UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

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File: 2278

# FUNCTIONAL SERVICING REPORT

## Mountain Road Condo
## Niagara Falls
## June 2023

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## INTRODUCTION

Upper Canada Consultants has been retained to undertake and provide a Functional Servicing Report to address the servicing needs and requirements as part of the Zoning By-law Ammendment submission for the proposed development. The project site is located at the south-west corner of the intersection of Mountain Road (Regional Road 101) and St. Paul Avenue (Regional Road 100) with an entrance off Mountain Road. A Hydro One corridor acts as the south limit of the site. The development site has historically been undeveloped vacant land.

As part of the site development, it is proposed to construct a 6-storey apartment building containing 70 residential units on the approximately 1.02 hectare property. The development will include associated asphalt parking lot, concrete curb, catch basins, and storm sewers.

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 200mm diameter municipal watermain located on the north side of Mountain Road (Regional Road 101) fronting the proposed development site as well as an existing service provided to the property line. Due to the size of this development, it is proposed to connect a 150mm diameter service to provide domestic supply and fire protection for the apartment building. An internal sprinkler system will provide fire protection for the proposed building with a fire department connection located within suitable distance to a fire hydrant. An existing hydrant on the north side of Mountain Road fronting the site will provide additional fire protection.

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## SANITARY SERVICING

There is an existing 250mm diameter municipal PVC sanitary sewer located on Mountain Road (Regional Road 101) conveying flows westerly with a maintenance hole acting as the eastern limit located approximately 20m west of the western property line. According to plans provided by the City of Niagara Falls, a service was constructed to the property line of the proposed development to provide an outlet for the site.

A sanitary analysis has been conducted as requested by the City of Niagara Falls in order to verify with their modelling that the downstream sanitary system has available capacity for the proposed development. The sanitary analysis (included in Appendix A) utilizes a conservative population density of 3 people per unit, resulting in an overall population of 210 persons on this site. The analysis concludes that a total peak flow of 3.50 L/s will discharge from the proposed development site to the existing Mountain Road sanitary sewer system under future conditions. It is expected that this will be an acceptable addition to the current capacity of the downstream sanitary sewer system.

## STORMWATER MANAGEMENT PLAN

As part of the site development for the proposed development, the following is a summary of the stormwater management plan.

The criteria provided by the City of Niagara Falls and Region of Niagara for this development includes the requirement to control future development stormwater flows to allowable levels from this site for up to and including the 100 year design storm event. It is also required to improve stormwater quality to MECP Normal Protection (70% TSS removal) levels prior to discharge to the existing storm sewer on Mountain Road (Regional Road 101).

### Existing Conditions

There is an existing 300mm diameter storm sewer fronting the site on Mountain Road (Regional Road 101) conveying flows east towards St. Paul Avenue (Regional Road 100) before ultimately being directed north on St. Paul Avenue. Due to the existing profile of the development site, stormwater flows are conveyed north via sheet flow towards the Mountain Road road allowance and stormwater management system under existing conditions at a Runoff Coefficient of 0.20.

### Proposed Conditions

The proposed development will consist of an apartment building and associated parking lot utilizing an on-site stormwater management system to capture stormwater flows prior to discharging directly to the Mountain Road (Regional Road 101) storm sewer system. A large portion (0.45 ha) of the site on the eastern side will remain undeveloped due to existing geotechnical conditions. This area will continue to convey stormwater flows overland towards the Mountain Road unrestricted. Stormwater flows contributed by the proposed building area and associated parking lot will be restricted to allowable levels prior to discharge to the existing storm sewer system up to and including the 100 year design storm event per Regional requirements.

A preliminary calculation has been conducted using the Modified Rational Method and included in Appendix B, to determine the expected amount of storage that will be required on-site to restrict flows to acceptable levels. Table 1 below outlines the peak stormwater flows directed to the Mountain Road storm sewer system under future and existing conditions. All calculations have utilized the City of Niagara Falls IDF Curves for the 5 and 100 year design storm events.

**Table 1. Peak Stormwater Flows**

| Design Storm | Existing Flow (L/s) | Future Flows (L/s) | | | Minimum Storage ($m^3$) |
|---|---|---|---|---|---|
| | | Uncontrolled | Controlled | Allowable | |
| 5 Year | 47.6 | 21.0 | 106.3 | 26.6 | 49.2 |
| 100 Year | 75.9 | 33.5 | 169.7 | 42.4 | 80.1 |

As stated previously, due to the grade of the development site, existing flows rates have been calculated using the entire site area at a Runoff Coefficient of 0.20. Uncontrolled peak flow rates have been determined from the entire eastern portion (approximately 0.45 hectares at Runoff Coefficient of 0.20) of the site that is to remain undeveloped as part of this site plan. The remaining 0.57 hectares will be developed and direct stormwater flows to the on-site stormwater management system at a Runoff Coefficient of 0.80 corresponding to the proposed land use. The minimum storage volumes outlined in Table 1 will be required to future stormwater flows (controlled) to allowable levels prior to discharge to the Mountain Road storm sewer system.

Therefore, it is expected that a minimum storage volume of approximately 80.1$m^3$ will be required on-site to provide adequate quantity controls with the proposed development plan. To limit future stormwater flows from the site to allowable levels, typically a control is placed on the outlet from the site that may include an orifice and site stormwater storage.

To improve stormwater quality levels from this development site, on oil/grit separator is typically proposed. For MECP Normal Protection, oil/grit separators are required to provide a minimum average of 70% TSS removal. The contributing drainage area to the proposed oil/grit separator is 0.57 hectares with an impervious coverage of approximately 90%. The modelling for a Hydroworks unit has indicated that a HD4 will provide 94% TSS overall removal and capture 99.6% of the stormwater flows. Therefore, the Hydroworks HD4 is proposed for this site development. All calculations regarding the quality assessment can be found in Appendix C.

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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 200mm diameter Mountain Road watermain will provide sufficient domestic water supply and fire volume for the proposed development. A proposed 150mm diameter service will be connected to the existing watermain to provide service.

2. Sanitary flows from the proposed development will discharge to the existing 250mm diameter sanitary sewer on Mountain Road.

3. Stormwater quantity controls will be provided to allowable conditions up to and including the 100 year design storm event prior to discharge to the Mountain Road storm sewer.

4. The site extreme stormwater overland route from the road system is to the Mountain Road (Regional Road 101) road allowance and ultimately to St. Paul Avenue (Regional Road 100).

5. Stormwater quality protection will be provided by an oil/grit separator prior to discharge to the existing Mountain Road (Regional Road 101) storm sewer system.

Based on the above and the accompanying calculations, there exists adequate municipal servicing for this 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.

Yours very truly,

Jason Schooley, P.Eng.
June 13, 2023

LICENSED PROFESSIONAL ENGINEER
J. P. SCHOOLEY
PROVINCE OF ONTARIO

Encl.

UPPER CANADA CONSULTANTS
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# APPENDICES

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# APPENDIX A

**Sanitary Sewer Calculation Sheet**

**UPPER CANADA CONSULTANTS**
**3-30 HANNOVER DRIVE**
**ST.CATHARINES, ONTARIO**
**L2W 1A3**

**DESIGN FLOWS**

| | | |
|---|---|---|
| RESIDENTIAL: | 320 | LITRES/PERSON/DAY (AVERAGE DAILY FLOW) |
| INFILTRATION RATE | 0.280 | L / s / ha (M.O.E FLOW ALLOWANCE IS BETWEEN 0.10 & 0.28 L / s / ha) |
| POPULATION DENSI | 3.0 | 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 :** MOUNTAIN ROAD CONDO
**PROJECT NO:** 2278

**SANITARY SEWER DESIGN SHEET**

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

| LOCATION | | | AREA | | POPULATION | | | ACCUMULATED PEAK FLOW | | | | DESIGN FLOW | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ocation and Descriptio** | **From M.H** | **To M.H.** | **Increment (hectares)** | **Accumulated (hectares)** | **Number of Units** | **Population Density (persons/unit)** | **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** |
| **Development** | Site | EX MH | 1.02 | 1.02 | 70 | 3.0 | 210 | 4.14 | 3.22 | 0.28 | 3.50 | 200 | 10.0 | 1.00 | 1.06 | 34.2 | 10.2% |
| | EX MH | EX MH | | 1.02 | | | 210 | 4.14 | 3.22 | 0.28 | 3.50 | 250 | 104.5 | 0.55 | 0.91 | 46.0 | 7.6% |

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# APPENDIX B

**Modified Rational Method – Peak Flows & Volumes – 5 Year Design Storm Event**
**Modified Rational Method – Peak Flows & Volumes – 100 Year Design Storm Event**

# STORM SEWER DESIGN SHEET

**PROJECT: MOUNTAIN ROAD CONDO, CITY OF NIAGARA FALLS**

| | LOCATION | | | | | TIME OF FLOW | | STORMWATER ANALYSIS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **DESCRIPTION** | **FROM M.H.** | **TO M.H.** | **PIPE LENGTH (m)** | **INCREMENT AREA (hectares)** | **TOTAL AREA (hectares)** | **TO UPPER END (min)** | **IN SECTION (min)** | **RUNOFF COEFF** | **SECTION A X R** | **ACCUMLD A x R** | **RAINFALL INTENSITY (mm/hr)** | **PEAK FLOW (L/s)** |
| **EXISTING CONDITIONS** | | | | | | | | | | | | |
| EX | SITE | OUTLET | | 1.02 | 1.02 | 10.00 | 0.00 | 0.200 | 0.204 | 0.204 | 83.954 | 47.6 |
| **FUTURE CONDITIONS** | | | | | | | | | | | | |
| A10 - Uncontrolled | SITE | OUTLET | | 0.45 | 0.45 | 10.00 | 0.00 | 0.200 | 0.090 | 0.090 | 83.954 | 21.0 |
| A10 - Controlled | SITE | OUTLET | | 0.57 | 0.57 | 10.00 | 0.00 | 0.800 | 0.456 | 0.456 | 83.954 | 106.3 |
| ALLOWABLE PEAK OUTFLOW | | | | | | | | | | | | 26.6 |
| PROVIDED OUTFLOW | | | | | | | | | | | | **26.6** |


**DESIGN BY:** **UPPER CANADA CONSULTANTS**
**30 HANNOVER DRIVE, UNIT 3**
**ST. CATHARINES, ON L2W 1A3**
**DESIGN BY:** **J.SCHOOLEY, P.ENG.**
**DATE:** **JUNE 2023**


**RAINFALL PARAMETERS:**

Time to Upper End = 10 min.

City of Niagara Falls - 5 Year IDF Curve

a = 719.50 mm/hr

b = 6.34 minutes

c = 0.77

# Modified Rational Method (MRM) Required Storage Volume

| | |
|---|---|
| Project: | MOUNTAIN ROAD CONDO, NIAGARA FALLS |
| Project No: | 2278 |
| Date: | JUNE 2023 |
| Design By: | J. SCHOOLEY, P.ENG. |
| Description: | STORMWATER MANAGEMENT PLAN |

Storm Event: **City of Niagara Falls - 5 Year IDF Curve**

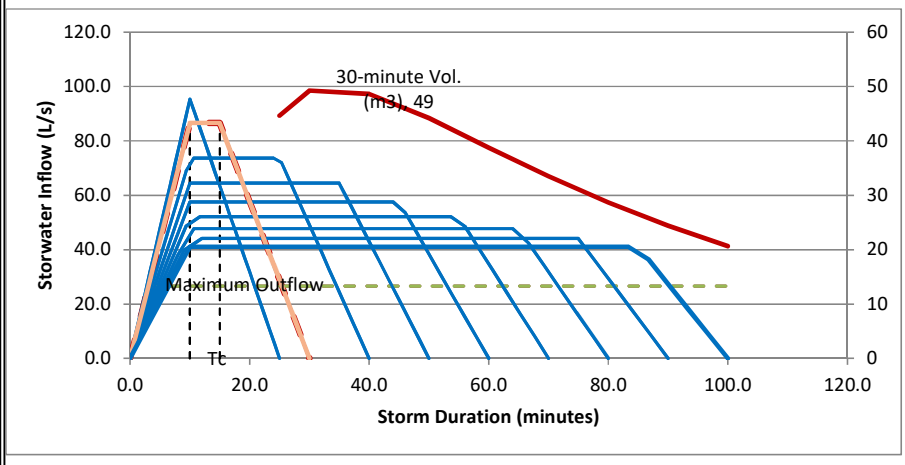
| | | |
|---|---|---|
| a = | 719.50 | mm/hr |
| b = | 6.34 | minutes |
| c = | 0.77 | |

| | | |
|---|---|---|
| Critical Storm Duration: | 30.00 minutes | Tail Multiplier (x1-11.5 |
| Tc From Design: | 10.00 minutes | |
| Storm Tail Time: | 15.00 minutes | |
| Accumulated Area x R (Ha): | 0.456 | <-- Area x Runoff Coefficient (Sewer Design Sheet) |
| Peak Rainfall Intensity: | 68.37 mm/hr | |
| Peak Inflow at Tc: | 86.60 L/s | |
| Maximum Release Rate: | 26.60 | <-- Outlet Full Flow Capacity (Design Sheet) |
| Time When Outlet Exceeded: | 3.07 | |

| Time (min) | Intensity (mm/hr) | Inflow (L/s) | Outflow (L/s) | Interval Volume (m3) | Total Required Volume (m3) |
|---|---|---|---|---|---|
| 0.0 | 0.00 | 0.00 | 26.60 | -1.6 | 0.0 |
| 1.0 | 6.84 | 8.66 | 26.60 | -1.1 | 0.0 |
| 2.0 | 13.67 | 17.32 | 26.60 | -0.6 | 0.0 |
| 3.0 | 20.51 | 25.98 | 26.60 | 0.0 | 0.0 |
| 4.0 | 27.35 | 34.64 | 26.60 | 0.5 | 0.5 |
| 5.0 | 34.19 | 43.30 | 26.60 | 1.0 | 1.5 |
| 6.0 | 41.02 | 51.96 | 26.60 | 1.5 | 3.0 |
| 7.0 | 47.86 | 60.62 | 26.60 | 2.0 | 5.0 |
| 8.0 | 54.70 | 69.28 | 26.60 | 2.6 | 7.6 |
| 9.0 | 61.54 | 77.94 | 26.60 | 3.1 | 10.7 |
| 10.0 | 68.37 | 86.60 | 26.60 | 3.6 | 14.3 |
| 11.0 | 68.37 | 86.60 | 26.60 | 3.6 | 17.9 |
| 12.0 | 68.37 | 86.60 | 26.60 | 3.6 | 21.5 |
| 13.0 | 68.37 | 86.60 | 26.60 | 3.6 | 25.1 |
| 14.0 | 68.37 | 86.60 | 26.60 | 3.6 | 28.7 |
| 15.0 | 68.37 | 86.60 | 26.60 | 3.6 | 32.3 |
| 16.0 | 63.81 | 80.83 | 26.60 | 3.3 | 35.5 |
| 17.0 | 59.26 | 75.06 | 26.60 | 2.9 | 38.5 |
| 18.0 | 54.70 | 69.28 | 26.60 | 2.6 | 41.0 |
| 19.0 | 50.14 | 63.51 | 26.60 | 2.2 | 43.2 |
| 20.0 | 45.58 | 57.74 | 26.60 | 1.9 | 45.1 |
| 21.0 | 41.02 | 51.96 | 26.60 | 1.5 | 46.6 |
| 22.0 | 36.47 | 46.19 | 26.60 | 1.2 | 47.8 |
| 23.0 | 31.91 | 40.42 | 26.60 | 0.8 | 48.6 |
| 24.0 | 27.35 | 34.64 | 26.60 | 0.5 | 49.1 |
| 25.0 | 22.79 | 28.87 | 26.60 | 0.1 | ***49.2*** |
| 26.0 | 18.23 | 23.09 | 26.60 | -0.2 | 49.0 |
| 27.0 | 13.67 | 17.32 | 26.60 | -0.6 | 48.5 |
| 28.0 | 9.12 | 11.55 | 26.60 | -0.9 | 47.6 |
| 29.0 | 4.56 | 5.77 | 26.60 | -1.2 | 46.3 |
| 30.0 | 0.00 | 0.00 | 26.60 | -1.6 | 44.7 |

**Variable Storm Duration Storage Requirements**

| *Duration* | *Max Storage* | *Duration* | *Max Storage* | *Duration* | *Max Storage* |
|---|---|---|---|---|---|
| 25 Min | 44.6 m3 | 50 Min | 44.2 m3 | 80 Min | 28.7 m3 |
| 30 Min | **49.2 m3** | 60 Min | 38.8 m3 | 90 Min | 24.4 m3 |
| 40 Min | 48.6 m3 | 70 Min | 33.5 m3 | 100 Min | 20.6 m3 |



# STORM SEWER DESIGN SHEET

**PROJECT: MOUNTAIN ROAD CONDO, CITY OF NIAGARA FALLS**

| | LOCATION | | | | | TIME OF FLOW | | STORMWATER ANALYSIS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **DESCRIPTION** | **FROM M.H.** | **TO M.H.** | **PIPE LENGTH (m)** | **INCREMENT AREA (hectares)** | **TOTAL AREA (hectares)** | **TO UPPER END (min)** | **IN SECTION (min)** | **RUNOFF COEFF** | **SECTION A X R** | **ACCUMLD A x R** | **RAINFALL INTENSITY (mm/hr)** | **PEAK FLOW (L/s)** |
| **EXISTING CONDITIONS** | | | | | | | | | | | | |
| EX | SITE | OUTLET | | 1.02 | 1.02 | 10.00 | 0.00 | 0.200 | 0.204 | 0.204 | 133.938 | 75.9 |
| **FUTURE CONDITIONS** | | | | | | | | | | | | |
| A10 - Uncontrolled | SITE | OUTLET | | 0.45 | 0.45 | 10.00 | 0.00 | 0.200 | 0.090 | 0.090 | 133.938 | 33.5 |
| A10 - Controlled | SITE | OUTLET | | 0.57 | 0.57 | 10.00 | 0.00 | 0.800 | 0.456 | 0.456 | 133.938 | 169.7 |
| ALLOWABLE PEAK OUTFLOW | | | | | | | | | | | | 42.4 |
| PROVIDED OUTFLOW | | | | | | | | | | | | **42.4** |


**DESIGN BY:** **UPPER CANADA CONSULTANTS**
**30 HANNOVER DRIVE, UNIT 3**
**ST. CATHARINES, ON L2W 1A3**
**DESIGN BY:** **J.SCHOOLEY, P.ENG.**
**DATE:** **MAY 2023**


**RAINFALL PARAMETERS:**
Time to Upper End = 10 min.
City of Niagara Falls - 100 Year IDF Curve

| | | |
|---|---|---|
| a = | 1264.60 | mm/hr |
| b = | 7.72 | minutes |
| c = | 0.78 | |

# Modified Rational Method (MRM) Required Storage Volume

| | |
|---|---|
| Project: | MOUNTAIN ROAD CONDO, NIAGARA FALLS |
| Project No: | 2278 |
| Date: | MAY 2023 |
| Design By: | J. SCHOOLEY, P.ENG. |
| Description: | STORMWATER MANAGEMENT PLAN |

Storm Event: **City of Niagara Falls - 100 Year IDF Curve**

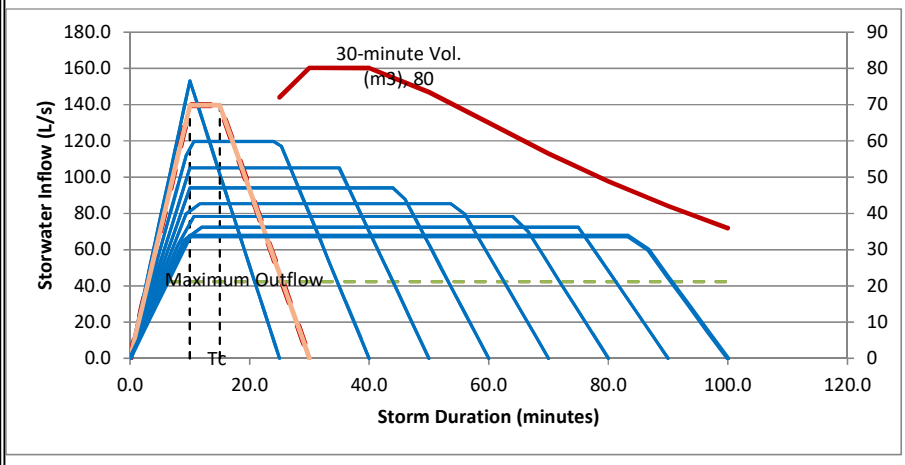
| | | |
|---|---|---|
| a = | 1264.60 | mm/hr |
| b = | 7.72 | minutes |
| c = | 0.78 | |

| | | | |
|---|---|---|---|
| Critical Storm Duration: | 30.00 | minutes | Tail Multiplier (x1-11.5 |
| Tc From Design: | 10.00 | minutes | |
| Storm Tail Time: | 15.00 | minutes | |
| Accumulated Area x R (Ha): | 0.456 | | <-- Area x Runoff Coefficient (Sewer Design Sheet) |
| Peak Rainfall Intensity: | 110.31 | mm/hr | |
| Peak Inflow at Tc: | 139.72 | L/s | |
| Maximum Release Rate: | 42.40 | | <-- Outlet Full Flow Capacity (Design Sheet) |
| Time When Outlet Exceeded: | 3.03 | | |

| Time (min) | Intensity (mm/hr) | Inflow (L/s) | Outflow (L/s) | Interval Volume (m3) | Total Required Volume (m3) |
|---|---|---|---|---|---|
| 0.0 | 0.00 | 0.00 | 42.40 | -2.5 | 0.0 |
| 1.0 | 11.03 | 13.97 | 42.40 | -1.7 | 0.0 |
| 2.0 | 22.06 | 27.94 | 42.40 | -0.9 | 0.0 |
| 3.0 | 33.09 | 41.92 | 42.40 | 0.0 | 0.0 |
| 4.0 | 44.12 | 55.89 | 42.40 | 0.8 | 0.8 |
| 5.0 | 55.15 | 69.86 | 42.40 | 1.6 | 2.5 |
| 6.0 | 66.18 | 83.83 | 42.40 | 2.5 | 4.9 |
| 7.0 | 77.21 | 97.80 | 42.40 | 3.3 | 8.3 |
| 8.0 | 88.24 | 111.78 | 42.40 | 4.2 | 12.4 |
| 9.0 | 99.28 | 125.75 | 42.40 | 5.0 | 17.4 |
| 10.0 | 110.31 | 139.72 | 42.40 | 5.8 | 23.3 |
| 11.0 | 110.31 | 139.72 | 42.40 | 5.8 | 29.1 |
| 12.0 | 110.31 | 139.72 | 42.40 | 5.8 | 34.9 |
| 13.0 | 110.31 | 139.72 | 42.40 | 5.8 | 40.8 |
| 14.0 | 110.31 | 139.72 | 42.40 | 5.8 | 46.6 |
| 15.0 | 110.31 | 139.72 | 42.40 | 5.8 | 52.5 |
| 16.0 | 102.95 | 130.41 | 42.40 | 5.3 | 57.7 |
| 17.0 | 95.60 | 121.09 | 42.40 | 4.7 | 62.5 |
| 18.0 | 88.24 | 111.78 | 42.40 | 4.2 | 66.6 |
| 19.0 | 80.89 | 102.46 | 42.40 | 3.6 | 70.2 |
| 20.0 | 73.54 | 93.15 | 42.40 | 3.0 | 73.3 |
| 21.0 | 66.18 | 83.83 | 42.40 | 2.5 | 75.8 |
| 22.0 | 58.83 | 74.52 | 42.40 | 1.9 | 77.7 |
| 23.0 | 51.48 | 65.20 | 42.40 | 1.4 | 79.1 |
| 24.0 | 44.12 | 55.89 | 42.40 | 0.8 | 79.9 |
| 25.0 | 36.77 | 46.57 | 42.40 | 0.3 | ***80.1*** |
| 26.0 | 29.41 | 37.26 | 42.40 | -0.3 | 79.8 |
| 27.0 | 22.06 | 27.94 | 42.40 | -0.9 | 78.9 |
| 28.0 | 14.71 | 18.63 | 42.40 | -1.4 | 77.5 |
| 29.0 | 7.35 | 9.31 | 42.40 | -2.0 | 75.5 |
| 30.0 | 0.00 | 0.00 | 42.40 | -2.5 | 73.0 |

**Variable Storm Duration Storage Requirements**

| *Duration* | *Max Storage* | *Duration* | *Max Storage* | *Duration* | *Max Storage* |
|---|---|---|---|---|---|
| 25 Min | 72.1 m3 | 50 Min | 73.5 m3 | 80 Min | 48.8 m3 |
| 30 Min | **80.1 m3** | 60 Min | 65.0 m3 | 90 Min | 42.0 m3 |
| 40 Min | 80.1 m3 | 70 Min | 56.5 m3 | 100 Min | 35.9 m3 |



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# APPENDIX C

## Hydroworks Oil/Grit Separator Output File

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```
          ************************************************
          *      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 *
          ************************************************
        Mountain Road Condo
         Niagara Falls
         HydroDome Simulation
       ########################################
       #  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.                        #
```

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```
#################################################
# "And wherever water goes, amoebae go along for  #
#  the ride"                    Tom Robbins     #
#################################################

                  Mountain Road Condo
                  Niagara Falls

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.
ead 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     75.50     0.57  90.00    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).             0.57
IMPERVIOUS AREA (HECTARES)......             0.51
PERVIOUS AREA (HECTARES)........             0.06
TOTAL WIDTH (METERS)............            75.50
PERCENT IMPERVIOUSNESS.........             90.00

*****************************************************
*     U P S T R E A M   S T O R A G E  D A T A      *
*****************************************************
     Storage        Flow
      (m3)         (m3/s)
         0.        0.000
        50.        0.026
        81.        0.042

*****************************************************
*     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) *
*************************************************************
```

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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 | ET PARAMETERS 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  *
**********

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```
  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         0.15     2.00  0.0E+00
  Totals (Loads in kg or other)    0.15     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
===> WARNING !! STORAGE UNIT IS FLOODING.  EXCESS VOLUME CONVEYED AS DISCHARGE
===> WARNING !! STORAGE UNIT IS FLOODING.  EXCESS VOLUME CONVEYED AS DISCHARGE
          ****************************************
          * Rainfall from Nat. Weather Serv. file  *
          * in units of hundredths of an inch      *
          ****************************************
         Mountain Road Condo
         Niagara Falls

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 =                    2056428
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   6222097   1586867

***********************************************
*     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)                  109796.     19263.
Total Infiltration                                     10902.      1913.
Total Evaporation                                      10181.      1786.
Surface Runoff from Watersheds                         89525.     15706.
Total Water remaining in Surface Storage                   0.         0.
Infiltration over the Pervious Area...                 10902.     19126.
                    --------
Infiltration + Evaporation +
Surface Runoff + Snow removal +
Water remaining in Surface Storage +
Water remaining in Snow Cover.........                110607.     19405.
Total Precipitation + Initial Storage.                109796.     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.................................       -0.739 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...........              89525.     15706.
Baseflow.................................                  0.
Groundwater Subsurface Inflow............                  0.         0.
Evaporation Loss from Channels...........                  0.         0.
Channel/Pipe/Inlet Outflow...............              89525.     15706.
Initial Storage + Inflow.................              89525.     15706.
Final Storage + Outflow..................              89525.     15706.
*********************************************
* 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                     5212.       914.
Final Subsurface Storage                       5212.       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
                                                 -------------  ----------------  -------------------------
                                      TOTAL      TOTAL          PEAK              PEAK                PEAK     PEAK
                GUTTER                SIMULATED  RUNOFF TOTAL RUNOFF    RUNOFF    RUNOFF      RUNOFF  RUNOFF   UNIT
SUBCATCH-  OR INLET  AREA  PERCENT  RAINFALL  DEPTH LOSSES  RATE     DEPTH     RATE        DEPTH   RATE    RUNOFF
MENT NO.      NO.    (HA)   IMPER.   (MM)      (MM)   (MM)   (CMS)     (MM)    (CMS)       (MM)   (CMS)   (MM/HR)
-------------------------------------------------------------------------------------------------------------------
     300        200    0.57    90.019262.47   144.677********   0.02317432.369    0.279 15703.600    0.303  192.745
        *** NOTE *** IMPERVIOUS AREA STATISTICS AGGREGATE IMPERVIOUS AREAS WITH AND WITHOUT DEPRESSION STORAGE
                              SUMMARY STATISTICS FOR CHANNEL/PIPES
                              ================================================
                                  MAXIMUM   MAXIMUM   MAXIMUM  MAXIMUM    TIME         LENGTH     MAXIMUM    RATIO OF  RATIO OF
          FULL     FULL      FULL    COMPUTED  COMPUTED  COMPUTED COMPUTED     OF          OF      SURCHARGE   MAX. TO  MAX. DEPTH
CHANNEL  FLOW   VELOCITY    DEPTH    INFLOW    OUTFLOW    DEPTH   VELOCITY OCCURRENCE    SURCHARGE   VOLUME     FULL      TO FULL
 NUMBER  (CMS)    (M/S)      (M)      (CMS)     (CMS)      (M)     (M/S)    DAY   HR.      (HOUR)     (CU-M)     FLOW       DEPTH
-------- ------------------------   ----------------------------------------------------  ---------------------- ------------------
     201                              0.00                                1/ 0/1900  0.00
     200                              0.30                                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........       12.
 2. TOTAL SURFACE BUILDUP.......    11022.
 3. INITIAL CATCHBASIN LOAD.....        0.
 4. TOTAL CATCHBASIN LOAD.......        0.
 5. TOTAL CATCHBASIN AND
    SURFACE BUILDUP (2+4).......    11022.
emaining Loads
--------------
 6. LOAD REMAINING ON SURFACE...        4.
 7. REMAINING IN CATCHBASINS....        0.
 8. REMAINING IN CHANNEL/PIPES..        0.
Removals
--------
 9. STREET SWEEPING REMOVAL.....      827.
10. NET SURFACE BUILDUP (2-9)...    10195.
11. SURFACE WASHOFF.............    10189.
12. CATCHBASIN WASHOFF..........        0.
```

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```
13. TOTAL WASHOFF (11+12).......    10189.
14. LOAD FROM OTHER CONSTITUENTS        0.
15. PRECIPITATION LOAD..........        0.
15a.SUM SURFACE LOAD (13+14+15).    10189.
16. TOTAL GROUNDWATER LOAD......        0.
16a.TOTAL I/I LOAD..............        0.
17. NET SUBCATCHMENT LOAD
    (15a-15b-15c-15d+16+16a)....    10189.
>>Removal in channel/pipes (17a, 17b):
17a.REMOVE BY BMP FRACTION......        0.
17b.REMOVE BY 1st ORDER DECAY...        0.
18. TOTAL LOAD TO INLETS........    10189.
19. FLOW WT'D AVE.CONCENTRATION  mg/l
    (INLET LOAD/TOTAL FLOW).....      114.

Percentages
-----------
20. STREET SWEEPING (9/2).......        7.
21. SURFACE WASHOFF (11/2)......       92.
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
      30.    10.0      2.65         0.000597            0.104277
      50.    10.0      2.65         0.001629            0.143403
     100.    20.0      2.65         0.006044            0.220958
     250.    20.0      2.65         0.026615            0.391296
    1000.    20.0      2.65         0.111334            0.928988

*****************************************************
*                                                   *
*              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   0.040          0.040               99.6                86.9
 HD 4         0.040          0.040               99.6                93.5
 HD 5         0.040          0.040               99.6                96.8
 HD 6         0.040          0.040               99.6                98.4
 Unavailabl   0.040          0.040               99.6                99.2
 HD 8         0.040          0.040               99.6                99.6
 HD 10        0.040          0.040               99.6                99.9
 HD 12        0.040          0.040               99.6                99.9
```

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**********
* *
* 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. | 10793. | 10356. | 200. | 184. | 16. | 0. | 95.9 | 91.9 |
| 1972. | 13729. | 13072. | 270. | 251. | 19. | 1. | 95.2 | 92.4 |
| 1973. | 13927. | 13927. | 287. | 268. | 19. | 0. | 100.0 | 93.4 |
| 1974. | 14171. | 14169. | 308. | 296. | 12. | 0. | 100.0 | 96.1 |
| 1975. | 12122. | 11992. | 261. | 244. | 17. | 1. | 98.9 | 93.3 |
| 1976. | 17930. | 17877. | 327. | 308. | 19. | 1. | 99.7 | 94.0 |
| 1977. | 19210. | 19105. | 313. | 284. | 29. | 1. | 99.5 | 90.5 |
| 1978. | 15492. | 15492. | 302. | 276. | 26. | 0. | 100.0 | 91.5 |
| 1979. | 18371. | 18359. | 343. | 320. | 23. | 0. | 99.9 | 93.2 |
| 1980. | 14785. | 14785. | 328. | 306. | 22. | 0. | 100.0 | 93.3 |
| 1981. | 20604. | 20599. | 361. | 344. | 16. | 0. | 100.0 | 95.4 |
| 1982. | 14564. | 14564. | 297. | 283. | 14. | 0. | 100.0 | 95.3 |
| 1983. | 19212. | 19211. | 378. | 354. | 24. | 0. | 100.0 | 93.6 |
| 1984. | 15393. | 15393. | 290. | 269. | 21. | 0. | 100.0 | 92.7 |
| 1985. | 13417. | 13417. | 290. | 273. | 17. | 0. | 100.0 | 94.0 |
| 1986. | 19594. | 19594. | 394. | 374. | 20. | 0. | 100.0 | 95.0 |
| 1987. | 20245. | 20244. | 394. | 369. | 25. | 0. | 100.0 | 93.7 |
| 1988. | 16169. | 16131. | 331. | 313. | 18. | 0. | 99.8 | 94.6 |
| 1989. | 17896. | 17863. | 315. | 301. | 14. | 0. | 99.8 | 95.5 |
| 1990. | 20366. | 20366. | 404. | 385. | 19. | 0. | 100.0 | 95.3 |
| 1991. | 19026. | 18974. | 377. | 356. | 21. | 0. | 99.7 | 94.3 |
| 1992. | 24178. | 24178. | 430. | 398. | 31. | 0. | 100.0 | 92.8 |
| 1993. | 16380. | 16380. | 377. | 360. | 17. | 0. | 100.0 | 95.4 |
| 1994. | 17409. | 17119. | 302. | 278. | 24. | 1. | 98.3 | 91.6 |
| 1995. | 20403. | 20403. | 361. | 334. | 27. | 0. | 100.0 | 92.4 |
| 1998. | 5091. | 5091. | 146. | 136. | 9. | 0. | 100.0 | 93.7 |
| 1999. | 12855. | 12855. | 284. | 264. | 20. | 0. | 100.0 | 92.9 |
| 2000. | 14916. | 14916. | 239. | 213. | 26. | 0. | 100.0 | 89.1 |
| 2001. | 11733. | 11733. | 233. | 224. | 9. | 0. | 100.0 | 96.2 |
| 2002. | 12206. | 12206. | 272. | 258. | 14. | 0. | 100.0 | 94.7 |
| 2003. | 13926. | 13926. | 278. | 257. | 21. | 0. | 100.0 | 92.3 |
| 2004. | 16718. | 16718. | 282. | 261. | 21. | 0. | 100.0 | 92.5 |
| 2005. | 11918. | 11809. | 215. | 193. | 22. | 0. | 99.1 | 89.8 |

HD 5

| Year | Flow Vol (m3) | Flow Treated (m3) | TSS In (kg) | TSS Rem (kg) | TSS Out (kg) | TSS Byp (kg) | Flow Treated (%) | TSS Removal (%) |
|---|---|---|---|---|---|---|---|---|
| 1971. | 10793. | 10356. | 200. | 191. | 9. | 0. | 95.9 | 95.2 |
| 1972. | 13729. | 13072. | 270. | 261. | 9. | 1. | 95.2 | 96.0 |
| 1973. | 13927. | 13927. | 287. | 276. | 11. | 0. | 100.0 | 96.3 |
| 1974. | 14171. | 14169. | 308. | 303. | 5. | 0. | 100.0 | 98.5 |
| 1975. | 12122. | 11992. | 261. | 252. | 9. | 1. | 98.9 | 96.4 |
| 1976. | 17930. | 17877. | 327. | 316. | 11. | 1. | 99.7 | 96.5 |
| 1977. | 19210. | 19105. | 313. | 296. | 16. | 1. | 99.5 | 94.6 |
| 1978. | 15492. | 15492. | 302. | 288. | 13. | 0. | 100.0 | 95.6 |
| 1979. | 18371. | 18359. | 343. | 328. | 15. | 0. | 99.9 | 95.7 |
| 1980. | 14785. | 14785. | 328. | 315. | 12. | 0. | 100.0 | 96.2 |
| 1981. | 20604. | 20599. | 361. | 354. | 6. | 0. | 100.0 | 98.2 |
| 1982. | 14564. | 14564. | 297. | 293. | 4. | 0. | 100.0 | 98.6 |
| 1983. | 19212. | 19211. | 378. | 366. | 12. | 0. | 100.0 | 96.8 |
| 1984. | 15393. | 15393. | 290. | 281. | 9. | 0. | 100.0 | 96.8 |
| 1985. | 13417. | 13417. | 290. | 284. | 6. | 0. | 100.0 | 97.8 |
| 1986. | 19594. | 19594. | 394. | 386. | 8. | 0. | 100.0 | 98.0 |
| 1987. | 20245. | 20244. | 394. | 381. | 12. | 0. | 100.0 | 96.9 |
| 1988. | 16169. | 16131. | 331. | 323. | 8. | 0. | 99.8 | 97.6 |
| 1989. | 17896. | 17863. | 315. | 308. | 8. | 0. | 99.8 | 97.6 |
| 1990. | 20366. | 20366. | 404. | 396. | 8. | 0. | 100.0 | 98.0 |
| 1991. | 19026. | 18974. | 377. | 365. | 12. | 0. | 99.7 | 96.8 |
| 1992. | 24178. | 24178. | 430. | 414. | 15. | 0. | 100.0 | 96.4 |
| 1993. | 16380. | 16380. | 377. | 371. | 6. | 0. | 100.0 | 98.3 |
| 1994. | 17409. | 17119. | 302. | 288. | 14. | 1. | 98.3 | 95.1 |
| 1995. | 20403. | 20403. | 361. | 345. | 17. | 0. | 100.0 | 95.4 |
| 1998. | 5091. | 5091. | 146. | 141. | 4. | 0. | 100.0 | 97.0 |
| 1999. | 12855. | 12855. | 284. | 275. | 9. | 0. | 100.0 | 96.8 |
| 2000. | 14916. | 14916. | 239. | 224. | 15. | 0. | 100.0 | 93.7 |
| 2001. | 11733. | 11733. | 233. | 229. | 3. | 0. | 100.0 | 98.5 |
| 2002. | 12206. | 12206. | 272. | 266. | 6. | 0. | 100.0 | 97.8 |
| 2003. | 13926. | 13926. | 278. | 268. | 10. | 0. | 100.0 | 96.4 |
| 2004. | 16718. | 16718. | 282. | 272. | 9. | 0. | 100.0 | 96.7 |
| 2005. | 11918. | 11809. | 215. | 203. | 12. | 0. | 99.1 | 94.1 |

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

Mountain Road Condo
Niagara Falls

| Date Mo/Da/Year | Time Hr:Min | Flow cum/s | Total Su mg/l |
|---|---|---|---|
| Flow wtd means..... | | 0.001 | 114. |
| Flow wtd std devs.. | | 0.002 | 208. |
| Maximum value..... | | 0.303 | 4025. |
| Minimum value..... | | 0.000 | 0. |
| Total loads..... | | 89241. | 10192. |

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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... June        9, 2023                *
*          Time...          11:13: 0.475               *
*   Ending Date... June        9, 2023                *
*          Time...          11:13: 3.602               *
*  Elapsed Time...               0.052 minutes.       *
*  Elapsed Time...               3.127 seconds.       *
*******************************************************
```