July 10, 2020

555 Canal Bank Developments GP Inc.
125 Villarboit Crescent
Vaughan, Ontario

Re: HAM-00801361-A1 Proposed Development
555 Canal Bank Street, Welland, Ontario
Pre and Post - Development Site Specific Water Balance Assessment

Dear Mr. Jeff Swartz:

As requested, EXP Services Inc. (EXP) is pleased to provide a pre- and post- development Site Specific Water Balance assessment for the proposed development located at 555 Canal Bank Street, Welland, Ontario.

Previously, the Site was partly occupied by a former industrial facility, which was demolished at the time of preparation of this assessment report. Based on the provided engineering drawing, the construction plan is anticipated to consist of a residential development including single family dwellings and townhouses, a mixed-use block, and an elementary school, as well as the associated roadways, stormwater management pond (SWMP), and site servicing. The proposed development plan is provided in Attachment 6. The Site location plan is shown on Figure 1.

1. Background Information

EXP has conducted a Hydrogeological Investigation for the Site (EXP, 2019 and 2020). The results of the noted investigation are presented under a separate cover; however, the pertinent information was utilized in this water balance assessment.

2. Methodology

The Thornthwaite water balance (Thornthwaite, 1948; Mather, 1978; 1979) is an accounting type method used to analyze the water components of the hydrologic cycle. This methodology was used to complete the pre-construction (existing conditions) and post-development water balance. The model input data includes monthly mean temperature, monthly mean precipitation, runoff factor, soil-moisture storage capacity, rain temperature threshold, snow temperature threshold, maximum melt rate and the latitude of the Site. The

model outputs are monthly potential and actual evapotranspiration, soil moisture storage, soil moisture storage change, surplus, infiltration, and runoff.

When rain precipitates (precipitation P), it can either runoff (R) through the surface water system, infiltrate (I) to the water table including an interflow component, or evapotranspire (ET) from the earth's surface and vegetation. The difference between total precipitation (P) and the total of evaporation and evapotranspiration (ET) is defined as the water surplus (S) which becomes available for both, infiltration (recharge to the groundwater system including interflow) and run-off. When long-term averages of P, R, I, and ET are used, no net change in groundwater storage (ST) is assumed. However, there is a potential for annual changes in ST.

The annual water budget can be stated as follows:

$$\mathbf{P = ET + R + I + \Delta ST}$$

Where:

P =	precipitation
ET =	evapotranspiration
R =	surface water run-off
I =	Infiltration
ΔST =	change in groundwater storage

For this assessment, the Thornthwaite and Mather method was used to estimate average infiltration rates based on the Site conditions. Infiltration corresponds to the vertical movement of water in the unsaturated zone in the shallow sub-surface (first few meters), and which later on discharges to surface water features.

Infiltration is governed by the surficial soil types, topography, land cover and depth to groundwater. The percolation rate of precipitation into soils with shallow water table is reduced and considered negligible.

The Thornthwaite and Mather Model based on the United Stated Geological Survey (USGS) graphical user interface was used for the calculation in this report, (Thornthwaite Monthly Water-Balance program, 2007).

2.1 Meteorological Data

Average monthly data for both, precipitation and temperature were obtained from the National Climate Data and Information Archive (Environment Canada) for the City of Welland (Station ID No. 6139445).

A 30-year cycle of climate data recorded between 1977 and 2006 was utilized for the assessment. Summary of input data is provided in Attachment 1.

2.2 Pre- and Post-Development Site Characteristics

2.2.1 Pre-Development Site Characteristics

Previously, the Site was partly occupied by a former industrial facility, which was demolished at the time of preparation of this assessment report.

A summary of the existing (pre-development) landscape features is provided in Table 2.1 below.

Table 2.1: Pre-Development (Existing) Land Use

Description	Pre-Construction (Existing) (m^2)
Total Site Area	747,290
Asphalt/Concrete and Existing Buildings	0
Landscape, Open Space (area available for infiltration)	747,290

The areas provided in Table 2.1 above were determined after reviewing the available Site plans and were considered for estimating the water balance.

As shown in Table 2.1, 100 % of the Site is pervious under pre-development conditions.

2.2.2 Post-Development Site Characteristics

Table 2.2 below provides a summary of the post-development Site characteristics. The proposed development plan is presented in Attachment 6.

Table 2.2: Post-Development Site Characteristics (Armstrong, 2020)

Description	Impervious Areas (ex: Buildings, Roads) m^2	Pervious Areas m^2	Total Areas Post Construction (Proposed) m^2
Previously Existing Retained Impervious	0	0	0
Road, Sidewalks, Parking (Right of Way)	123,590	0	123,590
Parks	0	42,230	42,230
Storm Water Management Ponds (SWMPs)	25,260	0	25,260
Open Space (Natural Features and Green Space)	0	265,660	265,660
Buildings' Roof Area (Assumed to be 60% of the lot area, if it is not defined)	165,468	0	165,468
Lawns and Gardens (Assumed to be 30% of the lot area, if it is not defined)	0	82,734	82,734
Driveways (Assumed to be 10% of the lot area, if it is not defined)	42,348	0	42,348
Totals	**356,666**	**390,624**	**747,290**

Under post-development conditions, the pervious area approximately covers 52 % of the total area.

3. Pre-Development Water Balance

3.1 Climate Data Analysis

The mean annual water surplus was calculated using the Thornthwaite and Mather (1955) method. Monthly average precipitation values were obtained for 30 years from 1977 to 2006.

A soil moisture storage of 200 mm/yr was assumed for soils and considered representative of the preconstruction Site conditions. The closest latitude to the Site is 43^0, which was used in the USGS model (2007). Summary of processed climate data is provided in Attachment 2.

Table 3.1 provides a summary of the annual climatic water balance analysis. Attachments 1 and 2 provide a summary of model input and a summary of the model output, respectively.

Table 3.1: Summary of Climatic Water Balance Analysis in Pre-Development Conditions

Soil Moisture Storage (mm/yr)	Precipitation (mm/yr)	Potential ET (mm/yr)	Actual ET (mm/yr)	Surplus (mm/yr)
200.0	1000.9	607.7	583.3	417.6

Note: ET = Evapotranspiration

The results of climatic water balance analysis for the Site shows that a surplus of 417.6 mm/year (= 1000.9 – 583.3 mm/year) of water is available for surface run-off and infiltration.

3.2 Infiltration

The infiltration is expected to be controlled by soil type, topography, and soil cover type. Surplus water is portioned between run-off and infiltration based on the controlling factors provided by MOECC (1995). It is noted that the controlling factors provided by the MOECC were used to estimate the infiltration.

Using this method, a total infiltration factor for the Site was estimated using the individual sub-factors representative of the topography, soil type and land cover conditions (attached Figures 2 through 4). Attachment 3 provides a summary of the sub factors and total infiltration factor based on the pre-development Site conditions. The estimated pre-development total infiltration factor of 0.51 represents the fraction of the water surplus available for infiltration. Therefore, the fraction of the available water for run-off is 0.49. The infiltration factor is utilized to calculate the infiltration volume (in units of m^3/yr) at the Site by multiplying it by the average annual water surplus estimate by the Site area available for infiltration.

Using the infiltration factor of 0.51 and a water surplus of 417.6 mm/yr, the resulting pre-development infiltration rate for the Site is estimated to be 213.4 mm/yr.

3.3 Pre-Development Water Balance Analysis

The water balance analysis is based on information available on a regional scale, which is deemed representative for the Site.

Table 3.2 summarizes the pre-development water balance analysis of the Site.

Table 3.2: Summary of Overall Pre-Development Water Balance Results

Location	Total Site Area (m^2)	Area Available for Infiltration (m^2)	Precipitation (m^3/yr)	Actual Evapo-transpiration (m^3/yr)	Run-off (m^3/yr)	Infiltration (m^3/yr)
Total Site	747,290	747,290	747,963	435,894	152,601	159,467
In Percentage (%)			100	58.3	20.4	21.3

The total Site area was used to estimate the total volume of annual precipitation for the Site. As summarized in Table 3.2, the pre-development water balance is as follows: approximately 36% of the total precipitation is subject to evapotranspiration, 51% to run-off and 13% to infiltration.

The pre-development water balance on a weighted average depth basis (in mm) can be expressed as follows:

$$P\ (1000.9) = ET\ (583.3) + R\ (204.2) + I\ (213.4) + \Delta ST\ (0.0)$$

4. Post--Development Water Balance

4.1 Post-Development Water Balance (Unmitigated)

Based on the proposed development drawing (Attachment 6), the total area for impervious areas under the post-development conditions is approximately 356,666 m^2, representing approximately 48 % of the Site area (Table 2.2).

Lot level post development infiltration sub-factors were determined based on the method recommended by MOE (1995), which was similar to the method used for estimating infiltration sub-factors for pre-development site conditions. Table 4.1 provides a summary of the overall post development water balance assessment.

Table 4.1: Summary of Overall Post-Development Water Balance Forecast - Unmitigated

Location	Total Site Area (m^2)	Area Available for Infiltration (m^2)	Precipitation (m^3/yr)	Evapotranspiration (m^3/yr)	Run-off (m^3/yr)	Infiltration (m^3/yr)
Total Site	747,290	390,624	747,963	227,851	436,755	83,357
In Percentage (%)			100	30.5	58.4	11.1

Due to a reduction of the infiltration rate from 159,467 m^3/year (pre-development) to 83,357 m^3/year (post-development), a total deficit of 76,110 m^3/year is estimated for the post-development phase (Attachment 4). The pre-development infiltration rate should be the reasonable target for the mitigated post infiltration rate; anything less than the 159,467 m^3/year, will result in an infiltration deficit for the Site.

The post-development unmitigated water balance on a weighted average depth basis (in mm) can be expressed as follows:

$$P\ (1000.9) = ET\ (304.9) + R\ (584.5) + I\ (111.5) + \Delta ST\ (0.0)$$

4.2 Post-Development Water Balance (Mitigated)

To maintain the estimated pre-development infiltration rate of 159,467 m^3/year, mitigation measures should be implemented to maintain the noted infiltration rate volume. The mitigation measures are anticipated to consist of roof leaders disconnected from the storm sewer system across the Site and directed to the landscaped areas for the residential lots. As per the LID guidelines, downspout disconnection requires a minimum flow path length across the pervious area of 5 meters. The Thornthwaite and Mather model was rerun to account for the additional precipitation on the landscaped areas coming from the downspouts which resulted in an increase in ETP, and surplus for landscaped areas. The increased surplus resulted in an increased infiltration rate.

Table 4.2 provides a summary of the overall mitigated post development water balance assessment.

Table 4.2: Summary of Overall Post Development Water Balance Forecast - Mitigated

Location	Total Site Area (m^2)	Area Available for Infiltration (m^2)	Precipitation (m^3/y)	Evapotranspiration (m^3/y)	Run-off (m^3/y)	Infiltration (m^3/yr)
Total Site	747,290	390,624	747,963	229,862	351,142	166,958
In Percentage (%)			100	30.7	46.9	22.3

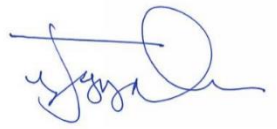
The post mitigation scenario indicates that hundred percent (100%) of residential lot roof runoff being directed to the lot landscaped areas is sufficient to mitigate the infiltration deficit in its entirety. This will result in an infiltration volume of 166,958 m^3/yr, which represents an infiltration surplus of approximately 7,491 m^3/yr (Attachment 5).

The post-development mitigated water balance on a weighted average depth basis (in mm) can be expressed as follows:

$$P\ (1000.9) = ET\ (307.6) + R\ (469.9) + I\ (223.4) + \Delta ST\ (0.0)$$

We trust that the information provided in this report meet your present purposes. Should you have any questions or require more information, please do not hesitate to contact the undersigned.

Sincerely,
EXP Services Inc.



Peyman Sayyah, M.Sc., P.Geo.
Senior Hydrogeologist
Environmental Services

Francois Chartier, M.Sc., P.Geo.
Head of Hydrogeology Group
Environmental Services

Figures:
Figure 1 – Site Location Plan
Figure 2 – Surficial Geology Map
Figure 3 – Existing Land Use Plan
Figure 4 – Existing Slope Map

Attachments:

Attachment 1 – Summary of Model Input Data
Attachment 2 – Summary of Model Output
Attachment 3 – Infiltration Factors
Attachment 4 – Summary of Pre-and Post-Development Water Balance Estimates (Unmitigated)
Attachment 5 – Summary of Pre-and Post-Development Water Balance Estimates (Mitigated)
Attachment 6 – Proposed Development Plan

References

1. Chapman, L. J., and Donald F. Putnam (1984). The Physiography of Southern Ontario [Ontario Geological Survey Special Volume 2], Third Edition. Government of Ontario.

2. Gregory J. McCabe and Steven L. Markstrom., Monthly Water-Balance Model Driven By a Graphical User Interface; for U.S. Geological Survey, U.S. Department of Interior; Open File Report 2007-1088, 2007

3. Ministry of Environment and Energy; MOEE Hydrogeological Technical Information Requirements for Land Development Applications, April 1995

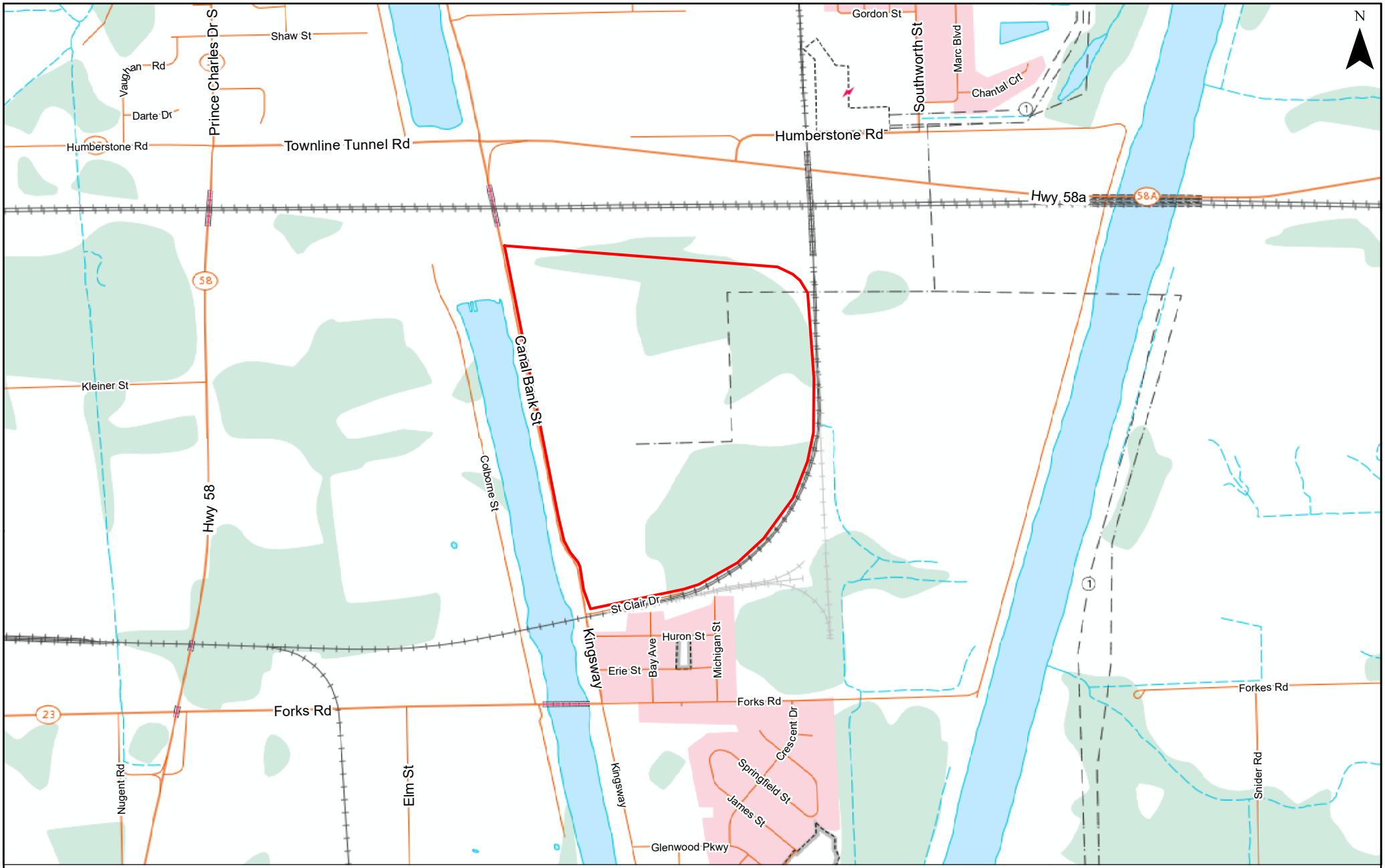
4. Ministry of Northern Development and Mines (May, 2012). OGS Earth. Retrieved from http://www.mndm.gov.on.ca/en/mines-and-minerals/applications/ogsearth.

5. EXP Services Inc. (April 4, 2019), Draft Preliminary Hydrogeological Investigation, 555 Canal Bank Street, Welland, Ontario

6. Armstrong (May, 2020), Draft Plan of the Subdivision, 555 Canal Bank Street, Welland, Ontario.

7. EXP Services Inc. (July 10, 2019), Draft Preliminary Hydrogeological Investigation, 555 Canal Bank Street, Welland, Ontario

FIGURES



Legend

Approximate Site Boundary

0 100 200 400 600 800 1,000 m

EXP Services Inc.
1595 Clark Boulevard
Brampton, ON, L6T 4V1
Phone: +1.905.793.9800
Fax: +1.905.793.0641

PROJECT TITLE:
WATER BALANCE INVESTIGATION
555 CANAL BANK STREET
WELLAND, ONTARIO

DRAWING TITLE:
SITE LOCATION PLAN

PROJECT No.: HAM-00801631-A0	DWN: AC
SCALE: AS NOTED	CHKD: RS
DATE: MARCH 2019	DWG. No.: 1

Legend

Approximate Site Boundary | 21: Man-made deposits | 8a: Fine-textured glaciolacustrine deposits

0 65 130 260 390 520 650 m

EXP Services Inc.
1595 Clark Boulevard
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Phone: +1.905.793.9800
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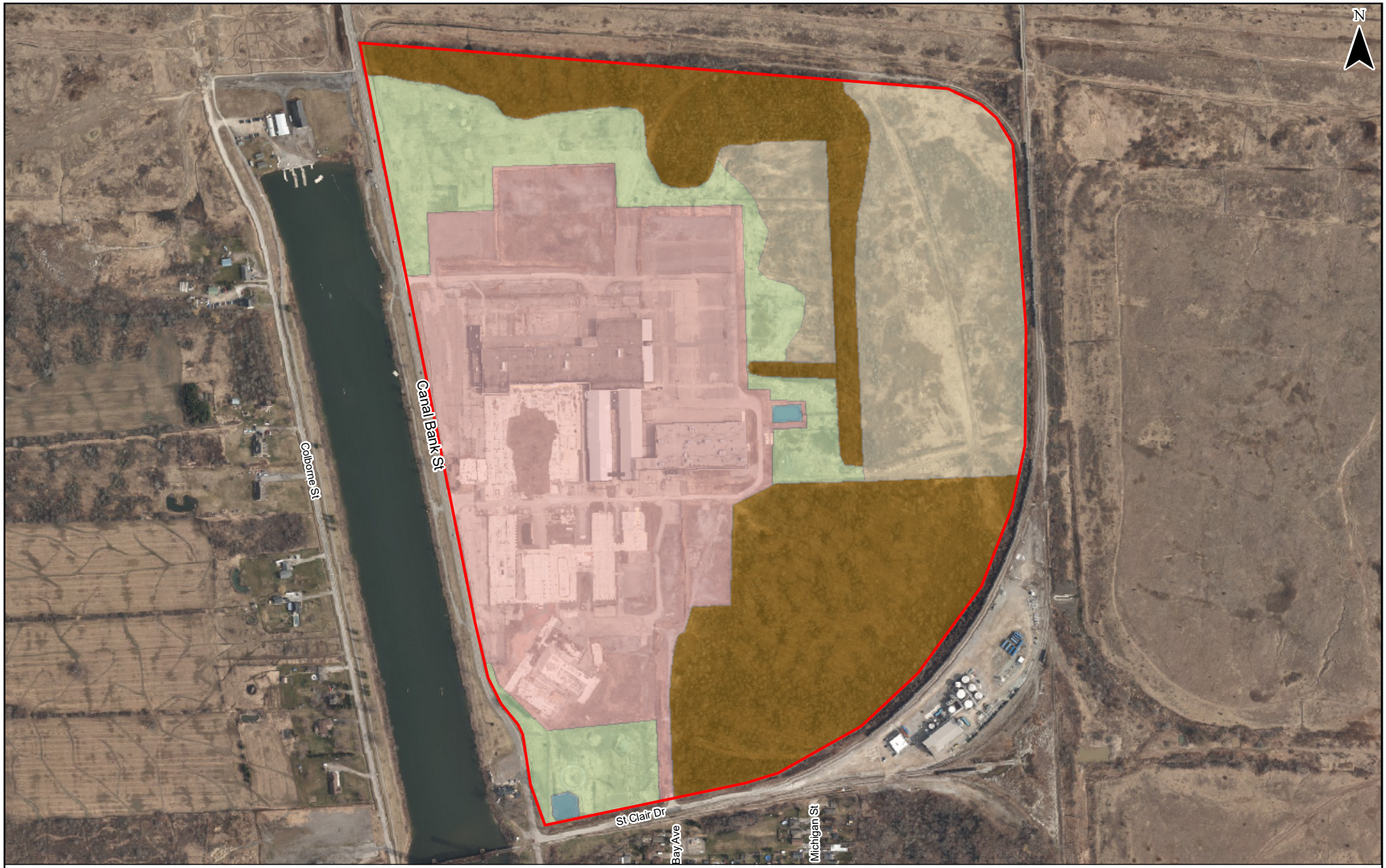
PROJECT TITLE:
WATER BALANCE INVESTIGATION
555 CANAL BANK STREET
WELLAND, ONTARIO

DRAWING TITLE:
SURFICIAL SOILS

PROJECT No.: HAM-00801631-A0	DWN: AC
SCALE: AS NOTED	CHKD: RS
DATE: MARCH 2019	DWG. No.: 2



Legend

Landuse

- Approximate Site Boundary
- Built-up Environment
- Landscape
- Shrubland
- Water
- Woodlot

0 50 100 200 300 400 500 m

EXP Services Inc.
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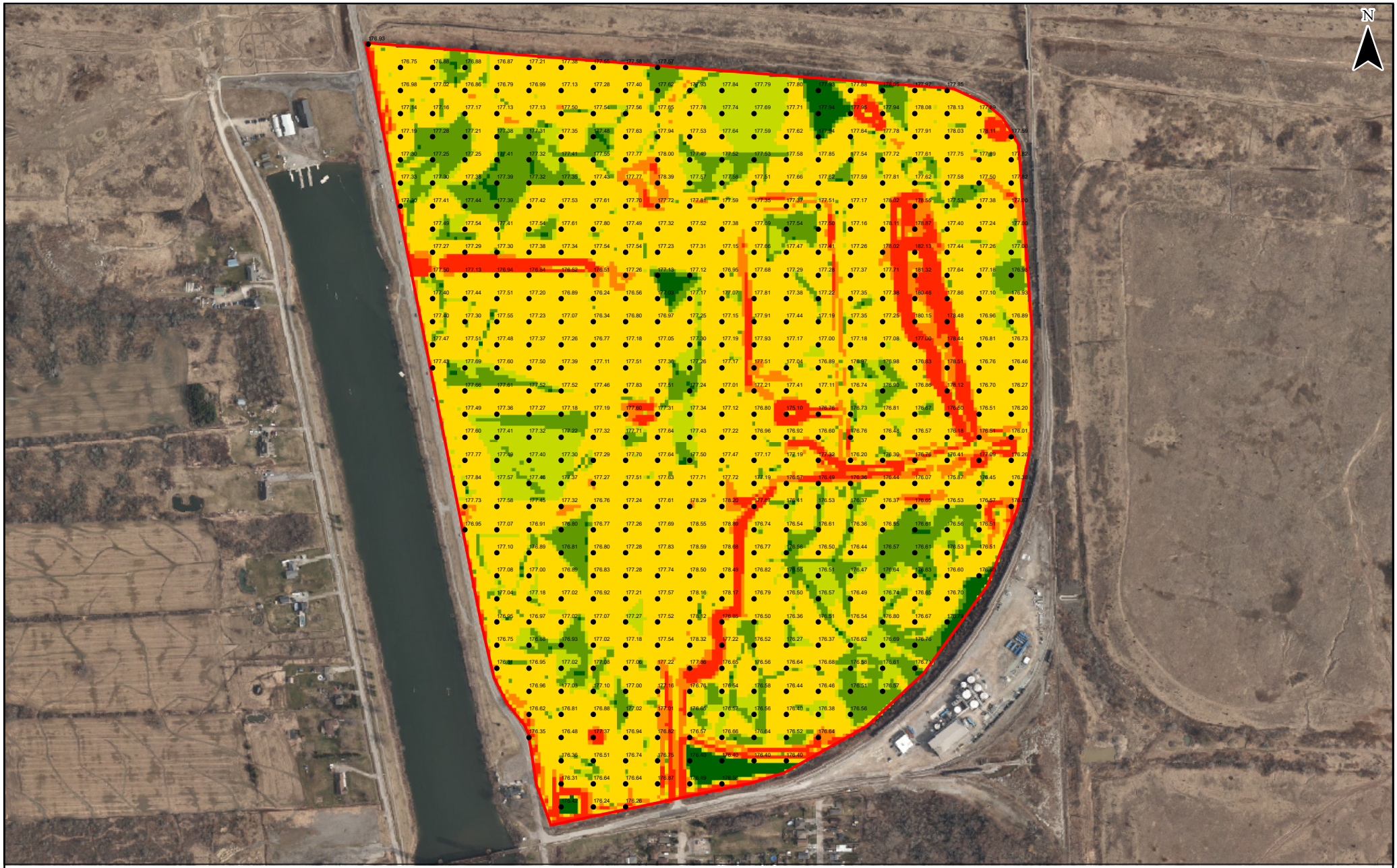
PROJECT TITLE:
WATER BALANCE INVESTIGATION
555 CANAL BANK STREET
WELLAND, ONTARIO

DRAWING TITLE:
EXISTING LAND USE

PROJECT No.: HAM-00801631-A0	DWN: AC
SCALE: AS NOTED	CHKD: RS
DATE: MARCH 2019	DWG. No.: 3



Elevation Data Source: Provincial Digital Elevation Model - Version 3. Ontario Ministry of Natural Resources and Forestry - Provincial Mapping Unit, 2013.

Legend

Existing Slope (Infiltration Factor)

- Approximate Site Boundary
- <0.06% (0.30)
- 0.06 - 0.28% (0.25)
- 0.28 - 0.38% (0.20)
- 0.38 - 2.8% (0.15)
- 2.8 - 4.7% (0.10)
- >4.7% (0.05)

0 50 100 200 300 400 500 m

EXP Services Inc.
1595 Clark Boulevard
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Phone: +1.905.793.9800
Fax: +1.905.793.0641

PROJECT TITLE:

WATER BALANCE INVESTIGATION
555 CANAL BANK STREET
WELLAND, ONTARIO

DRAWING TITLE:

EXISTING SLOPE

PROJECT No.: HAM-00801631-A0	DWN: AC
SCALE: AS NOTED	CHKD: RS
DATE: MARCH 2019	DWG. No.: 4

ATTACHMENTS

Attachment 1: Model Input

555 Canal Bank Street, Welland, ON

HAM-00801361-A1

Year	Month	Ave. T (^{0}C)	Ave P (mm)
1977-2006	1	-4.7	81.7
1977-2006	2	-4.0	57.6
1977-2006	3	0.7	70.9
1977-2006	4	7.3	77.6
1977-2006	5	13.5	81.6
1977-2006	6	18.7	80.4
1977-2006	7	21.6	82.8
1977-2006	8	20.8	84.4
1977-2006	9	16.6	104.1
1977-2006	10	10.1	89.7
1977-2006	11	4.6	96.3
1977-2006	12	-1.2	93.8

Note:

Welland

Climate Station ID: 6139445

Attachment 2: Model Output

555 Canal Bank Street, Welland, ON

HAM-00801361-A1

Month	PET	P	P-PET	Soil Moisture	AET	PET-AET	Snow Storage	Surplus
January	9.6	81.7	45.3	198.1	9.6	0.1	40.8	42.3
February	11.3	57.6	44.6	199.6	11.3	0.0	42.4	43.1
March	21.5	70.9	79.6	200.0	21.5	0.0	12.3	79.2
April	39.7	77.6	50.2	199.8	39.7	0.0	0.0	50.4
May	72.4	81.6	9.1	189.6	72.4	0.0	0.0	19.3
June	105.3	80.4	-24.9	160.7	103.1	2.2	0.0	6.2
July	125.2	82.8	-42.4	125.3	115.7	9.5	0.0	2.5
August	101.6	84.4	-17.3	115.7	91.3	10.3	0.0	2.6
September	60.5	104.1	43.6	144.9	58.2	2.3	0.0	16.8
October	32.2	89.7	57.4	175.6	32.2	0.0	0.0	26.8
November	17.3	96.3	78.9	191.9	17.3	0.0	0.1	62.5
December	11.0	93.8	69.0	196.7	11.0	0.0	14.0	64.2
Annual Rate (mm/yr)	607.7	1000.9	393.2	2097.9	583.3	24.3	109.6	415.9

Note:

Welland

Climate Station ID: 6139445

555 Canal Bank Street, Welland, Ontario
HAM-00801631

Attachment 3
Average Infiltration Factors

1. Average Infiltration Factor – Pre Development Conditions

Category	Weighted Infiltration Factor
Topography/Slope	0.16
Soil Type Fine Textured Glaciolacutrine and Fill	0.20
Cover Cultivated Lands and Woodlot	0.15
Total weighted Infiltration factor	**0.51**

2. Average Infilteration Factor – Post Development Conditions

Un-Mitigated

Category	Weighted IInfiltration Factor
Topography/Slope	0.16
Soil Type Fine Textured Glaciolacutrine and Fill	0.20
Cover Cultivated Lands and Woodlot	0.15
Total weighted Infiltration factor	**0.51**

Notes:

Landscaped area considered equivalent to Cultivated Cover

555 Canal Bank Street, Welland, Ontario
HAM-00801631-A1

Attachment 4
Summary of Pre and Post-Development Water Balance (Unmitigated)

1. Climate Data

	Pre-Development mm/a		Post-Development Un-Mitigated mm/a
Precipitation	1000.9		1000.9
Evapotranspiration	583.3		583.3
Water Surplus	417.6		417.6
Infiltration Rate	213.4		213.4
Runoff	204.2		204.2

2. Pre-Developed Study Area Statistics

	Area	
Open spaces/ Wood Lot / Medows/ Landscaped	747,290	sq.m.
Paved Surface and Existing Buildings	0	sq.m.
TOTAL	747,290	sq.m.

3. Proposed Lot Coverage	**Area**	**Roofs (60%)**	**Driveways (10%)**	**Lawns, Gardens, ets. (30%)**	
Residential Singles (10 m)	20,520	12,312	2,052	6,156	sq.m.
Residential Singles (8 m)	153,530	92,118	15,353	46,059	sq.m.
Residential Rear Access Singles (8 m)	14,770		14,770		sq.m.
Residential Townhomes (5.5 m)	37,910	22,746	3,791	11,373	sq.m.
Mixed-Use	40,560	24,336	4,056	12,168	sq.m.
School	23,260	13,956	2,326	6,978	sq.m.
Stormwater Management Pond	25,260				sq.m.
Park/Linear Park	42,230				sq.m.
Open Space	265,660				sq.m.
Walkway	230				sq.m.
30 m Right of Way (Canal Bank Street)	24,750				sq.m.
21 m Right of Way (Street A)	21,080				sq.m.
18 m Right of Way (Street B-M)	77,530				sq.m.
TOTAL	747,290	165,468	42,348	82,734	sq.m.

3. Annual Pre-Development Water Balance

Land Use	**Area (sq.m.)**	**Precipitation (cu.m.)**	**Actual Evapotranspiration (cu.m.)**	**Infiltration Rate (cu.m.)**	**Run-off (cu.m.)**
Total Impervious	0	0	0	0	0
Undeveloped	747,290	747,963	435,894	159,467	152,601
Total	747,290	747,963	435,894	159,467	152,601
	Pre-development Rates in mm/year		**583.3**	**213.4**	**204.2**

4. Annual Post-Development Water Balance Un-Mitigated

Land Use	**Area (sq.m.)**	**Precipitation (cu.m.)**	**Actual Evapotranspiration (cu.m.)**	**Infiltration Rate * (cu.m.)**	**Run-off (cu.m.)**
Previously existing Impervious	0	0	0	0	0
Roads, Sidewalks, Parkings (ROW)	123,590	123,701	0	0	123,701
Parks	42,230	42,268	24,633	9,012	8,624
SWM Ponds	25,260	25,283	0	0	25,283
Natural Features and Greenspaces	265,660	265,899	154,959	56,690	54,249
Lots					
Roofs	165,468	165,617	0	0	165,617
Driveways	42,348	42,386	0	0	42,386
Gardens, Lawns,etc.	82,734	82,808	48,259	17,655	16,895
TOTAL	747,290	747,963	227,851	83,357	436,755
	Post-development Rates in mm/year		**304.9**	**111.5**	**584.5**

5. Comparison of Pre-Development and Post-Development Un-Mitigated

	Precipitation (cu.m.)	**Actual Evapotranspiration (cu.m.)**	**Run-off (cu.m.)**	**Infiltration Rate for Areas with Shallow Groundwater Table (cu.m.)**	**Percent of Pervious Area with Grade and Water Table Greater Than 0 m %**
Pre-Development	747,963	435,894	152,601	159,467	100.00%
Post Development	747,963	227,851	436,755	83,357	100.00%
			Pre-development Infiltration Rate	**213.4**	**mm/a**
			Post-development Infiltration Rate Un-Mitigated	**111.5**	**mm/a**
			Deficit Post Development Un-Mitigated	**76,110**	**cu.m./a**

555 Canal Bank Street, Welland, Ontario
HAM-00801631-A1

Attachment 4
Summary of Pre and Post-Development Water Balance (Unmitigated)

1. Climate Data

	Pre-Development mm/a		Post Development - Greenspcaes mm/a (no additional topsoil)	Post Development Commercial Lots Landscaped Areas (100% roof leaders runoff to landscaped) mm/a
Precipitation	1000.9		1000.9	3002.67
Evapotranspiration	583.3		583.3	607.61
Water Surplus	417.6		417.6	2395.06
Infiltration Rate	213.4		213.4	1223.88
Runoff	204.2		204.2	1171.18

2. Pre-Developed Study Area Statistics

Open spaces/ Wood Lot / Medows/ Landscaped	747,290	sq.m.
Paved Surface and Existing Buildings	0	sq.m.
TOTAL	747,290	sq.m.

3. Proposed Lot Coverage	**Area**	**Roofs (60%)**	**Driveways (10%)**	**Lawns, Gardens, ets. (30%)**	
Residential Singles (10 m)	20,520	12,312	2,052	6,156	sq.m.
Residential Singles (8 m)	153,530	92,118	15,353	46,059	sq.m.
Residential Rear Access Singles (8 m)	14,770		14,770		sq.m.
Residential Townhomes (5.5 m)	37,910	22,746	3,791	11,373	sq.m.
Mixed-Use	40,560	24,336	4,056	12,168	sq.m.
School	23,260	13,956	2,326	6,978	sq.m.
Stormwater Management Pond	25,260				sq.m.
Park/Linear Park	42,230				sq.m.
Open Space	265,660				sq.m.
Walkway	230				sq.m.
30 m Right of Way (Canal Bank Street)	24,750				sq.m.
21 m Right of Way (Street A)	21,080				sq.m.
18 m Right of Way (Street B-M)	77,530				sq.m.
TOTAL	747,290	165,468	42,348	82,734	sq.m.

3. Annual Pre-Development Water Balance

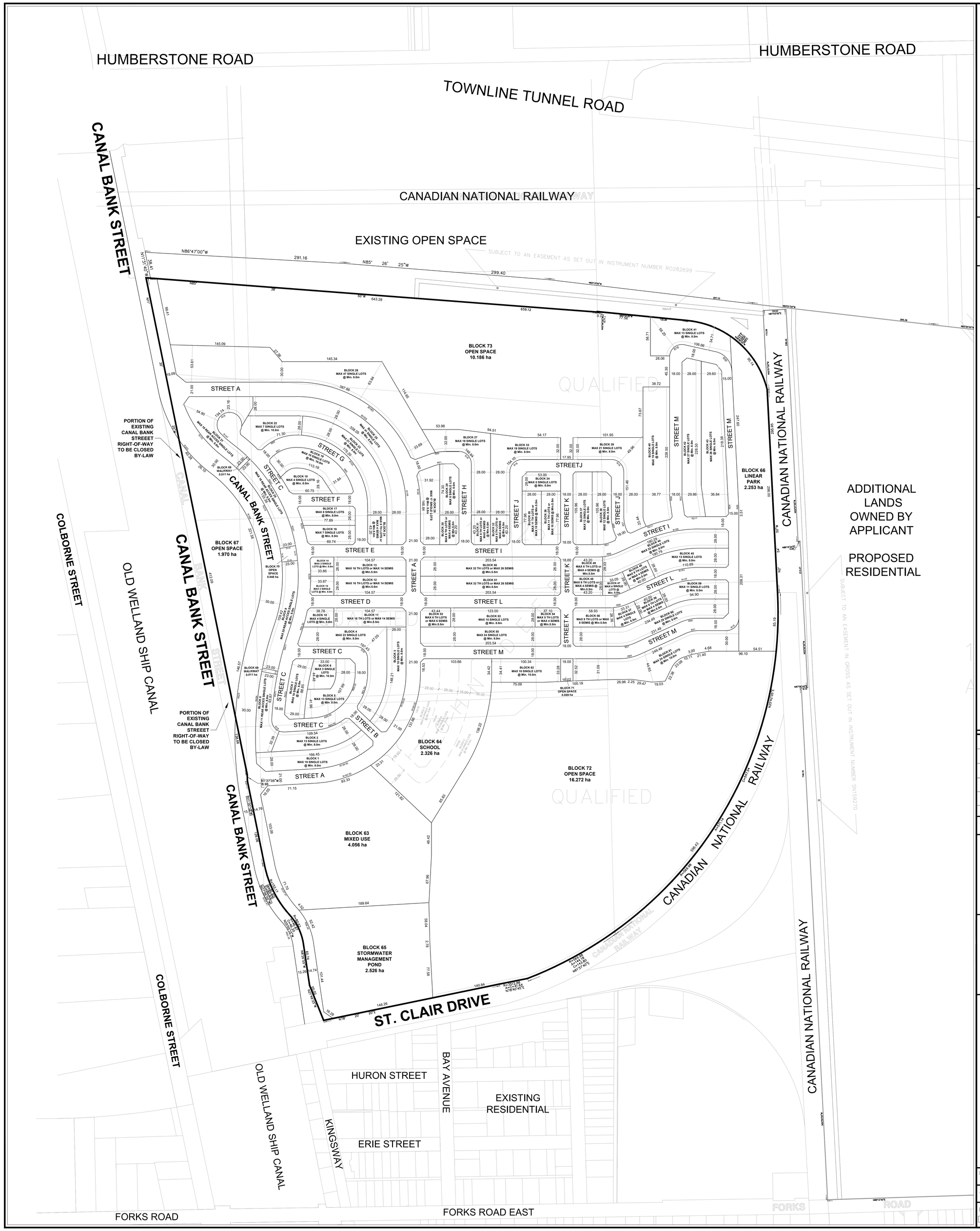
Land Use	**Area (sq.m.)**	**Precipitation (cu.m.)**	**Actual Evapotranspiration (cu.m.)**	**Infiltration Rate (cu.m.)**	**Run-off (cu.m.)**
Total Impervious	0	0	0	0	0
Undeveloped	747,290	747,963	435,894	159,467	152,601
Total	747,290	747,963	435,894	159,467	152,601
	Pre-development Rates in mm/year		**583.3**	**213.4**	**204.2**

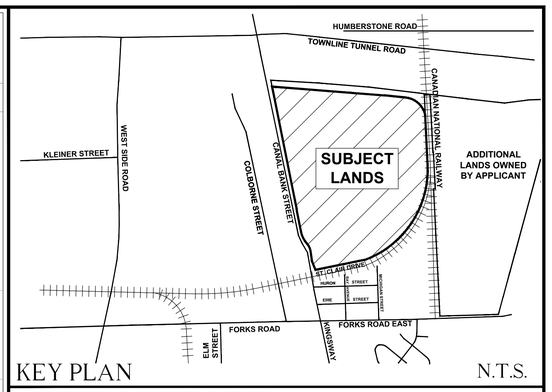
4. Annual Post-Development Water Balance Mitigated

Land Use	**Area (sq.m.)**	**Precipitation (cu.m.)**	**Actual Evapotranspiration (cu.m.)**	**Infiltration Rate (cu.m.)**	**Run-off (cu.m.)**
Previously existing Impervious	0	0	0	0	0
Roads, Sidewalks, Parkings (ROW)	123,590	123,701	0	0	123,701
Parks	42,230	42,268	24,633	9,012	8,624
SWM Ponds	25,260	25,283	0	0	25,283
Natural Features and Greenspaces	265,660	265,899	154,959	56,690	54,249
Lots					
Roofs (100% diverted to landscaped)	165,468	165,617	0	0	0
Driveways	42,348	42,386	0	0	42,386
Gardens, Lawns,etc.	82,734	82,808	50,270	101,256	96,899
TOTAL	747,290	747,963	229,862	166,958	351,142
	Post-development Rates in mm/year		**307.6**	**223.4**	**469.9**

5. Comparison of Pre-Development and Post-Development Un-Mitigated

	Precipitation (cu.m.)	**Actual Evapotranspiration (cu.m.)**	**Run-off (cu.m.)**	**Infiltration Rate for Areas with Shallow Groundwater Table (cu.m.)**	**Percent of Pervious Area with Grade and Water Table Greater Than 0 m %**
Pre-Development	747,963	435,894	152,601	159,467	100.00%
Post Development	747,963	229,862	351,142	166,958	100.00%
			Pre-development Infiltration Rate	**213.4**	**mm/a**
			Post-development Infiltration Rate Mitigated	**223.4**	**mm/a**
			Surplus in Infiltration Rate in Post Development Mitigated	**7,491**	**cu.m./a**





KEY PLAN N.T.S.

ADDITIONAL INFORMATION

Required Under Section 51(17)
Of The Planning Act R.S.O. 1990 c.P.13

a. SHOWN ON DRAFT PLAN
b. SHOWN ON DRAFT AND KEY PLANS
c. SHOWN ON KEY PLAN
d. LAND TO BE USED IN ACCORDANCE WITH LAND USE SCHEDULE
e. SHOWN ON DRAFT PLAN
f. SHOWN ON DRAFT PLAN
g. SHOWN ON DRAFT PLAN AND KEY PLAN
h. MUNICIPAL PIPED WATER TO BE PROVIDED
i. SOIL IS SILTY CLAY
j. SHOWN ON DRAFT PLAN
k. ALL MUNICIPAL SERVICES TO BE PROVIDED
l. SHOWN ON DRAFT PLAN

SCHEDULE OF LAND USE

TOTAL SITE AREA - 74.729 ha

Proposed Land Use	Units	Reference	Area (Ha.)
Residential Singles 10.0m	54	Blocks 6,19,22,61-62	2.052
Residential Singles 8.0m	553	Blocks 1-5,7,10,14-18,23,25-29,33,34,37-45,47,53,55,57,59,60	15.353
Residential Rear Access Singles 8.0m	63	Blocks 8,9,20,21	1.477
Residential Townhomes 5.5m	202	Blocks 11-13,24,30,31, 32,35-36,46,48,49,50,51, 52, 54,56,58	3.791
Mixed Use		Block 63	4.056
School		Block 64	2.326
Stormwater Management Pond		Block 65	2.526
Park / Linear Park		Blocks 66-67	4.223
Walkway		Blocks 68-69	0.023
Open Space		Blocks 70-73	26.566
ROADS			
30m R.O.W. (Canal Bank Street)			2.475
21m R.O.W. (Street A)			2.108
18m R.O.W. (Streets B-M)			7.753
TOTAL	872		74.729

Proposed Summary Yield		
Proposed Unit Mix	Unit Count with Alternate 5.50m Townhouse Units	Unit Count with Alternate 5.50m Semi-Detached Units
Residential Singles 10.0m	54	54
Residential Singles 8.0m	553	553
Residential Rear Lane Access Singles 8.0m	63	63
Residential Townhomes 5.5m	202	
Residential Semi-Detached 5.5m		164
TOTAL	872	834

No.	REVISION	DATE
5		
4		
3		
2		
1		

REVISIONS

OWNER'S CERTIFICATE

WE, BEING THE REGISTERED OWNER OF THE SUBJECT LANDS HEREBY AUTHORIZE ARMSTRONG PLANNING AND PROJECT MANAGEMENT TO PREPARE AND SUBMIT A DRAFT PLAN OF SUBDIVISION FOR APPROVAL.

SIGNED _____ DATE _____

SURVEYOR'S CERTIFICATE

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE SUBJECT LANDS AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN ON THIS PLAN.

SIGNED _____ DATE _____

DAIN CITY WEST
DRAFT PLAN OF SUBDIVISION

PART LOTS 21, 22 AND 23, CONCESSION 5,
PART OF THE ROAD ALLOWANCE BETWEEN
LOTS 22 AND 23, CONCESSION 5,
(CLOSED BY BY-LAW 855, INST NO. HU8243)
GEOGRAPHIC TOWNSHIP OF HUMBERSTONE)
THE CITY OF WELLAND
REGIONAL MUNICIPALITY OF NIAGARA

armstrong
planning | project management

DESIGN:	DRAWN:	SCALE 1: 2000
APPROVED	DATE: May 29, 2020	PROJECT No. 20.2699.00

DRAWING No. Dain City West Subdivison.dwg PHASES 1-2