UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

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File: 24002

FUNCTIONAL SERVICING REPORT

4336 WILLICK ROAD

December 2025

INTRODUCTION

This report addresses the servicing needs and requirements for the proposed development located on the northern portion of 4336 Willick Road that is within the Urban Boundary for the City of Niagara Falls, in support of the current application for Zoning Bylaw Amendment and Draft Plan of Vacant Land Condominium on the property. The site is located on the south side of Willick Road, west of Sodom Road and east of Emerald Avenue.

Hunters Drain traverses the site from south to north, dividing the proposed development into two areas. The overall property is approximately 19.8 hectares in size and is currently vacant, with the majority of the land used for agricultural purposes.

The proposed development area is approximately 2.5 hectares and will include four entrances onto Willick Road. The development will consist of 78 townhouse divided between either side of the Hunters Drain (41 units on the west side and 37 units on the east), and will include associated asphalt parking areas, concrete curbs, catch basins, storm sewers, sanitary servicing, and water servicing.

The objectives of this study are as follows:

1. Identify domestic and fire protection water service needs for the site;
2. Identify sanitary servicing needs for the site; and,
3. Identify stormwater management needs for the site.

WATER SERVICING

There is an existing 250mm diameter municipal watermain on along Willick Road. It is proposed to connect a private 150mm diameter watermain to the existing 250mm municipal watermain to provide water supply and fire protection to the 41 townhouse units located west of Hunters Drain watercourse.

To service the remaining 37 townhouse units located east of Hunters Drain, the 250mm diameter watermain is proposed to be extended eastward beneath the existing culvert, as shown in the Preliminary Plan and Profile enclosed in Appendix A, and serviced with a private 150mm diameter watermain extended into the development from the 250mm diameter extension.

Table 1 summarizes the projected water demand calculations for the proposed 778 townhouse units. The water demands were calculated based on the 2021 Niagara Water Master Servicing Plan Update (MSPU).

Table 1. Water Demand Calculations

Number of Units	Density (ppu)	Population (persons)	Avg. Day Demand Rate (L/cap/day)	Avg. Day Demand (L/s)	Max Day Demand		Peak Hour Demand	
					Peak Factor	(L/s)	Peak Factor	(L/s)
78	2.40	187	240	0.52	1.65	0.86	3.00	1.56

As shown in Table 1, the proposed development is expected to require an average day demand of 0.51 L/s, based on a projected population of 187 personss, and a consumption rate of 240 L/capita/day. Applying a maximum day peak factor of 1.65, the maximum day demand is estimated at 0.86 L/s. Using a peak hour factor of 3.0, the peak hour demand is calculated to be 1.56 L/s, in accordance with the 2021 MSPU guidelines.

There are two existing municipal fire hydrants located in front of the west portion of the site, on the north side of Willick Road. To ensure adequate fire protection for the entire development, it is proposed to construct additional fire hydrants. Location of future municipal of private fire hydrants will be coordinated as part of detailed engineering design.

Based on the Fire Underwriters Survey (FUS) guidelines, the required fire flow for the proposed development has been determined using Table 8 of the FUS document. The townhouse blocks are classified as ordinary construction with a minimum separation of 3 metres between buildings. Accordingly, the typical required fire flow is 133 L/s (8,000 L/min). Actual fire demands will be based on final building designs and the proposed water servicing system will be designed to deliver the required fire flow at a minimum residual pressure of 140 kPa (20 psi) at all hydrant locations.

Therefore, the existing 250mm diameter municipal watermain on Willick Road is expected to provide sufficient capacity to meet both the domestic water demand and the required fire protection for the proposed development.

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SANITARY SERVICING

There is an existing 200mm diameter municipal sanitary sewer along Willick Road that conveys flows westerly from the west side of Hunters Drain, and then northerly to the existing 250mm diameter sanitary sewer on Emerald Avenue to ultimately discharge to the existing siphon crossing the Welland River from Lyons Creek Road.

It is proposed to remove the existing segment of sanitary sewer on Willick Road, east of Emerald Avenue, and connect a new 250mm diameter sanitary sewer that will extend eastward and cross beneath the existing box culvert to service the 37 townhouse units located east of Hunters Drain.

In UCC's preliminary assessment of the existing sanitary sewer on Willick Road, an extension of a 200mm diameter sanitary sewer easterly at the slope of 0.40% from the existing sanitary manhole may conflict with the footing of the existing culvert crossing on Willick Road for Hunters Drain.

Therefore, it is proposed to replace the existing sanitary sewers on Willick Road from Emerald Drive with a new 250mm diameter sanitary sewer at slope of 0.28% to the front driveway entrance for the site on the east side of Hunters Drain.

It is understood that the City of Niagara Falls is considering the replacement of the existing culvert on Willick Road. As shown in the preliminary Plan and Profile drawing for Willick Road provided in Appendix A, this sewer replacement will provide adequate depth for the construction of a new 1.5m high concrete box culvert and service the proposed lands east of Hunters Drain.

The sewer replacement and culvert works can be coordinated with City Staff as part of Detailed Engineering Design.

The west portion of the development will be serviced by connecting a new 200mm diameter sanitary sewer directly to the existing maintenance hole located at the intersection of Willick Road and Emerald Avenue.

An analysis was conducted to assess the impact of the proposed development on the existing downstream sanitary sewer system. The analysis determined that the 250mm diameter sanitary sewer on Emerald Avenue, servicing the development, has a full flow capacity of approximately 35.09 L/s. The projected peak sanitary flow from the proposed development, including contributions from the upstream existing residential areas, is approximately 4.38 L/s, representing 12.5% of the sewer's total capacity.

Additionally, the analysis shows that the existing 375mm diameter sanitary sewer on Lyons Creek Road has a full flow capacity of 89.61 L/s. The total projected peak sanitary flow from the development and the existing subdivision lands north of Willick Road, is approximately 30.28 L/s, representing 33.8% of the total capacity of the 375mm sanitary sewer. Sanitary Drainage Area Plan and calculations are provided in Appendix B for reference.

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STORMWATER MANAGEMENT

The existing stormwater flows from the site currently flow overland to Hunters Drain, which conveys flows northward toward the existing culvert crossing Willick Road, as illustrated in Figure 2 (Appendix C). Beyond the culvert, Hunters Drain continues to flow north before ultimately discharging into Lyons Creek, located approximately 1.2 kilometres downstream of the subject lands, and immediately upstream of were Lyons Creek outlets to the Welland River.

The proposed development consists of 78 townhouse units distributed across two areas, located east and west of Hunters Drain. As there is no municipal storm sewer fronting the site, it is proposed to construct two independent storm sewer systems, each designed to convey peak flows from Willick Road during the 5 year storm event directly to Hunters Drain. A preliminary design of the proposed storm sewer outlets is provided in the attached Preliminary Plan and Profile drawing.

UCC has reviewed the NPCA's 2008 Floodplain Mapping Study for Hunters Drain, which identified the overall stormwater catchment areas for the watercourse, to the outlet into the Welland River. As shown in the Study Area Figure and Table 1 from the NPCA Study, provided in Appendix C, the controlling upstream peak within Hunters Drain where the subject lands are proposed to outlet would be generated within Catchment Areas HD_2, HD_3, and HD_4.

Table 1 from the NPCA Study outlines the associated times of concentration, lag times, and channel lengths for Hunters Drain within each catchment area. The most upstream area, HD_4, has a time of concentration of 1.47 hours (88 minutes) and a conservative estimate of the flow time from area HD_4 through the 3,344m along the watercourse to Willick Road puts the timing of the peak at approximately 2.40 hours (144 minutes) assuming a flow velocity of 1 m/s within Hunters Drain.

Assuming an initial time of concentration of 10 minutes within the subject lands and flow velocity of 1.0 m/s within the proposed storm sewers, the peak from either side of the subject lands would reach Hunters Drain in approximately 14 minutes, 130 minutes before the larger upstream peak. Detaining future stormwater flows within the subject lands will delay the peak from the subject lands to match closer with the larger upstream peak, resulting in a greater peak flow within the watercourse.

Therefore, stormwater management quantity controls for the 5 and 100 year design storm event are not considered necessary for the subject lands prior to discharging to Hunters Drain.

Major overland flows from the subject land will be conveyed to Hunters Drain and ultimately the Welland River.

To improve stormwater quality, an oil/grit separator will provide Enhanced Level Protection (80% Total Suspended Solids) prior to discharging to Hunters Drain.

The contributing Drainage Areas to the proposed Oil/Grit separators are approximately 1.02 and 1.11 hectares with an impervious coverage of 71.4% for the developments east and west of Hunters Drain respectively. The modelling for the Hydroworks units has indicated that a single HD4 unit at each outlet will provide 82% and 80% of TSS removal and capture 99% of the stormwater flows for the east and west development areas respectively. Therefore, two Hydroworks HD4 units are proposed for this site development. Output calculations for the quality assessment can be found in Appendix D.

Hunters Drain 100 Year Floodplain

The subject lands are located adjacent to Hunters Drain which contains a regulated 100 year floodplain. UCC has prepared a Floodplain Assessment, as required by the NPCA, to address the future impacts on the existing 100 year floodplain resulting from the proposed development and is included in Appendix F for reference.

As addressed in the enclosed assessment, there will be no negative impact on existing floodplain elevations resulting from the proposed development.

STORMWATER SYSTEM MAINTENANCE PROTOCAL

Regular inspections of the stormwater Maintenance Holes Oil/Grit interceptors will indicate whether maintenance is required or not. They should be made after every significant storm during the first two years of operation to ensure that it is functioning properly. This will translate into an average of six inspections per year. Points of regular inspections are as follows:

a) Is there sediment in the separator sump? The level of sediment can be measured from the surface without entry into the Oil/Grit separator via a dipstick tube equipped with a ball valve (Sludge Judge) or with a graduated pole with a flat plate attached to the bottom.

b) Is there oil in the separator sump? This can be checked from the surface by inserting a dipstick in the 150mm vent tube. The presence of oil is usually indicated by an oily sheen, frothing or unusual colouring. The separator should be cleaned in the event of a major spill contamination.

c) Is there debris or trash at the inlet weir and drop pipe? This can be observed from the surface without entry into the separator. Clogging at the inlet drop pipe will cause stormwater to bypass the sedimentation section and continue downstream without treatment.

d) Completion of the Inspection Report (a sample report is included in Appendix E for reference purposes). These reports will provide details about the operation and maintenance requirements for this type of stormwater quality device. After an evaluation period (usually 2 years) this information will be used to maximize efficiency and minimize the costs of operation and maintenance for the maintenance hole oil/grit separator.

Typically, stormwater MH Oil/Grit separators are cleaned out using vacuum pumping. No entry into the unit is required for maintenance. Cleaning should occur annually or whenever the accumulation reaches sediment storage specified by the manufacturer and after any major spills have occurred. Oil levels greater than 2.5 centimeters should be removed immediately by a licensed waste management firm.

Generally, the sediment removed from the separator will not be contaminated to the point that it would be classified as hazardous waste. However, the sediment should be tested to determine the disposal options. The Ministry of Environment, Conservation and Parks publishes sediment disposal guidelines which should be consulted for up-to-date information pertaining to the exact parameters and acceptable levels for the various disposal options. The preferred option is an off-site disposal, arranged by a licensed waste management firm.

The future owners of a Hydroworks facility are provided with an Owner's Manual upon installation, which explains the function, maintenance requirements and procedures for the facility with extensive use. It is recommended to follow the manufacturers instructions to allow the oil/grit separator to perform as intended.

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CONCLUSIONS AND RECOMMENDATIONS

Therefore, based on the above comments and design calculations provided for this site, the following summarizes the servicing for this site.

1. The existing municipal 250mm diameter watermain on Willick Road is expected to have sufficient capacity to provide both domestic and fire protection water supply for the entire development.

2. The existing 250mm diameter sanitary sewer on Emerald Avenue is expected to have adequate capacity for the entire development.

3. Stormwater quantity controls are not considered necessary for the subject lands.

4. Major overland flows form the subject lands will be conveyed to Hunters Drain.

5. Stormwater quality controls will be provided to MECP Enhanced protection (80% TSS removal) levels with Hydroworks HD4 Oil/Grit separator installed prior to the outlet from each site.

6. There will be no negative impact on the existing 100 year floodplain elevations resulting from the proposed development.

In conclusion, there exists adequate municipal infrastructure to service the proposed development. We trust the above comments and enclosed calculations are satisfactory for approval. If you have any questions or require additional information, please do not hesitate to contact our office.

Respectfully submitted,

B. Kapteyn

Brendan Kapteyn, P.Eng.
December 1, 2025

Encl.

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APPENDICES

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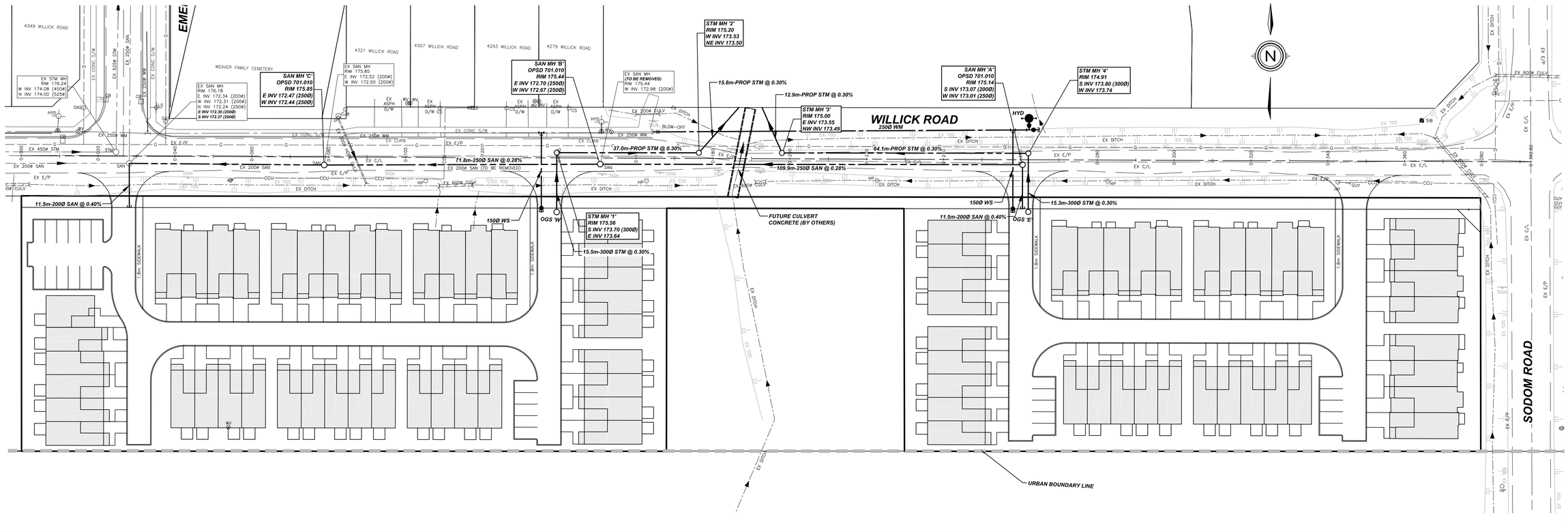
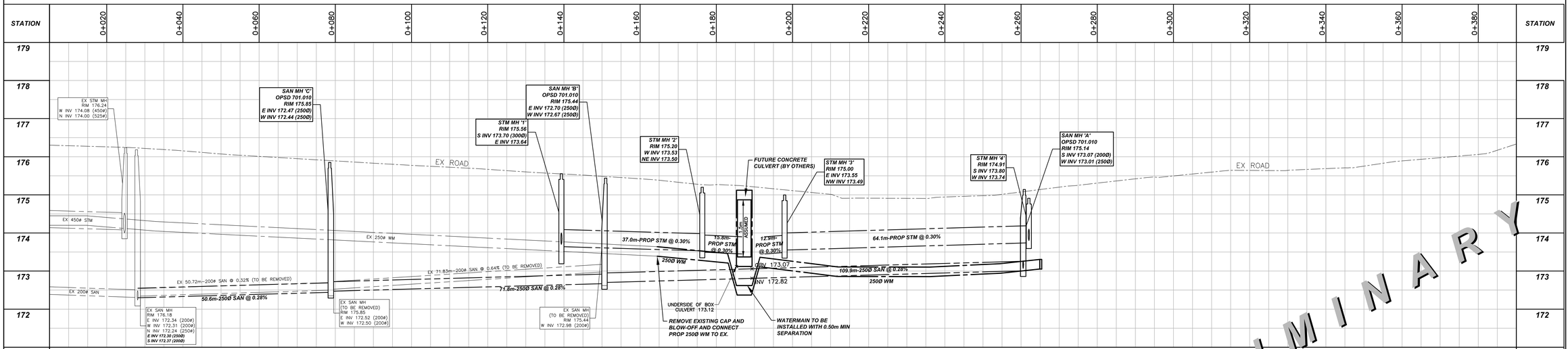
APPENDIX A

Preliminary Plan and Profile Plan – Willick Road





NOTES:

1. THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWER, AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.
2. PROPERTY LINES WERE PLOTTED USING REGISTERED PLANS AND BARS LOCATED IN THE FIELD. TO VERIFY THE ACCURACY OF THESE PROPERTY LINES, A LEGAL SURVEY SHOULD BE PERFORMED PRIOR TO CONSTRUCTION.
3. ALL CONSTRUCTION MUST COMPLY WITH THE NIAGARA PENINSULA STANDARD CONTRACT DOCUMENT.

#	REVISION	DATE	INIT

DRAFTING	A.S.
DESIGN	R.D
CHECKED BY	B.K.
APPROVED BY	B.K.

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4336 WILLICK ROAD
CITY OF NIAGARA FALLS

PRELIMINARY PLAN AND PROFILE

CONSULTANT FILE No.	24002
DATE	2025-10-20
PRINTED	2025-12-01
SCALE	1:500 m
REF No.	
DWG No.	24002-PRE_PP
REV	0

DRAWING FILE: F:\24002\Engineering\24002-BASE_FSR.dwg PLOTTED: Dec 01, 2025 - 2:29pm PLOTTED BY: tala

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APPENDIX B

Figure 1 – Future Sanitary Drainage Area Plan
Sanitary Sewer Design Sheet

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4336 WILLICK ROAD NIAGARA FALLS

FUTURE SANITARY DRAINAGE AREA PLAN

DATE	2025–10–20
SCALE	1:4000 m
REF No.	.
DWG No.	***FIGURE 1***

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3-30 HANNOVER DRIVE
ST.CATHARINES, ONTARIO
L2W 1A3

DESIGN FLOWS

RESIDENTIAL: 255 LITRES/PERSON/DAY (AVERAGE DAILY FLOW)
INFILTRATION RATE: 0.286 L /s /ha (M.O.E FLOW ALLOWANCE IS BETWEEN 0.10 & 0.28 L s
POPULATION DENSITY: 2.40 PERSONS /UNIT

SEWER DESIGN

PIPE ROUGHNESS: 0.013 FOR MANNING'S EQUATION
PIPE SIZES: 1.016 IMPERIAL EQUIVALENT FACTOR
PERCENT FULL: TOTAL PEAK FLOW / CAPACITY

MUNICIPALITY: CITY OF NIAGARA FALLS
PROJECT : 4336 WILLICK ROAD **SANITARY SEWER DESIGN SHEET**
PROJECT NO: 24002

Peaking Factor= $M = 1 + \frac{14}{4 + P^{0.5}}$ Where P = design population in thousands

LOCATION			AREA		POPULATION		ACCUMULATED PEAK FLOW				DESIGN FLOW					
Location and Description	**From M.H**	**To M.H.**	**Increment (hectares)**	**Accum. (hectares)**	**Population Increment**	**Total Population Served**	**Peaking Factor**	**Flow (L/s)**	**Infiltration Flow L/s**	**Total Peak Flow (L/s)**	**Pipe Diameter (mm)**	**Pipe Length (m)**	**Pipe Slope (%)**	**Full Flow Velocity (m/s)**	**Full Flow Capacity (L/s)**	**Percent Full**
A1 - SITE	SITE	EX	2.88	2.88	197	197	4.00	2.33	0.82	3.15						
EMERALD AVENUE																
A2	EX	EX	2.11	4.99	53	250	4.00	2.95	1.43	4.38	250	90.4	0.32	0.69	35.09	12.5%
A3	EX	EX	9.89	14.88	435	685	3.90	7.88	4.26	12.14	300	83.8	0.35	0.82	59.68	20.3%
MANN STREET																
A4	EX	EX	12.49	27.37	492	1177	3.75	13.04	7.83	20.87						
A5	EX	EX	7.65	35.02	288	1465	3.69	15.94	10.02	25.96	300	39.5	0.22	0.65	47.32	54.9%
LYON'S PARKWAY																
A6	EX	EX	6.15	41.17	113	1578	3.66	17.06	11.77	28.84	375	7.9	0.25	0.80	91.46	31.5%
LYON'S CREEK ROAD																
A7	EX	EX	3.63	44.80	41	1619	3.66	17.47	12.81	30.28	375	90.7	0.24	0.79	89.61	33.8%

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APPENDIX C

NPCA Hunters Drain Floodplain Mapping: Figure 2 – Study Area
NPCA Hunters Drain Floodplain Mapping: Table 1

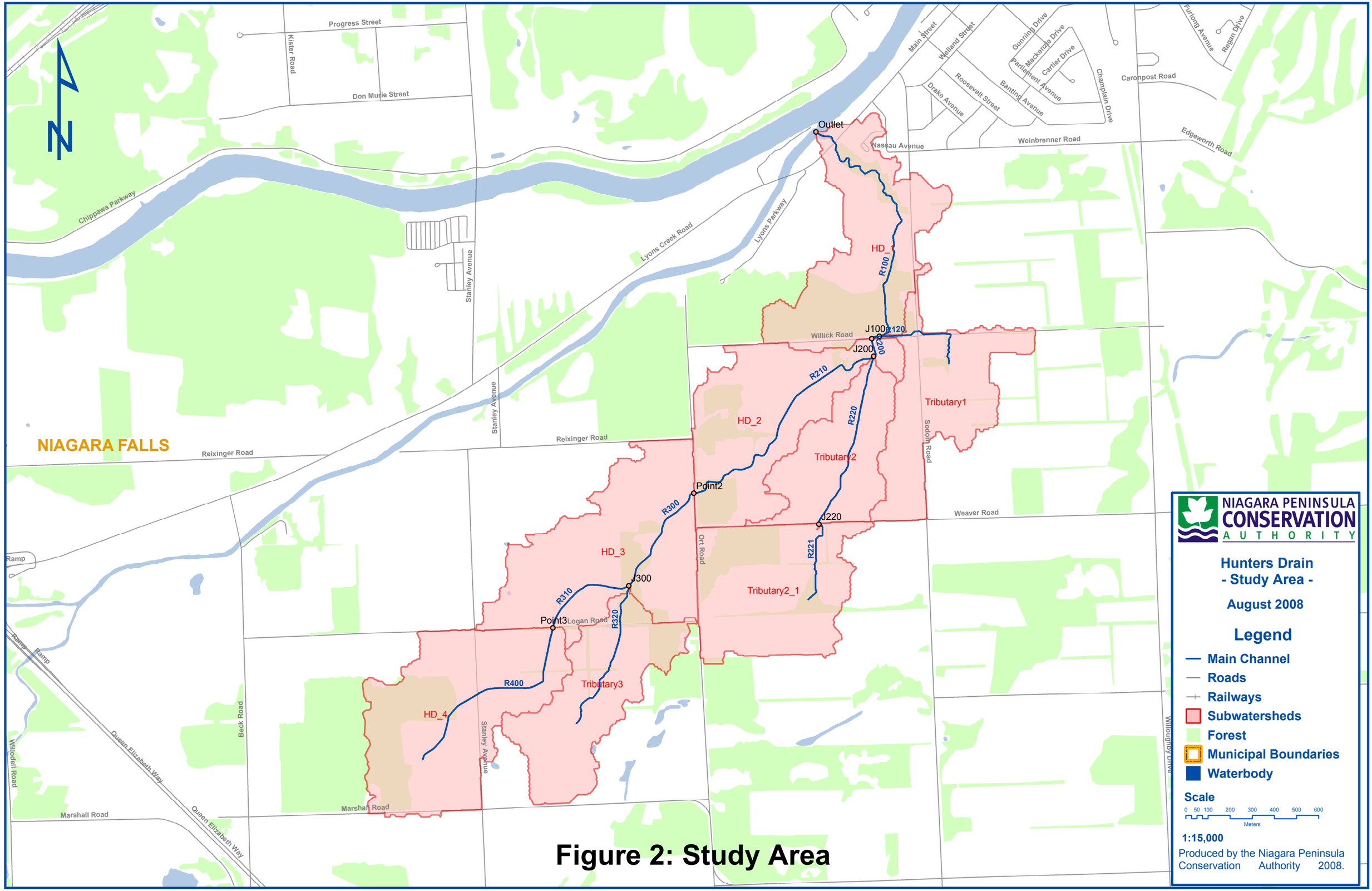

Figure 2: Study Area

TABLE 1: SUBWATERSHED PHYSICAL CHARACTERISTICS

SUB WATERSHED	AREA (km2)	SUBWATERSHED AVERAGE SLOPE (%)	SUBWATERSHED HYDRAULIC LENGTH (m)	INITIAL ABSTRACTION IA (mm)	SCS CURVE NUMBER CN	TIME OF CONCENTRATION T_c (h)	TIME OF CONCENTRATION T_c (min)	LAG (h)	CHANNEL SLOPE* (%)	CHANNEL LENGTH (m)
HD_1	0.44	2.45	2025.14	11.66	81.34	1.49	89.18	0.89	1.65	1394.9
HD_2	0.43	1.35	1699.56	12.87	79.78	1.82	109.22	1.09	0.13	1306.9
HD_3	0.53	0.86	1434.31	7.75	86.76	1.57	94.19	0.94	0.18	1029.7
HD_4	0.53	1.71	1642.57	11.09	82.09	1.47	88.18	0.88	0.05	1008.46
Tributary1	0.32	1.3	1308.31	8.28	85.99	1.22	73.15	0.73	6.29	496.16
Tributary2	0.27	1.05	1210.27	9.83	83.78	1.39	83.17	0.83	0.14	863.14
Tributary2_1	0.39	0.8	1240.23	9.42	84.36	1.59	95.19	0.95	7.45	404.89
Tributary3	0.34	1.21	1273.84	10.13	83.38	1.35	81.16	0.81	4.16	746.80

* Channel slopes were calculated as the average for the subwatersheds that have two reaches (such as HD_1, HD_2 and HD_3).

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APPENDIX D

Hydroworks Output Files

Hydrowors Output Files (East)

```
         ************************************************
         *      Storm Water Management Sizing Model     *
         *               Hydroworks, LLC                *
         *                Version 4.4                   *
         *                                              *
         *        Continuous Simulation Program         *
         *             Based on SWMM 4.4H               *
         *             Hydroworks, LLC                  *
         *              Graham Bryant                   *
         *               2003 - 2021                    *
         ************************************************

                          Developed by

         ************************************************
         *               Hydroworks, LLC                *
         *            Metcalf & Eddy, Inc.              *
         *           University of Florida              *
         *       Water Resources Engineers, Inc.        *
         *      (Now Camp Dresser & McKee, Inc.)        *
         *              Modified SWMM 4.4               *
         ************************************************

                   Distributed and Maintained by

         ************************************************
         *                                              *
         *               Hydroworks, LLC                *
         *                888-290-7900                  *
         *             www.hydroworks.com               *
         *                                              *
         ************************************************

         ************************************************
         *     If any problems occur executing this     *
         *     model, contact Mr. Graham Bryant at      *
         *     Hydroworks, LLC by phone at 888-290-7900 *
         *     or by e-mail: support@hydroworks.com     *
         ************************************************

         ************************************************
         *     This model is based on EPA SWMM 4.4      *
         *  "Nature is full of infinite causes which    *
         *   have never occurred in experience" da Vinci *
         ************************************************

         ************************************************
         * Entry made to the Rain Block                 *
         * Created by the University of Florida - 1988  *
         * Updated by Oregon State University, March 2000 *
         ************************************************

     ########################################
     #  Precipitation Block Input Commands  #
     ########################################

    Station Name.........................  St. Catherines A
    Station Location.....................  Ontario
    Station, ISTA........................    7287
    Beginning date, IYBEG (Yr/Mo/Dy).....  1971/ 1/ 1
    Ending date, IYEND (Yr/Mo/Dy).........  2005/12/31
    Minimum interevent time, MIT.........     1
    Number of ranked storms, NPTS.........    10
    NWS format, IFORM (See text).........     1
    Print storm summary, ISUM (O-No 1-Yes)     0
    Print all rainfall, IYEAR (O-No 1-Yes)     0
    Save storm event data on NSCRAT(1)....     0
    (IFILE =0 -Do not save, =1 -Save data)
    IDECID 0 - Create interface file
           1 - Create file and analyze
           2 - Synoptic analysis.........     2
    Plotting position parameter, A........  0.40
    Storm event statistics, NOSTAT........  1100
    KODEA (from optional group B0)........     2
     = 0, Do not include NCDC cumulative values.
     = 1, Average NCDC cumulative values.
     = 2, Use NCDC cumulative value as inst. rain.
    KODEPR (from optional group B0).......     0
     Print NCDC special codes in event summary:
     = 0, only on days with events.
     = 1, on all days with codes present.
     Codes: A = accumulated value, I = incomplete value,
            M = missing value,     O = other code present

*******************************************************
*  Precipitation output created using the Rain block   *
*  Number of precipitation stations...        1        *
*******************************************************

Location Station Number
-------- --------------
       1.     7287

STATION ID ON PRECIP. DATA INPUT FILE = 7287
REQUESTED STATION ID =     7287  CHECK TO BE SURE THEY MATCH.

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
Note, 15-min. data are being processed, but hourly
print-out, summaries, and statistics are based on
hourly totals only.  Data placed on interface file
are at correct 15-min. intervals.
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
```

```
################################################
# Entry made to the Runoff Block, last updated by #
# Oregon State University, and Camp, Dresser and  #
# McKee, Inc., March 2002.                        #
################################################
# "And wherever water goes, amoebae go along for  #
#  the ride"                    Tom Robbins       #
################################################

Snowmelt parameter - ISNOW.....................          0
Number of rain gages - NRGAG...................          1
Horton infiltration equation used - INFILM.....          2
Maximum infiltration volume is limited to RMAXINF input on  subcatchment lines.
Infiltration volume regenerates during  non rainfall periods.
Quality is simulated - KWALTY..................          1
IVAP is negative.  Evaporation will be set to zero
    during time steps with rainfall.
Read evaporation data on line(s) F1 (F2) - IVAP..          1
Hour of day at start of storm - NHR............          1
Minute of hour at start of storm - NMN.........          1
Time TZERO at start of storm (hours)...........      1.017
Use Metric units for I/O - METRIC..............          1
 ===> Ft-sec units used in all internal computations
Runoff input print control...                            0
Runoff graph plot control....                            1
Runoff output print control..                            0
Print headers every 50 lines - NOHEAD (0=yes, 1=no)      0
Print land use load percentages -LANDUPR (0=no, 1=yes)   0
Limit number of groundwater convergence messages to 10000 (if simulated)
Month, day, year of start of storm is:             1/ 1/1971
Wet time step length (seconds).......                  300.
Dry time step length (seconds).......                  900.
Wet/Dry time step length (seconds)...                  450.
Simulation length is......                      20051231.0 Yr/Mo/Dy
Percent of impervious area with zero detention depth    25.0
Horton infiltration model being used
Rate for regeneration of infiltration = REGEN * DECAY
DECAY is read in for each subcatchment
REGEN = ........................................   0.01000

*********************************************************
*   Processed Precipitation will be read from file      *
*********************************************************

  ############################
  #        Data Group F1     #
  # Evaporation Rate (mm/day) #
  ############################

 JAN.  FEB.  MAR.  APR.  MAY   JUN.  JUL.  AUG.  SEP.  OCT.  NOV.  DEC.
 ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----
 0.00  0.00  0.00  2.54  2.54  3.81  3.81  3.81  2.54  2.54  0.00  0.00

*********************************************************
*         C H A N N E L  A N D  P I P E  D A T A         *
*********************************************************

Input   NAMEG:     Drains                          Invert  L Side   R Side  Intial     Max  Mann-   Full
equen  Channel      to      Channel  Width  Length   Slope   Slope    Slope   Depth    Depth   ings   Flow
umber    ID #      NGTO:     Type     (m)    (m)     (m/m)   (m/m)    (m/m)    (m)      (m)    "N"   (cms)
-----  ---------- -------- -------- ------ -------   ------- -------- ------- ------- ------- -----  -----
  1        201        200   Dummy     0.0     0.0    0.0000   0.0000  0.0000     0.0     0.0  0.0000 0.00E+00

 ***************************************************
 *          S U B C A T C H M E N T  D A T A       *
 ***************************************************

*NOTE. SEE LATER TABLE FOR OPTIONAL SUBCATCHMENT PARAMETERS*
      SUBCATCH-  CHANNEL      WIDTH    AREA  PERCENT    SLOPE    RESISTANCE  FACTOR    DEPRES. STORAGE(MM) INFILTRATION   DECAY RATE GAGE
MAXIMUM
       MENT NO.  OR INLET       (M)     (HA)  IMPERV.    (M/M)     IMPERV.     PERV.   IMPERV.     PERV.      RATE(MM/HR)     (1/SEC)     NO.
VOLUME
                                                                                                              MAXIMUM MINIMUM
(MM)
 ---  --------   -------- --------- --------  -----   -------    -------  --------    ------    ------     ----   -------  -------  ------ ----
---
  1        300        200    100.99     1.02  71.00    0.0200      0.015     0.250     0.510     5.080    63.50   10.16    0.00055     1
101.60000

TOTAL NUMBER OF SUBCATCHMENTS...              1
TOTAL TRIBUTARY AREA (HECTARES).           1.02
IMPERVIOUS AREA (HECTARES)......           0.72
PERVIOUS AREA (HECTARES)........           0.30
TOTAL WIDTH (METERS)............         100.99
PERCENT IMPERVIOUSNESS.........           71.00

*********************************************************
*      G R O U N D W A T E R   I N P U T   D A T A      *
*********************************************************

    SUB-     CHANNEL     ========== E L E V A T I O N S ========  =========== F L O W   C O N S T A N T S ============
    CATCH         OR      GROUND  BOTTOM   STAGE     BC      TW       A1         B1        A2         B2        A3
    NUMBER     INLET        (M)     (M)      (M)     (M)     (M) (MM/HR-M^B1)          (MM/HR-M^B2)          (MM/HR-M^2)
    ------     -----     -------  ------  ------  ------  ------ -----------  -------  -----------  -------  -----------
         0       602        3.05    0.00    0.00    0.61    0.61   3.484E-04    2.600   0.000E+00    1.000    0.00E+00

*********************************************************
* G R O U N D W A T E R   I N P U T   D A T A (CONTINUED) *
*********************************************************
```

S O I L P R O P E R T I E S

SUBCAT. NO.	POROSITY	SATURATED HYDRAULIC CONDUCTIVITY (mm/hr)	WILTING POINT	FIELD CAPACITY	INITIAL MOISTURE	MAX. DEEP PERCOLATION (mm/hr)	PERCOLATION PARAMETERS HCO	PCO	E T P A R A M E T E R S DEPTH OF ET (m)	FRACTION OF ET TO UPPER ZONE
0	.4000	127.000	.1500	.3000	.3000	5.080E-02	10.00	4.57	4.27	0.350

```
**********************************************************
*    Arrangement of Subcatchments and Channel/Pipes      *
**********************************************************
* See second subcatchment output table for connectivity *
* of subcatchment to subcatchment flows.                *
**********************************************************

   Channel
   or Pipe
       201     No Tributary Channel/Pipes
               No Tributary Subareas.....

    INLET
       200     Tributary Channel/Pipes...        201
               Tributary Subareas........        300

************************************************************
* Hydrographs will be stored for the following   1 INLETS *
************************************************************
          200

##################################################
#            Quality Simulation                  #
##################################################
#      General Quality Control Data Groups       #
##################################################

 Description                          Variable       Value
 -----------                          --------       -----
 Number of quality constituents.....    NQS.......         1
 Number of land uses................  JLAND.......         1
 Standard catchbasin volume.........  CBVOL.......      1.22 cubic meters
 Erosion is not simulated.........    IROS........         0
 DRY DAYS PRIOR TO START OF STORM... DRYDAY.......      3.00 DAYS
 DRY DAYS REQUIRED TO RECHARGE
 CATCHBASIN CONCENTRATION TO
 INITIAL VALUES..................... DRYBSN.......      5.00 DAYS
 DUST AND DIRT
 STREET SWEEPING EFFICIENCY......... REFFDD.......     0.300
 DAY OF YEAR ON WHICH STREET
 SWEEPING BEGINS.................... KLNBGN.......       120
 DAY OF YEAR ON WHICH STREET
 SWEEPING ENDS...................... KLNEND.......       270

##########################################
#     Land use data on data group J2     #
##########################################
```

AND USE LNAME)	BUILDUP EQUATION TYPE (METHOD)	FUNCTIONAL DEPENDENCE OF BUILDUP PARAMETER(JACGUT)	LIMITING BUILDUP QUANTITY (DDLIM)	BUILDUP POWER (DDPOW)	BUILDUP COEFF. (DDFACT)	CLEANING INTERVAL IN DAYS (CLFREQ)	AVAIL. FACTOR FRACTION (AVSWP)	DAYS SINCE LAST SWEEPING (DSLCL)
Urban De	EXPONENTIAL(1)	AREA(1)	2.802E+01	0.500	67.250	30.000	0.300	30.000

```
##############################################
#     Constituent data on data group J3      #
##############################################

                              Total Su
                              --------
Constituent units.........      mg/l
Type of units.............         0
KALC......................         2
Type of buildup calc.....    EXPONENTIAL(2)
KWASH.....................         0
Type of washoff calc.....  POWER EXPONEN.(0)
KACGUT....................         1
Dependence of buildup....         AREA(1)
LINKUP....................         0
Linkage to snowmelt......   NO SNOW LINKAGE
Buildup param 1 (QFACT1).        28.020
Buildup param 2 (QFACT2).         0.500
Buildup param 3 (QFACT3).        67.250
Buildup param 4 (QFACT4).         0.000
Buildup param 5 (QFACT5).         0.000
Washoff power (WASHPO)...         1.100
Washoff coef. (RCOEF)....         0.086
Init catchb conc (CBFACT)       100.000
Precip. conc. (CONCRN)...         0.000
Street sweep effic (REFF)         0.300
Remove fraction (REMOVE).         0.000
1st order QDECAY, 1/day..         0.000
Land use number..........             1

************************************************
* Constant Groundwater Quality Concentration(s) *
************************************************

 Total Susp has a concentration of..    0.0000   mg/l

***********************************************
* REMOVAL FRACTIONS FOR SELECTED CHANNEL/PIPES *
* FROM J7 LINES                               *
***********************************************
```

CHANNEL/ PIPE	CONSTITUENT Total Susp
201	0.000

****
* Subcatchment surface quality on data group L1 *
****

	No.	Land Usage	Land Use No.	Total Gutter Length Km	Number of Catch- Basins	Input Loading load/ha Total Su
1	300	Urban De	1	0.20	2.00	0.0E+00
Totals (Loads in kg or other)				0.20	2.00	0.0E+00

****
* DATA GROUP M1 *
****

TOTAL NUMBER OF PRINTED GUTTERS/INLETS...NPRNT.. 1
NUMBER OF TIME STEPS BETWEEN PRINTINGS..INTERV.. 0
STARTING AND STOPPING PRINTOUT DATES..... 0 0

****
* DATA GROUP M3 *
****

CHANNEL/INLET PRINT DATA GROUPS..... -200

****
* Rainfall from Nat. Weather Serv. file *
* in units of hundredths of an inch *
****

Rainfall Station St. Catherines A
State/Province Ontario

Rainfall Depth Summary (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1971.	31.	0.	0.	0.	0.	0.	126.	93.	52.	60.	29.	0.	391.
1972.	0.	0.	0.	47.	65.	100.	39.	115.	63.	90.	1.	0.	521.
1973.	0.	0.	0.	103.	77.	71.	53.	29.	63.	139.	0.	0.	534.
1974.	0.	0.	0.	67.	105.	62.	50.	31.	74.	37.	110.	0.	536.
1975.	0.	0.	0.	0.	0.	94.	78.	76.	73.	56.	59.	6.	442.
1976.	0.	0.	0.	119.	136.	87.	101.	60.	72.	73.	13.	1.	662.
1977.	0.	0.	0.	94.	29.	69.	57.	150.	230.	71.	0.	1.	701.
1978.	0.	0.	0.	72.	43.	72.	43.	86.	156.	95.	0.	0.	567.
1979.	0.	0.	0.	84.	92.	33.	91.	88.	84.	129.	71.	0.	673.
1980.	0.	0.	0.	81.	39.	122.	60.	32.	79.	96.	45.	0.	554.
1981.	0.	0.	0.	91.	71.	106.	122.	61.	123.	91.	84.	0.	749.
1982.	0.	0.	0.	28.	65.	97.	36.	66.	82.	25.	143.	0.	544.
1983.	0.	0.	0.	78.	100.	65.	55.	106.	75.	122.	92.	0.	694.
1984.	0.	0.	0.	31.	113.	136.	19.	51.	144.	24.	44.	0.	562.
1985.	0.	0.	67.	32.	52.	64.	40.	94.	42.	109.	0.	1.	501.
1986.	0.	0.	0.	93.	113.	60.	85.	83.	98.	80.	43.	65.	719.
1987.	0.	2.	11.	77.	42.	80.	122.	97.	99.	71.	94.	34.	730.
1988.	0.	0.	41.	71.	42.	21.	110.	82.	70.	68.	75.	5.	585.
1989.	0.	0.	13.	63.	137.	108.	36.	45.	89.	73.	84.	0.	647.
1990.	0.	2.	38.	99.	124.	44.	68.	95.	56.	112.	96.	0.	735.
1991.	0.	0.	86.	124.	67.	31.	85.	57.	79.	64.	61.	28.	682.
1992.	0.	0.	29.	127.	56.	92.	185.	116.	77.	47.	103.	38.	869.
1993.	3.	0.	7.	83.	56.	86.	32.	61.	71.	92.	80.	38.	610.
1994.	0.	0.	44.	88.	105.	124.	48.	77.	117.	15.	0.	15.	633.
1995.	112.	23.	16.	48.	37.	60.	123.	66.	8.	137.	94.	0.	724.
1998.	0.	0.	0.	0.	51.	54.	64.	29.	9.	0.	1.	0.	207.
1999.	0.	0.	0.	79.	59.	35.	61.	58.	116.	78.	0.	0.	487.
2000.	0.	0.	0.	123.	134.	216.	51.	0.	0.	0.	10.	0.	534.
2001.	0.	0.	0.	56.	88.	45.	25.	30.	81.	129.	0.	0.	454.
2002.	0.	0.	0.	73.	104.	64.	53.	49.	52.	65.	8.	0.	468.
2003.	0.	0.	0.	10.	163.	77.	81.	64.	67.	73.	2.	0.	537.
2004.	0.	0.	0.	131.	126.	99.	115.	40.	88.	17.	0.	0.	616.
2005.	0.	0.	0.	38.	42.	78.	53.	120.	112.	0.	0.	0.	443.

Total Rainfall Depth for Simulation Period 19310. (mm)

Rainfall Intensity Analysis (mm/hr)

(mm/hr)	(#)	(%)	(mm)	(%)
2.50	21481	74.6	6454.	33.4
5.00	3585	12.4	3088.	16.0
7.50	1973	6.8	2886.	14.9
10.00	575	2.0	1233.	6.4
12.50	389	1.4	1070.	5.5
15.00	194	0.7	660.	3.4
17.50	210	0.7	846.	4.4
20.00	66	0.2	306.	1.6
22.50	92	0.3	487.	2.5
25.00	39	0.1	232.	1.2
27.50	37	0.1	246.	1.3
30.00	34	0.1	245.	1.3
32.50	29	0.1	228.	1.2
35.00	5	0.0	42.	0.2
37.50	10	0.0	90.	0.5
40.00	10	0.0	97.	0.5
42.50	12	0.0	124.	0.6
45.00	9	0.0	99.	0.5
47.50	1	0.0	12.	0.1
50.00	3	0.0	37.	0.2
>50.00	49	0.2	829.	4.3

Total # of Intensities 28803

Daily Rainfall Depth Analysis (mm)

(mm)	(#)	(%)	(mm)	(%)
2.50	1077	38.9	1247.	6.5
5.00	507	18.3	1850.	9.6
7.50	326	11.8	2006.	10.4
10.00	226	8.2	1958.	10.1
12.50	150	5.4	1672.	8.7
15.00	111	4.0	1495.	7.7
17.50	100	3.6	1620.	8.4
20.00	67	2.4	1260.	6.5
22.50	45	1.6	958.	5.0
25.00	37	1.3	881.	4.6
27.50	23	0.8	609.	3.2
30.00	20	0.7	575.	3.0
32.50	20	0.7	631.	3.3
35.00	12	0.4	405.	2.1
37.50	8	0.3	290.	1.5
40.00	9	0.3	350.	1.8
42.50	4	0.1	165.	0.9
45.00	4	0.1	173.	0.9
47.50	2	0.1	91.	0.5
50.00	4	0.1	192.	1.0
>50.00	15	0.5	882.	4.6

Total # Days with Rain 2767

****
* End of time step DO-loop in Runoff *
****

Final Date (Mo/Day/Year) = 1/ 1/2006
Total number of time steps = 2056429
Final Julian Date = 2006001
Final time of day = 4. seconds.
Final time of day = 0.00 hours.
Final running time = 306816.0000 hours.
Final running time = 12784.0000 days.

****
* Extrapolation Summary for Watersheds *
* # Steps ==> Total Number of Extrapolated Steps *
* # Calls ==> Total Number of OVERLND Calls *
****

Subcatch	# Steps	# Calls	Subcatch	# Steps	# Calls	Subcatch	# Steps	# Calls
300	6227353	1589871						

****
* Extrapolation Summary for Channel/Pipes *
* # Steps ==> Total Number of Extrapolated Steps *
* # Calls ==> Total Number of GUTNR Calls *
****

Chan/Pipe	# Steps	# Calls	Chan/Pipe	# Steps	# Calls	Chan/Pipe	# Steps	# Calls
201	0	0						

****
* Continuity Check for Surface Water *
****

	cubic meters	Millimeters over Total Basin
Total Precipitation (Rain plus Snow)	196476.	19263.
Total Infiltration	56713.	5560.
Total Evaporation	14464.	1418.
Surface Runoff from Watersheds	126412.	12394.
Total Water remaining in Surface Storage	0.	0.
Infiltration over the Pervious Area...	56713.	19173.

Infiltration + Evaporation + Surface Runoff + Snow removal + Water remaining in Surface Storage + Water remaining in Snow Cover.....	197590.	19372.
Total Precipitation + Initial Storage.	196476.	19263.

The error in continuity is calculated as

```
**************************************
* Precipitation + Initial Snow Cover  *
*      - Infiltration -               *
*Evaporation - Snow removal -         *
*Surface Runoff from Watersheds -     *
*Water in Surface Storage -           *
*Water remaining in Snow Cover        *
*-------------------------------------*
* Precipitation + Initial Snow Cover  *
**************************************
```

Error..... -0.567 Percent

****
* Continuity Check for Channel/Pipes *
****

	cubic meters	Millimeters over Total Basin
Initial Channel/Pipe Storage.....	0.	0.
Final Channel/Pipe Storage.....	0.	0.
Surface Runoff from Watersheds.....	126412.	12394.
Baseflow.....	0.	
Groundwater Subsurface Inflow.....	0.	0.
Evaporation Loss from Channels.....	0.	0.
Channel/Pipe/Inlet Outflow.....	126412.	12394.
Initial Storage + Inflow.....	126412.	12394.
Final Storage + Outflow.....	126412.	12394.

```
*******************************************
* Final Storage + Outflow + Evaporation  - *
* Watershed Runoff - Groundwater Inflow  - *
*     Initial Channel/Pipe Storage         *
*     ----------------------------------   *
*  Final Storage + Outflow  + Evaporation  *
*******************************************
Error.....................................      0.000 Percent

************************************************
*     Continuity Check for Subsurface Water    *
************************************************
```

	cubic meters	Millimeters over Subsurface Basin
Total Infiltration	0.	0.
Total Upper Zone ET	0.	0.
Total Lower Zone ET	0.	0.
Total Groundwater flow	0.	0.
Total Deep percolation	0.	0.
Initial Subsurface Storage	9327.	914.
Final Subsurface Storage	9327.	914.
Upper Zone ET over Pervious Area	0.	0.
Lower Zone ET over Pervious Area	0.	0.

```
*****************************************
* Infiltration + Initial Storage - Final *
* Storage - Upper and Lower Zone ET -    *
* Groundwater Flow - Deep Percolation    *
* -------------------------------------- *
*     Infiltration + Initial Storage     *
*****************************************
Error ....................................     0.000 Percent
```

SUMMARY STATISTICS FOR SUBCATCHMENTS

				PERVIOUS AREA			IMPERVIOUS AREA		TOTAL SUBCATCHMENT AREA		
SUBCATCHMENT NO.	GUTTER OR INLET NO.	AREA (HA)	PERCENT IMPER.	TOTAL SIMULATED RAINFALL (MM)	TOTAL RUNOFF DEPTH (MM)	TOTAL LOSSES (MM)	PEAK RUNOFF RATE (CMS)	RUNOFF DEPTH (MM)	PEAK RUNOFF RATE (CMS)	RUNOFF DEPTH (MM)	PEAK RUNOFF RATE (CMS)	PEAK UNIT RUNOFF (MM/HR)
300	200	1.02	71.01	9262.47	89.546********		0.088	17416.121	0.394	12391.414	0.482	171.527

*** NOTE *** IMPERVIOUS AREA STATISTICS AGGREGATE IMPERVIOUS AREAS WITH AND WITHOUT DEPRESSION STORAGE

SUMMARY STATISTICS FOR CHANNEL/PIPES

CHANNEL NUMBER	FULL FLOW (CMS)	FULL VELOCITY (M/S)	FULL DEPTH (M)	MAXIMUM COMPUTED INFLOW (CMS)	MAXIMUM COMPUTED OUTFLOW (CMS)	MAXIMUM COMPUTED DEPTH (M)	MAXIMUM COMPUTED VELOCITY (M/S)	TIME OF OCCURRENCE DAY	TIME OF OCCURRENCE HR.	LENGTH OF SURCHARGE (HOUR)	MAXIMUM SURCHARGE VOLUME (CU-M)	RATIO OF MAX. TO FULL FLOW	RATIO OF MAX. DEPTH TO FULL DEPTH
201				0.00				1/ 0/1900	0.00				
200				0.48				8/14/1972	14.25				

TOTAL NUMBER OF CHANNELS/PIPES = 2

*** NOTE *** THE MAXIMUM FLOWS AND DEPTHS ARE CALCULATED AT THE END OF THE TIME INTERVAL

```
################################################
#             Runoff Quality Summary Page      #
# If NDIM = 0 Units for:   loads    mass rates #
#             METRIC = 1    lb       lb/sec    #
#             METRIC = 2    kg       kg/sec    #
# If NDIM = 1 Loads are in units of quantity   #
#             and mass rates are quantity/sec  #
# If NDIM = 2 loads are in units of concentration #
#             times volume and mass rates have units#
#             of concentration times volume/second #
################################################

Total Su NDIM =  0
METRIC =  2
```

	Total Su
Inputs	
1. INITIAL SURFACE LOAD.....	22.
2. TOTAL SURFACE BUILDUP.....	17588.
3. INITIAL CATCHBASIN LOAD.....	0.
4. TOTAL CATCHBASIN LOAD.....	0.
5. TOTAL CATCHBASIN AND SURFACE BUILDUP (2+4).....	17588.
Remaining Loads	
6. LOAD REMAINING ON SURFACE...	9.
7. REMAINING IN CATCHBASINS....	0.
8. REMAINING IN CHANNEL/PIPES..	0.
Removals	
9. STREET SWEEPING REMOVAL.....	1507.
10. NET SURFACE BUILDUP (2-9)...	16082.
11. SURFACE WASHOFF.....	16070.
12. CATCHBASIN WASHOFF.....	0.
13. TOTAL WASHOFF (11+12).....	16070.
14. LOAD FROM OTHER CONSTITUENTS	0.
15. PRECIPITATION LOAD.....	0.

```
15a.SUM SURFACE LOAD (13+14+15).    16070.
16. TOTAL GROUNDWATER LOAD......        0.
16a.TOTAL I/I LOAD..............        0.
17. NET SUBCATCHMENT LOAD
    (15a-15b-15c-15d+16+16a)....    16070.
>>Removal in channel/pipes (17a, 17b):
17a.REMOVE BY BMP FRACTION......        0.
17b.REMOVE BY 1st ORDER DECAY...        0.
18. TOTAL LOAD TO INLETS........    16070.
19. FLOW WT'D AVE.CONCENTRATION  mg/l
    (INLET LOAD/TOTAL FLOW).....      127.

Percentages
-----------
20. STREET SWEEPING (9/2).......        9.
21. SURFACE WASHOFF (11/2)......       91.
22. NET SURFACE WASHOFF(11/10)..      100.
23. WASHOFF/SUBCAT LOAD(11/17)..      100.
24. SURFACE WASHOFF/INLET LOAD
    (11/18).....................      100.
25. CATCHBASIN WASHOFF/
    SUBCATCHMENT LOAD (12/17)...        0.
26. CATCHBASIN WASHOFF/
    INLET LOAD (12/18)..........        0.
27. OTHER CONSTITUENT LOAD/
    SUBCATCHMENT LOAD (14/17)...        0.
28. INSOLUBLE FRACTION/
    INLET LOAD (14/18)..........        0.
29. PRECIPITATION/
    SUBCATCHMENT LOAD (15/17)...        0.
30. PRECIPITATION/
    INLET LOAD (15/18)..........        0.
31. GROUNDWATER LOAD/
    SUBCATCHMENT LOAD (16/17)...        0.
32. GROUNDWATER LOAD/
    INLET LOAD (16/18)..........        0.
32a.INFILTRATION/INFLOW LOAD/
    SUBCATCHMENT LOAD (16a/17)..        0.
32b.INFILTRATION/INFLOW LOAD/
    INLET LOAD (16a/18).........        0.
32c.CH/PIPE BMP FRACTION REMOVAL/
    SUBCATCHMENT LOAD (17a/17)..        0.
32d.CH/PIPE 1st ORDER DECAY REMOVAL/
    SUBCATCHMENT LOAD (17b/17)..        0.
33. INLET LOAD SUMMATION ERROR
    (18+8+6a+17a+17b-17)/17.....        0.

CAUTION. Due to method of quality routing (Users Manual, Appendix IX)
quality routing through channel/pipes is sensitive to the time step.
Large "Inlet Load Summation Errors" may result.
These can be reduced by adjusting the time step(s).
Note: surface accumulation during dry time steps at end of simulation is
not included in totals.  Buildup is only performed at beginning of
wet steps or for street cleaning.

******************************************************
*            TSS Particle Size Distribution          *
******************************************************
   Diameter    %     Specific    Settling Velocity   Critical Peclet
     (um)            Gravity        (m/s)               Number

      20.    20.0      2.65         0.000267            0.080977
      60.    20.0      2.65         0.002319            0.160673
     150.    20.0      2.65         0.012234            0.284537
     400.    20.0      2.65         0.047806            0.524584
    2000.    20.0      2.65         0.180097            1.431405

******************************************************
*                                                    *
*              Summary of TSS Removal                *
*                                                    *
******************************************************

TSS Removal based on Lab Performance Curve

 Model      Low Q Treated  High Q Treated     Runoff Treated        TSS Removed
   #           (cms)          (cms)               (%)                  (%)

 Unavailabl   0.130          0.130               99.4                 72.4
 HD 4         0.130          0.130               99.4                 81.5
 HD 5         0.130          0.130               99.4                 87.5
 HD 6         0.130          0.130               99.4                 91.2
 Unavailabl   0.130          0.130               99.4                 93.5
 HD 8         0.130          0.130               99.4                 95.1
 HD 10        0.130          0.130               99.4                 97.4
 HD 12        0.130          0.130               99.4                 98.4
```

****
* Summary of Annual Flow Treatmnet & TSS Removal *
****

HD 4

Year	Flow Vol (m3)	Flow Treated (m3)	TSS In (kg)	TSS Rem (kg)	TSS Out (kg)	TSS Byp (kg)	Flow Treated (%)	TSS Removal (%)
1971.	13190.	12885.	316.	252.	65.	1.	97.7	79.5
1972.	16946.	15628.	413.	341.	72.	15.	92.2	79.6
1973.	16834.	16834.	450.	368.	81.	0.	100.0	81.9
1974.	17196.	17005.	476.	409.	67.	3.	98.9	85.4
1975.	14579.	14534.	411.	332.	78.	0.	99.7	80.8
1976.	21701.	21346.	513.	422.	91.	7.	98.4	81.2
1977.	23248.	22820.	499.	379.	120.	6.	98.2	75.1
1978.	18558.	18558.	479.	377.	102.	0.	100.0	78.8
1979.	22219.	21925.	543.	446.	97.	4.	98.7	81.6
1980.	17889.	17889.	511.	419.	93.	0.	100.0	81.9
1981.	24708.	24708.	571.	479.	92.	0.	100.0	83.8
1982.	17407.	17407.	464.	395.	69.	0.	100.0	85.2
1983.	22968.	22844.	595.	483.	112.	3.	99.5	80.9
1984.	18482.	18482.	459.	368.	92.	0.	100.0	80.1
1985.	16114.	16114.	452.	374.	78.	0.	100.0	82.7
1986.	23507.	23507.	618.	516.	102.	0.	100.0	83.5
1987.	24309.	24140.	621.	508.	113.	1.	99.3	81.6
1988.	19448.	19448.	519.	435.	85.	0.	100.0	83.7
1989.	21438.	21438.	502.	426.	76.	0.	100.0	84.9
1990.	24302.	24293.	638.	533.	104.	0.	100.0	83.6
1991.	22772.	22772.	595.	495.	100.	0.	100.0	83.2
1992.	28949.	28949.	692.	549.	143.	0.	100.0	79.3
1993.	19689.	19689.	584.	503.	81.	0.	100.0	86.1
1994.	21078.	20690.	479.	361.	118.	5.	98.2	74.6
1995.	24484.	24411.	574.	455.	119.	2.	99.7	79.1
1998.	6331.	6331.	220.	182.	38.	0.	100.0	82.7
1999.	15507.	15507.	443.	367.	75.	0.	100.0	83.0
2000.	17870.	17870.	388.	288.	99.	0.	100.0	74.4
2001.	14135.	14135.	361.	315.	46.	0.	100.0	87.2
2002.	14753.	14753.	423.	358.	65.	0.	100.0	84.7
2003.	16785.	16785.	436.	354.	82.	0.	100.0	81.3
2004.	20115.	20115.	449.	364.	86.	0.	100.0	80.9
2005.	14521.	14340.	342.	259.	83.	1.	98.7	75.6

****
* Summary of Quantity and Quality Results at   *
* Location   200 INFlow in cms.   *
* Values are instantaneous at indicated time step *
****

4336 WILLICK ROAD

Date Mo/Da/Year	Time Hr:Min	Flow cum/s	Total Su mg/l
Flow wtd means.....		0.000	127.
Flow wtd std devs..		0.003	66.
Maximum value.....		0.482	291.
Minimum value.....		0.000	0.
Total loads.....		126384.	16079.
		Cub-Met	KILOGRAM

===> Runoff simulation ended normally.

===> SWMM 4.4   simulation ended normally.
     Always check output file for possible warning messages.

****
*   SWMM 4.4   Simulation Date and Time Summary *
****
* Starting Date... August   5, 2025   *
*   Time...   10:10:26.231   *
*   Ending Date... August   5, 2025   *
*   Time...   10:10:29.104   *
* Elapsed Time...   0.048 minutes.   *
* Elapsed Time...   2.873 seconds.   *
****

Hydrowors Output Files (West)

```
         ************************************************
         *      Storm Water Management Sizing Model     *
         *               Hydroworks, LLC                *
         *                Version 4.4                   *
         *                                              *
         *        Continuous Simulation Program         *
         *              Based on SWMM 4.4H              *
         *              Hydroworks, LLC                 *
         *               Graham Bryant                  *
         *                2003 - 2021                   *
         ************************************************

                          Developed by

         ************************************************
         *               Hydroworks, LLC                *
         *             Metcalf & Eddy, Inc.             *
         *            University of Florida             *
         *       Water Resources Engineers, Inc.        *
         *      (Now Camp Dresser & McKee, Inc.)        *
         *              Modified SWMM 4.4               *
         ************************************************

                   Distributed and Maintained by

         ************************************************
         *                                              *
         *               Hydroworks, LLC                *
         *                888-290-7900                  *
         *             www.hydroworks.com               *
         *                                              *
         ************************************************
         ************************************************
         *     If any problems occur executing this     *
         *     model, contact Mr. Graham Bryant at      *
         *     Hydroworks, LLC by phone at 888-290-7900 *
         *     or by e-mail: support@hydroworks.com     *
         ************************************************

         ************************************************
         *     This model is based on EPA SWMM 4.4      *
         *  "Nature is full of infinite causes which    *
         *   have never occurred in experience" da Vinci *
         ************************************************

         ************************************************
         * Entry made to the Rain Block                 *
         * Created by the University of Florida - 1988  *
         * Updated by Oregon State University, March 2000 *
         ************************************************

     ########################################
     #  Precipitation Block Input Commands  #
     ########################################

    Station Name.........................  St. Catherines A
    Station Location.....................  Ontario
    Station, ISTA........................    7287
    Beginning date, IYBEG (Yr/Mo/Dy).....  1971/ 1/ 1
    Ending date, IYEND (Yr/Mo/Dy).........  2005/12/31
    Minimum interevent time, MIT.........     1
    Number of ranked storms, NPTS.........    10
    NWS format, IFORM (See text).........     1
    Print storm summary, ISUM (O-No 1-Yes)     0
    Print all rainfall, IYEAR (O-No 1-Yes)     0
    Save storm event data on NSCRAT(1)....     0
    (IFILE =0 -Do not save, =1 -Save data)
    IDECID 0 - Create interface file
           1 - Create file and analyze
           2 - Synoptic analysis.........     2
    Plotting position parameter, A........  0.40
    Storm event statistics, NOSTAT........  1100
    KODEA (from optional group B0).........     2
     = 0, Do not include NCDC cumulative values.
     = 1, Average NCDC cumulative values.
     = 2, Use NCDC cumulative value as inst. rain.
    KODEPR (from optional group B0).......     0
     Print NCDC special codes in event summary:
     = 0, only on days with events.
     = 1, on all days with codes present.
     Codes: A = accumulated value, I = incomplete value,
            M = missing value,     O = other code present

*******************************************************
*  Precipitation output created using the Rain block   *
*  Number of precipitation stations...        1        *
*******************************************************

Location Station Number
-------- --------------
       1.     7287

STATION ID ON PRECIP. DATA INPUT FILE = 7287
REQUESTED STATION ID =     7287  CHECK TO BE SURE THEY MATCH.

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
Note, 15-min. data are being processed, but hourly
print-out, summaries, and statistics are based on
hourly totals only.  Data placed on interface file
are at correct 15-min. intervals.
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
```

```
##################################################
# Entry made to the Runoff Block, last updated by #
# Oregon State University, and Camp, Dresser and  #
# McKee, Inc., March 2002.                        #
##################################################
# "And wherever water goes, amoebae go along for  #
#  the ride"                    Tom Robbins       #
##################################################

Snowmelt parameter - ISNOW.....................          0
Number of rain gages - NRGAG...................          1
Horton infiltration equation used - INFILM.....          2
Maximum infiltration volume is limited to RMAXINF input on  subcatchment lines.
Infiltration volume regenerates during  non rainfall periods.
Quality is simulated - KWALTY..................          1
IVAP is negative.  Evaporation will be set to zero
    during time steps with rainfall.
Read evaporation data on line(s) F1 (F2) - IVAP..          1
Hour of day at start of storm - NHR............          1
Minute of hour at start of storm - NMN.........          1
Time TZERO at start of storm (hours)...........      1.017
Use Metric units for I/O - METRIC..............          1
 ===> Ft-sec units used in all internal computations
Runoff input print control...                             0
Runoff graph plot control....                             1
Runoff output print control..                             0
Print headers every 50 lines - NOHEAD (0=yes, 1=no)       0
Print land use load percentages -LANDUPR (0=no, 1=yes)    0
Limit number of groundwater convergence messages to 10000 (if simulated)
Month, day, year of start of storm is:             1/ 1/1971
Wet time step length (seconds).......                 300.
Dry time step length (seconds).......                 900.
Wet/Dry time step length (seconds)...                 450.
Simulation length is.....                      20051231.0 Yr/Mo/Dy
Percent of impervious area with zero detention depth    25.0
Horton infiltration model being used
Rate for regeneration of infiltration = REGEN * DECAY
DECAY is read in for each subcatchment
REGEN = ........................................   0.01000

*******************************************************
*   Processed Precipitation will be read from file    *
*******************************************************

  ############################
  #       Data Group F1      #
  # Evaporation Rate (mm/day) #
  ############################

 JAN.  FEB.  MAR.  APR.  MAY   JUN.  JUL.  AUG.  SEP.  OCT.  NOV.  DEC.
 ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----
 0.00  0.00  0.00  2.54  2.54  3.81  3.81  3.81  2.54  2.54  0.00  0.00

*******************************************************
*         C H A N N E L  A N D  P I P E  D A T A       *
*******************************************************

Input   NAMEG:     Drains                          Invert  L Side   R Side  Intial     Max  Mann-   Full
equen  Channel      to     Channel  Width  Length    Slope   Slope    Slope   Depth   Depth   ings   Flow
umber    ID #      NGTO:    Type     (m)    (m)     (m/m)   (m/m)    (m/m)    (m)     (m)   "N"   (cms)
-----  ---------- -------- ------ ------- -------  ------- -------- ------- ------- ------- -----  -----
  1        201        200   Dummy     0.0     0.0    0.0000   0.0000  0.0000     0.0     0.0  0.0000 0.00E+00

 ***************************************************
 *          S U B C A T C H M E N T  D A T A       *
 ***************************************************

*NOTE. SEE LATER TABLE FOR OPTIONAL SUBCATCHMENT PARAMETERS*
      SUBCATCH-  CHANNEL      WIDTH     AREA  PERCENT    SLOPE    RESISTANCE  FACTOR    DEPRES. STORAGE(MM) INFILTRATION   DECAY RATE GAGE
MAXIMUM
       MENT NO.  OR INLET       (M)     (HA)  IMPERV.    (M/M)     IMPERV.     PERV.   IMPERV.     PERV.      RATE(MM/HR)     (1/SEC)    NO.
VOLUME
                                                                                                                MAXIMUM MINIMUM
(MM)
 ---  --------   -------- --------- --------  -----   -------    -------  --------    ------    ------     ----   -------  -------  ------ ----
---
  1        300        200    105.36     1.11  71.40    0.0200      0.015     0.250     0.510     5.080    63.50   10.16    0.00055     1
101.60000

TOTAL NUMBER OF SUBCATCHMENTS...              1
TOTAL TRIBUTARY AREA (HECTARES).           1.11
IMPERVIOUS AREA (HECTARES)......           0.79
PERVIOUS AREA (HECTARES)........           0.32
TOTAL WIDTH (METERS)............         105.36
PERCENT IMPERVIOUSNESS.........           71.40

*******************************************************
*      G R O U N D W A T E R   I N P U T   D A T A    *
*******************************************************


    SUB-     CHANNEL     ========== E L E V A T I O N S ========  =========== F L O W   C O N S T A N T S ===========
    CATCH         OR      GROUND  BOTTOM   STAGE     BC      TW       A1         B1       A2         B2        A3
    NUMBER     INLET        (M)     (M)     (M)     (M)     (M) (MM/HR-M^B1)          (MM/HR-M^B2)          (MM/HR-M^2)
    ------     -----     -------  ------  ------  ------  ------ -----------  ------- -----------  ------- -----------
         0       602        3.05    0.00    0.00    0.61    0.61  3.484E-04    2.600   0.000E+00    1.000    0.00E+00
```

```
*********************************************************
* G R O U N D W A T E R   I N P U T   D A T A (CONTINUED) *
*********************************************************

              S O I L   P R O P E R T I E S
                      SATURATED                                        PERCOLATION     E T  P A R A M E T E R S
      SUBCAT.           HYDRAULIC  WILTING  FIELD   INITIAL     MAX. DEEP   PARAMETERS         DEPTH  FRACTION OF ET
      NO.   POROSITY CONDUCTIVITY  POINT  CAPACITY MOISTURE   PERCOLATION   HCO    PCO        OF ET  TO UPPER ZONE
                        (mm/hr)                                  (mm/hr)                      (m)
     ----   ------     -------    ------  ------   ------    ----------  ------ ------     ------      ------
        0    .4000     127.000     .1500   .3000    .3000     5.080E-02  10.00   4.57       4.27       0.350

*********************************************************
*    Arrangement of Subcatchments and Channel/Pipes     *
*********************************************************
* See second subcatchment output table for connectivity *
* of subcatchment to subcatchment flows.                *
*********************************************************
   Channel
   or Pipe
       201     No Tributary Channel/Pipes
               No Tributary Subareas.....

    INLET
       200     Tributary Channel/Pipes...        201
               Tributary Subareas........        300

*********************************************************
* Hydrographs will be stored for the following   1 INLETS *
*********************************************************
          200

###################################################
#              Quality Simulation                 #
###################################################
#      General Quality Control Data Groups        #
###################################################

 Description                            Variable       Value
 -----------                            --------       -----

 Number of quality constituents.....    NQS.......         1

 Number of land uses.................   JLAND.......       1

 Standard catchbasin volume.........    CBVOL.......      1.22 cubic meters

 Erosion is not simulated.........      IROS........         0

 DRY DAYS PRIOR TO START OF STORM...    DRYDAY.......      3.00 DAYS

 DRY DAYS REQUIRED TO RECHARGE
 CATCHBASIN CONCENTRATION TO
 INITIAL VALUES..................... DRYBSN.......      5.00 DAYS

 DUST AND DIRT
 STREET SWEEPING EFFICIENCY......... REFFDD.......     0.300

 DAY OF YEAR ON WHICH STREET
 SWEEPING BEGINS.................... KLNBGN.......       120

 DAY OF YEAR ON WHICH STREET
 SWEEPING ENDS...................... KLNEND.......       270


##########################################
#     Land use data on data group J2     #
##########################################

                                                                  LIMITING                          CLEANING  AVAIL.    DAYS SINCE
                                                                  BUILDUP    BUILDUP  BUILDUP       INTERVAL  FACTOR      LAST
AND USE   BUILDUP EQUATION TYPE   FUNCTIONAL DEPENDENCE OF       QUANTITY   POWER    COEFF.        IN DAYS   FRACTION   SWEEPING
LNAME)            (METHOD)        BUILDUP PARAMETER(JACGUT)    (DDLIM)    (DDPOW)  (DDFACT)      (CLFREQ)  (AVSWP)    (DSLCL)
-------   --------------------   -------------------------    --------   -------  --------      --------  -------    ---------
Urban De  EXPONENTIAL(1)                  AREA(1)              2.802E+01     0.500    67.250       30.000     0.300     30.000

###############################################
#     Constituent data on data group J3       #
###############################################

                              Total Su
                              --------
Constituent units........      mg/l
Type of units............          0
KALC.....................          2
Type of buildup calc.....    EXPONENTIAL(2)
KWASH....................          0
Type of washoff calc.....  POWER EXPONEN.(0)
KACGUT...................          1
Dependence of buildup....         AREA(1)
LINKUP...................          0
Linkage to snowmelt......   NO SNOW LINKAGE
Buildup param 1 (QFACT1).         28.020
Buildup param 2 (QFACT2).          0.500
Buildup param 3 (QFACT3).         67.250
Buildup param 4 (QFACT4).          0.000
Buildup param 5 (QFACT5).          0.000
Washoff power (WASHPO)...          1.100
Washoff coef. (RCOEF)....          0.086
Init catchb conc (CBFACT)        100.000
Precip. conc. (CONCRN)...          0.000
Street sweep effic (REFF)          0.300
Remove fraction (REMOVE).          0.000
1st order QDECAY, 1/day..          0.000
Land use number.........              1
```

```
************************************************
* Constant Groundwater Quality Concentration(s) *
************************************************

 Total Susp has a concentration of..    0.0000   mg/l

************************************************
* REMOVAL FRACTIONS FOR SELECTED CHANNEL/PIPES *
* FROM J7 LINES                                *
************************************************

  CHANNEL/   CONSTITUENT
     PIPE Total Susp
----------  --------
       201     0.000

*****************************************************
*     Subcatchment surface quality on data group L1 *
*****************************************************

                                Total   Number   Input
                        Land    Gutter     of    Loading
                Land     Use    Length   Catch-  load/ha
           No.  Usage    No.      Km     Basins   Total Su
        ------ --------  ----   -------- --------  -------
   1        300 Urban De  1         0.21     2.00  0.0E+00
   Totals (Loads in kg or other)    0.21     2.00  0.0E+00

    **********************
    *    DATA GROUP M1    *
    **********************

TOTAL NUMBER OF PRINTED GUTTERS/INLETS...NPRNT..        1
NUMBER OF TIME STEPS BETWEEN PRINTINGS..INTERV..        0
STARTING AND STOPPING PRINTOUT DATES.....               0        0

    **********************
    *    DATA GROUP M3    *
    **********************

CHANNEL/INLET PRINT DATA GROUPS......       -200

          ****************************************
          * Rainfall from Nat. Weather Serv. file  *
          * in units of hundredths of an inch      *
          ****************************************

Rainfall Station    St. Catherines A
State/Province      Ontario

Rainfall Depth Summary (mm)
Year     Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec    Total
1971.     31.    0.    0.    0.    0.    0.  126.   93.   52.   60.   29.    0.    391.
1972.      0.    0.    0.   47.   65.  100.   39.  115.   63.   90.    1.    0.    521.
1973.      0.    0.    0.  103.   77.   71.   53.   29.   63.  139.    0.    0.    534.
1974.      0.    0.    0.   67.  105.   62.   50.   31.   74.   37.  110.    0.    536.
1975.      0.    0.    0.    0.    0.   94.   78.   76.   73.   56.   59.    6.    442.
1976.      0.    0.    0.  119.  136.   87.  101.   60.   72.   73.   13.    1.    662.
1977.      0.    0.    0.   94.   29.   69.   57.  150.  230.   71.    0.    1.    701.
1978.      0.    0.    0.   72.   43.   72.   43.   86.  156.   95.    0.    0.    567.
1979.      0.    0.    0.   84.   92.   33.   91.   88.   84.  129.   71.    0.    673.
1980.      0.    0.    0.   81.   39.  122.   60.   32.   79.   96.   45.    0.    554.
1981.      0.    0.    0.   91.   71.  106.  122.   61.  123.   91.   84.    0.    749.
1982.      0.    0.    0.   28.   65.   97.   36.   66.   82.   25.  143.    0.    544.
1983.      0.    0.    0.   78.  100.   65.   55.  106.   75.  122.   92.    0.    694.
1984.      0.    0.    0.   31.  113.  136.   19.   51.  144.   24.   44.    0.    562.
1985.      0.    0.   67.   32.   52.   64.   40.   94.   42.  109.    0.    1.    501.
1986.      0.    0.    0.   93.  113.   60.   85.   83.   98.   80.   43.   65.    719.
1987.      0.    2.   11.   77.   42.   80.  122.   97.   99.   71.   94.   34.    730.
1988.      0.    0.   41.   71.   42.   21.  110.   82.   70.   68.   75.    5.    585.
1989.      0.    0.   13.   63.  137.  108.   36.   45.   89.   73.   84.    0.    647.
1990.      0.    2.   38.   99.  124.   44.   68.   95.   56.  112.   96.    0.    735.
1991.      0.    0.   86.  124.   67.   31.   85.   57.   79.   64.   61.   28.    682.
1992.      0.    0.   29.  127.   56.   92.  185.  116.   77.   47.  103.   38.    869.
1993.      3.    0.    7.   83.   56.   86.   32.   61.   71.   92.   80.   38.    610.
1994.      0.    0.   44.   88.  105.  124.   48.   77.  117.   15.    0.   15.    633.
1995.    112.   23.   16.   48.   37.   60.  123.   66.    8.  137.   94.    0.    724.
1998.      0.    0.    0.    0.   51.   54.   64.   29.    9.    0.    1.    0.    207.
1999.      0.    0.    0.   79.   59.   35.   61.   58.  116.   78.    0.    0.    487.
2000.      0.    0.    0.  123.  134.  216.   51.    0.    0.    0.   10.    0.    534.
2001.      0.    0.    0.   56.   88.   45.   25.   30.   81.  129.    0.    0.    454.
2002.      0.    0.    0.   73.  104.   64.   53.   49.   52.   65.    8.    0.    468.
2003.      0.    0.    0.   10.  163.   77.   81.   64.   67.   73.    2.    0.    537.
2004.      0.    0.    0.  131.  126.   99.  115.   40.   88.   17.    0.    0.    616.
2005.      0.    0.    0.   38.   42.   78.   53.  120.  112.    0.    0.    0.    443.
Total Rainfall Depth for Simulation Period    19310. (mm)

Rainfall Intensity Analysis (mm/hr)
(mm/hr)   (#)       (%)       (mm)       (%)
  2.50  21481      74.6      6454.      33.4
  5.00   3585      12.4      3088.      16.0
  7.50   1973       6.8      2886.      14.9
 10.00    575       2.0      1233.       6.4
 12.50    389       1.4      1070.       5.5
 15.00    194       0.7       660.       3.4
 17.50    210       0.7       846.       4.4
 20.00     66       0.2       306.       1.6
 22.50     92       0.3       487.       2.5
 25.00     39       0.1       232.       1.2
 27.50     37       0.1       246.       1.3
 30.00     34       0.1       245.       1.3
 32.50     29       0.1       228.       1.2
 35.00      5       0.0        42.       0.2
 37.50     10       0.0        90.       0.5
 40.00     10       0.0        97.       0.5
```

```
 42.50     12       0.0      124.       0.6
 45.00      9       0.0       99.       0.5
 47.50      1       0.0       12.       0.1
 50.00      3       0.0       37.       0.2
>50.00     49       0.2      829.       4.3
Total # of Intensities  28803

Daily Rainfall Depth Analysis (mm)
  (mm)     (#)       (%)      (mm)       (%)
  2.50    1077      38.9     1247.       6.5
  5.00     507      18.3     1850.       9.6
  7.50     326      11.8     2006.      10.4
 10.00     226       8.2     1958.      10.1
 12.50     150       5.4     1672.       8.7
 15.00     111       4.0     1495.       7.7
 17.50     100       3.6     1620.       8.4
 20.00      67       2.4     1260.       6.5
 22.50      45       1.6      958.       5.0
 25.00      37       1.3      881.       4.6
 27.50      23       0.8      609.       3.2
 30.00      20       0.7      575.       3.0
 32.50      20       0.7      631.       3.3
 35.00      12       0.4      405.       2.1
 37.50       8       0.3      290.       1.5
 40.00       9       0.3      350.       1.8
 42.50       4       0.1      165.       0.9
 45.00       4       0.1      173.       0.9
 47.50       2       0.1       91.       0.5
 50.00       4       0.1      192.       1.0
>50.00      15       0.5      882.       4.6
Total # Days with Rain   2767

************************************************
*      End of time step DO-loop in Runoff      *
************************************************

Final Date (Mo/Day/Year)   =                  1/ 1/2006
Total number of time steps =                    2056443
Final Julian Date  =                            2006001
Final time of day  =                                  4. seconds.
Final time of day  =                                0.00   hours.
Final running time =                           306816.0000   hours.
Final running time =                            12784.0000    days.

************************************************
*     Extrapolation Summary for Watersheds       *
* # Steps ==> Total Number of Extrapolated Steps *
* # Calls ==> Total Number of OVERLND Calls      *
************************************************

 Subcatch   # Steps   # Calls  Subcatch   # Steps   # Calls  Subcatch   # Steps   # Calls
 --------   -------   -------  --------   -------   -------  --------   -------   -------
      300   6235766   1593298

************************************************
*     Extrapolation Summary for Channel/Pipes    *
* # Steps ==> Total Number of Extrapolated Steps *
* # Calls ==> Total Number of GUTNR Calls       *
************************************************

Chan/Pipe   # Steps   # Calls Chan/Pipe   # Steps   # Calls Chan/Pipe   # Steps   # Calls
 --------   -------   -------  --------   -------   -------  --------   -------   -------
      201         0         0

*********************************************
*       Continuity Check for Surface Water  *
*********************************************
                                                                Millimeters over
                                                cubic meters    Total Basin
Total Precipitation (Rain plus Snow)                213813.      19263.
Total Infiltration                                   60869.       5484.
Total Evaporation                                    15911.       1433.
Surface Runoff from Watersheds                      138216.      12452.
Total Water remaining in Surface Storage                 0.          0.
Infiltration over the Pervious Area...               60869.      19174.
                    --------
Infiltration + Evaporation +
Surface Runoff + Snow removal +
Water remaining in Surface Storage +
Water remaining in Snow Cover.........              214996.      19369.
Total Precipitation + Initial Storage.              213813.      19263.

The error in continuity is calculated as
*************************************
* Precipitation + Initial Snow Cover  *
*      - Infiltration -               *
*Evaporation - Snow removal -         *
*Surface Runoff from Watersheds -     *
*Water in Surface Storage -           *
*Water remaining in Snow Cover        *
*-----------------------------------*
* Precipitation + Initial Snow Cover  *
*************************************
Error.................................       -0.554 Percent

*********************************************
*       Continuity Check for Channel/Pipes  *
*********************************************
                                                                Millimeters over
                                                cubic meters    Total Basin
Initial Channel/Pipe Storage.................            0.          0.
Final Channel/Pipe Storage...................            0.          0.
Surface Runoff from Watersheds...............       138216.      12452.
Baseflow.....................................            0.
Groundwater Subsurface Inflow................            0.          0.
```

```
Evaporation Loss from Channels.............                  0.        0.
Channel/Pipe/Inlet Outflow.................              138216.     12452.
Initial Storage + Inflow...................              138216.     12452.
Final Storage + Outflow....................              138216.     12452.
*******************************************
* Final Storage + Outflow + Evaporation  - *
* Watershed Runoff - Groundwater Inflow  - *
*     Initial Channel/Pipe Storage         *
*     ---------------------------------    *
*  Final Storage + Outflow  + Evaporation  *
*******************************************
Error.....................................      0.000 Percent

*************************************************
*     Continuity Check for Subsurface Water     *
*************************************************

                                                              Millimeters over
                                                cubic meters  Subsurface Basin

Total Infiltration                                       0.        0.
Total Upper Zone ET                                      0.        0.
Total Lower Zone ET                                      0.        0.
Total Groundwater flow                                   0.        0.
Total Deep percolation                                   0.        0.
Initial Subsurface Storage                           10149.      914.
Final Subsurface Storage                             10149.      914.
Upper Zone ET over Pervious Area                         0.        0.
Lower Zone ET over Pervious Area                         0.        0.

***************************************
* Infiltration + Initial Storage - Final *
* Storage - Upper and Lower Zone ET -    *
* Groundwater Flow - Deep Percolation    *
* -------------------------------------- *
*     Infiltration + Initial Storage     *
***************************************
Error .....................................     0.000 Percent
```

SUMMARY STATISTICS FOR SUBCATCHMENTS

SUBCATCHMENT NO.	GUTTER OR INLET NO.	AREA (HA)	PERCENT IMPER.	TOTAL SIMULATED RAINFALL (MM)	PERVIOUS AREA TOTAL RUNOFF DEPTH (MM)	PERVIOUS AREA TOTAL LOSSES (MM)	PERVIOUS AREA PEAK RUNOFF RATE (CMS)	IMPERVIOUS AREA RUNOFF DEPTH (MM)	IMPERVIOUS AREA PEAK RUNOFF RATE (CMS)	TOTAL SUBCATCHMENT AREA RUNOFF DEPTH (MM)	TOTAL SUBCATCHMENT AREA PEAK RUNOFF RATE (CMS)	TOTAL SUBCATCHMENT AREA PEAK UNIT RUNOFF (MM/HR)
300	200	1.11	71.419	262.47	88.446********		0.093	174.330	0.431	12449.131	0.524	171.480

*** NOTE *** IMPERVIOUS AREA STATISTICS AGGREGATE IMPERVIOUS AREAS WITH AND WITHOUT DEPRESSION STORAGE

SUMMARY STATISTICS FOR CHANNEL/PIPES

CHANNEL NUMBER	FULL FLOW (CMS)	FULL VELOCITY (M/S)	FULL DEPTH (M)	MAXIMUM COMPUTED INFLOW (CMS)	MAXIMUM COMPUTED OUTFLOW (CMS)	MAXIMUM COMPUTED DEPTH (M)	MAXIMUM COMPUTED VELOCITY (M/S)	TIME OF OCCURRENCE DAY	TIME OF OCCURRENCE HR.	LENGTH OF SURCHARGE (HOUR)	MAXIMUM SURCHARGE VOLUME (CU-M)	RATIO OF MAX. TO FULL FLOW	RATIO OF MAX. DEPTH TO FULL DEPTH
201				0.00				1/ 0/1900	0.00				
200				0.52				8/14/1972	14.25				

TOTAL NUMBER OF CHANNELS/PIPES = 2

*** NOTE *** THE MAXIMUM FLOWS AND DEPTHS ARE CALCULATED AT THE END OF THE TIME INTERVAL

```
##########################################################
#             Runoff Quality Summary Page                #
# If NDIM = 0 Units for:   loads    mass rates           #
#             METRIC = 1    lb        lb/sec             #
#             METRIC = 2    kg        kg/sec             #
# If NDIM = 1 Loads are in units of quantity             #
#             and mass rates are quantity/sec            #
# If NDIM = 2 loads are in units of concentration        #
#             times volume and mass rates have units     #
#             of concentration times volume/second       #
##########################################################

Total Su NDIM =  0
METRIC =  2
```

	Total Su
Inputs	
1. INITIAL SURFACE LOAD	24.
2. TOTAL SURFACE BUILDUP	19161.
3. INITIAL CATCHBASIN LOAD	0.
4. TOTAL CATCHBASIN LOAD	0.
5. TOTAL CATCHBASIN AND SURFACE BUILDUP (2+4)	19161.
Remaining Loads	
6. LOAD REMAINING ON SURFACE	9.
7. REMAINING IN CATCHBASINS	0.
8. REMAINING IN CHANNEL/PIPES	0.
Removals	
9. STREET SWEEPING REMOVAL	1636.
10. NET SURFACE BUILDUP (2-9)	17525.
11. SURFACE WASHOFF	17512.

```
12. CATCHBASIN WASHOFF.....         0.
13. TOTAL WASHOFF (11+12).....     17512.
14. LOAD FROM OTHER CONSTITUENTS        0.
15. PRECIPITATION LOAD.....         0.
15a.SUM SURFACE LOAD (13+14+15).    17512.
16. TOTAL GROUNDWATER LOAD.....         0.
16a.TOTAL I/I LOAD.............         0.
17. NET SUBCATCHMENT LOAD
    (15a-15b-15c-15d+16+16a)....    17512.
>>Removal in channel/pipes (17a, 17b):
17a.REMOVE BY BMP FRACTION.....         0.
17b.REMOVE BY 1st ORDER DECAY...        0.
18. TOTAL LOAD TO INLETS........    17512.
19. FLOW WT'D AVE.CONCENTRATION  mg/l
    (INLET LOAD/TOTAL FLOW).....      127.

Percentages
-----------
20. STREET SWEEPING (9/2).......        9.
21. SURFACE WASHOFF (11/2)......       91.
22. NET SURFACE WASHOFF(11/10)..      100.
23. WASHOFF/SUBCAT LOAD(11/17)..      100.
24. SURFACE WASHOFF/INLET LOAD
    (11/18).....................      100.
25. CATCHBASIN WASHOFF/
    SUBCATCHMENT LOAD (12/17)...        0.
26. CATCHBASIN WASHOFF/
    INLET LOAD (12/18).........         0.
27. OTHER CONSTITUENT LOAD/
    SUBCATCHMENT LOAD (14/17)...        0.
28. INSOLUBLE FRACTION/
    INLET LOAD (14/18).........         0.
29. PRECIPITATION/
    SUBCATCHMENT LOAD (15/17)...        0.
30. PRECIPITATION/
    INLET LOAD (15/18).........         0.
31. GROUNDWATER LOAD/
    SUBCATCHMENT LOAD (16/17)...        0.
32. GROUNDWATER LOAD/
    INLET LOAD (16/18).........         0.
32a.INFILTRATION/INFLOW LOAD/
    SUBCATCHMENT LOAD (16a/17)..        0.
32b.INFILTRATION/INFLOW LOAD/
    INLET LOAD (16a/18).........        0.
32c.CH/PIPE BMP FRACTION REMOVAL/
    SUBCATCHMENT LOAD (17a/17)..        0.
32d.CH/PIPE 1st ORDER DECAY REMOVAL/
    SUBCATCHMENT LOAD (17b/17)..        0.
33. INLET LOAD SUMMATION ERROR
    (18+8+6a+17a+17b-17)/17.....        0.

CAUTION. Due to method of quality routing (Users Manual, Appendix IX)
quality routing through channel/pipes is sensitive to the time step.
Large "Inlet Load Summation Errors" may result.
These can be reduced by adjusting the time step(s).
Note: surface accumulation during dry time steps at end of simulation is
not included in totals.  Buildup is only performed at beginning of
wet steps or for street cleaning.

*********************************************************
*            TSS Particle Size Distribution             *
*********************************************************
   Diameter    %     Specific    Settling Velocity   Critical Peclet
     (um)             Gravity        (m/s)                Number


      20.    20.0      2.65         0.000267            0.080977
      60.    20.0      2.65         0.002319            0.160673
     150.    20.0      2.65         0.012234            0.284537
     400.    20.0      2.65         0.047806            0.524584
    2000.    20.0      2.65         0.180097            1.431405

*****************************************************
*                                                   *
*              Summary of TSS Removal               *
*                                                   *
*****************************************************

TSS Removal based on Lab Performance Curve

 Model      Low Q Treated  High Q Treated     Runoff Treated        TSS Removed
   #           (cms)          (cms)               (%)                  (%)

 Unavailabl   0.129          0.129               99.2                 70.7
 HD 4         0.129          0.129               99.2                 80.4
 HD 5         0.129          0.129               99.2                 86.5
 HD 6         0.129          0.129               99.2                 90.5
 Unavailabl   0.129          0.129               99.2                 93.0
 HD 8         0.129          0.129               99.2                 94.6
 HD 10        0.129          0.129               99.2                 97.1
 HD 12        0.129          0.129               99.2                 98.2
```

```
**************************************************
*                                                *
*  Summary of Annual Flow Treatmnet & TSS Removal  *
*                                                *
**************************************************
```

HD 4

Year	Flow Vol (m3)	Flow Treated (m3)	TSS In (kg)	TSS Rem (kg)	TSS Out (kg)	TSS Byp (kg)	Flow Treated (%)	TSS Removal (%)
1971.	14416.	13991.	345.	270.	75.	1.	97.0	78.1
1972.	18519.	17034.	449.	367.	82.	17.	92.0	78.7
1973.	18405.	18405.	490.	395.	95.	0.	100.0	80.6
1974.	18800.	18538.	517.	441.	76.	5.	98.6	84.6
1975.	15941.	15806.	447.	356.	90.	2.	99.2	79.5
1976.	23727.	23287.	557.	454.	103.	9.	98.1	80.2
1977.	25418.	24899.	542.	406.	137.	8.	98.0	73.8
1978.	20291.	20291.	522.	406.	116.	0.	100.0	77.8
1979.	24293.	23921.	590.	482.	108.	5.	98.5	80.9
1980.	19559.	19559.	557.	448.	109.	0.	100.0	80.4
1981.	27015.	27015.	622.	513.	109.	0.	100.0	82.5
1982.	19034.	19034.	506.	422.	83.	0.	100.0	83.5
1983.	25115.	24941.	647.	519.	128.	4.	99.3	79.8
1984.	20208.	20208.	502.	396.	106.	0.	100.0	78.9
1985.	17618.	17618.	493.	402.	90.	0.	100.0	81.7
1986.	25703.	25703.	673.	556.	117.	0.	100.0	82.5
1987.	26580.	26342.	676.	546.	130.	2.	99.1	80.5
1988.	21263.	21248.	567.	468.	99.	0.	99.9	82.5
1989.	23444.	23443.	547.	458.	89.	0.	100.0	83.8
1990.	26576.	26529.	694.	574.	120.	1.	99.8	82.5
1991.	24903.	24892.	649.	533.	116.	0.	100.0	82.1
1992.	31658.	31658.	754.	588.	166.	0.	100.0	78.0
1993.	21528.	21528.	636.	539.	97.	0.	100.0	84.8
1994.	23044.	22476.	519.	384.	134.	8.	97.5	73.0
1995.	26776.	26583.	623.	488.	135.	5.	99.3	77.7
1998.	6917.	6917.	239.	195.	44.	0.	100.0	81.6
1999.	16952.	16952.	484.	398.	86.	0.	100.0	82.3
2000.	19542.	19542.	422.	307.	115.	0.	100.0	72.8
2001.	15453.	15453.	394.	342.	52.	0.	100.0	86.8
2002.	16128.	16128.	461.	384.	76.	0.	100.0	83.5
2003.	18350.	18350.	475.	381.	95.	0.	100.0	80.1
2004.	21992.	21992.	490.	389.	100.	0.	100.0	79.5
2005.	15873.	15552.	371.	279.	92.	2.	98.0	74.8

```
**************************************************
*  Summary of Quantity and Quality Results at    *
*  Location       200  INFlow in cms.            *
*  Values are instantaneous at indicated time step *
**************************************************
```

4336 WILLICK ROAD

Date Mo/Da/Year	Time Hr:Min	Flow cum/s	Total Su mg/l
Flow wtd means.....		0.000	127.
Flow wtd std devs..		0.003	66.
Maximum value.....		0.524	291.
Minimum value.....		0.000	0.
Total loads.....		138184.	17522.
		Cub-Met	KILOGRAM

===> Runoff simulation ended normally.

===> SWMM 4.4 simulation ended normally.
Always check output file for possible warning messages.

```
**************************************************
*       SWMM 4.4    Simulation Date and Time Summary  *
**************************************************
* Starting Date... July        1, 2025               *
*          Time...          9:15: 0. 50              *
*   Ending Date... July        1, 2025               *
*          Time...          9:15: 2.868              *
*  Elapsed Time...               0.047 minutes.      *
*  Elapsed Time...               2.818 seconds.      *
**************************************************
```

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

APPENDIX E

Oil/Grit Sample Inspection Report

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

SAMPLE INSPECTION REPORT

Owner:

Location:

Manhole Oil/Grit Separator:

Type of Inspection ☐ Monthly ☐ Annually ☐ Special

Inlet/Outlet Information

	Inlet		Outlet	
Clear of Debris	☐ Yes	☐ No	☐ Yes	☐ No
Build Up of Sediment	☐ Yes	☐ No	☐ Yes	☐ No

Action Taken:

Sediment Tank Information

A. Manhole Sump Depth: ± m from cover rim (to be as-constructed verified)

B. Measurement from Rim to Sediment Level: m

C. Depth of Sediment: m (A - B)

Note: If the measured depth of sediment is greater than **200mm** then sediment removal is required.

Presence of Contaminants

Oil	☐ Yes	☐ No	Depth	m
Foam	☐ Yes	☐ No	Depth	m

Action Taken:

Name of Regulatory Agency Telephone No.:

Transaction No.:

Name of Licensed Waste Management Collector Telephone No.:

Transaction No.:

Owner Notification ☐ Yes ☐ No Other:

Time: Date:

Name of Inspector:

Signed: Date:

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

APPENDIX F

4336 Willick Road Floodplain Assessment (UCC, 2025)

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

Upper Canada
Planning &
Engineering Ltd.
3-30 Hannover Drive
St. Catharines, ON
L2W 1A3
Phone 905-688-9400
Fax 905-688-5274

100 YEAR FLOODPLAIN ANALYSIS

4336 Willick Road
City of Niagara Falls
October 19, 2025

INTRODUCTION

Upper Canada Planning & Engineering Ltd. (UCC) has been retained to provide an analysis of the 100 Year Floodplain within Hunters Drain at 4336 Willick Road in the City of Niagara Falls, in support of the current application for Zoning Bylaw Amendment and Draft Plan of Vacant Land Condominium on the property. The subject property is located on the south side of Willick Road, west of Sodom Road, and east of Emerald Avenue.

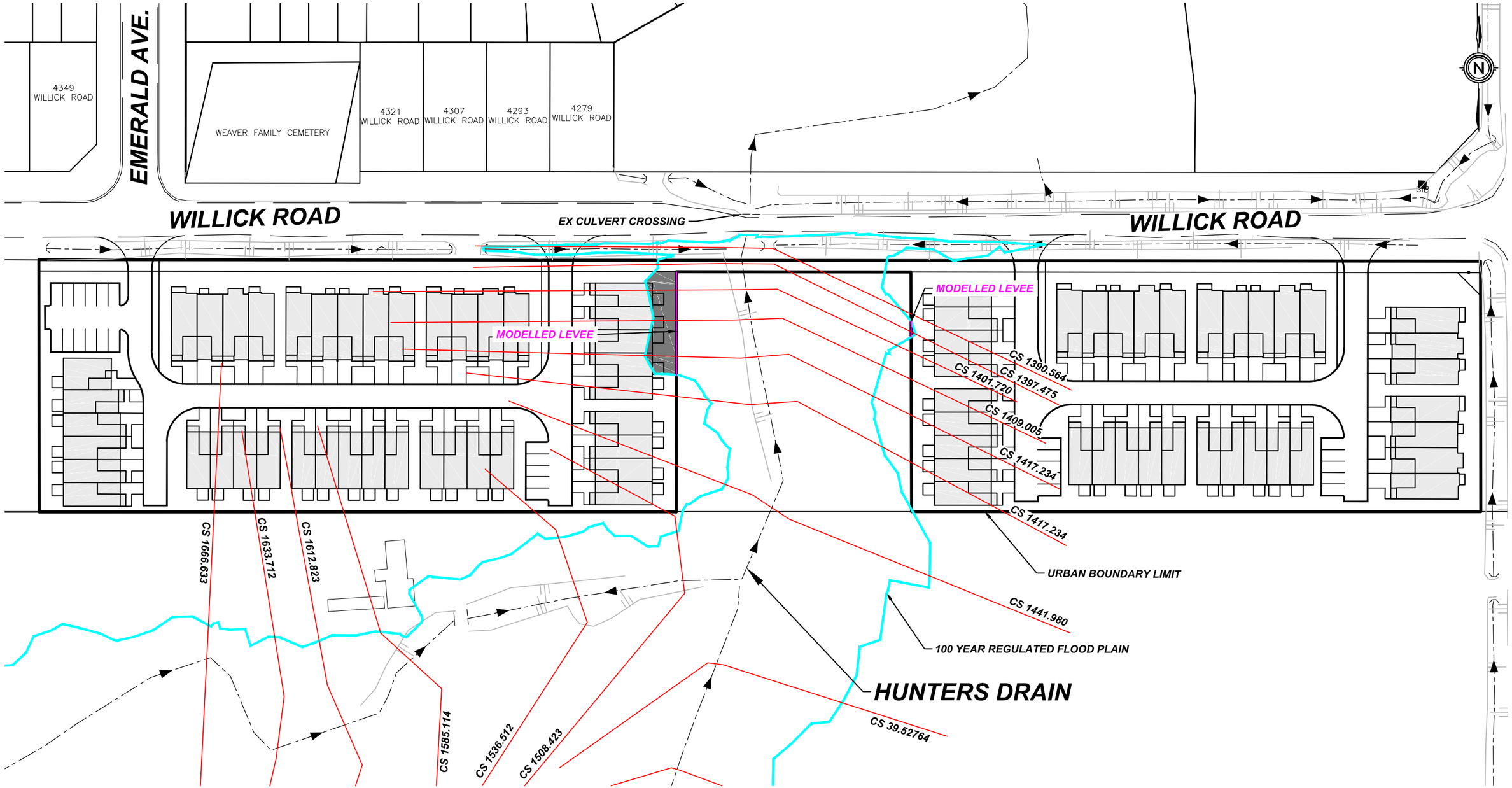
A Floodplain Mapping Study was prepared by the NPCA for Hunters Drain in 2008 which delineated the existing stormwater drainage areas, peak 100 year stormwater flows, the regulated 100 year floodplain extents within the watercourse up to the outlet into the Welland River, and included a detailed HEC-RAS Hydraulic Model with elevation data provided from the NPCA's Digital Terrain Model (DTM).

UCC recently prepared a detailed topographical survey of the subject property with GPS survey equipment and note that there is a discrepancy between the elevations in UCC's detailed topographical survey and the NPCA's DTM resulting from the elevation datums used in the DTM and UCC's GPS survey equipment.

In UCC's assessment of the subject property, the overall elevation difference amounts to the DTM being 0.40m higher than UCC's topographical survey. Therefore, for the purposes of this assessment the 100 floodplain elevations reported from the HEC-RAS modelling will be adjusted by -0.40m when determining the floodplain extents within the subject property.

As shown in Figure 1, it is proposed to develop the subject property as a residential condominium containing future townhouse dwellings on either side of Hunters Drain. To determine the impact of the proposed development limits on the existing 100 year floodplain, a levee was added to the HEC-RAS modelling along the proposed development limits on Cross Sections 1401.720,1409.005, 1417.234, and 1427.977.

The existing and modified floodplain elevations within the subject property are summarized below in Table 1.



UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

4336 WILLICK ROAD

CITY OF NIAGARA FALLS

FLOODPLAIN ASSESSMENT

DATE	2025–10–20
SCALE	1:1000 m
REF No.	***24002***
DWG No.	***FIGURE 1***

Table 1. Existing vs Modified 100 Year Floodplain Elevations			
Cross-section ID	**Flood Elevation (m)**		**Change (m)**
	Existing Model	**Modified Model**	
1397.475	175.50	175.50	0.00
1401.720	175.50	175.50	0.00
1409.005	175.51	175.50	0.00
1417.234	175.51	175.51	0.00
1427.977	175.51	175.51	0.00
1441.980	175.52	175.52	0.00
1476.408	175.53	175.53	0.00
1508.423	175.54	175.54	0.00
1536.512	175.57	175.57	0.00
1585.114	175.67	175.67	0.00
1612.823	175.69	175.69	0.00
1633.712	175.72	175.72	0.00
1666.633	175.73	175.73	0.00

As shown in Table 1, the future 100 year floodplain elevations across the subject property show no change as a result of the proposed development limits. Therefore, there is expected to be no negative impacts to adjacent or downstream lands as a result of the proposed development.

Table 2 below summarizes the floodplain elevations to be referenced against the NPCA's DTM Datum and the datum utilized in UCC's GPS Equipment.

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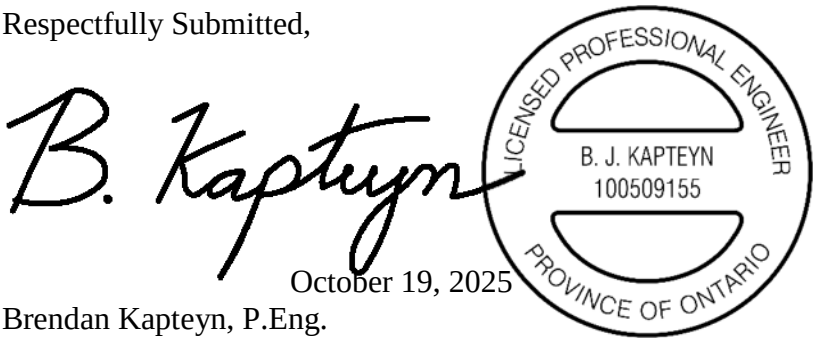
Table 5. NPCA DTM Datum to UCC GPS Datum Comparison		
Cross-section ID	**NPCA DTM Datum**	**UCC GPS Datum**
1397.475	175.50	175.90
1401.720	175.50	175.90
1409.005	175.51	175.91
1417.234	175.51	175.91
1427.977	175.51	175.91
1441.980	175.52	175.92
1476.408	175.53	175.93
1508.423	175.54	175.94
1536.512	175.57	175.97
1585.114	175.67	176.07
1612.823	175.69	176.09
1633.712	175.72	176.12
1666.633	175.73	176.13

We trust the above is satisfactory for approval. If you have any questions or require additional information, please do not hesitate to contact our office.

Respectfully Submitted,



October 19, 2025
Brendan Kapteyn, P.Eng.

Encl.