APPENDIX E

Drainage and Stormwater Management Report

Drainage and Stormwater Management Report

Courtneypark Drive East
Class EA & Preliminary Design

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City of Mississauga

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1.0 Introduction

Stantec Consulting Ltd. (Stantec) has been retained by the City of Mississauga (City) to complete a Class Environmental Assessment (Class EA) 'Schedule C' and preliminary design for Courtneypark Drive East, from Kennedy Road to Dixie Road. The project study area covers a road distance of approximately 2.75 km, the intersections at Kennedy Road, Tomken Road, Ordan Drive/Shawson Drive, Ordan Drive and Vipond Drive, as well as the interchange with Highway 410 (study area). The study alternatives include maintaining the present conditions, widening the road, and completing the existing interchange at Highway 410 and Courtneypark Drive East.

The Class EA will develop a recommendation and preliminary design for a preferred alternative that seeks to meet network demands, improve traffic flow, identify and address safety issues and access constraints, accommodate active transportation and rehabilitation of the existing road conditions.

This Stormwater Management (SWM) Report has been prepared to document the existing drainage, water quantity and quality conditions in the study area, evaluate the relative impacts of the preferred design on the receiving surface water systems, and recommend measures to mitigate the potential impacts.

The following materials were reviewed in the preparation of this report:

- *Preliminary Geotechnical and Pavement Investigation Report*, by SPL Consulting Ltd., April 2015 [Geotechnical Report];
- *Stormwater Management Criteria*, prepared by Toronto and Region Conservation Authority (TRCA), August 2012 [TRCA SWM Guidelines];
- *Etobicoke and Mimico Creeks Watersheds, Technical Update Report*, Executive Summary 2010, prepared by Toronto and Region Conservation Authority (TRCA), [*Etobicoke* Watershed Report];
- *Low Impact Development Stormwater Management Planning and Design Guidelines*, prepared by Credit Valley Conservation (CVC) and TRCA, 2010 [CVC and TRCA LID Guidelines];
- *Highway 410 from South of Highway 401 Northerly to Queen Street, Class Environmental Assessment for Provincial Transportation Facilities, Group 'B'*, prepared by Morrison Hershfield, January 2010; and,
- *Stormwater Design Requirements, Development Requirements Manual, Transportation and Works Department*, City of Mississauga, 2009 [City of Mississauga Design Manual].

2.0 Existing Conditions

2.1 GENERAL

Courtneypark Drive East is an arterial road running east/west in the northern part of the City of Mississauga. The road is located in Ward 5 and travels through both business employment and industrial lands. The area falls within Tributary 3, Etobicoke Creek subwatershed, which is part of Etobicoke Creek Watershed and falls under the jurisdiction of TRCA.

The majority of the lands within the Etobicoke Creek watershed were developed prior to the adoption of current SWM standards; accordingly, stormwater in most of these areas does not receive any treatment before discharging to the receiving watercourse. The study area drains generally from west to east, and drainage is collected via a combination of rural and urban storm drainage systems (roadside ditches, catchbasins, sewers and manholes). The water receives no treatment before discharging to the receiving watercourses, other than grassed swales.

2.2 EXISTING DRAINAGE PATTERNS

Runoff from Courtneypark Drive drainage area is collected via existing road side ditches and storm sewer systems. Flow from all existing ditches and storm sewers ultimately discharges into Tributary 3, Etobicoke Creek, which is located about 300 m north of the road. Existing drainage patterns were studied using servicing plans and topographical map, obtained from digital aerial imagery, provided by the City of Mississauga. Nine catchment areas (numbered 101 to 109) were identified in the existing drainage pattern, as illustrated in the attached **Figures 1.1** to **1.4.**

Catchment 101 includes the northern part of Courtneypark Drive East right-of-way (ROW) and adjacent areas, between Kennedy Road and Highway 410. Minor flows from this catchment are collected via catchbasins located along the north of the road. The catchbasins discharge into a roadside ditch (RD1) flowing in an easterly direction. The ditch discharges into the existing culvert CE1, to the north of Courtneypark Drive East at the Highway 410 interchange. Major flows from this catchment are conveyed via the roadway to a low point, located about 230 m west of Highway 410. Flow is then directed toward the north, crosses Highway 410 via the existing culvert CE1, and ultimately discharges into Tributary 3.

Catchment 102 includes the southern part of Courtneypark Drive East ROW and adjacent areas, between Kennedy Road and Highway 410. Minor flows from this catchment are collected via catchbasins located along the south sides of the road, the catchbasins discharge into a roadside ditch (RD2) flowing in an easterly direction. The ditch discharges into an existing culvert (CE2) across Highway 410 to the south of the interchange. Major flow from the southern portion of the road is directed from the low point toward the south, through curb cut, into the road side ditch, which discharges into the existing culvert CE1.

Catchment 103 extends along the northern part of Courtneypark Drive East ROW and adjacent areas, between Highway 410 and Tomken Road. Minor runoff from this catchment is collected

via catchbasins located on the north side of the road, and connected to existing storm sewer system along the property. The storm sewer discharges northerly to a 1200 mm storm sewer located on Gottardo Court, which then discharges into Tributary 3 of Etobicoke Creek, approximately 400 m north of Courtneypark Drive East. The major road flow is conveyed via the roadway toward Tomken Road.

The major portion of the sewer system is on the north side of Courtneypark Drive East ROW, which runs from east of the ramp in the northeast quadrant of Courtneypark Drive East & Highway 410 interchange to Tomken Road. A small portion of the sewer system is on the south side of Courtneypark Drive East ROW, which only collects stormwater runoff from the southwest corner area of the Courtneypark Drive East & Tomken Road intersection, connecting to the north side storm sewer system through a 750 mm storm sewer crossing Courtneypark Drive East.

Catchment 104 extends along the southern part of Courtneypark Drive East ROW and adjacent areas, between Highway 410 and Tomken Road. Minor runoff from this catchment is collected via catchbasins, which are connected to an existing roadside ditch (RD3) flowing in an easterly direction. The ditch discharges into an existing 450 mm storm sewer system located near the intersection of Courtneypark Drive East and Tomken Road. The storm sewer crosses Courtneypark Drive East to join Catchment 103 storm sewer. The major road flow is conveyed via the roadway towards the east.

Catchment 105 extends along Courtneypark Drive East ROW from Tomken Road to about 180 m east of Ordan Drive. An existing storm sewer system along Courtneypark Drive East collects runoff from this catchment. The storm sewer discharges into the existing 1200 mm storm sewer flowing in a northerly direction along Ordan Drive, and ultimately discharges to Tributary 3, Etobicoke Creek, approximately 600 m north of Courtneypark Drive East.

Catchment 106 extends along Courtneypark Drive East between Catchment 105 to the west and Vipond Drive to east. The runoff from this catchment is collected via an existing 300 mm storm sewer and conveyed to a 375 mm storm sewer flowing northerly along Vipond Drive.

Catchment 107 extends along Courtneypark Drive East, between Vipond Drive and Dixie Road. Runoff from this catchment is collected via an existing storm sewer and flows into a 525 mm storm sewer along Ordan Drive and ultimately discharges to Upper Etobicoke Creek.

Catchment 108 represents Highway 410 northbound exit ramp and the surrounding lands. This area slopes towards a catchbasin located in the middle of the catchment. Runoff is captured by the catchbasin and conveyed to Tributary 3 via an existing 450 mm storm sewer. Catchment 109 represents the area to the west of Highway 410, between Courtneypark Drive East and Derry Road. This area sheet flows toward exiting ditches and watercourses with the Highway 410 ROW.

Highway 410 northbound and southbound in the vicinity of Courtneypark Drive East is divided by grass medians. The crown of the road is located in the centre of the northbound & southbound lanes. Stormwater runoff drains laterally from the outer lanes into roadside ditches. The inner lanes drain to a central ditch within the grass median. The ditches then drain either north or south and outlet into the nearby tributary of Etobicoke Creek. Historically, stormwater runoff from Highway 410 has not received treatment before discharging to Etobicoke Creek and tributaries.

However, the current drainage system of grassed embankments and ditches/swales does provide some water quality benefits by filtering runoff before discharging into the receiving water courses.

The main hydrologic feature in the area is Tributary 3 of Etobicoke Creek, which flows from north to south east. Under existing conditions, no storm water quality, quantity or erosion controls exist within the study area. There is an existing SWM wet pond (SWP1), located at the northwest quadrant of Highway 410 and Courtneypark Drive East interchange. The pond provides quality, quantity and erosion control for areas adjacent to the study area, on the west side of Highway 410. **Table 1** below provides a summary of the existing conditions.

Table 1: Existing Drainage Areas and Discharge Coefficient

Description	Catchment ID	Area (ha)			Runoff Coefficient C
		Impervious	Pervious	Total	
Kennedy Road to Highway 410, northbound	101	0.81	1.25	2.06	0.50
Kennedy Road to Highway 410, southbound	102	0.65	4.19	4.85	0.34
Highway 410 to Tomken Road, northbound	103	3.25	2.58	5.83	0.61
Highway 410 to Tomken Road, southbound	104	0.67	1.29	1.96	0.47
Tomken Road to east of Ordan Drive/Shawson Drive	105	9.70	8.40	18.10	0.60
East of Ordan Drive/Shawson Drive to Vipond Drive	106	0.53	0.23	0.76	0.70
Vipond Drive to Dixie Road	107	3.10	1.41	4.51	0.70
Parking lot	108	0.64	1.530	2.17	0.44
Highway 410 interchange, southbound off-ramp	109	0.17	1.55	1.72	0.30
Total		**19.52**	**22.44**	**41.95**	**0.55**

3.0 SWM Criteria

Additional stormwater runoff from new pavement can impact receiving watercourses and flood conditions. Quantity and quality control measures to treat runoff should be considered for all new impervious areas and, where possible, existing surfaces. The following applicable SWM criteria are based on the City of Mississauga Design Manual and the Etobicoke Watershed Report:

- **Quantity Control**: Post-development peak flows to be controlled to pre-development peak flows for the 2 to 100 year design storms;
- **Quality Control**: Implement Enhanced Level (80% Total Suspended Solids (TSS) Removal) water quality control for all new developments;
- **Erosion and Sediment Control**: Minimum 24 hour detention of the 25mm storm event; and
- **Conveyance**: The storm sewer system should be designed to capture and convey runoff generated by the 10-year storm event. The minimum initial time of concentration is to be 15 minutes.

4.0 SWM Plan

The proposed development includes widening Courtneypark Drive East roadway and interchange improvements at Highway 410. The road widening consists of two additional lanes, new median, 1.5 m sidewalk and 3.5 m multi-use pathway. The interchange improvement includes new movements to the north and from the south, as well as a new commuter parking lot as illustrated in the attached **Figures 2.1** to **2.4.** The post-development catchments are assigned ID numbers 201 to 208, which correspond to pre-development catchments 101 to 108.

It should be noted that the detailed design of SWM infrastructure for Catchment 208 (parking lot) has been conducted by MTO as part of the improvements to Highway 410; therefore, it has not been included in this report. The detailed design of SWM infrastructure for Catchment 209 (Highway 410 interchange, southbound ramp) should be completed during detailed design of the improvements to Courtneypark Drive East.

The proposed development will increase the total paved area from 6.24 to 11.9 ha (an increase of 5.66 ha, or 91% of the original road area). Due to constraints associated with stormwater management options in Catchments 205, 206 and 207, the post-development areas within these catchments cannot be directed to the proposed quantity control facilities. Therefore, an equivalent area of existing pavement in the remaining catchments will receive treatment, as shown in **Table 2** below, to offset the lack of controls in 205, 206 and 207.

Table 2: Additional Pavement Areas and Proposed Treatment

Zone	Catchment ID	Pavement Area (ha)			Proposed SWM Treatment
		Existing	Additional	% of Existing	
Kennedy Road to Highway 410 interchange	201+202	1.58	0.61	39%	Enhanced Swales
Highway 410 interchange to Tomken Road	203+204	1.23	0.79	64%	Enhanced Swales
Tomken Road to east of Ordan Drive/Shawson Drive	205	1.35	0.81	60%	OGS
East of Ordan Drive/Shawson Drive to Vipond Drive	206	0.24	0.14	59%	OGS
Vipond Drive to Dixie Road	207	1.37	0.72	53%	OGS
Parking lot	208	0.30	0.70	233%	Sediment basin
Highway 410 Interchange, southbound off-ramp	209	0.17	1.89	1112%	Sediment basin
Total		**6.24**	**5.66**	**91%**	-

It is proposed to provide the required SWM treatment through the implementation of Low Impact Development (LID) practices and installation of Oil Grit Separators (OGS). Proposed LID features include four enhanced grassed swales and a sediment basin. The proposed SWM plan addresses the Courtneypark Drive East roadway improvements and accommodates the

proposed full interchange with Highway 410. It is also compatible with MTO's design for the reconfigured partial interchange.

Additional quantity and quality control will be required for Catchment 209 – i.e. the new pavement area resulting from construction of the proposed off-ramp from southbound Highway 410 to Courtneypark Drive East, which is an extension of the existing off-ramp to Derry Road. These additional controls should be provided by a new sediment basin constructed in the undeveloped area between the proposed off-ramp and the west Highway 410 ROW boundary. This sediment basin would require a minimum storage capacity of 400 m^3 and would be owned/maintained by MTO. Ultimately, it would discharge to Tributary 3 of Etobicoke Creek on the west side of Highway 410. See **Figure 2.5** for further details. The overall SWM design for the full interchange, including the proposed sediment basin, should be completed during detailed design.

4.1 QUANTITY CONTROL

The SWM criteria require controlling post-development peak flows to pre-development peak flows for the 2 to 100 year design storms. The study area currently does not include any measures to control the runoff before reaching the receiving Tributary 3. Due to study area constraints, it is proposed that no quantity control measures will be applied to the flow from Catchments 205, 206 and 207. The required quantity control target will be achieved by over-controlling runoff from Catchments 201, 202, 203, 204, 208, and 209.

The allowable release rates were calculated using the Rational Method and the existing conditions discharge coefficients. **Table 3** provides a summary of the 100-year allowable release rates and the corresponding post-development discharges without controls. The proposed development will increase the 100-year total discharge from 8.87 m^3/s to 9.83 m^3/s. Quantity control measures will be provided to control the total release rates to pre-development levels. The Modified Rational Method was used to calculate the 871 m^3 required quantity control storage volume.

Table 3: 100-Year Allowable Release Rates and Post-Development Discharges

Catchment ID	Area (ha)	Pre-Development		Post-Development	
		Discharge Coefficient C	Discharge (m^3/s)	Discharge Coefficient C	Discharge (m^3/s)
201	2.06	0.50	0.41	0.60	0.48
202	4.85	0.34	0.64	0.38	0.72
203	2.26	0.61	1.40	0.66	1.50
204	5.34	0.47	0.36	0.60	0.46
205	18.10	0.60	4.23	0.63	4.44
206	0.70	0.70	0.21	0.84	0.25
207	5.99	0.70	1.23	0.77	1.36
208	1.83	0.44	0.37	0.61	0.51
209	1.72	0.30	0.20	0.90	0.60
Total	**42.84**	**0.55**	**9.05**	**0.63**	**10.33**

The quantity control target will be achieved by over-controlling flow from Catchments 201, 202, 203, 204, 208, and 209. The required storage volume will be provided via a proposed sediment basin for Catchment 208, via a proposed sediment basin or enhanced swales in Catchment 209 (see Section 4.0), and via enhanced swales and rock check dams for the remaining controlled catchments. Runoff from Catchments 205, 206 and 207 will be released uncontrolled. **Table 4** below provides a summary of the releases rates and storage volumes. Detailed calculations are provided in **Appendix A**.

It should be noted that the detailed design of the proposed sediment basin for the parking lot in Catchment 208 will be prepared as part of MTO's work for the widening of Highway 410/reconfiguration of the partial interchange, hence, this basin will not be included in the detailed design of the Courtneypark Drive East project.

Table 4: Summary of Quantity Control Parameters

Description	Catchment ID	Allowable Release	Required Storage	Proposed Release	Required Storage
		m^3/s	m^3	m^3/s	m^3
Kennedy Road to Highway 410, northbound	201	0.406	71	0.210	247
Kennedy Road to Highway 410, southbound	202	0.639	71	0.450	241
Highway 410 to Tomken Road, northbound	203	1.395	92	1.140	321
Highway 410 to Tomken Road, southbound	204	0.362	91	0.465	0
Tomken Road to east of Ordan Drive/Shawson Drive	205	4.232	187	4.440	0
East of Ordan Drive/Shawson Drive to Vipond Drive	206	0.209	37	0.230	0
Vipond Drive to Dixie Road	207	1.228	120	1.810	0
Parking lot	208	0.375	126	0.100	418
Highway 410 interchange, southbound off-ramp	209	0.202	368	0.202	368
Total		**9.05**	**1163**	**9.05**	**1595**

4.2 QUALITY CONTROL

The study area currently does not include any water quality control measures to treat runoff before discharging to receiving watercourse, Tributary 3 of Etobicoke Creek. The SWM criteria require the implementation of enhanced level water quality control for all new developments. It is proposed to achieve the required quality control target by providing three enhanced grassed swales and three OGS units.

Three enhanced grassed swales are proposed to treat the runoff from Catchments 201, 202, 203, 204, and 209. Grassed swales can be effective for pollutant removal if designed as per the MOE guidelines, which recommends shallow, wide swales with flow velocity below 0.5 m/s for the 25 mm, 4 hr. Chicago storm event. The grass should be allowed to grow higher than 75 mm to enhance the filtration of suspended solids. The swales will be located along the existing Courtneypark Drive East roadside ditches, between Kennedy Road and Tomken Road. Runoff from Catchments 208 and 209 will be treated via two proposed sediment basins, which will be located at the northwestern corner of the parking area and to the west of the existing culvert CE1.

Three OGS units are proposed to treat the runoff from Catchments 205, 206 and 207. These units were sized using the PCSWMM Stormceptor sizing software, assuming target TSS removal of 80%. An STC9000 unit is proposed to replace the existing manhole MH37 and treat runoff from Catchment 205. An STC2000 unit is proposed to replace the existing manhole MH41 and treat

runoff from Catchment 206. An STC9000 is proposed to replace the existing manhole MH48 and treat runoff from Catchment 207. OGS sizing calculations are included in **Appendix B**.

To achieve the quality control target, it is required to remove 80% of the TSS from the new 5.33 ha pavement area. The initial sediment load is assumed to be 1.0 unit of sediment x Catchment Area, i.e. 5.33 sediment units. By removing 80% of the TSS, the removed sediment is equal to 80%* 5.33 = 4.30 sediment units. The pre-development TSS removal efficiency for the project total drainage area of 41.95 ha was calculated as 65%. The proposed quality control measures will increase the overall study area TSS removal efficiency by 22.5% (from 42.4%to 64.8%). Therefore, the additional sediment load removed from the treated areas (i.e. 22.5% * 42.12 = 9.5 sediment units) is more than the required target removal of 4.40 units. Detailed quality control calculations are included in **Appendix B**.

4.3 EROSION AND SEDIMENT CONTROL

4.3.1 Detention Storage

The erosion and sediment control criterion requires a minimum 24 hour detention of the 25 mm storm event. Therefore, a detention volume of 1415 m^3 will be required for the 5.66 ha of new paved area. The enhanced swales and sediment basin will be utilized to provide a total detention volume of about 1875 m^3, which exceeds the required erosion and sediment control storage volume.

4.3.2 Retention Storage

TRCA SWM Guidelines require on-site retention of a minimum of 5 mm of runoff from impervious areas in order to maintain downstream erosion rates. CVC and TRCA LID Guidelines includes a number of LID measures to satisfy this requirement. The following LID measures were reviewed:

- Bioretention: bioretention areas are planted depressions that store and filter rainwater to enhance water quality. They may be used to pre-treat runoff, prior to discharge into infiltration systems. Bioretention areas can be used to store excess stormwater when the downstream infiltration system has been surcharged. This allows infiltration to occur over an extended duration of time allowing more runoff to be infiltrated by the system. Bioretention areas also treat stormwater runoff by passing it through an engineered filter medium, collecting it in an underdrain and then returning it back to the storm drain system. Bioretention is used as both a water quality and water balance measure.
- Filter Strips: filter strips are vegetated areas that treat sheet flow from adjacent impervious areas. Filter strips slow runoff velocities and settle out sediment and pollutants. Small depressions can be used to provide some storage. In permeable soils, storage and infiltration occurs. Filter strips are mainly used as a water quality measure and, in suitable soils, also a water balance measure.

Bioretention LID is proposed as a suitable measure to satisfy the on-site retention requirement for the proposed widening of Courtneypark Drive East. The total required retention volume is

calculated as 283 m^3, which is equivalent to a total infiltration trench volume of 708 m^3 (assuming a void ratio of 0.40). It is proposed to install the bioretention areas within swales SW1, SW2, and SW3. The Geotechnical Report states that clay till to clayey silt till deposits were encountered in the vicinity of swales SW1 to SW3 (boreholes BH101 to BH108), extending to depths ranging from 5.6 m to 6.7 m below the existing grade. Clay till to clayey silt till deposits are considered to have medium to low permeability. The actual dimensions of the bioretention areas will be determined during the detailed design stage, when further percolation tests results are available at the proposed bioretention areas.

4.4 DRAINAGE SYSTEM

Runoff from Catchments 203 to 207 is collected via the existing stormwater systems and conveyed to Tributary 3 of Etobicoke Creek. The City of Mississauga Design Manual requires that the storm sewer network should be designed with adequate capacity to accommodate runoff generated by the 10-year storm events, and recommends 15 minutes initial time of concentration.

An analysis was conducted to evaluate the capacity of the three existing networks, and to determine if the networks can adequately accommodate the increased post-development runoff. The analysis was based on the available information provided by the City. This includes plans and profiles of the existing network, topographic map of the existing roadway and adjacent areas, and the actual drainage area for each storm sewer. The analysis was done based on the best available information; however, it is highly recommended that additional information should be acquired during the detailed design stage to confirm the boundaries and characteristics of the existing drainage areas. The drainage system calculations and analysis should then be updated accordingly.

Based on the available information, the analysis showed that the existing storm sewer network 1, which is located to the north of Courtneypark Drive East and receives runoff from Catchments 102, 103 and 104, has adequate capacity. The network also has adequate capacity to convey the post-development flow, since the flow from the four catchments is controlled to pre-development conditions. Network 2, which is located along the roadway centerline, and receives runoff from Catchment 105, has inadequate capacity for both pre- and post-development conditions. Network 3, which is located along the roadway centerline, and receives runoff from Catchments 106 and 107, has inadequate capacity for both pre- and post-development conditions. **Table 5** and **Table 6** below provide summary of the network analysis, detailed analysis is provide in **Appendix C**.

Therefore, it is proposed that the existing storm sewer system be replaced with larger pipes for Networks 2 and 3 between Tomken Road and Dixie Road.

Table 5: Stormsewer Networks Pre-Development Conditions

Stormsewer Network	Catchment	Street	From MH	To MH	Pipe Diameter (mm)	Full Flow Capacity (m^3/s)	% Full*
Network 1	103	Courtneypark Drive East	MH21	MH23	525	0.430	44%
	103	Courtneypark Drive East	MH22	MH23	450	0.285	67%
	-	Courtneypark Drive East	MH23	MH24	750	1.113	34%
	103+104	Courtneypark Drive East	MH24	MH29	825	0.962	64%
	102	Courtneypark Drive East	MH25	MH27	900	1.809	25%
	104	Courtneypark Drive East	MH26	MH27	375	0.213	81%
	102+104	Courtneypark Drive East	MH27	MH28	1050	2.217	39%
	102+104	Courtneypark Drive East	MH28	MH29	1050	2.300	36%
	-	Gottardo Ct	MH29	MH1	1200	3.897	36%
Network 2	105	Courtneypark Drive East	MH31	MH32	600	0.614	81%
	105	Courtneypark Drive East	MH32	MH33	750	0.862	112%
	105	Courtneypark Drive East	MH33	MH34	750	0.995	142%
	105	Courtneypark Drive East	MH34	MH37	750	0.995	184%
	105	Courtneypark Drive East	MH35	MH36	600	0.336	148%
	105	Courtneypark Drive East	MH36	MH37	600	0.388	244%
Network 3	106	Courtneypark Drive East	MH40	MH41	300	0.068	199%
	106	Courtneypark Drive East	MH41	MH42	375	0.175	75%
	107	Courtneypark Drive East	MH43	MH44	300	0.072	318%
	107	Courtneypark Drive East	MH44	MH45	375	0.124	350%
	107	Courtneypark Drive East	MH45	MH48	375	0.175	354%
	107	Courtneypark Drive East	MH46	MH47	300	0.068	336%
	107	Courtneypark Drive East	MH47	MH48	375	0.124	349%
	107	Courtneypark Drive East	MH48	MH4	375	0.175	571%

*For 10-year storm return period

Table 6: Stormsewer Networks Post-Development Conditions

Stormsewer Network	Catchment	Street	From MH	To MH	Pipe Diameter (mm)	Full Flow Capacity (m3/s)	% Full
Network 1	203	Courtneypark Drive East	MH21	MH23	525	0.430	44%
	203	Courtneypark Drive East	MH22	MH23	450	0.285	67%
	-	Courtneypark Drive East	MH23	MH24	750	1.113	34%
	203+204	Courtneypark Drive East	MH24	MH29	825	0.962	65%
	202	Courtneypark Drive East	MH25	MH27	900	1.809	25%
	204	Courtneypark Drive East	MH26	MH27	450	0.347	51%
	202+204	Courtneypark Drive East	MH27	MH28	1050	2.217	39%
	202+204	Courtneypark Drive East	MH28	MH29	1050	2.300	37%
	-	Gottardo Ct	MH29	MH1	1200	3.897	36%
Network 2	205	Courtneypark Drive East	MH31	MH32	675	0.840	62%
	205	Courtneypark Drive East	MH32	MH33	900	1.402	73%
	205	Courtneypark Drive East	MH33	MH34	1050	2.441	61%
	205	Courtneypark Drive East	MH34	MH37	1050	2.441	80%
	205	Courtneypark Drive East	MH35	MH36	825	0.786	66%
	205	Courtneypark Drive East	MH36	MH37	1050	1.144	58%
Network 3	206	Courtneypark Drive East	MH40	MH41	450	0.201	80%
	206	Courtneypark Drive East	MH41	MH42	450	0.285	55%
	207	Courtneypark Drive East	MH43	MH44	525	0.322	79%
	207	Courtneypark Drive East	MH44	MH45	750	0.787	62%
	207	Courtneypark Drive East	MH45	MH48	750	1.113	64%
	207	Courtneypark Drive East	MH46	MH47	600	0.434	59%
	207	Courtneypark Drive East	MH47	MH48	825	1.014	49%
	207	Courtneypark Drive East	MH48	MH4	900	1.809	64%

5.0 Summary

The proposed plan meets the SWM criteria as summarized below:

- **Water Quantity Control**: Enhanced swales and sediment basin will be used to achieve the quantity control target of controlling post-development peak flow rates to pre-development levels.
- **Water Quantity Control**: Enhanced swales, OGS units (3), and a sediment basin will be used to achieve the quality control target of 80 % TSS removal efficiency for the developed areas.
- **Erosion and Sediment Control**: Enhanced swales and sediment basin will be used to detain runoff generated by the 25 mm storm event for a minimum of 24 hours.
- **Conveyance**: The existing storm sewer Network 1 has adequate capacity, while Networks 2 and 3 do not have sufficient capacity to convey the current or post-development flows. Additional information regarding the actual drainage areas should be obtained during the detailed design stage.

Table 7 and **Table 8** below provide summary of the proposed SWM and drainage works:

Table 7: Existing and Proposed Stormsewer Sizes (1)

Stormsewer Network	From MH	To MH	Existing Pipe (mm)	Proposed Pipe (mm)
Network 1	MH21	MH23	525	525
	MH22	MH23	450	450
	MH23	MH24	750	750
	MH24	MH29	825	825
	MH25	MH27	900	900
	MH26	MH27	375	450
	MH27	MH28	1050	1050
	MH28	MH29	1050	1050
	MH29	MH1	1200	1200
Network 2	MH31	MH32	**600**	**675**
	MH32	MH33	**750**	**900**
	MH33	MH34	**750**	**1050**
	MH34	MH37	**750**	**1050**
	MH35	MH36	**600**	**825**
	MH36	MH37	**600**	**1050**
Network 3	MH40	MH41	**300**	**450**
	MH41	MH3	**375**	**450**
	MH43	MH44	**300**	**525**
	MH44	MH45	**375**	**750**
	MH45	MH48	**375**	**750**
	MH46	MH47	**300**	**600**
	MH47	MH48	**375**	**825**
	MH48	MH4	**325**	**900**

(1) *The highlighted existing pipes should be upsized as shown*

Table 8: Proposed Enhanced Swales

ID	From	To	Bed Width (m)	Length (m)	No. of Dams
Swale 1	*Kennedy Road*	*Highway 410*	0.75	420	3
Swale 2	*Kennedy Road*	*Highway 410*	1.0	500	4
Swale 3	*Highway 410*	*Tomken Road*	1.50	320	3

We trust the information provided will assist you in completing your review of the SWM plan for this study area. Should you require any additional information, please contact the undersigned.

Sincerely,
STANTEC CONSULTING LTD.

Mustafa Mukhtar, P.Eng.
Water Resources Engineer
Tel : (905) 944-6833
Fax: (905) 474-9889
mustafa.mukhtar@stantec.com

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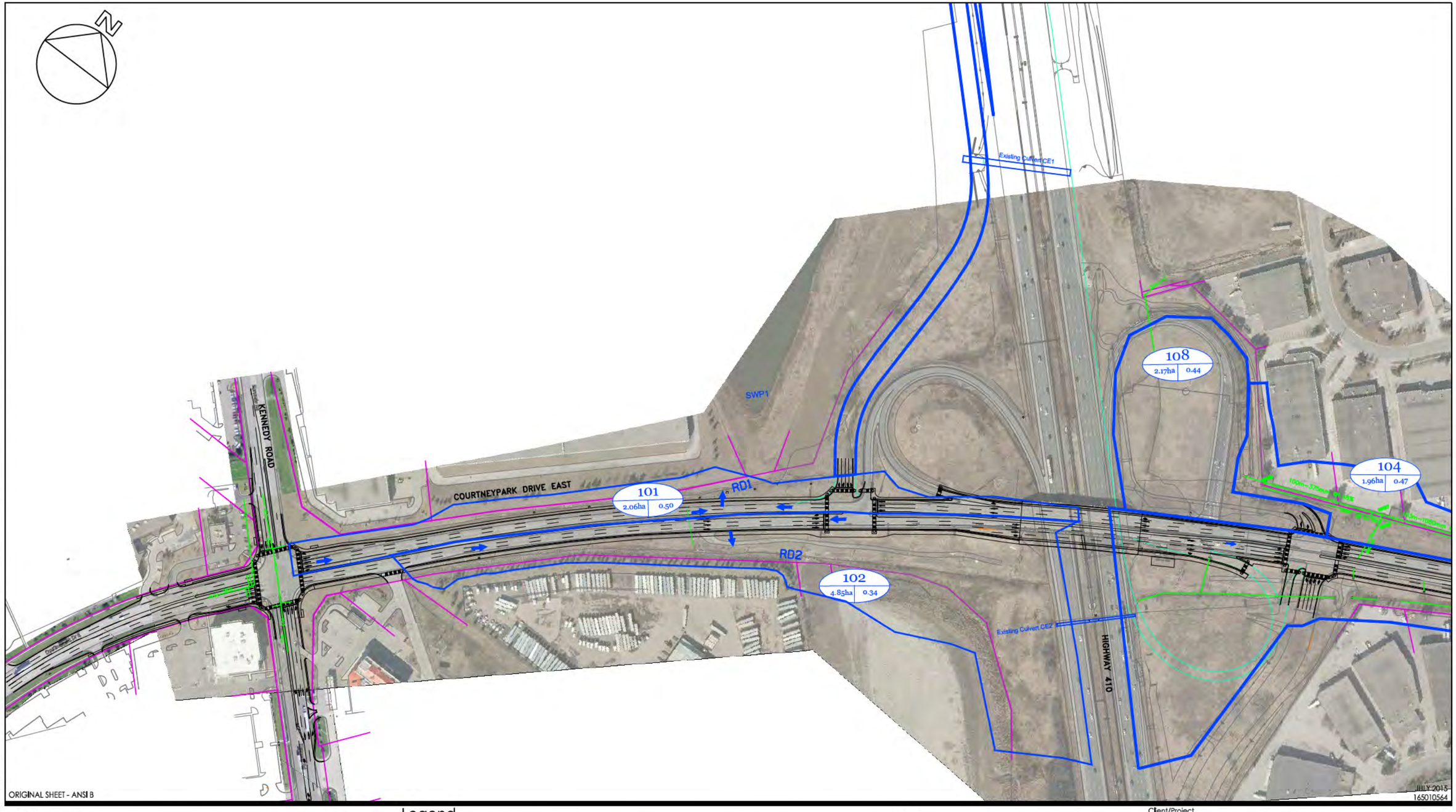
2015/11/09 10:34 AM By: Sanchez, Claudia



ORIGINAL SHEET - ANSI B

JULY 2015
165010564

Legend

- PROPERTY BOUNDARY
- STORM SEWER
- CATCH BASIN
- CATCH BASIN MANHOLE
- MINOR FLOW
- OVERLAND FLOW
- DRAINAGE BOUNDARY
- ROCK CHECK DAM
- 102 / 4.85ha / 0.38 — CATCHMENT ID, RUNOFF COEFFICIENT, AREA (Ha)

Notes

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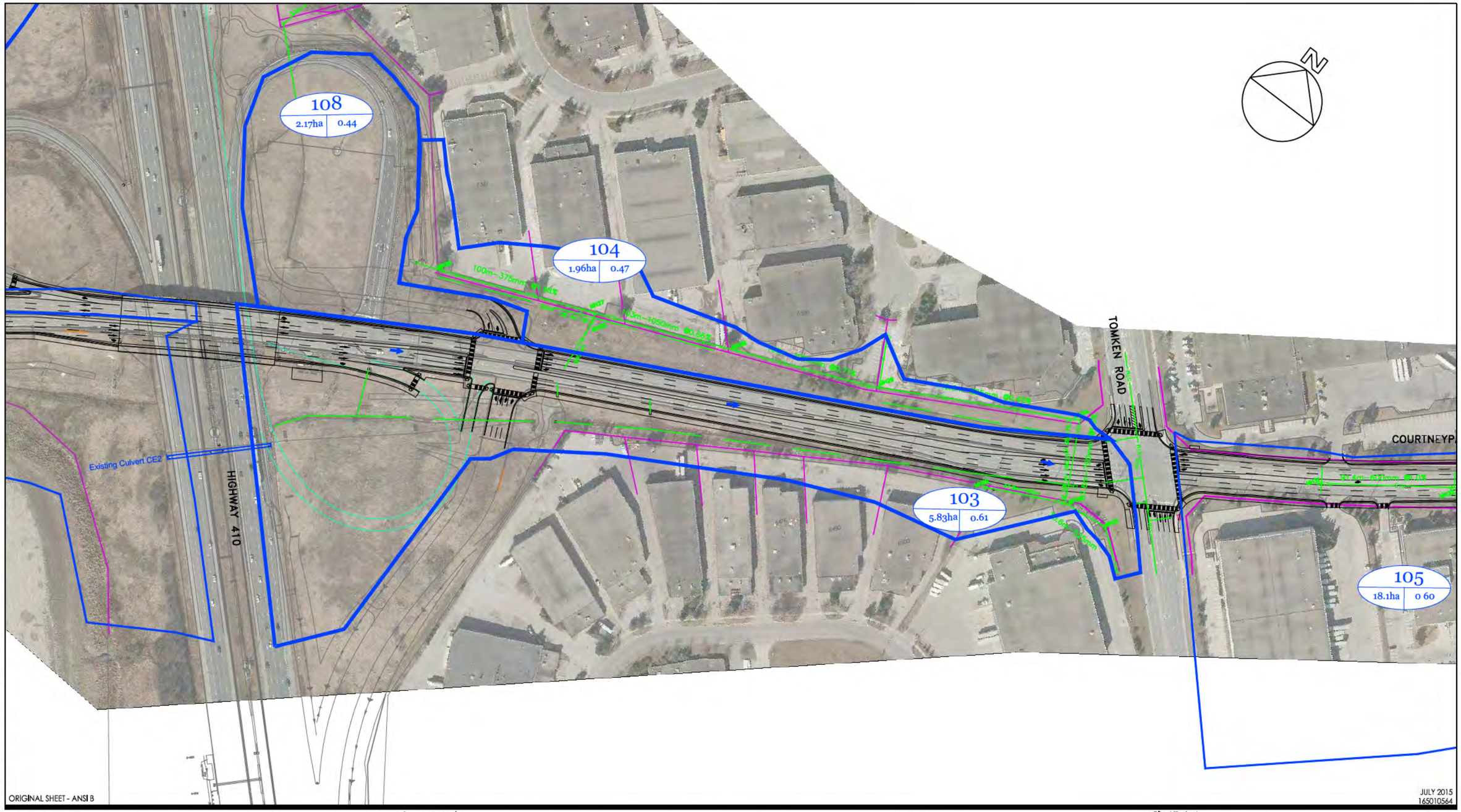
Client/Project
CITY OF MISSISSAUGA

Figure No.
1.1

Title
COURTNEYPARK DRIVE EAST
SWM PLAN ZONE 1



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Legend

- PROPERTY BOUNDARY
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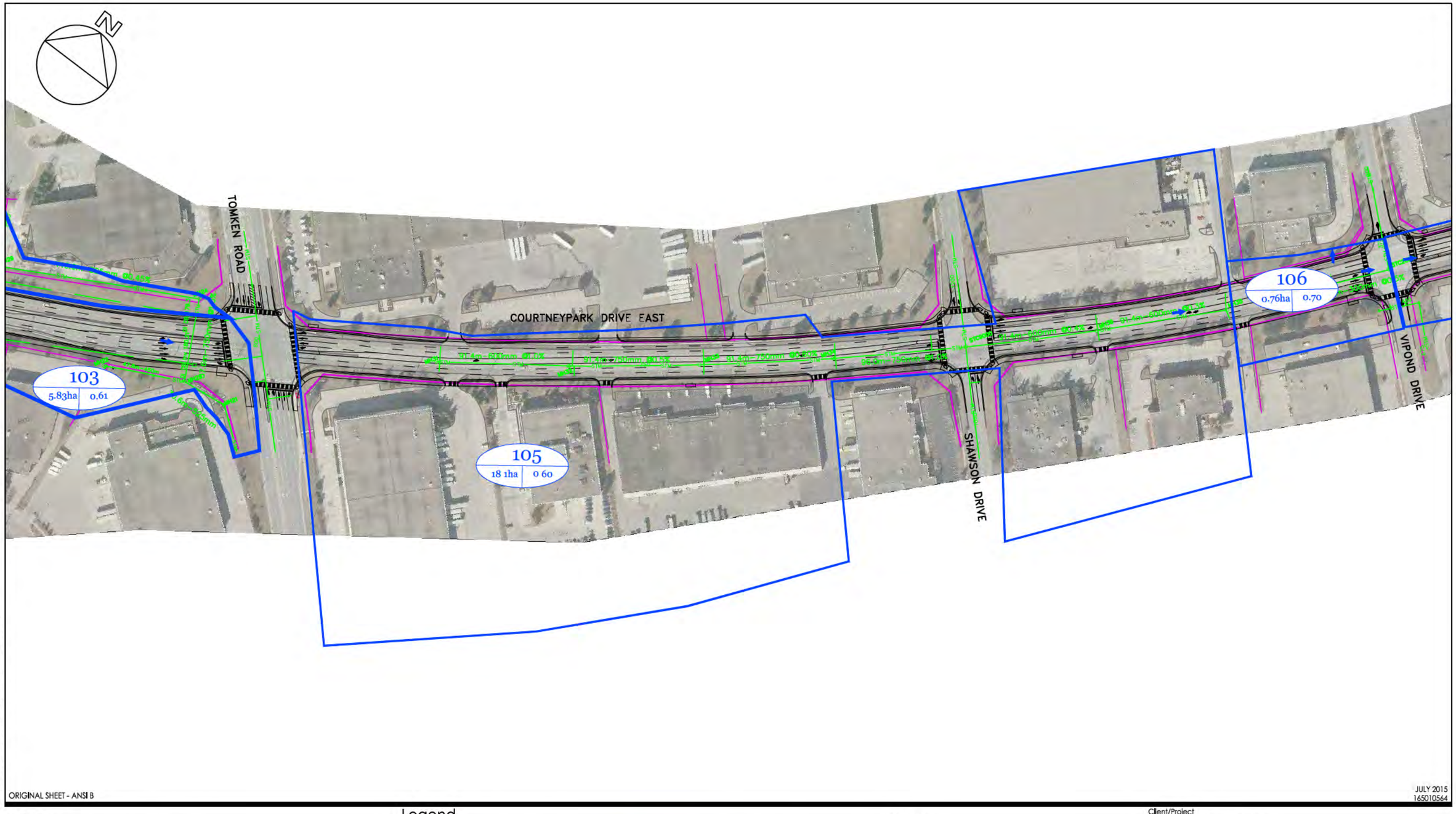
- ROCK CHECK DAM
- CATCHMENT ID
- RUNOFF COEFFICIENT
- AREA (Ha)

Notes

Client/Project
CITY OF MISSISSAUGA

Figure No.
1.2

Title
COURTNEYPARK DRIVE EAST
SWM PLAN ZONE 2



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ORIGINAL SHEET - ANSI B

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Legend

- PROPERTY BOUNDARY
- STORM SEWER
- CATCH BASIN
- CATCH BASIN MANHOLE
- MINOR FLOW
- OVERLAND FLOW
- DRAINAGE BOUNDARY
- ROCK CHECK DAM
- 102 / 4.85ha / 0.38 — CATCHMENT ID; RUNOFF COEFFICIENT; AREA (Ha)

Notes

Client/Project
CITY OF MISSISSAUGA

Figure No.
1.3

Title
COURTNEYPARK DRIVE EAST
SWM PLAN ZONE 3

V:\01650\active\165010564 - Courtneypark Drive East Class EA\Design\Drainage\D Drawings\from_1606_20150330\swm_10564_fig_20150427_cms.dwg
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ORIGINAL SHEET - ANSI B

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Legend

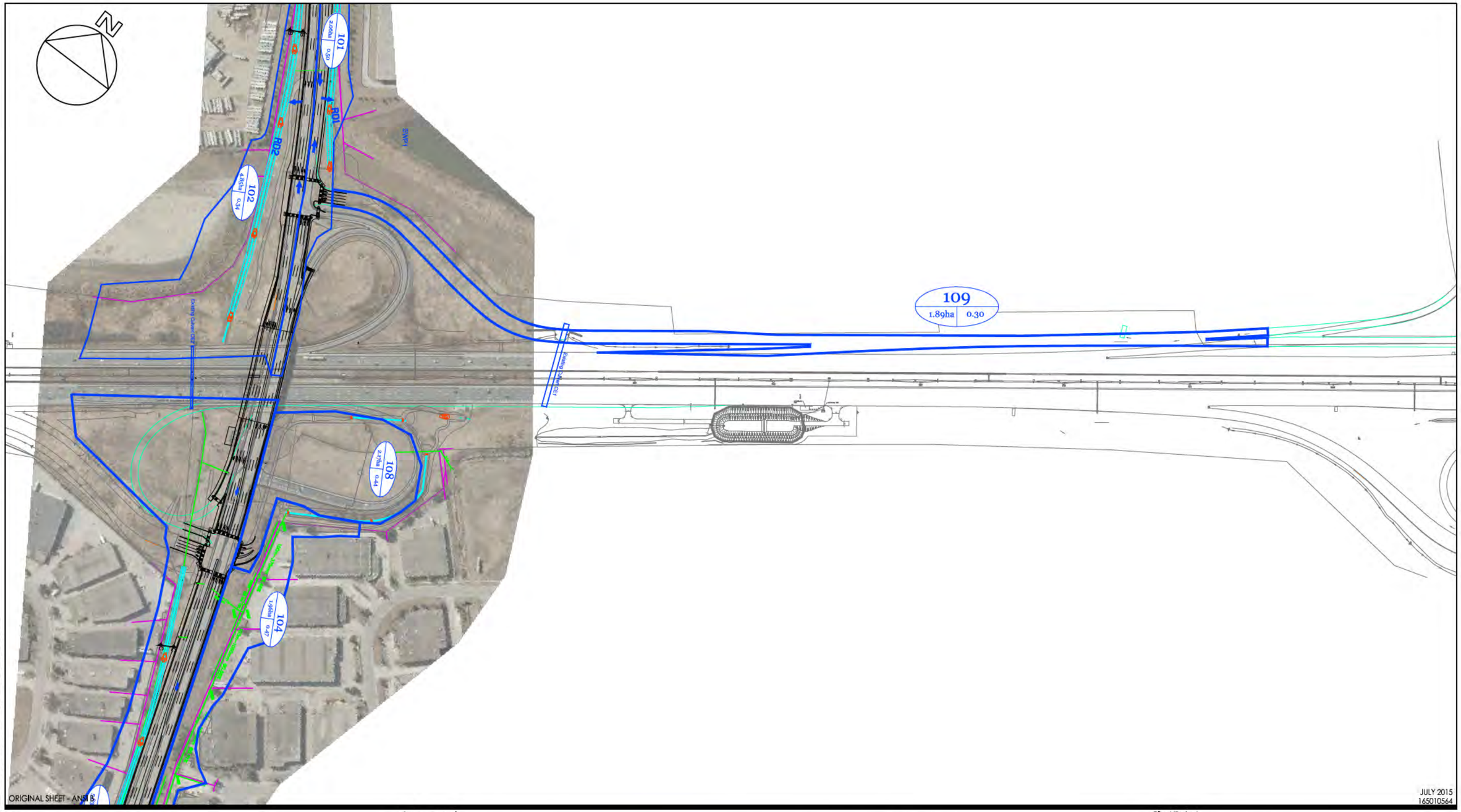
- PROPERTY BOUNDARY
- STORM SEWER
- CATCH BASIN
- CATCH BASIN MANHOLE
- MINOR FLOW
- OVERLAND FLOW
- DRAINAGE BOUNDARY
- ROCK CHECK DAM
- 102 / 4.85ha / 0.38 — CATCHMENT ID; RUNOFF COEFFICIENT; AREA (Ha)

Notes

Client/Project
CITY OF MISSISSAUGA

Figure No.
1.4

Title
COURTNEYPARK DRIVE EAST
SWM PLAN ZONE 4



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Legend

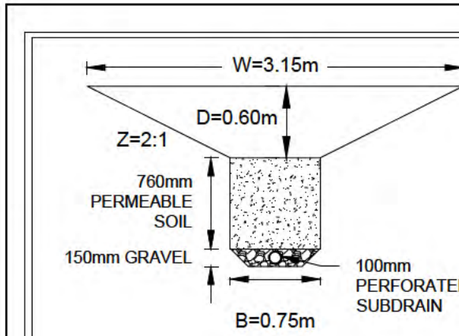
- PROPERTY BOUNDARY
- STORM SEWER
- CATCH BASIN
- CATCH BASIN MANHOLE
- MINOR FLOW
- OVERLAND FLOW
- DRAINAGE BOUNDARY
- ROCK CHECK DAM
- 202 / 4.85ha | 0.38 — CATCHMENT ID / RUNOFF COEFFICIENT / AREA (Ha)

Notes

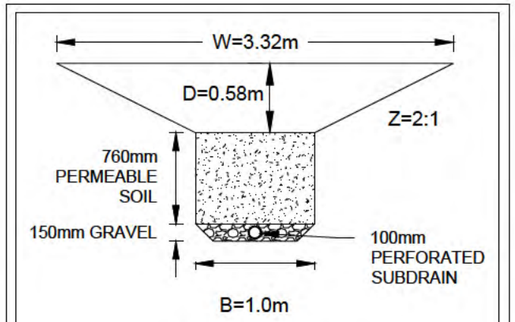
Client/Project
CITY OF MISSISSAUGA

Figure No.
1.5

Title
COURTNEYPARK DRIVE EAST
SWM PLAN ZONE 5



SECTION A-A
SWALE SW1



SECTION B-B
SWALE SW2

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Legend

- PROPERTY BOUNDARY
- STORM SEWER
- CATCH BASIN
- CATCH BASIN MANHOLE
- MINOR FLOW
- OVERLAND FLOW
- DRAINAGE BOUNDARY
- ROCK CHECK DAM
- CATCHMENT ID
- RUNOFF COEFFICIENT
- AREA (Ha)

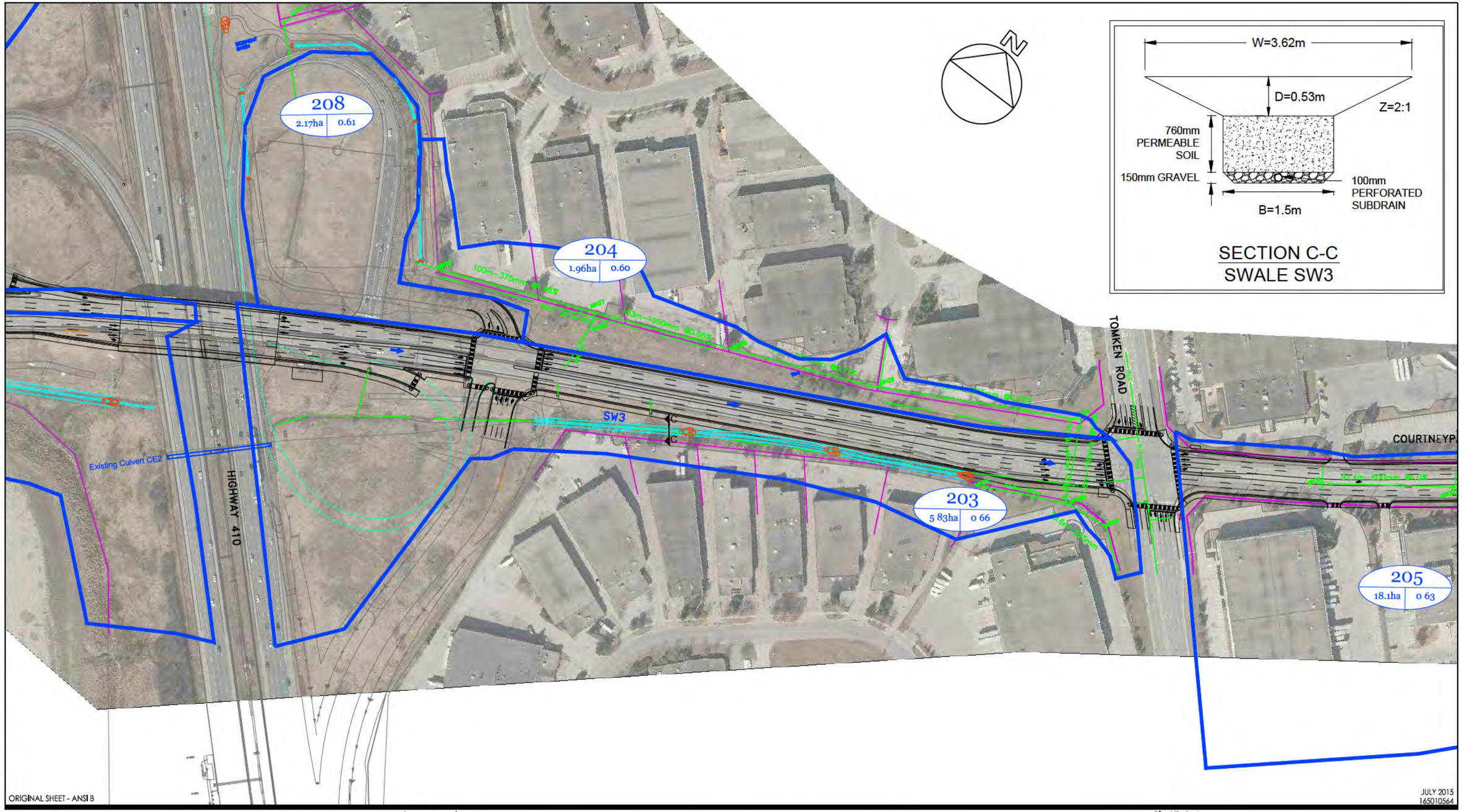
202 / 4.85ha / 0.38

Notes

Client/Project
CITY OF MISSISSAUGA

Figure No.
2.1

Title
COURTNEYPARK DRIVE EAST
SWM PLAN ZONE 1



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Legend

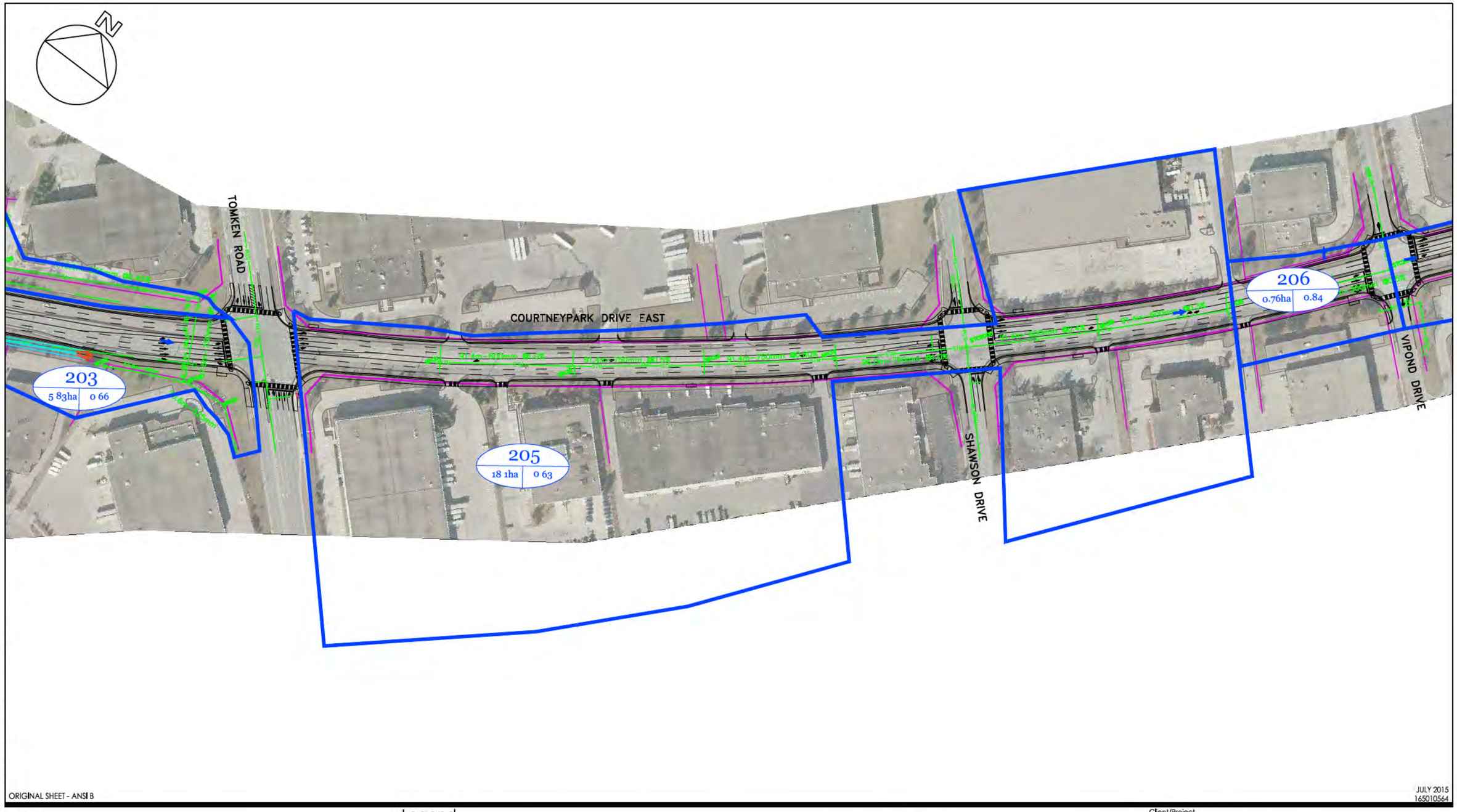
- PROPERTY BOUNDARY
- STORM SEWER
- CATCH BASIN
- CATCH BASIN MANHOLE
- MINOR FLOW
- OVERLAND FLOW
- DRAINAGE BOUNDARY
- ROCK CHECK DAM
- 202 / 4.85ha / 0.38 — CATCHMENT ID, RUNOFF COEFFICIENT, AREA (Ha)

Notes

Client/Project
CITY OF MISSISSAUGA

Figure No.
2.2

Title
COURTNEYPARK DRIVE EAST
SWM PLAN ZONE 2



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Legend

- PROPERTY BOUNDARY
- STORM SEWER
- CATCH BASIN
- CATCH BASIN MANHOLE
- MINOR FLOW
- OVERLAND FLOW
- DRAINAGE BOUNDARY
- ROCK CHECK DAM
- 202 / 4.85ha / 0.38 — CATCHMENT ID; RUNOFF COEFFICIENT; AREA (Ha)

Notes

Client/Project
CITY OF MISSISSAUGA

Figure No.
2.3

Title
COURTNEYPARK DRIVE EAST
SWM PLAN ZONE 3

V:\01650\active\165010564 - Courtneypark Drive East Class EA\Design\Drainage\D Drawings\from_1606_20150330\swm_10564_fig_20150427_cms.dwg
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Legend

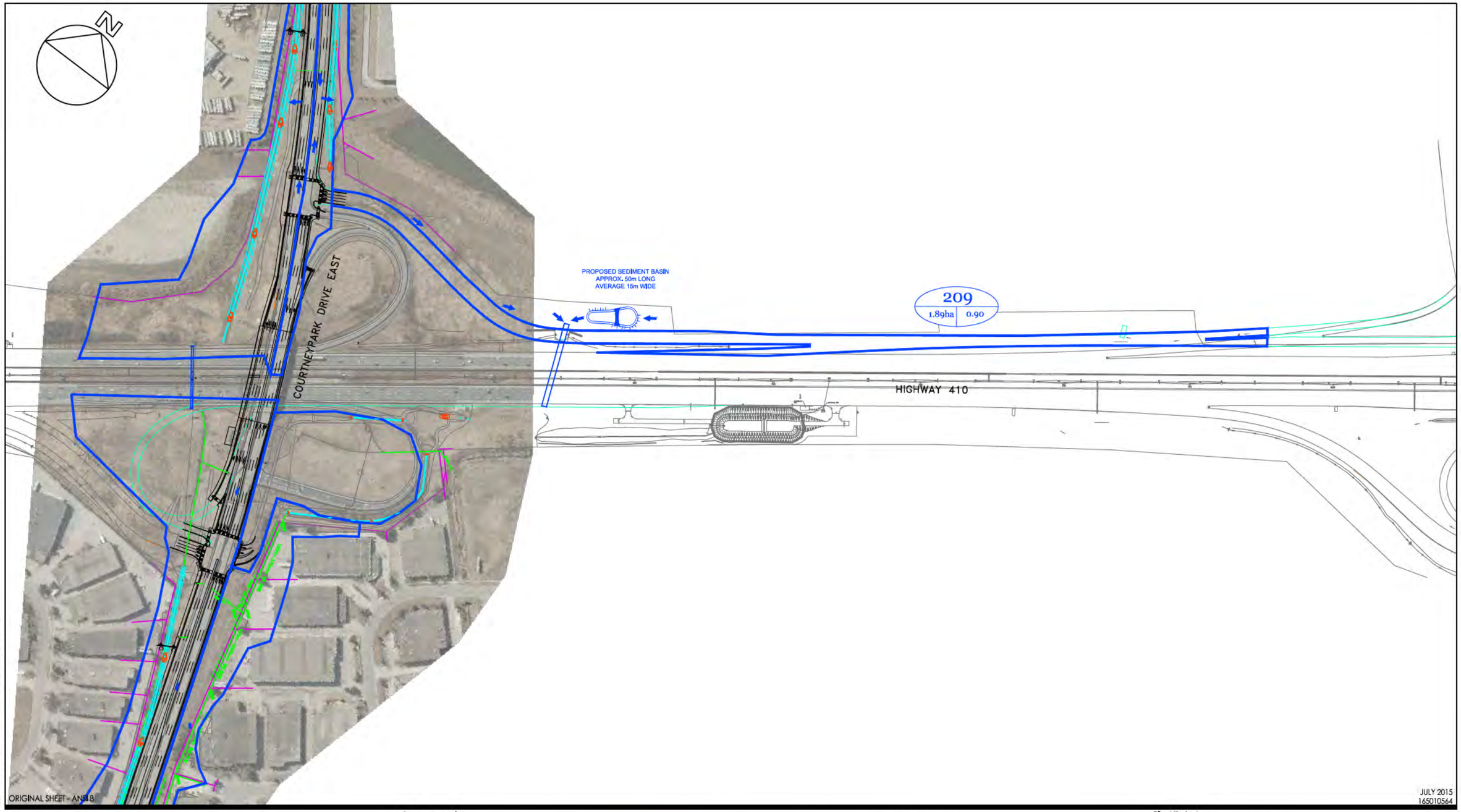
- PROPERTY BOUNDARY
- STORM SEWER
- CATCH BASIN
- CATCH BASIN MANHOLE
- MINOR FLOW
- OVERLAND FLOW
- DRAINAGE BOUNDARY
- ROCK CHECK DAM
- 202 / 4.85ha / 0.38 — CATCHMENT ID, RUNOFF COEFFICIENT, AREA (Ha)

Notes

Client/Project
CITY OF MISSISSAUGA

Figure No.
2.4

Title
COURTNEYPARK DRIVE EAST
SWM PLAN ZONE 4



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Legend

- PROPERTY BOUNDARY
- STORM SEWER
- CATCH BASIN
- CATCH BASIN MANHOLE
- MINOR FLOW
- OVERLAND FLOW
- DRAINAGE BOUNDARY
- ROCK CHECK DAM
- 202 / 4.85ha | 0.38 — CATCHMENT ID / RUNOFF COEFFICIENT / AREA (Ha)

Notes

Client/Project
CITY OF MISSISSAUGA

Figure No.
2.5

Title
COURTNEYPARK DRIVE EAST
SWM PLAN ZONE 5

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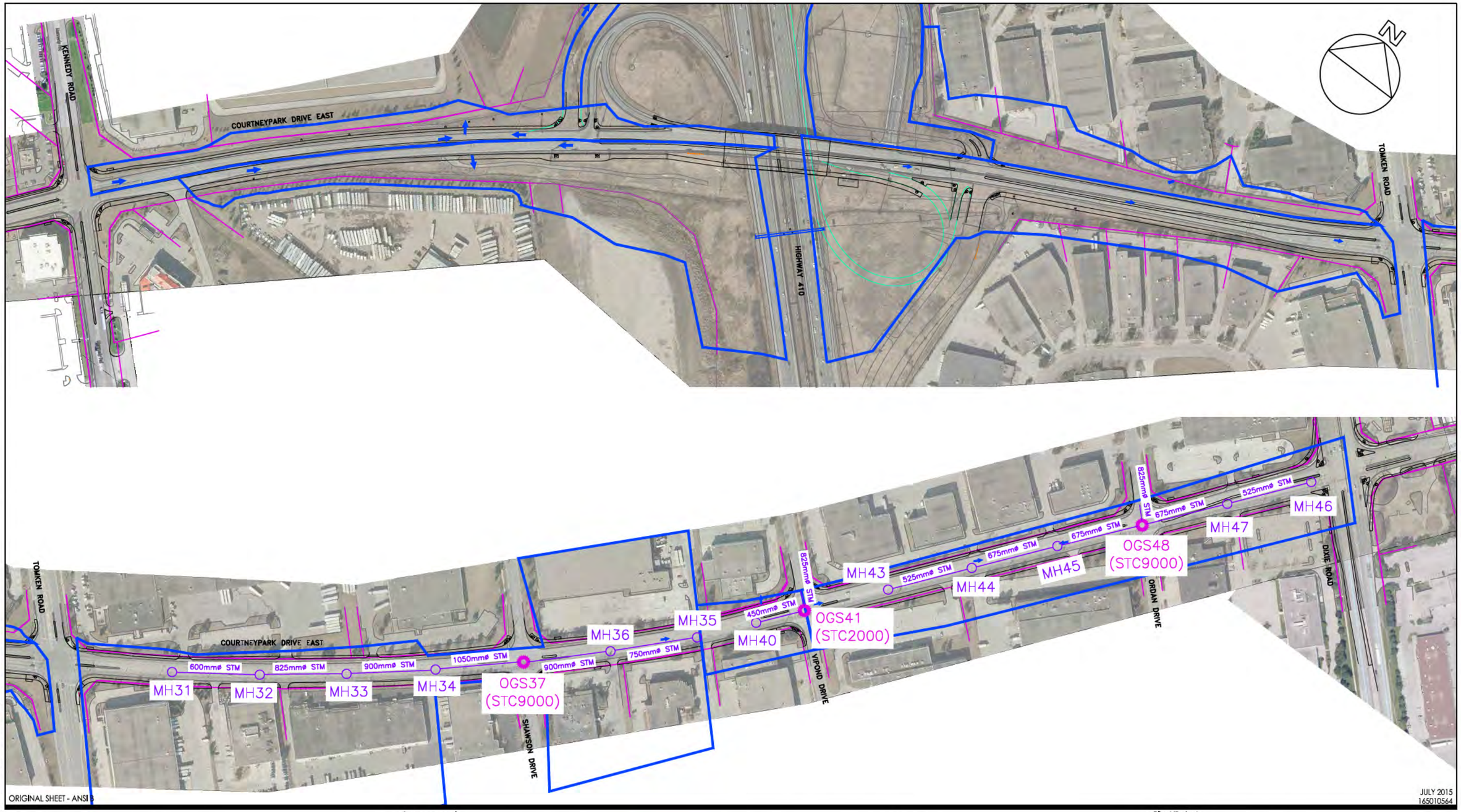

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Legend

- PROPERTY BOUNDARY
- STORM SEWER
- MANHOLE (MH)
- OIL-GRIT SEPARATOR (OGS)
- MINOR FLOW
- OVERLAND FLOW
- DRAINAGE BOUNDARY
- ROCK CHECK DAM
- CATCHMENT ID
- RUNOFF COEFFICIENT
- AREA (Ha)

202
4.85ha | 0.38

Notes

Client/Project
CITY OF MISSISSAUGA

Figure No.
3.0

Title
COURTNEYPARK DRIVE EAST
OVERALL DRAINAGE PLAN

Appendix A

Quantity Control Calculations

Modified Rational Method

100 Year Storm Event

Project Name : **Courtneypark Dr E Class EA**

Project No. : **165010564** 28-Apr-15

Mississauga Rainfall Parameters:

5-Year	820	4.6	0.78
10-Year	1010	4.6	0.78
100-Year	1450	4.9	0.78

Pre-Development Conditions:

Description	Catchment ID	Area (ha)			Discharge Coefficient C
		Impervious	Pervious	Total	
Kennedy to Highway 410 N	101	0.81	1.25	2.06	0.50
Kennedy to Highway 410 S	102	0.65	4.19	4.85	0.34
Highway 410 to Tomken S	103	3.25	2.58	5.83	0.61
Highway 410 to Tomken N	104	0.67	1.29	1.96	0.47
Tomken to East of Ordan	105	9.70	8.40	18.10	0.60
East of Ordan to Vipond	106	0.53	0.23	0.76	0.70
Vipond to Dixie	107	3.10	1.41	4.51	0.70
Parking lot	108	0.64	1.53	2.17	0.44
410 Interchange	109	0.26	1.64	1.89	0.30
Total		19.60	22.52	42.12	0.55

Post-Development Conditions:

Description	Catchment ID	Area (ha)			Discharge Coefficient C
		Impervious	Pervious	Total	
Kennedy to Highway 410 N	201	1.11	0.95	2.06	0.60
Kennedy to Highway 410 S	202	0.96	3.89	4.85	0.38
Highway 410 to Tomken N	203	3.65	2.18	5.83	0.66
Highway 410 to Tomken S	204	1.07	0.89	1.96	0.60
Tomken to East of Ordan	205	10.51	7.59	18.10	0.63
East of Ordan to Vipond	206	0.69	0.07	0.76	0.84
Vipond to Dixie	207	3.62	0.89	4.51	0.77
Parking lot	208	1.19	0.98	2.17	0.61
410 Interchange	209	1.89	0.00	1.89	0.90
Total		24.69	17.44	42.12	0.63

stantec.com

Project Name : Courtneypark Dr E Class EA
Project No. : 165010564 **28-Apr-15**

Allowable and Recommended Release Rates

100 Year storm

Rainfall intensity i: i=a/(t+b)^c

a,b & c are Intensity-Duration-Frequency (IDF) parameters form Missusssaga

IDF Parameters
a = 1450
t = 15 min
b = 4.90
c = 0.78

Allowable release rate calculated using the Rational Method:

Q=CiA/360

Q= Allowable release rate m^3/s
I = Rainfall intensity mm/hr 141
A = Draiange Area ha
C = Pre-development Discharge Co-effecient

Allowable Release Calculations

Description	Catchment ID	Area ha	Discharge Coefficient C	Release Rate m^3/s
Kennedy to Highway 410 N	101	2.06	0.50	0.406
Kennedy to Highway 410 S	102	4.85	0.34	0.639
Highway 410 to Tomken N	103	5.83	0.61	1.395
Highway 410 to Tomken S	104	1.96	0.47	0.362
Tomken to East of Ordan	105	18.10	0.60	4.232
East of Ordan to Vipond	106	0.76	0.70	0.209
Vipond to Dixie	107	4.51	0.70	1.228
Parking lot	108	2.17	0.44	0.375
410 Interchange	109	1.89	0.30	0.222
Total		**42.12**		**9.07**

Release Rates and Required Storage

Description	Catchment ID	Allowable Release m^3/s	Required Storage m^3	Proposed Release m^3/s	Required Storage m^3
Kennedy to Highway 410 N	201	0.406	71	0.210	247
Kennedy to Highway 410 S	202	0.639	71	0.450	241
Highway 410 to Tomken N	203	1.395	92	1.140	321
Highway 410 to Tomken S	204	0.362	91	0.465	0
Tomken to East of Ordan	205	4.232	187	4.440	0
East of Ordan to Vipond	206	0.209	37	0.230	0
Vipond to Dixie	207	1.228	120	1.810	0
Parking lot	208	0.375	126	0.100	418
410 Interchange	209	0.222	428	0.222	428
Total		**9.07**	**1223**	**9.07**	**1656**

Modified Rational Method

100 Year Storm Event

Controlled Release

Project Name :	**Courtneypark Dr E Class EA**			
Project No. :	**165010564**			**28-Apr-15**
Area ID:	**201**			
Description:	**Kennedy to Highway 410 N**			
Area =	2.06	ha		
"C" =	0.60			
AC=	1.24			
Tc =	15.0	min	Missussaga	100yr
Time Increment =	1.0	min	a=	1450
Release Rate =	406	l/s	b=	4.9
Max.Storage =	71	m^3	c=	0.780

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
15	141	484	436	365	71	<<<<
16	135	466	448	390	58	
17	131	450	459	414	44	
18	126	434	469	439	30	
19	122	420	479	463	16	
20	118	407	488	487	1	
21	115	394	497	512	0	
22	111	383	505	536	0	
23	108	372	514	560	0	

Modified Rational Method

100 Year Storm Event

Over-Controlled Release

Project Name : Courtneypark Dr E Class EA
Project No. : 165010564 **28-Apr-15**
Area ID: 201
Description: Kennedy to Highway 410 N

Area =	2.06	ha		
"C" =	0.60			
AC=	1.24			
Tc =	15.0	min	Missussaga	100yr
Time Increment =	5.0	min	a=	1450
Release Rate =	210	l/s	b=	4.9
Max.Storage =	247	m^3	c=	0.780

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
15	141	484	436	189	247	<<<<
20	118	407	488	252	236	
25	102	353	529	315	214	
30	91	313	563	378	185	
35	82	282	591	441	150	
40	75	257	616	504	112	
45	69	236	639	567	72	
50	64	220	659	630	29	
55	60	205	677	693	0	

Modified Rational Method

100 Year Storm Event

Controlled Release

Project Name : **Courtneypark Dr E Class EA** **28-Apr-15**
Project No. : **165010564**
Area ID: **202**
Description: Kennedy to Highway 410 S

Area =	4.85	ha		
"C" =	0.38			
AC=	1.83		Missussaga	100yr
Tc =	15.0	min	a=	1450
Time Increment =	1.0	min	b=	4.9
Release Rate =	639	l/s	c=	0.78
Max.Storage =	71	m^3		

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
15	141	717	646	575	71	<<<<
16	135	691	663	613	50	
17	131	666	679	652	27	
18	126	643	695	690	4	
19	122	622	709	728	0	
20	118	602	723	767	0	
21	115	584	736	805	0	
22	111	567	749	843	0	
23	108	551	761	882	0	
24	105	536	772	920	0	
25	102	522	783	958	0	
26	100	509	794	997	0	
27	97	497	804	1035	0	
28	95	485	814	1073	0	
29	93	474	824	1112	0	
30	91	463	833	1150	0	
31	89	453	842	1188	0	
32	87	443	851	1227	0	

Modified Rational Method

100 Year Storm Event

Over-Controlled Release

Project Name : **Courtneypark Dr E Class EA** **28-Apr-15**
Project No. : **165010564**
Area ID: **202**
Description: **Kennedy to Hi ha**

Area =	4.8			
"C" =	0.38			
AC=	1.83		Missussaga	100yr
Tc =	15.0	min	a=	1450
Time Increment =	5.0	min	b=	4.9
Release Rate =	450	l/s	c=	0.780
Max.Storage =	241	m^3		

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
15	141	717	646	405	241	<<<<
20	118	602	723	540	183	
25	102	522	783	675	108	
30	91	463	833	810	23	
35	82	417	876	945	0	
40	75	380	913	1080	0	
45	69	350	946	1215	0	
50	64	325	975	1350	0	
55	60	304	1002	1485	0	

Modified Rational Method

100 Year Storm Event

Controlled Release

Project Name : Courtneypark Dr E Class EA **28-Apr-15**

Project No. : 165010564

Area ID: 203

Description: Highway 410 to Tomken N

Area =	5.83	ha		
"C" =	0.66			
AC=	3.83			
Tc =	15.0	min	Missussaga	100yr
Time Increment =	1.0	min	a=	1450
Release Rate =	1395	l/s	b=	4.9
Max.Storage =	92	m^3	c=	0.78

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
15	141	1497	1347	1256	92	<<<<
16	135	1441	1383	1339	44	
17	131	1389	1417	1423	0	
18	126	1342	1449	1507	0	
19	122	1298	1479	1590	0	
20	118	1257	1508	1674	0	
21	115	1219	1536	1758	0	
22	111	1183	1562	1842	0	
23	108	1150	1587	1925	0	
24	105	1119	1611	2009	0	
25	102	1090	1635	2093	0	
26	100	1062	1657	2176	0	
27	97	1036	1678	2260	0	
28	95	1011	1699	2344	0	
29	93	988	1719	2427	0	

Modified Rational Method

100 Year Storm Event

Over Controlled Release

Project Name :	**Courtneypark Dr E Class EA**				**28-Apr-15**
Project No. :0	**165010564**				
Area ID:	**203**				
Description:	Highway 410 to Tomken N				
Area =	5.829	ha			
"C" =	0.66				
AC=	3.83				
Tc =	15.0	min	Missussaga	100yr	
Time Increment =	5.0	min	a=	1450	
Release Rate =	1140	l/s	b=	4.9	
Max.Storage =	321	m^3	c=	0.780	

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
15	141	1497	1347	1026	321	<<<<
20	118	1257	1508	1368	140	
25	102	1090	1635	1710	0	
30	91	966	1739	2052	0	
35	82	870	1827	2394	0	
40	75	794	1905	2736	0	
45	69	731	1973	3078	0	
50	64	678	2035	3420	0	
55	60	634	2091	3762	0	

Modified Rational Method

100 Year Storm Event

Controlled Release

Project Name : Courtneypark Dr E Class EA
Project No. : 165010564 **28-Apr-15**
Area ID: 204
Description: Highway 410 to Tomken S

Area =	1.96	ha		
"C" =	0.60			
AC=	1.18			
Tc =	15.0	min	Missussaga	100yr
Time Increment =	1.0	min	a=	1450
Release Rate =	362	l/s	b=	4.9
Max.Storage =	91	m^3	c=	0.78

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
15	141	463	417	326	91	<<<<
16	135	445	428	347	80	
17	131	429	438	369	69	
18	126	415	448	391	57	
19	122	401	457	412	45	
20	118	389	466	434	32	
21	115	377	475	456	19	
22	111	366	483	477	5	
23	108	356	491	499	0	
24	105	346	498	521	0	
25	102	337	505	543	0	
26	100	328	512	564	0	
27	97	320	519	586	0	

Modified Rational Method

100 Year Storm Event

Over-Controlled Release

Project Name : Courtneypark Dr E Class EA
Project No. : 165010564 **28-Apr-15**
Area ID: 204
Description: Highway 410 to Tomken S

Area =	1.96	ha		
"C" =	0.60			
AC=	1.18			
Tc =	15.0	min	Missussaga	100yr
Time Increment =	5.0	min	a=	1450
Release Rate =	465	l/s	b=	4.9
Max.Storage =	0	m^3	c=	0.780

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
15	141	463	417	419	0	<<<<
20	118	389	466	558	0	<<<<
25	102	337	505	698	0	<<<<
30	91	299	537	837	0	<<<<
35	82	269	565	977	0	<<<<
40	75	245	589	1116	0	<<<<
45	69	226	610	1256	0	<<<<
50	64	210	629	1395	0	<<<<
55	60	196	647	1535	0	<<<<

Modified Rational Method

100 Year Storm Event

Project Name : Courtneypark Dr E Class EA
Project No. : 165010564 **28-Apr-15**
Area ID: 205

Description: Tomken to East of Ordan

Area =	18.10	ha		
"C" =	0.63			
AC=	11.35			
Tc =	15.0	min	Missussaga	100yr
Time Increment =	1.0	min	a=	1450
Release Rate =	4232	l/s	b=	4.9
Max.Storage =	187	m^3	c=	0.78

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
15	141	4441	3997	3809	187	<<<<
16	135	4274	4103	4063	40	
17	131	4121	4204	4317	0	
18	126	3980	4298	4571	0	
19	122	3850	4388	4825	0	
20	118	3728	4474	5079	0	
21	115	3616	4556	5333	0	
22	111	3510	4634	5587	0	
23	108	3412	4708	5841	0	
24	105	3319	4780	6095	0	
25	102	3232	4849	6349	0	
26	100	3151	4915	6603	0	
27	97	3073	4979	6857	0	
28	95	3000	5040	7110	0	
29	93	2931	5100	7364	0	
30	91	2865	5157	7618	0	
31	89	2803	5213	7872	0	
32	87	2743	5267	8126	0	
33	85	2687	5320	8380	0	
34	83	2633	5371	8634	0	
35	82	2581	5420	8888	0	
36	80	2532	5468	9142	0	
37	79	2484	5515	9396	0	
38	77	2439	5561	9650	0	

Modified Rational Method

100 Year Storm Event

Project Name : Courtneypark Dr E Class EA
Project No. : 165010564 **28-Apr-15**
Area ID: 205
Description: Tomken to East of Ordan

Area =	18.1	ha		
"C" =	0.63			
AC=	11.35			
Tc =	15.0	min	Missussaga	100yr
Time Increment =	5.0	min	a=	1450
Release Rate =	4444	l/s	b=	4.9
Max.Storage =	0	m^3	c=	0.780

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)
15	141	4441	3997	4000	0
20	118	3728	4474	5333	0
25	102	3232	4849	6666	0
30	91	2865	5157	7999	0
35	82	2581	5420	9332	0
40	75	2354	5650	10666	0
45	69	2168	5853	11999	0
50	64	2012	6037	13332	0
55	60	1880	6204	14665	0

Modified Rational Method

100 Year Storm Event

Project Name : Courtneypark Dr E Class EA
Project No. : 165010564 **28-Apr-15**
Area ID: 206
Description: 206

Area =	0.76	ha		
"C" =	0.84			
AC=	0.64			
Tc =	15.0	min	Missussaga	100yr
Time Increment =	1.0	min	a=	1450
Release Rate =	209	l/s	b=	4.9
Max.Storage =	37	m^3	c=	0.78

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
15	141	250	225	188	37	<<<<
16	135	241	231	201	31	
17	131	232	237	213	24	
18	126	224	242	226	17	
19	122	217	247	238	9	
20	118	210	252	251	2	
21	115	204	257	263	0	
22	111	198	261	276	0	
23	108	192	265	288	0	
24	105	187	270	301	0	
25	102	182	273	313	0	
26	100	178	277	326	0	
27	97	173	281	338	0	
28	95	169	284	351	0	
29	93	165	288	363	0	
30	91	162	291	376	0	
31	89	158	294	389	0	
32	87	155	297	401	0	
33	85	151	300	414	0	
34	83	148	303	426	0	
35	82	146	306	439	0	
36	80	143	308	451	0	
37	79	140	311	464	0	
38	77	138	314	476	0	

Modified Rational Method

100 Year Storm Event

Project Name : **Courtneypark Dr E Class EA**
Project No. : **165010564** **28-Apr-15**
Area ID: **206**
Description: **206**

Area =	0.76	ha		
"C" =	0.84			
AC=	0.64			
Tc =	15.0	min	Missussaga	100yr
Time Increment =	5.0	min	a=	1450
Release Rate =	250	l/s	b=	4.9
Max.Storage =	0	m^3	c=	0.780

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)
15	141	250	225	225	0
20	118	210	252	300	0
25	102	182	273	375	0
30	91	162	291	450	0
35	82	146	306	525	0
40	75	133	319	600	0
45	69	122	330	675	0
50	64	113	340	750	0
55	60	106	350	825	0

Modified Rational Method

100 Year Storm Event

Project Name : Courtneypark Dr E Class EA
Project No. : 165010564 **28-Apr-15**
Area ID: 207
Description: Vipond to Dixie

Area =	4.51	ha
"C" =	0.77	
AC=	3.48	
Tc =	15.0	min
Time Increment =	1.0	min
Release Rate =	1228	l/s
Max.Storage =	120	m^3

Missussaga	100yr
a=	1450
b=	4.9
c=	0.78

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
15	141	1362	1226	1105	120	<<<<
16	135	1311	1258	1179	79	
17	131	1264	1289	1253	36	
18	126	1220	1318	1326	0	
19	122	1180	1346	1400	0	
20	118	1143	1372	1474	0	
21	115	1109	1397	1547	0	
22	111	1076	1421	1621	0	
23	108	1046	1444	1695	0	
24	105	1018	1466	1768	0	
25	102	991	1487	1842	0	
26	100	966	1507	1916	0	
27	97	942	1527	1990	0	
28	95	920	1546	2063	0	
29	93	899	1564	2137	0	
30	91	879	1581	2211	0	
31	89	859	1599	2284	0	
32	87	841	1615	2358	0	
33	85	824	1631	2432	0	
34	83	807	1647	2505	0	
35	82	791	1662	2579	0	
36	80	776	1677	2653	0	
37	79	762	1691	2726	0	
38	77	748	1705	2800	0	

Modified Rational Method

100 Year Storm Event

Project Name : Courtneypark Dr E Class EA
Project No. : 165010564 **28-Apr-15**
Area ID: 207
Description: Vipond to Dixie

Area =	4.51	ha		
"C" =	0.77			
AC=	3.48			
Tc =	15.0	min	Missussaga	100yr
Time Increment =	5.0	min	a=	1450
Release Rate =	1362	l/s	b=	4.9
Max.Storage =	0	m^3	c=	0.780

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)
15	141	1362	1226	1226	0
20	118	1143	1372	1634	0
25	102	991	1487	2043	0
30	91	879	1581	2452	0
35	82	791	1662	2860	0
40	75	722	1732	3269	0
45	69	665	1795	3677	0
50	64	617	1851	4086	0
55	60	576	1902	4495	0

Modified Rational Method

100 Year Storm Event

Controlled Release

Project Name : Courtneypark Dr E Class EA
Project No. : 165010564 **28-Apr-15**
Area ID: 208

Description: Parking lot

Area =	2.17	ha		
"C" =	0.61			
AC=	1.32			
Tc =	15.0	min	Missussaga	100yr
Time Increment =	5.0	min	a=	1450
Release Rate =	375	l/s	b=	4.9
Max.Storage =	126	m^3	c=	0.78

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
15	141	515	463	337	126	<<<<
20	118	432	519	450	69	
25	102	375	562	562	0	
30	91	332	598	674	0	
35	82	299	628	787	0	
40	75	273	655	899	0	
45	69	251	678	1011	0	
50	64	233	700	1124	0	
55	60	218	719	1236	0	
60	56	205	737	1349	0	
65	53	193	753	1461	0	
70	50	183	769	1573	0	
75	48	174	783	1686	0	
80	45	166	797	1798	0	
85	43	159	810	1910	0	
90	42	152	822	2023	0	
95	40	146	833	2135	0	
100	38	141	845	2248	0	
105	37	136	855	2360	0	
110	36	131	865	2472	0	
115	35	127	875	2585	0	
120	34	123	884	2697	0	
125	33	119	894	2809	0	
130	32	116	902	2922	0	

Modified Rational Method

100 Year Storm Event

Over-Controlled Release

Project Name :	**Courtneypark Dr E Class EA**				
Project No. :	**165010564**			**28-Apr-15**	
Area ID:	**208**				
Description:	**Parking lot**				
Area =	2.2	ha			
"C" =	0.61				
AC=	1.32				
Tc =	15.0	min	Missussaga		100yr
Time Increment =	5.0	min	a=	1450	
Release Rate =	100	l/s	b=	4.9	
Max.Storage =	418	m^3	c=	0.780	

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
15	141	515	463	90	373	
20	118	432	519	120	399	
25	102	375	562	150	412	
30	91	332	598	180	418	
35	82	299	628	210	418	<<<<
40	75	273	655	240	415	
45	69	251	678	270	408	
50	64	233	700	300	400	
55	60	218	719	330	389	

Modified Rational Method

100 Year Storm Event

Controlled Release

Project Name : Courtneypark Dr E Class EA
Project No. : 165010564 **28-Apr-15**
Area ID: 209

Description: Highway 410 Interchange

Area =	1.89	ha
"C" =	0.90	
AC=	1.70	
Tc =	15.0	min
Time Increment =	5.0	min
Release Rate =	202	l/s
Max.Storage =	428	m^3

Missussaga	100yr
a=	1450
b=	4.9
c=	0.78

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
15	141	665	599	182	417	
20	118	559	670	242	428	<<<<
25	102	484	726	303	423	
30	91	429	773	364	409	
35	82	387	812	424	388	
40	75	353	846	485	362	
45	69	325	877	545	332	
50	64	301	904	606	298	
55	60	282	929	667	263	
60	56	265	953	727	225	
65	53	250	974	788	186	
70	50	237	994	848	145	
75	48	225	1012	909	103	
80	45	215	1030	970	60	
85	43	205	1047	1030	16	
90	42	197	1062	1091	0	
95	40	189	1077	1151	0	
100	38	182	1092	1212	0	
105	37	175	1105	1273	0	
110	36	169	1118	1333	0	
115	35	164	1131	1394	0	
120	34	159	1143	1454	0	
125	33	154	1155	1515	0	
130	32	150	1166	1576	0	

Project Name : **Courtneypark Dr E Class EA**
Project No. : **165010564** **28-Apr-15**

Swales and Check Dams Design

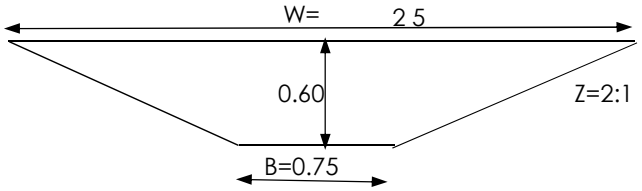
Swale SW1

(Located North of the proposed road between Kennedy Road and Highway 410)

Storage Calculations:

Drainage Area		ha	2.06	
Swale Length		m	420	
Upstream Invert		m	190.5	
Downstream Invert		m	189	
Longitudinal Slope	(S)		0.36%	
Bed Width	(B)	m	0.75	
Side Slope	(Z)		2	
Manning Coefficient	(n)		0.04	(grassed swale)
Allowable Release rate (100-Year)		m^3/s	0.210	
Required Storage Volume		m^3	247	
To provide storage, install 3 concrte check dams @140 m intervals				
Average length of swale reach		m	140	
Upstream max depth		m	0.1	
Upstream flow X-section area		m^2	0.10	
Downstream maximum depth		m	0.60	(100 Year Storm flow)
Downstream flow X-section area		m^2	1.17	
Stored water Volume per reach		m^3	89	(between check dams)
Total swale storage volume		m^3	266	(For full length of swale)

Swale D/S Cross Section



Swale Flow Capacity and Velocity Calculations

Rational Method Used to Calculate Catchment Peak Flow *(Q= .028*C*I*A)*
Manning's Equation to Calcualate Channel Flow Velocity *($V=R^{2/3} * S^{1/2}/n$)*

Storm Event		**2 Yaer**	**100 Yaer**	
Rainfall intensity	mm/hr	60	141	
Peak Flow	m^3/s	0.21	0.48	*(Rational Marthod)*
Water Depth (D)	m	0.29	0.43	*(Assumed)*
Top Width (W)	m	1.91	2.46	*(W=B+2*Z*D)*
Flow Area (A)	m^2	0.386	0.685	*(A=W+B)/2*D*
Wetted Perimeter (P)	m	2.05	2.66	*(P=B+2*D*sqrt(1+2*Z2)^)*
Hydraulic Radius 'R	m	0.19	0.26	*(R=A/P)*
Design Velocity V(des)	m/s	0.49	0.60	*($V=R^{2/3} * S^{1/2}/n$)*
Channel Discharge (Q)	m^3/s	0.19	0.41	*(Q=V * A)*

Project Name : **Courtneypark Dr E Class EA**
Project No. : **165010564** **28-Apr-15**

Swales and Check Dams Design

Flow across the dams will be controlled by orifice tubes and broad crested weirs
The orifice tubes will be located at the bottom of the check dams
The broad crested weirs will be located 0.3 m below the maximum water elevation
3 concrete check dams will be installed @140 m intervals

Check Dam 1:

The dam will be located 140 m from swale upstream end

Dam height	0.60	m
Dam width	3.1	m
The allowable 100 Year Flow	0.07	m^3/s

Orifice tube flow:

Orifice Equation: $Q = CdA(2gh)^{1/2}$

Max. water elevation	190.60	m
Invert	190.00	m
Size	75	mm
C	0.8	
Obvert	190.08	m
Area	0.004	m^2
Head	0.56	m
Maximum Release	0.012	m^3/s

Rectangular Broad Crested Weir Flow:

Rectangular Broad Crested Weir equation		$Q=CLH^{\wedge 1.5}$
Weir Invert =	190.30	m
Weir Length =	0.3	m
Maximum water elevation	190.60	m
Head above weir	0.30	m
Weir Coefficient (C_d)	1.6	
Flow Area	0.09	m^2
Weir flow	0.08	m^3/s

Total flow through the check dam

(orifice + weir flow)	0.09	m^3/s

Project Name : **Courtneypark Dr E Class EA**
Project No. : **165010564** **28-Apr-15**

Swales and Check Dams Design

Check Dam 2:

The dam will be located 280 m from swale upstream end

Dam height	0.60	m
Dam width	3.1	m
The allowable 100 Year Flow	0.14	m^3/s

Orifice tube flow:

Orifice Equation: $Q = CdA(2gh)^{1/2}$

Max. water elevation	190.10	m
Invert	189.50	m
Size	75	mm
C	0.8	
Obvert	189.58	m
Area	0.004	m^2
Head	0.56	m
Maximum Release	0.012	m^3/s

Rectangular Broad Crested Weir Flow:

Rectangular Broad Crested Weir equation	$Q=CLH^{\wedge 1.5}$	
Weir Invert =	189.80	m
Weir Length =	0.67	m
Maximum water elevation	190.10	m
Head above weir	0.30	m
Weir Coefficient (C_d)	1.6	
Flow Area	0.201	m^2
Weir flow	0.18	m^3/s

Total flow through the check dam

(orifice + weir flow)	0.19	m^3/s

Project Name : **Courtneypark Dr E Class EA**
Project No. : **165010564** **28-Apr-15**

Swales and Check Dams Design

Check Dam 3:

The dam will be located 420 m from swale upstream end

Dam height	0.60	m
Dam width	3.1	m
The allowable 100 Year Flow	0.21	m^3/s

Orifice tube flow:

Orifice Equation: $Q = CdA(2gh)^{1/2}$

Max. water elevation	189.60	m
Invert	189.00	m
Size	100	mm
C	0.8	
Obvert	189.10	m
Area	0.008	m^2
Head	0.55	m
Maximum Release	0.021	m^3/s

Rectangular Broad Crested Weir Flow:

Rectangular Broad Crested Weir equation	$Q=CLH^{\wedge 1.5}$	
Weir Invert =	189.30	m
Weir Length =	0.97	m
Maximum water elevation	189.60	m
Head above weir	0.30	m
Weir Coefficient (C_d)	1.6	
Flow Area	0.291	m^2
Weir flow	0.26	m^3/s

Total flow through the check dam

(orifice + weir flow)	0.28	m^3/s

Project Name : **Courtneypark Dr E Class EA**
Project No. : **165010564** **28-Apr-15**

Swales and Check Dams Design

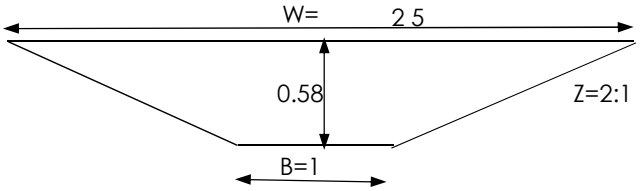
Swale SW2

(Located South of the proposed road between Kennedy Road and Highway 410)

Storage Calculations:

Drainage Area		ha	4.85	
Swale Length		m	500	
Upstream Invert		m	190	
Downstream Invert		m	188.5	
Longitudinal Slope	(S)		0.30%	
Bed Width	(B)	m	1.00	
Side Slope	(Z)		2	
Manning Coefficient	(n)		0.04	(grassed swale)
Allowable Release rate (100-Year)		m^3/s	0.45	
Required Storage Volume		m^3	241	
To provide storage, install 4 concrte check dams @125 m intervals				
Average length of swale reach		m	125	
Upstream max depth		m	0.2	
Upstream flow X-section area		m^2	0.28	
Downstream maximum depth		m	0.58	(100 Year Storm flow)
Downstream flow X-section area		m^2	1.24	
Stored water Volume per reach		m^3	95	(between check dams)
Total swale storage volume		m^3	379	(For full length of swale)

Swale D/S Cross Section



Swale Flow Capacity and Velocity Calculations

Rational Method Used to Calculate Catchment Peak Flow *(Q= .028*C*I*A)*
Manning's Equation to Calcualate Channel Flow Velocity *($V=R^{2/3} * S^{1/2}/n$)*

Storm Event		**2 Yaer**	**100 Yaer**	
Rainfall intensity	mm/hr	60	141	
Peak Flow	m^3/s	0.31	0.67	*(Rational Marthod)*
Water Depth (D)	m	0.30	0.64	*(Assumed)*
Top Width (W)	m	2.20	3.54	*(W=B+2*Z*D)*
Flow Area (A)	m^2	0.480	1.441	*(A=W+B)/2*D*
Wetted Perimeter (P)	m	2.34	3.84	*(P=B+2*D*sqrt(1+2*Z2)^)*
Hydraulic Radius 'R	m	0.20	0.38	*(R=A/P)*
Design Velocity V(des)	m/s	0.48	0.71	*($V=R^{2/3} * S^{1/2}/n$)*
Channel Discharge (Q)	m^3/s	0.23	1.03	*(Q=V * A)*

Project Name : **Courtneypark Dr E Class EA**
Project No. : **165010564** **28-Apr-15**

Swales and Check Dams Design

Flow across the dams will be controlled by orifice tubes and broad crested weirs
The orifice tubes will be located at the bottom of the check dams
The broad crested weirs will be located 0.3 m below the maximum water elevation
3 concrete check dams will be installed @125 m intervals

Check Dam 1:

The dam will be located 125 m from swale upstream end

Dam height	0.57	m
Dam width	3.3	m
The allowable 100 Year Flow	0.11	m^3/s

Orifice tube flow:

Orifice Equation: $Q = CdA(2gh)^{1/2}$

Max. water elevation	190.20	m
Invert	189.63	m
Size	75	mm
C	0.8	
Obvert	189.70	m
Area	0.004	m^2
Head	0.54	m
Maximum Release	0.012	m^3/s

Rectangular Broad Crested Weir Flow:

Rectangular Broad Crested Weir equation		$Q=CLH\wedge^{1.5}$
Weir Invert =	189.90	m
Weir Length =	0.45	m
Maximum water elevation	190.20	m
Head above weir	0.30	m
Weir Coefficient (C_d)	1.6	
Flow Area	0.135	m^2
Weir flow	0.12	m^3/s

Total flow through the check dam

(orifice + weir flow)	0.13	m^3/s

Project Name : **Courtneypark Dr E Class EA**
Project No. : **165010564** **28-Apr-15**

Swales and Check Dams Design

Check Dam 2:

The dam will be located 250 m from swale upstream end

Dam height	0.57	m
Dam width	3.3	m
The allowable 100 Year Flow	0.23	m^3/s

Orifice tube flow:

Orifice Equation: $Q = CdA(2gh)^{1/2}$

Max. water elevation	189.83	m
Invert	189.25	m
Size	100	mm
C	0.8	
Obvert	189.35	m
Area	0.008	m^2
Head	0.52	m
Maximum Release	0.021	m^3/s

Rectangular Broad Crested Weir Flow:

Rectangular Broad Crested Weir equation	$Q=CLH^{\wedge 1.5}$	
Weir Invert =	189.53	m
Weir Length =	0.9	m
Maximum water elevation	189.83	m
Head above weir	0.30	m
Weir Coefficient (C_d)	1.6	
Flow Area	0.27	m^2
Weir flow	0.24	m^3/s

Total flow through the check dam

(orifice + weir flow)	0.26	m^3/s

Project Name : **Courtneypark Dr E Class EA**
Project No. : **165010564** **28-Apr-15**

Swales and Check Dams Design

Check Dam 3:

The dam will be located 375 m from swale upstream end

Dam height	0.57	m
Dam width	3.3	m
The allowable 100 Year Flow	0.34	m^3/s

Orifice tube flow:

Orifice Equation: $Q = CdA(2gh)^{1/2}$

Max. water elevation	189.45	m
Invert	188.88	m
Size	100	mm
C	0.8	
Obvert	188.98	m
Area	0.008	m^2
Head	0.52	m
Maximum Release	0.021	m^3/s

Rectangular Broad Crested Weir Flow:

Rectangular Broad Crested Weir equation	$Q=CLH^{\wedge 1.5}$	
Weir Invert =	189.15	m
Weir Length =	1.35	m
Maximum water elevation	189.45	m
Head above weir	0.30	m
Weir Coefficient (C_d)	1.6	
Flow Area	0.405	m^2
Weir flow	0.35	m^3/s

Total flow through the check dam

(orifice + weir flow)	0.38	m^3/s

Project Name : **Courtneypark Dr E Class EA**
Project No. : **165010564** **28-Apr-15**

Swales and Check Dams Design

Check Dam 4:

The dam will be located 500 m from swale upstream end

Dam height	0.58	m
Dam width	3.3	m
The allowable 100 Year Flow	0.45	m^3/s

Orifice tube flow:

Orifice Equation: $Q = CdA(2gh)^{1/2}$

Max. water elevation	2.92	m
Invert	2.35	m
Size	150	mm
C	0.8	
Obvert	2.50	m
Area	0.018	m^2
Head	0.50	m
Maximum Release	0.045	m^3/s

Rectangular Broad Crested Weir Flow:

Rectangular Broad Crested Weir equation	$Q=CLH^{\wedge 1.5}$	
Weir Invert =	2.62	m
Weir Length =	1.75	m
Maximum water elevation	2.92	m
Head above weir	0.30	m
Weir Coefficient (C_d)	1.6	
Flow Area	0.525	m^2
Weir flow	0.46	m^3/s

Total flow through the check dam

(orifice + weir flow)	0.51	m^3/s

Project Name : **Courtneypark Dr E Class EA**
Project No. : **165010564** **28-Apr-15**

Swales and Check Dams Design

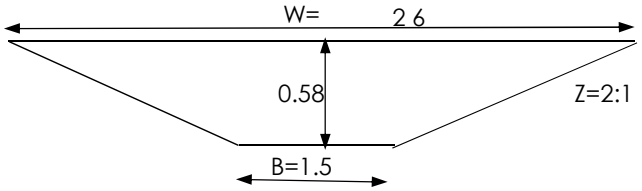
Swale SW3

(Located South of the proposed road between Highway 410 and Tomken)

Storage Calculations:

Drainage Area		ha	7.79	
Swale Length		m	320	
Upstream Invert		m	184	
Downstream Invert		m	183	
Longitudinal Slope	(S)		0.31%	
Bed Width	(B)	m	1.50	
Side Slope	(Z)		2	
Manning Coefficient	(n)		0.04	(grassed swale)
Allowable Release rate (100-Year)		m^3/s	0.45	
Required Storage Volume		m^3	241	
To provide storage, install 3 concrte check dams @106 m intervals				
Average length of swale reach		m	106	
Upstream max depth		m	0.25	
Upstream flow X-section area		m^2	0.50	
Downstream maximum depth		m	0.58	(100 Year Storm flow)
Downstream flow X-section area		m^2	1.55	
Stored water Volume per reach		m^3	109	(between check dams)
Total swale storage volume		m^3	328	(For full length of swale)

Swale D/S Cross Section



3.62

Swale Flow Capacity and Velocity Calculations

Rational Method Used to Calculate Catchment Peak Flow *(Q= .028*C*I*A)*
Manning's Equation to Calcualate Channel Flow Velocity *($V=R^{2/3} * S^{1/2}/n$)*

Storm Event		**2 Yaer**	**100 Yaer**	
Rainfall intensity	mm/hr	65	141	
Peak Flow	m^3/s	0.85	1.84	*(Rational Marthod)*
Water Depth (D)	m	0.46	0.68	*(Assumed)*
Top Width (W)	m	3.32	4.22	*(W=B+2*Z*D)*
Flow Area (A)	m^2	1.100	1.945	*(A=W+B)/2*D*
Wetted Perimeter (P)	m	3.54	4.54	*(P=B+2*D*sqrt(1+2*Z2)^)*
Hydraulic Radius 'R	m	0.31	0.43	*(R=A/P)*
Design Velocity V(des)	m/s	0.64	0.79	*($V=R^{2/3} * S^{1/2}/n$)*
Channel Discharge (Q)	m^3/s	0.71	1.54	*(Q=V * A)*

Project Name : **Courtneypark Dr E Class EA**
Project No. : **165010564** **28-Apr-15**

Swales and Check Dams Design

Flow across the dams will be controlled by orifice tubes and broad crested weirs
The orifice tubes will be located at the bottom of the check dams
The broad crested weirs will be located 0.3 m below the maximum water elevation
3 concrete check dams will be installed @106 m intervals

Check Dam 1:

The dam will be located 106 m from swale upstream end

Dam height	0.58	m
Dam width	3.8	m
The allowable 100 Year Flow	0.15	m^3/s

Orifice tube flow:

Orifice Equation: $Q = CdA(2gh)^{1/2}$

Max. water elevation	184.25	m
Invert	183.67	m
Size	75	mm
C	0.8	
Obvert	183.74	m
Area	0.004	m^2
Head	0.54	m
Maximum Release	0.012	m^3/s

Rectangular Broad Crested Weir Flow:

Rectangular Broad Crested Weir equation		$Q=CLH^{\wedge 1.5}$
Weir Invert =	183.95	m
Weir Length =	0.6	m
Maximum water elevation	184.25	m
Head above weir	0.30	m
Weir Coefficient (C_d)	1.6	
Flow Area	0.18	m^2
Weir flow	0.16	m^3/s

Total flow through the check dam

(orifice + weir flow)	0.17	m^3/s

Project Name : **Courtneypark Dr E Class EA**
Project No. : **165010564** **28-Apr-15**

Swales and Check Dams Design

Check Dam 2:

The dam will be located 212 m from swale upstream end

Dam height	0.58	m
Dam width	3.8	m
The allowable 100 Year Flow	0.30	m^3/s

Orifice tube flow:

Orifice Equation: $Q = CdA(2gh)^{1/2}$

Max. water elevation	183.92	m
Invert	183.34	m
Size	100	mm
C	0.8	
Obvert	183.44	m
Area	0.008	m^2
Head	0.53	m
Maximum Release	0.021	m^3/s

Rectangular Broad Crested Weir Flow:

Rectangular Broad Crested Weir equation	$Q=CLH^{\wedge 1.5}$	
Weir Invert =	183.62	m
Weir Length =	1.2	m
Maximum water elevation	183.92	m
Head above weir	0.30	m
Weir Coefficient (C_d)	1.6	
Flow Area	0.36	m^2
Weir flow	0.32	m^3/s

Total flow through the check dam

(orifice + weir flow)	0.34	m^3/s

Project Name : **Courtneypark Dr E Class EA**
Project No. : **165010564** **28-Apr-15**

Swales and Check Dams Design

Check Dam 3:

The dam will be located 318 m from swale upstream end

Dam height	0.58	m
Dam width	3.8	m
The allowable 100 Year Flow	0.45	m^3/s

Orifice tube flow:

Orifice Equation: $Q = CdA(2gh)^{1/2}$

Max. water elevation	183.59	m
Invert	183.01	m
Size	150	mm
C	0.8	
Obvert	183.16	m
Area	0.018	m^2
Head	0.51	m
Maximum Release	0.046	m^3/s

Rectangular Broad Crested Weir Flow:

Rectangular Broad Crested Weir equation	$Q=CLH^{\wedge 1.5}$	
Weir Invert =	183.29	m
Weir Length =	1.78	m
Maximum water elevation	183.59	m
Head above weir	0.30	m
Weir Coefficient (C_d)	1.6	
Flow Area	0.534	m^2
Weir flow	0.47	m^3/s

Total flow through the check dam

(orifice + weir flow)	0.51	m^3/s

Project Name : **Courtneypark Dr E Class EA**
Project No. : **165010564** **28-Apr-15**

Swales and Check Dams Design

Check Dam 4:

The dam will be located 424 m from swale upstream end

Dam height	0.58	m
Dam width	3.8	m
The allowable 100 Year Flow	0.60	m^3/s

Orifice tube flow:

Orifice Equation: $Q = CdA(2gh)^{1/2}$

Max. water elevation	3.49	m
Invert	2.91	m
Size	100	mm
C	0.8	
Obvert	3.01	m
Area	0.008	m^2
Head	0.53	m
Maximum Release	0.021	m^3/s

Rectangular Broad Crested Weir Flow:

Rectangular Broad Crested Weir equation	$Q=CLH^{\wedge 1.5}$	
Weir Invert =	3.19	m
Weir Length =	0.97	m
Maximum water elevation	3.49	m
Head above weir	0.30	m
Weir Coefficient (C_d)	1.6	
Flow Area	0.291	m^2
Weir flow	0.26	m^3/s

Total flow through the check dam

(orifice + weir flow)	0.28	m^3/s

Appendix B

Quality Control Calculations

Project Name : **Courtneypark Dr E Class EA**

Project No. : **165010564** 12-Jun-15

TSS Removal Efficiency Calculations

Pre-Development Conditions

Table 1 below calculates the overall site pre-development TSS removal effeciency

No quality control measures exist in the pre-develpoment conditions

Overall TSS Removal Efficiency Calculations:

Catchment		Total Starting Load [1]	Landscape			
			Treated	Starting [1]	Amount [2]	Remaining
ID	Area		Area	Load	Removed	Load [3]
101	2.06	2.06	1.25	1.25	1.00	1.06
102	4.85	4.85	4.19	4.19	3.36	1.49
103	5.83	5.83	1.00	1.00	0.80	5.03
104	1.96	1.96	1.96	1.96	1.57	0.39
105	18.10	18.10	8.40	8.40	6.72	11.38
106	0.76	0.76	0.21	0.21	0.17	0.59
107	4.51	4.51	1.89	1.89	1.51	3.00
108	2.17	2.17	1.53	1.53	1.22	0.95
109	1.89	1.89	1.89	1.89	1.51	0.38
Totals	42.12	42.12	22.32	22.32	17.86	24.27

[1] *Load" assumed to be 1.0 unit of sediment x Catchment Area*

[2] Amount Removed from landscaped areas= Starting Load * .8

[3] Remaining Load = Starting Load - Amount Removed

Overall Removal Efficiency =100*(1-remaining Load/Total Load)%

= **42%**

Water Quality Control
TSS Removal Efficiency Calculations
Post-Development Conditions

Objective: Implement Enhanced Level (Level 1) water quality control for all new developments. Due to the site constraints, it is proposed to achieve the required quality control target by over-controlling runoff from catchments 201, 202, 203 , 204, 208 and 209. No quality control measures will be applied to the flow from Catchments 205, 206 and 207.

Catchment ID	Total Area	Total Starting Load [1]	BMP			
			Landscape			
			Treated Area	Starting [1] Load	Amount [2] Removed	Remaining Load [3]
201	2.06	2.06	0.95	0.95	0.76	1.30
202	4.85	4.85	3.89	3.89	3.11	1.74
203	5.83	5.83	0.60	0.60	0.48	5.35
204	1.96	1.96	1.96	1.96	1.57	0.39
205	18.10	18.10	7.59	7.59	7.75	10.35
206	0.76	0.76	0.07	0.07	0.66	0.10
207	4.51	4.51	1.16	1.16	2.59	1.92
208	2.17	2.17	0.83	0.83	0.66	1.51
209	1.89	1.89	0.00	0.00	0.00	1.89
Totals	42.12	42.12	17.05	17.05	17.58	24.55

[1] *Load" assumed to be 1.0 unit of sediment x Catchment Area*

[2] Amount Removed = Starting Load * BMP Effeciency

[3] Remining Load = Starting Load - Amount Removed

Catchment ID	BMP					
	Swales			Sediment Basin		
	Starting Load	Amount Removed	Remaining Load	Starting Load	Amount Removed	Remaining Load
201	1.30	1.04	0.26	0.26	0.00	0.26
202	1.74	1.39	0.35	0.35	0.00	0.35
203	5.35	4.28	1.07	1.07	0.00	1.07
204	0.39	0.31	0.08	0.08	0.00	0.08
205	10.35	0.00	10.35	10.35	0.00	10.35
206	0.10	0.00	0.10	0.10	0.00	0.10
207	1.92	0.00	1.92	1.92	0.00	1.92
208	1.51	0.00	1.51	1.51	1.20	0.30
209	1.89	1.51	0.38	0.38	0.00	0.38
Totals	24.55	8.53	16.01	16.01	1.20	14.81

Overall Removal Efficiency =100*(1-remaining Load/Total Load)%

= **64.8%**

BMP Effeciency

BMP		TSS Removal %
Landscape		**80%**
Swale		**80%**
Sediment Basin		**80%**

Total site area	42.12 ha			
New development area	5.50 ha			
Required amount to be removed	=80% * 5.5	=	4.4	units
Pre-develpoment TSS removal effeciency		=	42.4%	
Post-develpoment TSS removal effeciency		=	64.8%	
Addditional TSS removal achieved		=	22.5%	
Total amount removed	=22.5% * 42.12	=	9.5	units

Hence additional amount removed > required amount to be removed

Stormceptor Design Summary

PCSWMM for Stormceptor

Project Information

Date	6/15/2015
Project Name	City of Missussaga
Project Number	165010564
Location	Courtneypark Drive

Designer Information

Company	Stantec
Contact	Mustafa

Notes

C205

Drainage Area

Total Area (ha)	2.16
Imperviousness (%)	100

The Stormceptor System model STC 9000 achieves the water quality objective removing 82% TSS for a City of Toronto (clay, silt and sand) particle size distribution.

Rainfall

Name	TORONTO CENTRAL
State	ON
ID	100
Years of Records	1982 to 1999
Latitude	45°30'N
Longitude	90°30'W

Water Quality Objective

TSS Removal (%)	80

Upstream Storage

Storage (ha-m)	Discharge (L/s)
0	0

Stormceptor Sizing Summary

Stormceptor Model	TSS Removal %
STC 300	49
STC 750	60
STC 1000	61
STC 1500	61
STC 2000	67
STC 3000	69
STC 4000	73
STC 5000	74
STC 6000	77
STC 9000	**82**
STC 10000	81
STC 14000	85

Particle Size Distribution

Removing silt particles from runoff ensures that the majority of the pollutants, such as hydrocarbons and heavy metals that adhere to fine particles, are not discharged into our natural water courses. The table below lists the particle size distribution used to define the annual TSS removal.

City of Toronto (clay, silt and sand)

Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s		Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s
10	20	2.65	0.0004					
30	10	2.65	0.0008					
50	10	2.65	0.0022					
95	20	2.65	0.0063					
265	20	2.65	0.0366					
1000	20	2.65	0.1691					

Stormceptor Design Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor version 1.0
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal.
- Only the STC 300 is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 750 to STC 6000 may accommodate multiple inlet pipes.
- Inlet and outlet invert elevation differences are as follows:

Inlet and Outlet Pipe Invert Elevations Differences

Inlet Pipe Configuration	STC 300	STC 750 to STC 6000	STC 9000 to STC 14000
Single inlet pipe	75 mm	25 mm	75 mm
Multiple inlet pipes	75 mm	75 mm	Only one inlet pipe.

- Design estimates are based on stable site conditions only, after construction is completed.
- Design estimates assume that the storm drain is not submerged during zero flows. For submerged applications, please contact your local Stormceptor representative.
- Design estimates may be modified for specific spills controls. Please contact your local Stormceptor representative for further assistance.
- For pricing inquiries or assistance, please contact Imbrium Systems Inc., 1-800-565-4801.

Stormceptor Design Summary

PCSWMM for Stormceptor

Project Information

Date	6/15/2015
Project Name	City of Missussaga
Project Number	165010564
Location	Courtneypark Drive

Designer Information

Company	Stantec
Contact	Mustafa

Notes

C207

Drainage Area

Total Area (ha)	2.09
Imperviousness (%)	100

The Stormceptor System model STC 9000 achieves the water quality objective removing 82% TSS for a City of Toronto (clay, silt and sand) particle size distribution.

Rainfall

Name	TORONTO CENTRAL
State	ON
ID	100
Years of Records	1982 to 1999
Latitude	45°30'N
Longitude	90°30'W

Water Quality Objective

TSS Removal (%)	80

Upstream Storage

Storage (ha-m)	Discharge (L/s)
0	0

Stormceptor Sizing Summary

Stormceptor Model	TSS Removal %
STC 300	50
STC 750	61
STC 1000	61
STC 1500	62
STC 2000	68
STC 3000	69
STC 4000	74
STC 5000	74
STC 6000	78
STC 9000	**82**
STC 10000	82
STC 14000	85

Particle Size Distribution

Removing silt particles from runoff ensures that the majority of the pollutants, such as hydrocarbons and heavy metals that adhere to fine particles, are not discharged into our natural water courses. The table below lists the particle size distribution used to define the annual TSS removal.

City of Toronto (clay, silt and sand)

Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s		Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s
10	20	2.65	0.0004					
30	10	2.65	0.0008					
50	10	2.65	0.0022					
95	20	2.65	0.0063					
265	20	2.65	0.0366					
1000	20	2.65	0.1691					

Stormceptor Design Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor version 1.0
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal.
- Only the STC 300 is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 750 to STC 6000 may accommodate multiple inlet pipes.
- Inlet and outlet invert elevation differences are as follows:

Inlet and Outlet Pipe Invert Elevations Differences

Inlet Pipe Configuration	STC 300	STC 750 to STC 6000	STC 9000 to STC 14000
Single inlet pipe	75 mm	25 mm	75 mm
Multiple inlet pipes	75 mm	75 mm	Only one inlet pipe.

- Design estimates are based on stable site conditions only, after construction is completed.
- Design estimates assume that the storm drain is not submerged during zero flows. For submerged applications, please contact your local Stormceptor representative.
- Design estimates may be modified for specific spills controls. Please contact your local Stormceptor representative for further assistance.
- For pricing inquiries or assistance, please contact Imbrium Systems Inc., 1-800-565-4801.

Stormceptor Design Summary

PCSWMM for Stormceptor

Project Information

Date	6/15/2015
Project Name	City of Missussaga
Project Number	165010564
Location	Courtneypark Drive

Designer Information

Company	Stantec
Contact	Mustafa

Notes

C206

Drainage Area

Total Area (ha)	0.76
Imperviousness (%)	84

The Stormceptor System model STC 2000 achieves the water quality objective removing 81% TSS for a City of Toronto (clay, silt and sand) particle size distribution.

Rainfall

Name	TORONTO CENTRAL
State	ON
ID	100
Years of Records	1982 to 1999
Latitude	45°30'N
Longitude	90°30'W

Water Quality Objective

TSS Removal (%)	80

Upstream Storage

Storage (ha-m)	Discharge (L/s)
0	0

Stormceptor Sizing Summary

Stormceptor Model	TSS Removal %
STC 300	66
STC 750	75
STC 1000	75
STC 1500	76
STC 2000	**81**
STC 3000	82
STC 4000	85
STC 5000	86
STC 6000	88
STC 9000	91
STC 10000	91
STC 14000	93

Particle Size Distribution

Removing silt particles from runoff ensures that the majority of the pollutants, such as hydrocarbons and heavy metals that adhere to fine particles, are not discharged into our natural water courses. The table below lists the particle size distribution used to define the annual TSS removal.

City of Toronto (clay, silt and sand)

Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s		Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s
10	20	2.65	0.0004					
30	10	2.65	0.0008					
50	10	2.65	0.0022					
95	20	2.65	0.0063					
265	20	2.65	0.0366					
1000	20	2.65	0.1691					

Stormceptor Design Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor version 1.0
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal.
- Only the STC 300 is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 750 to STC 6000 may accommodate multiple inlet pipes.
- Inlet and outlet invert elevation differences are as follows:

Inlet and Outlet Pipe Invert Elevations Differences

Inlet Pipe Configuration	STC 300	STC 750 to STC 6000	STC 9000 to STC 14000
Single inlet pipe	75 mm	25 mm	75 mm
Multiple inlet pipes	75 mm	75 mm	Only one inlet pipe.

- Design estimates are based on stable site conditions only, after construction is completed.
- Design estimates assume that the storm drain is not submerged during zero flows. For submerged applications, please contact your local Stormceptor representative.
- Design estimates may be modified for specific spills controls. Please contact your local Stormceptor representative for further assistance.
- For pricing inquiries or assistance, please contact Imbrium Systems Inc., 1-800-565-4801.

Appendix C

Stormsewer Hydraulic Calculations

Storm Sewer Design Sheet
Courtneypark Drive East

Rainfall Intensity = $\frac{A}{(Tc+B)^c}$

10-YEAR

A= 1010
B= 4.6
c= 0.78
Starting Tc = 15 min

Pre-Development Conditions

Project: Courtney Dr EA
Project No: 165010564
Date: 12-Jun-15
Designed by: MM

STREET	FROM MH	TO MH	10-YR AREA (ha)	10-YR RUNOFF COEFFICIENT "R"	10-YR "AR"	10-YR ACCUM. "AR"	10-YR RAINFALL INTENSITY (mm/hr)	10-YR ACCUM. FLOW (m^3/s)	Total Flow (m^3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	ACC. TIME OF CONC. (min)	% Full
Courtneypark Drive East	MH21	MH23	1.13	0.61	0.69	0.69	99.17	0.191	0.191	30.60	1.00	525	0.430	1.987	15.257	44%
Courtneypark Drive East	MH22	MH23	1.13	0.61	0.69	0.69	99.17	0.191	0.191	47.80	1.00	450	0.285	1.793	15.444	67%
Courtneypark Drive East	MH23	MH24	0	0.00	0.00	1.38	97.45	0.375	0.375	57.60	1.00	750	1.113	2.520	15.825	34%
Courtneypark Drive East	MH24	MH29	2	0.47	0.94	2.33	96.03	0.621	0.621	140.60	0.45	825	0.962	1.801	17.126	65%
Courtneypark Drive East	MH25	MH27	4.85	0.34	1.64	1.64	99.17	0.451	0.451	20.00	1.00	900	1.809	2.846	15.117	25%
Courtneypark Drive East	MH26	MH27	1.34	0.47	0.63	0.63	99.17	0.174	0.174	100.00	1.48	375	0.213	1.931	15.863	82%
Courtneypark Drive East	MH27	MH28	2	0.47	0.94	3.21	95.89	0.856	0.856	103.00	0.66	1050	2.217	2.562	16.533	39%
Courtneypark Drive East	MH28	MH29	0	0.00	0.00	3.21	93.51	0.835	0.835	100.00	0.71	1050	2.300	2.657	17.160	36%
Gottardo Court	MH29	MH1	0	0.00	0.00	5.54	91.40	1.407	1.407	20.00	1.00	1200	3.897	3.447	17.257	36%
Courtneypark Drive East	MH31	MH32	3.017	0.60	1.81	1.81	99.17	0.497	0.497	91.40	1.00	600	0.614	2.172	15.701	81%
Courtneypark Drive East	MH32	MH33	3.017	0.60	1.81	3.61	96.48	0.968	0.968	91.40	0.60	750	0.862	1.952	16.482	112%
Courtneypark Drive East	MH33	MH34	3.017	0.60	1.81	5.42	93.69	1.409	1.409	91.40	0.80	750	0.995	2.254	17.158	142%
Courtneypark Drive East	MH34	MH37	3.017	0.60	1.81	7.22	91.41	1.833	1.833	96.70	0.80	750	0.995	2.254	17.873	184%
Courtneypark Drive East	MH35	MH36	3.017	0.60	1.81	1.81	99.17	0.497	0.497	91.40	0.30	600	0.336	1.189	16.281	148%
Courtneypark Drive East	MH36	MH37	3.017	0.60	1.81	3.61	94.39	0.947	0.947	91.40	0.40	600	0.388	1.373	17.390	244%
Courtneypark Drive East	MH40	MH41	0.7	0.70	0.49	0.49	99.17	0.136	0.136	52.80	0.50	300	0.068	0.967	15.910	198%
Courtneypark Drive East	MH41	MH42	0	0.00	0.00	0.49	95.72	0.131	0.131	20.00	1.00	375	0.175	1.587	16.120	75%
Courtneypark Drive East	MH43	MH44	1.2	0.70	0.84	0.84	99.17	0.230	0.230	91.40	0.56	300	0.072	1.024	16.488	318%
Courtneypark Drive East	MH44	MH45	1.2	0.70	0.84	1.67	93.66	0.435	0.435	91.40	0.50	375	0.124	1.123	17.845	351%
Courtneypark Drive East	MH45	MH48	1.2	0.70	0.84	2.51	89.22	0.622	0.622	91.40	1.00	375	0.175	1.587	18.805	355%
Courtneypark Drive East	MH46	MH47	1.2	0.70	0.84	0.84	99.17	0.230	0.230	91.40	0.50	300	0.068	0.967	16.575	337%
Courtneypark Drive East	MH47	MH48	1.2	0.70	0.84	1.67	93.36	0.434	0.434	91.40	0.50	375	0.124	1.123	17.932	350%
Courtneypark Drive East	MH48	MH4	0	0.00	0.00	4.18	86.35	1.003	1.003	20.00	1.00	375	0.175	1.587	19.015	572%

Storm Sewer Design Sheet
Courtneypark Drive East

Post-Development Conditions

Rainfall Intensity = $\frac{A}{(Tc+B)^{c}}$

10-YEAR
A= 1010
B= 4.6
c= 0.78
Starting Tc = 15 min

Project: Courtney Dr EA
Project No: 165010564
Date: 12-Jun-15
Designed by: MM

STREET	FROM MH	TO MH	10-YR AREA (ha)	10-YR RUNOFF COEFFICIENT "R"	10-YR "AR"	10-YR ACCUM. "AR"	10-YR RAINFALL INTENSITY (mm/hr)	10-YR ACCUM. FLOW (m^3/s)	Total Flow (m^3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	ACC. TIME OF CONC. (min)	% Full
Courtneypark Drive East	MH21	MH23	1.13	0.61	0.69	0.69	99.17	0.190	0.190	30.60	1.00	525	0.430	1.987	15.257	44%
Courtneypark Drive East	MH22	MH23	1.13	0.61	0.69	0.69	99.17	0.190	0.190	47.80	1.00	450	0.285	1.793	15.444	67%
Courtneypark Drive East	MH23	MH24	0	0.00	0.00	1.38	97.45	0.373	0.373	57.60	1.00	750	1.113	2.520	15.825	34%
Courtneypark Drive East	MH24	MH29	2	0.48	0.96	2.34	96.03	0.624	0.624	140.60	0.45	825	0.962	1.801	17.126	65%
Courtneypark Drive East	MH25	MH27	4.85	0.34	1.65	1.65	99.17	0.454	0.454	20.00	1.00	900	1.809	2.846	15.117	25%
Courtneypark Drive East	MH26	MH27	1.34	0.48	0.64	0.64	99.17	0.177	0.177	100.00	1.48	450	0.347	2.181	15.764	51%
Courtneypark Drive East	MH27	MH28	2	0.48	0.96	3.25	96.25	0.870	0.870	103.00	0.66	1050	2.217	2.562	16.434	39%
Courtneypark Drive East	MH28	MH29	0	0.00	0.00	3.25	93.85	0.848	0.848	100.00	0.71	1050	2.300	2.657	17.061	37%
Gottardo Court	MH29	MH1	0	0.00	0.00	5.59	91.51	1.421	1.421	20.00	1.00	1200	3.897	3.447	17.223	36%
Courtneypark Drive East	MH31	MH32	3.017	0.63	1.89	1.89	99.17	0.521	0.521	91.40	1.00	675	0.840	2.349	15.648	62%
Courtneypark Drive East	MH32	MH33	3.017	0.63	1.89	3.79	96.68	1.016	1.016	91.40	0.60	900	1.402	2.204	16.340	73%
Courtneypark Drive East	MH33	MH34	3.017	0.63	1.89	5.68	94.18	1.485	1.485	91.40	0.80	1050	2.441	2.821	16.880	61%
Courtneypark Drive East	MH34	MH37	3.017	0.63	1.89	7.57	92.33	1.942	1.942	96.70	0.80	1050	2.441	2.821	17.451	80%
Courtneypark Drive East	MH35	MH36	3.017	0.63	1.89	1.89	99.17	0.521	0.521	91.40	0.30	825	0.786	1.471	16.036	66%
Courtneypark Drive East	MH36	MH37	3.017	0.63	1.89	3.79	95.26	1.002	1.002	91.40	0.40	1050	1.726	1.995	16.799	58%
Courtneypark Drive East	MH40	MH41	0.7	0.84	0.59	0.59	99.17	0.162	0.162	52.80	0.50	450	0.201	1.268	15.694	81%
Courtneypark Drive East	MH41	MH42	0	0.00	0.00	0.59	96.51	0.158	0.158	20.00	1.00	450	0.285	1.793	15.880	55%
Courtneypark Drive East	MH43	MH44	1.2	0.77	0.93	0.93	99.17	0.255	0.255	91.40	0.56	525	0.322	1.487	16.025	79%
Courtneypark Drive East	MH44	MH45	1.2	0.77	0.93	1.85	95.30	0.490	0.490	91.40	0.50	750	0.787	1.782	16.880	62%
Courtneypark Drive East	MH45	MH48	1.2	0.77	0.93	2.78	92.33	0.713	0.713	91.40	1.00	750	1.113	2.520	17.484	64%
Courtneypark Drive East	MH46	MH47	1.2	0.77	0.93	0.93	99.17	0.255	0.255	91.40	0.50	600	0.434	1.536	15.992	59%
Courtneypark Drive East	MH47	MH48	1.2	0.77	0.93	1.85	95.42	0.491	0.491	91.40	0.50	750	0.787	1.782	16.847	62%
Courtneypark Drive East	MH48	MH4	0	0.00	0.00	4.63	90.35	1.162	1.162	20.00	1.00	900	1.809	2.846	17.601	64%