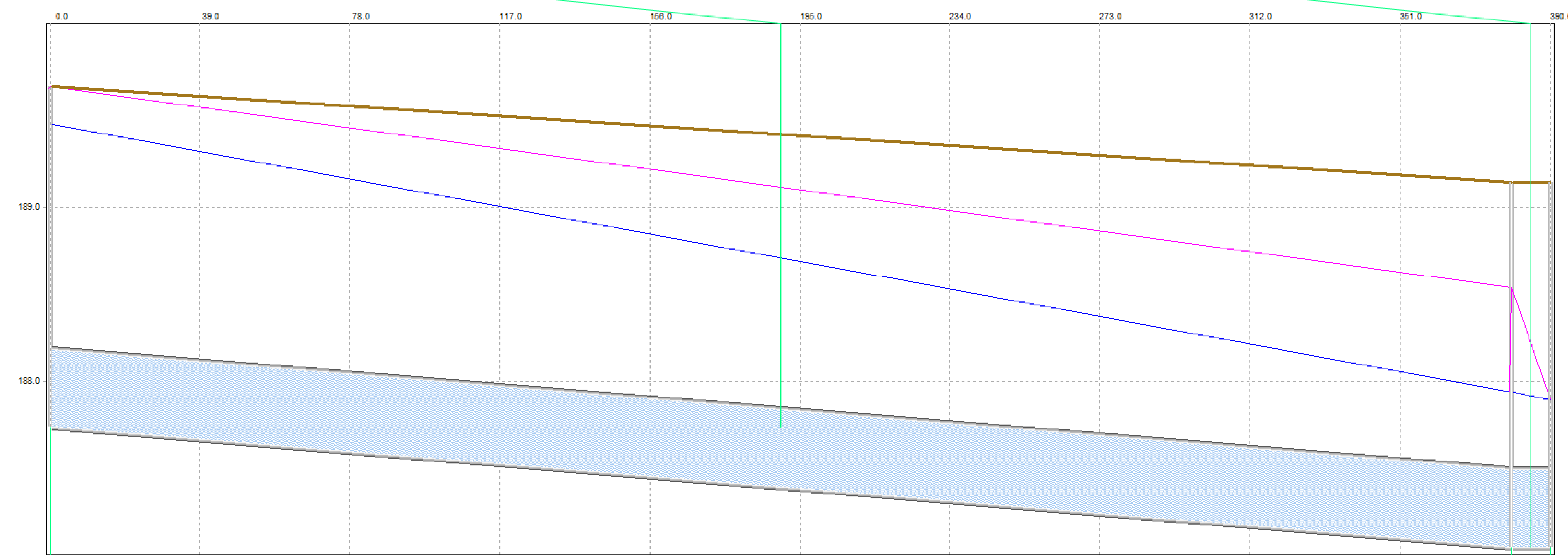
	Node41	Node17	Node52	Node18
Ground Eleva	184.900	184.900	185.400	186.100
Invert Elevati	183.050	183.050	183.190	183.750
Storage Nod	☐	☐	☐	☐
Outfall Flag	☑	☐	☐	☐
Outlet Contro	183.900	0.000	0.000	0.000

Node

Figure 33: Lauzon Parkway Extension (Sta. 15+000 - 16+000) - Permanent Pool Elevation + 1.0m Backwater Condition

Link

	Link24	Link25
Shape	Circular	Circular
Length	380.000	10.000
Conduit Slop	0.182	0.000
Diameter (He	0.450	0.450
Downstream	187.050	187.050
Upstream Inv	187.740	187.050



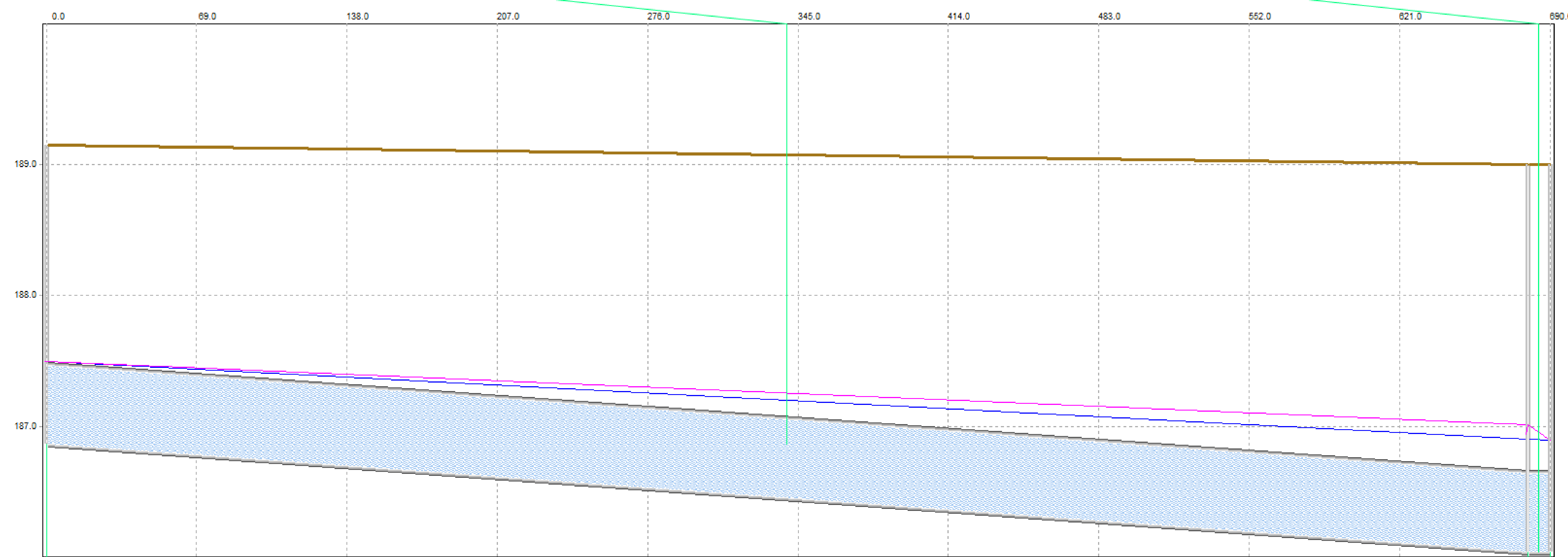
	Node19	Node20	Node43
Ground Eleva	189.700	189.150	189.150
Invert Elevati	187.740	187.050	187.050
Storage Nod	☐	☐	☐
Outfall Flag	☐	☐	☑
Outlet Contro	0.000	0.000	187.900

Node

Figure 34: E-W Arterial (Sta. 10+360 - 10+740) - Permanent Pool Elevation + 1.0m Backwater Condition

Link

	Link26	Link27
Shape	Circular	Circular
Length	680.000	10.000
Conduit Slop	0.121	0.000
Diameter (He	0.600	0.600
Downstream	186.050	186.050
Upstream Inv	186.870	186.050



	Node21	Node22	Node44
Ground Eleva	189.150	189.000	189.000
Invert Elevati	186.870	186.050	186.050
Storage Nod	☐	☐	☐
Outfall Flag	☐	☐	☑
Outlet Contro	0.000	0.000	186.900

Node

Figure 35: E-W Arterial (Sta. 10+760 - 11+425) - Permanent Pool Elevation + 1.0m Backwater Condition

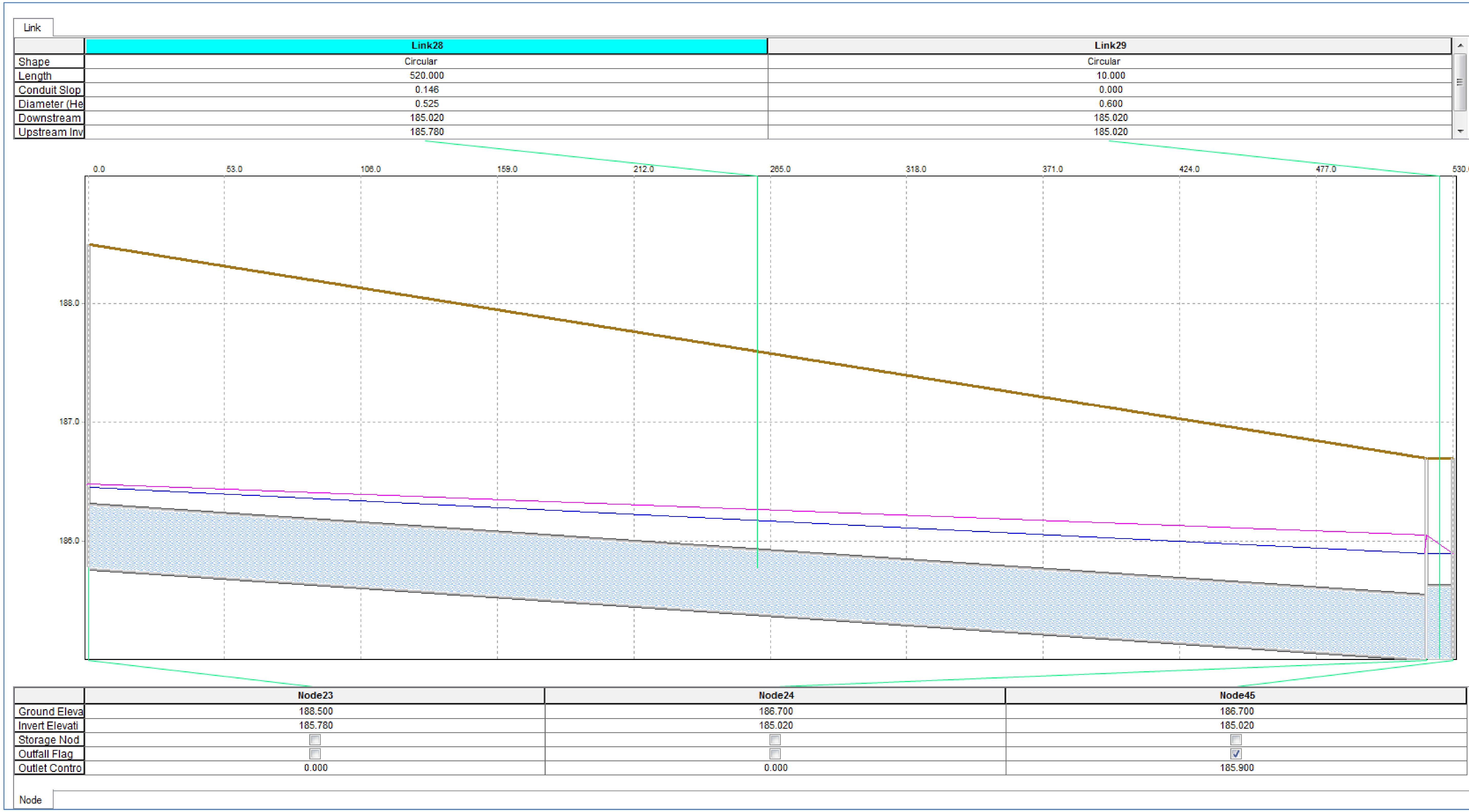
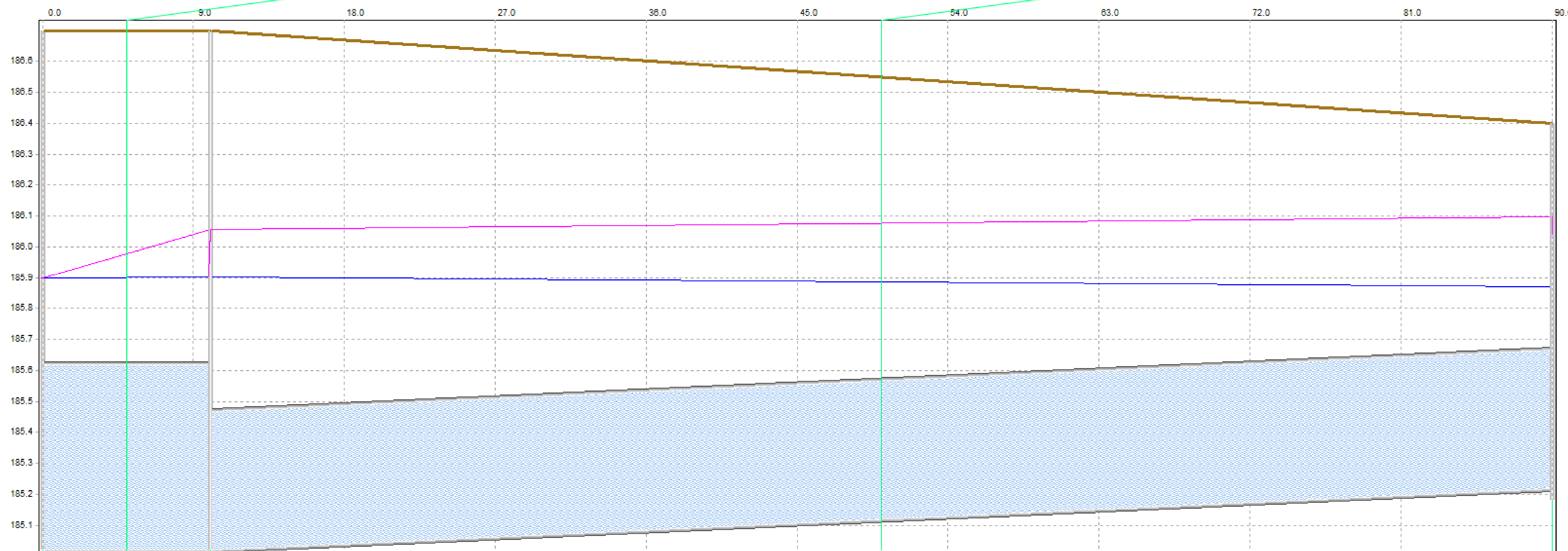


Figure 36: E-W Arterial (Sta. 11+500 - 12+020) - Permanent Pool Elevation + 1.0m Backwater Condition

Link

	Link29	Link30
Shape	Circular	Circular
Length	10.000	80.000
Conduit Slop	0.000	0.250
Diameter (He	0.600	0.450
Downstream	185.020	185.020
Upstream Inv	185.020	185.220



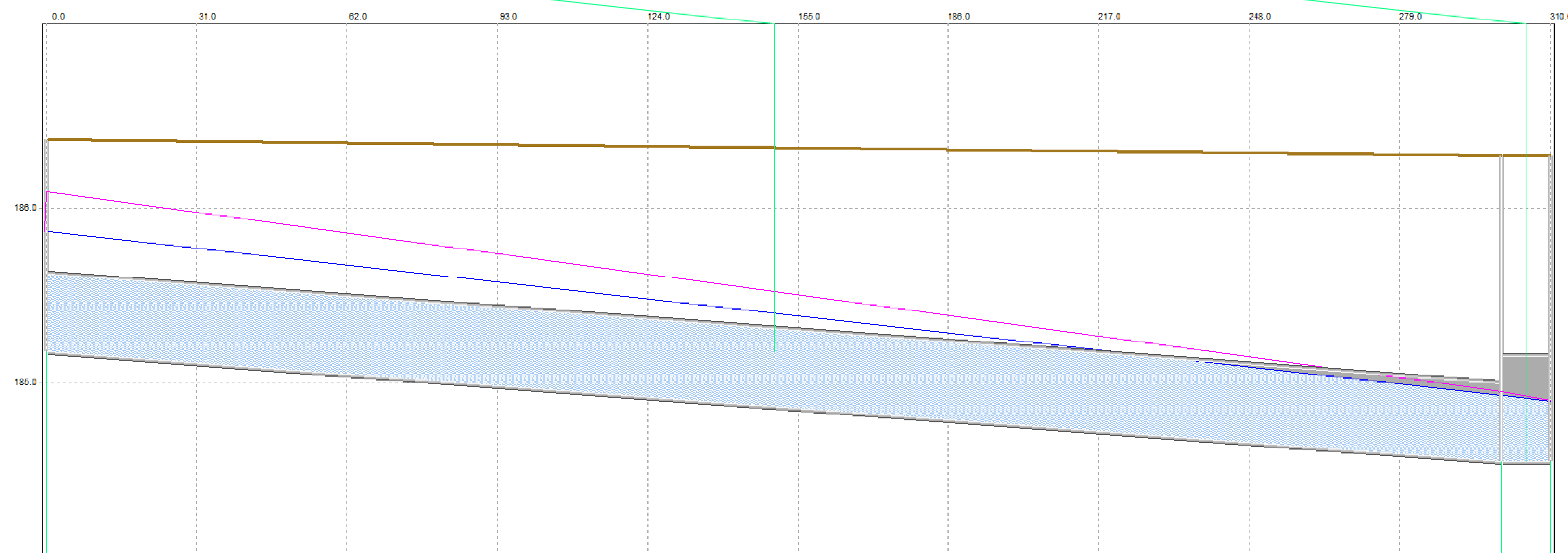
	Node45	Node24	Node25
Ground Eleva	186.700	186.700	186.400
Invert Elevati	185.020	185.020	185.180
Storage Nod	☐	☐	☐
Outfall Flag	☑	☐	☐
Outlet Contro	185.900	0.000	0.000

Node

Figure 37: E-W Arterial (Sta. 12+020 - 12+100) - Permanent Pool Elevation + 1.0m Backwater Condition

Link

	Link31	Link32
Shape	Circular	Circular
Length	300.000	10.000
Conduit Slop	0.210	0.000
Diameter (He	0.450	0.600
Downstream	184.550	184.550
Upstream Inv	185.180	184.550



	Node25	Node26	Node46
Ground Eleva	186.400	186.300	186.300
Invert Elevati	185.180	184.550	184.550
Storage Nod	☐	☐	☐
Outfall Flag	☐	☐	☑
Outlet Contro	0.000	0.000	184.900

Node

Figure 38: E-W Arterial (Sta. 12+100 - 12+400) - Permanent Pool Elevation + 1.0m Backwater Condition

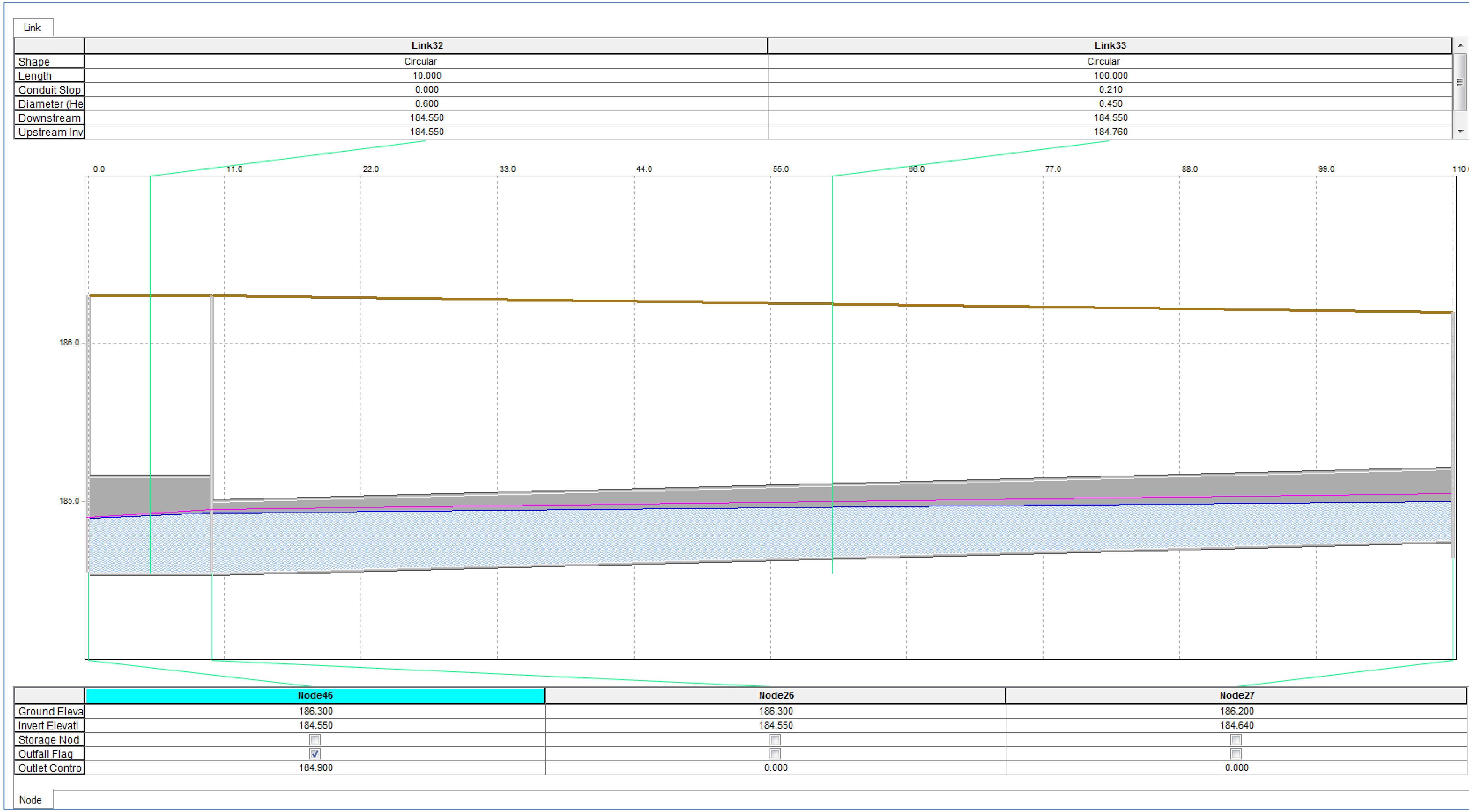
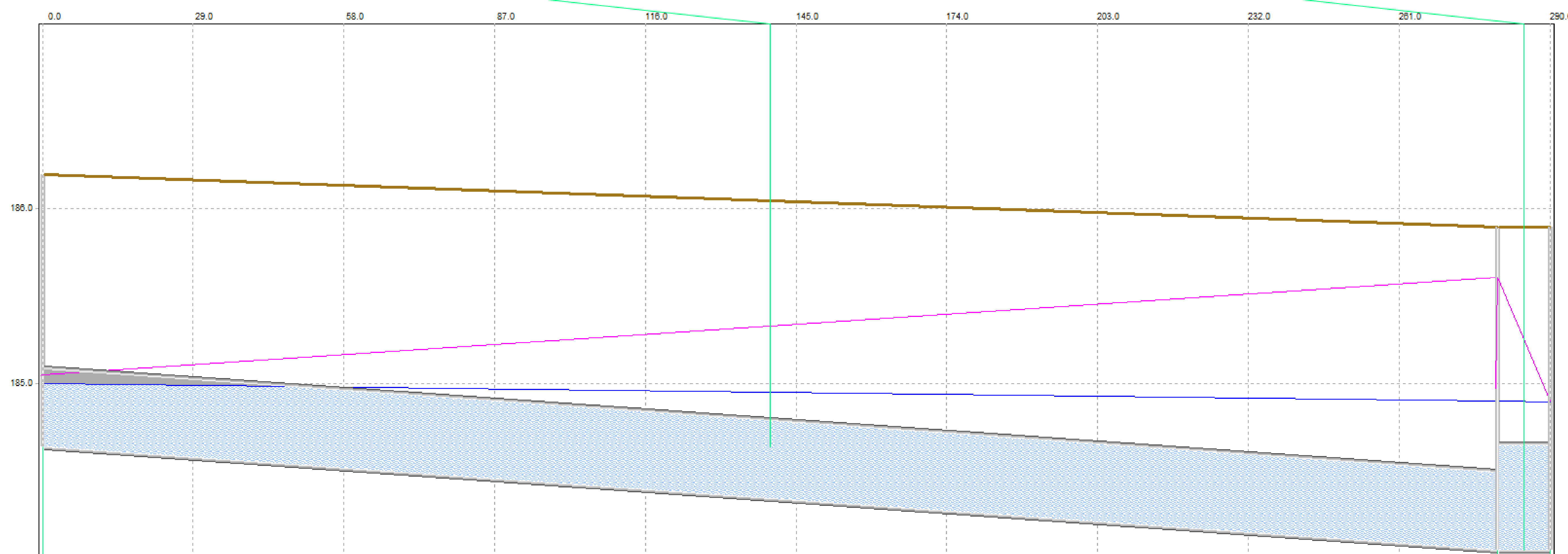


Figure 39: E-W Arterial (Sta. 12+400 - 12+500) - Permanent Pool Elevation + 1.0m Backwater Condition

Link

	Link34	Link35
Shape	Circular	Circular
Length	280.000	10.000
Conduit Slop	0.211	0.000
Diameter (He	0.450	0.600
Downstream	184.050	184.050
Upstream Inv	184.640	184.050

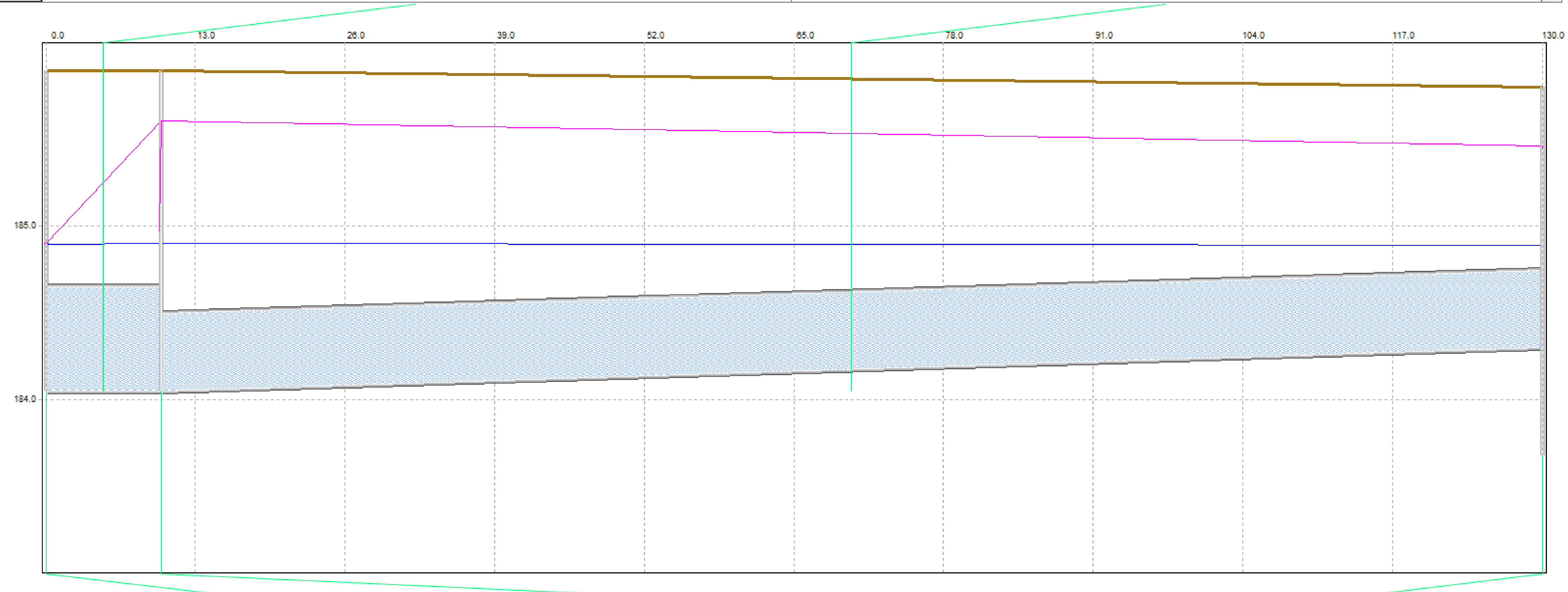


	Node27	Node28	Node47
Ground Eleva	186.200	185.900	185.900
Invert Elevati	184.640	184.050	184.050
Storage Nod	☐	☐	☐
Outfall Flag	☐	☐	☑
Outlet Contro	0.000	0.000	184.900

Node

Figure 40: E-W Arterial (Sta. 12+500 - 12+780) - Permanent Pool Elevation + 1.0m Backwater Condition

Link	Link35	Link36
Shape	Circular	Circular
Length	10.000	120.000
Conduit Slop	0.000	0.208
Diameter (He	0.600	0.450
Downstream	184.050	184.050
Upstream Inv	184.050	184.300



Node	Node47	Node28	Node29
Ground Eleva	185.900	185.900	185.800
Invert Elevati	184.050	184.050	183.680
Storage Nod	☐	☐	☐
Outfall Flag	☑	☐	☐
Outlet Contro	184.900	0.000	0.000

Figure 41: E-W Arterial (Sta. 12+780 - 12+900) - Permanent Pool Elevation + 1.0m Backwater Condition

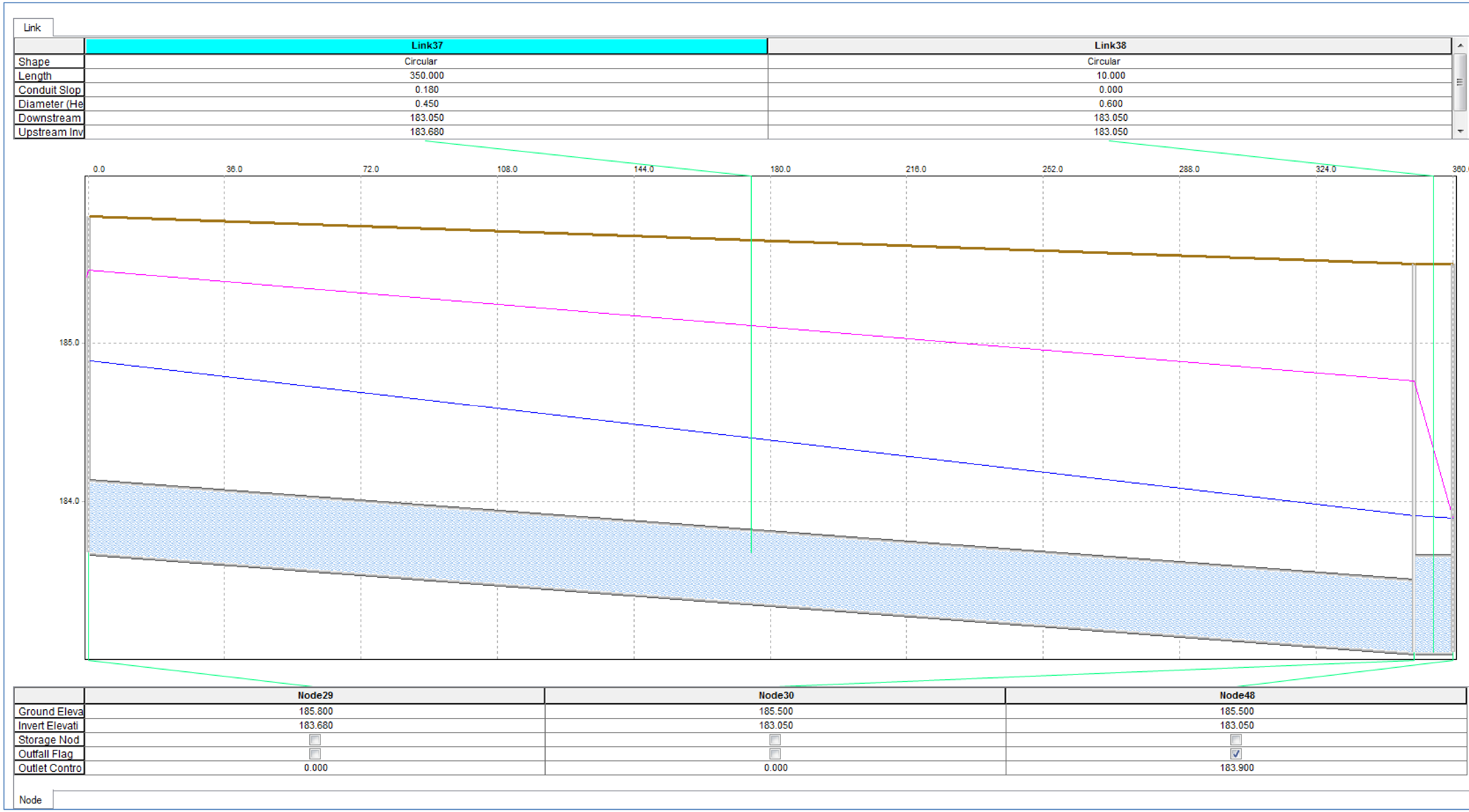


Figure 42: E-W Arterial (Sta. 12+900 - 13+250) - Permanent Pool Elevation + 1.0m Backwater Condition

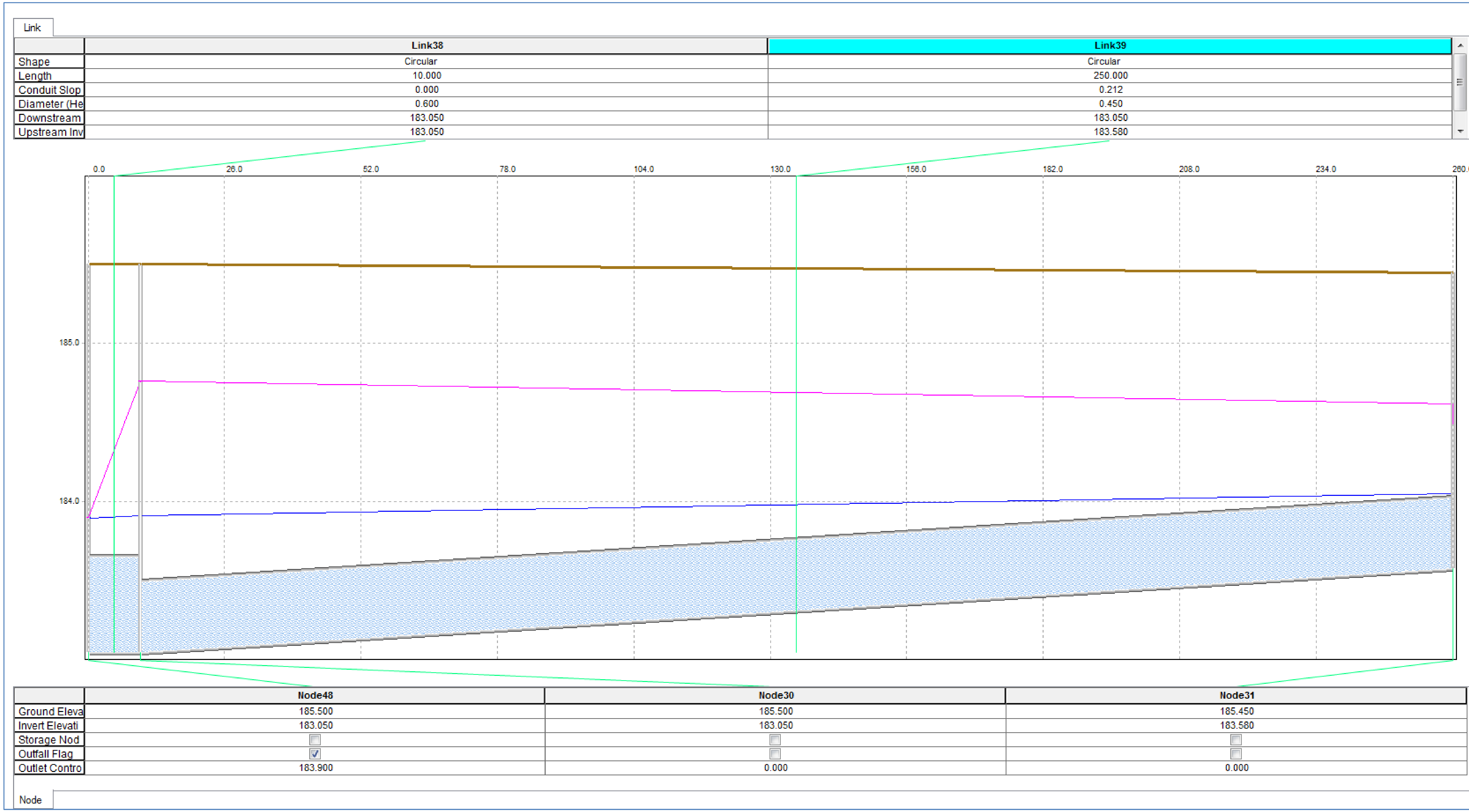
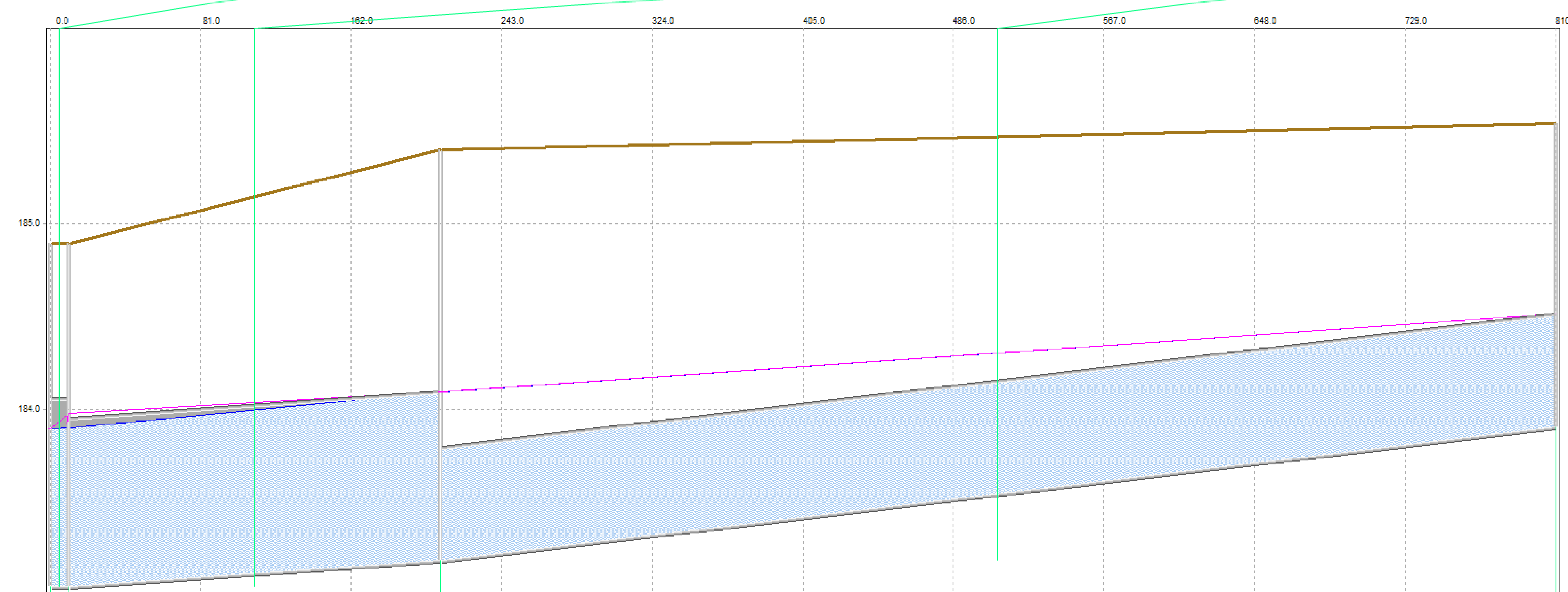


Figure 43: E-W Arterial (Sta. 13+250 - 13+500) - Permanent Pool Elevation + 1.0m Backwater Condition

Link

	Link22	Link44	Link43
Shape	Circular	Circular	Circular
Length	10.000	200.000	600.000
Conduit Slop	0.000	0.000	0.120
Diameter (He	1.000	0.900	0.600
Downstream	183.050	183.050	183.190
Upstream Inv	183.050	183.190	183.910



	Node41	Node17	Node52	Node53
Ground Eleva	184.900	184.900	185.400	185.540
Invert Elevati	183.050	183.050	183.190	183.910
Storage Nod	☐	☐	☐	☐
Outfall Flag	☑	☐	☐	☐
Outlet Contro	183.900	0.000	0.000	0.000

Node

Figure 44: E-W Arterial (Sta. 13+590 – 14+190) - Permanent Pool Elevation + 1.0m Backwater Condition