



Stormwater Management Report

36 Unit Apartment Building 1115 10th Street East, Owen Sound

Owen Sound, Ontario

Submitted to:

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Submitted by:

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March 31, 2025 Project No. 2408466



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Certification

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Record of Revisions

Identification	Date	Description of Issued and/or Revision
SWM Report	March 31, 2025	Issued for Zoning By-law Amendment Application

Statement of Conditions

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1. Introduction

1.1. Background

GEI Consultants Canada Ltd. (formerly GM BluePlan Engineering Limited.) has been retained by Paaji Inc. to provide engineering services in support of the development of a 36 unit apartment building located at 1115 10th Street East Owen Sound. The existing lot was previously a long-term care home with a 979.9m² one story building. The site will be serviced by the storm, water and sanitary sewers along 10th Street East. This report was prepared in support of a Zoning Bylaw Amendment Application.

1.2. Site Description

The site consists of a single-story former long-term care facility located at 1115 10th Street East, with associated parking and landscaped areas. It can be accessed by a driveway from 10th Street East, which is a collector road with a bus stop along the property frontage. The site has a total area of 7,899 m² (1.95 acres) with a depth of approximately 124 m. Residential, commercial, institutional, employment, and vacant residential lands surround the property.

The site is currently serviced with a 100mmØ ductile iron potable water service and a 150mmØ A.C. sanitary service extending out of the Northwest corner of the site. The site is also serviced by a 250mmØ concrete storm pipe per Gamsby and Mannerow Ltd. 10th Street East Plans and Profiles dated March 1975. Figure 1.0 enclosed shows the site location for reference (Appendix A).

1.3. Purpose and Scope

The proposed development seeks to convert the existing single-storey former long-term care facility located at 1115 10th Street East, Owen Sound to a 36-dwelling apartment building complete with a building addition and rehabilitation parking and landscaped areas. The completion of this project will involve the following:

- Conversion of the existing single storey building to contain eleven dwelling units,
- A three-storey addition at the north end of the existing building with:
 - o Seven units on the lower floor,
 - Nine units on the ground floor, and
 - Nine units on the second floor
- A surface parking area containing approximately 45 parking stalls, including two barrier-free stalls, and a loading space. All of which is to be accessed from 10th Street East; and
- Site landscaping



This report and associated hydrological modelling have been prepared to estimate and summarize the existing peak runoff flow rates within the site area discharging to 10th Street East storm conveyance infrastructure and regional drainage corridor directed ultimately to Georgian Bay.

Further, post-development peak runoff flow rate modelling estimations have been completed based upon the construction of the 36-dwelling unit apartment building to validate the 5-Year to 100-Year post-development peak flow rates will be attenuated to the 5-Year existing levels entering the Municipal storm infrastructure upon the completion of the apartment building.

1.4. Stormwater Management Design Criteria

The Stormwater Management Design Criteria established for the site have been established considering such factors as:

- Historic drainage issues around the site-specific area in Owen Sound, including the Right-of-Ways of 10th Street East
- The existing site topography and existing Municipal infrastructure along 10th Street East.
- City of Owen Sound Engineering comments
- City of Owen Sound Site Plan Engineering Standards

Taking into consideration the information noted above, the following SWM Criteria has been developed for the site:

- 1) The SWM Strategy for the site must attenuate the post-development peak runoff flow rates to 5-year existing conditions for the 5-year through 100-year design storms for the 3 to 4-hour Chicago-Owen Sound Site Development Engineering Standards (2021); and
- 2) Mitigate the Total Suspended Solids (TSS) transportation of sediment & deleterious materials offsite pre-construction, during construction and post-construction.
- 3) Per phone conversations with Owen Sound Engineering staff, we have been instructed to attempt to reduce the post-development conditions to 5-year pre-development green field conditions. With the expectation that per Owen Sound Site Development Engineering Standards for infill lots, post-development peak flow levels are not to exceed the 5-year design storm level. This is due to the current surcharging storm system downstream of the subject site.



2. Background Review

2.1. Standards and Guidelines

This report has been prepared recognizing the following Government Guidelines, Provincial and Municipal Standard and Publications:

- <u>Stormwater Management Planning and Design Manual</u>, The Ministry of The Environment, Conservation & Parks (March 2017), (<u>www.ontario.ca</u>)
- <u>MTO Drainage Management Manual</u>, The Ministry of Transportation Ontario, (<u>www.library.mto.gov.on.ca</u>), (October 1997)
- <u>Site Development Engineering Standards</u>, The Owen Sound Engineering Standards, (<u>www.owensound.ca</u>), (February 2021)
- Gery Sauble Conservation Authority (GSCA) General Policies, Development, Interference with Wetlands and Alterations to Shorelines and Watercourses, (May 2009, rev. January 2010), (www.greysauble.on.ca)
- <u>Zoning By-Law (2010-078)</u>, Owen Sound Zoning by-law, (<u>www.owensound.ca</u>), (December 2023); and
- <u>17th Street East Stormwater Management Study</u>, Gamsby and Mannerow Limited, (May 2013)
- <u>10th Street East Plan & Profiles</u>, Gamsby and Mannerow Limited, (March 1975)

2.2. Municipal Zoning & By-Law Considerations

The applicant is proposing to develop a 36-dwelling unit apartment building while renovating the existing long-term care home into eleven-dwelling units. The lot will be serviced via 10th Street East with municipal sanitary, water and storm. The site will have access from 10th Street East through the existing driveway.

A Zoning By-Law Amendment (ZBA) is required to change the lands currently zoned Institutional (I) to General Residential (R5), to permit "Dwellings, Apartments". This designation relates to the runoff coefficients used to model the proposed site conditions.

2.3. Existing Stormwater Drainage and Storm Sewer Infrastructure

The existing drainage patterns of 1115 10th Street East flow generally from south to north with a site area of approximately 0.79 ha. There are two existing catch basins on-site which ultimately outlet into the City's infrastructure noted as CB-2 on Gamsby & Mannerow's Plan & Profiles dated (1975) centered with the existing driveway along the curbline.



The existing CB has been identified as the primary Municipal outlet for the 36-dwelling unit apartment building. This outlet has been identified by GEI Consultants Ltd. as the primary outlet for post-development peak runoff flow rates.

CB-2 is connected to the existing (+/-) 450mmØ concrete storm sewer on the north side of 10th Street East via a (+/-) 250mmØ concrete storm pipe. This (+/-) 250mmØ storm pipe originates from CB-2 and connects to CBMH-B-1 per Gamsby and Mannerow's Plan and Profiles dated March 1975.

It should be noted at this time that per Gamsby and Mannerow's 17th Street East Stormwater Management Study revised May 2013. The city currently has two undersized storm sewer reaches along 10th Street East downstream of 1115 10th Street East. Reaches between 9th Ave E and 10th Ave E (east leg) both of which are over 200% capacity as shown in Table 1 below.

|--|

	%		
Street	From	То	Capacity
10 th Street East	9 th Ave East	10 th Ave E (west leg)	284.6%
10 th Street East	10 th Ave E (west leg)	10 th Ave E (east leg)	238.7%

Due to the lack of capacity in the city's infrastructure downstream of the subject site GEI will propose to match the 5-Year design storm under existing condition peak flow for post-development storm events from 5-Year through to 100-Year. With the goal to attenuate the flow to the 5-Year green field condition. We note that per Owen Sound Site Development Engineering Standards for infill lots, postdevelopment peak flow levels are not to exceed the 5-year design storm level.

The full table and catchment area from Gamsby and Mannerow's 17th Street East Stormwater Management Study can be found in Appendix E for reference.

3. Existing Hydrological Conditions

3.1. Hydrological Modelling using Visual OTTHYMO

Existing condition modelling for the site has been completed using the hydrological modelling software Visual OTTHYMO to estimate peak surface water runoff flow rates for the 5-Year through to 100-Year 3 to 4-Hour Chicago Design Storm Event a long with the Regional (Timmins) Storm Events for the development site draining to the existing 10th Street East storm sewer.

Based on a variety of source maps, including OpenSource LIDAR, aerial imagery, and site-specific topographic survey, the catchment area that directs surface water runoff to the city system on 10th Street East is approximately 0.79 ha.



3.2. Existing Land Use

The drainage catchment area (CA100) contains the abandoned single story long-term care home, with associated parking and landscaped areas. Under existing conditions, catchment 100 generally directs surface runoff from south to north at an average grade 7.7% and a Total imperviousness of approximately 37%. Table 2 below highlights the modelling parameters used.

The existing conditions impervious calculations are enclosed in Appendix B for reference.

Catchment Parameter:	CA100
Catchment Area (ha)	0.79
Total Impervious (%)	37.2
Total Impervious – Directly Connected (%)	37.2
Impervious Slope (%)	7.7
Impervious Flow Length (m)	72.57
Impervious Mannings n	0.013
Pervious Slope (%)	7.7
Pervious Flow Length (m)	124
Pervious Mannings n	0.025

Table 2: Existing Catchment Modelling Parameters

Figure 2 – Existing Catchment Area Plan in Appendix A is included for reference.

3.3. Soil Conditions

For the purposes of the report, the following information was used:

- <u>Soil survey of Grey County Report No. 17</u>, The Ontario Soil Survey; The Canadian Department of Agriculture and the Ontario Agricultural Collage (1954) (<u>https://sis.agr.gc.ca</u>);
- <u>Ontario Agricultural al Maps (AGMaps)</u>, Ministry of Agricultural, Food & Ruhl Affairs (2024), (<u>www.lioapplications.lrc.gov.on.ca</u>)

The on-site soil is classified as Vincent Silty Clay Loam and is characterized as having a Hydrological Soil Group BC.

The drainage of the Vincent Silty Clay Loam is moderate to good. The loam consists of fine-textured limestone till which is slightly stoney. As the proposed storm water management strategy is to install



a stone retention gallery that is capable to contain up to the 100-Year 4-Hour Chicago Design storm event, the percolation time will not affect the overall function of the SWM facility.

3.4. Rainfall Data

The site-specific rainfall data has been established based on the 3 to 4-Hour Chicago Distribution. The pre-development peak runoff flow rate for CA100 has been derived from the Owen Sound Site Development Standards revised (February 2021). A copy of the Owen Sound Site Development Standards (Storm Water Modelling Parameters) is enclosed in Appendix B for reference.

The rainfall intensity for the Otthymo Model was calculated based on the data from the Owen Sound Site Development Standards using the following formula:

$$I = At^B$$

3.5. Existing Peak Runoff Flow Rate Modelling Results

Developing the OTTHYMO model for the existing peak runoff flow rate estimations is based on the criteria established in the previous sections.

Utilizing the current Owen Sound Engineering Development Standards and the catchment characteristics determined, the estimated existing conditions peak runoff flow rates directed to 10th Street East CB-2 are summarized in Table 3 below:

Storm Event	Peak Runoff Flow Rate (m ³ /s)
2-Year	0.068
5-Year	0.097
25-Year	0.149
100-Year	0.192
Regional (Timmins) Storm	0.086

Table 3: Existing Peak Runoff Flow Rates

Detailed modelling results and the existing conditions catchment area schematic are enclosed in Appendix C.

Under Pre-Development "Green Field" Conditions the 5-year design storm peak runoff for the site is 0.029 (m³/s). As stated previously, attenuated post-development conditions meet the 5-year existing conditions peak runoff with the goal to reduce peak runoff to the 5-year green field conditions per City of Owen Sound Engineering Staff comments.

4. Strategic Storm Management (SWM) Strategy

4.1. Post-Development

The proposed stormwater management (SWM) strategy employed to attenuate the postdevelopment peak runoff flow rates will be completed through a private subsurface stone retention gallery system. The peak runoff will be attenuated and released to 10th Street East through a 150mmØ orifice restriction cap on the outlet of CBMH-1. By using the stone retention gallery in the parking lot of the proposed development the flows will be attenuated before being released through an EFO4 Stormceptor to meet the target of 80% of Total Suspended Solids are removed prior to entering the city's storm sewer. Further details relating to the design of the subsurface stone retention gallery is provided in Section 4.4.

4.2. Post-Development Land Use Parameters

Developing the OTTHYMO model for the post-development peak runoff flow rate estimations is based on the criteria established in the previous sections. To estimate the post-development peak runoff flow rates the site was broken down into four (4) catchment areas. Catchment 201 presents the uncontrolled front yard drainage to 10th Street East. As the existing topography of the front yard of the site does not lend itself to practical stormwater management control devices. Catchment 202 represents the front yard parking lot along with catchment 203 representing the rear yard parking lot. With the final catchment 204 representing the backyard drainage swale. The post development impervious calculations are in Appendix B and Figure 3 shows the Post-Development Catchment Area Plan in Appendix A.

Utilizing the Owen Sound Engineering Standards and the catchment characteristics determined, the estimated post-development catchment parameters directed to 10th Street East CB-2 are summarized in Table 4 below.

Catchment Parameter:	CA201	CA202	CA203	CA204
Catchment Area (ha)	0.16	0.32	0.06	0.25
Total Impervious (%)	32.3	82.7	81.8	23.7
Total Impervious – Directly Connected (%)	21.2	82.7	81.8	1.0
Impervious Slope (%)	10	5	5	2
Impervious Flow Length (m)	32.7	46.2	20.0	40.8
Impervious Mannings n	0.013	0.013	0.013	0.013
Pervious Slope (%)	15	2	2	2
Pervious Flow Length (m)	20	3	3	40
Pervious Mannings n	0.025	0.025	0.025	0.025

Table 4: Post-Development Catchment Modelling Parameters



4.3. Post-Development Surface Water Modelling Results

Utilizing the Owen Sound Development Engineering Standards and the catchment characteristics determined, the estimated post-development peak runoff flow rates directed to the 10th Street East storm inlet are summarized in Table 5 below.

	Peak Runoff Flow Rate (m ³ /s)			
Storm Event	CA201	PD206	Total Site	
	(uncontrolled)	(storm facility)		
2-Year	0.014	0.036	0.046 (0.097)	
5-Year	0.021	0.045	0.060 (0.097)	
25-Year	0.034	0.058	0.080 (0.097)	
100-Year	0.045	0.072	0.097 (0.097)	
Regional (Timmins) Storm	0.018	0.058	0.075 (0.097)	

Table 5: Post-Development Peak Runoff Flow Rates

*(0.097) – 5-Year 3-Hour Chicago Design Storm (Existing Hydrological Conditions)

Detailed modelling results and the post-development catchment area schematic are enclosed in Appendix D for reference.

4.4. Sub-Surface Stone Retention Gallery

The stone retention gallery will be constructed in the proposed parking lot of the apartment building and will be privately owned and maintained.

The construction of the gallery will provide a volume of 136 m³ to adequately attenuate the postdevelopment peak runoff flow rates to existing levels.

The proposed stone retention gallery consists of the following parameters:

- Be constructed in a trench with dimensions of 10 m x 2 m (W x D);
- Include a 525 mmØ perforated HDPE pipe with a manufacturer installed filter sock at a slope of 0.5%;
- Include washed clear stone fill with a uniform diameter between 25mm & 52mm and a void ratio of 0.4;
- The bottom and sides of the retention gallery trench is to be wrapped in TeraFix 270R Fabric or approved equivalent with an impermeable membrane across the top to prevent fines from the parking lot entering the retention gallery;
- The north outlet of CBMH-1 will be fitted with a 150 mmØ orifice at an elevation of 232.80 MASL.
- Include an ADS StormTech retention chamber or equivalent to allow for increased storm retention capabilities and access for cleanout.



• The driveway aisle will act as a broad-crested weir (8 m long) running the full width of the driveway entrance at an elevation of 235.35 MASL. This is to act as the spill point under regional storm events. With maximum ponding occurring in the parking lot of 0.05m before over toping the weir under a regional storm event.

The post-development function of the stone retention gallery is demonstrated in Table 6 below.

Table 6: Stone Gallery Function

Design Storm	Storage Used (m ³)	Depth Used (m)
2-Year	41	0.59
5-Year	62	0.91
25-Year	101	1.49
100-Year	134	1.97
Regional (Timmins) Storm	136	2.0

It can be noted, the available storage volume provided for the post-to-existing development peak runoff flow is adequate to attenuate post-development conditions up to the 100-year storm event. As the proposed stone storage is 136 m³, while the 100-Year retention volume of 134 m³ as noted in Table 6 above.

The Stage-Storage-Discharge information and design details are included in Appendix B for reference.

4.5. Site Grading and Drainage

Upon completion of the construction and lot grading for the lot, it is anticipated that the overland drainage from the existing rear year will be directed from west to east into the proposed DICB with a swale grade of 0.5%. This will act as a temporary stormwater management area to further attenuate flows from the rear yard. Under a regional storm event, ponding in the rear yard would eventually overtop into the parking lot and travel north through the parking lot. Runoff would ultimately overtop the weir at the top driveway at 235.35 MASL. Surface water runoff from all storm events including the regional storm will continue flowing from south-to-north to 10th Street East as it does under existing conditions.

It is estimated that under a regional storm event the depth of water accumulated in the parking lot of 1115 10th Street East will be 0.05m before overtopping the weir at the top of the driveway. Flow will continue to 10th Street East and head West which ultimately outlets into Georgian Bay.

The preliminary storm sewer design for 1115 10th Street East and have included it in Appendix B for reference.



4.6. Stormwater Quality Objectives

The water quality for the site has been reviewed in accordance with the Cities Site Development Engineering Standards section 3.1.2. and in the Stormwater Management Criteria established for the site.

The current preliminary design for this lot intends to use an EFO4 Stormceptor located midway up the driveway prior to entering the city's storm sewer. This unit meets the cities quality control requirement of a minimum of 80% TSS removal.

5. Recommendations and Conclusions

The SWM Strategy for the site is to attenuate the post-development peak runoff flow rates to the 5year existing condition for the post-development 5-year through 100-year design storms.

The removal of 80% TSS per The City of Owen Sounds Development Engineering Standards

The proposed stormwater management (SWM) strategy employed to attenuate the postdevelopment peak runoff flow rate manages the stormwater runoff from the site as a sub-surface stone retention gallery. With approximately 0.16 ha of uncontrolled drainage occurring in the front yard.

The storm retention gallery will be constructed under the proposed parking lot and will be privately owned and maintained. The construction of the gallery will provide a retention volume to adequately attenuate the post-development peak runoff flow rates to existing flow rates.

The current preliminary design for the lot intends to utilize a EFO4 Stormceptor to remove 85% of the TSS which exceeds the minimum requirement of 80% of the TSS to meet the requirements set in the City of Owen Sounds Development Engineering Standards.

Per the city's recommendation GEI has improved upon the existing peak flow rates under postdevelopment conditions.

With both the quantity and water quality criteria being met, the proposed site configuration (and zoning) is appropriate and can accommodate the stormwater management requirements.

The recommendations and design elements included in this report should be incorporated into the Site Plan development of the site.



Appendix A GEI Figures

- A.1. Site Location Map
- A.2. Existing Catchment Area Plan
- A.3. Post-Development Catchment Area Plan





FILE:\\geiconsultants.com\Data\Data_Storage\Working\PAAJI INC\2408466 1115 10th Street East OS\Drawings\2408466 - Paaji Heights BWW.dwg LAYOUT:Fig.(1) LAST SAVED BY:Browar4604, 3/25/2025 5:48:52 PM PLOTTED BY:Wardell, Brock 3/25/2025 5:50:55 PM





Appendix B Design Calculations

B.1. Owen Sound Site Development Engineering Standards – Storm Water Modelling Parameters

- B.2. Existing Impervious Calculations
- **B.3.** Post-Development Impervious Calculations
- B.4. SSD Information and Design Details
- B.5. GEI Storm Sewer Design Sheet

3.2 STORM WATER MODELLING PARAMETERS

To aid in the design of SWM facilities, the following information is to be used when calculating surface water volumes for the design of SWM systems.

For Rational Method Calculations:

 $Q = 0.00278 \ge C \ge i \ge A$

where: Q = runoff volume in m³/s

- **C** = runoff coefficient (see below)
- *i* = rainfall intensity in mm/hour

(for 5yr design storm use 109.68 mm/hr with 10 minute entry time for parks and residential; use 110 mm/hr with a 5 minute entry time for all other land uses)

A = area in hectares

Runoff Coefficients:

LAND USE	"C" VALUE	% IMPERVIOUS	ENTRY TIME
Green Field, Parks	0.2	0	10 minutes
Unimproved	0.3	14	10 minutes
Single Family	0.6	57	10 minutes
Semi-detached	0.7	71	10 minutes
Townhouses	0.75	79	10 minutes
Apartments, schools, churches	0.75	79	5 minutes
Industrial	0.9	85	5 minutes
Commercial	0.9	85	5 minutes

Intensity – Duration – Frequency Curves

IDF Curves for the Owen Sound area are attached as Appendix 'C' to this document. The curves are derived using the

following varia	bles	and	form	nula:
-	I mm	/hr =	A x	Tв

- Where
- *I* = intensity *A* = coefficient from chart
- **T** = time in hours
- B = coefficient from chart

Design Storm	Α	В
2 yr	22.3	-0.714
5 yr	29.1	-0.724
10 yr	33.6	-0.729
25 yr	39.3	-0.734
50 yr	43.5	-0.736
100 yr	47.7	-0.738

Chicago Storm Parameters

Most computer modelling programs use the "Chicago Storm" as the default method of simulating rainfall events. For the Owen Sound area, the parameters for modelling using the Chicago storm are as follows:



CHICAGO DESIGN STORM	2 yr	5 yr	25 yr	100 yr
Max. storm duration (min.)	180	180	210	210
Max. hydrograph length (min.)	360	360	360	360
Time step (min.)	5	5	5	5
Coefficient a	854.100	1234.576	1750.276	2171.754
Constant b	7.781	8.297	8.303	8.303
Exponent c	0.830	0.851	0.862	0.867
Fraction r	0.375	0.375	0.375	0.375
Duration t _d (min.)	180	180	210	210
Maximum Intensity (mm/hr)	101.673	134.692	165.718	202.862
Total Depth (mm)	33.228	42.929	59.007	71.271

3.3 STORM WATER MANAGEMENT REPORT

3.3.1 The owner shall have a Professional Engineer prepare a report detailing the modeling, design and features of the proposed SWM system. The SWM Report is to provide system performance data for the 5yr and 100yr design storms and must include scale drawings showing delineated drainage catchment areas, delineated surface pond limits for the 5-year and 100 year design storms (where applicable), overland flow route and a schematic diagram reflecting the model (complex models).

3.4 STORM WATER MANAGEMENT CERTIFICATION

3.4.1 The Professional Engineer who designed the SWM system must certify to the City that he/she supervised the construction of the storm water management system, that it was constructed as approved by the Manager of Engineering Services and that it is functioning properly.

3.5 MAINTENANCE NOTE

The following note is to appear on the SWM design drawing:

It is the owner's responsibility to conduct routine inspection and maintenance of any oil and grit interception devices or storm water management systems installed or constructed on the owner's property.

3.6 **REFERENCE DOCUMENTS**

Ontario Ministry Of The Environment Stormwater Management Planning and Design Manual (March 2003) ISBN 0-7794-2969-9

Stormwater Pollution Prevention Handbook (December 2001) Internet ISBN 0-7794-2553-7 Print ISBN 0-7794-2552-9



	Project:	1115 10th Street East OS	Date:	07-03-2025
	File No.:	2408466	Designed:	CS
GEI Consultants	Subject:	Existing Conditions Impervious Calculations	Checked:	AF
CATCHMENT AREA 100				
Total Catchment Area =	7899	00 m ²		
Building Area/Driveway Area	2940	% XIMP = 37.2%		
Road Area =	0.0) m ²		
Total Impervious Area (Estimate) =	2940	66 m ²		
Percent Impervious (%) =	37.	2		

	Project:	1115 10th Street East OS	D	ate:	25-03-2025
	File No.:	2408466	D	esigned:	CS
GEI Consultants	Subject:	Post- Development Site Development Impervious C	alculations Cl	hecked:	AF
CATCHMENT AREA 201 (FRONT YARD I	DRAINAGE)				
Total Catchment Area =	1586	26 m ²			
Building Area =	= 175.	%XIMP = 2	1.2%		
Driveway and Sidewalk Area =	336.	2 m ²			
Total Impervious Area (Estimate) =	512.	6 m ²			
Percent Impervious (%) =	32.	3			
CATCHMENT AREA 202 (POST-DEVELO	PMENT) - FRON	PARKING LOT			
Total Catchment Area =	3226	28 m ² %XIMP = 8	2.7%		
Building Area =	1177	40 m ²			
Parking and Sidewalk Area =	1491	94 m ²			
Total Impervious Area (Estimate) =	2669.34	m²			
Percent Impervious (%) =	82.	,			
CATCHMENT AREA 203 (POST-DEVELOP	MENT) - SIDE	YARD PARKING LOT			
Total Catchment Area =	601.	8 m ² %XIMP = 8	1.8%		
Building Area =	0.0	m ²			
Parking and Sidewalk Area =	492.	6 m ²			
Total Impervious Area (Estimate) =	492.	6 m ²			
Percent Impervious (%) =	81.	3			
CATCHMENT AREA 204 (POST-DEVELOF	PMENT) - REAR	YARD			
Total Catchment Area =	2484	69 m ² %XIMP = 1	1.0%		
Building Area =	408.	9 m ²			
Other Hardscape Areas =	179.	7 m ²			
Total Impervious Area (Estimate) =	588.	6 m ²			
Percent Impervious (%) =	23.	,			



Project: 1115 10th Street East, Owen Sound Date: 24-25-2025 File No.: 2408466 Designed: CS Stage-Storage-Discharge Curve Checked: AF Subject:

Stone Retention Gallery

Equivalent Length = 17 m Pipe Dia. = 0.52 Equivalent Width = 10 m Pipe Inv. = 232.8 Equivalent Depth = 2 m Stone Void Ratio = 0.4 Total Storage Vol. 136 m³

25	m	н	=	0.15
800	masl	L	=	8
		width	=	0.5

Weir Calculations

m m m

Botton Elevation Elev. = 232.800 m Top of Stone Elev. = 234.800 m Stage = 0.125 m

Elevation (m)	Incremental Depth (m)	Surface Area (sq.m)	Incremental Volume (cu.m)	Stone Storage (cu.m)	Pipe Storage (cu.m)	Total Storage Vol. (cu.m)	Description
232.800	0	170	0	0	0.000	0.000	Bottom of Stone
232.925	0.125	170	8.5	8.5	0.209	8.709	
233.050	0.125	170	8.5	17	0.834	17.834	
233.175	0.125	170	8.5	25.5	1.878	27.378	
233.300	0.125	170	8.5	34	3.338	37.338	
233.425	0.125	170	8.5	42.5	0.000	42.500	
233.550	0.125	170	8.5	51	0.000	51.000	
233.675	0.125	170	8.5	59.5	0.000	59.500	
233.800	0.125	170	8.5	68	0.000	68.000	
233.925	0.125	170	8.5	76.5	0.000	76.500	
234.050	0.125	170	8.5	85	0.000	85.000	
234.175	0.125	170	8.5	93.5	0.000	93.500	
234.300	0.125	170	8.5	102	0.000	102.000	
234.425	0.125	170	8.5	110.5	0.000	110.500	
234.550	0.125	170	8.5	119	0.000	119.000	
234.675	0.125	170	8.5	127.5	0.000	127.500	
234.800	0.125	170	8.5	136	0.000	136.000	Top of Stone
235.300	0.50	1.1	0.6	136.57	0.000	136.565	Top of Grate
235.350	0.05	64	1.07	137.63	0.000	137.632	Bottom of Weir
235.500	0.15	0	0	137.63	0.000	137.632	Top of Weir

Orfifice Details

Diametre:	=	0.150	m
Area:	=	0.0177	m²
Coeficient:	=	0.62	(0.62 - Plate, 0.8 - Tube Orfice
Invert Elev.	=	232.80	masl

Elevation (m)	Total Storage Vol. (cu.m)	Orifice Flow (cu.m/s)	Weir Flow (cu.m/s)
232.800	0.000	#NUM!	0
232.925	8.709	0.01534352	0
233.050	17.834	0.02301528	0
233.175	27.378	0.0287051	0
233.300	37.338	0.03344043	0
233.425	42.500	0.0375838	0
233.550	51.000	0.04131369	0
233.675	59.500	0.04473367	0
233.800	68.000	0.04791013	0
233.925	76.500	0.0508887	0
234.050	85.000	0.05370232	0
234.175	93.500	0.0563757	0
234.300	102.000	0.05892791	0
234.425	110.500	0.06137408	0
234.550	119.000	0.06372643	0
234.675	127.500	0.06599498	0
234.800	136.000	0.07438048	0
235.300	136.565	0.07516759	0
235.350	137.632	0.07748098	0
235.500	137.632	0.07935731	0.79241239

Discharge (cu.m/s)	Total Storge (ha.m)
0.000	0.000
0.015	0.001
0.023	0.002
0.029	0.003
0.033	0.004
0.038	0.004
0.041	0.005
0.045	0.006
0.048	0.007
0.051	0.008
0.054	0.009
0.056	0.009
0.059	0.010
0.061	0.011
0.064	0.012
0.066	0.013
0.074	0.014
0.075	0.014
0.077	0.014
0.872	0.014

2-Year	41	233.39
5-Year	62	233.71
25-Year	101	234.29
100-Year	134	234.77
Regional	N/A	N/A

	Project:	1115 10th Street East, Owen Sound	Date:	24-25-2025
	File No.:	2408466	Designed:	CS
GEI Consultants	Subject:	Stage-Storage-Discharge Curve	Checked:	AF

Existing Conditions		Post-Development			
Design Storm	CA100	CA201	400305	00206	Cumulativo
Design Storm	CAIOO	CA201	ADD205	PD200	cumulative
2-Year	0.068	0.014	0.085	0.036	0.046
5-Year	0.097	0.021	0.119	0.045	0.060
25-Year	0.149	0.034	0.176	0.058	0.080
100-Year	0.192	0.045	0.224	0.072	0.097
Regional	0.086	0.018	0.072	0.058	0.075

	Stone Gallery	
Design Storm	Storage Used (cu.m)	Elevation (m)
2-Year	41	233.39
5-Year	62	233.71
25-Year	101	234.29
100-Year	134	234.77
Regional	N/A	N/A

Note: Pre-Development "Green Field Conditions" 5-year Peak Design flow is 0.029 m³/s



OS Sit Design Storm	te Dev. Eng. Stds A	s (2021) B	Where Q = Q =	<pre>e Q = 2.78 AIC and I = A x Tc⁸ (where Tc in hours) Q = peak flow in litres per second (L/s) A = area in hectares (ha)</pre>									DES	IGN:	PRC	DJECT:	SHEET 1 0	г NO. f 1	
2 yr 5 yr 10 yr 25 yr 50 yr 100 yr	22.3 29.1 33.6 39.3 43.5 47.7	-0.714 -0.724 -0.729 -0.734 -0.736 -0.738	A : I C : A, B : Tc :	<pre>A = area in hectares (ha) I = rainfall intensity in millimetres per hour (mm/h) C = runoff coefficient A, B = design storm coefficients Tc = time of concentration in minutes (MIN. 10.0 minutes) AREA (ha)</pre>				1115 10th Street East STORM SEWER DESIGN SHEET					C.S. GEI Consultants Canada Ltd. DATE: March 2025 Proje		1115 Paa	ji Heights o: 2408466	GEI	Consultants	
	LOCATION			AREA (ha)			Time of	Rainfall	Peak					SEWER	DATA		<u></u>	
STREET	FROM	то	C =	C =	C =	Individual 2.78 AC	Cumulative 2.78 AC	Concentration Tc	Intensity I	Flow Q	Type of	Roughness Coefficient	Diameter	Slope	Length	Capacity	Full Flow Velocity	Time of Flow	Percent of Capacity
			0.20	0.75	0.90			(minutes)	(mm/h)	(L/s)	Ртре	(n)	(mm)	(%)	(m)	(L/S)	(m/s)	(minutes)	Used (%)
	DICB	CBMH-1		0.27		0.57	0.57	5.00	299	171	PVC	0.013	375	2.00	20	248	2.25	0.15	68.8%
	CBMH-1	CBMH-2		0.38		0.79	1.36	5.15	292	398	HDPE	0.013	525	1.00	60	430	1.99	0.50	92.6%
	CBMH-2	Outlet								11	PVC	0.013	200	5.00	28	73	2.33	0.20	14.7%
								Orifac	e Calculatio	n									
								Mannings 'n' Pipe diameter	0.013 150	mm									
								Pipe Slope	0.005	m/m									
								Wetted Perimeter	0.018	m-									
								Hydraulic	0.038	m									
								Pipe Flow (Q)	0.011	m³/s									
				Note:	CBMH-1 is t	:o have a 150	nm oriface or	the north outle	et, discharg	e is calcul	ated based	on 150mm ori	face flowi	ng full					

Appendix C Existing Conditions

- C.1. Existing OTTHYMO Schematic
- C.2. Existing OTTHYMO Output



NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CHICAGO STORM Ptotal= 60.35 mm	IDF cur	IDF curve parameters: A=1750.276 B= 8.303 C= 0.862 used in: INTENSITY = A / (t + B)^C								
	Duratic Storm Time to	on of st time ste peak ra	orm = 4 ep = 5 atio = 6	A / (t .00 hrs .00 min .38	+ в) ^с					
TIME hrs 0.00 0.08 0.17 0.25 0.33 0.42 0.50 0.58 0.58 0.67 0.75 0.83 0.92	RAIN mm/hr 2.69 2.86 3.05 3.28 3.54 3.54 3.85 4.23 4.68 5.25 5.98 6.94 8.27	TIME hrs 1.00 1.08 1.17 1.25 1.33 1.42 1.50 1.58 1.67 1.75 1.83 1.92	RAIN mm/hr 10.22 13.31 18.82 30.89 71.60 188.05 86.10 46.26 30.37 22.17 17.28 14.08	<pre>' TIME ' hrs 2.00 2.08 2.17 2.25 2.33 2.42 2.50 2.58 2.67 2.75 2.83 2.92</pre>	RAIN mm/hr 11.84 10.19 8.94 7.95 7.16 6.51 5.97 5.51 5.12 4.78 4.49 4.22	<pre>TIME hrs 3.00 3.08 3.17 3.25 3.33 3.42 3.50 3.58 3.67 3.75 3.83 3.92</pre>	RAIN mm/hr 3.99 3.78 3.60 3.43 3.28 3.14 3.01 2.89 2.79 2.69 2.59 2.51			
CALIB STANDHYD (0201) ID= 1 DT=10.0 min	Area Total Im	(ha)= p(%)= 3	0.16 32.30 [Dir. Conn	.(%)= 2	1.20				
Surface Area Dep. Storage Average Slope Length Mannings n NOTE: RAINFA	I (ha)= (mm)= (%)= (m)= = LL WAS TR	MPERVIOU 0.05 0.80 10.00 32.66 0.130 ANSFORME	JS PER	RVIOUS (i 0.11 1.50 15.00 20.00 0.250 0.0 MIN.) TIME STEF	D.				
TRANSFORMED HYETOGRAPH										

		1107			~		
TIME	RAIN	TIME	RAIN '	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr '	hrs	mm/hr	hrs	mm/hr

**************************************	*********** 4hr 5min Cl *********	********* nicago ** *******	с : :				
CHICAGO STORM Ptotal= 72.84 mm	IDF cu	rve param	neters: A	A=2171.75 B= 8.30	54 93		
	used i	n: INTI	ENSITY =	A / (t	+ B)^C		
	Duratio Storm Time to	on of st time sto o peak ra	orm = 4 ep = 5 atio = (4.00 hrs 5.00 min 0.38			
TIM	E RAIN	TIME	RAIN	' TIME	RAIN	TIME	RAIN
hr	s mm/hr	hrs	mm/hr	' hrs	mm/hr	hrs	mm/hr
0.0	0 3.15	1.00	12.18	2.00	14.13	3.00	4.70
0.0	8 3.35	1.08	15.91	2.08	12.15	3.08	4.46
0.1	7 3.59	1.17	22.59	2.17	10.64	3.17	4.23
0.2	5 3.85	1.25	37.28	2.25	9.45	3.25	4.03
0.3	3 4.17	1.33	87.10	2.33	8.50	3.33	3.85
0.4	2 4.54	1.42 1.50	230.33	2.42 2.60	7.72	3.42	3.69
0.5	8 5 5 3	1 1 58	56 05	2.50	6 52	3.50	3.54
0.5	7 6.21	1.50	36.64	2.50	6.05	3.67	3.27
0.7	5 7.08	1.75	26.66	2.75	5.65	3.75	3.15
0.83 8.23 1.83 20.72 2.83 5.29 3.83 3.							
0.9	2 9.83	1.92	16.84	2.92	4.98	3.92	2.94
- - CALIB							
STANDHYD (0100)	Area	(ha)=	0.79		- (%)	7 20	
1D= 1 DI= 5.0 min	IOTAL I	mp(%)=	37.20	Dir. Con	1.(%)= 3	7.20	
		IMPERVIO	JS PE	RVIOUS (i	i)		
Surface Area	(ha)=	0.29		0.50	,		
Dep. Storage	(mm)=	1.00		1.50			
Average Slope	(%)=	7.70		7.70			
Length	(m)=	72.57	1	24.00			
Mannings n	=	0.130		0.250			
Max.Eff.Inten.(mm/hr)= (min)	230.33	1	09.27 15 00			
Storage Coeff	$(\min) =$	3.26	(ii)	12.22 (i	i)		
Unit Hvd. Tpeak	(min)=	5.00	()	15.00	-,		
Unit Hyd. peak	(cms)=	0.27		0.09			
	. /				*TOT	ALS*	
PEAK FLOW	(cms)=	0.16		0.08	0.	192 (iii)	
ΤΙΜΕ ΤΟ ΡΕΑΚ	(hrs)=	1.50		1.67	1	.50	
RUNOFF VOLUME	(mm)=	71.84		43.82	54	.23	

TOTAL RAINFALL RUNOFF COEFFICIEN	(mm)= IT =	72.84 0.99		72.84 0.60	72 0	.84 .74	
***** WARNING: STORAGE	COEFF. I	S SMALL	ER THAN T	IME STEP	!		
(i) CN PROCEDUR CN* = 85 (ii) TIME STEP (THAN THE ST (iii) PEAK FLOW D	E SELECTE .0 Ia DT) SHOUL ORAGE COE OES NOT I	D FOR P = Dep. D BE SM FFICIEN NCLUDE	ERVIOUS L Storage ALLER OR IT. BASEFLOW	OSSES: (Above) EQUAL IF ANY.			
- ************************************	********* 5min Chi ********	****** Cago ** *****					
CHICAGO STORM Ptotal= 60.35 mm	IDF cur	ve para	meters: A E	A=1750.270 3= 8.30	5 3		
	used in	: INT	ENSITY =	C= 0.86 A / (t	2 + B)^C		
	Duratio Storm † Time to	n of st time st peak r	torm = 4 ep = 5 atio = 6	1.00 hrs .00 min).38			
TIME	RAIN	TIME	RAIN	' TIME	RAIN	TIME	RAIN
		1 00	10 22		11 Q/	2 00	3 00 IIIII/III.
0.00	2.09	1 08	13 31	2.00	10 10	3.00	3.78
0.03	3 05	1 17	18 82	2.00	8 94	3.00	3.60
0.25	3.28	1.25	30.89	2.25	7.95	3.25	3.43
0.33	3.54	1.33	71.60	2.33	7.16	3.33	3.28
0.42	3.85	1.42	188.05	2.42	6.51	3.42	3.14
0.50	4.23	1.50	86.10	2.50	5.97	3.50	3.01
0.58	4.68	1.58	46.26	2.58	5.51	3.58	2.89
0.67	5.25	1.67	30.37	2.67	5.12	3.67	2.79
0.75	5.98	1.75	22.17	2.75	4.78	3.75	2.69
0.83 0.92	6.94 8.27	1.83 1.92	17.28 14.08	2.83	4.49 4.22	3.83 3.92	2.59 2.51
-							
CALIB STANDHYD (0100) ID= 1 DT= 5.0 min	Area Total Im	(ha)= p(%)=	0.79 37.20 [Dir. Conn	.(%)= 3	7.20	
	т			RVTOUS (i	<u>۱</u>		
Surface Area Dep. Storage	(ha)= (mm)=	0.29 1.00		0.50 1.50	/		

Average Slope Length	(%)= (m)=	7.70 72.57	7.70 124.00		
Mannings n	=	0.130	0.250		
Max.Eff.Inten.(mm/hr)=	188.05	65.49		
over	(min)	5.00	15.00		
Storage Coeff.	(min)=	3.53 (1	ii) 14.53 (i:	i)	
Unit Hyd. Tpeak	(min)=	5.00	15.00		
Unit Hyd. peak	(cms)=	0.26	0.08		
				TOTALS	
PEAK FLOW	(cms)=	0.13	0.06	0.149 (ii:	i)
ΤΙΜΕ ΤΟ ΡΕΑΚ	(hrs)=	1.50	1.75	1.50	
RUNOFF VOLUME	(mm)=	59.35	33.40	43.05	
TOTAL RAINFALL	(mm)=	60.35	60.35	60.35	
RUNOFF COEFFICI	ENT =	0.98	0.55	0.71	
***** WARNING: STORA (i) CN PROCED	GE COEFF.	IS SMALLER ED FOR PER	THAN TIME STEP	!	
(ii) TIME STED		- Dep. Stu	ED OD EOUNI		
		LU DE SMALL	ER OR EQUAL		
(iii) DEAK FLOW	DOES NOT	TNCLUDE DAG			
(III) PEAK FLOW	DUES NUT .	INCLUDE BAS	SEFLOW IF ANY.		
- ************************************	********** r 5min Chi *********	****** Cago ** *****			
CHICAGO STORM	IDF cu	rve paramet	ters: A= 854.10	00	
Ptotal= 33.23 mm		-	B= 7.78	31	
			C= 0.83	30	
	used i	n: INTEN	SITY = A / (t	+ B)^C	
	Durati	on of stor	m - 3 00 hrs		
	Storm	time sten	= 5.00 min		
	Time t	o peak rat	io = 0.38		
ттм	F RΔTN		βάτη Ι' ττμ ε	RATN TTMF	R ΔTN
hr	s mm/hr	hrs	m/hr hrs	mm/hr hrc	mm/hr
	0 2 2 7		8 07 1 50		2 57
0.0	0 2.57 Q 7 EE			2 50 2.23	10.2
0.0			17.74 1.70	0.00 2.00	5.54 5.15
0.1	/ 2./9	0.92 1.00	1/./4 1.0/	/.24 2.42	3.13
0.2	5 5.0/				2.95
0.3	3 3.41		03.05 1.83	5.58 2.58	2.79
0.4	2 3.85		47.46 1.92	5.01 2.6/	2.65
0.5	v 4.42	1.25	26.04 2.00	4.55 2.75	2.52
0.5	8 5.20	1.33	1/.46 2.08	4.17 2.83	2.41
0.6	6.32	1.42	12.99 2.17	3.85 2.92	2.30

| CALIB STANDHYD (0100) Area (ha)= 0.79 |ID= 1 DT= 5.0 min | Total Imp(%)= 37.20 Dir. Conn.(%)= 37.20 -----IMPERVIOUS PERVIOUS (i) Surface Area (ha) =0.29 0.50 Dep. Storage (mm)= 1.00 1.50 Average Slope (%)= 7.70 7.70 Length 72.57 124.00 (m) =Mannings n = 0.130 0.250 Max.Eff.Inten.(mm/hr)= 103.05 21.51 over (min) 5.00 25.00 Storage Coeff. (min)= 4.49 (ii) 21.67 (ii) Unit Hyd. Tpeak (min)= 5.00 25.00 0.23 Unit Hyd. peak (cms)= 0.05 *TOTALS* PEAK FLOW (cms) =0.06 0.02 0.068 (iii) TIME TO PEAK (hrs)= 1.17 1.58 1.17 RUNOFF VOLUME (mm)= 32.23 13.15 20.23 33.23 TOTAL RAINFALL (mm)= 33.23 33.23 RUNOFF COEFFICIENT = 0.97 0.40 0.61 ***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP! (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES: CN* = 85.0 Ia = Dep. Storage (Above) (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT. (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY. ** SIMULATION:5yr 3hr 5min Chicago ** _____ CHICAGO STORM IDF curve parameters: A=1234.576 | Ptotal= 42.93 mm | B= 8.297 -----C= 0.851 used in: INTENSITY = $A / (t + B)^{C}$ Duration of storm = 3.00 hrs Storm time step = 5.00 min Time to peak ratio = 0.38RAIN |' TIME TIME RAIN | TIME RAIN RAIN | TIME mm/hr | hrs mm/hr | hrs hrs mm/hr | hrs mm/hr 10.17 | 1.50 13.13 | 2.25 0.00 2.80 | 0.75 4.31

0.08 0.17 0.25 0.33 0.42 0.50 0.58 0.67	3.04 3.33 3.68 4.11 4.67 5.40 6.40 7.87	0.83 0.92 1.00 1.08 1.17 1.25 1.33 1.42	14.27 23.16 52.75 136.52 63.26 34.39 22.78 16.75	1.58 1.67 1.75 1.83 1.92 2.00 2.08 2.17	10.75 9.08 7.85 6.91 6.16 5.57 5.07 4.66	2.33 2.42 2.50 2.58 2.67 2.75 2.83 2.92	4.01 3.75 3.53 3.33 3.15 2.99 2.84 2.71		
- CALIB STANDHYD (0100) ID= 1 DT= 5.0 min Surface Area	Area Total Im I (ha)=	(ha)= p(%)= MPERVIOL 0.29	0.79 37.20 D JS PER	ir. Conr VIOUS (i 0.50))	37.20			
Dep. Storage Average Slope Length Mannings n	(mm)= (%)= (m)= =	1.00 7.70 72.57 0.130	12 0	1.50 7.70 4.00 .250					
Max.Eff.Inten.(mm over (Storage Coeff. (Unit Hyd. Tpeak (Unit Hyd. peak (PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL RUNOFF COEFFICIEN	n/hr)= (min)= (min)= (cms)= (cms)= (hrs)= (mm)= (mm)= NT =	136.52 5.00 4.02 5.00 0.24 0.09 1.17 41.93 42.93 0.98	3 2 (ii) 1 2 1 4	9.94 0.00 7.42 (ii 0.00 0.06 0.03 1.50 9.90 2.93 0.46	.) *TOT 0. 1 28 42 6	ALS* 097 (iii 17 3.08 2.93 0.65)		
<pre>***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP! (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES: CN* = 85.0 Ia = Dep. Storage (Above) (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT. (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.</pre>									
- ************************************	********* Storm * *******	* * *							
READ STORM	Filenam	e: C:\Us	ers\cslo	combe\Ap	pD				

I I		ata\L	ocal\Ten	np\			
 9abd5862-7733-4c36-baad Ptotal=193.00 mm	d-389983f9 Comment	706a\d56d ts: Timmi	126b0 .ns Storm	1			
TIME hrs 0.00 1.00 2.00	RAIN mm/hr 15.00 20.00 10.00	TIME hrs 3.00 4.00 5.00	RAIN mm/hr 3.00 5.00 20.00	' TIME ' hrs 6.00 7.00 8.00	RAIN mm/hr 43.00 20.00 23.00	TIME hrs 9.00 10.00 11.00	RAI mm/h 13.00 13.00 8.00
-							
Surface Area	(ha)=	IMPERVIOU 0.29	IS PEF	RVIOUS (i 0.50	.)		
Dep. Storage	(mm)=	1.00		1.50			
Average Slope	(%)=	7.70		7.70			
Lengtn Mannings n	(m)= =	/2.5/	12	24.00 2.250			
NOTE: RAINFA	ALL WAS TR	ANSFORME	D TO 5	5.0 MIN.	TIME STE	Ρ.	
		TRA	NSEORMER		ADH		
TIME	RAIN		RAIN) III E TOGR ' TIME	RAIN	TIME	RAI
hrs	mm/hr	hrs	mm/hr	' hrs	mm/hr	hrs	mm/h
0.083	15.00	3.083	3.00	6.083	43.00	9.08	13.00
0.167	15.00	3.167	3.00	6.167	43.00	9.17	13.00
0.250	15.00	3.250	3.00	6.250	43.00	9.25	13.00
0.333	15.00	3.333 2.417	3.00	6.333 6.417	43.00	9.33	13.00
0.41/	12.00	1 2.41/	טט.כ	0.41/	43.00	7.42	13.O

0.000			2.00	0.000			
0.167	15.00	3.167	3.00	6.167	43.00	9.17	13.00
0.250	15.00	3.250	3.00	6.250	43.00	9.25	13.00
0.333	15.00	3.333	3.00	6.333	43.00	9.33	13.00
0.417	15.00	3.417	3.00	6.417	43.00	9.42	13.00
0.500	15.00	3.500	3.00	6.500	43.00	9.50	13.00
0.583	15.00	3.583	3.00	6.583	43.00	9.58	13.00
0.667	15.00	3.667	3.00	6.667	43.00	9.67	13.00
0.750	15.00	3.750	3.00	6.750	43.00	9.75	13.00
0.833	15.00	3.833	3.00	6.833	43.00	9.83	13.00
0.917	15.00	3.917	3.00	6.917	43.00	9.92	13.00
1.000	15.00	4.000	3.00	7.000	43.00	10.00	13.00
1.083	20.00	4.083	5.00	7.083	20.00	10.08	13.00
1.167	20.00	4.167	5.00	7.167	20.00	10.17	13.00
1.250	20.00	4.250	5.00	7.250	20.00	10.25	13.00
1.333	20.00	4.333	5.00	7.333	20.00	10.33	13.00
1.417	20.00	4.417	5.00	7.417	20.00	10.42	13.00
1.500	20.00	4.500	5.00	7.500	20.00	10.50	13.00

1.583	3 20.00	4.583	5.00	7.583	20.00	10.58	13.00
1.667	7 20.00	4.667	5.00	7.667	20.00	10.67	13.00
1.750	20.00	4.750	5.00	7.750	20.00	10.75	13.00
1.833	3 20.00	4.833	5.00	7.833	20.00	10.83	13.00
1.917	7 20.00	4.917	5.00	7.917	20.00	10.92	13.00
2.000	20.00	5.000	5.00	8.000	20.00	11.00	13.00
2.083	3 10.00	5.083	20.00	8.083	23.00	11.08	8.00
2.167	7 10.00	5.167	20.00	8.167	23.00	11.17	8.00
2.256	0 10.00	5.250	20.00	8.250	23.00	11.25	8.00
2.333	3 10.00	5.333	20.00	8.333	23.00	11.33	8.00
2.417	7 10.00	5.417	20.00	8.417	23.00	11.42	8.00
2.500	0 10.00	5.500	20.00	8.500	23.00	11.50	8.00
2.583	3 10.00	5.583	20.00	8.583	23.00	11.58	8.00
2.667	7 10.00	5.667	20.00	8.667	23.00	11.67	8.00
2.756	0 10.00	5.750	20.00	8.750	23.00	11.75	8.00
2.833	3 10.00	5.833	20.00	8.833	23.00	11.83	8.00
2.917	7 10.00	5.917	20.00	8.917	23.00	11.92	8.00
3.000	0 10.00	6.000	20.00	9.000	23.00	12.00	8.00
Max.Eff.Inten.(n	nm/hr)=	43.00		39.35			
over	(min)	5.00		20.00			
Storage Coeff.	(min)=	6.37	(ii) :	19.86 (ii	i)		
Unit Hyd. Tpeak	(min)=	5.00		20.00	,		
Unit Hyd. peak	(cms)=	0.18		0.06			
y	、 ,				*T0	TALS*	
PEAK FLOW	(cms)=	0.04		0.05	0	.086 (iii	.)
TIME TO PEAK	(hrs)=	7.00		7.00	-	7.00	
RUNOFF VOLUME	(mm)=	192.00	1	55.18	168	8.86	
TOTAL RAINFALL	(mm)=	193.00	19	93.00	193	3.00	
RUNOFF COEFFICIE	ENT =	0.99		0.80	(0.87	

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
- CN* = 85.0 Ia = Dep. Storage (Above) (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
- THAN THE STORAGE COEFFICIENT. (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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Appendix D Post-Development Conditions

- D.1. Post-Development OTTHYMO Schematic
- D.2. Post-Development OTTHYMO Output



CHICAGO STORM IDF curve parameters: A=2171.754 Ptotal= 72.84 mm B= 8.303 C= 0.867									
	used in	n: INT	ENSITY =	A / (t	/ + B)^C				
	Duratio	on of st	:orm = 4	1.00 hrs					
	Storm Time to	time st peak r	ep = 5 atio = 0	.00 min 0.38					
TIME	RAIN	TIME	RAIN	' TIME	RAIN	TIME	RAIN		
hrs	mm/hr	hrs	mm/hr	'hrs	mm/hr	hrs	mm/hr		
0.00	3.15	1.00	12.18	2.00	14.13	3.00	4.70		
0.08	3.35	1.08	15.91	2.08	12.15	3.08	4.46		
0.17	3.59	1.17	22.59	2.17	10.64	3.17	4.23		
0.25	3.85	1.25	37.28	2.25	9.45	3.25	4.03		
0.33	4.1/	1.33	87.10	2.33	8.50	3.33	3.85		
0.42	4.54	1.42	230.33	2.42	7.72	3.42	3.69		
0.50	4.98	1.50	104.88	2.50	7.07	3.50	3.54		
0.58	5.53	1.58	56.05	2.58	6.52	3.58	3.40		
0.6/	6.21	1.6/	36.64		6.05	3.6/	3.2/		
0.75	7.08	1.75	20.00		5.05	3.75	3.15		
0.83	8.23	1.83	20.72	2.83	5.29	3.83	3.04		
0.92	9.05	1.92	10.04	2.92	4.90	5.92	2.94		
STANDHYD (0201)	Area	(ha)=	0.16						
ID= 1 DT=10.0 min	Total In	ינייג) ום(%)=	32.30 I	Dir. Conn	(%) = 2	21.20			
		-F ()			- () -				
	1	MPERVIO	US PEI	RVIOUS (i)				
Surface Area	(ha)=	0.05		0.11					
Dep. Storage	(mm)=	0.80		1.50					
Average Slope	(%)=	10.00	-	15.00					
Length	(m)=	32.66		20.00					
Mannings n	=	0.130	(0.250					

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

TRANSFORMED HYETOGRAPH												
TIME	RAIN	TIME	RAIN	' TIME	RAIN	TIME	RAIN					
hrs	mm/hr	hrs	mm/hr	' hrs	mm/hr	hrs	mm/hr					
0.167	3.25	1.167	14.04	2.167	13.14	3.17	4.58					
0.333	3.72	1.333	29.93	2.333	10.04	3.33	4.13					

0.500 4.35 | 1.500 158.71 | 2.500 8.11 | 3.50 3.77 0.667 5.25 | 1.667 80.46 | 2.667 6.80 | 3.67 3.47 6.64 | 1.833 31.65 | 2.833 5.85 | 3.83 3.21 0.833 9.03 | 2.000 18.78 | 3.000 5.14 | 4.00 2.99 1.000 Max.Eff.Inten.(mm/hr)= 158.71 112.89 10.00 over (min) 10.00 Storage Coeff. (min)= 2.17 (ii) 4.59 (ii) 10.00 Unit Hyd. Tpeak (min)= 10.00 Unit Hyd. peak (cms)= 0.17 0.15 *TOTALS* PEAK FLOW (cms)= 0.01 0.03 0.045 (iii) TIME TO PEAK (hrs)= 1.50 1.50 1.50 RUNOFF VOLUME (mm)= 72.04 46.52 51.93 TOTAL RAINFALL (mm)= 72.84 RUNOFF COEFFICIENT = 0.99 72.84 72.84 0.64 0.71 ***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP! (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES: CN* = 85.0 Ia = Dep. Storage (Above) (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT. (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY. _____ | CALIB STANDHYD (0202) Area (ha)= 0.32 |ID= 1 DT= 5.0 min | Total Imp(%)= 82.70 Dir. Conn.(%)= 82.70 _____ IMPERVIOUS PERVIOUS (i) Surface Area (ha)= 0.26 0.06 Dep. Storage (mm)= 1.00 1.50 (%)= Average Slope 5.00 2.00 Length (m)= 46.19 3.00 Mannings n 0.130 0.250 = 230.33 Max.Eff.Inten.(mm/hr)= 109.27 over (min) 5.00 5.00 2.83 (ii) Storage Coeff. (min)= 3.40 (ii) Unit Hyd. Tpeak (min)= 5.00 5.00 Unit Hyd. peak (cms)= 0.28 0.26 *TOTALS* PEAK FLOW 0.15 0.02 (cms)= 0.168 (iii) TIME TO PEAK (hrs)= 1.50 1.50 1.50 71.84 RUNOFF VOLUME (mm)= 43.82 66.99 72.84 TOTAL RAINFALL (mm)= 72.84 72.84 RUNOFF COEFFICIENT = 0.99 0.60 0.92

***** WARNIN	NG: STORAG	E COEFF.	IS SMALL	ER THA	N TIME S	TEP!				
										
(1) UN PRUCEDURE SELECTED FUR PERVIOUS LUSSES: (N* - 85.0 Ta - Den Stanage (Above)										
$CN^{*} = 85.0$ Ia = Dep. Storage (Above) (ii) TIME STED (DT) SHOULD BE SMALLED OP FOLIAL										
(11)	IME SIEP	TOPACE C	OFFETCIE		JK EQUAL					
(iii) [DEAK FLOW	DOES NOT		NI. RASEELI		v				
(111) 1			INCLODE			••				
CALIB										
STANDHYD	(0203)	Area	(ha)=	0.06						
ID= 1 DT= 5	5.0 min	Total	Imp(%)=	81.80	Dir. C	onn.(%)=	81.80			
				NIC		(;)				
Sunfac		(ha)				(1)				
Surtace	a Area	(na)= (mm)-	1.00) }	1 50					
	_orage	(1000) = (5.00) A	2 00					
Length	= STOPE	(m) =	20 00	, 1	2.00					
Manning	gs n	() =	0.130	,)	0.250					
	50		01200		0.770					
Max.Eff	f.Inten.(m	m/hr)=	230.33	3	109.27					
	over	(min)	5.00)	5.00					
Storage	e Coeff.	(min)=	1.71	l (ii)	2.30	(ii)				
Unit Hy	/d. Tpeak	(min)=	5.00	9	5.00					
Unit Hy	yd. peak	(cms)=	0.32	2	0.30					
						-	FOTALS			
PEAK FL	_OM	(cms)=	0.03	3	0.00		0.034 (iii)			
TIME TO) PEAK	(hrs)=	1.50)	1.50		1.50			
RUNOFF	VOLUME	(mm)=	71.84	1	43.82		66.73			
		(mm)=	/2.84	1	/2.84		/2.84			
KUNUFF	CUEFFICIE	NI =	0.95	1	0.00		0.92			
**** WARNTN	JG∙ STOR∆G	E COFFE	τς ςμαιι	FR THΔ	N TTME S	TFPI				
WARTE I			15 SINCE							
(i) (N PROCEDU	RE SELEC	TED FOR P	ERVIOU	S LOSSES	:				
	CN* = 8	5.0 I	a = Dep.	Storag	e (Abov	e)				
(ii) 1	TIME STEP	(DT) SHO	ULD BE SM	ALLER	DR EQUAL	·				
T	THAN THE S	TORAGE C	OEFFICIE	NT.						
(iii) F	PEAK FLOW	DOES NOT	INCLUDE	BASEFL	OW IF AN	Υ.				
	 I									
STANDHYD ((0204)	Area	(ha)=	0.25						
ID= 1 DT=16	3.0 min	Total	Imp(%)=	23.70	Dir. C	onn.(%)=	1.00			
			F V 7	•		- ()				
			IMPERVIC	US	PERVIOUS	(i)				
Surface	e Area	(ha)=	0.06	5	0.19					
Dep. St	corage	(mm)=	0.80)	1.50					

Average Slope	(%)=	2.00	2.00
Length	(m)=	40.82	40.00
Mannings n	=	0.130	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

TRANSFORMED HYETOGRAPH								
TIM	E RAIN	TIME	RAIN	' TIME	RAIN	TIME	RAIN	
hr	s mm/hr	hrs	mm/hr	' hrs	mm/hr	hrs	mm/hr	
0.16	7 3.25	1.167	14.04	2.167	13.14	3.17	4.58	
0.33	3 3.72	1.333	29.93	2.333	10.04	3.33	4.13	
0.50	4. 35	1.500	158.71	2.500	8.11	3.50	3.77	
0.66	7 5.25	1.667	80.46	2.667	6.80	3.67	3.47	
0.83	6.64	1.833	31.65	2.833	5.85	3.83	3.21	
1.00	9.03	2.000	18.78	3.000	5.14	4.00	2.99	
Max.Eff.Inten.(n over Storage Coeff.	nm/hr)= (min) (min)=	158.71 10.00 4.01	1 (ii)	32.44 20.00 10.32 (ii)	1			
Unit Hyd. Tpeak	(min)=	10.00		20.00				
Unit Hyd. peak	(cms)=	0.16		0.08				
					TOT	ALS		
PEAK FLOW	(cms)=	0.00		0.05	0.	046 (iii)		
TIME TO PEAK	(hrs)=	1.50		1.67	1	.67		
RUNOFF VOLUME	(mm)=	72.04		48.38	48	.58		
TOTAL RAINFALL	(mm)=	72.84		72.84	72	.84		
RUNOFF COEFFICI	ENT =	0.99		0.66	0	.67		

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP! ***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20% YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES: CN* = 85.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0205)				
1 + 2 = 3	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (0202):	0.32	0.168	1.50	66.99
+ ID2= 2 (0203):	0.06	0.034	1.50	66.73
========================	=======	==========	========	=====
ID = 3 (0205):	0.38	0.202	1.50	66.94

וא חסא	 /D (020	 5)					
	2 = 1		ARFA	ΟΡΕΑΚ	TPF	AK R.V.	
			(ha)	(cms)	(hr	s) (mm`)
	ID1= 3 (0205):	0.38	0.202	ì.5	66.94	, ,
+	ID2= 2 (0204):	0.25	0.046	1.6	48.58	
	ID = 1 (0205):	0.63	0.224	 1.5	====== 0 59.65	
NO	TE: PEAK	FLOWS DO	NOT INCLU	DE BASEFL	OWS I	F ANY.	
RESER	 VOIR(0206 > OUT=	 5) 1	OVERFLOW I	S OFF			
DT= !	5.0 min	İ	OUTFLOW	STORAGE		OUTFLOW	STORAGE
			(cms)	(ha.m.)		(cms)	(ha.m.)
			0.0000	0.000	90	0.0537	0.0085
			0.0153	0.000	99	0.0564	0.0094
			0.0230	0.001	L8	0.0589	0.0102
			0.0287	0.002	27	0.0614	0.0111
			0.0334	0.003	37	0.0637	0.0119
			0.0376	0.004	13	0.0660	0.0128
			0.0413	0.005		0.0744	0.0136
			0.0447	0.000	50 - 0	0.0752	0.0137
			0.0479	0.000	ן אמ ו די	0.0775	0.0138
			0.0505	0.007		0.0710	0.0138
			ARF		АК	TPEAK	R.V.
			(ha	i) (cn	15)	(hrs)	(mm)
INFL	OW : ID= 2	(0205	6) 0.6	30 6).224	1.50	59.65
OUTFI	LOW: ID= 1	0206	j) 0.e	30 6	9.072	1.83	59.64
		PEAK TIME S MAXIMU	FLOW RE HIFT OF PE M STORAGE	DUCTION AK FLOW USED	[Qout/	(Qin](%)= 3 (min)= 20 (ha.m.)= 0	2.15 0.00 .0134
איא DDA	YD (020	7)					
1+	2 = 3		AREA	QPEAK	TPE	AK R.V	
			(ha)	(cms)	(hr	's) (mm))
	ID1= 1 (0201):	0.16	0.045	1.5	51.93	
+	1D2 = 2 (0206):	0.63	0.072	1.8	59.64	
	ID = 3 (0207):		 0.097	===== 1.5	====== 8 58.07	

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

0.16	7 2.77	/ 1.167 11.	76 2.167	11.02 3.17	3.89
0.33	3 3.17	/ 1.333 24.	86 2.333	8.45 3.33	3.51
0.50	0 3.76	1.500 129.	82 2.500	6.84 3.50	3.21
Ø. 66	7 4.4	$5 \mid 1.667 66.$	18 2.667	5.74 3.67	2.95
0.83	3 5 61	1 1 833 26	$27 \mid 2.833$	4 95 3 83	2 74
1 00	0 7 61	20.	68 3 000	4 35 4 4 4 4 4	2.74
1.00	,	1 2.000 13.		1.55 1.00	2.35
<pre>Max.Eff.Inten.(</pre>	mm/hr)=	129.82	83.77		
over	(min)	10.00	10.00		
Storage Coeff.	(min)=	2.35 (ii)	5.08 (ii`)	
Unit Hvd. Tpeak	(min)=	10.00	10.00	,	
Unit Hvd. peak	(cms) =	0.17	0.15		
onie nyat peak	((()))	012/	0125	*TOTALS*	
	(cms)-	Q Q1	Q Q2	0 034 (iii)	
	(cms) =	1 50	1 50	1 50	
	(1113) = (mm) =	I.30	25 75	1.50	
TOTAL BATNEALL	(mm)-	59.55	55.75	40.79	
	(mm)=	0.00	00.35	00.35	
KUNOFF CUEFFICI		0.99	0.59	0.00	
***** WARNING: STORA	GE COEFF.	IS SMALLER THA	AN TIME STEP!		
(i) CN PROCED	URE SELEC	TED FOR PERVIO	JS LOSSES:		
CN* =	85.0 1	a = Dep. Stora	ge (Above)		
(11) IIME SIEP	(DI) SHO	ULD BE SMALLER	OR EQUAL		
THAN THE	STORAGE (COEFFICIENT.			
(iii) PEAK FLOW	DOES NOT	INCLUDE BASEF	LOW IF ANY.		
		(1) 0			
STANDHYD (0202)	Area	(ha)= 0.32		(0)	
ID= 1 DT= 5.0 min	Total	Imp(%) = 82.70	Dir. Conn	.(%)= 82.70	
	•		PERVITOUS (1)	
Sunface Anon	$(h_2)_{-}$	0 26	0.06	/	
Don Stonage	(11a)= (mm)_	1 00	1 50		
Nonaga Clans	(1111)=	E 00 T.00	1.50 2 00		
Average Stope	(%)=	5.00	2.00		
Length	(m)=	46.19	3.00		
mannings n	=	0.130	0.250		
Max.Eff.Inten.(mm/hr)=	188.05	81.58		
over	(min)	5.00	5.00		
Storage Coeff	$(\min) =$	3.07 (ii)	3.69 (ii)	
Unit Hvd Tneak	$(\min) =$	5 00 (11)	5 00 (11)	/	
Unit Hyd. ipeak	(cmc) -	0.00 0.07	0.00		
оптс пуй. реак	(CIIIS)=	0.2/	0.25	*T0T11 C*	
	(cmc) =	A 17	0 01	0 100 /:::)	
TEAN FLUW	(cmS) = (bmc)	U.IZ 1 FO	1 50	1 FO 1 FO	
	$(\Pi S) =$	T.20	1.20	1.20	
KUNUEE VULUME	(mm)=	59.35	33.40	54.85	
IUIAL KAINFALL	(mm) =	60.35	60.35	60.35	

RUNOFF COEFFICIEN	IT =	0.98	0.55	0.91					
**** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!									
 (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES: CN* = 85.0 Ia = Dep. Storage (Above) (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT. (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY. 									
	Area Total :	(ha)= 0. Imp(%)= 81.	.06 .80 Dir. Conn.(%	6)= 81.80					
			DERVIOUS (i)						
Surface Area	(ha) =	0 05	0.01						
Dep. Storage	(mm) =	1.00	1.50						
Average Slope	(%)=	5.00	2.00						
Length	(m)=	20.00	3.00						
Mannings n	=	0.130	0.250						
Max.Eff.Inten.(mm	ı/hr)=	188.05	81.58						
over (min)	5.00	5.00						
Storage Coeff. (min)=	1.86 (i	li) 2.49 (ii)						
Unit Hyd. Tpeak (min)=	5.00	5.00						
Unit Hyd. peak (cms)=	0.32	0.29						
		0.00	0.00	*TOTALS*					
PEAK FLOW (cms)=	0.02	0.00	0.027 (111)					
TIME TO PEAK (hrs)=	1.50	1.50	1.50					
RUNUFF VULUME	(mm)=	59.35	33.40 60.35	54.61					
RUNOFF COEFFICIEN	(mm)= IT =	0.98	0.55	0.90					
***** WARNING: STORAGE	COEFF.	IS SMALLER	THAN TIME STEP!						
(i) CN PROCEDUR	E SELECT	TED FOR PERV	IOUS LOSSES:						
CN* = 85	.0 Ia	a = Dep. Sto	rage (Above)						
(11) TIME STEP (DT) SHOU	JLD BE SMALL	ER OR EQUAL						
IHAN IHE SI	ORAGE C	UEFFICIENI.							
(III) PEAK FLOW D		INCLUDE DAS	EFLOW IF ANY.						
	A		25						
SIANDHYD (0204)	Area	(ha)= 0.	25 70 Din Carr (*	() 1.00					
חדש מימד=ות ד =חדו	ισται .	$\lim_{n \to \infty} (\infty) = 23.$	יוע שור. Conn.(%	o)= T.00					
		IMPERVIOUS	PERVIOUS (i)						

(ha)=	0.06	0.19
(mm)=	0.80	1.50
(%)=	2.00	2.00
(m)=	40.82	40.00
=	0.130	0.250
	(ha)= (mm)= (%)= (m)= =	(ha)= 0.06 (mm)= 0.80 (%)= 2.00 (m)= 40.82 = 0.130

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME	RAIN	TIME	RAIN	' TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	' hrs	mm/hr	hrs	mm/hr
0.167	2.77	1.167	11.76	2.167	11.02	3.17	3.89
0.333	3.17	1.333	24.86	2.333	8.45	3.33	3.51
0.500	3.70	1.500	129.82	2.500	6.84	3.50	3.21
0.667	4.45	1.667	66.18	2.667	5.74	3.67	2.95
0.833	5.61	1.833	26.27	2.833	4.95	3.83	2.74
1.000	7.61	2.000	15.68	3.000	4.35	4.00	2.55

Max.Eff.Inten.(n	nm/hr)=	129.82	98.96	
over	(min)	10.00	20.00	
Storage Coeff.	(min)=	4.35	(ii) 11.43	(ii)
Unit Hyd. Tpeak	(min)=	10.00	20.00	
Unit Hyd. peak	(cms)=	0.15	0.08	
				TOTALS
PEAK FLOW	(cms)=	0.00	0.03	0.033 (iii)
TIME TO PEAK	(hrs)=	1.50	1.67	1.67
RUNOFF VOLUME	(mm)=	59.55	37.38	37.56
TOTAL RAINFALL	(mm)=	60.35	60.35	60.35
RUNOFF COEFFICIE	ENT =	0.99	0.62	0.62

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP! ***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20% YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES: CN* = 85.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0205)				
1 + 2 = 3	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (0202):	0.32	0.133	1.50	54.85
+ ID2= 2 (0203):	0.06	0.027	1.50	54.61

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (020 3 + 2 = 1 ID1= 3 (+ ID2= 2 (====== ID = 1 (0205): 0205): 0204): 0205):	AREA (ha) 0.38 0.25 0.63	QPEAK (cms) 0.160 0.033 ================================	TPEAK (hrs) 1.50 1.67 1.50	R.V. (mm) 54.81 37.56 ==== 47.96							
NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.												
RESERVOIR(020 IN= 2> OUT= DT= 5.0 min	 6) OVE 1 OUT (c 0 0 0 0 0 0 0 0 0 0 0 0 0	RFLOW IS FLOW 5 ms) .0000 .0153 .0230 .0287 .0334 .0376 .0413 .0447 .0479 .0479	OFF STORAGE (ha.m.) 0.0000 0.0009 0.0018 0.0027 0.0037 0.0043 0.0051 0.0060 0.0068 0.0068	OUTFI (cms 6 6 6 6 6 6 6	-OW ST(5) (h; 3.0537 3.0564 3.0589 3.0614 3.0637 3.0660 3.0744 3.0752 3.0775	DRAGE a.m.) 0.0085 0.0094 0.0102 0.0111 0.0119 0.0128 0.0136 0.0137 0.0138 0.0138						
INFLOW : ID= 2 OUTFLOW: ID= 2	2 (0205) L (0206) PEAK FL TIME SHIF MAXIMUM S	AREA (ha) 0.630 0.630 0.630 0.630 T OF PEA STORAGE	QPEAk (cms) 0 0.1 0 0.6 UCTION [Qd K FLOW USED	(TPP) (hr 176 958 put/Qin] (m: (ha.r	EAK rs) 1.50 1.83 (%)= 33.1 in)= 20.0 n.)= 0.01	R.V. (mm) 47.96 47.95 1 0 .01						
ADD HYD (020 1 + 2 = 3 ID1= 1 (+ ID2= 2 (07) 0201): 0206):	AREA (ha) 0.16 (40.79 0.63 (QPEAK (cms) 0.034 0.058	TPEAK (hrs) 1.50 1.83	R.V. (mm) 47.95							

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

_____ ** SIMULATION:2yr 3hr 5min Chicago ** _____ | CHICAGO STORM | IDF curve parameters: A= 854.100 | Ptotal= 33.23 mm | B= 7.781 C= 0.830 ------INTENSITY = $A / (t + B)^{C}$ used in: Duration of storm = 3.00 hrs Storm time step = 5.00 min Time to peak ratio = 0.38 TIME TIME RAIN | TIME RAIN |' TIME RAIN RAIN mm/hr | hrs hrs mm/hr | hrs mm/hr | hrs mm/hr 3.57 0.00 2.37 | 0.75 8.07 | 1.50 10.29 | 2.25 0.08 2.56 0.83 11.14 | 1.58 8.50 | 2.33 3.34 0.17 2.79 | 0.92 17.74 | 1.67 7.24 | 2.42 3.13 0.25 3.07 | 1.00 39.66 | 1.75 6.30 | 2.50 2.95 0.33 3.41 1.08 103.05 1.83 5.58 2.58 2.79 0.42 3.85 | 1.17 47.46 | 1.92 5.01 | 2.67 2.65 0.50 4.42 1.25 26.04 2.00 4.55 2.75 2.52 0.58 5.20 | 1.33 17.46 | 2.08 4.17 | 2.83 2.41 0.67 6.32 | 1.42 12.99 | 2.17 3.85 | 2.92 2.30 | CALIB | STANDHYD (0201)| Area (ha)= 0.16 |ID= 1 DT=10.0 min | Total Imp(%)= 32.30 Dir. Conn.(%)= 21.20 ------IMPERVIOUS PERVIOUS (i) Surface Area (ha)= 0.05 0.11 0.80 (mm)= Dep. Storage 1.50 Average Slope (%)= 10.00 15.00 Length 32.66 20.00 (m) =Mannings n 0.130 0.250 =

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

TRANSFORMED HYETOGRAPH								
TIME	RAIN	TIME	RAIN	' TIME	RAIN	TIME	RAIN	
hrs	mm/hr	hrs	mm/hr	' hrs	mm/hr	hrs	mm/hr	
0.167	2.47	1.000	14.44	1.833	6.77	2.67	2.87	

5.30 | 2.83 0.333 2.93 | 1.167 71.36 | 2.000 2.58 0.500 3.63 | 1.333 36.75 | 2.167 4.36 | 3.00 2.35 4.81 | 1.500 15.22 | 2.333 3.71 | 0.667 7.19 | 1.667 9.40 | 2.500 3.23 0.833 Max.Eff.Inten.(mm/hr)= 71.36 31.16 over (min) 10.00 10.00 2.98 (ii) Storage Coeff. (min)= 7.04 (ii) 10.00 Unit Hyd. Tpeak (min)= 10.00 Unit Hyd. peak (cms)= 0.16 0.13 *TOTALS* PEAK FLOW (cms)= 0.01 0.01 0.014 (iii) TIME TO PEAK (hrs)= 1.17 1.17 1.17 RUNOFF VOLUME (mm)= 32.43 14.48 18.27 33.23 TOTAL RAINFALL (mm)= 33.23 33.23 RUNOFF COEFFICIENT = 0.98 0.44 0.55 ***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP! (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES: CN* = 85.0 Ia = Dep. Storage (Above) (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT. (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY. _____ | CALIB STANDHYD (0202) Area (ha)= 0.32 |ID= 1 DT= 5.0 min | Total Imp(%)= 82.70 Dir. Conn.(%)= 82.70 _____ IMPERVIOUS PERVIOUS (i) Surface Area (ha)= 0.26 0.06 Dep. Storage (mm)= 1.00 1.50 (%)= Average Slope 5.00 2.00 Length (m)= 46.19 3.00 Mannings n 0.130 0.250 = Max.Eff.Inten.(mm/hr)= 103.05 31.04 over (min) 5.00 5.00 3.90 (ii) Storage Coeff. (min)= 4.69 (ii) Unit Hyd. Tpeak (min)= 5.00 5.00 Unit Hyd. peak (cms)= 0.25 0.22 *TOTALS* PEAK FLOW 0.06 0.00 (cms)= 0.066 (iii) TIME TO PEAK (hrs)= 1.17 1.17 1.17 RUNOFF VOLUME (mm)= 32.23 13.15 28.92 TOTAL RAINFALL (mm)= 33.23 33.23 33.23 RUNOFF COEFFICIENT = 0.97 0.40 0.87

***** WARNING: STORA	GE COEFF.	IS SMALLER	THAN TIME ST	EP!		
(1) CN PROCED	JKE SELEC	TED FOR PER	VIOUS LOSSES:	`		
		a = Dep. St	orage (Above	?)		
(II) IIME SIEP TUAN TUE	(DI) SHU STOPACE (OLD BE SMAL	LER OR EQUAL			
(iii) PEAK FLOW	DOES NOT	TNCLUDE BA	SEELOW TE AN⊻			
(III) FLAK ILOW	DOLS NOT	INCLUDE DA	SEILOW II ANI	•		
CALIB						
STANDHYD (0203)	Area	(ha)= 0	0.06			
ID= 1 DT= 5.0 min	Total	Imp(%)= 83	1.80 Dir.Co	onn.(%)=	81.80	
				(:)		
Curr Face Area	(ha)	IMPERVIOUS	PERVIOUS	(1)		
Surface Area	(na)= (mm)	0.05	0.01			
Dep. Storage	(mm)= (%)-	1.00	1.50			
Length	(n) = (m)	20 00	2.00			
Mannings n	("")=	0.130	0.250			
1011121185		01200	01290			
Max.Eff.Inten.(mm/hr)=	103.05	31.04			
over	(min)	5.00	5.00			
Storage Coeff.	(min)=	2.36 ((ii) 3.17 ((ii)		
Unit Hyd. Tpeak	(min)=	5.00	5.00			
Unit Hyd. peak	(cms)=	0.30	0.27			
				T	OTALS	
PEAK FLOW	(cms)=	0.01	0.00		0.014 (iii)	
ΤΙΜΕ ΤΟ ΡΕΑΚ	(hrs)=	1.17	1.17		1.17	
RUNOFF VOLUME	(mm)=	32.23	13.15		28.73	
TOTAL RAINFALL	(mm)=	33.23	33.23		33.23	
RUNUFF CUEFFICI	ENI =	0.97	0.40		0.80	
**** WARNING. STORA	GE COFFE	TS SMALLER	τηση ττωε στ	FDI		
	GE COLIT.	15 SHALLEN		LI .		
(i) CN PROCED	JRE SELEC	TED FOR PER	VIOUS LOSSES:			
CN* =	85.0 1	a = Dep. St	orage (Above	2)		
(ii) TIME STEP	(DT) SHC	ULD BE SMAL	LER OR EQUAL			
THAN THE	STORAGE (OEFFICIENT	•			
(iii) PEAK FLOW	DOES NOT	INCLUDE BA	SEFLOW IF ANY	•		
STANDHYD (0204)	Area	(ha)= 0	9.25			
ID= 1 DT=10.0 min	Total	$Imp(\%) = 2^{-3}$	8.70 Dir.Co	onn.(%)=	1.00	
		······································				
		IMPERVIOUS	PERVIOUS	(i)		
Surface Area	(ha)=	0.06	0.19			
Dep. Storage	(mm)=	0.80	1.50			

Average Slope	(%)=	2.00	2.00
Length	(m)=	40.82	40.00
Mannings n	=	0.130	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

		TRA	NSFORME	D HYETOGRAF	РН		
TIME	E RAIN	TIME	RAIN	' TIME	RAIN	TIME	RAIN
hrs	s mm/hr	hrs	mm/hr	' hrs	mm/hr	hrs	mm/hr
0.167	7 2.47	1.000	14.44	1.833	6.77	2.67	2.87
0.333	3 2.93	1.167	71.36	2.000	5.30	2.83	2.58
0.500	3.63	1.333	36.75	2.167	4.36 İ	3.00	2.35
0.667	7 4.81	1.500	15.22	2.333	3.71		
0.833	3 7.19	1.667	9.40	2.500	3.23		
					·		
Max.Eff.Inten.(n	nm/hr)=	71.36		32.98			
over	(min)	10.00		20.00			
Storage Coeff.	(min)=	5.52	(ii)	16.52 (ii)			
Unit Hyd. Tpeak	(min)=	10.00		20.00			
Unit Hyd. peak	(cms)=	0.14		0.06			
					TOTA	NLS	
PEAK FLOW	(cms)=	0.00		0.01	0.0	011 (iii)	
TIME TO PEAK	(hrs)=	1.17		1.50	1.	.50	
RUNOFF VOLUME	(mm)=	32.43		15.44	15.	. 58	
TOTAL RAINFALL	(mm)=	33.23		33.23	33.	.23	
RUNOFF COEFFICIE	ENT =	0.98		0.46	0.	.47	

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP! ***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20% YOU SHOULD CONSIDER SPLITTING THE AREA.

> (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES: CN* = 85.0 Ia = Dep. Storage (Above)
> (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.

(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0205) 1 + 2 = 3 | AREA QPEAK TPEAK R.V. (ha) (cms) (hrs) (mm) ID1= 1 (0202): 0.32 0.066 1.17 28.92 + ID2= 2 (0203): 0.06 0.014 1.17 28.73 ID = 3 (0205): 0.38 0.080 1.17 28.89

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0205	5)					
3 + 2 = 1		AREA	QPEAK (cms)	TPEAK	R.V. (mm)	
ID1= 3 (0205):	0.38	0.080	1.17	(1111)	
+ ID2= 2 (0204):	0.25	0.011	1.50	15.58	
ID = 1 (0205):	0.63	0.085	1.17	23.61	
NOTE: PEAK F	LOWS DO NO	T INCLU	DE BASEFLOW	IS IF A	NY.	
RESERVOIR(0206) OVE	RFLOW I	S OFF			
IN= 2> OUT= 1	L					
DT= 5.0 min	OUT	FLOW	STORAGE	OUT	FLOW	STORAGE
	(c	ms)	(ha.m.)	(c	ms)	(ha.m.)
	0	.0000	0.0000		0.0537	0.0085
	0	.0153	0.0009		0.0564	0.0094
	0	.0230	0.0018	ļ	0.0589	0.0102
	0	.0287	0.0027	ļ	0.0614	0.0111
	0	.0334	0.0037	ļ	0.0637	0.0119
	0	.0376	0.0043		0.0660	0.0128
	0	.0413	0.0051		0.0744	0.0136
	0	.0447	0.0060		0.0752	0.0137
	0	.0479	0.0068		0.0775	0.0138
	0	.0509	0.0077	I	0.8718	0.0138
		ARE	A QPEA	с т	PEAK	R.V.
		(ha) (cms) (hrs)	(mm)
INFLOW : ID= 2	(0205)	0.6	30 0.	ð85	1.17	23.61
OUTFLOW: ID= 1	(0206)	0.6	i 30 0.	036	1.42	23.60
	PEAK FL	OW RE	DUCTION [Q	out/Qin](%)= 42	2.37
	TIME SHIF	T OF PE	AK FLOW	(min)= 15	5.00
	MAXIMUM S	TORAGE	USED	(ha	.m.)= 0	.0041
ADD HYD (0207	7)				Б. V.	
ADD HYD (0207 1 + 2 = 3	7) 	AREA	QPEAK	TPEAK	K.V.	
ADD HYD (0207 1 + 2 = 3	7) 	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	к.v. (mm)	
ADD HYD (0207 1 + 2 = 3 ID1= 1 (7) 0201):	AREA (ha) 0.16	QPEAK (cms) 0.014	TPEAK (hrs) 1.17	R.V. (mm)	
ADD HYD (0207 1 + 2 = 3 ID1= 1 (7) 0201):	AREA (ha) 0.16 18.27	QPEAK (cms) 0.014	TPEAK (hrs) 1.17	R.V. (mm)	
ADD HYD (0207 1 + 2 = 3 ID1= 1 (+ ID2= 2 (7) 0201): 0206):	AREA (ha) 0.16 18.27 0.63	QPEAK (cms) 0.014 0.036	TPEAK (hrs) 1.17 1.42	R.V. (mm) 23.60	
ADD HYD (0207 1 + 2 = 3 ID1= 1 (+ ID2= 2 (7) 0201): 0206): 	AREA (ha) 0.16 18.27 0.63	QPEAK (cms) 0.014 0.036	TPEAK (hrs) 1.17 1.42	R.V. (mm) 23.60 ===== 22.51	

CHICAGO STORM Ptotal= 42.93 mm	IDF cur used in	ve para	meters: A I ENSITY =	A=1234.570 B= 8.29 C= 0.855 A / (t	6 7 1 + B)^C			
	Duratio	n of st	corm = 3	3.00 hrs				
Storm time step = 5.00 min								
	Time to	peak r	atio = 0	0.38				
TIME	RAIN	TIME	RAIN	' TIME	RAIN	TIME	RAIN	
hrs	mm/hr	hrs	mm/hr	' hrs	mm/hr	hrs	mm/hr	
0.00	2.80	0.75	10.17	1.50	13.13	2.25	4.31	
0.08	3.04	0.83	14.27	1.58	10.75	2.33	4.01	
0.17	3.33	0.92	23.16	1.67	9.08	2.42	3.75	
0.25	3.68	1.00	52.75	1.75	7.85	2.50	3.53	
0.33	4.11	1.08	136.52	1.83	6.91	2.58	3.33	
0.42	4.67	1.17	63.26	1.92	6.16	2.67	3.15	
0.50	5.40	1.25	34.39	2.00	5.57	2.75	2.99	
0.58	6.40	1.33	22.78	2.08	5.07	2.83	2.84	
0.67	7.87	1.42	16.75	2.17	4.66	2.92	2.71	

CALIB STANDHYD (0201) ID= 1 DT=10.0 min	Area Total	(ha)= Imp(%)=	0.16 32.30	Dir.	Conn.(%)=	21.20
Surface Area Dep. Storage Average Slope Length Mannings n	(ha)= (mm)= (%)= (m)= =	IMPERVI 0.0 0.8 10.0 32.6 0.13	DUS 5 9 9 6 9	PERVIOU 0.11 1.50 15.00 20.00 0.250	JS (i) L 0 0 0	

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

		TRA	ANSFORMED) HYETOGRA	APH		
TIME	RAIN	TIME	RAIN	' TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	' hrs	mm/hr	hrs	mm/hr
0.167	2.92	1.000	18.71	1.833	8.46	2.67	3.43
0.333	3.50	1.167	94.64	2.000	6.53	2.83	3.07
0.500	4.39	1.333	48.82	2.167	5.32	3.00	2.78
0.667	5.90	1.500	19.76	2.333	4.49		

0.833 9.02 | 1.667 11.94 | 2.500 3.88 | Max.Eff.Inten.(mm/hr)= 94.64 49.55 10.00 10.00 over (min) Storage Coeff. (min)=2.66 (ii)6.03 (ii)Unit Hyd. Tpeak (min)=10.0010.00Unit Hyd. peak (cms)=0.170.14 *TOTALS* PEAK FLOW 0.01 (cms)= 0.021 (iii) 0.01 (hrs)= 1.17 (mm)= 42.13 (mm)= 42.13 0.01 TIME TO PEAK (hrs)= 1.17 1.17 21.63 RUNOFF VOLUME 25.96 TOTAL RAINFALL (mm)= 42.93 42.93 42.93 RUNOFF COEFFICIENT = 0.98 0.50 0.60 ***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP! (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES: CN* = 85.0 Ia = Dep. Storage (Above) (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT. (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY. | CALIB | STANDHYD (0202)| Area (ha)= 0.32 |ID= 1 DT= 5.0 min | Total Imp(%)= 82.70 Dir. Conn.(%)= 82.70 _____ IMPERVIOUS PERVIOUS (i) Surface Area (ha)= 0.26 0.06 Dep. Storage (mm)= 1.00 1.50 $\binom{\%}{=}$ 5.00 2.00 $\binom{m}{=}$ 46.19 3.00 = 0.130 0.250 Average Slope Length Mannings n 136.52 Max.Eff.Inten.(mm/hr)= 49.17 over (min) 5.00 5.00 3.49 (ii) 4.19 (ii) 5.00 5.00 Storage Coeff. (min)= Unit Hyd. Tpeak (min)= Unit Hyd. peak (cms)= 0.26 0.24 *TOTALS* 0.01 (cms)= 0.08 (hrs)= 1.17 (mm)= 41.93 PEAK FLOW 0.091 (iii) TIME TO PEAK (hrs)= 1.17 1.17 19.90 RUNOFF VOLUME 38.11 42.93 TOTAL RAINFALL (mm)= 42.93 42.93 RUNOFF COEFFICIENT = 0.46 0.89 0.98

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:

CN* = 85.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB STANDHYD (0203) | Area (ha)= 0.06 |ID= 1 DT= 5.0 min | Total Imp(%)= 81.80 Dir. Conn.(%)= 81.80 _____ IMPERVIOUS PERVIOUS (i) Surface Area (ha)= 0.05 0.01 Dep. Storage Average Slope (mm) = 1.00 (%) = 5.00 (m) = 20.001.50 (%)= 2.00 Length 3.00 Mannings n 0.130 0.250 = Max.Eff.Inten.(mm/hr)= 136.52 49.17
 136.52
 49.17

 5.00
 5.00

 2.11 (ii)
 2.83 (ii)
 over (min) Storage Coeff. (min)= 5.00 Unit Hyd. Tpeak (min)= 5.00 Unit Hyd. peak (cms)= 0.31 0.28 *TOTALS* PEAK FLOW (cms)= 0.02 0.00 0.019 (iii) (hrs)= TIME TO PEAK 1.17 1.17 1.17 19.90 RUNOFF VOLUME(mm)=41.93TOTAL RAINFALL(mm)=42.93RUNOFF COEFFICIENT=0.98 37.89 42.93 42.93 0.46 0.88 ***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES: CN* = 85.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB STANDHYD (0204) Area (ha)= 0.25 |ID= 1 DT=10.0 min | Total Imp(%)= 23.70 Dir. Conn.(%)= 1.00 ______ IMPERVIOUS PERVIOUS (i) Surface Area (ha)= 0.06 0.19 Dep. Storage 1.50 (%)= Average Slope 2.00 40.00 Length Mannings n 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----TIME RAIN | TIME RAIN |' TIME RAIN TIME RAIN mm/hr |' hrs hrs mm/hr hrs mm/hr hrs mm/hr 2.92 | 1.000 18.71 | 1.833 8.46 | 2.67 0.167 3.43 0.333 3.50 | 1.167 94.64 | 2.000 6.53 | 2.83 3.07 0.500 4.39 | 1.333 48.82 | 2.167 5.32 | 3.00 2.78 5.90 | 1.500 19.76 | 2.333 4.49 0.667 9.02 | 1.667 11.94 | 2.500 3.88 | 0.833 Max.Eff.Inten.(mm/hr)= 94.64 59.30 over (min) 10.00 20.00 4.93 (ii) 13.63 (ii) Storage Coeff. (min)= Unit Hyd. Tpeak (min)= 10.00 20.00 Unit Hyd. peak (cms)= 0.15 0.07 *TOTALS* 0.02 0.00 1.17 PEAK FLOW (cms)= 0.019 (iii) TIME TO PEAK (hrs)= 1.33 1.33 TOTAL RAINFALL (mm)= 42.13 RUNOFF COEFFICIENT = 0.98 22.86 23.02 42.93 42.93 0.53 0.54 ***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP! ***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20% YOU SHOULD CONSIDER SPLITTING THE AREA. (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES: CN* = 85.0 Ia = Dep. Storage (Above) (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT. (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY. _____ ------ADD HYD (0205) AREA QPEAK TPEAK 1 + 2 = 3 R.V. (cms) (hrs) -----(ha) (mm) ID1= 1 (0202): 0.32 + ID2= 2 (0203): 0.06 0.091 1.17 38.11 0.019 1.17 37.89 _____ ID = 3 (0205):0.38 0.111 1.17 38.08 NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0205)			TDEAK	D V	
5 + Z =	⊥ 	AKEA (ba)	QPEAK	(hpc)	K.V. (mm)	
TD1= 3	(0205).	(11 <i>a</i>) 0 38	0 111	1 17	(1111)	
101- 3	(0205).	38.08	0.111	±•±/		
+ ID2= 2	(0204):	0.25	0.019	1.33	23.02	
====== ID = 1	(0205):	============== 0.63	0.119		32.10	
NOTE: PE	AK FLOWS DO) NOT INCLU	IDE BASEFL	OWS IF AN	IY.	
RESERVOIR((IN= 2> OU	0206) T= 1	OVERFLOW 1	LS OFF			
DT= 5.0 min	İ	OUTFLOW	STORAGE	OUT	FLOW S	TORAGE
		(cms)	(ha.m.)) (ci	ms) (ł	na.m.)
		0.0000	0.000	90	0.0537	0.0085
		0.0153	0.000	99	0.0564	0.0094
		0.0230	0.001	18	0.0589	0.0102
		0.0287	0.002	27	0.0614	0.0111
		0.0334	0.003	37	0.0637	0.0119
		0.0376	0.004	43	0.0660	0.0128
		0.0413	0.005	51	0.0744	0.0136
		0.0447	0.006	50	0.0752	0.0137
		0.0479	0.000	58	0.0775	0.0138
		0.0509	0.007	//	0.8/18	0.0138
		ARE	EA QPE	EAK T	PEAK	R.V.
		(ha	a) (cn	ns) (hrs)	(mm)
INFLOW : ID	= 2 (020	5) 0.6	530 6	9.119	1.17	32.10
OUTFLOW: ID	= 1 (0200	5) 0.6	530 6	0.045	1.42	32.09
	PEAK	FLOW RE	DUCTION [[Qout/Qin](%)= 38.	15
	TIME	SHIFT OF PI	EAK FLOW	(1	min)= 15.0	00 00
	MAXIM	UM STORAGE	USED	(ha	.m.)= 0.0	9062
ADD HYD (0207)					
1 + 2 =	3	AREA	QPEAK	TPEAK	R.V.	
		(ha)	(cms)	(hrs)	(mm)	
ID1= 1	(0201):	0.16	0.021	1.17	25.96	
+ ID2= 2	(0206):	0.63	0.045 ======	1.42	32.09	
ID = 3	(0207):	0.79	0.060	1.33	30.84	
NOTE DE	AK FLOWS DO	NOT INCLU	DE BASEFL	OWS IF AN	IY.	
NOTE: PE						

READ STORM	Filename:	C:\Us ata\L b27be	sers\cslo .ocal\Temp 8bb-5b62-	combe\Ap p\ 4d85-b50	pD f-b14cc96	5021e9\d5	6d26b0
Ptotal=193.00 mm	Comments:	Timmi	ns Storm.				
TIME hrs 0.00 1.00 2.00	RAIN mm/hr 15.00 20.00 10.00	TIME hrs 3.00 4.00 5.00	RAIN mm/hr 3.00 5.00 20.00	' TIME ' hrs 6.00 7.00 8.00	RAIN mm/hr 43.00 20.00 23.00	TIME hrs 9.00 10.00 11.00	RAIN mm/hr 13.00 13.00 8.00

CALIB					
STANDHYD (0201)	Area	(ha)=	0.16		
ID= 1 DT=10.0 min	Total	Imp(%)=	32.30	Dir. Conn.(%)=	21.20
		IMPERVI	OUS	PERVIOUS (1)	
Surface Area	(ha)=	0.0	5	0.11	
Dep. Storage	(mm)=	0.8	0	1.50	
Average Slope	(%)=	10.0	0	15.00	
Length	(m)=	32.6	6	20.00	
Mannings n	=	0.13	0	0.250	

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME	RAIN	TIME	RAIN	' TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	' hrs	mm/hr	hrs	mm/hr
0.167	15.00	3.167	3.00	6.167	43.00	9.17	13.00
0.333	15.00	3.333	3.00	6.333	43.00	9.33	13.00
0.500	15.00	3.500	3.00	6.500	43.00	9.50	13.00
0.667	15.00	3.667	3.00	6.667	43.00	9.67	13.00
0.833	15.00	3.833	3.00	6.833	43.00	9.83	13.00
1.000	15.00	4.000	3.00	7.000	43.00	10.00	13.00
1.167	20.00	4.167	5.00	7.167	20.00	10.17	13.00
1.333	20.00	4.333	5.00	7.333	20.00	10.33	13.00
1.500	20.00	4.500	5.00	7.500	20.00	10.50	13.00
1.667	20.00	4.667	5.00	7.667	20.00	10.67	13.00
1.833	20.00	4.833	5.00	7.833	20.00	10.83	13.00
2.000	20.00	5.000	5.00	8.000	20.00	11.00	13.00
2.167	10.00	5.167	20.00	8.167	23.00	11.17	8.00
2.333	10.00	5.333	20.00	8.333	23.00	11.33	8.00
2.500	10.00	5.500	20.00	8.500	23.00	11.50	8.00
2.667	10.00	5.667	20.00	8.667	23.00	11.67	8.00

2.833 10.00 | 5.833 20.00 | 8.833 23.00 | 11.83 8.00 10.00 | 6.000 20.00 9.000 23.00 | 12.00 3.000 8.00 46.73 Max.Eff.Inten.(mm/hr)= 43.00 over (min) 10.00 10.00 Storage Coeff. (min)= 3.65 (ii) 7.10 (ii) 10.00 Unit Hyd. Tpeak (min)= 10.00 Unit Hyd. peak (cms)= 0.16 0.13 *TOTALS* (cms)= PEAK FLOW 0.00 0.01 0.018 (iii) ΤΙΜΕ ΤΟ ΡΕΑΚ (hrs)= 6.83 7.00 7.00 192.20 RUNOFF VOLUME (mm)= 159.64 166.53 TOTAL RAINFALL (mm)= 193.00 193.00 193.00 RUNOFF COEFFICIENT = 1.00 0.83 0.86 ***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP! (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES: CN* = 85.0 Ia = Dep. Storage (Above) (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT. (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY. CALIB | STANDHYD (0202)| Area (ha)= 0.32 |ID= 1 DT= 5.0 min | Total Imp(%)= 82.70 Dir. Conn.(%)= 82.70 _____ IMPERVIOUS PERVIOUS (i) Surface Area 0.26 0.06 (ha)= Dep. Storage (mm)= 1.00 1.50 Average Slope (%)= 5.00 2.00 Length (m) =46.19 3.00 Mannings n 0.130 0.250 = NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP. ---- TRANSFORMED HYETOGRAPH ----RAIN |' TIME RAIN TIME TIME RAIN TIME RAIN mm/hr |' hrs mm/hr hrs hrs mm/hr | hrs mm/hr 15.00 | 3.083 3.00 | 6.083 43.00 | 9.08 0.083 13.00 0.167 15.00 | 3.167 3.00 | 6.167 43.00 9.17 13.00 0.250 15.00 | 3.250 3.00 | 6.250 43.00 | 9.25 13.00 15.00 | 3.333 3.00 | 6.333 43.00 | 9.33 0.333 13.00 0.417 15.00 3.417 3.00 6.417 43.00 9.42 13.00 15.00 | 3.500 3.00 | 6.500 0.500 43.00 9.50 13.00

0.583

0.667

15.00 | 3.583

15.00 | 3.667 3.00 | 6.667

3.00 | 6.583

43.00 | 9.58

43.00 | 9.67

13.00

13.00

0.75	0 15.00	3.750	3.00	6.750	43.00	9.75	13.00
0.83	3 15.00	3.833	3.00	6.833	43.00	9.83	13.00
0.91	7 15.00	3.917	3.00	6.917	43.00	9.92	13.00
1.00	0 15.00	4.000	3.00	7.000	43.00	10.00	13.00
1.08	3 20.00	4.083	5.00	7.083	20.00	10.08	13.00
1.16	7 20.00	4.167	5.00	7.167	20.00	10.17	13.00
1.25	0 20.00	4.250	5.00	7.250	20.00	10.25	13.00
1.33	3 20.00	4.333	5.00	7.333	20.00	10.33	13.00
1.41	7 20.00	4.417	5.00	7.417	20.00	10.42	13.00
1.50	0 20.00	4.500	5.00	7.500	20.00	10.50	13.00
1.58	3 20.00	4.583	5.00	7.583	20.00	10.58	13.00
1.66	7 20.00	4.667	5.00	7.667	20.00	10.67	13.00
1.75	0 20.00	4.750	5.00	7.750	20.00	10.75	13.00
1.83	3 20.00	4.833	5.00	7.833	20.00	10.83	13.00
1.91	7 20.00	4.917	5.00	7.917	20.00	10.92	13.00
2.00	0 20.00	5.000	5.00	8.000	20.00	11.00	13.00
2.08	3 10.00	5.083	20.00	8.083	23.00	11.08	8.00
2.16	7 10.00	5.167	20.00	8.167	23.00	11.17	8.00
2.25	0 10.00	5.250	20.00	8.250	23.00	11.25	8.00
2.33	3 10.00	5.333	20.00	8.333	23.00	11.33	8.00
2.41	7 10.00	5.417	20.00	8.417	23.00	11.42	8.00
2.50	0 10.00	5.500	20.00	8.500	23.00	11.50	8.00
2.58	3 10.00	5.583	20.00	8.583	23.00	11.58	8.00
2.66	7 10.00	5.667	20.00	8.667	23.00	11.67	8.00
2.75	0 10.00	5.750	20.00	8.750	23.00	11.75	8.00
2.83	3 10.00	5.833	20.00	8.833	23.00	11.83	8.00
2.91	7 10.00	5.917	20.00	8.917	23.00	11.92	8.00
3.00	0 10.00	6.000	20.00	9.000	23.00	12.00	8.00
Max.Eff.Inten.(mm/hr)=	43.00		39.44			
over	(min)	5.00		10.00			
Storage Coeff.	(min)=	5.53	(ii)	6.65 (i	i)		
Unit Hyd. Tpeak	(min)=	5.00		10.00			
Unit Hyd. peak	(cms)=	0.20		0.14			
					T0	TALS	
PEAK FLOW	(cms)=	0.03		0.01	0	.038 (iii	L)

PEAK FLOW	(cms)=	0.03	0.01	0.038 (ii
TIME TO PEAK	(hrs)=	7.00	7.00	7.00
RUNOFF VOLUME	(mm)=	192.00	155.18	185.62
TOTAL RAINFALL	(mm)=	193.00	193.00	193.00
RUNOFF COEFFICI	ENT =	0.99	0.80	0.96

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:

CN* = 85.0 Ia = Dep. Storage (Above)

- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 - THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB STANDHYD (0203) ID= 1 DT= 5.0 min	Area Total	(ha)= Imp(%)=	0.06 81.80	Dir. Conn.(%)=	81.80
		IMPERVI	DUS	PERVIOUS (i)	
Surface Area	(ha)=	0.0	5	0.01	
Dep. Storage	(mm)=	1.0	9	1.50	
Average Slope	(%)=	5.0	9	2.00	
Length	(m)=	20.0	9	3.00	
Mannings n	=	0.13	9	0.250	

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

		TRA	NSFORMED) HYETOGR	APH		
TIME	RAIN	TIME	RAIN	' TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	' hrs	mm/hr	hrs	mm/hr
0.083	15.00	3.083	3.00	6.083	43.00	9.08	13.00
0.167	15.00	3.167	3.00	6.167	43.00	9.17	13.00
0.250	15.00	3.250	3.00	6.250	43.00	9.25	13.00
0.333	15.00	3.333	3.00	6.333	43.00	9.33	13.00
0.417	15.00	3.417	3.00	6.417	43.00	9.42	13.00
0.500	15.00	3.500	3.00	6.500	43.00	9.50	13.00
0.583	15.00	3.583	3.00	6.583	43.00	9.58	13.00
0.667	15.00	3.667	3.00	6.667	43.00	9.67	13.00
0.750	15.00	3.750	3.00	6.750	43.00	9.75	13.00
0.833	15.00	3.833	3.00	6.833	43.00	9.83	13.00
0.917	15.00	3.917	3.00	6.917	43.00	9.92	13.00
1.000	15.00	4.000	3.00	7.000	43.00	10.00	13.00
1.083	20.00	4.083	5.00	7.083	20.00	10.08	13.00
1.167	20.00	4.167	5.00	7.167	20.00	10.17	13.00
1.250	20.00	4.250	5.00	7.250	20.00	10.25	13.00
1.333	20.00	4.333	5.00	7.333	20.00	10.33	13.00
1.417	20.00	4.417	5.00	7.417	20.00	10.42	13.00
1.500	20.00	4.500	5.00	7.500	20.00	10.50	13.00
1.583	20.00	4.583	5.00	7.583	20.00	10.58	13.00
1.667	20.00	4.667	5.00	7.667	20.00	10.67	13.00
1.750	20.00	4.750	5.00	7.750	20.00	10.75	13.00
1.833	20.00	4.833	5.00	7.833	20.00	10.83	13.00
1.917	20.00	4.917	5.00	7.917	20.00	10.92	13.00
2.000	20.00	5.000	5.00	8.000	20.00	11.00	13.00
2.083	10.00	5.083	20.00	8.083	23.00	11.08	8.00
2.167	10.00	5.167	20.00	8.167	23.00	11.17	8.00
2.250	10.00	5.250	20.00	8.250	23.00	11.25	8.00
2.333	10.00	5.333	20.00	8.333	23.00	11.33	8.00
2.417	10.00	5.417	20.00	8.417	23.00	11.42	8.00
2.500	10.00	5.500	20.00	8.500	23.00	11.50	8.00
2.583	10.00	5.583	20.00	8.583	23.00	11.58	8.00
2.667	10.00	5.667	20.00	8.667	23.00	11.67	8.00
2.750	10.00	5.750	20.00	8.750	23.00	11.75	8.00

10.00 | 5.833 20.00 | 8.833 23.00 | 11.83 2.833 8.00 10.00 | 5.917 20.00 | 8.917 2.917 23.00 | 11.92 8.00 3.000 10.00 | 6.000 20.00 | 9.000 23.00 | 12.00 8.00 Max.Eff.Inten.(mm/hr)= 43.00 39.44 over (min) 5.00 5.00 Storage Coeff. (min)= 3.35 (ii) 4.49 (ii) Unit Hyd. Tpeak (min)= 5.00 5.00 Unit Hyd. peak (cms)= 0.26 0.23 *TOTALS* 0.01 6.67 0.00 7.00 PEAK FLOW (cms)= 0.007 (iii) (hrs)= TIME TO PEAK 7.00 RUNOFF VOLUME(mm)=192.00TOTAL RAINFALL(mm)=193.00 155.18 185.24 193.00 193.00 RUNOFF COEFFICIENT = 0.99 0.80 0.96 ***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP! (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES: CN* = 85.0 Ia = Dep. Storage (Above) (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT. (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY. _____ | CALIB STANDHYD (0204) | Area (ha)= 0.25 Total Imp(%)= 23.70 Dir. Conn.(%)= 1.00 |ID= 1 DT=10.0 min | _____ IMPERVIOUS PERVIOUS (i) Surface Area (ha)= 0.06 0.19 Dep. Storage (mm)= 0.80 1.50 Average Slope (%)= 2.00 2.00 Length (m)= 40.82 40.00 Mannings n = 0.130 0.250 NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP. ---- TRANSFORMED HYETOGRAPH ----Ν

TIME	RAIN	TIME	RAIN	' TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	' hrs	mm/hr	hrs	mm/hr
0.167	15.00	3.167	3.00	6.167	43.00	9.17	13.00
0.333	15.00	3.333	3.00	6.333	43.00	9.33	13.00
0.500	15.00	3.500	3.00	6.500	43.00	9.50	13.00
0.667	15.00	3.667	3.00	6.667	43.00	9.67	13.00
0.833	15.00	3.833	3.00	6.833	43.00	9.83	13.00
1.000	15.00	4.000	3.00	7.000	43.00	10.00	13.00
1.167	20.00	4.167	5.00	7.167	20.00	10.17	13.00

1.333 20	0.00 4.3	33 5.00	9 7.333	20.00	10.33	13.00
1.500 20	0.00 4.5	00 5.00	9 7.500	20.00	10.50	13.00
1.667 20	0.00 4.6	67 5.00	9 7.667	20.00	10.67	13.00
1.833 20	9.00 4.8	33 5.00	9 7.833	20.00	10.83	13.00
2.000 20	9.00 5.0	00 5.00	9 8.000	20.00	11.00	13.00
2.167 10	9.00 5.1	67 20.00	9 8.167	23.00	11.17	8.00
2.333 10	9.00 5.3	33 20.00	9 8.333	23.00	11.33	8.00
2.500 10	0.00 5.5	00 20.00	9 8.500	23.00	11.50	8.00
2.667 10	3.00 5.6	67 20.00	9 8.667	23.00	11.67	8.00
2.833 10 3.000 10	0.00 5.8 0.00 6.0	33 20.00 00 20.00) 8.833) 9.000	23.00 23.00	11.83 12.00	8.00 8.00
Max.Eff.Inten.(mm/hr)= 43	.00	52.66			
over (min)	10	.00	20.00			
Storage Coeff. (min))= 6	.76 (ii)	15.89 (ii)		
Unit Hvd. Tpeak (min))= 10	.00	20.00	/		
Unit Hyd. peak (cms))= 0	.13	0.06			
	. 0			*T01	ALS*	
PEAK FLOW (cms))= Ø	.00	0.03	 	.027 (iii)
TIME TO PEAK (hrs)= 7	.00	7.00		7.00	- /
RUNOFF VOLUME (mm))= 192	.20	162.57	162	2.84	
TOTAL RAINFALL (mm)= 193	.00	193.00	193	3.00	
RUNOFF COEFFICIENT	= 1	.00	0.84	ē	9.84	
<pre>(i) CN PROCEDURE SE CN* = 85.0 (ii) TIME STEP (DT) THAN THE STORAG (iii) PEAK FLOW DOES</pre>	ELECTED FOI Ia = Dep SHOULD BE GE COEFFIC NOT INCLUI	R PERVIOUS D. Storage SMALLER O IENT. DE BASEFLO	LOSSES: (Above R EQUAL W IF ANY)		
ADD HYD (0205) 1 + 2 = 3 ID1= 1 (0202): + ID2= 2 (0203):	AREA (ha) 0.32 0.06	QPEAK (cms) 0.038 0.007	TPEAK (hrs) 7.00 7.00	R.V. (mm) 185.62 185.24		
======================================	e======== 0.38		========= 7.00	===== 185.56		
	NOT THE U					
NUTE: PEAK FLOWS DO	NUT INCLUL	E RASEFLO	WS IF AN	Υ.		

3 + 2 = 1	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 3 (0205):	0.38	0.045	7.00	185.56
+ ID2= 2 (0204):	0.25	0.027	7.00	162.84
ID = 1 (0205):	0.63	0.072	7.00	176.54

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

RESERVOIR(0206) IN= 2> OUT= 1	OVERFLOW I	S OFF		
DT= 5.0 min	OUTFLOW	STORAGE	OUTFLOW	STORAGE
	(cms)	(ha.m.)	(cms)	(ha.m.)
	0.0000	0.0000	0.0537	0.0085
	0.0153	0.0009	0.0564	0.0094
	0.0230	0.0018	0.0589	0.0102
	0.0287	0.0027	0.0614	0.0111
	0.0334	0.0037	0.0637	0.0119
	0.0376	0.0043	0.0660	0.0128
	0.0413	0.0051	0.0744	0.0136
	0.0447	0.0060	0.0752	0.0137
	0.0479	0.0068	0.0775	0.0138
	0.0509	0.0077	0.8718	0.0138
			TDEAK	D \/
	ARE (ba	A QPEAN	(hps)	К.V. (mm)
	(11a (11a (11a)) (CIIIS) 30 0.072	7 00	176 54
OUTELOW: $TD = 1$ (0205) 0.0 0206) 0.6	30 0.072	7.08	176.53
	0200) 010	50 01050	,	2,0000
Р	EAK FLOW RE	DUCTION [Oout	:/Oinl(%)= 80	0.32
Т	IME SHIFT OF PE	AK FLOW	(min)= 5	.00
M	AXIMUM STORAGE	USED	(ha.m.)= 0	.0099
ADD HYD (0207)	4554			
1 + 2 = 3	AREA	QPEAK IP	EAK R.V.	
TD1 1 / 00/	(na)	(cms) (n	rs) (mm)	
1020) C -COT -	0.10 0.10		00 176 53	
+ IDZ= Z (020		/.		
ID = 3 (020	 07): 0.79	0.075 7.	00 174.50	
Ϋ́,	•			

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

Appendix E Additional Information

E.1. Gamsby & Mannerow Limited 17th Street East SWM Study – 10th Street Undersized Pipes.

1			Deficienti Di		2				
Sub-		Location		Existi	ing Sewer	Data	Existing	Design Peak	%
Catchment #	Street	From	То	Diameter (mm)	Slope (%)	Length (m)	Capacity (m ³ /sec)	Flow (m ³ /sec)	Capacity
103	10TH Ave E	8 th st E	12m N of 8 th St E	250	1.6	12	0.075	0.153 (49.1%)	204.0%
103	10TH Ave E	62mN of 8 th St E	94m N of 8 th St E	375	0.3	32	0.096	0.186 (59.6%)	193.8%
103	10TH Ave E	94m N of 8 th St E	152m N of 8 th st E	375	0.5	58	0.124	0.218 (70.2%)	175.8%
103	10TH Ave E	152m N of 8 th St E	244m N of 8 th St E	375	2.1	92	0.254	0.273 (87.7%)	107.5%
103	10TH Ave E	12m S of 10 th St E	10 ¹¹¹ StE	375	0.8	12	0.157	0.311 (100%)	198.1%
104	10TH STE	lOrn Ave E (east leg)	10 ¹¹¹ Ave E (west leg)	600	0.4	123	0.388	0.926	238.7%
105	10TH STE	10 th Ave E (west leg)	9 th Ave E	675	0.2	143	0.376	1.070	284.6%
110	9TH Ave E	15' ¹¹ StAE	16 th St E	1050	0.2	193	1.221	1.935	158.5%

Table 4-1 - Catchment I00's Deficient Storm Sewers

4.1.3 Recommended Replacement Pipe Sizes

We recommend that the following storm sewer improvements be incorporated into road improvements planned within Catchment 100. These improvements are summarized in the following Table 4-2:

Sub-	Location			Propo	sed Sewer	Data	Proposed	Design	
Catchment #	Street	From	То	Diameter (mm)	Slope (%)	Length (m)	Sewer Capacity (m ³ /sec)	Peak Flow (m3 /sec)	% Capacity
103	10TH Ave E	8 th St E	12m N of _{gth} St E	525	1.6	12	0.544	0.153	28.1%
103	10TH Ave E	62m N of 8 th St E	94m N of 8 th St E	525	0.3	32	0.236	0.186	78.8%
103	10TH Ave E	94m N of 8 th St E	152mN of 8 th St E	525	0.5	58	0.304	0.218	71.7%
103	!Orn Ave E	152m N of 8 th St E	244mN of 8 th St E	450	2.1	92	0.413	0.273	66.1%
103	10TH Ave E	12m S of IO th StE	$10^{1h}\mathrm{st}\mathrm{E}$	525	0.8	12	0.385	0.311	80.8%
104	10TH STE	10 th Ave E (east leg)	10 th Ave E (west leg)	900	0.4	123	1.145	0.926	80.9%
105	10TH STE	IOrn Ave E (west leg)	9 th Ave E	1050	0.2	143	1.221	1.070	87.6%
110	9TH Ave E	15^{th} St A E	16 th St E	1350	0.2	193	2.387	1.935	81.1%

Table 4-2 - Catchment 100's Recommended Improvements