Memo

To: Curtis Tighe, Town of Ingersoll

From: Cameron Rickert, P.Eng., Dillon Consulting Limited (Dillon)

cc: Justine Giancola, Dillon
Ron Shishido, Dillon
Ron Versteegen, Oxford County

Date: June 14, 2023

Subject: Stormwater Management Infrastructure Memorandum

Our File: 22-4365

The Southwest Ingersoll Secondary Plan project area is located south of the Town of Ingersoll, within the Upper Thames River Subwatershed. The Study Area generally slopes from south to north towards the Thames River. Elevations range from approximately 305 meters at the south limits to 270 m at the north limits near the Thames River. Currently, lands within the Study Area are drained by roadside ditches and drainage culverts as most of this area is currently undeveloped. These drainage features ultimately outlet to Municipal Drains and tributaries within the Study Area.

Existing Land Use

The predominant land uses in the study area are actively cropped agricultural lands, rural residential lots, and some existing industrial lands. Runoff is conveyed to respective outlets as surface flow. Based on soils mapping presented in the 1961 Soil Survey of Oxford County, local soils are predominantly Honeywood-Guelph silty till and loam till, and Guelph loam.

Design Criteria

Stormwater management design criteria for the subject site has been developed based on documentation provided by the Town of Ingersoll and The Upper Thames River Conservation Authority (UTRCA). These design criteria include:

- Minor system infrastructure (storm sewers) will be sized to convey the 2-year rainfall event;
- Major system infrastructure (overland flow, typically roadways/swales) will be sized to convey the 250-year event.
- Flood and Water Quantity Control - managing the peak discharges from the 2 through 250-year events to pre-development levels;
- Water Quality Control – Volume control for storage facilities for a minimum of 24 hours from a 25 mm rainfall that provides Enhanced Protection Level water quality treatment to provide 80% total suspended solids removal of 80%;

- Stream Channel Erosion – Control peak flows and runoff volume for the 2-year through 250-year events; and
- Baseflow – Infiltrating the first 5 mm of rainfall.

Design criteria from the 2003 Stormwater Management Planning and Design Manual, prepared by the Ministry of Environment, Conservation, and Parks (MECP), were also considered in the conceptual design process.

Drainage Areas

The Municipal Drains that convey runoff from the Study Area include:

- Ruckle Drain;
- Halls Creek Drain;
- Whiting Creek Drain;
- Michael Sheanan Drain (and tributaries);
- Thompson Drain; and,
- Hart Drain.

Figure 1 shows the drainage boundaries for each of these municipal drains through the Study Area. The Study Area is broken down into three subareas, generally divided by Highway 401; East, South and West. Within these areas, an existing drainage area plan was developed, as shown on **Figure 2.**

East Subarea

This portion of the Study Area drains to both the Ruckle Drain and the Halls Creek Drain. A portion of this area drains south towards Clarke Road where runoff is collected by a roadside ditch. With the exception of a small property north of Clarke Road, this area is entirely cropped agricultural lands. Subcatchments within this area are prefaced with "E".

South Subarea

The southern portion of the Study Area drains to the Halls Creek Drain, the Whiting Creek Drain, and the Michael Sheanan Drain. There is a portion of this subarea that does not have a surface water outlet as a resulting of existing topography. It is assumed that drainage within this area collects and infiltrates into the ground. Generally, the lands within the southern subarea are cropped agricultural lands. Subcatchments within this area are prefaced with S_E or S_W, depending on location relative to the Whiting Creek Drain.

West Subarea

The west portion of the Study Area consists mostly of the CAMI Assembly Facility. Immediately west of CAMI, there is agricultural area for which a functional servicing report of an industrial development has been prepared. The northern portion of the west subarea is actively cropped agricultural area with residential lots fronting on King Street West. Subcatchments within this area are prefaced with "W".

Existing Condition Hydrologic Analysis

To assist with the delineation of existing catchments within the Study Area, several outlets were identified within each Municipal Drain catchment. The locations of these outlets and areas draining to these locations are shown in **Figure 2**.

A hydrologic assessment was completed using Visual Otthymo 6 (VO6) to calculate the existing peak discharge rates at each outlet. Existing land use, topography, and soil type were considered as part of the assessment. These parameters are documented in **Appendix A**. **Table 1** provides the anticipated peak flows under existing conditions.

Table 1: Existing Conditions Peak Flows (m^3/s)

Outlet (Contributing Subcatchments)	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	250-Year
Outlet 1 (E1+E2)	0.14	0.32	0.46	0.62	0.74	0.92	1.25
Outlet 2 (E3+E4+E4_Ext+E5)	0.09	0.24	0.35	0.47	0.56	0.70	0.99
Outlet 3 (S_E1)	0.16	0.37	0.53	0.72	0.86	1.06	1.47
Outlet 4 (S_E3+S_W2)	0.21	0.57	0.83	1.14	1.38	1.71	2.45
Outlet 5 (S_W3)	0.42	0.90	1.24	1.61	1.89	2.28	3.10
Outlet 6 (S_W3_Ext2+S_W4+S_W4Ext3)	0.40	0.98	1.39	1.85	2.20	2.68	3.75
Outlet 7 (W1)	0.18	0.49	0.74	1.03	1.25	1.58	2.25
Outlet 8 (W2)	0.25	0.57	0.81	1.09	1.30	1.61	2.18
Outlet 9 (W3)	0.05	0.15	0.25	0.37	0.46	0.60	0.89
Outlet 10 (W4)	0.00	0.01	0.02	0.04	0.05	0.07	0.11
Outlet 11 (W5)	0.01	0.07	0.14	0.22	0.30	0.40	0.68
Outlet 12 (W6)	0.02	0.07	0.12	0.19	0.24	0.32	0.51

.

Design criteria for water quantity control dictates that the post development peak flows are to be controlled to pre-development levels for the 2 to 250-year design storm events. Therefore, the existing conditions peak flows presented in **Table 1** will serve as the target discharge rates for the proposed development conditions.

Proposed Conditions Hydrologic Analysis

Future development within the Secondary Plan Area includes low and medium density residential, open space, prime industrial, and service commercial land uses. The locations of these proposed land uses are presented in **Figure 3**.

Catchments S_W3_b, S_E2, and S_W1do not have an existing surface water outlet. Runoff from these areas currently infiltrates into the underlying soils. A new surface water outlet will be required to discharge the proposed conditions runoff from these areas since controlling the stormwater from future development using infiltration measures likely isn't feasible. Additionally, portions of the West subarea are already included in an existing stormwater servicing strategy. These areas include annexed property that is part of the CAMI facility, and the area west of Wallace Line which is intended for industrial development.

As a result of the increased imperviousness from paved areas, roof tops, road networks, sidewalks, etc., increases in peak stormwater flows and volumes are anticipated within each catchment. Stormwater management facilities will be required to mitigate these increases. VO6 was used to calculate future condition peak flows from the proposed subcatchments and develop preliminary design volumes for each proposed stormwater management facility. Based on the estimated required volumes and design criteria from the Stormwater Management Planning and Design Manual (SWMPDM) (MOE, 2003), an estimated footprint was calculated for each location. Pond land requirements were estimated for each facility based on the following assumptions:

- Side slopes are 5H:1V;
- Length to width ratio of 4:1; and
- Freeboard of 30 cm during the regional (250-year) design storm event.

Water quality treatment is another consideration that can affect the minimum footprint size of a SWM facility. The permanent pool volume of a SWM facility is dependant on the impervious coverage of its service area and the water quality treatment criteria of the receiving watercourse. The SWMPDM Table 4.6 provides guidance on the permanent pool and erosion control volume requirements based on catchment characteristics. This information, combined with the active storage volume requirements, was used to estimate the total SWM facility footprint area. A side slope of 3:1 (H:V) within the permanent pool was assumed to maximize volume in the smallest footprint to achieve the estimated minimum storage requirements.

A summary of the anticipated SWM facility footprints are provided in **Table 2**.

Table 2: Estimated SWM Facility Footprint

	Outlet 1	Outlet 3	Outlet 4	Outlet 5	Outlet 6	Outlet 12
Minimum Required **Permanent Pool Volume (m^3)**	6,700	11,200	9,400	11,600	3,800	2,600
Minimum Required **Active Storage Volume (m^3)**	12,000	25,500	17,000	23,000	4,250	1,400
Required Area (ha)	0.85	1.35	1.00	1.25	0.55	0.35

Stormwater conveyance will be provided by storm sewers and overland flow routes, generally following the location of proposed streets within the Study Area, as shown on **Figure 3**. The sewers and overland flow routes will generally follow the future road grades to the low point within each catchment and discharge to the associated SWM facility.

Opinion of Probable Construction Costs

Construction costs related to stormwater management infrastructure have been prepared based on the City of London Growth Management Implementation Strategy (GMIS) for 2023. This reference should provide an appropriate comparison because it captures recent construction costs- given the rapidly changing economic climate- and cost implications of the local geography.

Pond Construction

The City of London GMIS presents anticipated costs for engineering studies, EAs, design, and construction administration for SWMFs planned to service growth areas in future years. A contingency amount of 20% and an engineering allowance of 15-20% has been used on top of the capital costs. For the purposes of this cost estimation, these buffers have been removed to determine the capital costs and a 30% contingency has been applied for conservatism. The proposed SWMFs presented in the GMIS are intended to service primarily residential areas and for this reason, a correction has been applied based on the anticipated land use identified in the Secondary Plan. **Table 3** shows the anticipated costs to construct the ponds servicing the Secondary Plan area.

Table 3: Estimate of SW Ingersoll SWMF Costs

Pond Name	Contributing Area (ha)	Assumed Runoff Coefficient	Estimated Construction Cost	Estimated Cost Including 30% Contingency
P1	45	0.60	$2,600,000	$3,400,000
P3	60	0.85	$4,900,000	$6,400,000
P4	50	0.85	$4,100,000	$5,300,000
P5	62	0.85	$5,100,000	$6,600,000
P6	20	0.85	$1,700,000	$2,200,000
P7	26	0.55	$1,400,000	$1,800,000
Wallace Line	79	0.70	$5,300,000	$6,900,000

Storm Sewer Construction

Storm sewers within the Study Area will be constructed beneath roadways and therefore will generally follow the topography and have similar length. These characteristics were used to estimate the required storm sewer size to convey the 2-year design storm event runoff and estimate the total supply and construction cost. **Table 4** shows the construction costs of the proposed trunk storm sewers within the Study Area.

Table 4: Estimate of SW Ingersoll SWMF Costs

Catchment	Catchment Area (ha)	Calculated 2-Year Flow Rate (cms)	Approximate Diameter (mm)	Estimated Cost per metre (Installed)	Approximate Length (m)	Estimated Cost Including 30% Contingency
P1	45	0.47	750	$1,050	900	$1,300,000
P3	60	1.51	1050	$1,850	780	$1,900,000
P4	50	1.07	975	$1,600	920	$2,000,000
P5	62	1.90	1200	$2,300	995	$3,000,000
P6	20	1.02	750	$1,050	500	$700,000
P7	26	0.004	300	$300	620	$300,000
Wallace Line	79	1.40	1350	$2,950	1,060	$4,100,000

Construction Phasing

Phasing of the proposed stormwater management infrastructure should follow standard practices within most catchments since they are generally very uniform. This includes the following procedure:

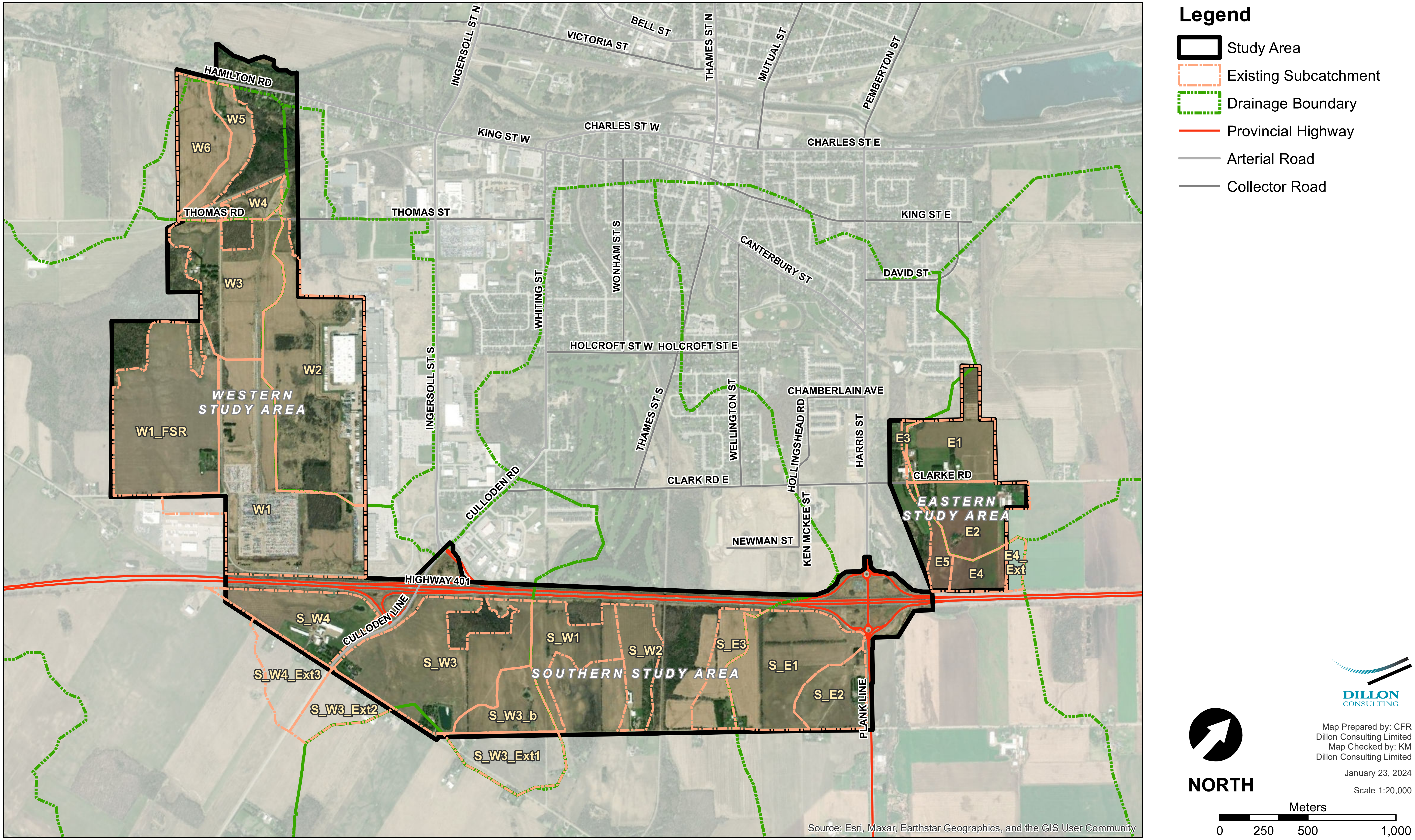
1. Construction of the stormwater management facility
2. Construction of linear infrastructure
3. Roads and servicing

The exception is the east subarea where there is proposed residential development north and south of Clarke Road. It is important that the development north of Clarke Road takes precedence as this is where the stormwater management facility will be located.

Attachments:
Figure 1 – Existing Drains
Figure 2 – Existing Drainage Plan
Figure 3 – Proposed Drainage Plan
Background Hydrology Calculations

SOUTH WEST INGERSOLL SECONDARY PLAN

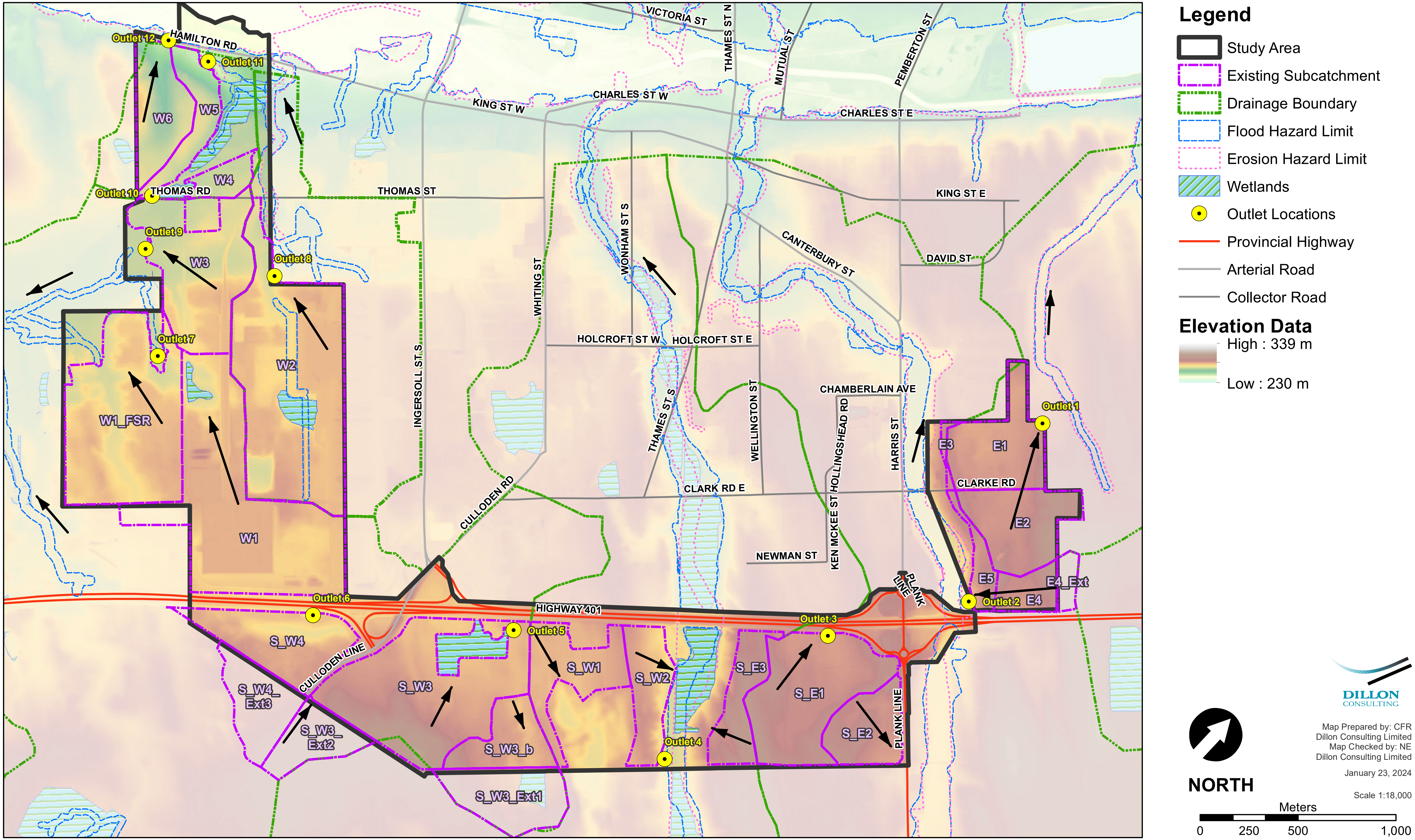
FIGURE 1: EXISTING DRAINS



File Location: K:\2022\224365\Product\Client\20240118_SWM_Tech_Memo\Figure 1 - Existing Drains.mxd

SOUTH WEST INGERSOLL SECONDARY PLAN

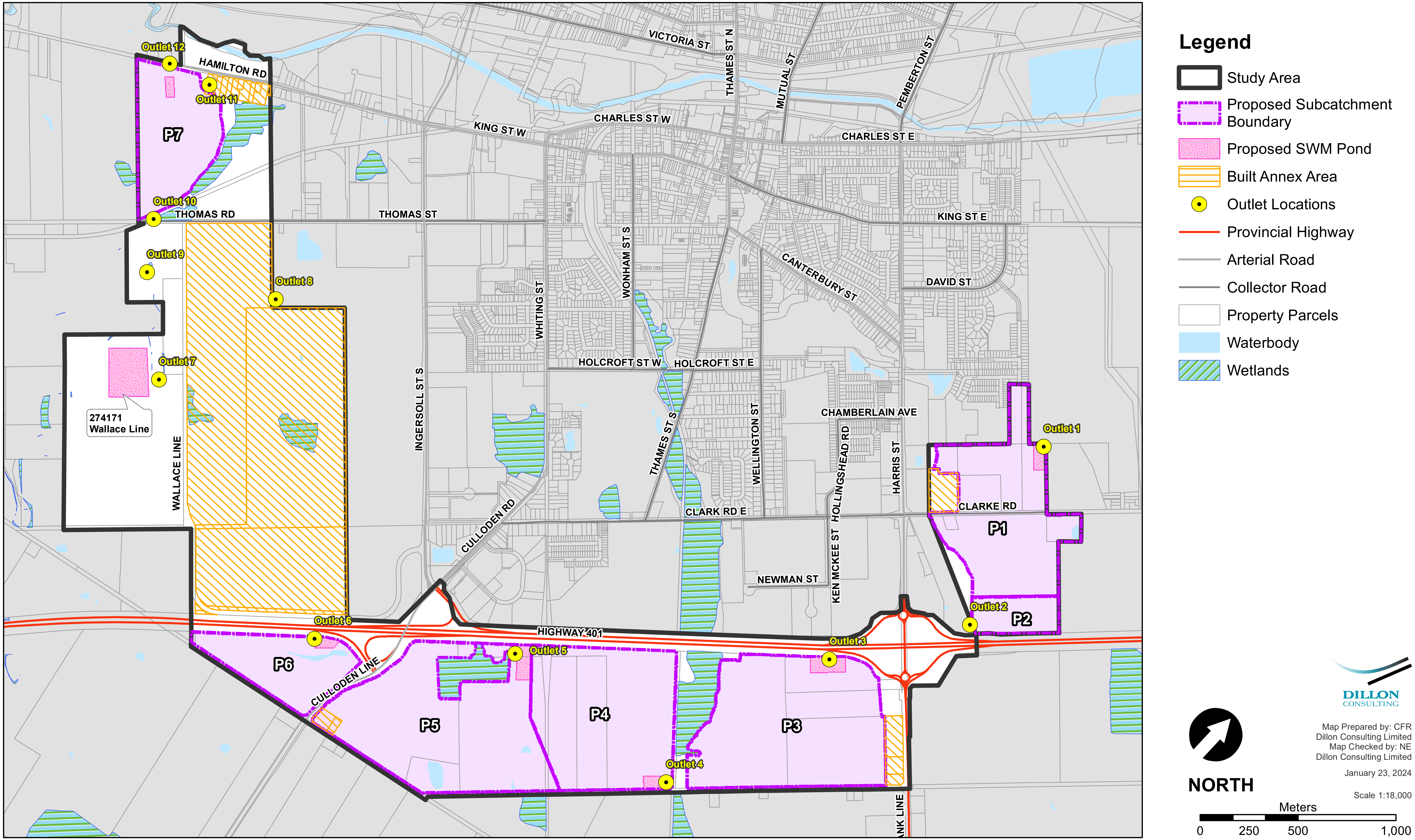
FIGURE 2: EXISTING DRAINAGE PLAN



File Location: K:\2022\224365\Product\Client\20240118_SWM_Tech_Memo\Figure 2 - Existing Drainage Plan.mxd

SOUTH WEST INGERSOLL SECONDARY PLAN

FIGURE 3: PROPOSED DRAINAGE PLAN



File Location: K:\2022\224365\Product\Client\20240118_SWM_Tech_Memo\Figure 3 - Proposed Drainage Plan.mxd

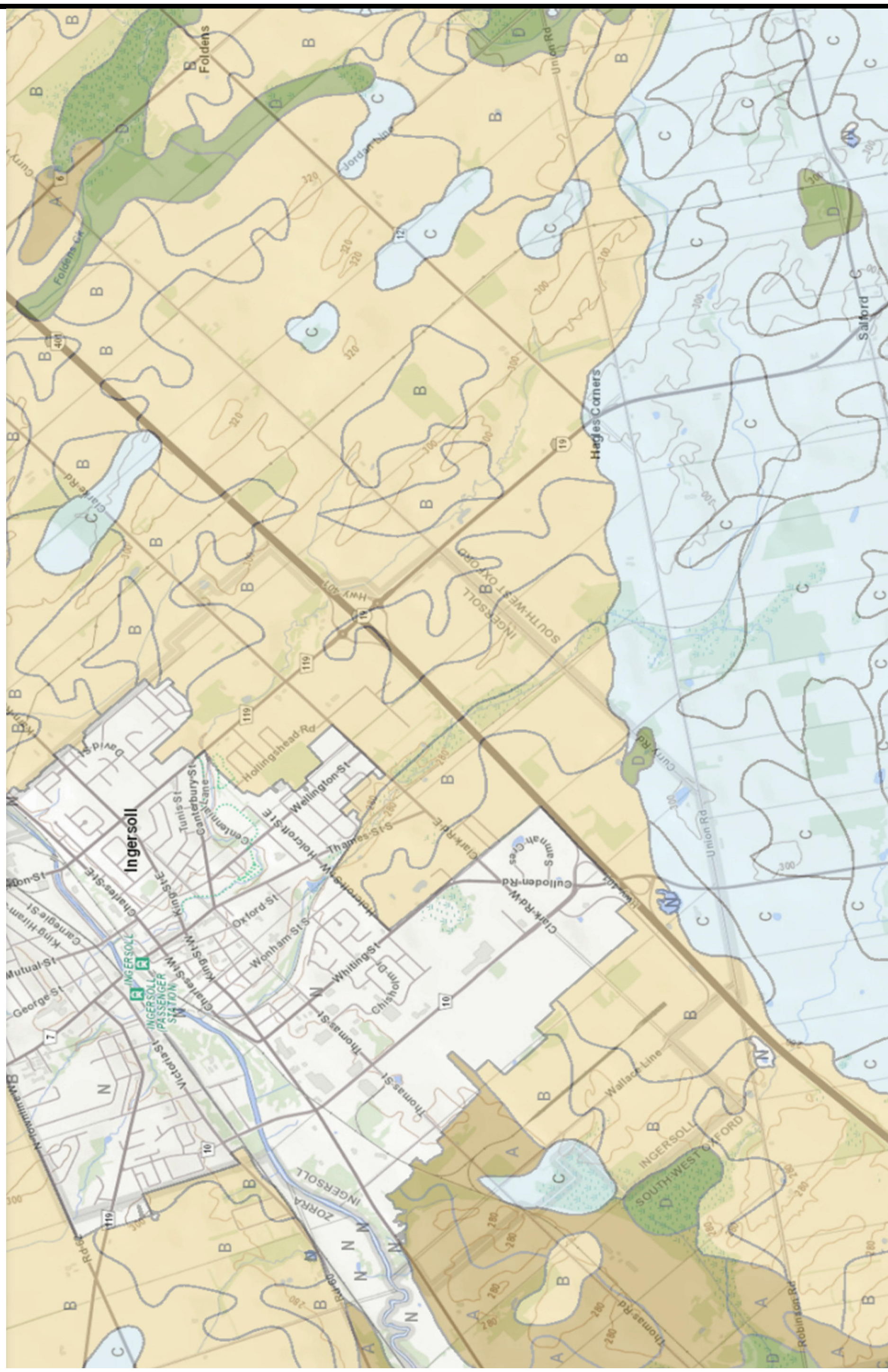
SW Ingersoll Secondary Plan
STORMWATER MANAGEMENT

Project Number: 22-4365
Date: February 28, 2023
Design By: Cam Rickert, P.Eng.

File: 22-4365 / Analysis & Design / SWM

DILLON CONSULTING

FIGURE
Study Area Soils
Hydrologic Soil Group



SW Ingersoll Secondary Plan
STORMWATER MANAGEMENT

Project Number: 22-4365
Date: February 28, 2023
Design By: Cam Rickert, P.Eng.

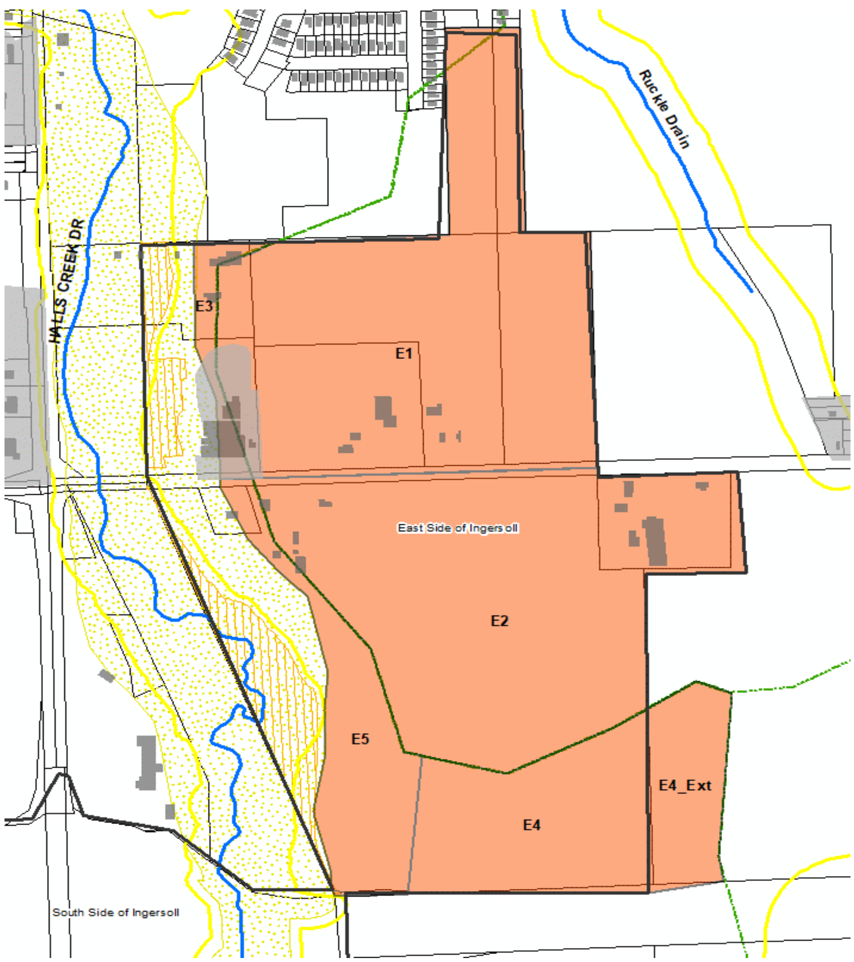
File: 22-4365 / Analysis & Design / SWM

East Subarea Catchments
Hydrologic Parameters
Existing Conditions

Catchment ID	Catchment	Area (Ha)	HSG	CN	Length (m)	Slope (%)	Tc* (h)
E1+E2	Ruckle Drain	32.82	B	78	800	0.44	1.8
E3	Halls Creek	1.07	B	78	30	1.1	0.3
E4	Halls Creek	6.58	B	78	265	0.5	1.0
E4_Ext.	Halls Creek	2.96	B	78	227	1.05	0.7
E5	Halls Creek	4.82	B	78	140	0.5	0.7

* Tc calculated using the Airport Method

$$t = \frac{3.26 * (1.1 - C) * L^{0.5}}{S^{0.33}}$$



SW Ingersoll Secondary Plan
STORMWATER MANAGEMENT

DILLON CONSULTING

Project Number: 22-4365
Date: February 28, 2023
Design By: Cam Rickert, P.Eng.

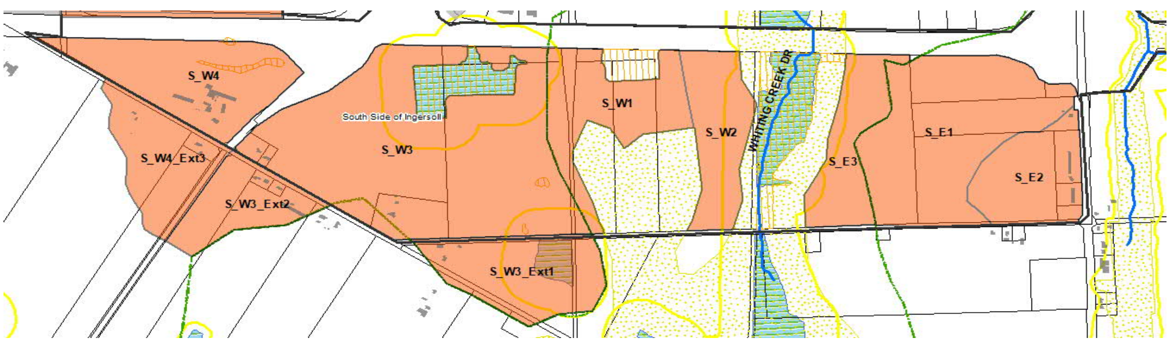
File: 22-4365 / Analysis & Design / SWM

South Subarea Catchments
Hydrologic Parameters
Existing Conditions

Catchment ID	Catchment	Area (Ha)	HSG	CN	Length (m)	Slope (%)	Tc* (h)
S_E1	Halls Creek	33.36	B	78	580	0.5	1.5
S_E2	Halls Creek	13.51	B	78	610	0.833	1.3
S_E3	Whiting Cr	11.97	B	78	215	2.9	0.5
S_W1	Whiting Cr	16.61	B	78	275	0.73	0.9
S_W2	Whiting Cr	13.13	B	78	200	3.5	0.5
S_W3	Michael Sheanan Dr	49.08	B	78	790	1.5	1.2
S_W3_b	Michael Sheanan Dr	12.67	C	86	400	2.5	0.7
S_W3_Ext1	Michael Sheanan Dr	17.18	C	78	300	2.67	0.6
S_W3_Ext2	Michael Sheanan Dr	11.13	C	78	365	2.2	0.7
S_W4	Michael Sheanan Dr	20.98	B/C	82	340	5.5	0.5
S_W4_Ext3	Michael Sheanan Dr	14.26	C	78	380	0.9	1.0

* Tc calculated using the Airport Method

$$t = \frac{3.26 * (1.1 - C) * L^{0.5}}{S^{0.33}}$$



SW Ingersoll Secondary Plan
STORMWATER MANAGEMENT

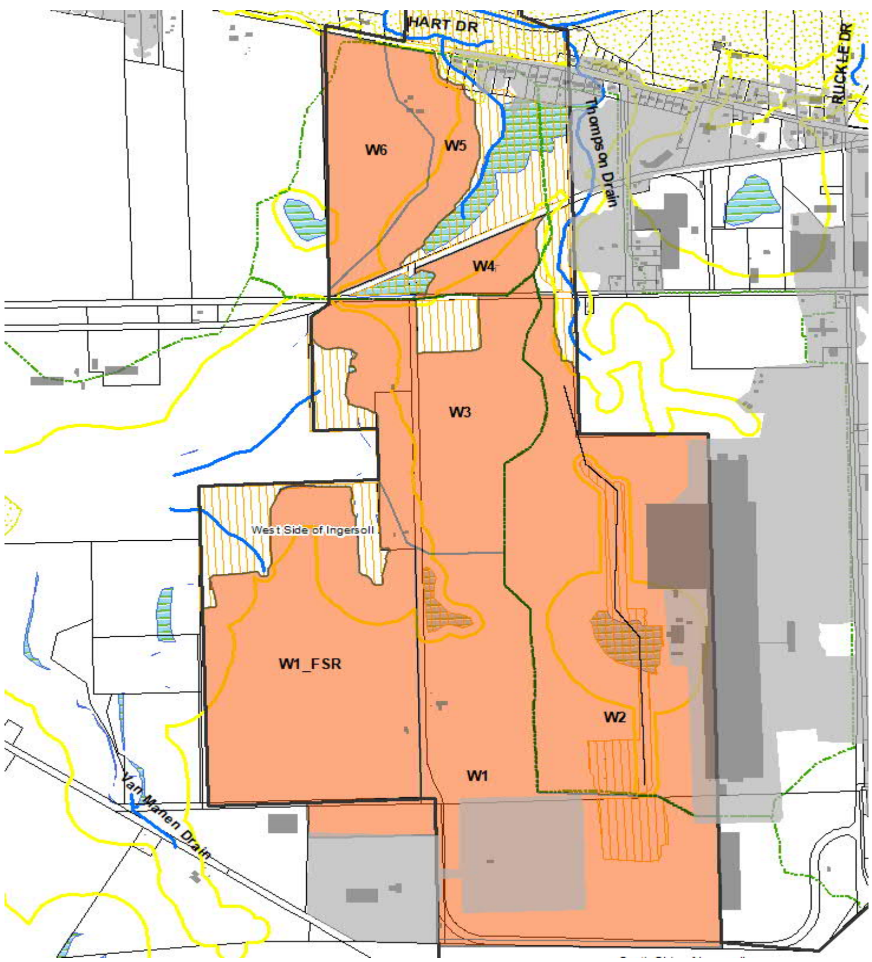
Project Number: 22-4365
Date: February 28, 2023
Design By: Cam Rickert, P.Eng.
File: 22-4365 / Analysis & Design / SWM

West Subarea Catchments
Hydrologic Parameters
Existing Conditions

Catchment ID	Catchment	Area (Ha)	HSG	CN	Length (m)	Slope (%)	Tc* (h)
W1	Michael Sheanan Dr	64.19	B	74.4	975	0.81	1.6
W1_FSR	Michael Sheanan Dr	49.74	B	78	575	0.52	1.5
W2	Thompson Drain	64.09	B	78.1	1250	0.58	2.1
W3	Michael Sheanan Dr	32.69	A/B	69.8	625	0.45	1.6
W4	Michael Sheanan Dr	5.04	A	64.5	400	0.38	1.3
W5	Hart Drain	10.31	A	67	110	3.6	0.3
W6	Hart Drain	15.94	A	67	625	1.6	1.0

* Tc calculated using the Airport Method

$$t = \frac{3.26 * (1.1 - C) * L^{0.5}}{S^{0.33}}$$



SW Ingersoll Secondary Plan
STORMWATER MANAGEMENT

Project Number: 22-4365
Date: February 28, 2023
Design By: Cam Rickert, P.Eng.

Model Summary
Existing Peak Flow

File: 22-4365 / Analysis & Design / SWM

		Peak Flow (cms)						
Area No	Notes	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr	250 Yr
E1+E2	Outlet 1	0.138	0.324	0.461	0.621	0.741	0.915	1.254
E3		0.011	0.032	0.047	0.067	0.081	0.101	0.144
E4		0.038	0.097	0.14	0.188	0.226	0.279	0.395
E4_Ext		0.021	0.055	0.079	0.108	0.13	0.16	0.23
E5		0.034	0.089	0.129	0.176	0.211	0.261	0.374
S_E1	Outlet 3	0.156	0.374	0.534	0.719	0.858	1.059	1.47
S_E2		0.068	0.167	0.239	0.322	0.385	0.475	0.664
S_E3		0.098	0.271	0.396	0.544	0.657	0.814	1.169
S_W1		0.102	0.262	0.378	0.511	0.613	0.756	1.075
S_W2		0.108	0.297	0.434	0.597	0.721	0.893	1.282
S_W3	Outlet 5	0.416	0.903	1.238	1.612	1.89	2.281	3.101
S_W3_b		0.205	0.565	0.823	1.144	1.41	1.77	2.336
S_W3_Ext1		0.129	0.348	0.51	0.692	0.833	1.034	1.479
S_W3_Ext2		0.078	0.206	0.298	0.406	0.488	0.603	0.863
S_W4		0.295	0.691	0.968	1.275	1.504	1.816	2.51
S_W4_Ext3		0.083	0.21	0.302	0.408	0.488	0.603	0.855
W1	Outlet 7	0.182	0.494	0.737	1.029	1.252	1.58	2.246
W1_FSR		0.232	0.558	0.796	1.072	1.279	1.578	2.192
W2	Outlet 8	0.251	0.574	0.812	1.093	1.302	1.608	2.178
W3	Outlet 9	0.045	0.153	0.247	0.365	0.458	0.598	0.885
W4	Outlet 10	0.002	0.013	0.024	0.039	0.052	0.071	0.114
W5	Outlet 11	0.011	0.072	0.138	0.224	0.297	0.402	0.679
W6	Outlet 12	0.015	0.067	0.119	0.185	0.239	0.32	0.51
NHYD 30	Outlet 2	0.094	0.241	0.348	0.47	0.564	0.696	0.991
NHYD 31	Outlet 6	0.399	0.979	1.385	1.846	2.195	2.676	3.749
NHYD 38	Outlet 4	0.206	0.567	0.829	1.141	1.378	1.707	2.451

Indicates External Drainage Areas
Indicates Areas With Completed SWM Design
Unrealistic to Include More Development

SW Ingersoll Secondary Plan
STORMWATER MANAGEMENT

Project Number: 22-4365
Date: February 28, 2023
Design By: Cam Rickert, P.Eng.

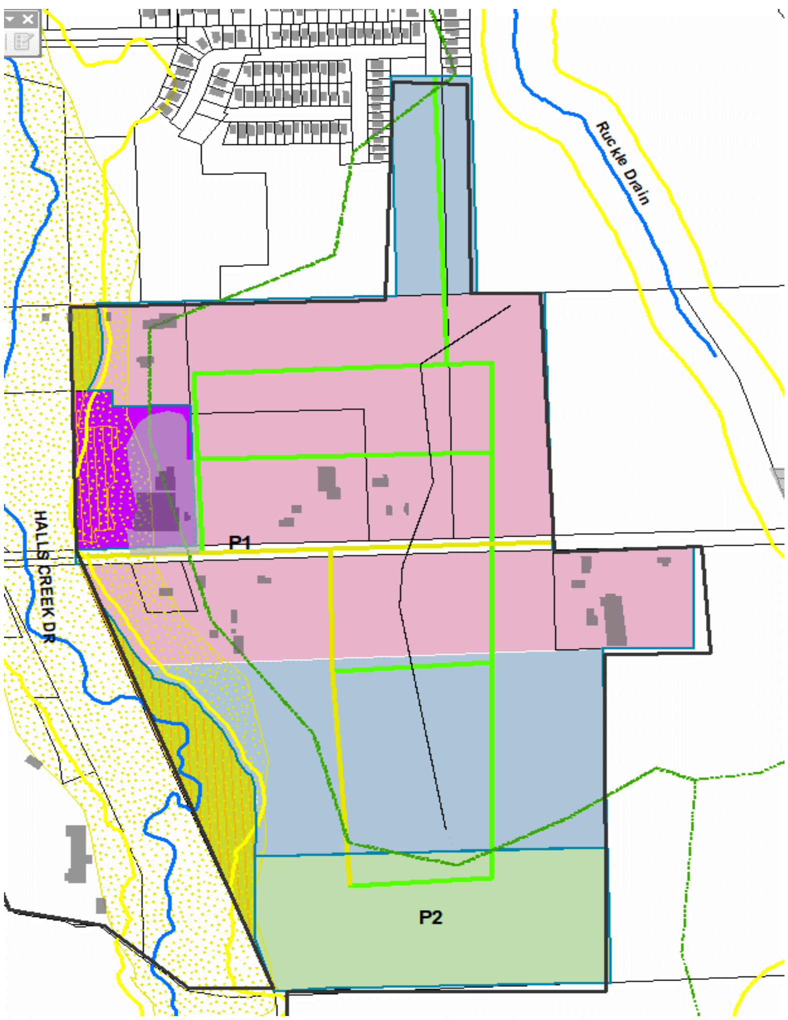
East Subarea Catchments
Proposed Hydrologic Parameters

File: 22-4365 / Analysis & Design / SWM

Area No	Catchment	Area (Ha)	HSG	CN	Length (m)	Slope (%)	Tc* (h)
P1	Ruckle Drain	44.81	B	81	800	0.25	0.7
P2	Halls Creek	8.39	B	69	400	1.25	0.9 (Airport)
P2_E4_Ext.	Halls Creek	2.96	B	78	227	1.05	0.7 (Airport)

* Tc calculated using Bransby Williams

$$t_c = 0.057 \times L/(S_w^{0.2} \times A^{0.1})$$



SW Ingersoll Secondary Plan
STORMWATER MANAGEMENT

Project Number: 22-4365
Date: February 28, 2023
Design By: Cam Rickert, P.Eng.

South Subarea Catchments
Proposed Hydrologic Parameters

File: 22-4365 / Analysis & Design / SWM

Area No	Catchment	Area (Ha)	HSG	CN	Length (m)	Slope (%)	Tc* (h)
P3	Halls Creek	60.06	B	88	825	0.5	0.6
P4	Whiting Cr	50.21	B	88	975	0.33	0.8
P5	Michael Sheanan Dr	61.95	B/C	90	850	0.5	0.6
P6	Michael Sheanan Dr	20.42	B/C	90	400	1	0.3

* Tc calculated using Bransby Williams

$t_c = 0.057 \times L/(S_w^{0.2} \times A^{0.1})$

SW Ingersoll Secondary Plan
STORMWATER MANAGEMENT

Project Number: 22-4365
Date: February 28, 2023
Design By: Cam Rickert, P.Eng.

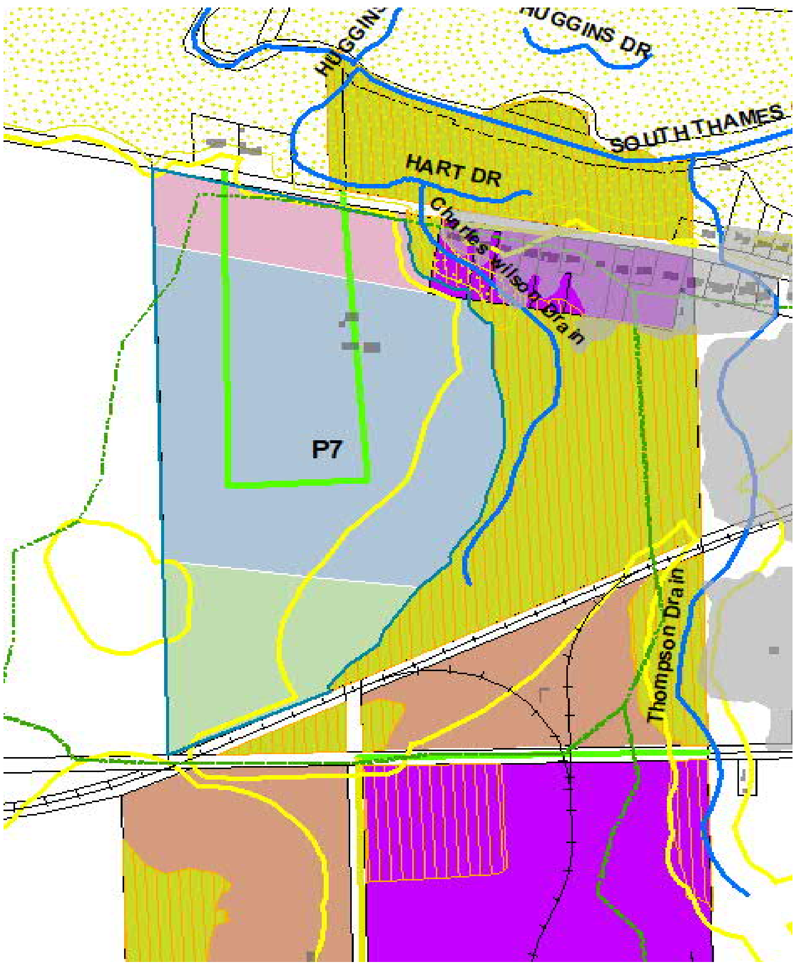
West Subarea Catchments
Proposed Hydrologic Parameters

File: 22-4365 / Analysis & Design / SWM

Area No	Catchment	Area (Ha)	HSG	CN	Length (m)	Slope (%)	Tc* (h)
P7	Hart Drain	26.27	A	61.0	500	2	0.3

* Tc calculated using Bransby Williams

$t_c = 0.057 \times L/(S_w^{0.2} \times A^{0.1})$



SW Ingersoll Secondary Plan
STORMWATER MANAGEMENT

Project Number: 22-4365
Date: February 28, 2023
Design By: Cam Rickert, P.Eng.

Model Summary
Proposed Peak Flow

File: 22-4365 / Analysis & Design / SWM

Proposed Peak Flow (cms)								
Area No	Notes	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr	250 Yr
P1	Outlet 1	0.466	1.102	4.072	2.038	2.408	2.932	4.072
P3	Outlet 3	1.512	2.915	8.385	4.768	5.467	6.394	8.385
P4	Outlet 4	1.066	2.026	5.775	3.283	3.766	4.412	5.775
P5	Outlet 5	1.903	3.479	9.325	5.493	6.242	7.226	9.325
P6	Outlet 6	1.016	1.894	4.18	3.123	3.589	4.18	5.184
P7	Outlet 12	0.004	0.053	1.065	0.256	0.372	0.552	1.065
NHYD 30	Outlet 2	0.028	0.096	0.351	0.219	0.273	0.351	0.531

SW Ingersoll Secondary Plan
STORMWATER MANAGEMENT

Project Number: 22-4365
Date: February 28, 2023
Design By: Cam Rickert, P.Eng.

File: 22-4365 / Analysis & Design / SWM

DILLON CONSULTING

Model Summary
Storage Discharge Curves

Proposed Storage-Discharge Curves

Outlet 1		Outlet 3		Outlet 4	
Discharge (cms)	Storage (Ha.m)	Discharge (cms)	Storage (Ha.m)	Discharge (cms)	Storage (Ha.m)
0.138	0.200	0.156	0.700	0.206	0.500
0.324	0.400	0.374	1.100	0.567	0.750
0.461	0.500	0.534	1.350	0.829	0.900
0.621	0.650	0.719	1.650	1.141	1.100
0.741	0.750	0.858	1.800	1.378	1.250
0.915	0.900	1.059	2.100	1.707	1.400
1.254	1.200	1.470	2.550	2.451	1.700

Outlet 5		Outlet 6		Outlet 12	
Discharge (cms)	Storage (Ha.m)	Discharge (cms)	Storage (Ha.m)	Discharge (cms)	Storage (Ha.m)
0.416	0.650	0.399	0.150	0.015	0.001
0.903	1.000	0.979	0.225	0.067	0.004
1.238	1.250	1.385	0.260	0.119	0.012
1.612	1.500	1.846	0.300	0.185	0.027
1.890	1.700	2.195	0.325	0.239	0.040
2.281	1.900	2.676	0.375	0.320	0.065
3.101	2.300	3.749	0.425	0.510	0.140

Proposed Controlled Peak Flow (cms)

Area No	Notes	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr	250 Yr
P1	Outlet 1	0.13	0.30	0.46	0.46	0.61	0.73	1.23
P3	Outlet 3	0.14	0.35	0.50	0.50	0.68	0.84	1.46
P4	Outlet 4	0.20	0.55	0.82	0.82	1.09	1.29	2.34
P5	Outlet 5	0.40	0.89	1.20	1.20	1.56	1.80	3.10
P6	Outlet 6	0.36	0.90	1.32	1.32	1.76	2.13	3.62
P7	Outlet 12	0.00	0.05	0.11	0.11	0.17	0.23	0.49

SW Ingersoll Secondary Plan
STORMWATER MANAGEMENT

DILLON CONSULTING

Project Number: 22-4365
Date: February 28, 2023
Design By: Cam Rickert, P.Eng.

Calculation Sheet
Pond Volume/Area Calculations

File: 22-4365 / Analysis & Design / SWM

Active Storage Volume

	Outlet 1	Outlet 3	Outlet 4	Outlet 5	Outlet 6	Outlet 12
a (Top width)	42.5	54	47	52	30	22
b (Top length)	117.5	156	128	148	90	70
c (Bottom width)	25	34	27	32	20	16
d (Bottom length)	100	136	108	128	80	64
Freeboard (m)	0.3	0.3	0.3	0.3	0.3	0.3
L:W Ratio	4:1	4:1	4:1	4:1	4:1	4:1
h (depth)	1.75	2	2	2	1	0.6
Side Slopes	5:1	5:1	5:1	5:1	5:1	5:1
Required Volume	12000 m3	25500 m3	17000 m3	23000 m3	4250 m3	1400 m3
Provided Volume	13114 m3	26096 m3	17864 m3	23584 m3	4300 m3	1538 m3
Top area (ha)	0.55	0.91	0.66	0.83	0.31	0.18
Buffer Width	5.0	5.0	5.0	5.0	5.0	5.0
Width	55.5	67	60	65	43	35
Length	130.5	169	141	161	103	83
Area required (Ha)	0.85	1.35	1.00	1.25	0.55	0.35

SW Ingersoll Secondary Plan
STORMWATER MANAGEMENT

DILLON CONSULTING

Project Number: 22-4365
Date: February 28, 2023
Design By: Cam Rickert, P.Eng.

Calculation Sheet
Pond Volume/Area Calculations

File: 22-4365 / Analysis & Design / SWM

Water Quality Storage Requirements Based on Enhanced Level of Protection (80% TSS Removal)				
SWMP TYPE	Imperviousness			
	35%	***55%***	***70%***	***85%***
Wetponds	140 m^3/ha	190 m^3/ha	225 m^3/ha	250 m^3/ha

Water Quality Requirements (Wet Pond)

Area No	Notes	Upstream Area (Ha)	Imp. (%)	Storage Vol (m3/Ha)	Ext. Det. Vol. (m3/Ha)	Perm Pool Vol. (m3/Ha)	Perm Pool Vol. (m3)
P1	Outlet 1	44.8	56%	192.3		152	6700
P3	Outlet 3	60.1	72%	229.7		190	11200
P4	Outlet 4	50.2	72%	229.7	40	190	9400
P5	Outlet 5	62.0	72%	229.7		190	11600
P6	Outlet 6	20.4	72%	229.7		190	3800
P7	Outlet 12	26.3	34%	137.5		98	2600

Permanent Pool Volume						
	Outlet 1	Outlet 3	Outlet 4	Outlet 5	Outlet 6	Outlet 12
a (Top width)	25	34	27	32	20	16
b (Top length)	100	136	108	128	80	64
c (Bottom width)	14.2	25	13.5	20	9.5	1
d (Bottom length)	89.2	127	94.5	116	69.5	49
h (depth)	1.8	1.5	2.25	2	1.75	2.5
Side Slopes	3:1	3:1	3:1	3:1	3:1	3:1
Required Volume	6700 m3	11200 m3	9400 m3	11600 m3	3800 m3	2600 m3
Provided Volume	6780 m3	11699 m3	9431 m3	12832 m3	3955 m3	2683 m3