



vallee

*Consulting Engineers,
Architects & Planners*

December 15, 2023

Norfolk County
Community Development – Planning Department
185 Robinson Street
Simcoe, ON N3Y 5L6

Attention: Mr. Mohammad Alam

**Reference: Detailed Design Submission 1
Charles Street Subdivision
Waterford – Norfolk County
Our Project #21-169**

G. Douglas Vallee Limited has reviewed the conditions for the draft plan of subdivision required by Norfolk County for application 28TPL2022267. Please find the following items enclosed as part of our first detailed design submission:

- 1) Engineering Drawing Set, by G. Douglas Vallee Limited dated 2023-12-12.
- 2) Rev0 - Schedule H Securities Cost Estimate, by G. Douglas Vallee Limited dated 2023-12-15.
- 3) Functional Servicing Report, by G. Douglas Vallee Limited dated 2023-12-15.
- 4) Stormwater Management Report, by G. Douglas Vallee Limited dated 2023-12-15.
- 5) Rev1 - Revised Waterford South Municipal Drain Design Brief dated 2023-12-15.
- 6) Functional Servicing Report Appendix A – Charles Street Subdivision Transportation Impact Study, by Paradigm Transportation Solutions Limited dated 2022-06-16.

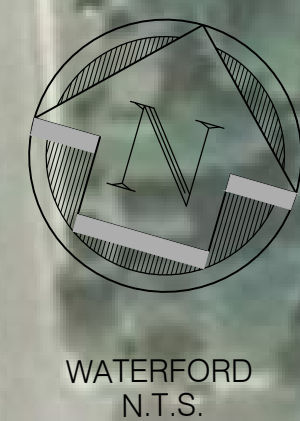
We request that this design submission be reviewed by the County's external review consultant and we trust that this information is complete and sufficient. Should you have any questions or require further information please do not hesitate to contact us.

Respectfully submitted,

Natalie Biesinger, P.Eng
G. DOUGLAS VALLEE LIMITED
Consulting Engineers, Architects and Planners

H:\Projects\2021\21-169 Legend Tire Waterford Development Charles\Agency\Submission\2023.12.15 - 1st Detailed Design Submission\21169 Submission 1 Cover Letter.docx

WATERFORD
NORFOLK COUNTY



G. DOUGLAS VALLEE LIMITED

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21-169-01	GENERAL PLAN OF SERVICES	
21-169-02	P&P WASHINGTON STREET	0+000 - 0+280
21-169-03	P&P CHARLES STREET	0+000 - 0+300
21-169-04	PLAN AND PROFILE STREET B	0+000 - 0+200
21-169-05	PLAN AND PROFILE STREET A	0+000 - 0+190
21-169-06	PLAN AND PROFILE STREET A	0+190 - 0+414
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21-169-SAN	SANITARY DRAINAGE AREA'S	
21-169-STM	STORM DRAINAGE AREA'S	
21-169-XS-01	CHARLES STREET CROSS SECTIONS	

1. SPIKE IN FACE OF WOOD HYDRO POLE ALONG WEST SIDE OF WASHINGTON STREET. 46m NORTH OF DWELLING AT #210.
ELEVATION 246.32
2. SPIKE IN FACE OF WOOD HYDRO POLE ALONG NORTH SIDE OF CHARLES STREET. 26m EAST OF CB IN FRONT OF DWELLING AT #173 EAST OF DRIVEWAY.
ELEVATION 241.91
2. SPIKE IN FACE OF WOOD HYDRO POLE ALONG NORTH SIDE OF CHARLES STREET. 3m SOUTHWEST OF CONCRETE SLANTED CB IN FRONT OF DWELLING @ 173 WEST OF DRIVEWAY.
ELEVATION 241.35

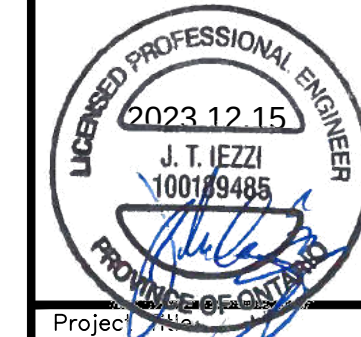
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NOTE:
THE CONTRACTOR IS CAUTIONED THAT ALL OF THE EXISTING UTILITIES ARE NOT INDICATED ON THIS DRAWING. THE CONTRACTOR MUST ARRANGE FOR LOCATES FROM EACH AREA UTILITY COMPANY PRIOR TO ANY CONSTRUCTION OR EXCAVATION. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR THE PROTECTION OF ALL UTILITIES INCLUDING THOSE NOT INDICATED ON THIS DRAWING. G. DOUGLAS VALLEE LTD. CAN NOT ACCEPT RESPONSIBILITY FOR DAMAGE TO ANY EXISTING UTILITY WHICH MAY OR MAY NOT BE INDICATED ON THIS DRAWING.



G. DOUGLAS VALLEE LIMITED
2 TALBOT STREET NORTH
SIMCOE, ONTARIO N3Y 3W4
(519) 426-6270

Stamp



Project

CHARLES STREET
SUBDIVISION
WATERFORD - NORFOLK COUNTY

Drawing Title

COVER PAGE

Designed by :

NBN/NLB

Checked by :

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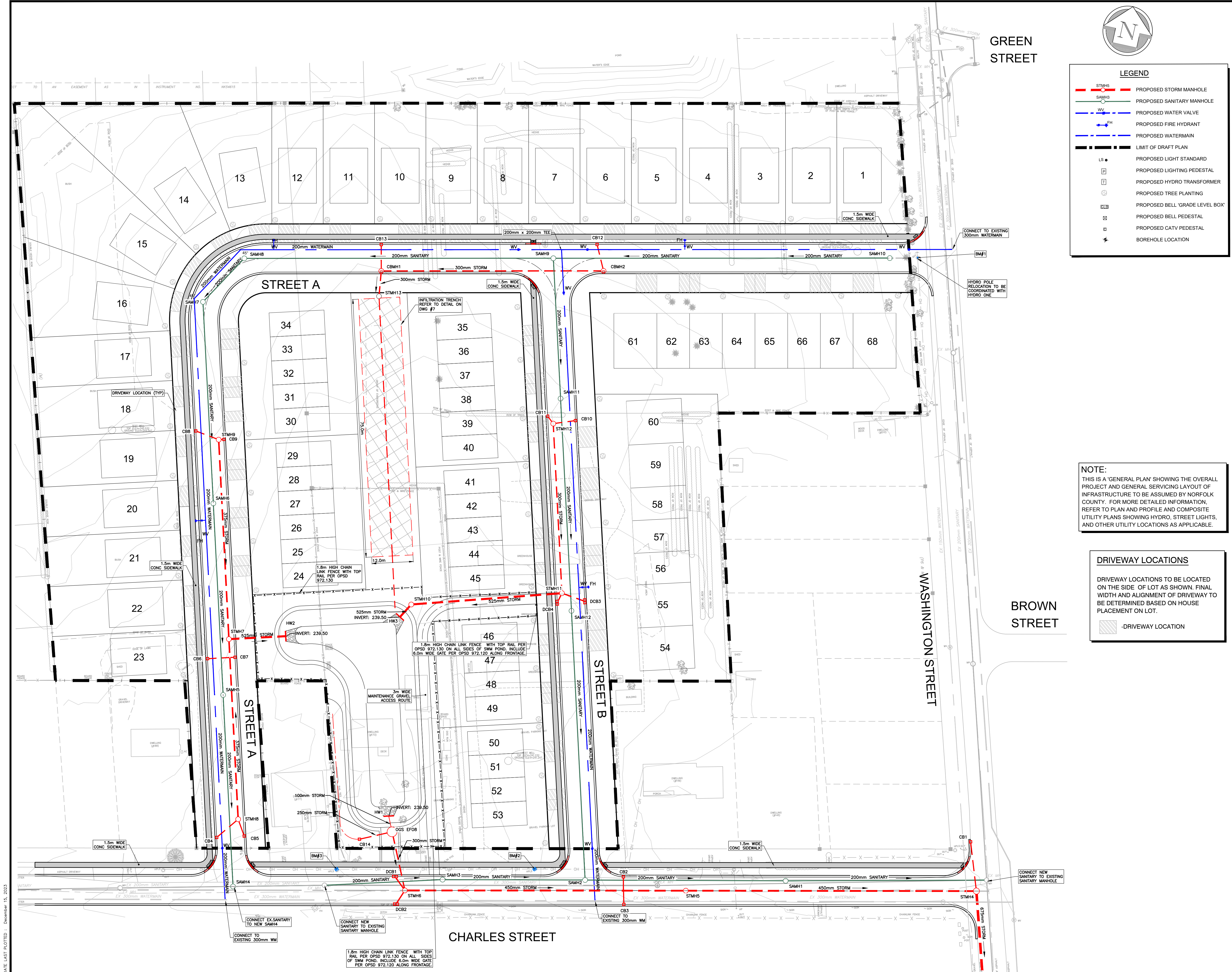
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Project No. 2-

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STMH5

SAH5

WV

FH

WM

LS

HT

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PROPOSED STORM MANHOLE

PROPOSED SANITARY MANHOLE

PROPOSED WATER VALVE

PROPOSED FIRE HYDRANT

PROPOSED WATERMAIN

LIMIT OF DRAFT PLAN

PROPOSED LIGHT STANDARD

PROPOSED LIGHTING PEDESTAL

PROPOSED HYDRO TRANSFORMER

PROPOSED TREE PLANTING

PROPOSED BELL 'GRADE LEVEL BOX'

PROPOSED BELL PEDESTAL

PROPOSED CATV PEDESTAL

BOREHOLE LOCATION

NOTE:

THIS IS A 'GENERAL PLAN' SHOWING THE OVERALL PROJECT AND GENERAL SERVICING LAYOUT OF INFRASTRUCTURE TO BE ASSUMED BY NORFOLK COUNTY. FOR MORE DETAILED INFORMATION, REFER TO PLAN AND PROFILE AND COMPOSITE UTILITY PLANS SHOWING HYDRO, STREET LIGHTS, AND OTHER UTILITY LOCATIONS AS APPLICABLE.

DRIVEWAY LOCATIONS

DRIVEWAY LOCATIONS TO BE LOCATED ON THE SIDE OF LOT AS SHOWN. FINAL WIDTH AND ALIGNMENT OF DRIVEWAY TO BE DETERMINED BASED ON HOUSE PLACEMENT ON LOT.

-DRIVEWAY LOCATION

REV. No.

DATE

REVISION

0

12/12/2023

FIRST SUBMISSION TO COUNTY

NOTE:

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SITE BENCHMARKS:

1.

SPIKE IN FACE OF WOOD HYDRO POLE ALONG WEST SIDE OF WASHINGTON STREET. 46m NORTH OF DWELLING AT #210. ELEVATION 246.32

2.

SPIKE IN FACE OF WOOD HYDRO POLE ALONG NORTH SIDE OF CHARLES STREET. 20m EAST OF CB IN FRONT OF DWELLING AT #173. ELEVATION 241.91

3.

SPIKE IN FACE OF WOOD HYDRO POLE ALONG NORTH SIDE OF CHARLES STREET. 3m SOUTHWEST OF CONCRETE SLANTED CB IN FRONT OF DWELLING AT #173 WEST OF DRIVEWAY. ELEVATION 241.35

DEPRESSED CURB FOR CROSSWALKS (DEPRESSED CURB AND TACTILE PLATES TO EXTEND FOR ENTIRE LENGTH OF 2.5m CROSSWALK WIDTH)

1.5m TAPER FOR DEPRESSED CURB

0

15

25

HORIZONTAL : 1 : 500

vallee

Consulting Engineers, Architects & Planners

G. DOUGLAS VALLEE LIMITED

2 TALBOT STREET NORTH

SIMCOE, ONTARIO N3Y 3W4

(519) 426-6270

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2023.12.15

J. T. JEZDI

100189408

PROVINCE OF ONTARIO

Project Title

CHARLES STREET SUBDIVISION

WATERFORD - NORFOLK COUNTY

Drawing Title

GENERAL PLAN OF SERVICES

Designed by :

NBN/NLB

Drawn By :

NBN

Checked by :

NLB/JTI

Date Started :

05/03/2023

Drawing Scale :

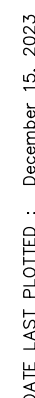
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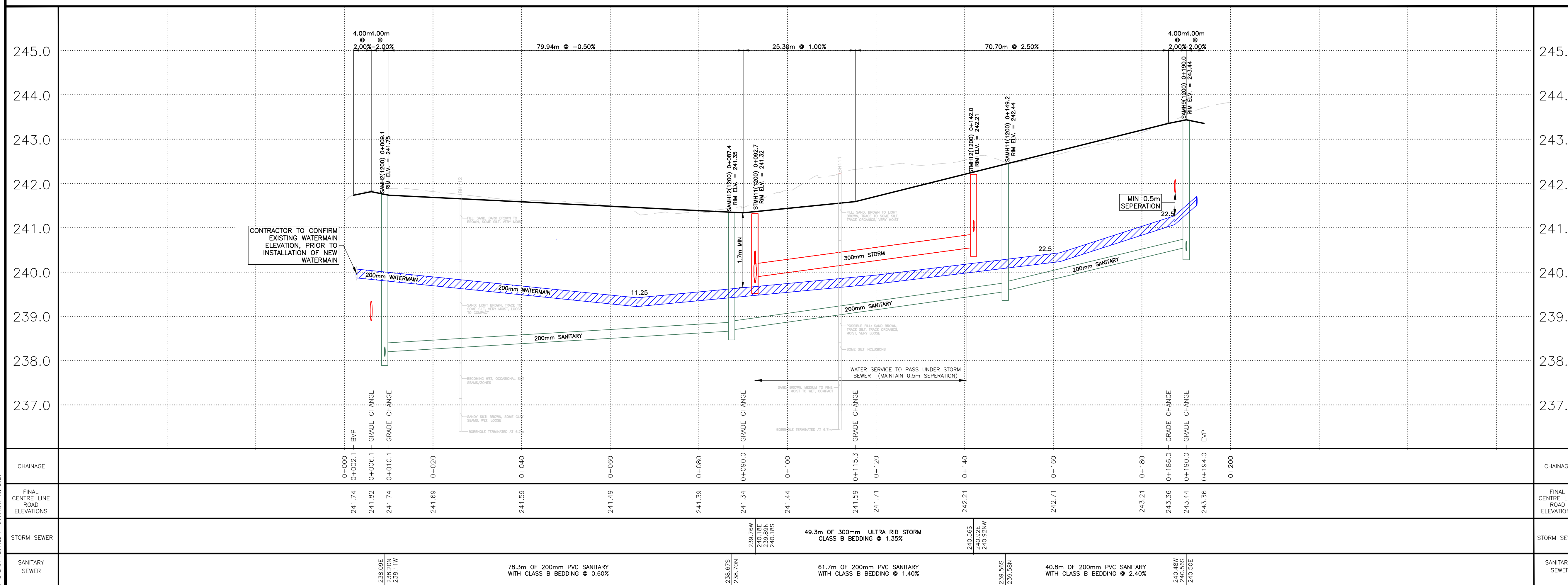
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Project No.

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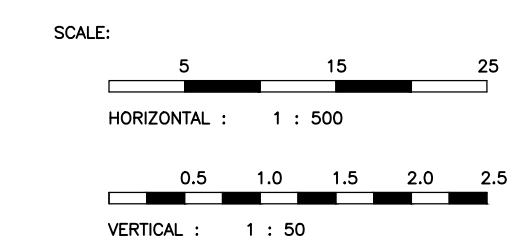


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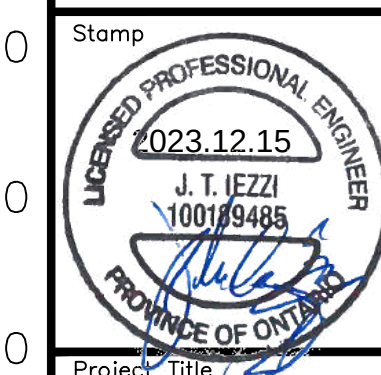
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	DEPRESSED CURB FOR CROSSWALKS (DEPRESSED CURB AND TACTILE PLATES TO EXTEND FOR ENTIRE LENGTH OF 2.5m CROSSWALK WIDTH)
	1.5m TAPER FOR DEPRESSED CURB

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G. DOUGLAS VALLEE LIMITED
2 TALBOT STREET NORTH
SIMCOE, ONTARIO N3Y 3W4
(519) 426-6270



Project Title CHARLES STREET
SUBDIVISION
WATERFORD - NORFOLK COUNTY

E	Drawing Title	PLAN AND PROFILE STREET
		0+000 - 0+190

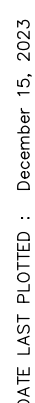
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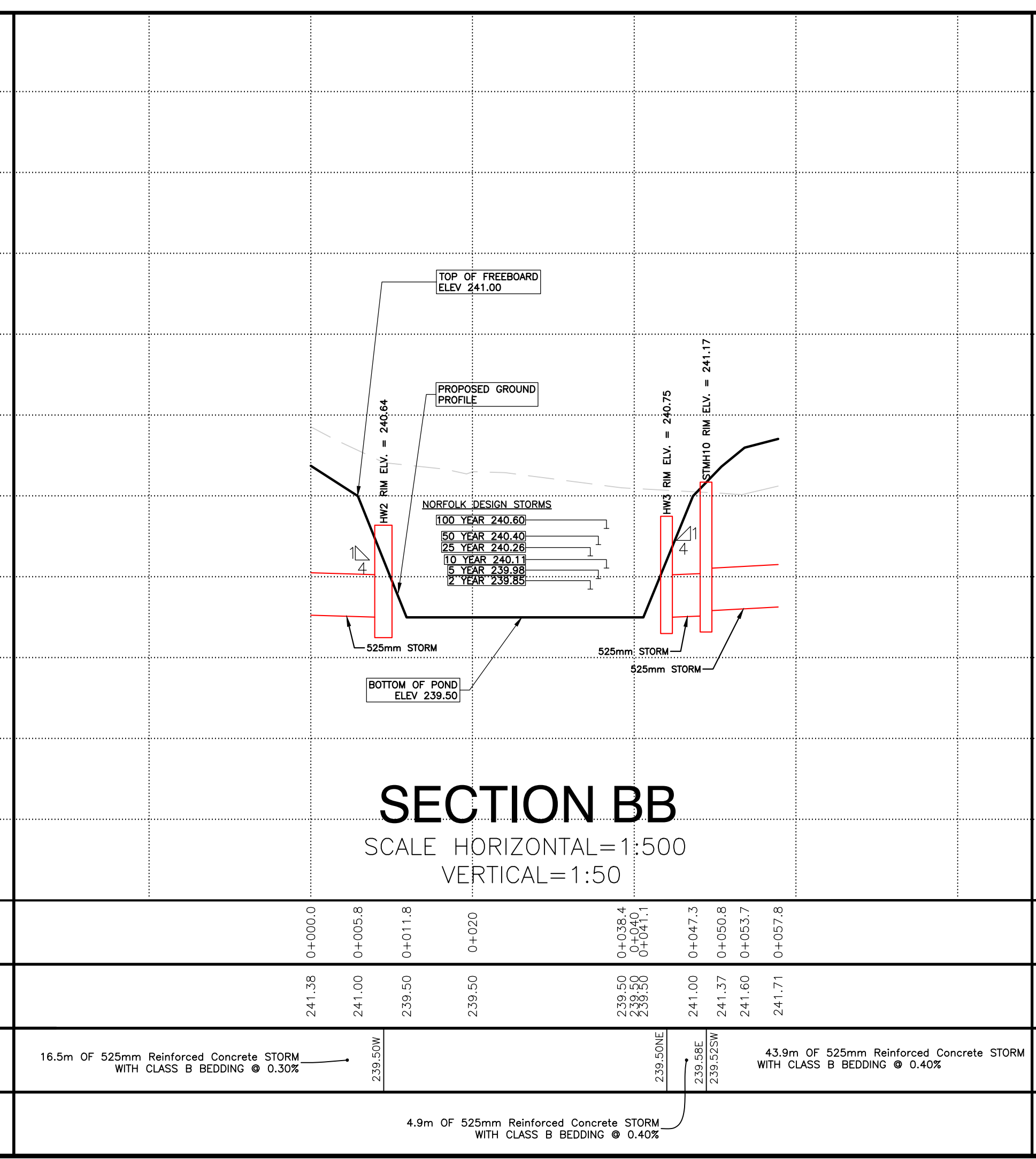
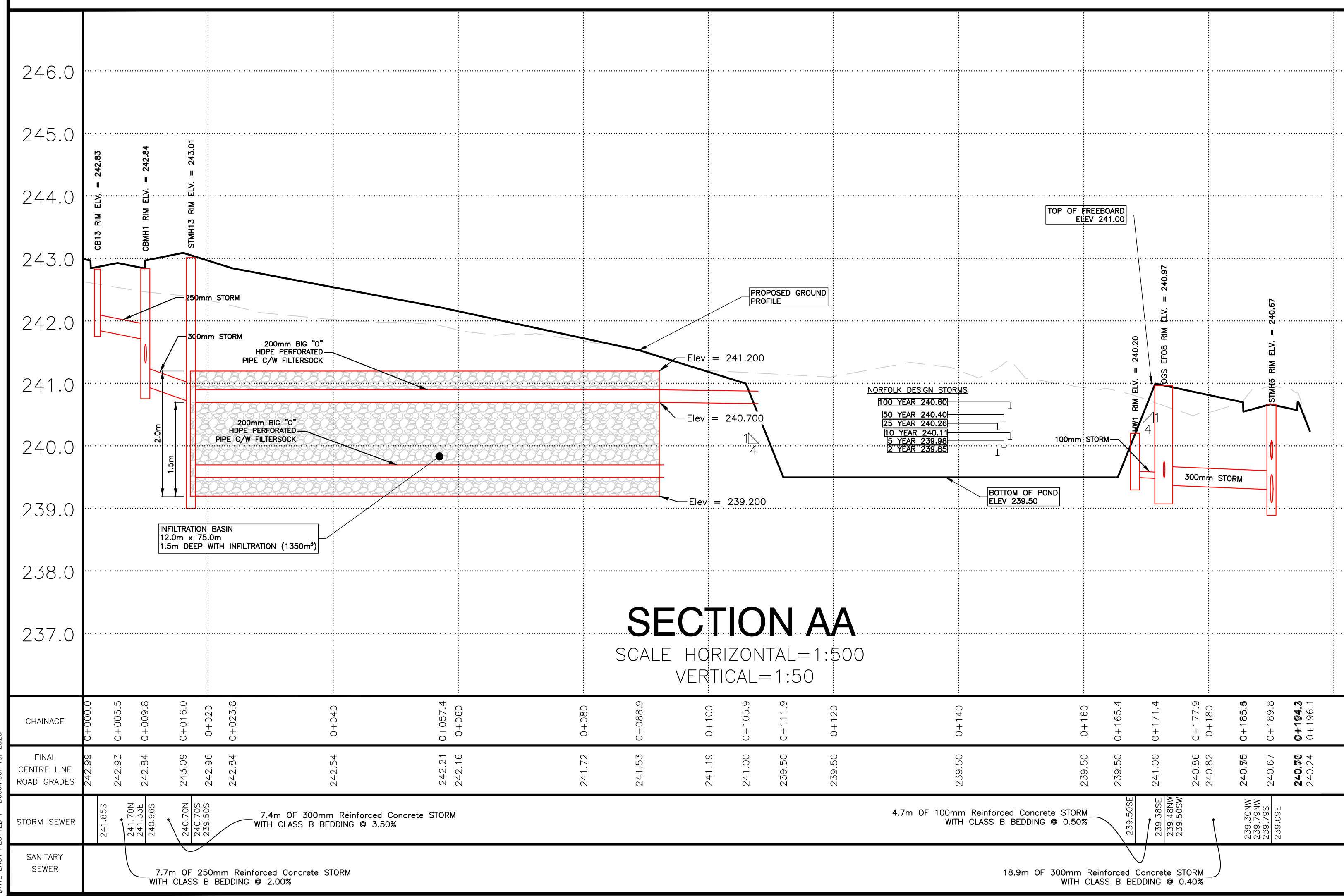
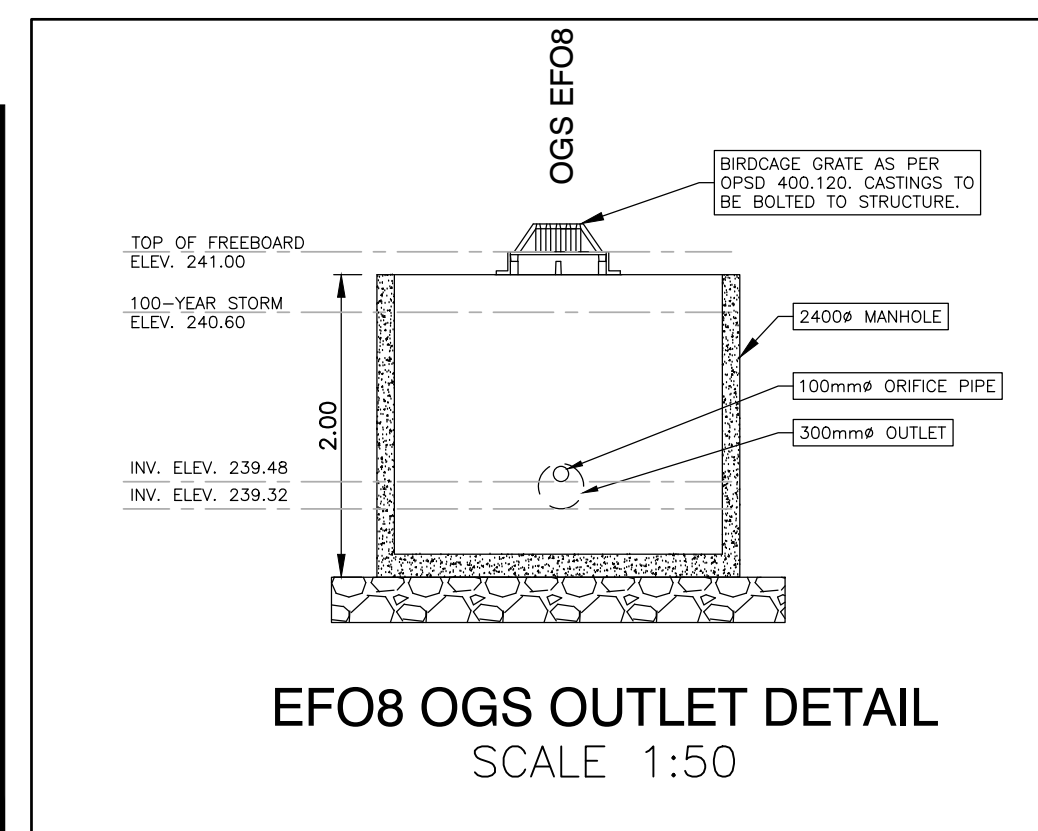
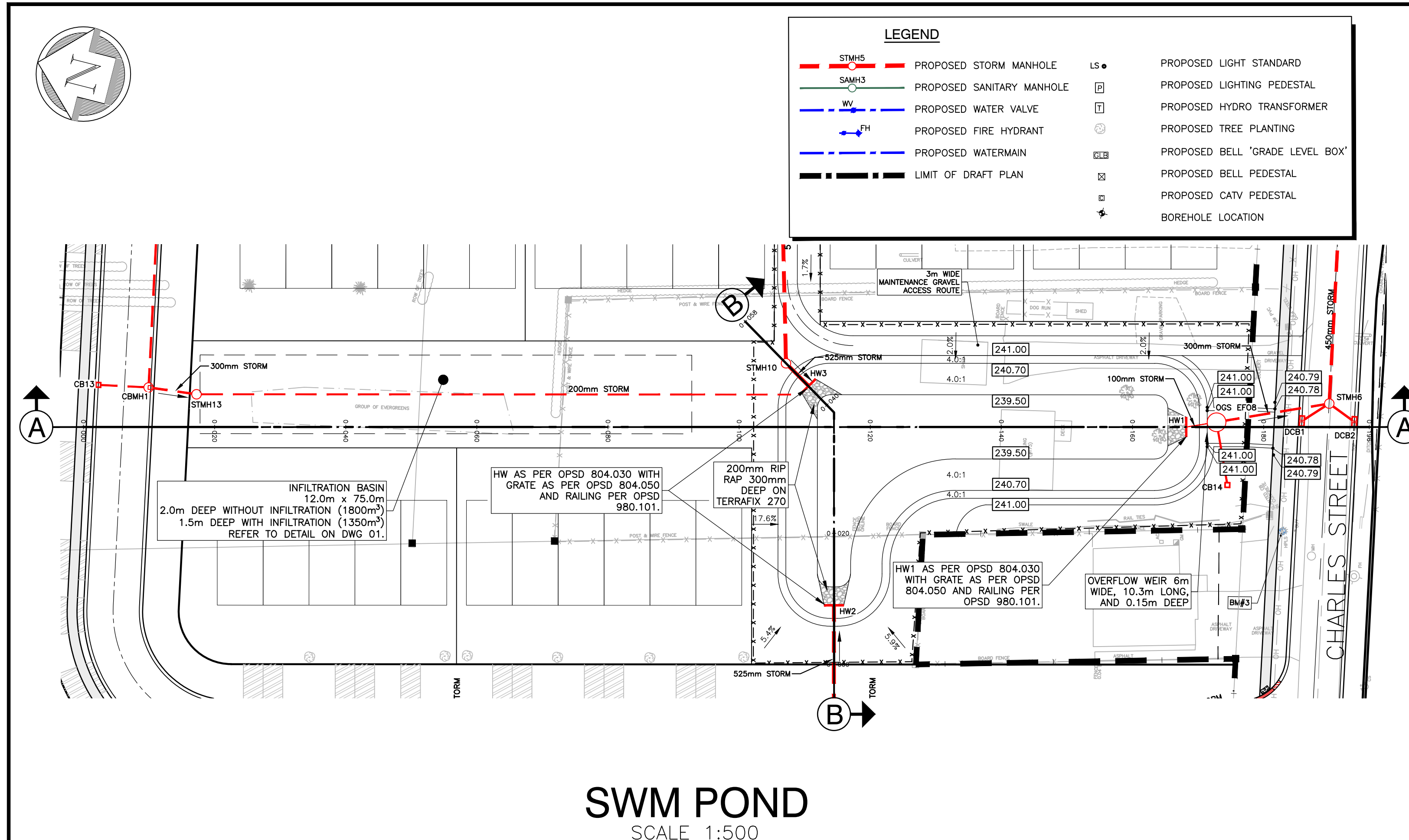
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NLB/JTI	05/03/2023

DRAWING	Drawing Scale :	Drawing No.
	AS SHOWN	05

Project No. 21-169

05



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ELEVATION 241.35

VOLUME SUMMARY:

INFILTRATION BASIN

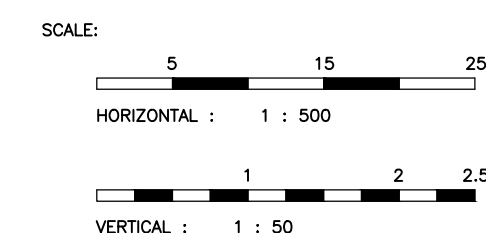
STORAGE: 540m³

POND

ACTIVE STORAGE to 241.00: 1281m³

TOTAL (TOP OF FREEBOARD) STORAGE TO 241.00: 1760m³

**PRELIMINARY
DRAWING**
NOT TO BE USED
FOR CONSTRUCTION



G. DOUGLAS VALLEE LIMITED
2 TALBOT STREET NORTH
SIMCOE, ONTARIO N3Y 3W4
(519) 426-6270



CHARLES STREET
SUBDIVISION
WATERFORD - NORFOLK COUNTY

Drawing Title	PLAN AND PROFILE SWM POND
---------------	---------------------------

Designed by : NBN/NLB	Drawn By : NBN
Checked by : NLB/JTI	Date Started : 05/03/2023
Drawing Scale : AS SHOWN	Drawing No. 07
Project No. 21-169	



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- 3. SPIKE IN FACE OF WOOD HYDRO POLE ALONG WEST SIDE OF CHATELAIN STREET, 3m SOUTH OF G. OF CONCRETE, SITUATED CB IN FRONT OF DWELLING G. 173 WEST OF DWELLING.

**PRELIMINARY
DRAWING**

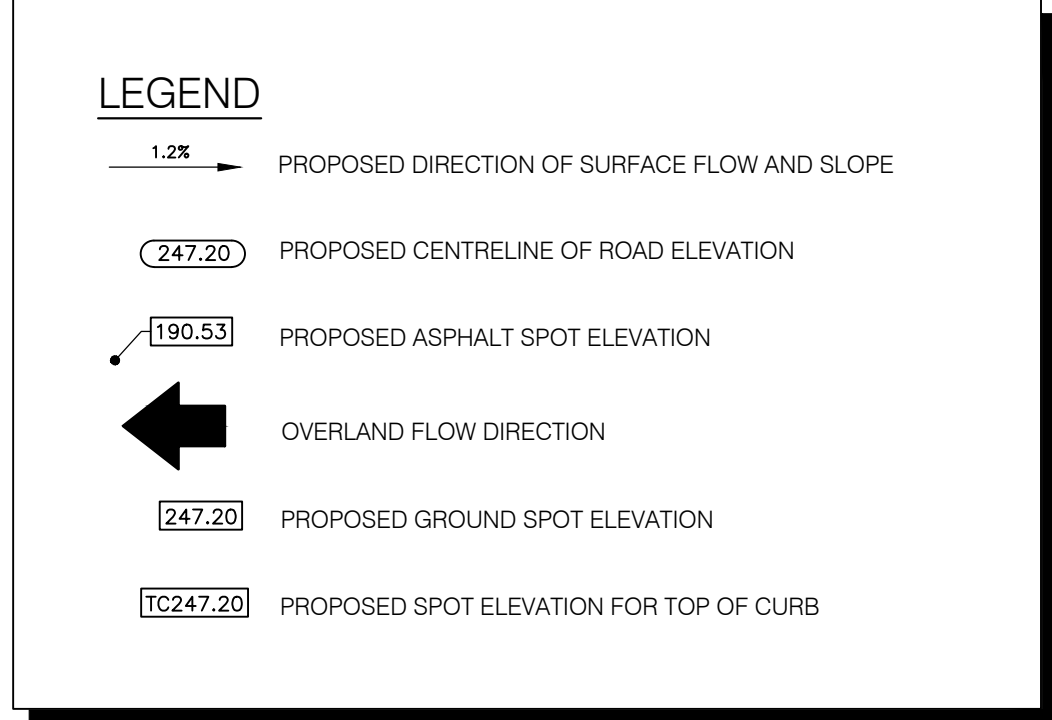
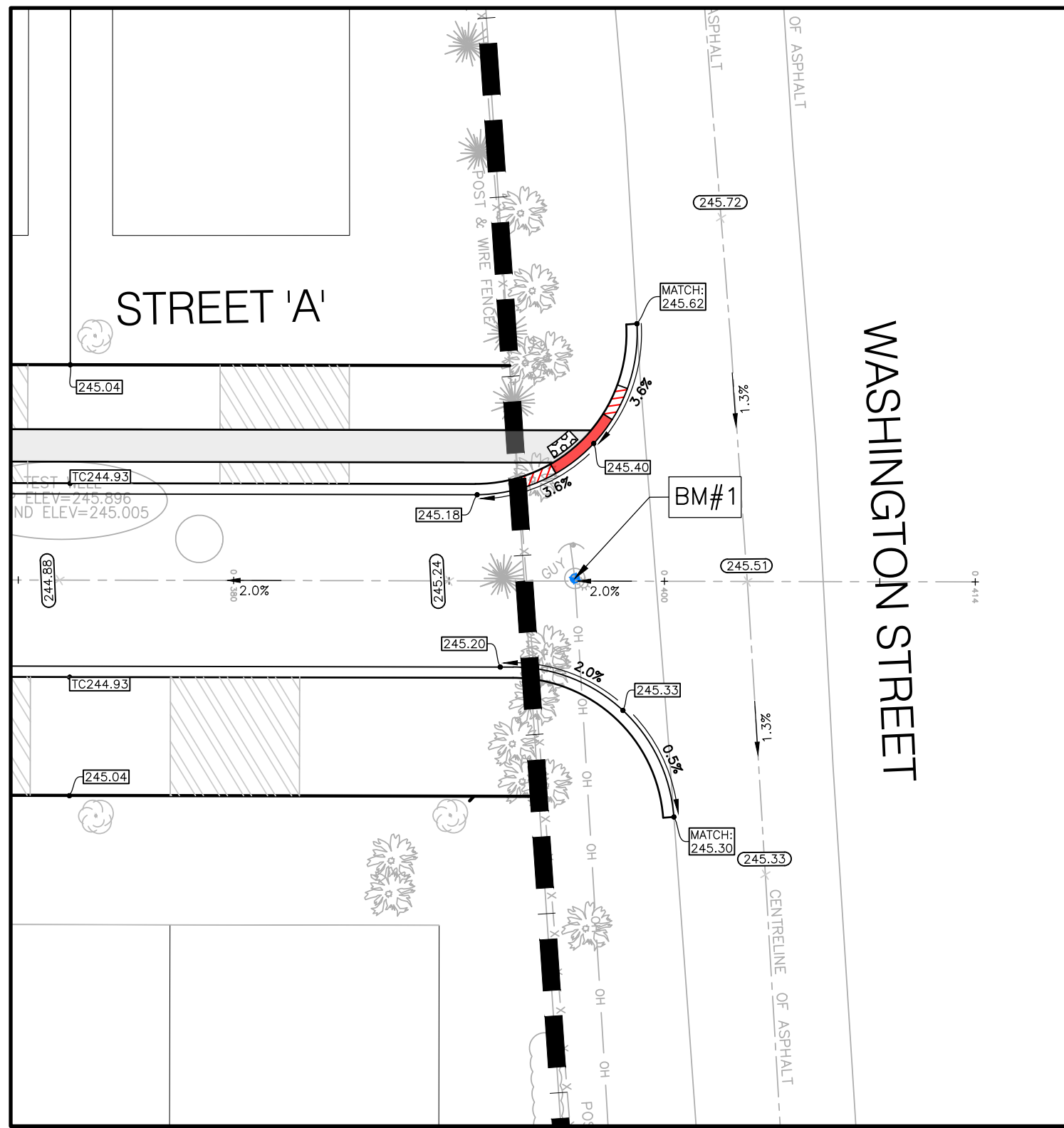
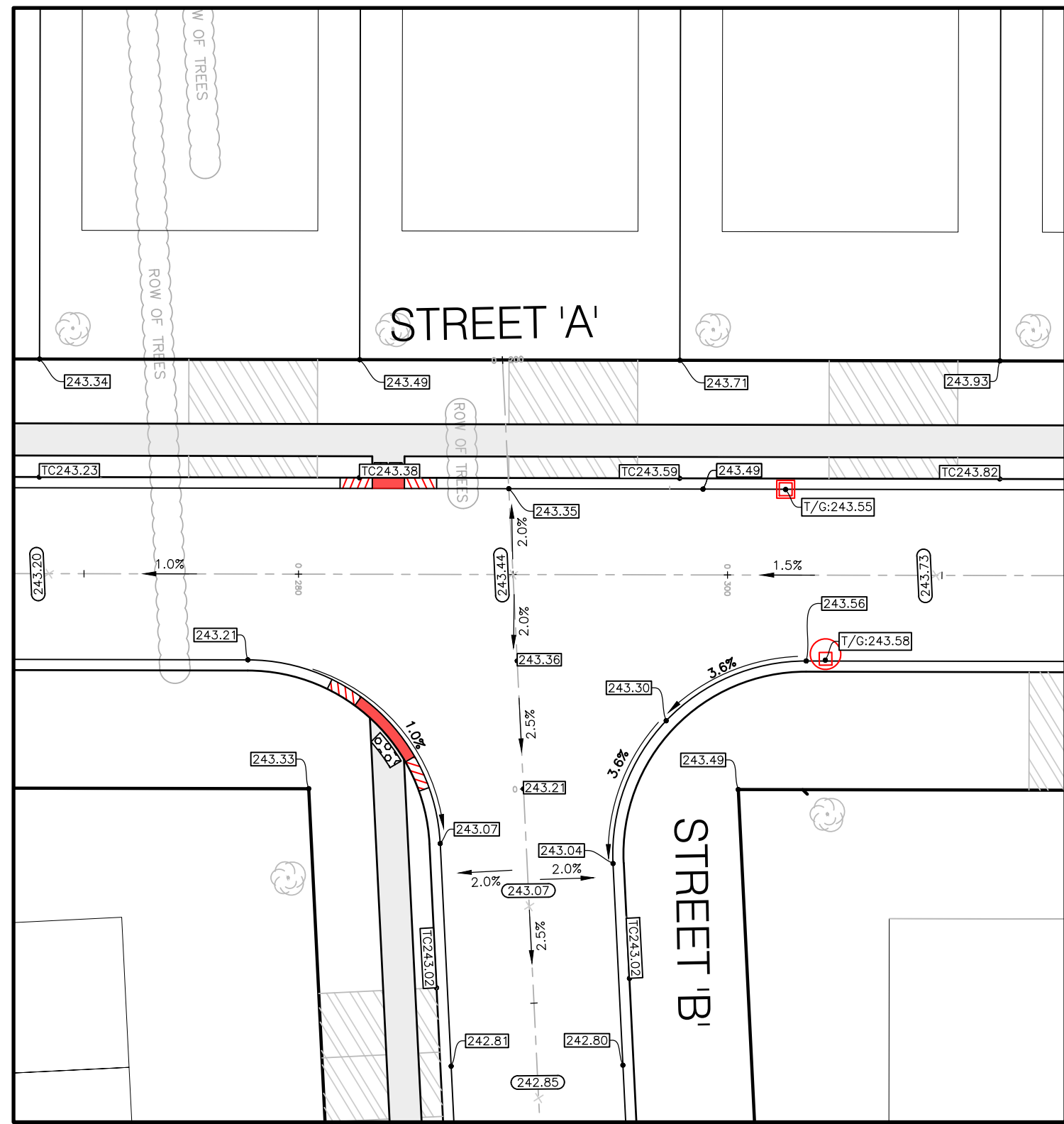
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FOR CONSTRUCTION**



Stamp



Designed by : NBN/NLB	Drawn By : NBN
Checked by : NLB/JTI	Date Started : 05/03/2023
Drawing Scale : AS SHOWN	Drawing No. 08
Project No. 21-169	



GENERAL NOTES

CONTRACTOR TO ENSURE THAT HOUSE FOUNDATION IS PLACED ON SUITABLE, DRY SOIL.

ACCORDING TO NORFOLK COUNTY REQUIREMENTS ALL FINAL GRADING MUST BE INSPECTED AND CERTIFIED BY THE ENGINEER. THE BUILDER SHALL ENSURE THAT THE REQUIRED INSPECTIONS ARE CARRIED OUT IN ACCORDANCE WITH COUNTY REQUIREMENTS.

ALL DISTANCES AND ELEVATIONS ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.

BUILDER TO CONFIRM BOTTOM OF FOOTING ELEVATION AND TOP OF FOUNDATION ELEVATION PRIOR TO COMMENCEMENT OF CONSTRUCTION.

SITE SPECIFIC GRADING PLANS MAY BE REQUIRED FOR SOME HOUSE STYLES.

ANY ADJUSTMENTS OR CHANGES TO THIS GRADING PLAN MUST BE APPROVED BY THE ENGINEER AND THE COUNTY PRIOR TO CONSTRUCTION.

ON LOTS THAT DRAIN FROM FROM FRONT TO BACK, THE TOP OF THE SOD AT THE REAR OF THE HOUSE HAS BEEN DESIGNED BASED ON THE ASSUMPTION THAT THE BACK OF THE HOUSE IS 2.0m FROM THE FRONT LOT LINE. VARIATIONS ON THIS DISTANCE MAY REQUIRED REVISIONS TO THE GRADING DESIGN.

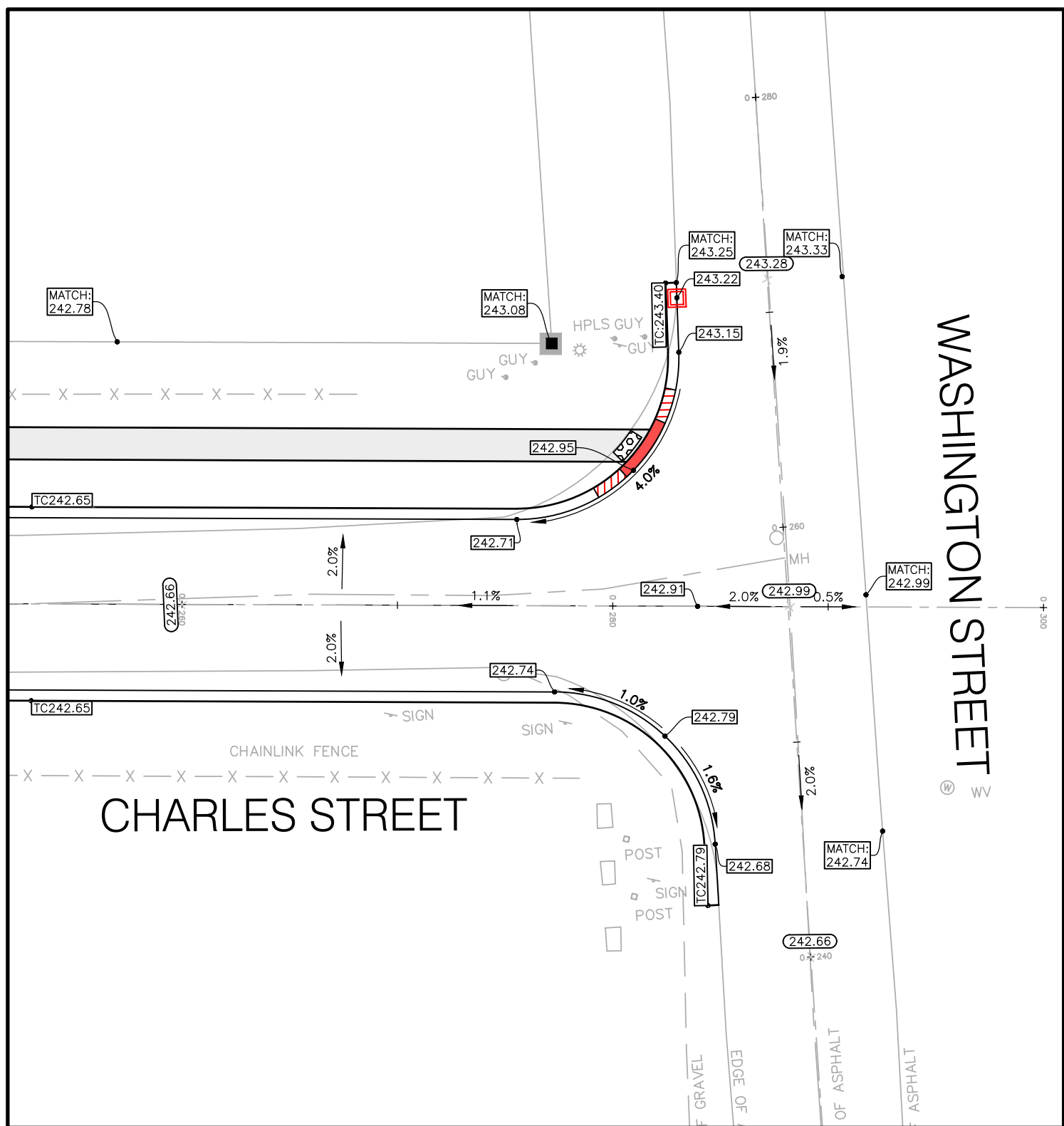
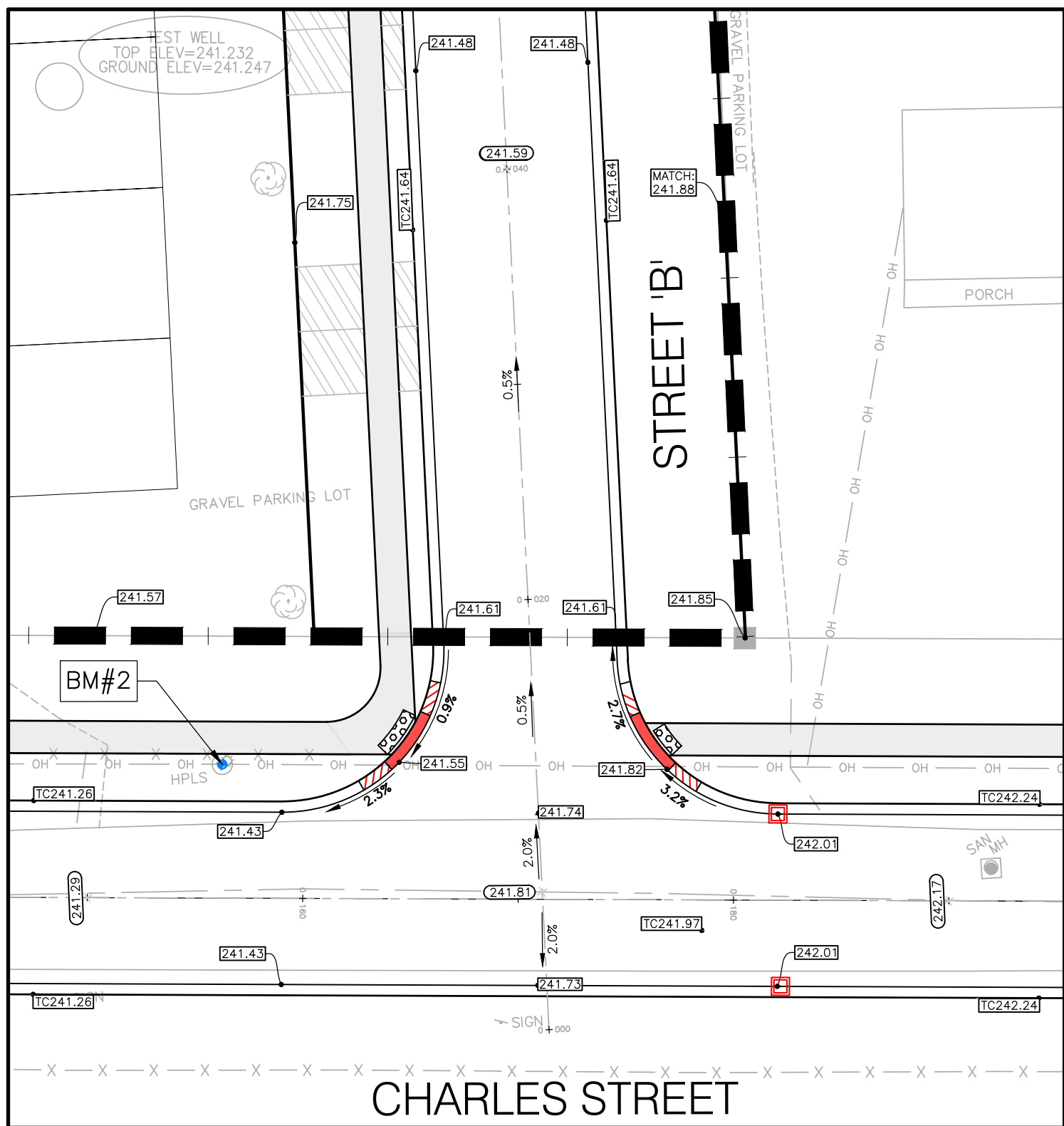
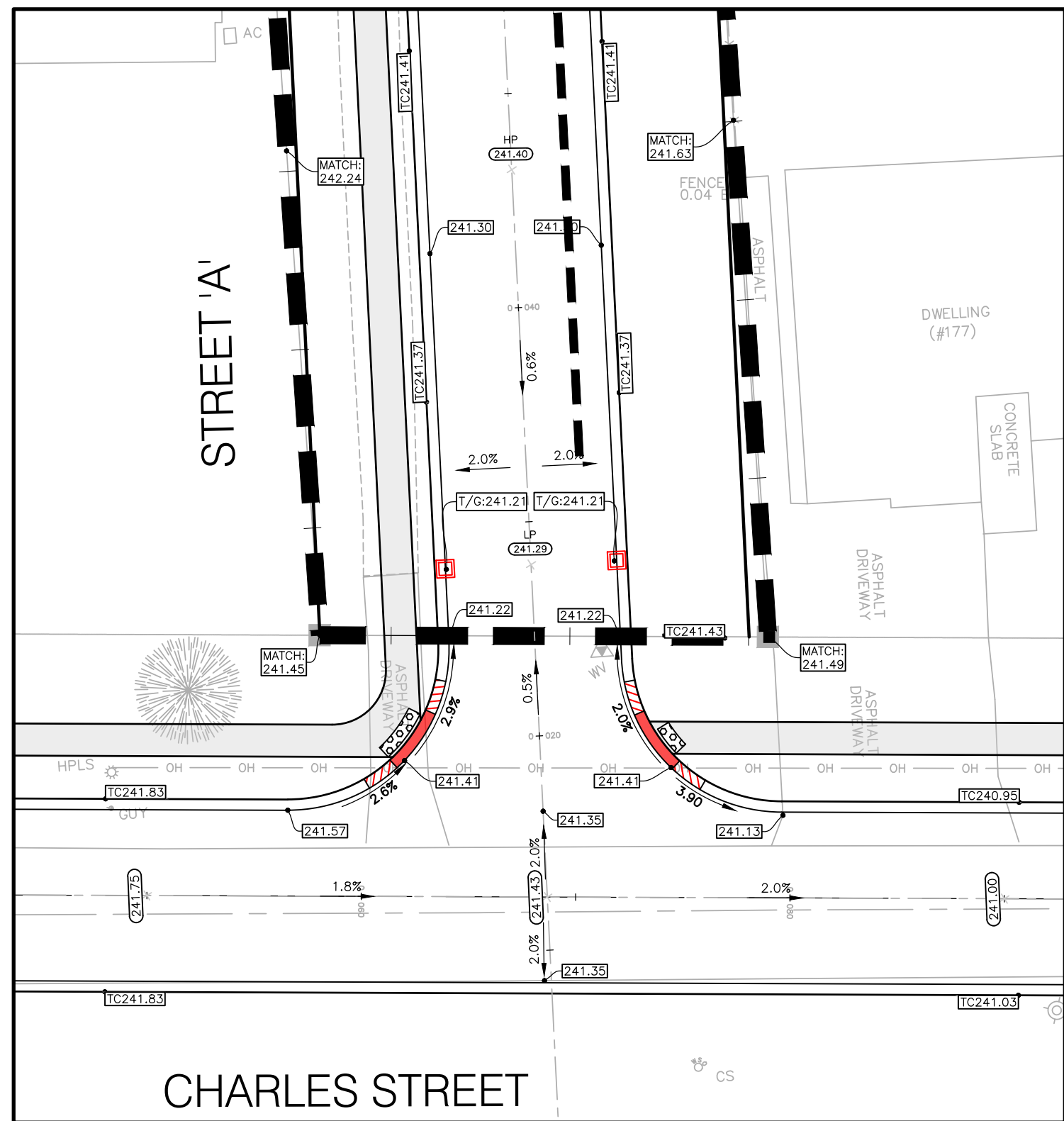
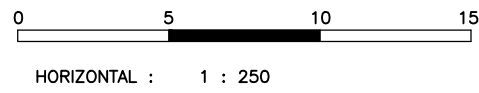
REV. No.	DATE	REVISION
0	12/12/2023	FIRST SUBMISSION TO COUNTY

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- SITE BENCHMARKS:**
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 2. SPIKE IN FACE OF WOOD HYDRO POLE ALONG NORTH SIDE OF CHARLES STREET. 26m EAST OF CB IN FRONT OF DWELLING AT #173 EAST OF DRIVEWAY. ELEVATION 241.91
 2. SPIKE IN FACE OF WOOD HYDRO POLE ALONG NORTH SIDE OF CHARLES STREET. 3m SOUTHWEST OF CONCRETE SLANTED CB IN FRONT OF DWELLING @ 173 WEST OF DRIVEWAY. ELEVATION 241.35

- DEPRESSED CURB FOR CROSSWALKS (DEPRESSED CURB AND TACTILE PLATES TO EXTEND FOR ENTIRE LENGTH OF 2.5m CROSSWALK WIDTH)
- 1.5m TAPER FOR DEPRESSED CURB

**PRELIMINARY
DRAWING**
NOT TO BE USED
FOR CONSTRUCTION



G. DOUGLAS VALLEE LIMITED
2 TALBOT STREET NORTH
SIMCOE, ONTARIO N3Y 3W4
(519) 426-6270



Project Title
**CHARLES STREET
SUBDIVISION
WATERFORD - NORFOLK COUNTY**

Drawing Title
INTERSECTION GRADING PLAN

Designed by : NBN/NLB	Drawn By : NBN
Checked by : NLB/JTI	Date Started : 05/03/2023
Drawing Scale : AS SHOWN	Drawing No. 09
Project No. 21-169	

[illegible]

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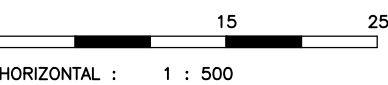
SITE BENCHMARKS:

1. SPIKE IN FACE OF WOOD HYDRO POLE ALONG WEST SIDE OF WASHINGTON STREET, 46m NORTH OF DWELLING AT #210.
ELEVATION 246.32

2. SPIKE IN FACE OF WOOD HYDRO POLE ALONG NORTH SIDE OF CHARLES STREET, 26m EAST OF CB IN FRONT OF DWELLING AT #173 EAST OF DRIVEWAY.
ELEVATION 241.91

3. SPIKE IN FACE OF WOOD HYDRO POLE ALONG NORTH SIDE OF CHARLES STREET, 3m SOUTHWEST OF CONCRETE PLANTED CB IN FRONT OF DWELLING AT 173 WEST OF DRIVEWAY.
ELEVATION 241.35

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DRAWING**
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FOR CONSTRUCTION**



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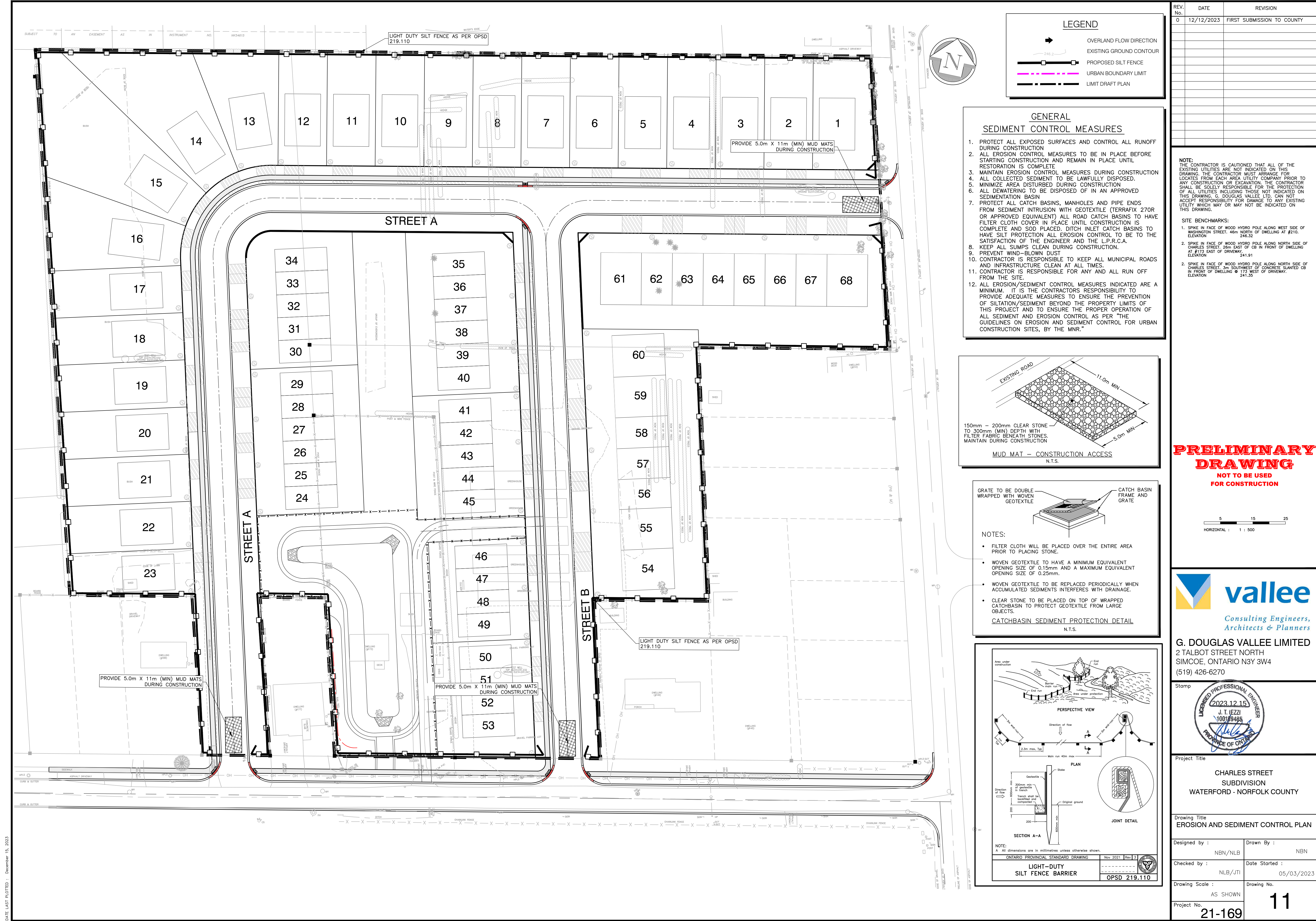


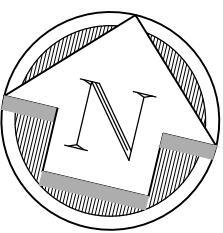
Project Title Charles Street

CHARLES STREET
SUBDIVISION
WATERFORD - NORFOLK COUNTY

Drawing Title
EXCESS CUT-FILL PLAN

Designed by : NBN/NLB	Drawn By : NBN
Checked by : NLB/JTI	Date Started : 05/03/2023
Drawing Scale : AS SHOWN	Drawing No. 10
Project No. 21-169	



[illegible]

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SITE BENCHMARKS:

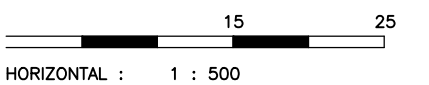
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ELEVATION 241.91
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ELEVATION 241.35

 DEPRESSED CURB FOR CROSSWALKS
(DEPRESSED CURB AND TACTILE PLATES
TO EXTEND FOR ENTIRE LENGTH OF 2.5m
CROSSWALK WIDTH)

 1.5m TAPER FOR DEPRESSED CURB

PRELIMINARY DRAWING

**NOT TO BE USED
FOR CONSTRUCTION**



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SIMCOE, ONTARIO N3Y 3W4
(519) 426-6270

Stamp



Project Title

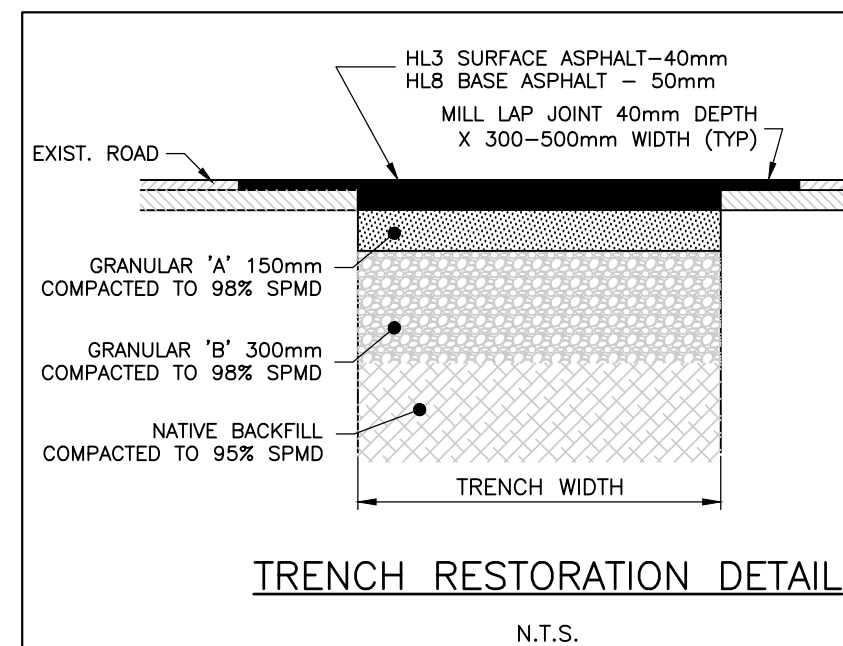
CHARLES STREET
SUBDIVISION
WATERFORD - NORFOLK COUNTY

Drawing Title	SIGNAGE AND TRAFFIC CONTROL PLAN
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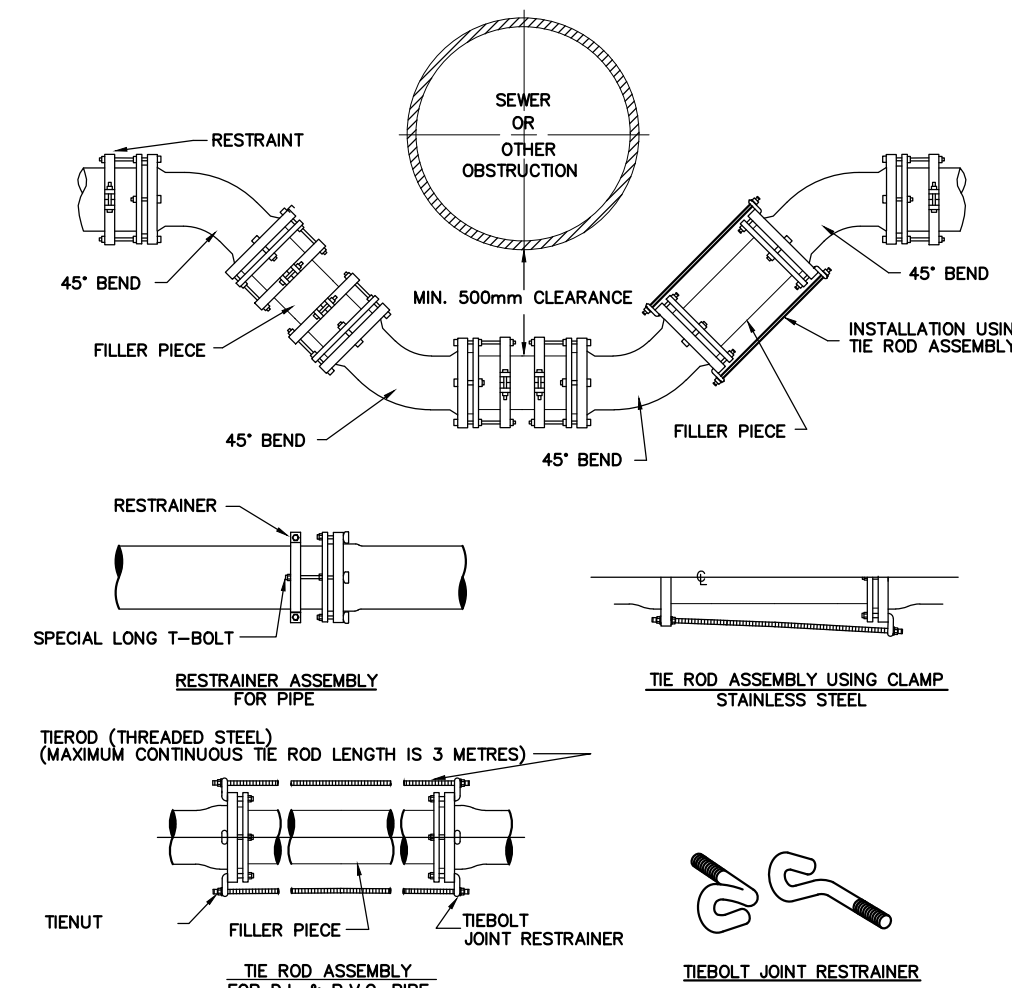
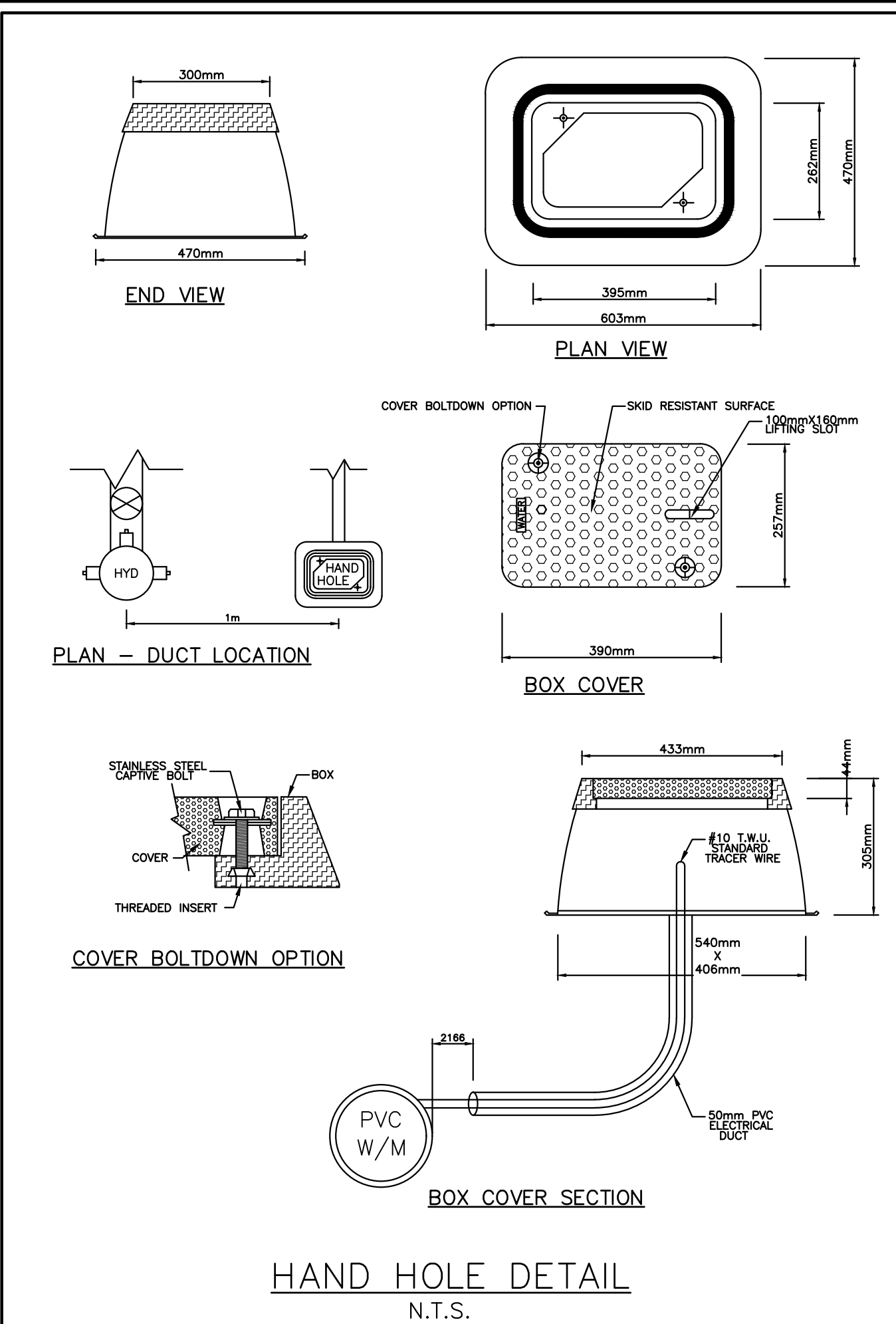
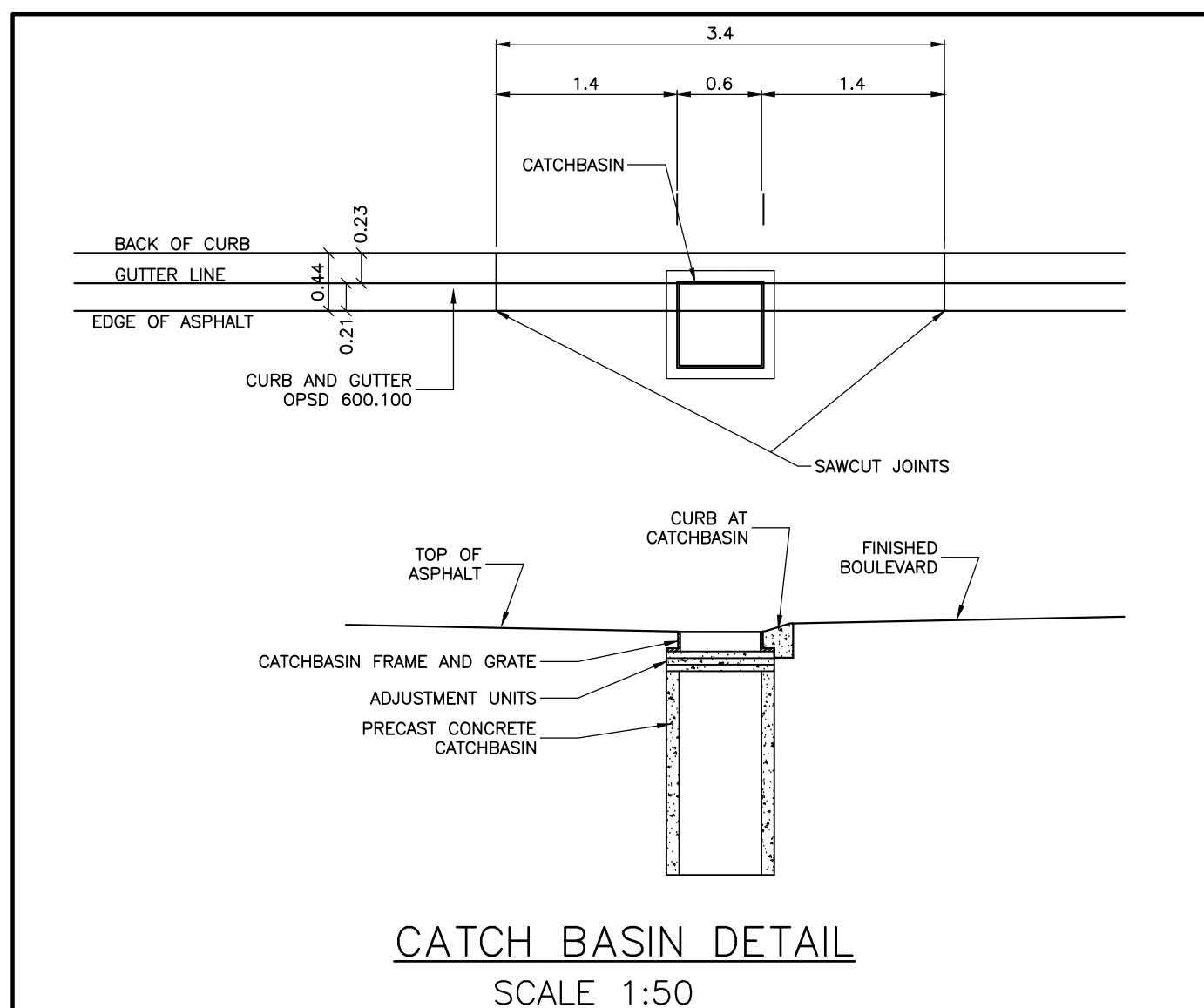
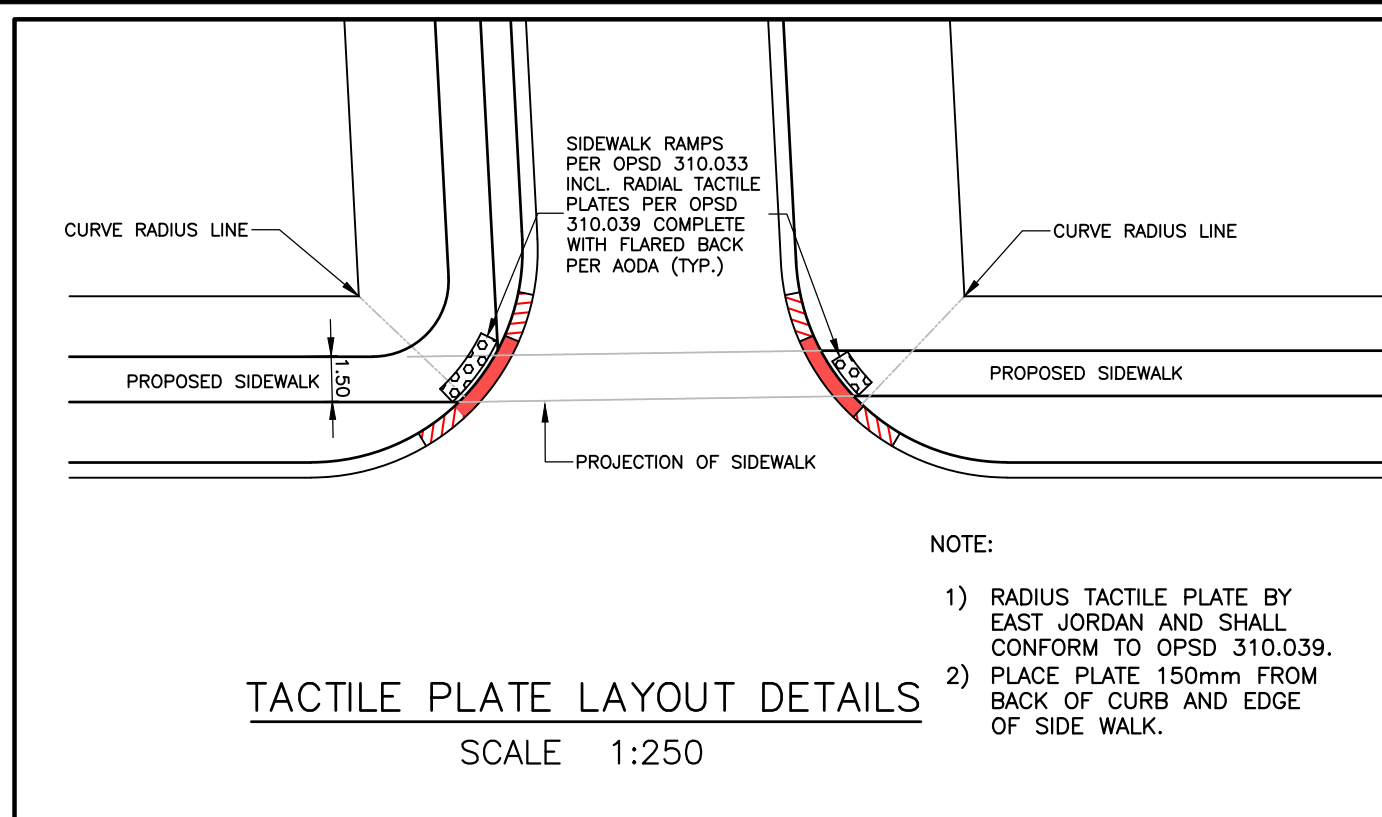
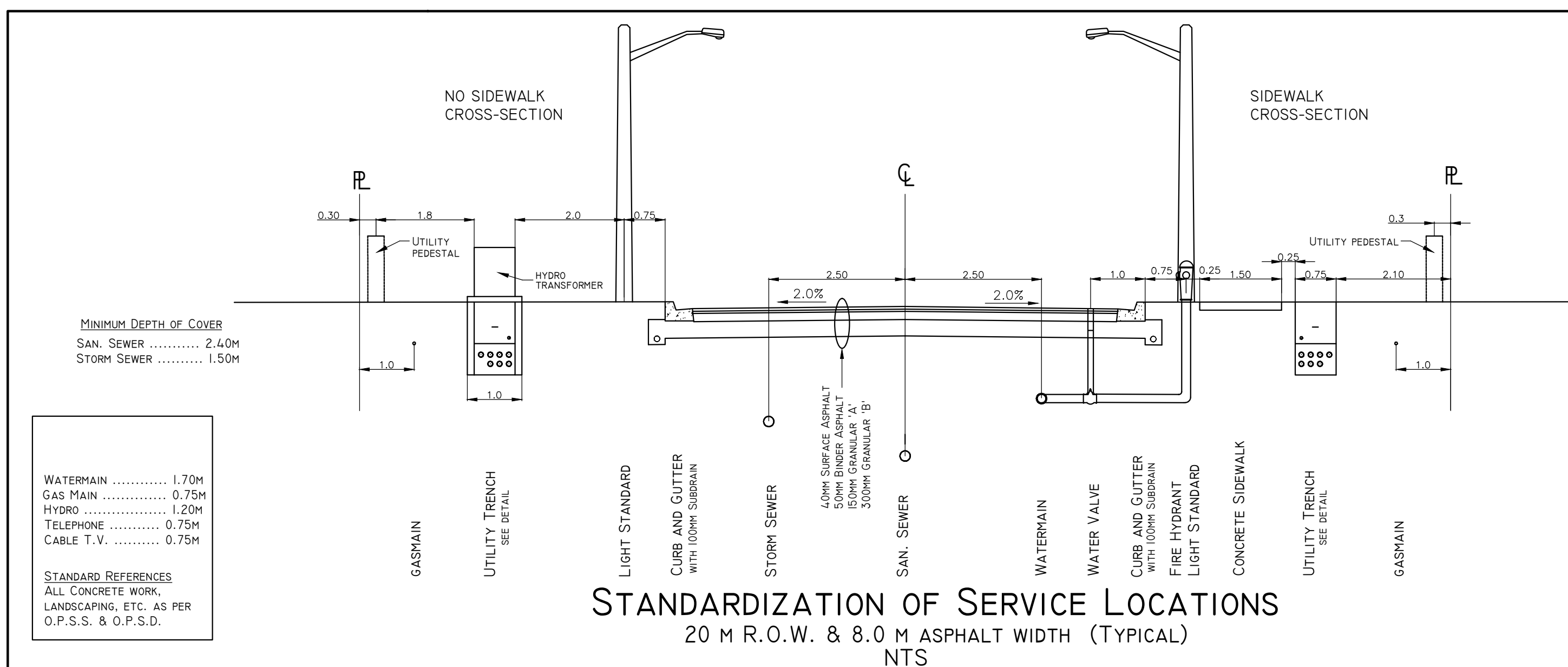
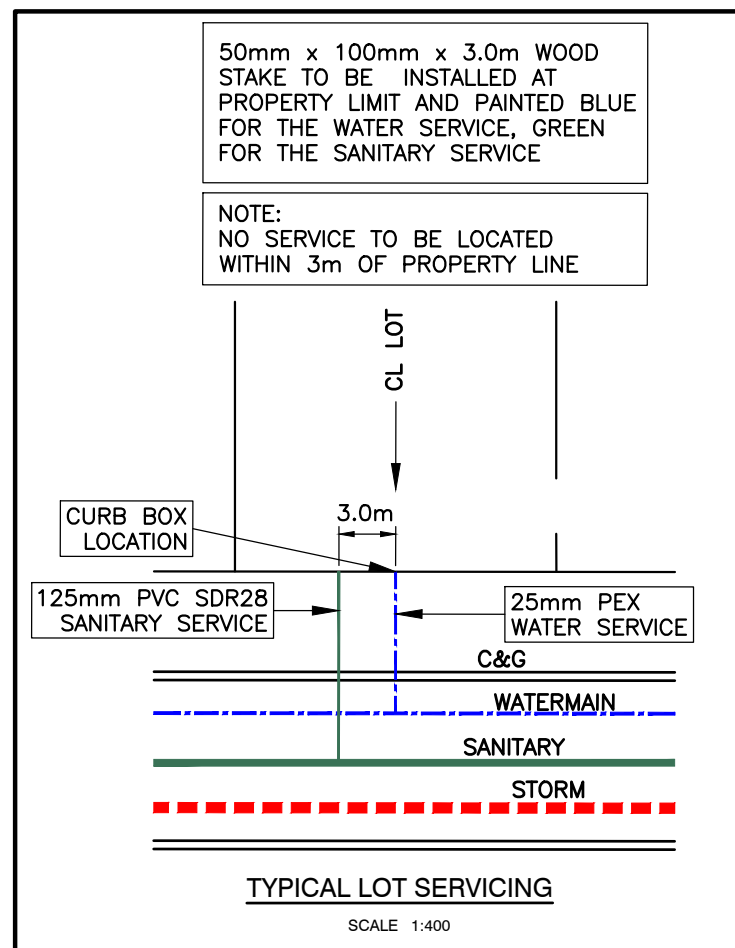
Designed by : NBN/NLB	Drawn By : NBN
Checked by : NLB/JTI	Date Started : 05/03/2023
Drawing Scale : AS SHOWN	Drawing No. 12
Project No. 21-169	

1. PRIOR TO CLOSING ANY STREET, THE CONTRACTOR SHALL OBTAIN CLEARANCE BY FILLING OUT THE COUNTY'S NOTICE OF ROAD CLOSURE FORM AND NOTIFY SCHOOL BUS OPERATORS AND THE STREET USES OF THE PROJECT. THE CONTRACTOR SHALL OBTAIN A PERMIT FROM THE COUNTY TO DETOUR AND THE CONTRACTOR MUST SUPPLY AND MAINTAIN ADEQUATE LOCAL DETOUR SIGNS AND LIGHTS. THE CONTRACTOR MUST MAINTAIN MAXIMUM ACCESS TO ALL PROPERTIES AS DIRECTED BY THE ENGINEER.
2. THE CONTRACTOR SHALL CONSTRUCT TEMPORARY MEASURES TO CONTROL SILT ENTERING THE STORM DRAINAGE SYSTEM TO THE SPECIFICATIONS OUTLINED IN THE GUIDELINES ON EROSION AND SEDIMENT CONTROL FOR URBAN CONSTRUCTION SITES PREPARED BY THE UNIVERSITY OF NATURAL RESOURCES. THESE MEASURES ARE TO BE INSTALLED PRIOR TO COMMENCING ANY CONSTRUCTION FOR THIS STREET AND ARE TO REMAIN IN PLACE UNTIL CONSTRUCTION HAS BEEN COMPLETED TO THE SPECIFICATIONS OF THE ENGINEER.
3. THE CONTRACTOR IS TO MEET ALL THE REQUIREMENTS OF THE OWNERS OF THE UTILITIES ON THE PROJECT PLAN, AND MAINTAIN SATISFACTORY ARRANGEMENTS WITH THE UTILITY COMPANIES FOR CROSSING THEIR INSTALLATIONS AND FOR PROVIDING ADEQUATE PROTECTION DURING CONSTRUCTION.
4. PRIOR TO COMMENCING ANY CONSTRUCTION, ALL EXISTING UNDERGROUND UTILITIES SHALL BE LOCATED AND MARKED. ANY UTILITIES DAMAGED OR DISTURBED DURING CONSTRUCTION SHALL BE REPAIRED OR REPLACED TO THE SATISFACTION OF THE OWNER AT THE CONTRACTORS EXPENSE.
5. ALL ORGANIC, SUITABLE OR UNSUITABLE MATERIALS BENEATH THE ROAD ALLOWANCES MUST BE REMOVED AND THESE AREAS BACKFILLED WITH AN APPROVED FILL MATERIAL. ALL TO THE SATISFACTION OF THE ENGINEER.
6. PRIOR TO COMMENCING ANY CONSTRUCTION, ALL EXISTING SEWER OUTLET INFORMATION, BENCHMARKS, DIMENSIONS, ELEVATIONS AND GRADES MUST BE CHECKED AND VERIFIED AND ANY DISCREPANCIES REPORTED TO THE ENGINEER IMMEDIATELY.
7. PDC'S SHALL BE 125mm PVC PDR28 WITH CLASS 'B' BEDDING. PDC'S SHALL BE LAID AT A 2% (min) grade c/w 22.5" or 45" LONG RADIUS BEDS AS REQUIRED. PDC'S SHALL BE EXTENDED TO THE PROPERTY LINE AND PROPPED WITH A MINIMUM 25mm PEX. PDC'S SHALL BE USED 22.5" OR 45" LONG RADIUS BEDS AND A MINIMUM 2% GRADE TO AVOID CONFLICTS WITH EXISTING SEWERS, WATERMANS AND ALDS.
8. EACH CATCH BASIN LEAD FOR SINGLE CATCH BASINS SHALL BE 250mm x PVC DSR35 WITH CLASS 'B' BEDDING. ALL CATCH BASIN LEADS FOR TWIN INLET CATCH BASINS SHALL BE 300mm x PVC DSR35 WITH CLASS 'B' BEDDING.
9. ALL PVC WATERMAIN SHALL HAVE TWO 10 COPPER TRACING WIRES LAID ALONG ENTIRE LENGTH. WATERMAIN SHALL HAVE 1.7m to 1.9m COVER TO CATCH BASIN 'B' BEDDING.
10. ALL NEW WATERSERVICES SHALL BE TYPE 25mm PEX
11. WATERMAIN FITTINGS SHALL BE MECHANICAL JOINT OR PUSH-ON JOINT INSTALLED WITH APPROVED MECHANICAL THRUST RESTRAINTS.
12. ALL MECHANICAL THRUST RESTRAINTS SHALL CONFORM TO CONTRACT DOCUMENT SPECIFICATIONS.

- i. ALL DISTURBED AREAS SHALL BE RESTORED AS FOLLOWS:
 - 40mm H3.3 SURFPAVEMENT
 - 150mm H18 BASE ASPHALT (7% OR 9% SPMD)
 - 150mm GRANULAR "A" BASE (98% SPMD)
 - 150mm GRANULAR "B" BASE (98% SPMD)
 - GRANULAR "B" TO BE EXTENDED 0.3m BEHIND BACK OF CURB
 - IF EXISTING THICKNESSES OBSERVED DURING CONSTRUCTION DIFFER THAN WHATS NOTED, USE WHICHEVER IS GREATER
- ii. BOULEVARDS SHALL BE RESTORED WITH SOD OVER 100mm TOPSOIL (min) UNLESS OTHERWISE NOTED
- iii. ASPHALT DRIVEWAYS SHALL BE RESTORED WITH 150mm OF GRANULAR "A" (100% SPMD) WITH 50mm of H13.3 ASPHALT (9% MARSHALL)
- iv. CONCRETE DRIVEWAYS SHALL BE RESTORED WITH 150mm OF GRANULAR "A" (100% SPMD)
- v. CONCRETE DRIVEWAYS SHALL BE RESTORED WITH 150mm OF GRANULAR "A" (100% SPMD) WITH 150mm OF CONCRETE (25MPa MINIMUM)



	EX. STORM SEWER		PROPOSED WATERMAIN
	PROPOSED STORM SEWER		EX. WATERMAIN
	EX. SANITARY SEWER		PROPOSED 3-WAY FIRE HYDRANT C/W STORZ CONNECTION
	PROPOSED SANITARY SEWER		EX. FIRE HYDRANT
	PROPOSED STORM MANHOLE		PROPOSED WATERVALVE
	PROPOSED SANITARY MANHOLE		EX. WATERVALVE
	EX. MANHOLE		EX. BURIED GAS LINE
	PROPOSED CATCHBASIN		EX. BURIED BELL LINE
	PROPOSED TWIN INLET CATCHBASIN		EX. BURIED CABLE LINE
	PROPOSED CATCHBASIN MANHOLE		EX. UNDERGROUND HYDRO LINE
	EX. CATCHBASIN		
	PROPOSED 1.5m SIDEWALK		



WATERMAIN RESTRAINTS TABLE						
DIAMETER (mm)	MINIMUM LENGTH TO BE RESTRAINED ON EACH SIDE OF FITTINGS (m)					
	11-1/4"	22-1/2"	45"	90° BENDS AND TEE'S	REDUCER (IN DIRECTION OF LARGER PIPE)	DEAD END AND VALVES
100	N/A			N/A	N/A	N/A
150		1.0		5	N/A	10
200		1.8		6	6	14
250		2.4		N/A	N/A	17
300		N/A		N/A	N/A	N/A

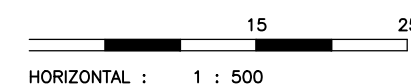
1. ALL JOINTS WITHIN DISTANCES SHOWN SHALL BE RESTRAINED WITH A MEG-A-LUG JOINT RESTRAINT.
2. ALL TEES SHALL HAVE A MINIMUM OF 1.0m SOLID PIPE OUT EACH SIDE OF THE MAIN RUN OF THE TEE.
3. ALL DISTANCES TO BE CONFIRMED TO THE MANUFACTURERS STANDARDS FOR ALTERNATE RESTRAINTS TO MEGALUG.

[illegible]

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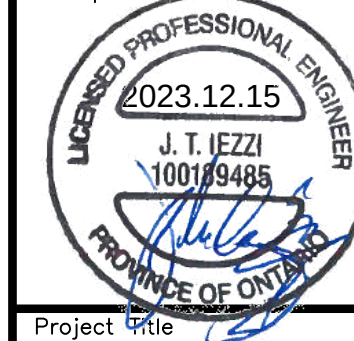
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ELEVATION 246.32
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ELEVATION 241.91
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ELEVATION 241.35

**PRELIMINARY
DRAWING**
NOT TO BE USED
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G. DOUGLAS VALLEE LIMITED
2 TALBOT STREET NORTH
SIMCOE, ONTARIO N3Y 3W4
(519) 426-6270

Stamp



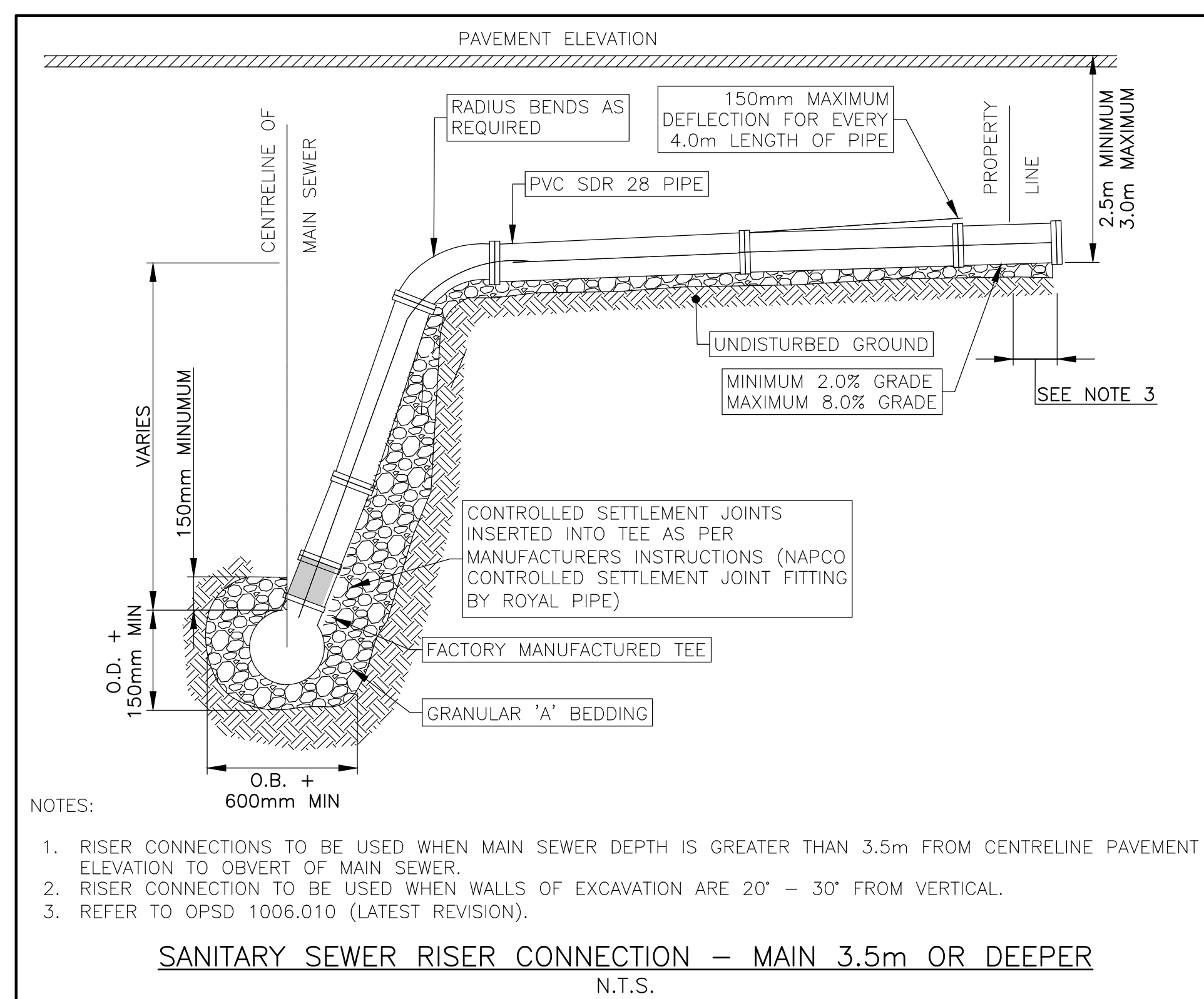
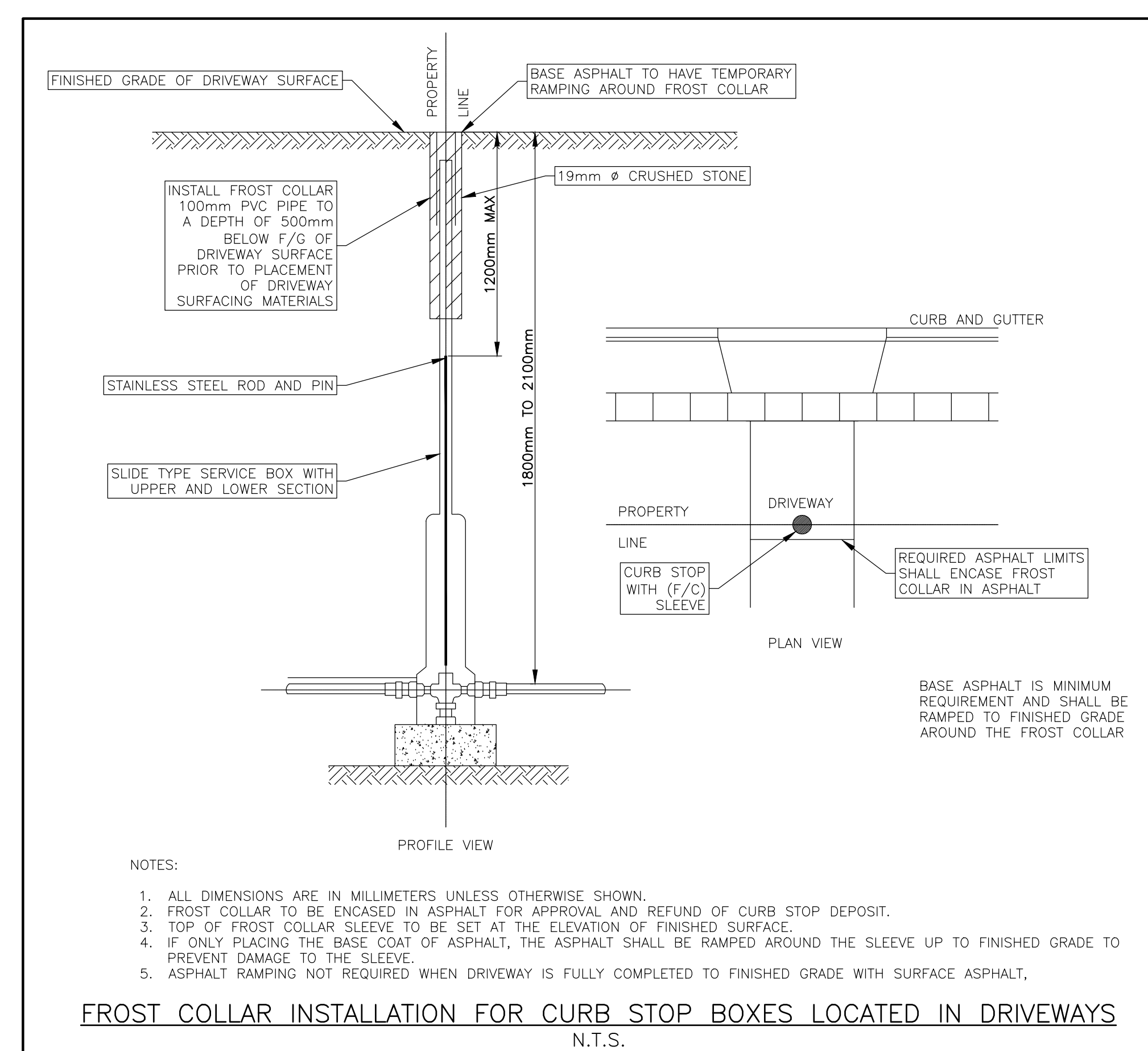
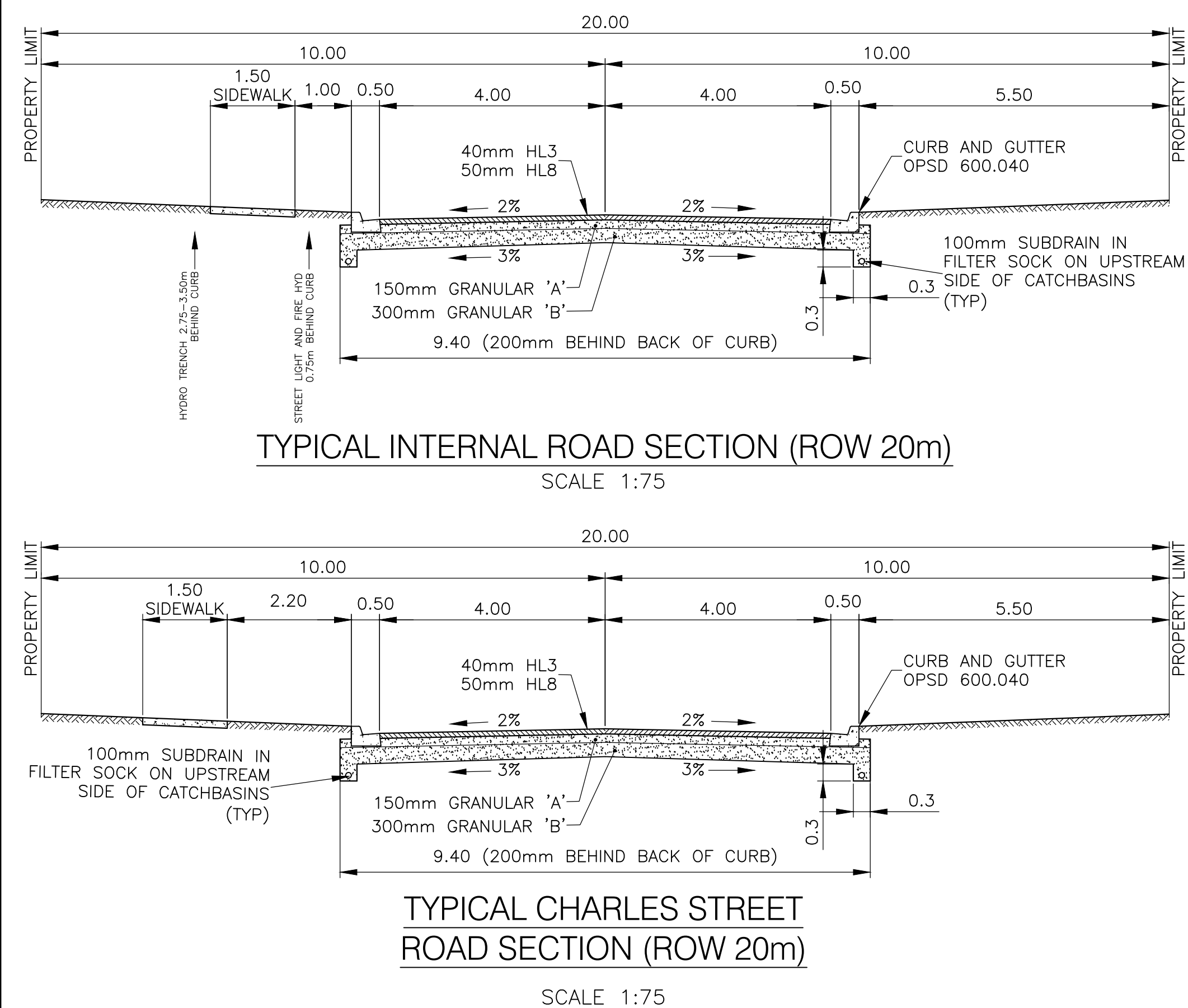
Project Title CHARLES STREET
SUBDIVISION
WATERFORD - NORFOLK COUNTY

Drawing Title
GENERAL NOTES - PART I

Designed by : NBN/NLB	Drawn By : NBN
Checked by : NLB/JTI	Date Started : 05/03/2023

Drawing Scale :	Drawing No.
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AS SHOWN	13
Project No. 21-169	

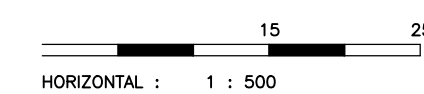
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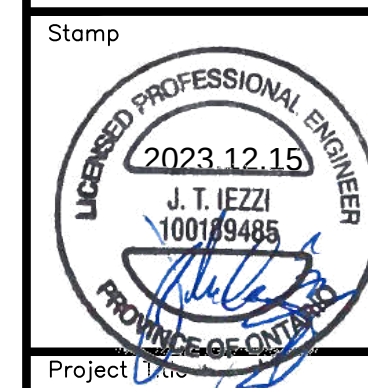
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ELEVATION 241.91
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ELEVATION 241.35

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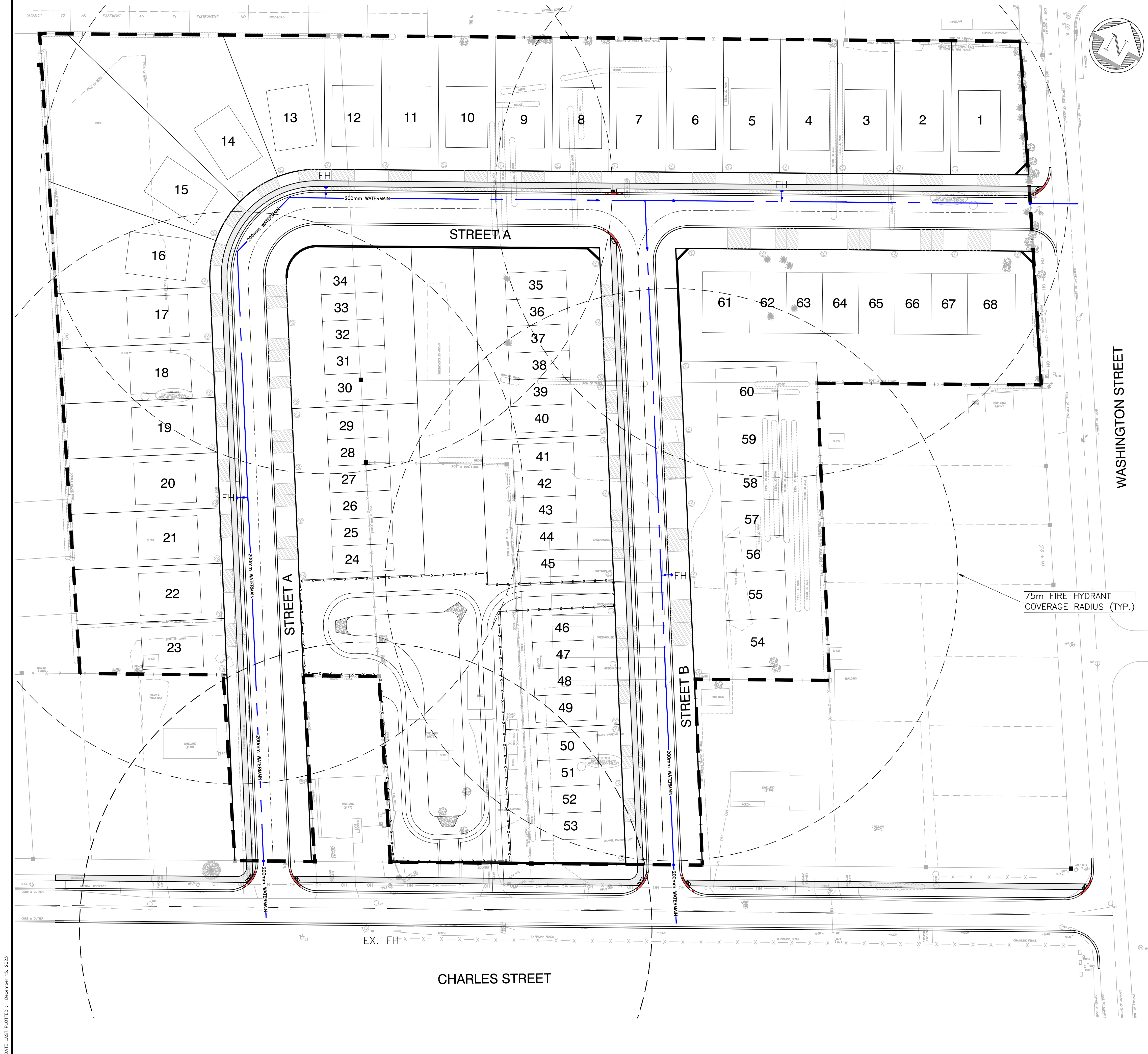
G. DOUGLAS VALLEE LIMITED
2 TALBOT STREET NORTH
SIMCOE, ONTARIO N3Y 3W4
(519) 426-6270



CHARLES STREET
SUBDIVISION
WATERFORD - NORFOLK COUNTY

Drawing Title	GENERAL NOTES - PART II
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Designed by : NBN/NLB	Drawn By : NBN
Checked by : NLB/JTI	Date Started : 05/03/2023
Drawing Scale : AS SHOWN	Drawing No. 14
Project No. 21-169	

[illegible]

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ELEVATION 241.35

**PRELIMINARY
DRAWING**
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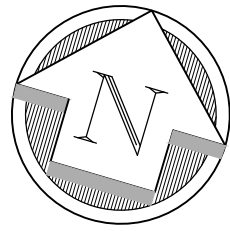
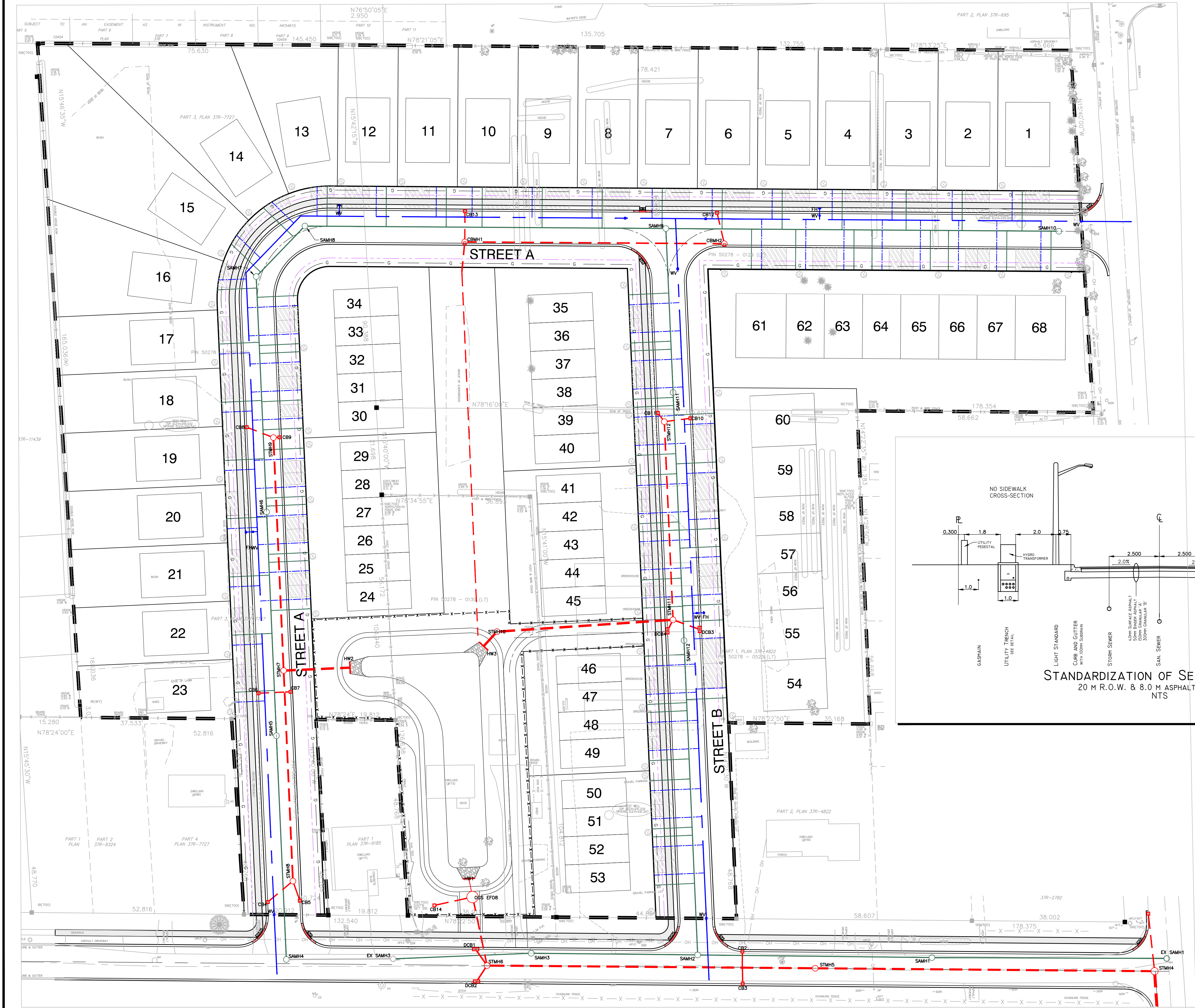


Project Title

CHARLES STREET
SUBDIVISION
WATERFORD - NORFOLK COUNTY

Drawing Title	HYDRANT SPACING PLAN
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Designed by :	NBN/NLB	Drawn By :	NBN
Checked by :	NLB/JTI	Date Started :	05/03/2020
Drawing Scale :	AS SHOWN	Drawing No.	HYD
Project No.	21-169		



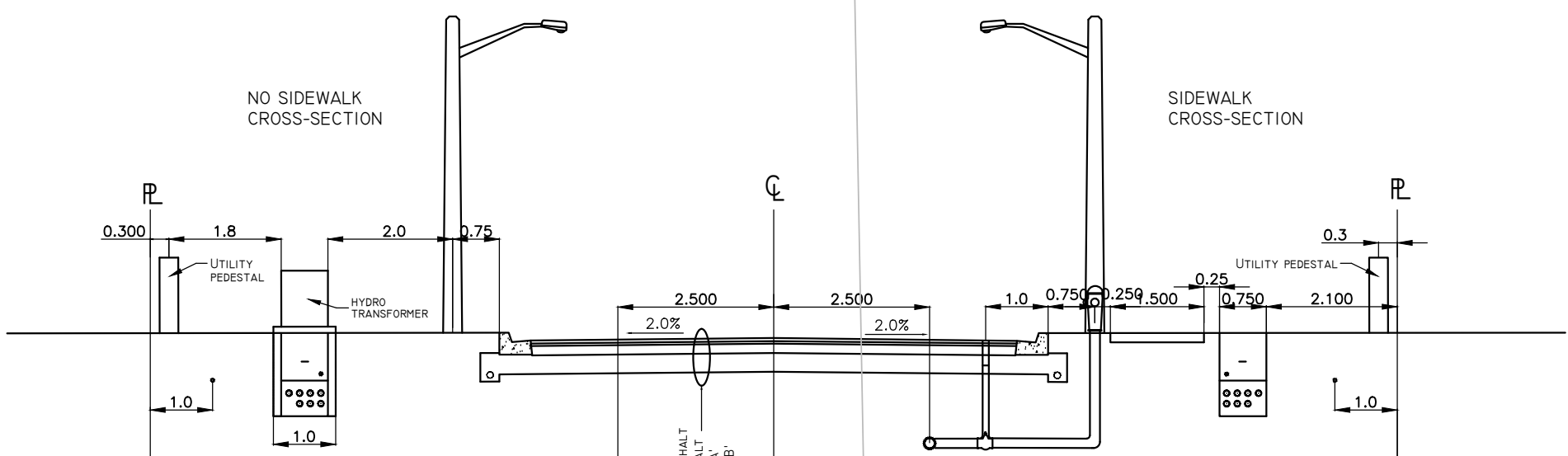
LEGEND	
	PROPOSED STORM MANHOLE
	PROPOSED SANITARY MANHOLE
	PROPOSED WATER VALVE
	PROPOSED FIRE HYDRANT
	URBAN BOUNDARY LIMIT
	LIMIT OF DRAFT PLAN
	SA PROPOSED SANITARY SERVICE
	ST PROPOSED STORM SERVICE
	WS PROPOSED WATER SERVICE
	PROPOSED GAS LINE (ASSUMED)
	PROPOSED HYDRO/BELL/CATV/STREET LIGHT SHARED TRENCH
	PROPOSED LIGHT STANDARD
	PROPOSED LIGHTING PEDESTAL
	PROPOSED HYDRO TRANSFORMER
	PROPOSED TREE PLANTING
	PROPOSED BELL 'GRADE LEVEL BOX'
	PROPOSED BELL PEDESTAL
	PROPOSED CATV PEDESTAL

COMPOSITE UTILITY PLAN IS PREPARED BASED ON STORM, WATER, AND SANITARY DESIGNS (PREPARED BY VALLEE), HYDRO DESIGN BY HYDRO ONE, STREET LIGHTING DESIGN BY ERTL, AND STANDARDIZATION OF SERVICE LOCATIONS AS PROVIDED BY NORFOLK COUNTY. REFER TO VALLEE PLAN AND PROFILE DRAWINGS FOR STORM, WATER, AND SEWER LOCATIONS. REFER TO HYDRO ONE DRAWING FOR THE LOCATION OF HYDRO AND APPURTENANCES. REFER TO ERTL DRAWINGS FOR LOCATION OF STREET LIGHTS AND APPURTENANCES.

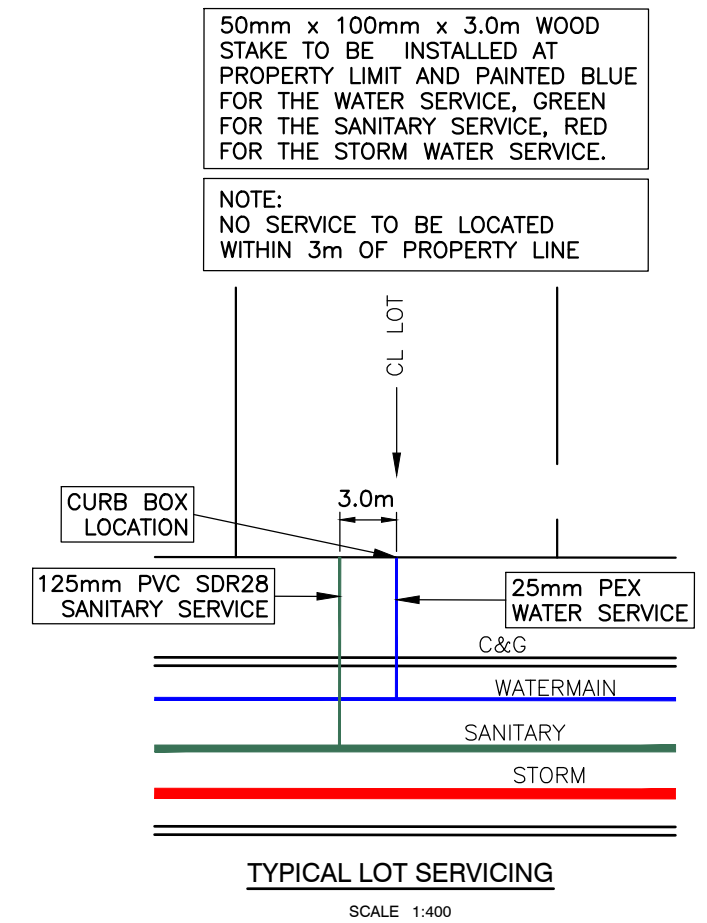
DRIVEWAY LOCATIONS

DRIVEWAY LOCATIONS TO BE LOCATED ON THE SIDE OF LOT AS SHOWN. FINAL WIDTH AND ALIGNMENT OF DRIVEWAY TO BE DETERMINED BASED ON HOUSE PLACEMENT ON LOT.

-DRIVEWAY LOCATION



STANDARDIZATION OF SERVICE LOCATIONS
20 M R.O.W. & 8.0 M ASPHALT WIDTH (TYPICAL)
NTS

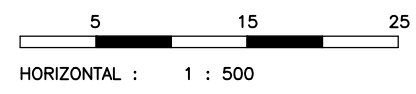


REV. No.	DATE	REVISION
0	12/12/2023	FIRST SUBMISSION TO COUNTY

NOTE:
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DRAWING**
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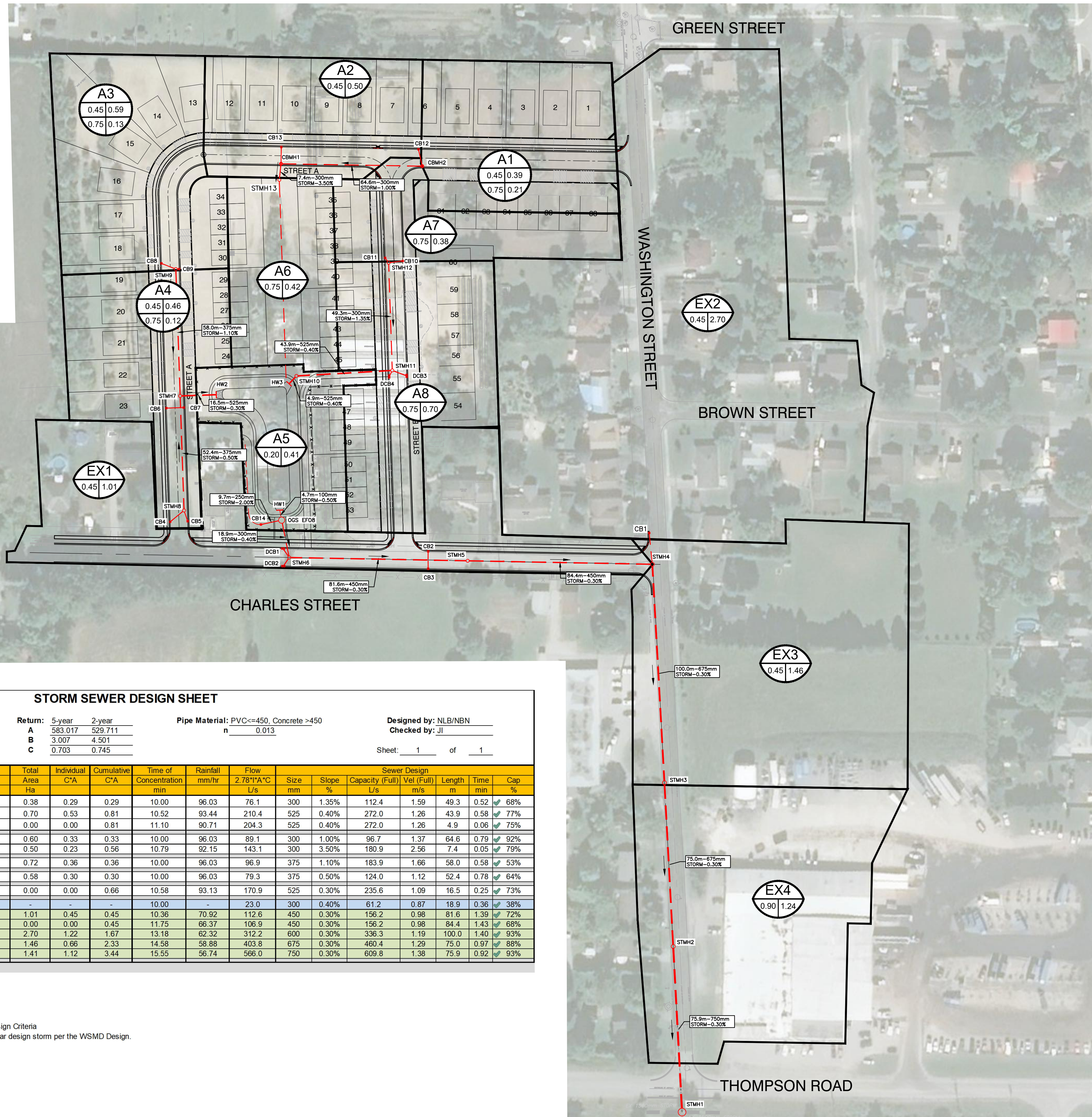
G. DOUGLAS VALLEE LIMITED
2 TALBOT STREET NORTH
SIMCOE, ONTARIO N3Y 3W4
(519) 426-6270



Project Title
**CHARLES STREET
SUBDIVISION
WATERFORD - NORFOLK COUNTY**

Drawing Title
COMPOSITE UTILITY PLAN

Designed by : NBN/NLB	Drawn By : NBN
Checked by : NLB/JTI	Date Started : 05/03/2023
Drawing Scale : AS SHOWN	Drawing No. COM
Project No. 21-169	



LEGEND:

	= 100-year flow from SWMM Pong obtained from OTTHYMO
	= 2-Year Design Storm for Municipal storm sewers

NOTES:

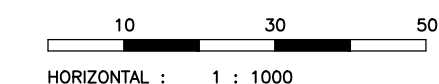
- 1) Internal storm sewers sized using the 5-year design storm per Norfolk County Design Criteria
- 2) External storm sewers along Charles and Washington Street sizes using the 2-year design storm per the WSMD Design.

NOTE:
THE CONTRACTOR IS CAUTIONED THAT ALL OF THE EXISTING UTILITIES ARE NOT INDICATED ON THIS DRAWING. THE CONTRACTOR MUST ARRANGE FOR LOCATING EACH UTILITY PRIOR TO ANY CONSTRUCTION OR EXCAVATION. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR THE PROTECTION OF ALL UTILITIES LOCATED BY THE CONTRACTOR ON THIS DRAWING. G. DOUGLAS VALLÉE LTD. CAN NOT BE HELD RESPONSIBLE FOR ANY DAMAGE TO ANY EXISTING UTILITY WHICH MAY OR MAY NOT BE INDICATED ON THIS DRAWING.

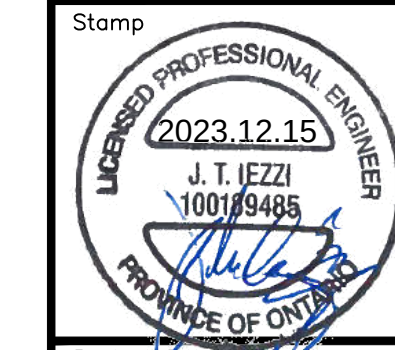
SITE BENCHMARKS:

- 1. SPIKE IN FACE OF WOOD HYDRO POLE ALONG WEST SIDE OF
LEWISON STREET, 46m NORTH OF DWELLING AT #210.
ELEVATION 246.32.
- 2. SPIKE IN FACE OF WOOD HYDRO POLE ALONG NORTH SIDE OF
CHAMBERLAIN STREET, 3m SOUTH OF CB IN FRONT OF DWELLING
AT #173 EAST OF DWELLING. 241.91.
- 2. SPIKE IN FACE OF WOOD HYDRO POLE ALONG NORTH SIDE OF
CHAMBERLAIN STREET, 3m SOUTH OF CONCRETE SLANTED CB
IN FRONT OF DWELLING @ 173 WEST OF DWELLING.

**PRELIMINARY
DRAWING**
NOT TO BE USED
FOR CONSTRUCTION



G. DOUGLAS VALLEE LIMITED
2 TALBOT STREET NORTH
SIMCOE, ONTARIO N3Y 3W4
(519) 426-6270



Project Title 21

CHARLES STREET
SUBDIVISION
WATERFORD - NORFOLK COUNTY

Drawing Title
STORM DRAINAGE AREA'S

Designed by : NBN/NLB	Drawn By : NBN
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Checked by : NLB/JTI	Date Started : 05/17/2023
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Drawing Scale :	Drawing No.
AS SHOWN	CTM

Project No. **21-169**

STM

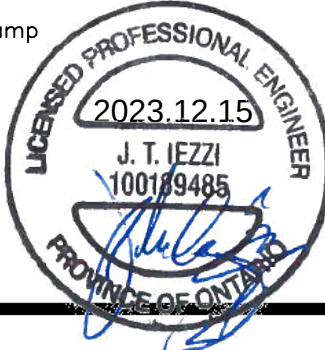
DATE LAST PLOTTED: December 15, 2023



G. DOUGLAS VALLEE LIMITED
2 TALBOT STREET NORTH
SIMCOE, ONTARIO N3Y 3W4
(519) 426-6270

Project Title	CHARLES STREET SUBDIVISION
Location	WATERFORD, NORFOLK COUNTY
Drawing Title	CHARLES STREET CROSS SECTIONS

Stamp



REV. No.	DATE	REVISION

REV. No.	DATE	REVISION

Designed by :

Drawn By :

Project No.

Checked by :

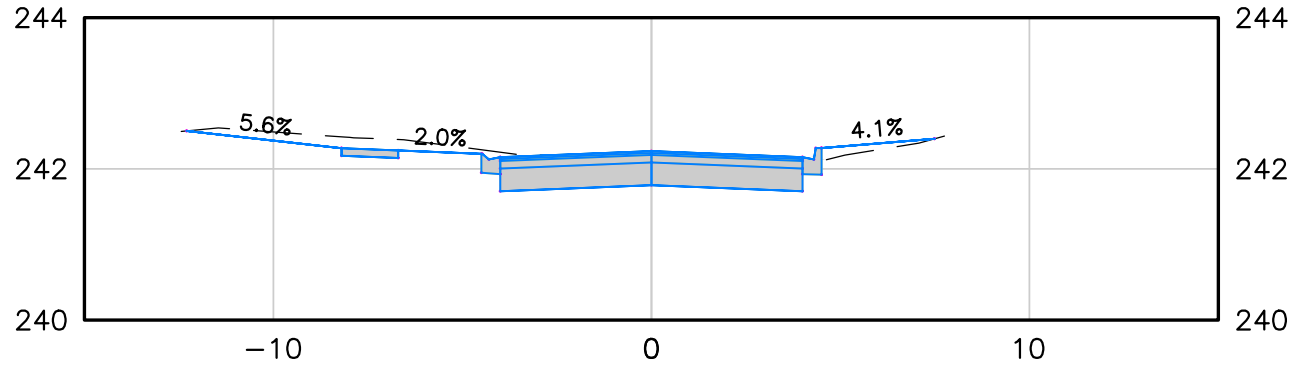
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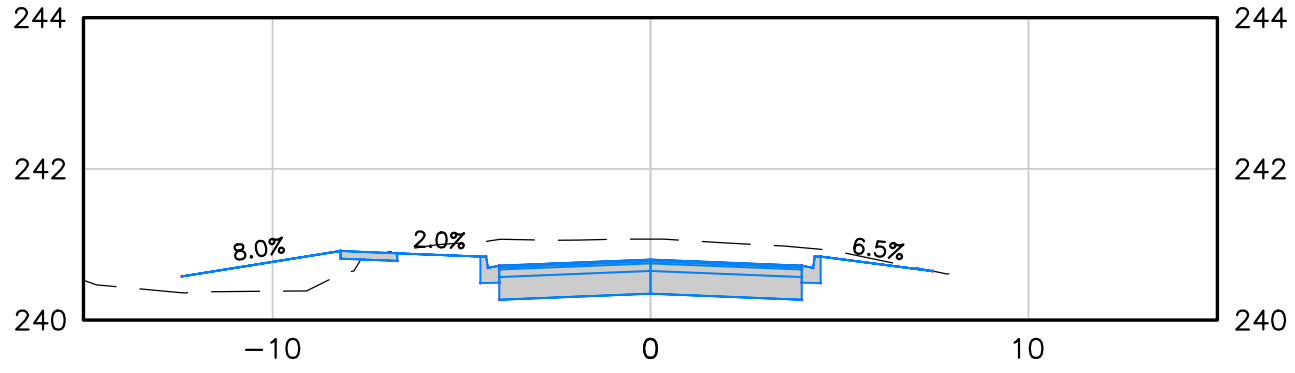
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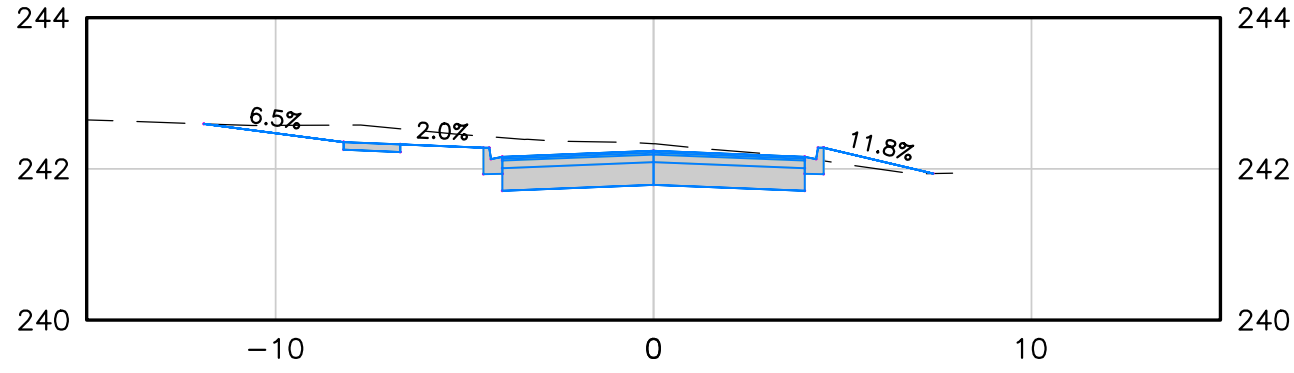
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PROP C/L 242.23



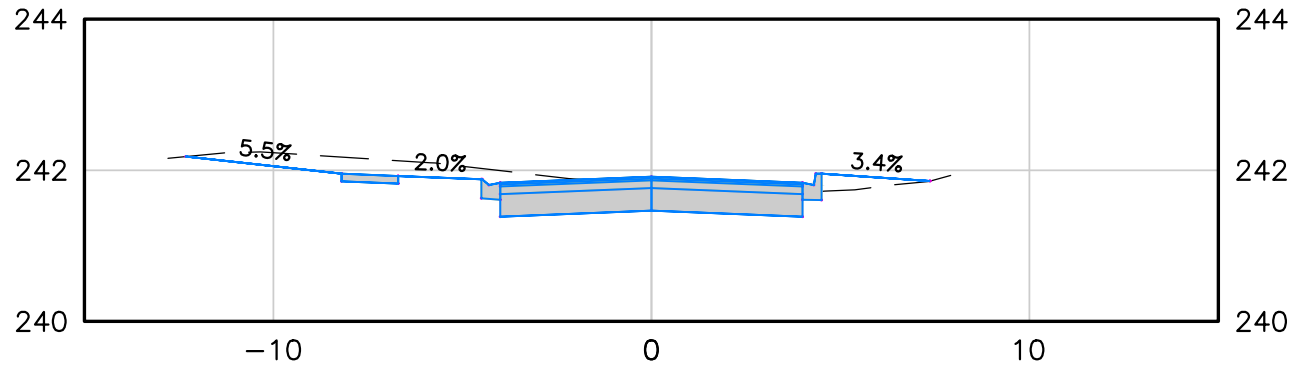
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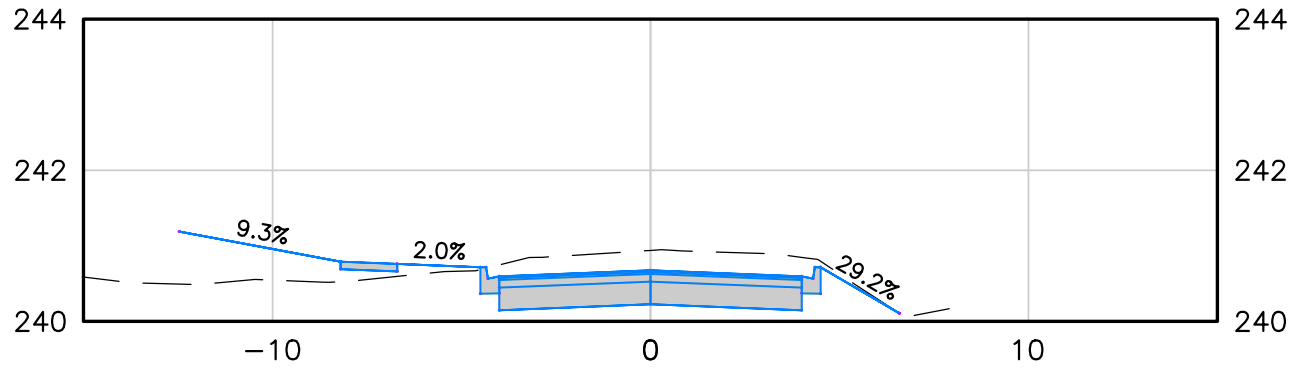
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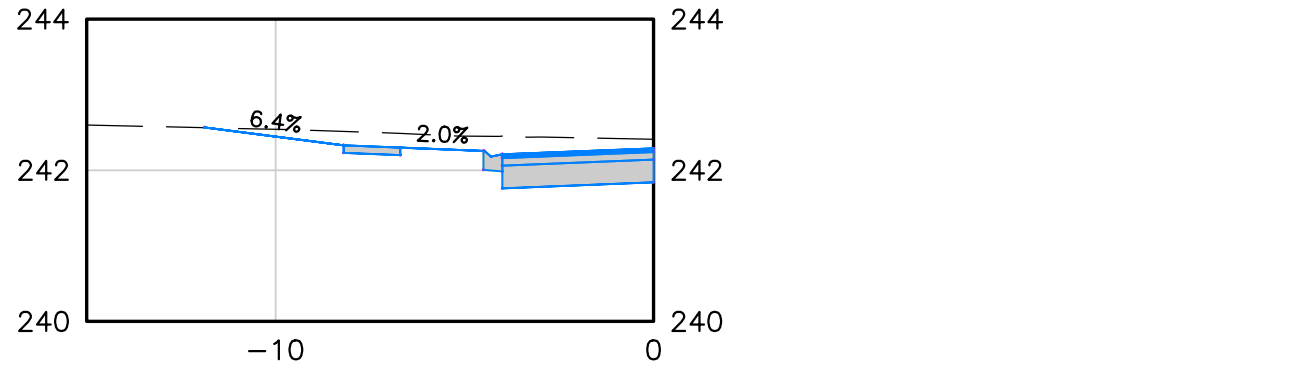
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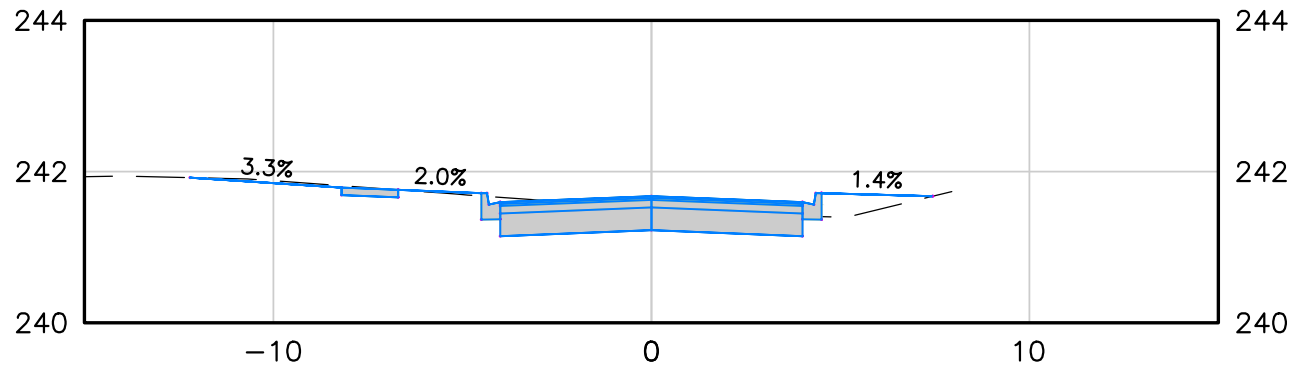
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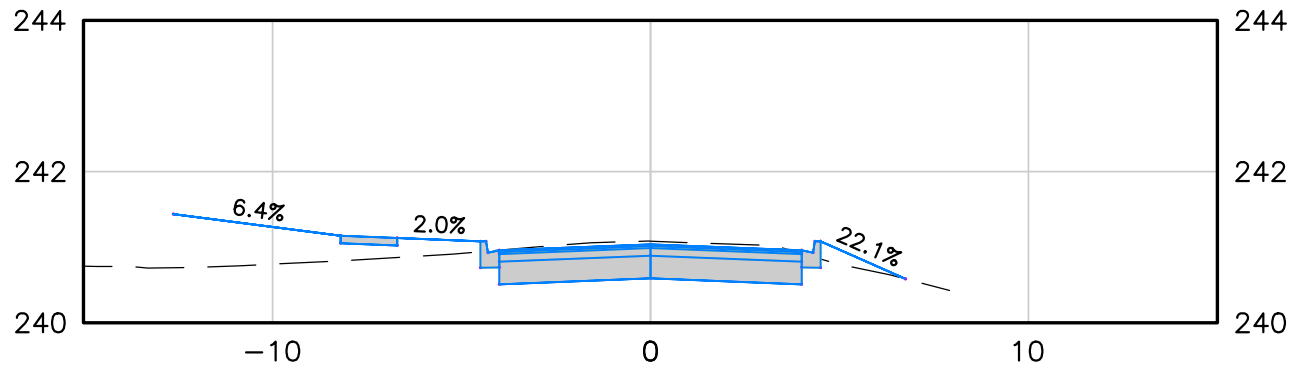
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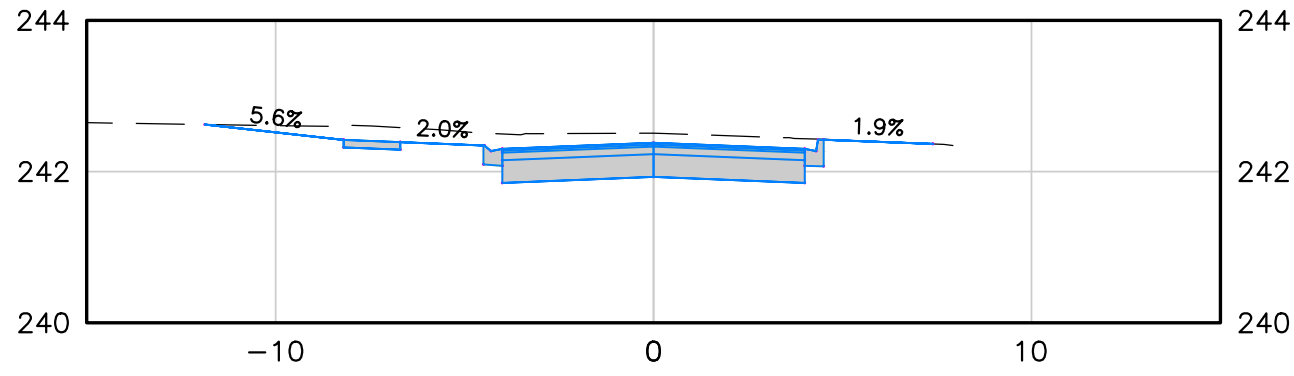
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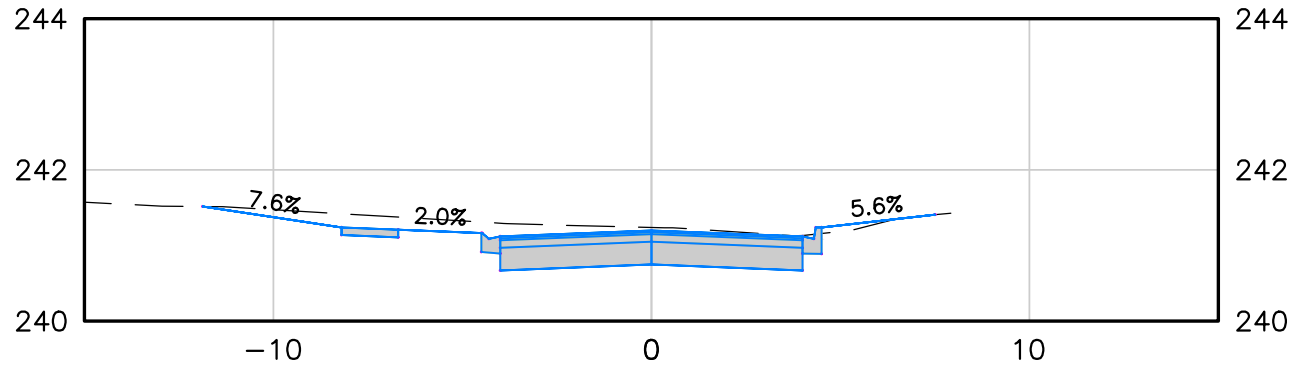
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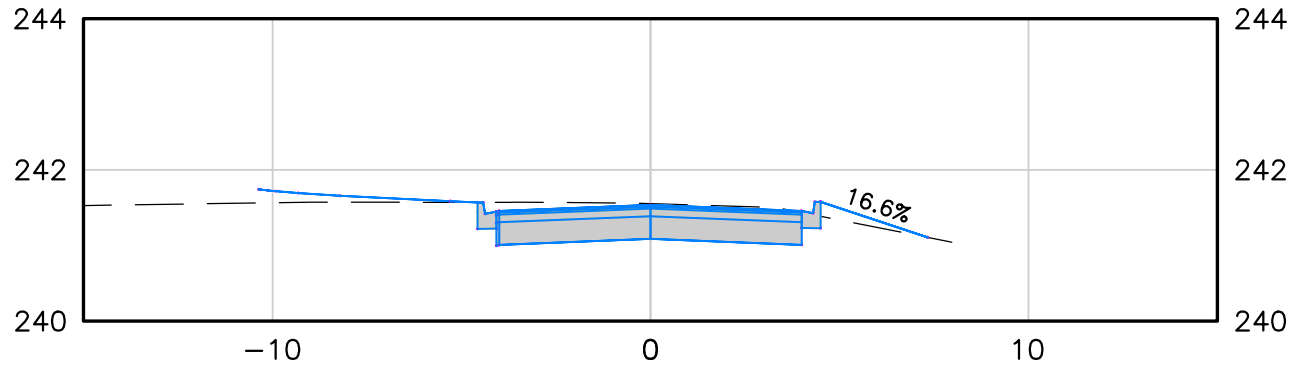
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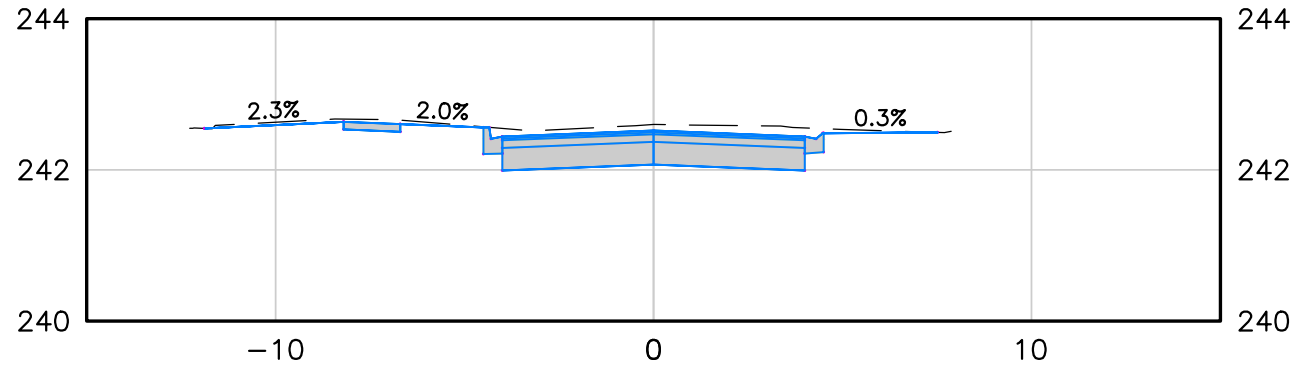
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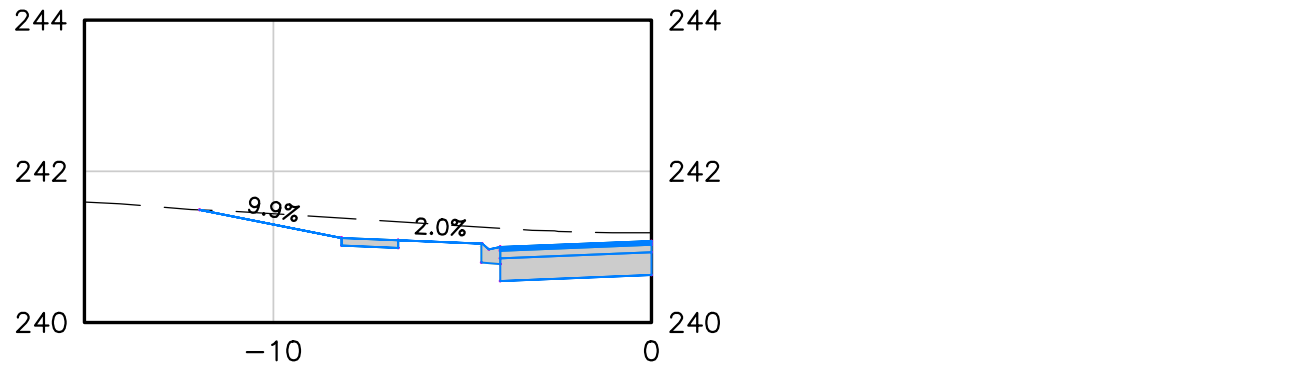
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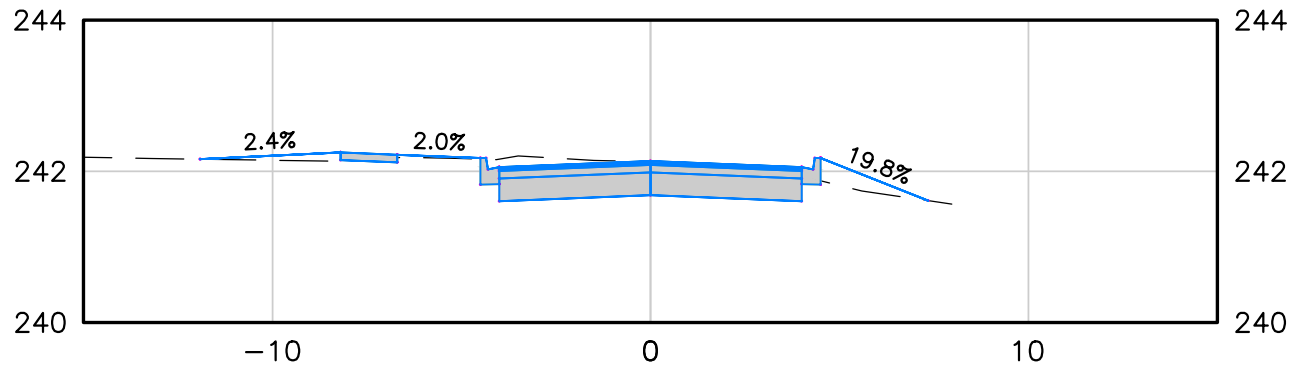
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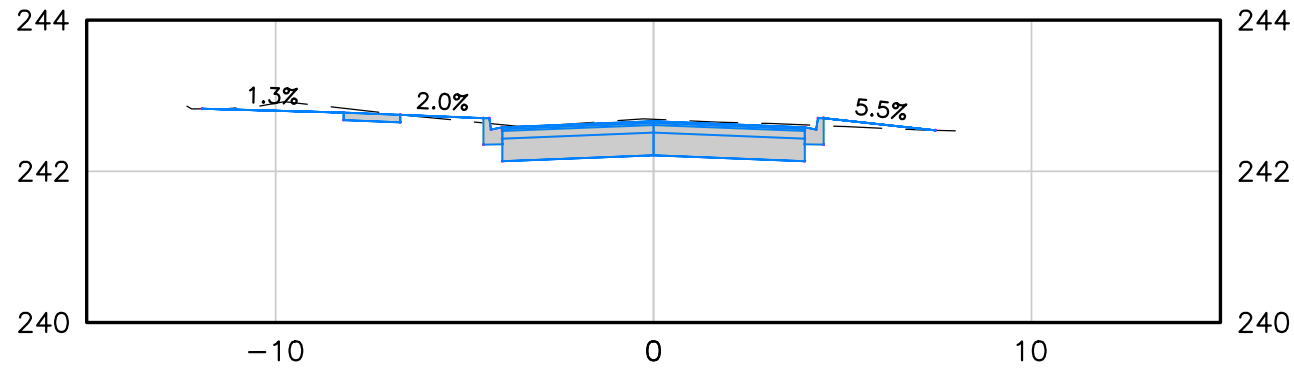
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PROP C/L 242.13



0+260
EX C/L 242.69
PROP C/L 242.66



Charles Street Subdivison

Waterford, NORFOLK COUNTY

Estimated Cost and Securities

Rev0 - 2023-12-15

Project #21-169

ITEM	DESCRIPTION	UNIT	APPROX. QUANTITY	UNIT PRICE	AMOUNT	SECURITY %	SECURITY AMOUNT
A. SANITARY SEWERS							
1	Connect exsiting sanitary on Charles Street to SAMH4, including backfill and restoration.	L.S.	1	\$3,000	\$3,000	100%	\$3,000
2	Connect new sanitary to EX SAMH on Charles Street at station 0+095, including backfill and restoration.	L.S.	1	\$3,000	\$3,000	100%	\$3,000
3	Connect new sanitary to EX SAMH at Charles Street and Washington Street intersection, including backfill and restoration.	L.S.	1	\$3,000	\$3,000	100%	\$3,000
4	Supply and install 125mm dia. sanitary services including all fittings and marker 1m from proposed buidling within development site.	Each.	68	\$1,000	\$68,000	10%	\$6,800
5	Supply and install 125mm dia. sanitary services including all fittings and connect to existing services along Charles Street	Each.	2	\$1,000	\$2,000	100%	\$2,000
6	Supply and install 200mm PVC sanitary sewers.						
a)	EX. SAMH at Charles & Washington To SAMH1	metre	58.4	\$250.00	\$14,600	100%	\$14,600
b)	SAMH1 To SAMH2	metre	58.3	\$250.00	\$14,575	100%	\$14,575
c)	SAMH2 To SAMH3	metre	41.4	\$250.00	\$10,350	100%	\$10,350
d)	SAMH2 To EX SAMH at station 0+095	metre	34.4	\$250.00	\$8,588	100%	\$8,588
e)	SAMH4 To Property Line	metre	10.0	\$200.00	\$2,000	100%	\$2,000
f)	Property Line To SAMH5	metre	45.7	\$200.00	\$9,140	10%	\$914
g)	SAMH5 To SAMH6	metre	55.7	\$200.00	\$11,140	10%	\$1,114
h)	SAMH6 To SAMH7	metre	58.6	\$200.00	\$11,720	10%	\$1,172
i)	SAMH7 To SAMH8	metre	17.4	\$200.00	\$3,480	10%	\$348
j)	SAMH8 To SAMH9	metre	89.8	\$200.00	\$17,960	10%	\$1,796
k)	SAMH9 To SAMH10	metre	97.8	\$200.00	\$19,560	10%	\$1,956
l)	SAMH2 To Property Line	metre	8.0	\$200.00	\$1,600	100%	\$1,600
m)	Property Line To SAMH12	metre	70.3	\$200.00	\$14,060	10%	\$1,406
n)	SAMH12 To SAMH11	metre	61.7	\$200.00	\$12,340	10%	\$1,234
o)	SAMH11 To SAMH9	metre	40.8	\$200.00	\$8,160	10%	\$816
7	Supply and install 1200mm dia. precast concrete maintenance holes complete with benching.						
a)	SAMH1	L.S.	1	\$10,000	\$10,000	100%	\$10,000
b)	SAMH2	L.S.	1	\$10,000	\$10,000	100%	\$10,000
c)	SAMH3	L.S.	1	\$10,000	\$10,000	100%	\$10,000
d)	SAMH4	L.S.	1	\$7,000	\$7,000	100%	\$7,000
e)	SAMH5	L.S.	1	\$7,000	\$7,000	10%	\$700
f)	SAMH6	L.S.	1	\$7,000	\$7,000	10%	\$700
g)	SAMH7	L.S.	1	\$7,000	\$7,000	10%	\$700
h)	SAMH8	L.S.	1	\$7,000	\$7,000	10%	\$700
i)	SAMH9	L.S.	1	\$7,000	\$7,000	10%	\$700
j)	SAMH10	L.S.	1	\$7,000	\$7,000	10%	\$700
k)	SAMH11	L.S.	1	\$7,000	\$7,000	10%	\$700
l)	SAMH12	L.S.	1	\$7,000	\$7,000	10%	\$700
8	Flush and CCTV Video Sanitary System.	L.S.	1	\$6,000	\$6,000	10%	\$600
TOTAL SANITARY SEWERS					\$337,273		\$123,469

ITEM	DESCRIPTION	UNIT	APPROX. QUANTITY	UNIT PRICE	AMOUNT	SECURITY %	SECURITY AMOUNT
B. WATERMAINS							
1	Connect new 200mm watermain Along Street A to existing 300mm watermain on Charles Street at station 0+065.	L.S.	1	\$3,000	\$3,000	100%	\$3,000
2	Connect new 200mm watermain Along Street B to existing 300mm watermain on Charles Street at station 0+175.	L.S.	1	\$3,000	\$3,000	100%	\$3,000
3	Connect new 200mm watermain Along Street A to existing 300mm watermain on Washington Street at station 0+405.	L.S.	1	\$3,000	\$3,000	100%	\$3,000
4	Supply and install 200mm dia. water main including all fittings and anodes within development site.	metre	545	\$170.00	\$92,650	10%	\$9,265
5	Supply and install 200mm dia. water main including all fittings and anodes within County ROW.	metre	45	\$170.00	\$7,650	100%	\$7,650
6	Supply and install water service including all fittings and anodes within development site.	each	68	\$1,000.00	\$68,000	10%	\$6,800
7	Supply and install hydrant set complete with valve within development site.	each	4	\$5,000.00	\$20,000	10%	\$2,000
TOTAL WATERMAIN					\$197,300		\$34,715

ITEM	DESCRIPTION	UNIT	APPROX. QUANTITY	UNIT PRICE	AMOUNT	SECURITY %	SECURITY AMOUNT
C. STORM SEWERS							
1	Supply and install 300mm dia. storm sewers.						
	a) CBMH1 To CBMH2	metre	64.6	\$130.00	\$8,398	10%	\$840
	b) STMH13 To CBMH1	metre	7.4	\$130.00	\$962	10%	\$96
	c) STMH11 To STMH12	metre	49.3	\$130.00	\$6,409	10%	\$641
	d) STMH6 To OGS EFO8	metre	18.9	\$130.00	\$2,457	100%	\$2,457
2	Supply and install 375mm dia. storm sewers.						
	a) STMH7 To STHM9	metre	58.0	\$150.00	\$8,700	10%	\$870
	b) STMH7 To STHM8	metre	52.4	\$150.00	\$7,860	10%	\$786
3	Supply and install 450mm dia. storm sewers.						
	a) STMH4 to STMH5	metre	84.4	\$180.00	\$15,192	100%	\$15,192
	b) STMH5 to STMH6	metre	81.6	\$180.00	\$14,688	100%	\$14,688
4	Supply and install 525mm dia. storm sewers.						
	a) HW2 To STMH7	metre	16.5	\$250.00	\$4,125	10%	\$413
	b) HW3 To STMH10	metre	4.9	\$250.00	\$1,225	10%	\$123
	c) STHM10 to STMH11	metre	43.9	\$250.00	\$10,975	10%	\$1,098
5	Supply and install 675mm dia. storm sewers.						
	a) STMH2 to STMH3	metre	100.0	\$375.00	\$37,500	100%	\$37,500
	b) STMH3 to STMH4	metre	75.0	\$375.00	\$28,125	100%	\$28,125
6	Supply and install 750mm dia. storm sewers.						
	a) STMH1 To STMH2	metre	75.9	\$420.00	\$31,878	100%	\$31,878
7	Supply and install 1200mm dia. precast concrete maintenance holes complete with benching.						
	a) STMH5	L.S.	1	\$10,000	\$10,000	100%	\$10,000
	b) STMH6	L.S.	1	\$7,000	\$7,000	100%	\$7,000
	c) STMH7	L.S.	1	\$7,000	\$7,000	10%	\$700
	d) STMH8	L.S.	1	\$7,000	\$7,000	10%	\$700
	e) STMH9	L.S.	1	\$7,000	\$7,000	10%	\$700
	f) STMH10	L.S.	1	\$7,000	\$7,000	10%	\$700
	g) STMH11	L.S.	1	\$7,000	\$7,000	10%	\$700
	h) STMH12	L.S.	1	\$7,000	\$7,000	10%	\$700
	i) STMH13	L.S.	1	\$7,000	\$7,000	10%	\$700
	j) CBMH1	L.S.	1	\$7,000	\$7,000	10%	\$700
	k) CBMH2	L.S.	1	\$7,000	\$7,000	10%	\$700
8	Supply and install 1500mm dia. precast concrete maintenance holes complete with benching.						
	a) STMH2	L.S.	1	\$15,000	\$15,000	100%	\$15,000
	b) STMH3	L.S.	1	\$15,000	\$15,000	100%	\$15,000
	c) STMH4	L.S.	1	\$15,000	\$15,000	100%	\$15,000
9	Supply and install 3000mm dia. precast concrete maintenance holes complete with benching.						
	a) STMH1	L.S.	1	\$25,000	\$25,000	100%	\$25,000

ITEM	DESCRIPTION	UNIT	APPROX. QUANTITY	UNIT PRICE	AMOUNT	SECURITY %	SECURITY AMOUNT
10	Supply and install 600x600 precast concrete catch basins complete with grate, connections, and						
	a) Within Development	each	11	\$2,500	\$27,500	10%	\$2,750
	b) County ROW	each	3	\$2,500	\$7,500	100%	\$7,500
11	Supply and install 600x1200 precast concrete double catch basins complete with grate, connections, and subdrains.						
	a) Within Development	each	2	\$5,000	\$10,000	10%	\$1,000
	b) County ROW	each	2	\$5,000	\$10,000	100%	\$10,000
12	Supply and install 250mm catchbasin leads.						
	a) Within Development	m	61.5	\$100	\$6,150	10%	\$615
	b) County ROW	m	22.4	\$100	\$2,240	100%	\$2,240
13	Supply and install 300mm catchbasin leads.						
	a) Within Development	m	8	\$130	\$1,040	10%	\$104
	b) County ROW	m	8	\$130	\$1,040	100%	\$1,040
14	Construct Headwalls per OPSD 804.030.	each	3	\$5,500.00	\$16,500	10%	\$1,650
15	Construct proposed stormwater management pond.	L.S.	1	\$200,000.00	\$200,000	10%	\$20,000
16	Supply and place rip rap at stormwater inlets and outlet.	L.S.	1	\$3,500.00	\$3,500	100%	\$3,500
17	Supply and install oil and grit separator Stormceptor EFO8 or approved equivalent.	L.S.	1	\$30,000.00	\$30,000	10%	\$3,000
18	Flush and CCTV video storm system	L.S.	1	\$6,000.00	\$6,000	10%	\$600
TOTAL STORM SEWER					\$649,964		\$282,004

ITEM	DESCRIPTION	UNIT	APPROX. QUANTITY	UNIT PRICE	AMOUNT	SECURITY %	SECURITY AMOUNT
D. ROAD CONSTRUCTION							
DEVELOPMENT SITE							
1	Sub-excavation to a depth of 540mm below finish grade for proposed asphalt areas.	L.S.	1	\$40,000	\$40,000	10%	\$4,000
2	Supply, place and compact 300mm Granular 'B' Type 2 100% crushed limestone for asphalt area.	tonne	4025	\$15.00	\$60,375	10%	\$6,038
3	Supply, place and compact 150mm Granular 'A' 100% crushed limestone for asphalt area.	tonne	2175	\$20.00	\$43,500	10%	\$4,350
4	Supply, place and compact 50mm of HL8 base asphalt pavement for asphalt area.	tonne	600	\$100.00	\$60,000	10%	\$6,000
5	Supply, place and compact 40mm of HL3 top asphalt pavement for asphalt area.	tonne	475	\$110.00	\$52,250	10%	\$5,225
6	Supply, place and compact 250mm Granular 'A' 100% crushed limestone for SWM pond access road	tonne	225	\$20.00	\$4,500	10%	\$450
7	Construct 1.5m wide sidewalk	sqm	825	\$50.00	\$41,250	10%	\$4,125
8	Construct curb and gutter.	m	1050	\$40.00	\$42,000	10%	\$4,200
9	Adjust manholes to base asphalt.	each	13	\$350.00	\$4,550	10%	\$455
10	Adjust manholes to surface asphalt.	each	13	\$350.00	\$4,550	10%	\$455
COUNTY ROW							
1	Relocate existing Hydro Poles on Washington Street.	L.S.	1	\$50,000.00	\$50,000	100%	\$50,000
2	Sub-excavation to a depth of 540mm below finish grade for proposed asphalt areas.	L.S.	1	\$22,000	\$22,000	100%	\$22,000
3	Supply, place and compact 300mm Granular 'B' Type 2 100% crushed limestone for asphalt area.	tonne	2150	\$15.00	\$32,250	100%	\$32,250
4	Supply, place and compact 150mm Granular 'A' 100% crushed limestone for asphalt area.	tonne	1175	\$20.00	\$23,500	100%	\$23,500
5	Supply, place and compact 50mm of HL8 base asphalt pavement for asphalt area.	tonne	350	\$100.00	\$35,000	100%	\$35,000
6	Supply, place and compact 40mm of HL3 top asphalt pavement for asphalt area.	tonne	275	\$110.00	\$30,250	100%	\$30,250
7	Construct 1.5m wide sidewalk	sqm	380	\$50.00	\$19,000	100%	\$19,000
8	Construct curb and gutter.	m	575	\$40.00	\$23,000	100%	\$23,000
9	Adjust existing sanitary manholes to surface asphalt.	each	2	\$500.00	\$1,000	100%	\$1,000
TOTAL ROAD CONSTRUCTION					\$588,975		\$271,298

ITEM	DESCRIPTION	UNIT	APPROX. QUANTITY	UNIT PRICE	AMOUNT	SECURITY %	SECURITY AMOUNT
E. LANDSCAPING							
1	Landscaping Allowance	L.S.	1	<u>\$50,000.00</u>	<u>\$50,000</u>	<u>100%</u>	<u>\$50,000</u>
TOTAL LANDSCAPING					\$50,000		\$50,000
F. RECORD DRAWINGS							
1	Complete record drawings for development site and work within county ROW.	L.S.	1	<u>\$4,000.00</u>	<u>\$4,000</u>	<u>100%</u>	<u>\$4,000</u>
TOTAL RECORD DRAWINGS					\$4,000		\$4,000
SECURITY SUMMARY							
A.	SANITARY SEWERS						<u>\$123,469</u>
B.	WATERMAIN						<u>\$34,715</u>
C.	STORM SEWERS						<u>\$282,004</u>
D.	ROAD CONSTRUCTION						<u>\$271,298</u>
E.	LANDSCAPING						<u>\$50,000</u>
F.	RECORD DRAWINGS						<u>\$4,000</u>
GRAND TOTAL							\$765,485



vallee

*Consulting Engineers,
Architects & Planners*

December 12, 2023

2863088 Ontario Inc
3156 Countess Crescent
Mississauga, ON
L5M 0E2

Attention: Mr. Roger Sharma

**Reference: Functional Servicing Report
Charles Street Subdivision
Waterford, Norfolk County
Our Project # 21-169**

Introduction

This Functional Servicing Report has been completed on behalf of 2863088 Ontario Inc. in support of the detailed design for the proposed Charles Street Subdivision located in Waterford, Norfolk County, Ontario. It is the intention to submit this report to Norfolk County and the Long Point Region Conservation Authority for review and approval.

The proposed 4.35 ha development site is located on the western side of Waterford and is bounded by Washington Street to the east, Charles Street to the south, and residential areas to the west and north. The development site was formerly home to Peter Overdevest and Sons Landscaping and Nursery, agricultural farmland, and an open grassed area. Refer to Figure 1 below.

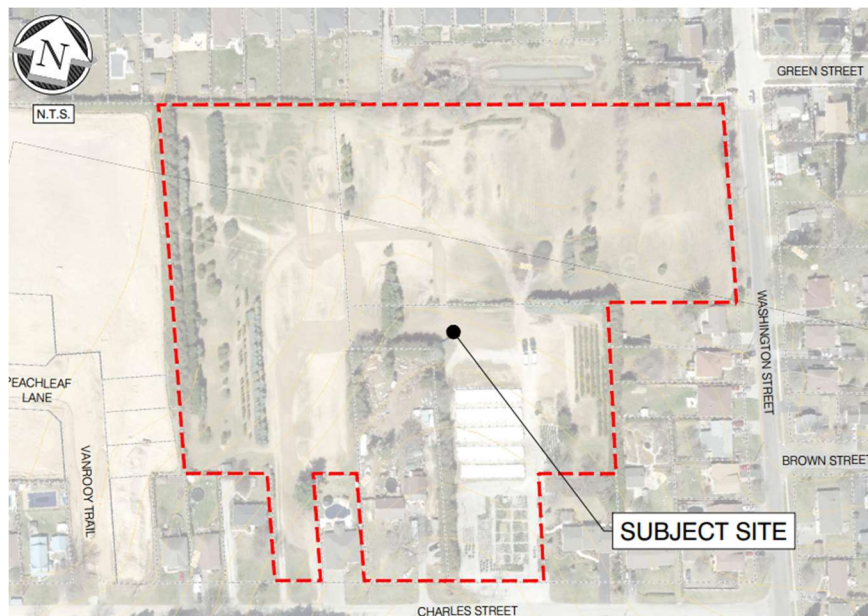


Figure 1 – Site Location

Land Use and Design Assumptions

The subject property is currently zoned as a “Development Zone (D)” and “urban Residential R1-A(H)”. The proposed development will be zoned as “Urban Residential Type 1 Zone (R1-B)” and Urban Residential Type 4 Zone (R4), and will consist of the following construction:

- Single Detached Dwellings
 - 23 – 1 or 2-storey residential dwelling units
- Street Townhouses
 - 30 – 2-storey single-car garage residential dwelling units
 - 9 – 1-storey single-car garage residential dwelling units
 - 6 – 1-storey double-car garage residential dwelling units
- Storm and sanitary infrastructure to support proposed construction
- Stormwater management facility
- Curbs, sidewalks and other miscellaneous items to support the proposed construction

The following table outlines the mix of land use, and calculates the anticipated population based on a dwelling density of 2.75 people per unit (ppu) as utilized in the Norfolk County Design Criteria – August 2017.

Table 1 Subject Lands – Estimate of Population		
Land Use	Number of Units	Population
Single-detached dwellings	23 units @ 2.75 ppu	63 people
Townhouse dwellings	45 units @ 2.75 ppu	124 people
Total		187 people

Roads & Traffic Impact

The proposed road layout is presented on drawing 21-169-01 – General Plan of Services. The proposed development will have two entrances off Charles Street and one off of Washington Street. Paradigm Transportation Solutions Limited was retained to complete a traffic impact study for the proposed development to review the impacts of the new roads and intersections. In summary, it was concluded that the Charles Street Subdivision poses no adverse effects to the existing or future traffic operations within the study area. Refer to the complete traffic impact study dated June 2022 in Appendix A.

Geotechnical

G2S Consulting Inc. was retained to complete a geotechnical investigation, soil sampling and chemical testing program, and assessment of past uses report for the proposed Charles Street development. Refer to the complete details of all reports in Appendix B.

Sanitary Servicing

Under existing conditions, there is a 200mm diameter sanitary sewer on Charles Street and 250mm diameter sanitary sewer on Washington Street. An internal sanitary sewer network will service the entirety of the development site and will discharge sanitary flows to the existing sanitary sewer along Charles Street. The proposed configuration of the sanitary network is detailed on drawing 21-169-01 – General Plan of Services.

Sanitary design flows for the proposed development were calculated using the Norfolk County Design Criteria. The peak sanitary design flow associated with the proposed development is presented below. In summary, the proposed development is anticipated to generate a total additional sanitary flow of approximately 5.27 L/s to the existing sanitary sewer along Charles Street. Detailed calculations are outlined in Appendix C.

- | | |
|----------------------------|-----------------------|
| • Total Number of Units: | 68 |
| • Population Density: | 2.75 persons per unit |
| • Population: | 187 people |
| • Average Per Capita Flow: | 450 L/person/day |
| • Infiltration Allowance: | 0.28 L/sec/ha |
| • Development Area: | 4.35 ha |
| • Peaking Factor: | 4.16 |
| • Sewage Flow: | 0.97 L/s |
| • Infiltration Flow: | 1.22 L/s |
| • Peak Design Flow: | 5.27 L/s |

Sanitary Network Review

R. V. Anderson Associates (RVA) Limited was retained by Norfolk County to determine the impact of the proposed Charles Street Subdivision on the conveyance capacity of the existing sanitary sewer sewers and pumping stations along the route to the Waterford Wastewater Treatment Plant (WWTP). The following conclusions resulted:

- From Charles Street to the Blueline Road Pumping Station, no sewer capacities are exceeded. However, the sewers are approaching capacity, therefore, RVA recommends the County complete flow monitoring to determine if upgrades are required.
- Under current conditions, the Blueline Road Pumping Station cannot accommodate the existing peak flows, as noted in the Norfolk County Integrated Sustainable Master Plan (ISMP). Therefore, an improvement to the Blueline Road Pumping Station is recommended before the addition of the Charles Street Subdivision flows.
- Under current conditions, the capacity of the sanitary sewer that crosses the county ROW from Main Street North to Deer Park Road is exceeded. RVA notes that it is likely the higher peaking factor used to estimate flows in the upstream sewer sections has been carried through to the end of the collection system. As such RVA does not believe the capacity of this section is exceeded and does not recommend any upgrades to accommodate the proposed development.

Refer to Appendix C for complete details of the sanitary servicing review completed by R.V. Anderson Associates. In addition, it should be noted Norfolk County is currently completing sanitary flow monitoring studies in Waterford, and any required infrastructure upgrades will only be considered after the sanitary flow monitoring studies have been completed, and RVA updates their modelling accordingly.

Stormwater Management

Under existing conditions, the subject site features the Peter Overdevest and Sons Landscaping and Nursery, agricultural land and open grassed area. Runoff from the site drains overland in a southerly direction towards Charles Street. Runoff is then conveyed under Charles Street via an existing culvert at #177, where it continues to flow overland across the St. Bernard's School and Church properties, and ultimately discharges to the Waterford South Municipal Drain (WSMD) watercourse.

As-constructed drawings from Norfolk County indicate there is an existing 1500mm diameter municipal storm sewer system located within Thompson Road allowance. This storm sewer flows to the west and outlets downstream to an existing Stormwater Management (SWM) pond, where it ultimately discharges to the Waterford South Municipal Drain watercourse. It is the intention to utilize the 1500mm diameter storm sewer as the outlet for the proposed development. Under current conditions, there are no storm sewers located on Charles Street or Washington Street, therefore a storm sewer will be constructed along Washington Street and Charles Street to connect the proposed subdivision to the existing storm sewer along Thompson Road.

The proposed Charles Street Subdivision site is located outside of the original WSMD drainage area. However, as per the Revised Waterford South Municipal Drain Design Brief, the proposed development has been added to the WSMD drainage system with the assumption that the site will feature an on-site stormwater management facility that will reduce the post-development peak flows and ensure that the capacity of the Thompson Road storm sewer is not exceeded. The site was given a peak flow allowance corresponding to the 2-year pre-development peak flow rate.

The overall SWM strategy is to utilize site grading and a storm sewer system to convey flows from the 2-year through the 100-year storm events to the proposed SWM facility. The proposed SWM system includes an infiltration basin at the center of the development and a SWM pond at the southern end of the site. Runoff released from the storage facility will be directed to the proposed storm sewer along Charles Street and Washington Street. The proposed SWM system will have two primary functions:

1. Reduce or control the post-development peak flow rates from the site to levels that do not exceed the 2-year pre-development flow rate, for all storm events up to and including the 100-year storm event.
2. Treat stormwater to an Enhanced Protection Level as defined in the Ministry of the Environment's *Stormwater Management Practices Planning and Design Manual* (March 2003).

The following summarizes the proposed SWM Facility, for Charles Street Subdivision:

- A 1.5m deep infiltration basin with an overflow connection to the stormwater management pond.
- A dry pond facility with a pond bottom of elevation of 239.50m, a top of freeboard elevation of 241.00m.
- Active storage depth of 1.2m.
- Total active storage volume provided for the 100-year storm event is 1096 m³.
- Discharge from the proposed facility controlled by a 100mm diameter orifice at elevation 239.50m.
- A 6.0m emergency overflow spillway is provided at 241.00m to safely convey the peak inflow rate from the 100-year storm event to the existing watercourse.
- An EFO8 Stormceptor unit, or approved equal, shall be utilized to achieve an enhanced level of water quality protection.

Complete details of the SWM design are provided in the Charles Street Subdivision Stormwater Management Report dated December 12, 2023.

Water Servicing

The Norfolk County Integrated Sustainable Master Plan (ISMP) indicates an existing 300mm diameter watermain along Charles Street and Washington Street, and a second 300mm diameter watermain along Washington Street. It is proposed that the existing 300mm watermain along Charles Street and Washington Street will be used to service the proposed development.

Norfolk County's design criteria stipulates that a water system must be designed to meet the greater of either the maximum daily demand (MDD) plus fire flow (FF) or peak hourly demand (PHD). The system pressure requirements are as follows;

- Fire flow conditions– not less than 140 kPa (20 psi)
- Normal operating conditions – not less than 280 kPa (40 psi)

Domestic Water Demand

The following summarizes the flow information for the proposed development:

- | | |
|---|--------------------------------------|
| • Total Number of Units: | 68 |
| • Population Density: | 2.75 persons per unit |
| • Population: | 187 people |
| • Average Daily Water Demand (per person) | 0.450 m ³ /person/day |
| • Average Daily Water Demand: | 84.2 m ³ /day (0.97 L/s) |
| • Maximum Day Demand Factor: | 2.25 |
| • Maximum Day Demand: | 189.3 m ³ /day (2.19 L/s) |
| • Peak Hourly Demand Factor (Residential) | 4.00 |
| • Peak Hourly Demand | 14.0 m ³ /hr (3.90 L/s) |

In summary, the proposed development is anticipated to have a total maximum daily demand of 2.19 L/s and a peak hourly demand of 3.90 L/s. Refer to Appendix D for detailed calculations.

Fire Water Service

According to Norfolk County GIS online mapping, there are three existing fire hydrants located within proximity to the proposed development. One is located on the south side of Charles Street, across from #177 Charles Street, the second is located on the northeast corner of the intersection of Washington Street and Brown Street West, and the third is located on the west side of the intersection of Washington Street and Green Street. However, these hydrants do not provide substantial coverage of the proposed development. Consequently, four fire hydrants will be installed on the subject property to service the proposed development.

Typically, available fire flow during the maximum day demand is the critical criteria when evaluating a watermain distribution system's ability to service a residential subdivision. The estimated fire flow requirement for the development has been determined using both the recommendations of the Fire Underwriters Survey – 1999 (FUS) and the Ontario Building Code (OBC) method. Using the FUS recommendations and the OBC fire flow calculation procedure, the minimum required fire flow was determined to be 250 L/s and 150 L/s, respectively. Supporting calculations for both methods are detailed in Appendix D.

Water Network Review

R. V. Anderson Associates Limited (RVA) was retained by Norfolk County to determine the impact of the proposed Charles Street Subdivision on the existing distribution system and evaluate the proposed watermain's ability to deliver sufficient water flow per Norfolk County's design criteria. Based on a proposed 200mm watermain network with three connections, the following conclusions resulted:

- The pressures during the PHD were found to be between 56 to 59 psi, greater than the required pressure of 40 psi.
- The available fire flow during the MDD was found to be 179 to 193 L/s, greater than the required OBC fire flow, but less than the required FUS fire flow.

It should be noted that the FUS method is generally conservative. Therefore, Norfolk County is currently revising their fire flow criteria to a hybrid approach between the FUS and OBC methods. As such, the required flow will be re-evaluated when the updated approach is confirmed.

Refer to Appendix D for complete details of the hydraulic modelling completed by R.V. Anderson Associates. The proposed location and configuration of the watermain network are detailed on drawing 21-169-01 – General Plan of Services.

Conclusions and Recommendations

The functional servicing design for the proposed development can be summarized as follows:

- The Charles Street Subdivision poses no adverse effects to the existing or future traffic operations within the study area.
- The proposed development will be serviced by a sanitary sewer that connects to the existing 200mm sanitary sewer along Charles Street.
- Sanitary capacity in the existing infrastructure will be re-evaluated once the on-going flow monitoring studies by Norfolk County have been completed, and RVA's sanitary flow modelling has been updated accordingly.
- Overland flow during major storm events, and internal storm sewers during minor storm events will convey stormwater to the proposed SWM facility, which will discharge to the proposed storm sewer along Charles Street and Washington Street, ultimately connecting to the existing 1500mm storm sewer along Thompson Road.
- Under all storm events, the proposed on-site SWM facility controls post-development peak runoff rates to less than the allowable 2-year pre-development peak flow rate.
- An EFO8 Stormceptor unit, or approved equal, shall be utilized to achieve an enhanced level of water quality protection.
- The 300mm watermain along Charles Street and Washington Street shall serve as the water supply for the proposed development.
- Water modelling by Norfolk County's consultant confirmed that the existing and proposed watermain systems in the Eggink Subdivision provide adequate pressures.
- The fire flow capacity will be re-evaluated when the revised fire flow requirements are confirmed by Norfolk County.

It is recommended that this report be provided to Norfolk County and the Long Point Region Conservation Authority in support of the detailed design for the Charles Street Subdivision.

We trust that this information is complete and sufficient for submission. Should you have any questions or require further information please do not hesitate to contact us.

Respectfully submitted,



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Appendix A

- Charles Street Subdivision Transportation Impact Study
(*Paradigm Transportation Solutions Ltd, June 2022*)

Appendix B

- Charles Street & Washington Street Geotechnical Investigation (*G2S Consulting Inc., March 2023*)
- Charles Subdivision Soil Sampling and Chemical Testing Program (*G2S Consulting Inc., March 2023*)
- Charles Street Subdivision Assessment of Past Uses (*G2S Consulting Inc., March 2023*)

Appendix C

- Sanitary Flow Calculations
- Charles Street Subdivision Sanitary Report (*R.V. Anderson Associates Limited, October 22, 2022*)

Appendix D

- Domestic Water Demand Calculations
- FUS Calculations
- OBC Calculations
- Charles Street Subdivision Water Modeling (*R.V. Anderson Associates Limited, October 22, 2022*)

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Professional Engineers
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to offer professional engineering services



Ontario Association
of Architects

APPENDIX A

Charles Street Subdivision Transportation Impact Study
(Paradigm Transportation Solutions Ltd, June 2022)

APPENDIX B

Charles Street & Washington Street Geotechnical Investigation
(G2S Consulting Inc., March 2023)

Charles Subdivision Soil Sampling and Chemical Testing Program
(G2S Consulting Inc., March 2023)

Charles Street Subdivision Assessment of Past Uses
(G2S Consulting Inc., March 2023)

Geotechnical Investigation Proposed Residential Development



Charles Street & Washington Street, Waterford, Ontario
G2S22008

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Attention: Roger Sharma

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- Appendix A: Drawings
- Appendix B: Borehole Logs, & Grain Size Analysis Graphs
- Appendix C: Soil Infiltration Assessment

1. Introduction

G2S Consulting Inc. (G2S) was retained by Roger Sharma, 2863088 Ontario Inc. (the Client) to complete a geotechnical investigation for a land parcel comprising four properties included in the proposed Charles Street Subdivision plan located in Waterford, Ontario, hereinafter referred to as the 'Site'. The irregularly shaped Site is located on the north side of Charles Street and west of Washington Street and covers an approximate plan area of 4.39 ha (10.8 ac.). Refer to the Borehole Location Plan in Appendix A, Drawing 1, for a layout of the Site location.

The irregularly shaped Site is currently a mix of agricultural and residential land. It is understood that the current structures will be demolished to make way for the proposed residential development. This geotechnical investigation was carried out as outlined in G2S' Proposal No. PROP-G2S22008, dated February 10, 2022.

2. Site and Project Overview

2.1 Site Description

The Site is an irregular shaped property covering an approximate plan area of 4.39 hectares (10.8 acres). At the time of the investigation, the proposed development area was occupied by a former landscape and nursery supply business at the centre of the Site, residential property located at the southeast corner, and the remaining portion of the Site is vacant agricultural land with municipal addresses of 183 Charles Street, 173 Charles Street, and 155 Charles Street. The Site is bound to the north by a row of single-family residential properties fronting onto Cottonwood Street, and to the west by agricultural land. The east side of the Site has a broken frontage along Washington Street, jogging west to the rear property line of existing residential properties at 210 to 226 Washington Street. On its southern side, the Site borders Charles Street with a broken frontage jogging to the north around existing residential properties at 145 and 177 Charles Street. The ground surface is undulating with elevations at the borehole locations ranging between Elev. 240.9 and 245.3 metres.

2.2 Proposed Development

Based on G2S's correspondence with the Client, it is understood that consideration is presently being given to developing the following structures on the Site:

- 23 single family residential dwellings abutting the north and west property lines,
- 5 blocks with a total of 25 two-storey town units at the centre of the Site,
- 2 blocks with a total of 15 bungalow town units at the southeast portion of the Site,
- Park Block for outdoor activities with an area of approximately 0.22 ha (0.54 acres) at the southern centre of the Site,
- Stormwater Management Pond block at the southern edge of the Site; and
- The associated access roads and municipal services.

The purpose of this geotechnical investigation was to determine the subsurface conditions at a total of twenty (20) borehole locations (16 geotechnical boreholes and 4 shallow environmental boreholes) and to interpret these findings with respect to the design and construction of the underground services, foundations, and related earthworks for this project from a geotechnical point-of-view.

This report is based on the above summarized project description, and on the assumption that the design and construction will be performed in accordance with applicable codes and standards. Any significant deviations from the proposed project design may void the recommendations given in this report. If significant changes are made to the proposed design, then G2S must be consulted to review the new design with respect to the results of this investigation. The information contained in this report does not reflect upon the environmental aspects of the Site and therefore have not been addressed in this document.

3. Investigation Methodology

A total of twenty (20) sampled boreholes were advanced at the locations illustrated in the attached Drawing 1, Borehole Location Plan in Appendix A. Prior to ground disturbance, underground services were located and marked. G2S coordinated the public utility locates through Ontario One-Call and retained the services of a private locator to locate and mark private utilities.

The geotechnical boreholes BH101 to BH116 were put down uncased using continuous flight hollow stem auger equipment while boreholes BH117 to BH120, which were advanced on Site for environmental purposes, were put down using Pionjar sampling equipment. This report will discuss the information from the geotechnical boreholes only. The drilling and sampling operations were carried out under the direction and supervision of a G2S staff member. The boreholes were advanced to depths of between approximately 6.7 to 9.8 metres below the existing grade (mbeg). On completion of drilling, the boreholes were backfilled in general accordance with Ontario Regulation 903.

Representative samples of the subsoils were recovered at specified intervals using a 51 mm (2 inch) outside diameter split-barrel sampler at depths noted on the attached borehole logs in Appendix B. Boreholes BH101 to BH116 were driven in accordance with the Standard Penetration Test procedure (ASTM D1586). After undergoing a general field examination, the soil samples were preserved and transported to the soil laboratory for visual, tactile, and olfactory classifications. Moisture content tests were performed on the soil samples recovered from the borings. Grain size analysis determination was carried out on selective soil samples.

Details of the conditions encountered in the boreholes, together with the results of the field and laboratory tests, are presented in Borehole (BH) Logs BH101 to BH116, inclusive, included in Appendix B. It is noted that the boundaries of soil types indicated on the borehole logs are inferred from non-continuous soil sampling and observations made during drilling. These boundaries are intended to reflect transition zones for the purpose of geotechnical design and therefore should not be construed as the exact plans of geological change.

Elevations at the ground surface of the borehole locations were interpolated from the provided Topographic Survey No. 21-3286-TOPO, file entitled "*Topographic Site Plan of Part of Block 32 Registered Plan 19-B Town of Waterford in the Norfolk County*", by Jewitt and Dixon LTD., dated June 10, 2022. This topographic survey plan was later utilized to produce the Borehole Location Plan, Drawing 1, in Appendix A.

4. Subsurface Conditions

The subsurface soil conditions have been evaluated in sixteen (16) boreholes (BH101 to BH116) investigated by G2S at the Site for the purpose of this report. It should be considered that the subsurface conditions may not be consistent between and beyond the locations investigated at the Site. The soil descriptions outlined in the following stratigraphic summary are based on our interpretation of non-continuous samples of soil obtained from the boreholes.

The subsurface conditions encountered at the borehole locations are summarized as follows:

4.1 Granular

A granular layer was encountered at the surface in BH107, BH112, and BH113 with thicknesses ranging from approximately 50 to 75 mm.

4.2 Topsoil

Topsoil veneer was contacted at the surface in BH101, BH102, BH106, BH108, BH110, BH114, BH115 and BH116, and beneath the surficial granular layer in BH107 and BH113 (150 to 200 mm). The thicknesses of the topsoil veneer ranged between 100 and 460 mm.

The depth of topsoil must be expected to vary across the Site from the depths encountered at the borehole locations. In this report the term “topsoil” has been used from a geotechnical point of view and does not necessarily reflect the suitability of the material to support plant growth. If it is to be used for landscaping or agricultural purposes, its suitability should be confirmed by tests on representative samples for organic and nutrient content and therefore its ability to support plant growth.

4.3 Fill/Possible Fill

Below the topsoil in boreholes BH101, BH102, BH106 to BH108, BH110, and BH113 to BH116, below the granular in BH112, and at the surface in the remaining boreholes, fill material was encountered. This layer extended to depths ranging between 0.6 and 3.8 mbeg. The fill material consisted mainly of brown to dark brown sand/silty sand and contained traces to some organics. The moisture content for the fill layer ranged between 5 and 26%, indicating moist to wet conditions.

Below the fill layer in BH105 and BH111, possible fill material was encountered and extended to depths of approximately 3.1 and 4.6 mbeg, respectively. With SPT N-values ranging between 1 and 5 blows per 300 mm of penetration, the possible fill was classified as very loose to loose in compactness. The moisture content for the possible fill layer ranged between 3 and 18%, indicating moist to very moist conditions.

4.4 Upper Sand/Silty Sand

Underlying the fill/possible fill in BH101 to BH104, and BH106 to BH116, a native deposit of sand/silty sand was encountered. The sand/silty sand deposit extended to depths ranging between 3.8 and 8.2 (~Elev. 238.1 – 234.8 m) mbeg. Boreholes BH102 to BH104, BH110, BH111, and BH113 to BH116 were terminated in this deposit. The sand/silty sand deposit was generally brown in color and contained traces to some silt.

The SPT N-values for the sand/silty sand ranged between 5 and in excess of 68 blows per 300 mm of penetration, indicating loose to very dense compactness. The moisture content for the sand/silty sand deposit ranged from 3 to 22% indicating moist to wet conditions. Grain size analysis was carried out on selected soil samples of the sand/silty sand deposit. Based on the laboratory testing, the sand/silty sand consisted of 78 to 94% sand, and 6 to 22% fines (silt & clay). The results of the grain size analyses are indicated on the borehole logs and the grain size distribution graphs, included in Appendix B.

4.5 Sandy Silt / Sandy Silt Till

Sandy silt/sandy silt till deposit was encountered below the sand/silty sand in BH101, BH106 to BH109, and BH112, below the possible fill in BH105, and extended to depths ranging between 3.8 and 9.8 mbeg (~Elev. 237.8 – 231.1 m). BH101 and BH106 were terminated in this deposit. The sandy silt/sandy silt till deposit was generally brown in color and contained numerous sand and clay seams as well as traces to some gravel.

The SPT N-values for the sandy silt/sandy silt till ranged between 6 and in excess of 50 blows per 300 mm of penetration, indicating loose to very dense compactness. The moisture content for the sand/silty sand deposit ranged from 7 to 27% indicating moist to wet conditions. Grain size analysis was carried out on a selected soil sample of sandy silt/sandy silt till deposit. Based on the laboratory testing, the sandy silt/sandy silt till consisted of 0 to 22% gravel, 18 to 47% sand, 29 to 79% silt, and 1 to 8% clay. The results of the grain size analysis are indicated on the borehole logs and the grain size distribution graphs, included in Appendix B.

4.6 Lower Sand

Underlying the sandy silt/sandy silt till in BH105, BH107, BH108, BH109, and BH112, lower sand deposit was encountered and extended to depths ranging between approximately 6.7 and 9.8 mbeg, (~Elev. 235.6 – 231.5 m). The lower sand/silty sand deposit was generally brown in color and contained traces to some silt.

The SPT N-values for the lower sand ranged between 14 and 23 blows per 300 mm of penetration, indicating compact condition. The moisture content for the sand deposit ranged from 6 to 20% indicating moist to wet conditions. Grain size analysis was carried out on a selected soil sample of the lower sand deposit. Based on the laboratory testing, the sand consisted of 82% sand, 16% silt, and 2% clay. The results of the grain size analysis are indicated on the borehole logs and the grain size distribution graphs, included in Appendix B.

4.7 Groundwater Observations

Groundwater level observations in the open boreholes were recorded during the drilling operation. All boreholes were found dry upon completion of the drilling. Boreholes BH101, BH105, BH106, BH108, BH112, and BH113, were caved in at depths of approximately 5.2, 5.2, 3.8, 5.5, and 4.6 mbeg, respectively. Further, groundwater monitoring wells were installed in boreholes BH102, BH107, and BH115. Results of our groundwater monitoring to date are presented below:

Table 1:Groundwater Observations

BH/MW ID	Ground Surface Elevation (m)	Well Depth (m begs)	March 23, 2022		March 3, 2023	
			Depth (m)	Elevation (m)	Depth (m)	Elevation (m)
BH/MW102	244.55	6.1	Dry	-	Dry	-
BH/MW 107	241.25	6.1	4.24	237.0	4.33	236.9
BH/MW 115	245.01	7.6	Dry	-	Dry	-

Some infiltration of groundwater through the fill layer and from surface runoff should be anticipated during the excavation operations. Surface water should be directed away from the excavations. It is noted that the static groundwater level fluctuates based on seasonal conditions experienced during the wet and dry periods of the year. Refer to Appendix B for the list of abbreviations and borehole logs.

5. Geotechnical Considerations

5.1 Site Preparation

At the time of the investigation the grading plan for the Site was not yet available to G2S, however the following recommendations are based on the development plans as outlined in Section 2.2. above.

Prior to any earthworks, it will be necessary to remove any unacceptable fill (i.e., organics, excessively wet, debris, etc.) from the areas to be developed. Due to the depth of the fill material on Site, some engineered fill placement may be required in order to develop the Site.

The engineered fill required must consist of clean earth materials, free of topsoil, organics, rubble, wood, plant materials, etc. and be at a suitable placement water content for compaction. Selective re-use of excavated soil consisting of the existing fill material and near surface sand from the Site for engineered fill may be feasible provided adequate sorting for the fill material is carried out and subject to the weather conditions at the time of construction. For this reason, pre-grading activities should not be undertaken during wet weather conditions.

Engineered fill must be placed and uniformly compacted in maximum lift thicknesses of 300 mm for earth fill and 200 mm for commercially sourced granular material. Each lift of the engineered fill must be uniformly compacted to at least 98 percent of Standard Proctor Maximum Dry Density (SPMDD). The placement water content of the engineered fill material should be maintained within ± 3 percent of the laboratory optimum water content in order to achieve an acceptable degree of compaction.

The limits of any engineered fill placed during this operation can best be determined by the geotechnical engineer at the time of construction. If engineered fill will be used to support foundations or pavements, it must extend laterally at sufficient distance to develop adequate lateral resistance.

All aspects of engineered fill construction including final excavation, material selection, placement and compaction must be tested by the geotechnical engineer at the time of placement and compaction. In-situ density (compaction) testing is required during construction for all engineered fill placement.

It should be noted that extensive placement of engineered fill (i.e., more than 2 to 3 metres) may experience some form of post-earthwork settlement by as much as about 1 to 2 percent of the total thickness depending on the material used. Assessment of this type of geotechnical analysis was considered outside of the scope of this investigation.

5.2 Foundation Recommendations

The soil conditions encountered in the boreholes are generally considered suitable for supporting the proposed structures on conventional spread footings, founded on the native sand/silty sand and sandy silt till. Spread footings founded in the native sand/silty sand, and sandy silt till deposits may be designed using a factored Ultimate Limit State (ULS) bearing resistance ranging between 150 and 300 kPa and a Serviceability Limit State (SLS) bearing resistance ranging between 100 and 200 kPa, based on total and differential settlements being well within 25 and 20 mm, respectively.

Alternatively, the proposed structures can be founded on engineered fill utilizing factored Ultimate Limit State (ULS) bearing resistance of 225 kPa and a Serviceability Limit State (SLS) bearing resistance of 150 kPa.

It is noted that the SLS value represents the Serviceability Limit State, which is governed by the tolerable deflection (settlement) based on the proposed building type, using unfactored load combinations. The ULS value represents the Ultimate Limit State and is intended to reflect an upper limit of the available bearing capacity of the founding soils in terms of geotechnical design, using factored load combinations. There is no direct relationship between ULS and SLS, rather they are a function of the soil type and the tolerable deflections for serviceability, respectively. The above dissertation assumes a typical building. Evidently, the bearing capacity values would be lower for very settlement sensitive structures and larger for more flexible buildings.

The available bearing resistance and the relevant approximate founding elevations are presented in **Table No. 2** below:

Table 2: Bearing Resistance for Conventional Spread Footings

Borehole ID	Material	Bearing Resistance (kPa)	Recommended Founding Depth (m)	Approximate Founding Elevation (m)
BH 101	Sandy Silt Till	200 SLS/300 ULS	4.1	237.8
BH 102	Sand	100 SLS/150 ULS	1.5	243.1
		200 SLS/300 ULS	3.5	241.1
BH 103	Sand	100 SLS/150 ULS	1.5	241.8
		200 SLS/300 ULS	3.8	239.5
BH 104	Sand	100 SLS/150 ULS	1.5	241.1
		200 SLS/300 ULS	3.5	239.1
BH 105	Sand	200 SLS/300 ULS	3.8	237.9
BH 106	Sand	150 SLS/225 ULS	4.1	236.8
BH 107	Sand	100 SLS/150 ULS	2.4	238.9
		150 SLS/225 ULS	3.5	237.8

Borehole ID	Material	Bearing Resistance (kPa)	Recommended Founding Depth (m)	Approximate Founding Elevation (m)
BH 108	Sand	100 SLS/150 ULS	2.1	239.6
		100 SLS/150 ULS	3.5	238.2
BH 109	Sand	100 SLS/150 ULS	2.1	240.2
		150 SLS/225 ULS	3.5	238.8
BH 110	Sand	200 SLS/300 ULS	1.5	242.1
		150 SLS/225 ULS	3.5	240.1
BH 111	Sand	200 SLS/300 ULS	4.6	237.6
BH 112	Sand	200 SLS/300 ULS	2.1	239.6
		200 SLS/300 ULS	3.5	238.2
BH 113	Sand	150 SLS/225 ULS	3.8	238.0
BH 114	Silty Sand	150 SLS/225 ULS	1.8	241.1
		150 SLS/225 ULS	3.5	239.4
BH 115	Sand	200 SLS/300 ULS	3.5	241.5
BH 116	Sand	100 SLS/150 ULS	1.5	243.8
		200 SLS/300 ULS	3.5	241.8

5.3 Foundation Construction

The footings beds in the sand/silty sand will be prone to disturbance from construction, foot traffic and precipitation. It would be prudent to consider the placement of a 50 mm concrete 'mud' slab over the footing bases once evaluated and confirmed. This will protect the footing beds from disturbance and provide a clean working surface for the placement of formwork and reinforcing steel.

In areas where it will be necessary to provide adjacent footings at different founding elevations, the lower footing should be constructed before the higher footing, if possible. To limit stress transfer from higher footings to lower footings, the higher footing should be set below a line drawn up from the edge of the lower footing at 10 horizontal to 7 vertical.

All footings exposed to the environment must be provided with a minimum of 1.2 m of earth cover or equivalent insulation, which is generally the frost depth in southern Ontario, to protect against frost damage. This frost protection would also be required if construction were undertaken during the winter months. All footings and foundations should be designed and constructed in accordance with the current Ontario Building Code. We would recommend, where applicable, the placement of a 50 mm thick high-density sheet of Styrofoam insulation against the exterior of the foundation walls, followed by the placement of a 10-mil sheet of 'double' polyethylene ('fold' placed at 'top') to prevent frost heaving/adfreezing action.

With foundations designed as outlined above and as required by the current Ontario Building Code, and with careful attention paid to construction detail, total and differential settlements should be well within normally tolerated limits of 25 and 20 mm, respectively. However, as is typical in most commercial/residential construction, 'cosmetic' cracking of plasterboard, foundation walls, etc. may occur within the first year of construction because of shrinkage, minor settlement, etc. Subsequent to repair, additional cracking should be minimal.

It is imperative that an engineer be retained from this office to provide geotechnical engineering services during the excavation and foundation construction phases of the project. This is to observe compliance with the design concepts and recommendations of this report and to allow changes to be made if subsurface conditions differ from the conditions identified at the borehole locations.

5.4 Seismic Design Parameters

The structures shall be designed according to Section 4.1.8 of the Ontario Building Code, Ontario Regulation 332/12. Based on the subsurface soil conditions encountered in this investigation the applicable Site Classification for the seismic design is Site Class D- Stiff soils, based on the average soil characteristics for the Site. The conducting of site specific shear wave velocity testing may be considered to confirm the site class.

The seismic data as per the 2015 National Building Code interpolated seismic hazard values, based on the acceleration and velocity-based site coefficients, F_a and F_v , are as follows.

$S_a[0.2]$	$S_a[0.5]$	$S_a[1.0]$	$S_a[2.0]$	$S_a[5.0]$	$S_a[10.0]$	PGA	PGV
0.185	0.109	0.066	0.030	0.008	0.003	0.123	0.094

It should be noted that the F_a and F_v values are determined from Tables 4.1.8.4.B. and 4.1.8.4.C of the Building Code, respectively. The structural engineer responsible for the project should review the earthquake loads and effects.

5.5 Floor Slab Considerations

The slab-on-grade for the proposed building is expected to be constructed on the sand, sandy silt, silty sand material. The exposed subgrade should be prepared by carefully examining the surface for any loose or unsuitable material. All unsuitable and loose material should be removed and replaced with approved suitable material and be compacted to at least 98 percent of its

Standard Proctor Maximum Dry Density (SPMDD), in the presence of a representative of G2S. Oversized particles in excess of 4 inches (100 mm) in diameter should not be permitted in the backfilling operations. Imported granular fill is preferred due to its relative insensitivity to weather conditions, its relative ease in achieving the required degree of compaction, and its quick response to applied stresses. Based on the conditions encountered in the boreholes, backfill recommendations, and the floor slab considerations as included in our report, a modulus of sub-grade reaction, k_s , of 25 MPa/m (based on a loaded area of 300 mm x 300 mm) can be used for the design of the slab-on-grade floor slab.

As with all concrete floor slabs, there is a tendency for the floor slabs to crack. The slab thickness, concrete mix design, and/or wire mesh placed into the concrete slab, if any, will therefore be a function of the owner's tolerance for cracks in, and movements of, the slabs-on-grade, etc. The 'saw-cuts' in the concrete floors, for crack control, should extend a minimum of 1/3 the thickness of the slab.

A moisture barrier will be required under the floor slabs, such as the placement of at least 200 mm of well-compacted 19 mm clear crushed stone. At a minimum, the moisture barrier material should contain less than 10 percent passing the No. 4 sieve.

Curing of the slab-on-grade must be carefully specified to ensure that slab curl is minimized. This is especially critical during the hot summer months of the year when the surface of the slab tends to dry out quickly while high moisture conditions in the moisture barrier or water trapped on top of any 'poly' sheet at the saw cut joints and cracks, and at the edges of the slabs, maintains the underside of the slab in a moist condition.

It is also important that excess free water not be added to the concrete during its placement as this could increase the potential for shrinkage, cracking and curling of the slab.

5.6 Lateral Earth Pressure and Perimeter Drainage

The following soil properties, provided in **Table 3**, may be considered for the design of structures subject to an unbalanced earth loading. These properties have been estimated based on our review and laboratory testing of the soil samples, which were recovered during the geotechnical investigation, as well as type of backfill material, which is expected to be used in construction.

Table 3: Soil Properties for Design of Earth Retaining Structures

Material	ϕ	γ	K_a	K_o	K_p
Fill: Earth fill – Stiff to very stiff/ compact	28	19.0	0.35	0.53	2.78
Fill: OPSS 1010 Granular B - compact	32	21.0	0.27	0.47	3.25
Sand /Silty Sand – Compact to dense	34	19.5	0.28	0.44	3.54

Φ = Angle of Internal Friction (degrees), γ = Bulk Unit Weight of Soil (kN/m^3), K_a = Active Earth Pressure Coefficient, K_o = At-rest Earth Pressure Coefficient, K_p = Passive Earth Pressure Coefficient.

Lateral earth pressures on the basement foundation walls can be calculated as per the following:

$$p = K (\gamma h + q)$$

Where,

- p = Lateral earth pressure, in kPa acting at depth h
- K = Coefficient of earth pressure
- γ = Unit weight of backfill (kN/m^3)
- h = Depth to point of interest (m)
- q = Surcharge load acting adjacent to the wall at the ground surface (kPa)

The above formula is based on the assumption that a perimeter drainage system prevents hydrostatic pressure build-up behind the wall and free-draining granular material will be used for backfilling behind the wall.

The following equation can be used to calculate the earth pressure acting on the retaining walls including the effects of groundwater pressure:

$$p = K (h_1 + \gamma' h_2 + q) + \gamma_w h_2$$

Where,

- h_1 = depth in meters above the water table
- γ' = effective unit weight of soil, a value of 11 kN/m^3 may be assumed
- h_2 = depth in metres below the water table
- q = equivalent value of surcharge on the ground surface in kPa
- γ_w = unit weight of water (10 kN/m^3)

The hydraulic uplift pressure, P , below the waterproofed structure can be calculated using the following formula:

$$p = \gamma_w h_w$$

Where,

- γ_w = unit weight of water (10 kN/m^3)
- h_w = depth in metres below the water table

A permanent perimeter drainage system should be provided around the structure to prevent the build-up of water against the basement walls. As a minimum, it is recommended that the perimeter weeping tile consist of a 150 mm diameter perforated pipe with a geofabric 'sock', surrounded with 200 mm of 19 mm clear stone, with the stone in turn encased by a heavy geotextile filter fabric. The suppliers of the geotextile filter fabric should be consulted as to the type best suited for this project.

The perimeter drainage system should outlet to a gravity storm sewer connection, fitted with a suitable back-flow prevention valve. In the event that a sump pump system is required, it should be constructed with an 'oversized' reservoir to limit pumping intervals and include an alarm in the

event that the system fails to operate as per design, with a municipal water operated backup pump to operate during power outages and when maintenance of the main pump is required.

If the structure is not designed as a watertight structure, it is recommended to install an underfloor drain. The underfloor drain should be connected to a positive outlet.

G2S should examine the installation of the perimeter and subfloor drains. Even a small break in the filtering materials could result in loss of 'fines' into the drains with attendant performance difficulties, including settlements of the ground surface. The exterior grade around the structure should be sloped away from the structure to prevent water ponding against the foundation walls.

Additional well graded granular material should be placed and compacted in exterior sidewalk and accessibility ramp areas to reduce the effects of frost heaving. Alternatively, insulation could be placed in these areas, or a structural 'frost' slab should be constructed at the doorways.

5.7 Excavations and Groundwater Control

It is understood that the excavation for the proposed structures is expected to extend below depths ranging between 3.0 m and 4.0 m beg. Based on the investigation findings, excavation for basements and foundations will be carried out through the fill/possible fill and native sand, silty sand/sandy silt, and sandy silt till.

The excavation must be completed in accordance with the current OHSA regulations. For guidance, soft soils and soils below the groundwater level are classified as Type 4. The fill material is classified as Type 3 soil. The native loose to compact sand, silty sand/sandy silt, and sandy silt till is classified as Type 3 soil. The dense to very dense soils can be classified as Type 2 soil. If the excavation contains more than one type of soil, the soil shall be classified as the type with the highest number.

Excavation slopes steeper than those required in the Safety Act must be supported or a trench box must be provided, and a senior Geotechnical Engineer from G2S should supervise the work. We note that the rate of excavation may be slowed when existing buried services and foundations, and floor slabs of the existing structures are encountered by the contractor.

Where workers must enter excavations extending deeper than 1.2 m below grade, the excavation sidewalls must be suitably sloped and/or braced in accordance with the Occupational Health and Safety Act and Regulation for Construction Projects. It should be noted that the glacial tills are non-sorted sediments and therefore may contain boulders. Provisions must be made in any excavation or drilling contract for the removal of possible boulders.

Based on the monitoring wells which were installed during the current investigation, infiltration of groundwater as well as surface runoff should be anticipated, and localized dewatering will likely be required to facilitate the excavation. Filtered sumps, trenches, and oversized excavations, can be used to mitigate this issue. However, if these techniques fail to control the groundwater seepage, an adequate dewatering technique, which should be carried out by a specialized contractor, should be considered. G2S will be pleased to review and comment on the contractor's proposed dewatering system. Techniques such as a series of ditching and sump pumps may be used, however the method of dewatering is the responsibility of the contractor.

Ontario Regulation 387/04 requires authorization from the Ministry of the Environment, Conservation, and Parks (MECP) for all water takings over 50,000 L/day. Ontario Regulation 63/16 specifies that for temporary construction dewatering at rates between 50,000 and 400,000 L/day an Environmental Activity and Sector Registry (EASR) may be obtained in lieu of a Permit to Take Water (PTTW). Dewatering at rates of more than 400,000 L/day require a PTTW to authorize groundwater withdrawal.

5.8 Temporary Shoring

A temporary shoring system may be required for the underground utility installation or foundation excavation. Trench boxes may be used to reduce the lateral extent of the excavations for portions of the utility installation. However, in Type 4 soil or in trenches with a depth exceeding 6 m or a width exceeding 3.6 m, prefabricated support systems cannot be used. Consequently, a designed engineered support system will be required.

If a shoring system is required, we would recommend an active coefficient of lateral earth pressure, $K_a = 0.35$ if small lateral deformations are acceptable, or 0.5 in fill against rigid walls. Any additional pressures due to surcharge loading must be included in the design. A unit weight of retained soil of 22 kN/m³ can be used. The shoring wall must be designed and constructed as a rigid shoring system. The shoring system must be designed by a professional engineer experienced in shoring design and should be based on the procedure detailed in the latest edition of the Canadian Foundation Engineering Manual. The shoring system should be constructed by an experienced contractor. Any surcharge loads must be incorporated into the shoring design. The structural member stiffness and stability is the responsibility of the shoring design engineer and the shoring contractor. The excavation must provide 'space' for the construction of the footings and foundation walls, with an allowance for access by workers. In the event that a shoring system is required for this project, we would recommend that this office be retained to review the selected design and provide monitoring during installation.

5.9 Pipe Bedding

For underground services installation, no bearing capacity issues are anticipated for pipes founded in dewatered native soils. A minimum 150 mm bedding thickness of OPSS Granular 'A' crusher-run limestone is recommended under the pipes. The bedding material should be compacted to 98 percent SPMDD. For pipes founded in wet native soils, the pipe bedding should consist of 19 mm clear stone completely wrapped in geotextile filter fabric to prevent the migration of fines into the void spaces of the bedding material. High performance aggregate can also be used in excessively wet areas.

Granular material should be extended upward as trench backfill for at least 300 mm above the obvert of the pipe. The remaining trench to final subgrade level should be backfilled in 300 mm thick lifts with approved excavated material compacted to at least 98 percent SPMDD.

Frequent inspection by G2S geotechnical personnel should be carried out to examine and approve backfill materials, to carefully inspect placement, and to verify that the specified degree of compaction has been obtained.

5.10 Thrust Block

Thrust blocks in the native sand, silty sand/sandy silt, and sandy silt till may be sized as recommended by the applicable Ontario Provincial Standard Specification (OPSS). A design allowable bearing pressure of 200 kPa may conservatively be used in the design of thrust blocks. Any backfill required behind the blocks should be granular and should be compacted to 100 percent of their standard Proctor Density.

5.11 Backfill Considerations

Most of the excavated material will consist of the fill and the native sand, silty sand/sandy silt, and sandy silt till. We expect that most of the excavated material will be removed from the Site to accommodate the basement level. The remaining material is considered suitable for use as service trench backfill and as engineered fill, provided that the moisture content can be controlled to within 3 percent of the standard Proctor optimum value and that it is free of soft soils and/or organic matter. Some moisture content conditioning of the excavated material may be required, depending upon weather conditions experienced at the time of construction, to achieve acceptable compaction densities and minimize long-term settlements. Dusting could be a problem in the 'dry' summer months.

We note that where backfill material is placed near or slightly above its optimum content, the potential for long-term settlements due to the ingress of groundwater and collapse of the fill structure is reduced. Correspondingly, the shear strength of 'wet' backfill material is also lowered, thereby reducing its ability to support construction traffic, and therefore impacting roadway construction. If the soil is well 'dry' of its optimum value, it will appear to be very strong when compacted, but will tend to settle with time as the moisture content in the fill increases to equilibrium condition. The soils may require high compaction energy to achieve acceptable densities if the moisture content is not close to their standard Proctor optimum value. It is therefore very important that the placement moisture content of the backfill soils be within 3 percent of its standard Proctor optimum moisture content during placement and compaction.

Any imported fill required in service trenches or to raise the subgrade elevation should have its moisture content within 3 percent of its optimum moisture content and meet the necessary environmental guidelines.

The backfilling and compaction operations should be monitored by a representative of G2S to monitor uniform compaction of the backfill material to project specification requirements. Close supervision is prudent in areas that are not readily accessible to compaction equipment, for instance, near the end of compaction 'runs', and around the foundation walls. Any engineered fill should be compacted to 100 percent SPMDD. A method should be developed to assess compaction efficiency, employing the on-site compaction equipment and backfill materials during construction.

5.12 Pavement Consideration

The pavement areas should be stripped of all topsoil, organic, and other unsuitable materials. The exposed subgrade should be proof rolled with 3 to 4 passes of a loaded tandem truck in the presence of a representative of G2S, prior to the placement of the sub-base material. Any areas of distress revealed by this, or any other means must be sub-excavated and replaced with suitable backfill material. Alternatively, the soft areas may be repaired by the placement of coarse aggregate, such as 50 mm clear crushed stone.

The need for sub-excavations of a softened subgrade will be reduced if construction is undertaken during periods of dry weather and careful attention is paid to the compaction operations. At areas of weak subgrade, suitable geogrid product such as Tensar TriAx (TX) geogrid or equivalent can be used to stabilize the subgrade. The fill placed over shallow utilities that cut into or across the paved areas must also be compacted to 100 percent of its SPMDD.

Good draining provisions will optimise the long-term performance of the pavement structure. The subgrade must be properly crowned and shaped to promote drainage to the subdrain system. Subdrains should be installed to intercept excess subsurface water and to prevent softening of the subgrade material. Surface water should not be allowed to pond adjacent to the outer limits of the paved area.

The most severe loading conditions on the subgrade typically occur during the course of construction, therefore, precautionary measures may have to be taken to ensure that the subgrade is not unduly disturbed by construction traffic. These measures would include minimizing the amount of heavy traffic travelling over the subgrade, such as during the placement of granular base layers.

If construction is conducted under adverse weather conditions, additional subgrade preparation may be required. During wet weather conditions, such as typically experienced during the fall and spring months, it should be anticipated that the additional subgrade preparation would be required, such as the provision of an additional depth of Granular B sub-base coarse material. It is also important that the sub-base and base coarse granular layers of the pavement structure be placed as soon after exposure and preparation of the subgrade level as practical.

The suggested pavement structures for the pavement areas outlined in **Table 4** are based on subgrade parameters estimated based on visual and tactile examinations of the on-Site soils and past experience. The outlined pavement structures may be expected to have an approximate ten-year life, assuming that regular maintenance is performed. Should a more detailed pavement structure design be required, Site specific traffic information would be needed, together with detailed laboratory testing of the subgrade soils.

Table 4: Suggested Pavement Structure

Layer Description	Compaction Requirements	Light Duty Sections	Heavy Duty (Truck Route)
Asphaltic Concrete Wearing course OPSS HL 3 or HL 3A	Min 92.0 % *MRD	65 mm	40 mm
Binder Course OPSS HL 8	Min 92.0 % *MRD	--	65 mm
Base Course OPSS Granular A	100% **SPMDD	150 mm	150 mm
Sub-base Course OPSS Granular B Type II	100% **SPMDD	200 mm	350 mm

* MRD denotes maximum relative density, MTO LS-264

** SPMDD denotes Standard Proctor Maximum Dry Density, ASTM-D698.

Depending on the arrangement of light duty and heavy-duty pavement sections, the transition between sections may present some difficulty for contractors. In this regard, consideration might be given to a slightly increased light duty pavement structure consisting of 50 mm of HL8 binder course and 40 millimetres of HL3 surface course asphaltic concrete. This structure will provide for a continuous depth of surface course asphalt allowing for ease of construction. As well, such a structure would have an improved performance over an increased design life. Such an arrangement of asphalt layers would also allow for future rehabilitation with a 'mill and pave' type operation.

6. SWM Facility Recommendations

It is understood that the proposed stormwater management facility will be an offline wet pond with forebay for settlement of suspended solids. The proposed SWM block has an area of 0.21 ha and is bounded to the east and south by road right of ways, to the north by a proposed park block, and to the west by a residential property. It is assumed that the facility will be designed per provincial recommendations as outlined in the *2003 MOE Stormwater Management Design Guidelines*, including maximum depths, side slopes, etc.

6.1 Soil Conditions

Boreholes BH106 and BH107 are located within the proposed SWM block and revealed the presence of fill material extending to depths ranging from 2.1 to 3.8 mbeg, underlain by sand, sandy silt, and sandy silt till. The groundwater level at the time of the investigation was in the order of 4.2 to 4.3 mbeg (~Elev. 236.9 to 237.0 m). It should be noted that the base elevation for the proposed pond was not available at the time of the investigation.

6.2 Soil Coefficient of Permeability

G2S retained Hydrogeology Consulting Services Inc. (HCS) to assess the near-surface soil infiltration capacity within the SWM facility through the completion of Double Ring Infiltrometer (DRI) testing. The findings were provided in a report dated December 1, 2022, which is included in Appendix C.

6.3 Side Slope Stability

The pond side walls are recommended to be constructed with a side slope of 3 horizontal to 1 vertical or flatter. However, for the section of the sidewalls which are located within the groundwater seasonal fluctuation area, it is recommended that the side slopes be flattened to 4 horizontal to 1 vertical to resist erosion by wavelet action. It is also recommended that the side slopes be vegetated and additional measures to stabilize the surface and reduce the risk of surficial erosion (i.e. rip rap stone, erosion mats) be installed, as needed.

6.4 Impermeable Liner

Based on the subsoil conditions at the Site and in order to facilitate construction of a wet pond capable of maintaining standing water, avoiding groundwater infiltration and the potential contamination, which may result from the collected surface water being in direct contact with the groundwater, the pond will require the installation of an impermeable liner. There are different options available for impermeable liners including a solid clay liner, a geosynthetic clay liner, or a plastic liner such as PVC or HDPE liner. Considerations relevant to different liner options should be evaluated depending on the project design requirements. Regardless of its type, the liner should be impermeable and shall extend at minimum to the top of the design maximum water level. As the liner extends up the sides of the facility the thickness of the liner or liner overburden may be decreased proportional to the decreasing depth.

The following sections will discuss the various available options to construct or install the pond liner. Marker/ballast layer with a minimum thickness of 200 mm consisting of 150 mm diameter stones should be installed on top of the liner material to serve as a marker for the maintenance crew to avoid damaging the liner material during maintenance operations.

6.4.1 *Compacted Clay Liner*

A compacted clay liner with a minimum thickness of 600 mm should be installed. The liner should be compacted to a minimum of 95% of the material Standard Proctor Maximum Dry Density (SPMDD). The material to be used in the liner construction should be analyzed as per LS 702/703, (ASTM D4318 and ASTM D7928) and the grain size distribution and the Atterberg Limits for this material should meet the following criteria:

1. Percent of fine particles passing Sieve Size 0.075 mm $\geq$ 50 percent
2. Percent of particles passing Sieve Size 0.002 mm (clay content) $\geq$ 20 percent
3. Percent of particles between passing 2.0 mm and retained on 0.06 mm $\leq$ 45 percent
4. Plasticity Index $\geq$ 20 percent
5. Liquid Limit LL $\geq$ 50 percent

Based on the grain size analysis results for the material encountered on Site, the on-Site material is not considered suitable for use in the construction of the clay liner. Clay liner can be accepted based on the results of hydraulic conductivity laboratory testing to be completed for at least three soil samples taken from the already placed material, which should be compacted to a minimum of 95% of the material SPMDD. The hydraulic conductivity for the liner material based on the as built conditions should be in the order of 1×10^{-8} or less. Alternatively, a mixture of 1 part bentonite to 3.5 parts by volume of Granular 'A' conforming with the OPSS.MUNI 1010 requirements, could be used to produce the clay liner material, provided that an approved mechanical mixer is used in the production of the liner material.

The subgrade at the pond area should be proofrolled and approved by a representative of G2S geotechnical staff prior to the placement of the liner material. The material should be placed in loose lifts not exceeding 150 mm in thickness or 25 mm less than the tamping foot length of the compaction equipment and be compacted to a minimum of 95% of its SPMDD. The moisture content for the liner material should be within 90 and 120% of its Optimum Moisture Content as determined by the laboratory Standard Proctor testing (ASTM D698). The surface of the material during placement and compaction operation must be free of any of tree branches, organics, foreign debris, oversized gravel in excess of 75 mm in diameter, or any otherwise deleterious material. The operations should be carried out during favorable weather conditions to avoid frost penetration at the surface between the lifts during cold weather, or surface cracking and material shrinkage of the materials due to moisture loss during hot weather.

6.4.2 *Synthetic Liner*

Geosynthetic clay liner such as AGRU GeoClay liner or equivalent can be used. AGRU GeoClay is a reinforced needle-punched geosynthetic clay liner that consists of a uniform layer of natural granular sodium bentonite encapsulated between a woven and a nonwoven geotextile, or between scrim reinforced woven and nonwoven geotextiles. The subgrade should be prepared by removing all organics and unacceptable materials, proofrolled and approved by a representative of G2S geotechnical staff prior to the placement of the liner material. The groundwater level must be lowered to at least 0.5 m below the pond base level during installation. The synthetic liner should be installed as per the manufacturer recommendations.

6.4.3 Hydraulic Uplift

Groundwater was noted in BH/MW107 at elevation of 237.00 m (4.24 m begs) as shown in **Table 1** above, however it is noted that the static groundwater level fluctuates based on seasonal conditions experienced during the wet and dry periods of the year. It is recommended that further evaluation of groundwater levels be completed to assess an average annual groundwater level. Should the proposed bottom of the SWM pond or liner extend below the groundwater table it should be designed to resist hydraulic uplift in the most conservative condition; that being when the pond is empty. This scenario is possible during construction, depending on implementation of dewatering practices, as well as in the case of dewatering of the facility for maintenance purposes. In order to resist uplift pressure under the proposed liner, the weight of the liner plus any cover material such as the marker stone/ballast must be greater than the uplift force acting on the bottom of the liner. Drainage blanket consisting of a 150 mm diameter perforated pipes, wrapped in geotextile fabric (i.e., Terrafix 270R or equivalent), and topped with a leveling blanket consisting of 150 mm of leveling sand should be installed below the liner.

The hydraulic uplift pressure, P , below the pond liner can be calculated using the following formula:

$$P = \gamma_w h_w$$

Where:

P = The hydraulic pressure acting on the base of the structure (kPa)

γ_w = Unit weight of water (10 kN/m³)

h_w = Depth in metres of the liner below the water table

And the corresponding required liner thickness can be calculated as follows:

$$h_L = P / \gamma_L$$

Where:

γ_L = Unit weight of liner in kN/m³

h_L = Thickness in metres of the liner and any overburden material

7. General Comments

The comments provided in this document are intended only for the guidance of the design team. The subsoil descriptions and borehole information are only intended to describe conditions at the borehole locations. Contractors undertaking this project should carry out due diligence to verify the results of this investigation and to determine how the subsurface conditions will affect their operations.

The action of stripping topsoil and unsuitable near-surficial soils as well as the selection and placement of engineered fill should be tested by the geotechnical engineer at the time of construction. In-situ density testing should be carried out on any engineered fill placed at the Site.

All foundations should be reviewed on Site by the geotechnical engineer as they are constructed, as required by Section 4.2.2.2 of the Ontario Building Code (2012). If G2S is not retained to review the foundation bearing conditions or the construction of the foundations in the field, then G2S assumes no responsibility for the performance of the foundations as constructed.

The long-term performance of slabs-on-grade is dependent on the subgrade support conditions. Subgrades to support slabs-on-grade should be inspected by the geotechnical engineer prior to final construction. It is important that any engineered fill constructed beneath slabs on grade is carried out as outlined in this report.

8. Limitations

The geotechnical engineering advice and recommendations provided in this report are considered preliminary and were based on the factual information obtained during this investigation.

It may be possible that the subsurface conditions vary between and beyond the investigated borehole locations. For the purpose of this report, it is assumed that the conditions outside of and between the exact borehole locations are similar to the conditions observed in the boreholes. The change in subsurface stratigraphy reported on the borehole logs has also been interpreted based on non-continuous sampling, therefore, changes in stratigraphy as shown on the borehole logs and as discussed in this report should not be regarded as exact lines of geological change. The subsurface conditions at the Site may change with the passage of time and/or by human intervention.

The findings along with the geotechnical engineering advice and recommendations provided in this report are limited to the conditions at the Site at the time of this investigation as described herein. Conclusions presented in this report should not be construed as legal advice. If Site conditions or applicable standards change or if any additional information becomes available at a future date, changes to the findings, conclusions and recommendations in this report may be necessary.

Through any subsurface investigation by boreholes, it may not be possible to identify all aspects of the subsurface conditions at the Site that could affect construction costs, techniques, equipment, and scheduling. Contractors bidding on or undertaking work on the project must be directed to draw their own conclusions as to how the subsurface conditions may affect them, based on their interpretation of the subsurface conditions and/or their own investigations.

This report has been prepared for the sole benefit of the Client and is intended to provide geotechnical engineering advice and recommendations based on the subsurface conditions investigated at the subject Site. This report is the copyright of G2S Consulting Inc. (G2S) and may not be used by any other person or entity without the expressed written consent of the Client and G2S. Any use which a third party makes of this report, or any reliance on decisions made based on it, is the responsibility of such third parties. G2S accepts no responsibility for damages, if any suffered by any third party as a result of decisions made or actions based on this report. It is recognized that The Town of Waterford in their capacity as the planning and building authority under Provincial statutes, may make use of and rely upon this report cognizant of the limitations thereof, both as are expressed and implied.

Secondary review of this report was completed for general QA/QC and adherence to company standards and does not include a detailed technical review of engineering conclusions and recommendations. This report does not address any environmental conditions such as soil and groundwater chemical quality and suitability of excess soils for off-site re-use.

9. Closing Remarks

We trust this report is satisfactory for your present purposes. Should you have any questions, please do not hesitate to contact this office.

Yours truly,

G2S Consulting Inc.

Secondary Review:



Ashraf Abass, P. Eng.
Senior Geotechnical Engineer

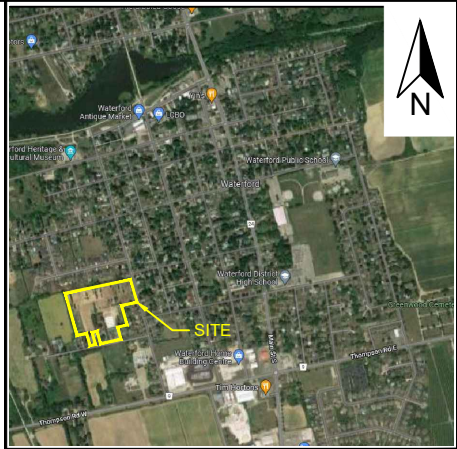


Melissa King, P.Geo.
Head of Environmental Services

Appendix A:

Drawings





LEGEND	
	BOREHOLE LOCATION
	MONITORING WELL LOCATION
245.01	GROUND SURFACE ELEVATION (m)
236.92	GROUNDWATER ELEVATION (2023-03-03)
	PROPOSED BUILDING LOCATION
	PROPOSED PARK LOCATION
	PROPOSED SWM POND LOCATION

TITLE:		BOREHOLE LOCATION PLAN
CLIENT:		2863088 ONTARIO INC.
LOCATION:		CHARLES STREET WATERFORD, ONTARIO
PROJECT:		G2S22008
DRAWING:	1	
SCALE:	AS SHOWN	
DATE:	MARCH 2023	
DRAWN BY:	DB	
FILE NAME:	G2S22008 BH Location Plan	



Appendix B:

Borehole Logs
Grain Size Analysis Graphs



LIST OF ABBREVIATIONS

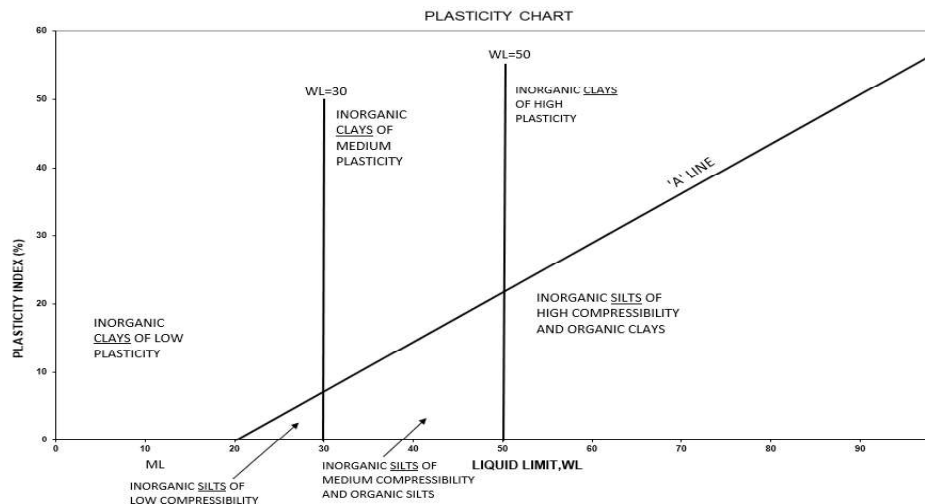
Description of Soil

The consistency of cohesive soils and the relative density or compactness of cohesionless soils are described in the following terms:

COHESIVE SOIL			COHESIONLESS SOIL	
CONSISTENCY	N (blows/0.3 m)	C (kPa)	DENSENESS	N (blows/0.3 m)
Very Soft	0 – 2	0 – 12	Very Loose	0 – 4
Soft	2 – 4	12 – 25	Loose	4 – 10
Firm	4 – 8	25 – 50	Compact	10 – 30
Stiff	8 – 15	50 – 100	Dense	30 – 50
Very Stiff	15 – 30	100 – 200	Very Dense	>50
Hard	>30	>200		
Moisture conditions				
Moist: dark or greyish color, may feel cool upon				
Wet: same as moist with free water seepage when handled				

Abbreviations

SS	Split Spoon Sample
AS	Auger Sample
GS	Grab Sample
DP	Direct Push
S	Sample
RC	Rock Core
SPT	Standard Penetration Test
N	Blow counts per 300mm of penetration. (ASTMD1586)
MC	Moisture Content
PL	Plastic Limits
LL	Liquid Limits
PI	Plasticity Index



Penetration Resistance

Standard Penetration Resistance N: The number of blows required to advance a standard split spoon sampler 0.3 m into the subsoil. Driven by means of a 63.5 kg hammer falling freely a distance of 0.76 m. The value reported are as noted in the field without corrections.

Soil Classification Dynamic Penetration Resistance: The number of blows required to advance a 51 mm, 60-degree cone, fitted to the end of drill rods, 0.3 m into the subsoil. The driving energy being 475 J per blow. Soils descriptions are made in accordance with the Canadian Foundations Engineering Manual (CFEM), following the International Society for Soil Mechanics and Foundation Engineering. (ISSMFE)

Notes

Soil samples will be discarded after three months unless directed otherwise by the Client.

Unless the grain size analysis is performed in our lab, soil samples are classified based on visual, tactile, and olfactory examinations, which may not be sufficient for accurate classification or precise grain sizing.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse		
	0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	200

EQUIVALENT GRAIN DIAMETER IN MILLIMETERS

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-17 **COMPLETED** 22-3-17 **GROUND ELEVATION** 241.89 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
0.10	TOPSOIL: ~100 mm	241.79		SS1	SPT	2	▲			0/0		
0.76	FILL: Silty sand, brown, some silt, trace organics, moist	241.13										
1	SAND: Brown, trace silt, moist, loose, reworked appearance at top portion			SS2	SPT	5	▲			0/0		
2				SS3	SPT	8	▲			0/0		0 94 6
2.3	occasional silty zones, very moist to wet	239.60		SS4	SPT	13	▲			0/0		
3				SS5	SPT	12	▲			0/0		
3.8		238.08		SS6	SPT	22	▲			0/0		
4	SANDY SILT TILL: Brown, some gravel, trace clay, very moist, dense			SS7	SPT	48				0/0		16 47 29 8
5												
6												
6.1	clay seams	235.79		SS8	SPT	30	▲			0/0		
6.7		235.18										

Borehole terminated at 6.7 m.

Upon completion of augering
Cave at 5.2 m

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-16 **COMPLETED** 22-3-16 **GROUND ELEVATION** 244.55 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/BL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
0.15	TOPSOIL: ~150 mm	244.40										
0.76	FILL: Silty sand, brown, some organics, rootlets	243.79		SS1	SPT	2	▲			0/0		
1	SAND: Brown, trace to some silt, moist, compact, medium to fine			SS2	SPT	12	▲			0/0		
2				SS3	SPT	12	▲			0/0		
3				SS4	SPT	20	▲			0/0		
3.1	occasional silt seams	241.50		SS5	SPT	18	▲			0/0		
4				SS6	SPT	23	▲			0/0		
5				SS7	SPT	14	▲			0/0		
5.3	becoming greyish brown, fine	239.22		SS8	SPT	22	▲			0/0		
6				SS9	SPT	19	▲			0/0		
6.7		237.84										

Borehole terminated at 6.7 m.

Water Level Readings:

Date	Depth (m)	Elev. (m)
2022-03-23	Dry	--
2023-03-03	Dry	--

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-16 **COMPLETED** 22-3-16 **GROUND ELEVATION** 243.31 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer X Vane +					
							40 80 120 160		PL MC LL	10 20 30		
0.76	FILL: Silty sand, brown, trace gravel, moist	242.55		SS1	SPT	6	▲		●	0/0		
1	SAND: Brown, some silt, very moist, loose to compact, medium to fine			SS2	SPT	5	▲		●	0/0		
2				SS3	SPT	9	▲		●	0/0		
3				SS4	SPT	26		▲	●	0/0		
4				SS5	SPT	12	▲		●	0/0		
4.6	occasional silty zones, compact to dense	238.74		SS6	SPT	22		▲	●	0/0		
6												
6.7		236.60		SS7	SPT	30		▲	●	0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
No cave
No free water

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-16 **COMPLETED** 22-3-16 **GROUND ELEVATION** 242.60 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer X Vane +					
							40 80 120 160		PL MC LL 10 20 30			
0.76	FILL: Silty sand, brown, trace organics, very moist	241.84		SS1	SPT	4	▲		●	0/0		
1	SAND: Brown, trace silt, moist, loose to compact, medium to fine			SS2	SPT	6	▲		●	0/0		
2				SS3	SPT	8	▲		●	0/0		
3				SS4	SPT	13	▲		●	0/0		
3.1	becoming greyish brown	239.55		SS5	SPT	20	▲		●	0/0		
4												
5				SS6	SPT	25	▲		●	0/0		
6												
6.1	becoming fine with occasional silty zones, wet	236.50		SS7	SPT	29	▲		●	0/0		
6.7		235.89										
Borehole terminated at 6.7 m.												Upon completion of augering No cave No free water

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-16 **COMPLETED** 22-3-16 **GROUND ELEVATION** 241.65 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
0.61	FILL: Silty sand, brown, trace organics, wet	241.04		SS1	SPT	4	▲		●	0/0		
1	POSSIBLE FILL: Sand, brown to yellow, some silt, trace organics, wet, very loose			SS2	SPT	3	▲		●	0/0		
2				SS3	SPT	2	▲		●	0/0		
3				SS4	SPT	3	▲		●	0/0		
3.1		238.60										
3.8	SANDY SILT: Brown, trace clay, very moist, loose	237.84		SS5	SPT	6	▲		●	0/0		0 18 79 3
4												
5	SAND: Brown, medium to fine, wet, compact			SS6	SPT	23	▲		●	0/0		
6				SS7	SPT	19	▲		●	0/0		
6.7		234.94		SS8	SPT	23	▲		●	0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
Cave at 5.2 m

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-17 **COMPLETED** 22-3-17 **GROUND ELEVATION** 240.88 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer X Vane +					
							40 80 120 160	40	PL MC LL	10 20 30		
0.46	TOPSOIL: ~460 mm	240.42		SS1	SPT	2	▲		●	0/0		
1	FILL: Sand, brown to yellow, some silt, some gravel, trace organics, moist to wet			SS2	SPT	4	▲		●	0/0		
2				SS3	SPT	3	▲		●	0/0		
3				SS4	SPT	4	▲		●	0/0		
4				SS5	SPT	12	▲		●	0/0		
3.8	SAND: Brown, medium to fine, some silt, wet, very loose	237.07		SS6	SPT	16	▲		●	0/0		0 87 13
5				SS7	SPT	22	▲		●	0/0		
6												
6.1	SANDY SILT TILL: Brown, trace to some gravel, wet, compact to very dense	234.78		SS8	SPT	29	▲		●	0/0		22 18 59 1
7												
8				SS9	SPT	50		▲	●	0/0		
9												
9.8	Borehole terminated at 9.8 m.	231.13		SS10	SPT	50		▲	●	0/0		

Upon completion of augering
Cave at 3.8 m

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-17 **COMPLETED** 22-3-17 **GROUND ELEVATION** 241.25 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							10 20 30 40	10 20 30 40				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer X Vane +					
							40 80 120 160		PL MC LL			
									10 20 30			
0.05	GRANULAR: ~50 mm	241.20		SS1	SPT	5	▲			0/0		
0.20	TOPSOIL: ~150 mm	241.05		SS2	SPT	3	▲			0/0		
1	FILL: Sand, brown, trace to some silt, moist to very moist											
2				SS3	SPT	4	▲			0/0		
2.1		239.12										
3	SAND: Light brown, some silt, occasional silt seams, very moist, loose to compact			SS4	SPT	13	▲			0/0		
4				SS5	SPT	14	▲			0/0		
4.6		236.68										
5	SANDY SILT: Brown, wet, loose to compact			SS6	SPT	9	▲			0/0		0 42 56 2
6												
6.1		235.15										
7	SAND: Brown, medium to fine, some silt, trace clay, moist, compact			SS7	SPT	18	▲			0/0		
8				SS8	SPT	16	▲			0/0		0 82 16 2
9												
9.8		231.50		SS9	SPT	22	▲			0/0		
Borehole terminated at 9.8 m.												
										Water Level Readings:		
										Date	Depth (m)	Elev. (m)
										2022-03-23	4.24	237.01
										2023-03-03	4.33	236.92

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-16 **COMPLETED** 22-3-16 **GROUND ELEVATION** 241.74 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/BL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values	CPT values				
							10 20 30 40	10 20 30 40				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer Vane					
							40 80 120 160	10 20 30				
0.41	TOPSOIL: ~410 mm	241.33		SS1	SPT	19				0/0		
1	FILL: Silty sand, brown to yellow, trace organics, moist, very loose to loose			SS2	SPT	2				0/0		
1.5		240.22										
2	SAND: Brown, trace to some silt, moist, very loose to loose, reworked appearance at top portion			SS3	SPT	5				0/0		
3				SS4	SPT	8				0/0		
4				SS5	SPT	9				0/0		
4.6	SANDY SILT: Brown, wet, compact	237.17		SS6	SPT	11				0/0		
6												
6.1	SAND: Brown, trace to some silt, wet, compact	235.64		SS7	SPT	18				0/0		
6.7		235.03										

Borehole terminated at 6.7 m.

Upon completion of augering
Cave at 5.5 m

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-15 **COMPLETED** 22-3-15 **GROUND ELEVATION** 242.29 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/BL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer X Vane +					
							40 80 120 160		PL MC LL 10 20 30			
1	FILL: Silty sand, brown to yellow, trace to some organics, moist			SS1	SPT	2	▲		●	0/0		
1.5		240.77		SS2	SPT	2	▲		●	0/0		
2	SAND: Brown, trace to some silt, moist, loose to compact			SS3	SPT	5	▲		●	0/0		
3				SS4	SPT	11	▲		●	0/0		
4				SS5	SPT	13	▲		●	0/0		
4.6		237.72										
5	SANDY SILT: Brown, trace clay, wet, compact			SS6	SPT	14	▲		●	0/0		
6		236.19										
6.1												
6.7	SAND: Brown, trace silt, very moist, compact	235.58		SS7	SPT	14	▲		●	0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
No cave
No free water

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-15 **COMPLETED** 22-3-15 **GROUND ELEVATION** 243.55 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer X Vane +					
							40 80 120 160		PL MC LL 10 20 30			
0.13	TOPSOIL: ~125 mm	243.43		SS1	SPT	3	▲			0/0		
0.76	FILL: Silty sand, brown, trace to some organics, moist	242.79										
1	SAND: Light brown, silt seams, moist to very moist, loose to dense			SS2	SPT	9	▲			0/0		
2				SS3	SPT	43		▲		0/0		
2.3	occasional wet silt seams / zones	241.26										
3				SS4	SPT	19	▲			0/0		
				SS5	SPT	14	▲			0/0		
3.8		239.74										
4	SILTY SAND: Brown, medium to fine, trace clay, moist to wet, loose to compact			SS6	SPT	9	▲			0/0		0 78 19 3
5				SS7	SPT	16	▲			0/0		
6												
6.7		236.84		SS8	SPT	28	▲			0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
No cave
No free water

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-16 **COMPLETED** 22-3-16 **GROUND ELEVATION** 242.24 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							Undrained Shear Strength (kPa) Pocket Penetrometer X Vane + 40 80 120 160		PL MC LL 10 20 30			
1	FILL: Sand, brown to light brown, trace to some silt, trace organics, very moist			SS1	SPT	7	▲		●	0/0		
1.5		240.72		SS2	SPT	0	▲		●	0/0		
2	POSSIBLE FILL: Sand, brown, trace silt, trace organics, moist, very loose			SS3	SPT	2	▲		●	0/0		
3				SS4	SPT	2	▲		●	0/0		
4	some silt inclusions, wet	238.43		SS5	SPT	1	▲		●	0/0		
4.6		237.67		SS6	SPT	5	▲		●	0/0		
5	SAND: Brown, medium to fine, moist to wet, compact			SS7	SPT	24	▲		●	0/0		
6												
6.7		235.53		SS8	SPT	19	▲		●	0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
No cave
No free water

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-17 **COMPLETED** 22-3-17 **GROUND ELEVATION** 241.71 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
0.08	GRANULAR: ~75 mm	241.64		SS1	SPT	3	▲			0/0		
1	FILL: Sand, Dark brown to brown, some silt, very moist			SS2	SPT	2	▲			0/0		
1.5		240.19										
2	SAND: Light brown, trace to some silt, very moist, loose to compact			SS3	SPT	6	▲			0/0		
3				SS4	SPT	19	▲			0/0		
4				SS5	SPT	21	▲			0/0		
3.8	becoming wet, occasional silt seams / zones	237.90		SS6	SPT	17	▲			0/0		
4.6		237.14		SS7	SPT	8	▲			0/0		
5	SANDY SILT: Brown, some clay seams, wet, loose											
6												
6.1		235.61										
6.7	SAND: Brown, trace silt, moist, compact	235.00		SS8	SPT	16	▲			0/0		
Borehole terminated at 6.7 m.												
Upon completion of augering Cave at 4.6 m												

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-16 **COMPLETED** 22-3-16 **GROUND ELEVATION** 241.77 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values	CPT values				
							10 20 30 40	10 20 30 40				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer Vane					
							40 80 120 160		PL MC LL			
									10 20 30			
0.05	GRANULAR: ~50 mm	241.72		SS1	SPT	6	▲		●	0/0		
0.25	TOPSOIL: ~200 mm	241.52										
	FILL: Sand, brown, some silt, moist											
1				SS2	SPT	2	▲		●	0/0		
2				SS3	SPT	2	▲		●	0/0		
3				SS4	SPT	6	▲		●	0/0		
3.1		238.72										
	SAND: Light brown, trace organics at the top portion, moist to wet, loose to compact, occasional silt seams / zones			SS5	SPT	8	▲		●	0/0		
4				SS6	SPT	13	▲		●	0/0		
5				SS7	SPT	8	▲		●	0/0		
6												
6.7		235.06		SS8	SPT	26	▲		●	0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
Cave at 5.5 m

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-15 **COMPLETED** 22-3-15 **GROUND ELEVATION** 242.89 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
0.23	TOPSOIL: ~225 mm	242.67										
	FILL: Sand, brown, some silt, moist			SS1	SPT	10	▲		●	0/0		
0.76		242.13										
1	becoming wet			SS2	SPT	2	▲		●	0/0		
1.5		241.37										
2	SILTY SAND: Brown to light brown, moist to very moist, compact			SS3	SPT	13	▲		●	0/0		
				SS4	SPT	11	▲		●	0/0		
3				SS5	SPT	16	▲		●	0/0		
4												
5				SS6	SPT	23	▲		●	0/0		
6												
6.7		236.18		SS7	SPT	13	▲		●	0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
No cave
No free water

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-15 **COMPLETED** 22-3-15 **GROUND ELEVATION** 245.01 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values	CPT values				
							10 20 30 40	10 20 30 40				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer Vane					
							40 80 120 160	10 20 30				
0.20	TOPSOIL: ~200 mm	244.81		SS1	SPT	3	▲		●	0/0		
1	FILL: Sand, brown, trace to some silt, some organics, very moist			SS2	SPT	2	▲		●	0/0		
2				SS3	SPT	2	▲		●	0/0		
3				SS4	SPT	2	▲		●	0/0		
3.1		241.96		SS5	SPT	14	▲		●	0/0		
4	SAND: Brown, medium to fine, trace to some silt, moist to very moist, compact to very dense			SS6	SPT	37		▲	●	0/0		
5				SS7	SPT	20	▲		●	0/0		
6												
7				SS8	SPT	17	▲		●	0/0		
8												
8.2		236.78		SS9	SPT	68	>>▲		●	0/0		

Borehole terminated at 8.2 m.

Water Level Readings:

Date	Depth (m)	Elev. (m)
2022-03-23	Dry	--
2023-03-03	Dry	--

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-15 **COMPLETED** 22-3-15 **GROUND ELEVATION** 245.29 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							Undrained Shear Strength (kPa) Pocket Penetrometer X Vane + 40 80 120 160		PL MC LL 10 20 30			
0.25	TOPSOIL: ~250 mm	245.04										
	FILL: Sand, brown to dark brown, some organics, moist	244.53		SS1	SPT	2	▲		●	0/0		
0.76												
1	SAND: Brown, trace to some silt, moist, loose to compact			SS2	SPT	6	▲		●	0/0		
2				SS3	SPT	12	▲		●	0/0		
3				SS4	SPT	17	▲		●	0/0		
3.1	occasional silt seams / zones	242.24										
				SS5	SPT	20	▲		●	0/0		
4												
5				SS6	SPT	21	▲		●	0/0		
6												
6.7		238.58		SS7	SPT	19	▲		●	0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
No cave
No free water

Project No.: G2S22008

Lab No.: 23006A

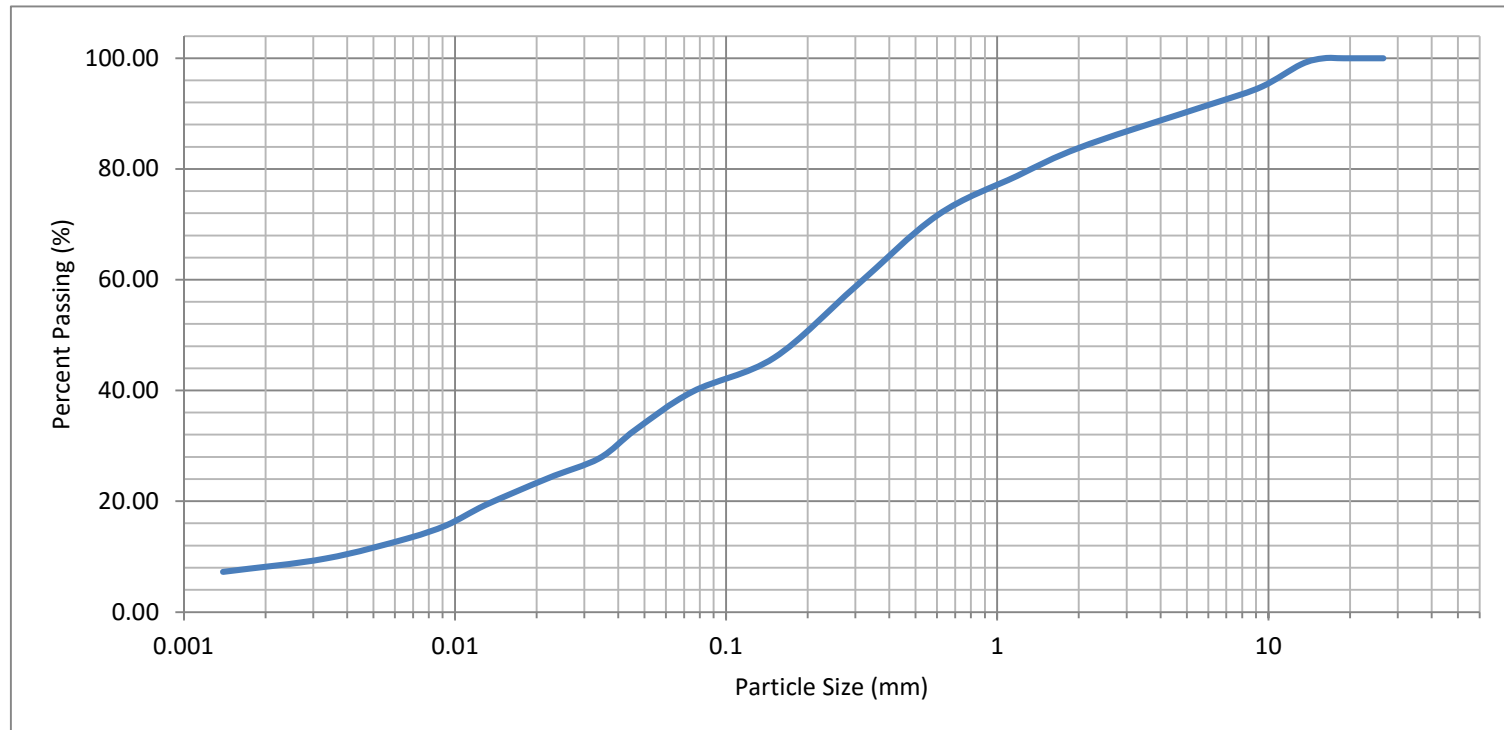
Project Name: Charles St. & Washington St., Waterford, ON

Borehole/Sample No.: BH101-SS7

ISSMGE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL		
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE

SIEVE SIZE: 1 2 6 20 60#200 #100 #50 #16 #8 #4 3/8" 3/4" 2-1/2"



Project No.: 23002A

Lab No.: 23002A

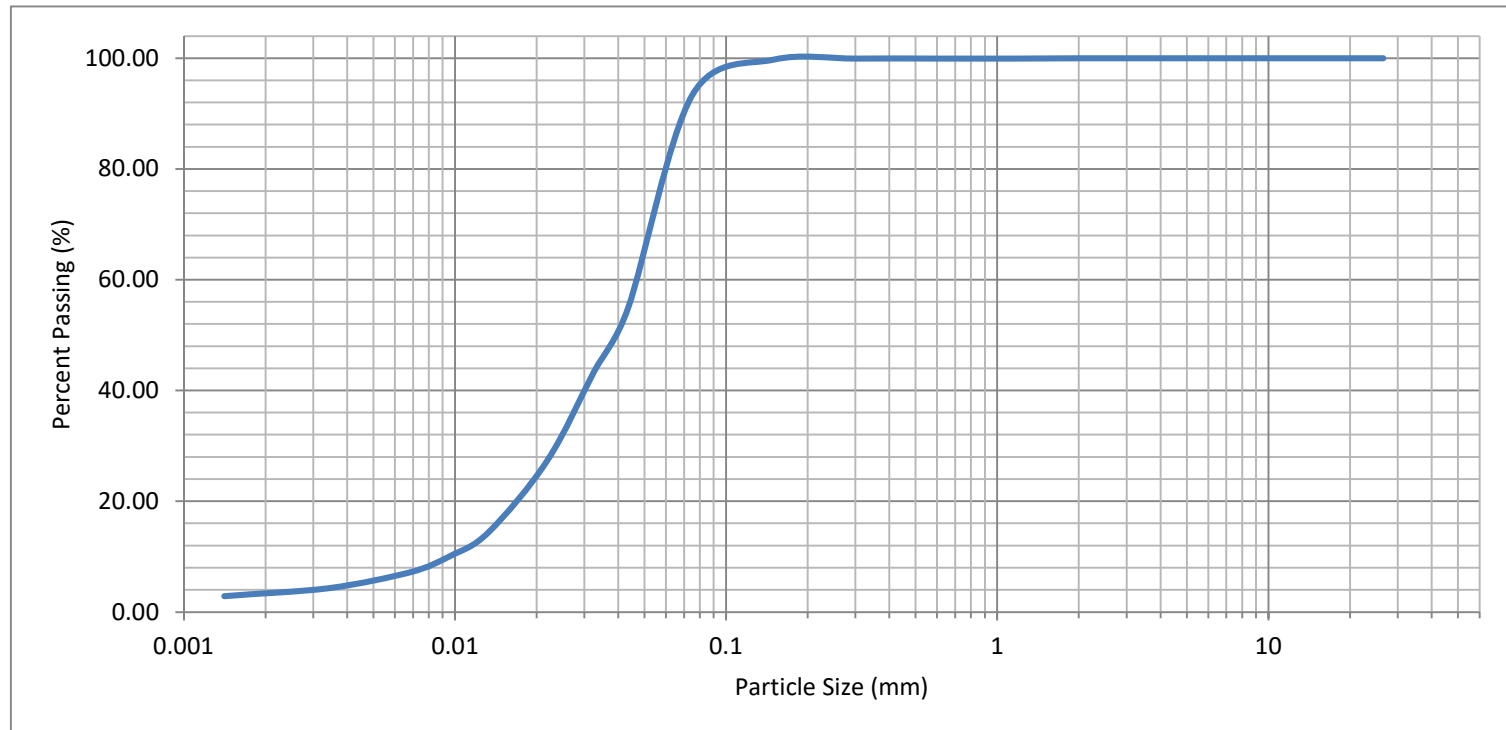
Project Name: Charles St. & Washington St., Waterford, ON

Borehole/Sample No.: BH105-SS5

ISSMGE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL		
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE

SIEVE SIZE: 1 2 6 20 60#200 #100 #50 #16 #8 #4 3/8" 3/4" 2-1/2"



Project No.: G2S22008

Lab No.: 22019E

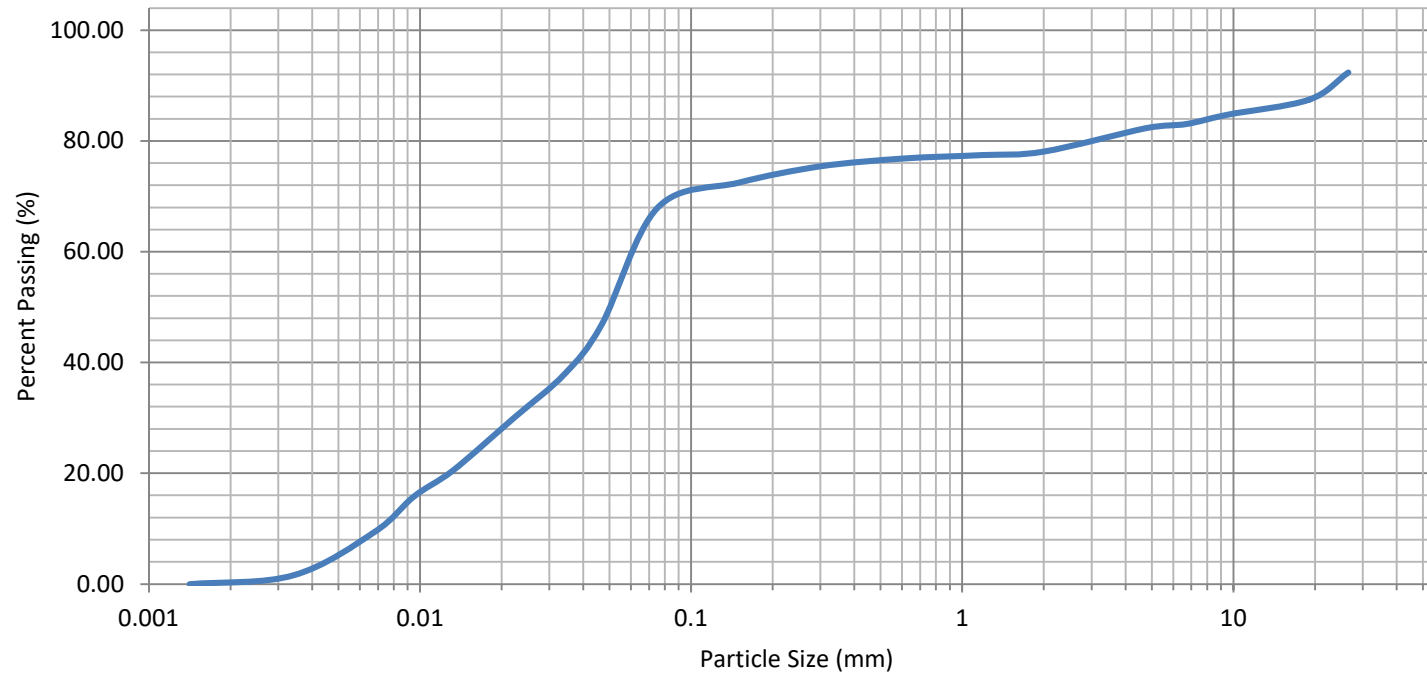
Project Name: Charles St. & Washington St., Waterford, ON

Borehole/Sample No.: BH106-SS8

ISSMGE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL		
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE

SIEVE SIZE: 1 2 6 20 60#200 #100 #50 #16 #8 #4 3/8" 3/4" 2-1/2"



Project No.: G2S22008

Lab No.: 23002B

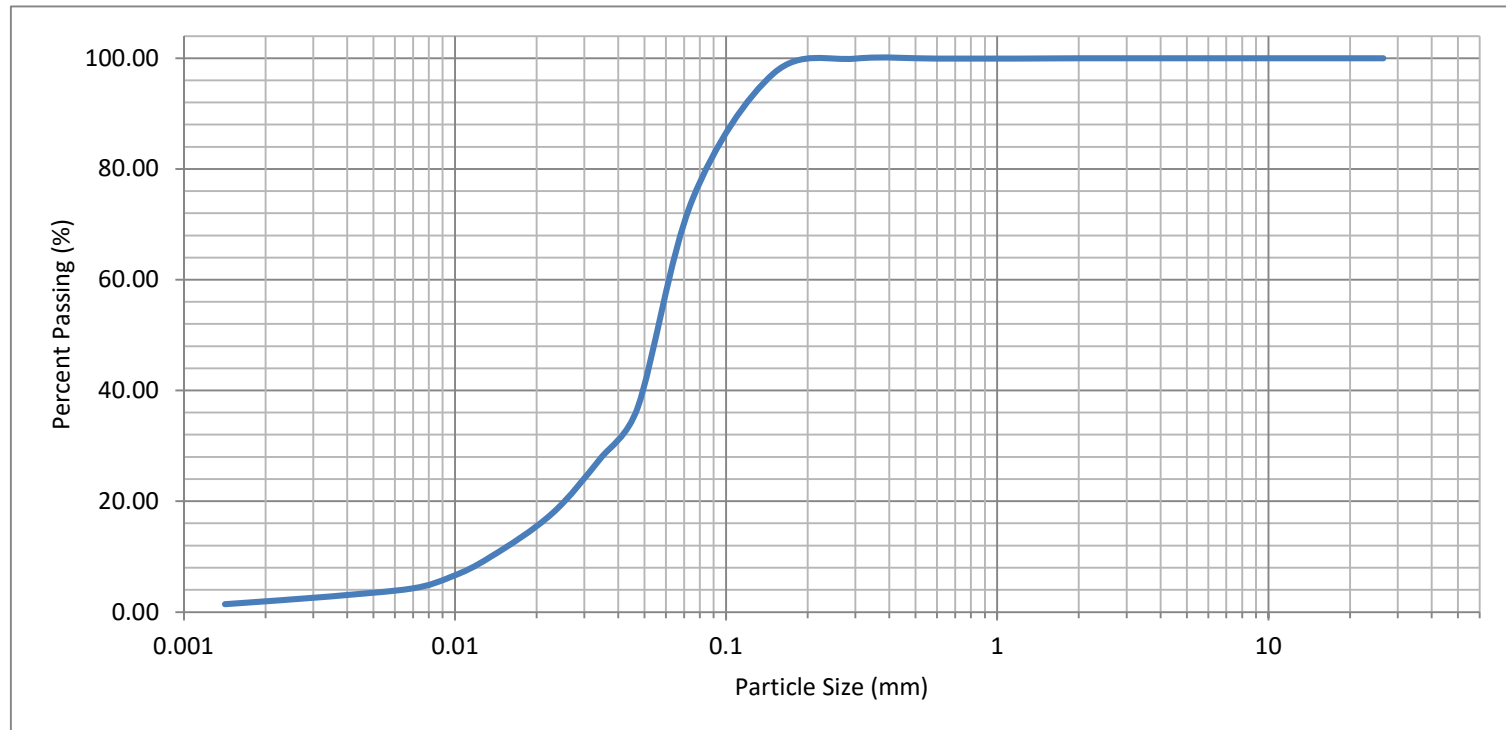
Project Name: Charles St. & Washington St., Waterford, ON

Borehole/Sample No.: BH107-SS6

ISSMGE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL		
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE

SIEVE SIZE: 1 2 6 20 60#200 #100 #50 #16 #8 #4 3/8" 3/4" 2-1/2"



Project No.: G2S22008

Lab No.: 23006B

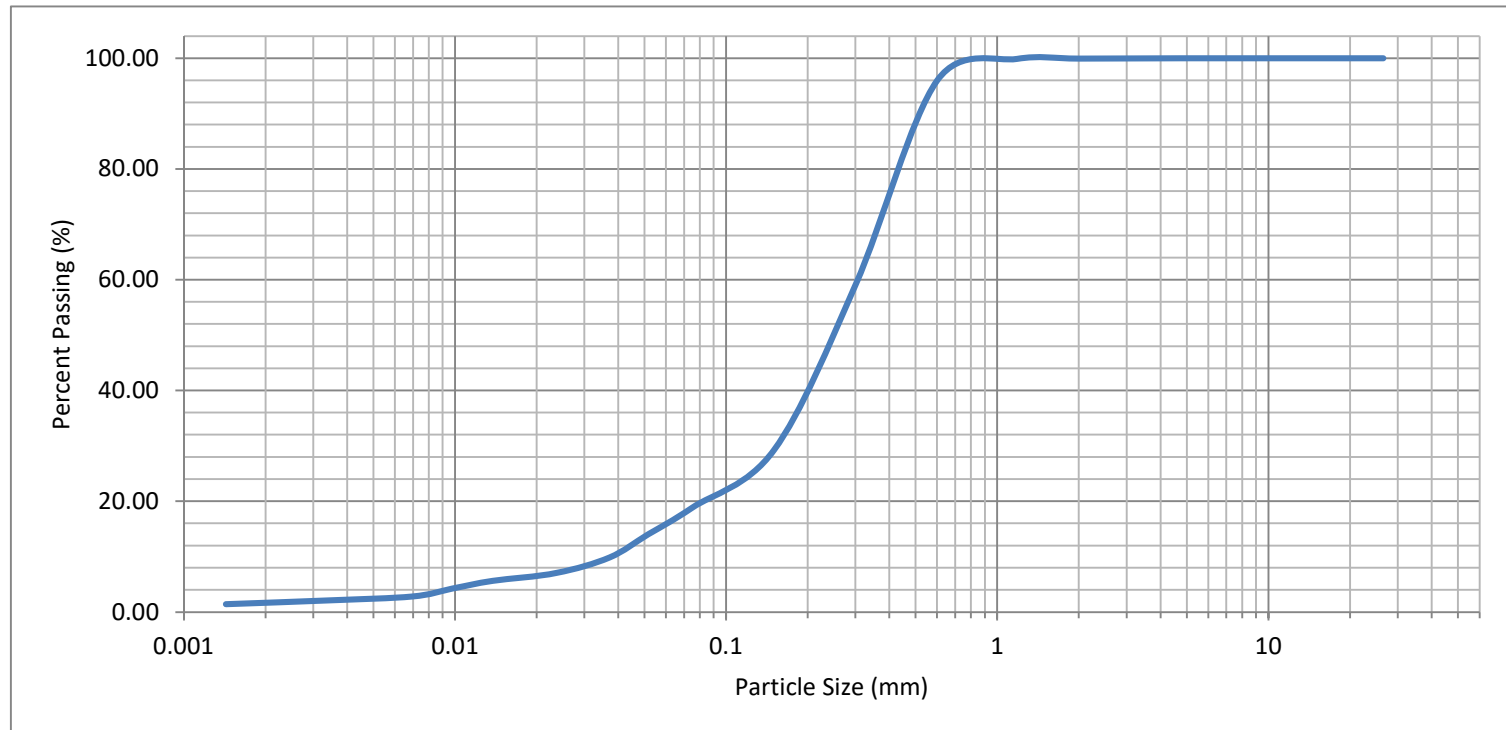
Project Name: Charles St. & Washington St., Waterford, ON

Borehole/Sample No.: BH107-S8

ISSMGE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL		
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE

SIEVE SIZE: 1 2 6 20 60#200 #100 #50 #16 #8 #4 3/8" 3/4" 2-1/2"



Project No.: G2S22008

Lab No.: 23006C

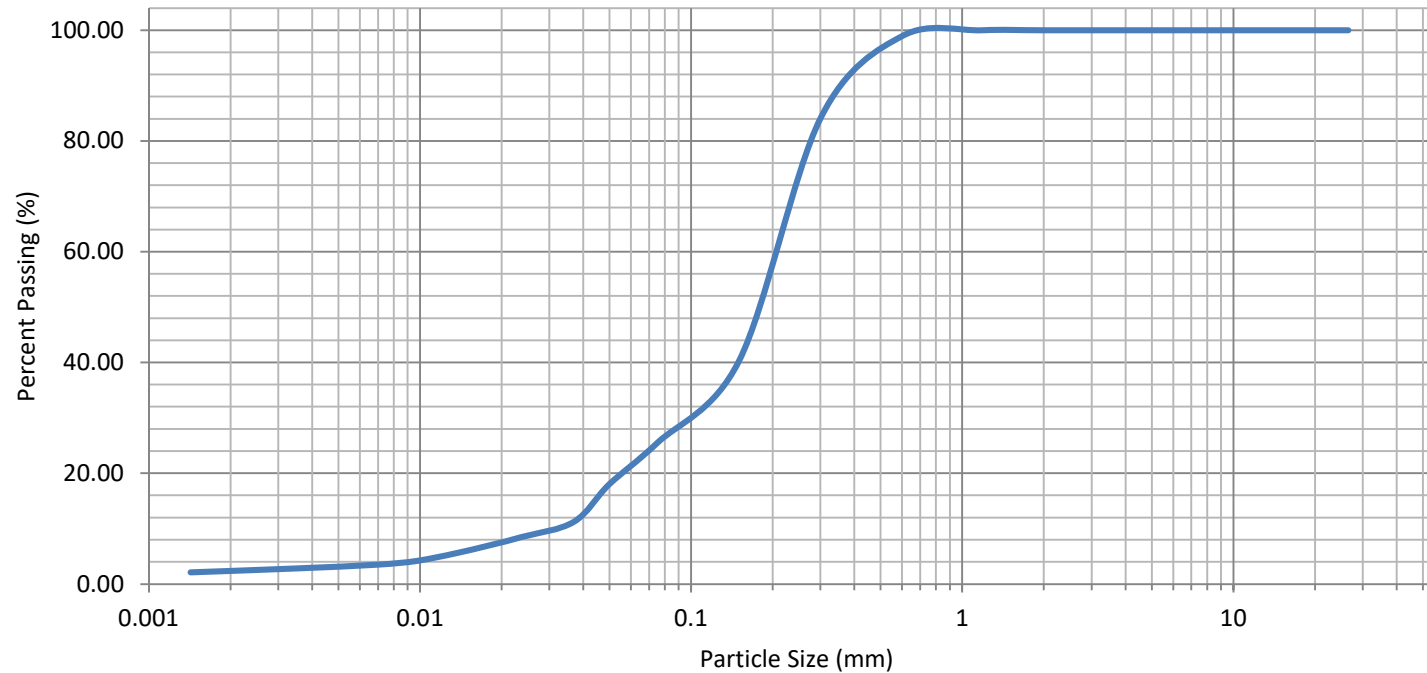
Project Name: Charles St. & Washington St., Waterford, ON

Borehole/Sample No.: BH110-S6

ISSMGE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL		
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE

SIEVE SIZE: 1 2 6 20 60#200 #100 #50 #16 #8 #4 3/8" 3/4" 2-1/2"



Project No.: G2S22008

Lab No.: 23006D

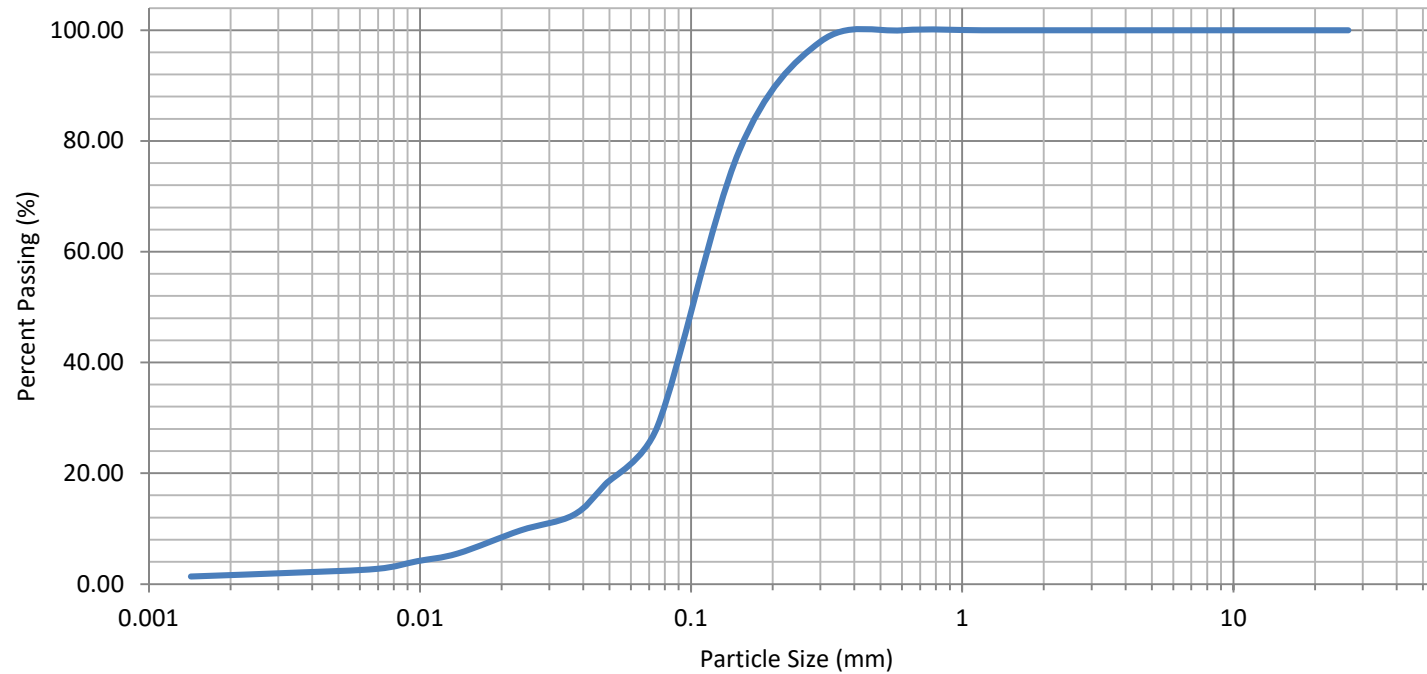
Project Name: Charles St. & Washington St., Waterford, ON

Borehole/Sample No.: BH114-S5

ISSMGE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL		
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE

SIEVE SIZE: 1 2 6 20 60#200 #100 #50 #16 #8 #4 3/8" 3/4" 2-1/2"

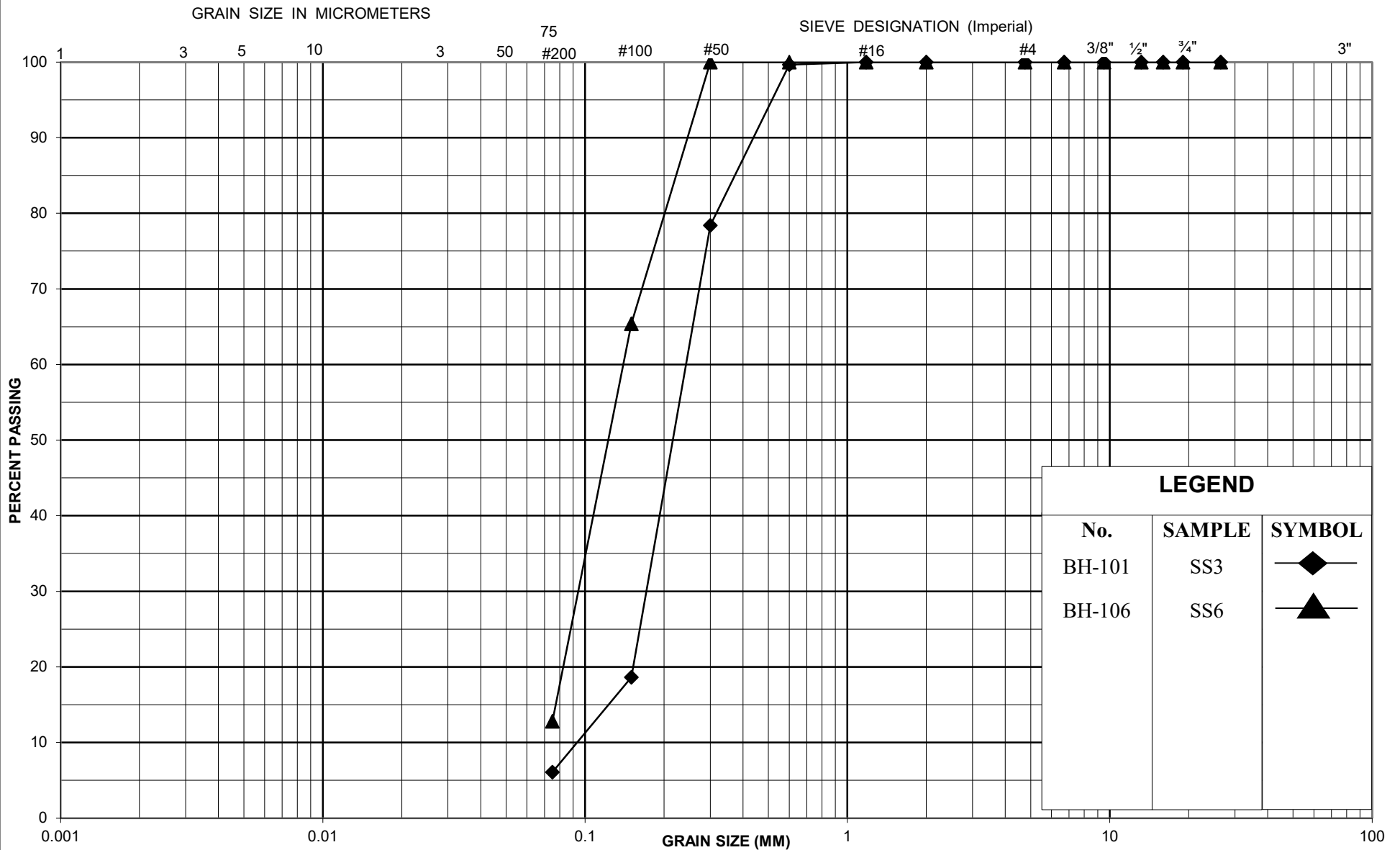


Project No.: G2S22008
Project Name: Charles St. & Washington St., Waterford, ON

Lab No.: 22019 A,D

ISSMFE SOIL CLASSIFICATION SYSTEM

CLAY	SILT			SAND			GRAVEL			Cobbles
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	



Appendix C:

Soil Infiltration Assessment



December 1, 2022

G2S Environmental Consulting Inc.
4361 Harvester Road, Unit 12
Burlington, ON
L7L 5M4
ATTN: Melissa King

Re: Sharma Subdivision,
155-183 Charles Street, Waterford
Soil Infiltration Assessment
Project 10193

Hydrogeology Consulting Services Inc. (HCS) was retained by G2S Environmental Consulting Inc. to assess the near-surface soil infiltration capacity at the above-referenced property.

Double Ring Infiltrometer Results

A double ring infiltrometer (DRI) from AMS Samplers was used to assess the surficial soil infiltration rate at the two locations shown on the attached Drawing 1 on November 18, 2022. At the time of testing the ground was not frozen as a thaw had recently occurred. Surface vegetation, topsoil, and overburden material was excavated at the test locations to a depth of approximately 0.9-1.0 mBGS using a tracked excavator to allow the DRI to seat into the native sandy soils. It is important to consider that factors such as roots and wormholes (which create preferential pathways for infiltrating water), and rocks and debris (which can prevent a proper seal of the infiltrometer rings into the soil and cause escape of water under the bottom of the ring) can result in erroneously high measured infiltration rates.

Water was added to the outer ring of the DRI during the test to maintain a vertical “curtain” of saturated soil around the inner ring. This curtain of saturated soil ensured that the DRI test only measured vertical percolation of water through the soil matrix beneath the inner ring. The water level of the outer ring was monitored to ensure it remained similar to the water level in the inner ring during the test. Water was added to the inner ring and the rate of infiltration timed with a stopwatch at regular intervals by measuring the drop in water level inside the inner ring. When the rate of change of water level reached an equilibrium, the test was considered complete.

The Toronto Region Conservation Authority (TRCA) and Credit Valley Conservation (CVC) provide a method of assessing soil infiltration rate in the Low Impact Development (LID) Stormwater Management (SWM) Planning and Design Guide (TRCA and CVC, 2010). Following the methodology outlined in Appendix C of the Guide the measured infiltration rates from the DRI tests were factored. Additionally, an estimated soil “T-Time” value based on the Ontario Building Code (OBC) classifications for major soil types is provided. The measured and estimated factored soil infiltration rates, plus OBC T-Time values, are included in Table 1 below.

Table 1: Calculated Estimated Soil Infiltration Rates and T-Times

DRI Test Location	Measured Soil Infiltration Rate – <u>Unfactored</u> (mm/hr)	Estimated Soil T-Time (mins/cm) (OBC)	Estimated Soil Infiltration Rate – Factored * (mm/hr)
DRI-01-22 (sand, trace-some silt)	225	15-20	90
DRI-02-22 (sand, trace-some silt)	150	17-22	60

* - Factor of 2.5 applied

As shown in Table 1 it is important to consider that the LID SWM Planning and Design Guide requires implementation a Safety Correction factor to calculate “Design Infiltration Rates” (e.g. for subdivision soakaway pits and infiltration galleries). The measured unfactored rates listed in the table are considered reasonable for comparative purposes and for design of sewage effluent leaching beds, while the factored rates would be applicable for design of high volume infiltration facilities.

The factored infiltration values show the near-surface native sandy deposits underlying topsoil beneath the subject property have a relatively high infiltration rate.

Grain Size Analysis Results

Samples of soil from the DRI test pits collected during excavation, and from on-site boreholes previously drilled on the subject property as part of a geotechnical investigation at the locations shown on the attached Drawing 2 (G2S Environmental Consulting Inc., April 2022) were submitted for analysis of particle size distribution (grain size). As shown on the appended grain size analysis graphs, the near-surface soils consist of silty sand to sand with trace-some silt. The grain size analysis results were used to estimate soil hydraulic conductivity (K) values by applying the Kaubisch, Breyer, Hazen, and Kozeny-Carman formulae where appropriate based on the limitations of each formula. The hydraulic conductivity estimates are summarized in Table 2 below:

Table 2: Calculated soil hydraulic conductivity values

Location	Sample Depth (mBGS)	Analysis Method	Hydraulic Conductivity (m/sec)
DRI-01-22	0.9	Kozeny Carman	5.2×10^{-6}
DRI-02-22	1.0	Breyer	6.5×10^{-5}
BH 107	(ss-8)	Breyer	8.6×10^{-5}

It is noted two borehole soil samples (BH 101 ss-3 and BH 114 ss-5) had no D_{10} values due to the high percentage of fine sand grains in the samples; therefore, hydraulic conductivity estimates could not be generated.

The hydraulic conductivity values of 5.2×10^{-6} – 8.6×10^{-5} m/sec indicate a relatively moderate to moderately high permeability.

The hydraulic conductivity estimates from the grain size analyses correlate well with published ranges for major soil types (Freeze and Cherry, 1979).

Soil Infiltration Rate and T-Time Calculations – Grain Size Analysis Results

The Toronto Region Conservation Authority (TRCA) and Credit Valley Conservation (CVC) provide a method of assessing soil infiltration rate in the Low Impact Development (LID) Stormwater Management (SWM) Planning and Design Guide (TRCA and CVC, 2010). Following the methodology outlined in Appendix C of the Guide the estimated soil hydraulic conductivity values from Table 2 above were converted into the infiltration rates listed in Table 3 below. Additionally, estimated soil “T-Time” values based on the Ontario Building Code (OBC) classifications for major soil types are provided.

Table 3: Estimated Soil Infiltration Rates from Grain Size Analysis Hydraulic Conductivity Values

Borehole Location and Sample Depth (m)	Estimated Soil Infiltration Rate – <u>Unfactored</u> (mm/hr)	Estimated Soil T-Time (mins/cm) (OBC)	Estimated Soil Infiltration Rate – Factored * (mm/hr)
DRI-01-22 (sand, trace-some silt)	62	15-20	25
DRI-02-22 (sand, trace-some silt)	128	17-22	51
BH 107 (fine-medium sand)	142	10	57

* - Factor of 2.5 applied

As discussed previously it is important to consider that the LID SWM Planning and Design Guide requires implementation a Safety Correction factor to calculate “Design Infiltration Rates” (e.g. for subdivision soakaway pits and infiltration galleries). The measured unfactored rates listed in the table are considered reasonable for comparative purposes and for design of sewage effluent leaching beds, while the factored rates would be applicable for design of high volume infiltration facilities.

The factored infiltration values show the near-surface native sandy deposits underlying topsoil beneath the subject property have a relatively moderate to moderately-high infiltration rate, somewhat lower than the DRI-estimated infiltration rates. The rates listed in Table 3 can be considered more conservative for the purposes of infiltration facility design.

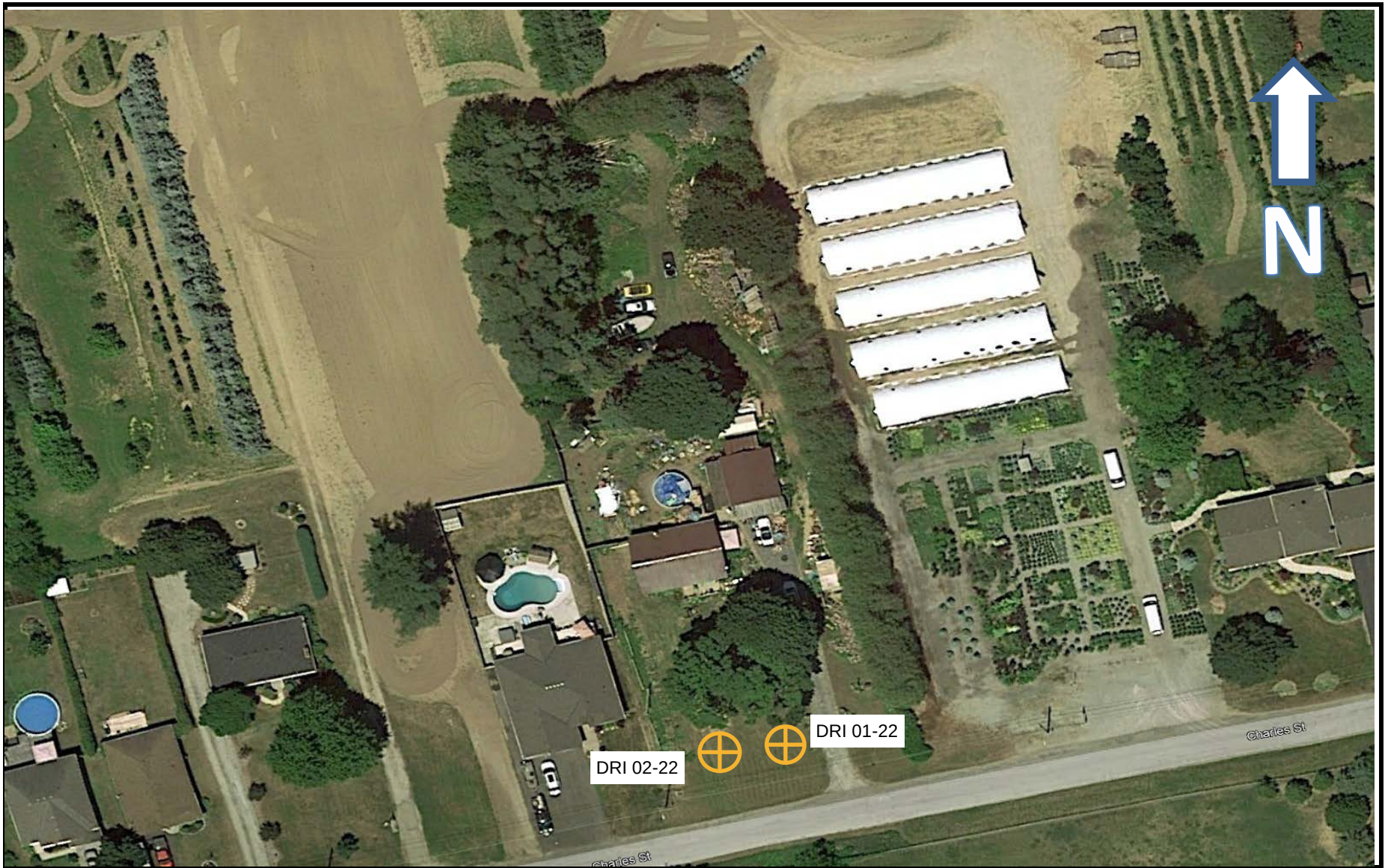
I trust this information is sufficient for your present requirements. If any further questions or comments arise, please feel free to contact me directly.

Respectfully submitted,

A handwritten signature in blue ink, appearing to read 'Chris Helmer', is written over a circular professional seal.A circular professional seal for Chris Helmer, a Professional Geoscientist in Ontario. The seal contains a stylized flower logo in the center. Text around the border reads 'PROFESSIONAL GEOSCIENTIST' and 'ONTARIO'. Inside the seal, it says '01-Dec-2022', 'CHRIS HELMER', 'PRACTISING MEMBER', and '2285'.

Chris Helmer, B.Sc., P.Geo.
Senior Hydrogeologist
MECP Licensed Well Contractor and Class 5 Well Technician
www.hydrog.ca

- encl. Drawing 1 – DRI Test Locations
- encl. Drawing 2 – Borehole Location Plan (G2S Environmental Consultants Inc.)
- encl. Grain Size Analysis Graphs



LEGEND



Double Ring
Infiltrator Test
Location
(approximate)

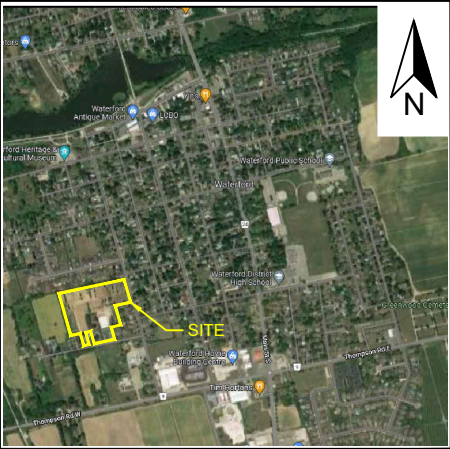
Drawing 1 - Site Plan
155-183 Charles Street, Waterford



HCS
HYDROGEOLOGY
CONSULTING
SERVICES INC

imagery from Google Earth © 2022

Drawn:	CFH
Date:	2022-11-29



KEY PLAN

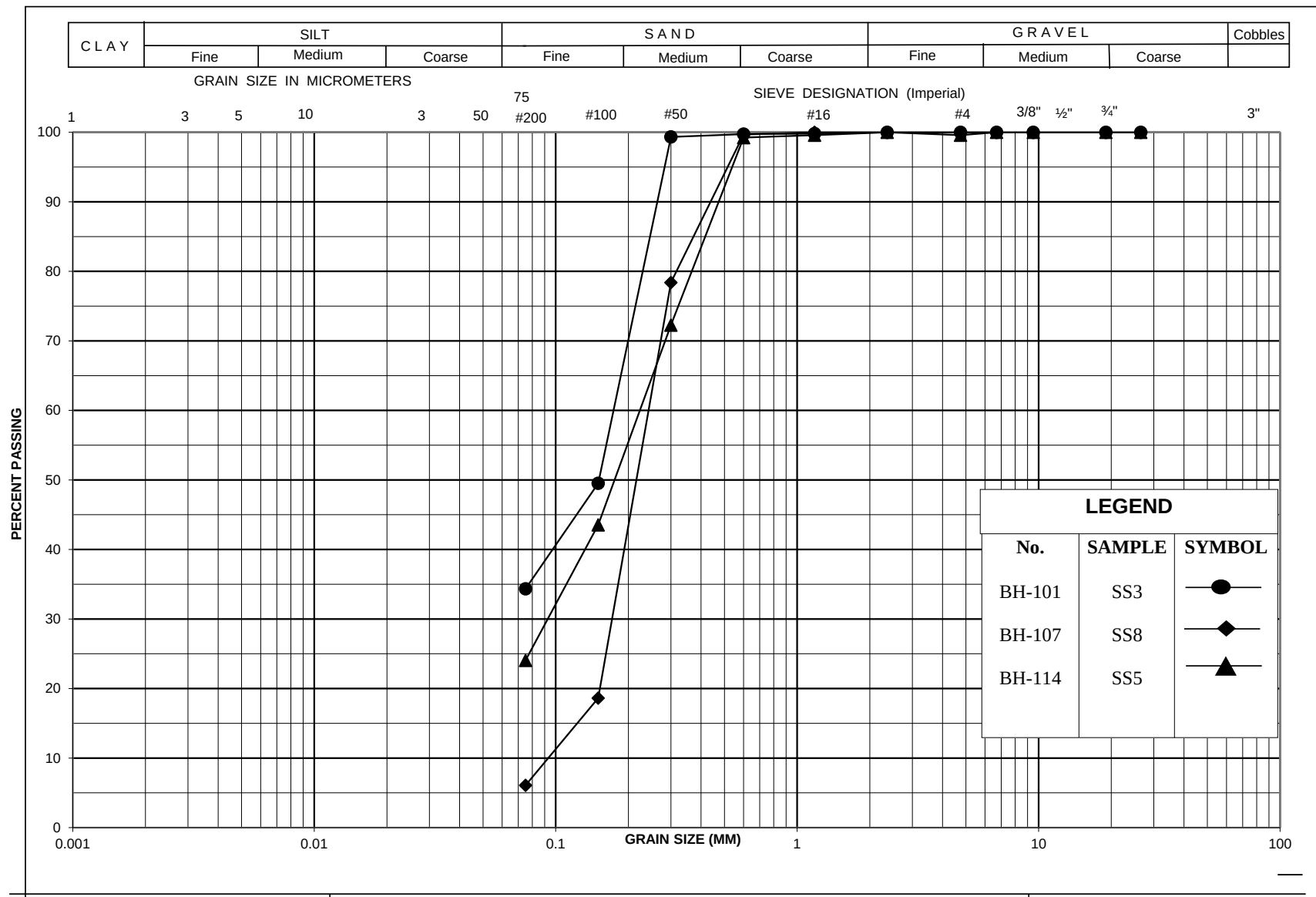
LEGEND

- BOREHOLE LOCATION
- MONITORING WELL LOCATION
- TEMPORARY BENCHMARK (TBM)
- XXX.XX GROUND SURFACE ELEVATION (m)
- XXX.XX GROUNDWATER ELEVATION (DATE)
- PROPOSED BUILDING LOCATION
- PROPOSED PARK LOCATION
- PROPOSED SWM POND LOCATION

TITLE:	
BOREHOLE LOCATION PLAN	
CLIENT:	
2863088 ONTARIO INC.	
LOCATION:	
CHARLES STREET	
WATERFORD, ONTARIO	
PROJECT:	
G2S22008	
DRAWING:	2
SCALE:	AS SHOWN
DATE:	APRIL 2022
DRAWN BY:	DB
FILE NAME:	G2S22008 BH Location Plan



ISSMFE SOIL CLASSIFICATION SYSTEM



Project No.: G2S22008

Lab No.: 22075A

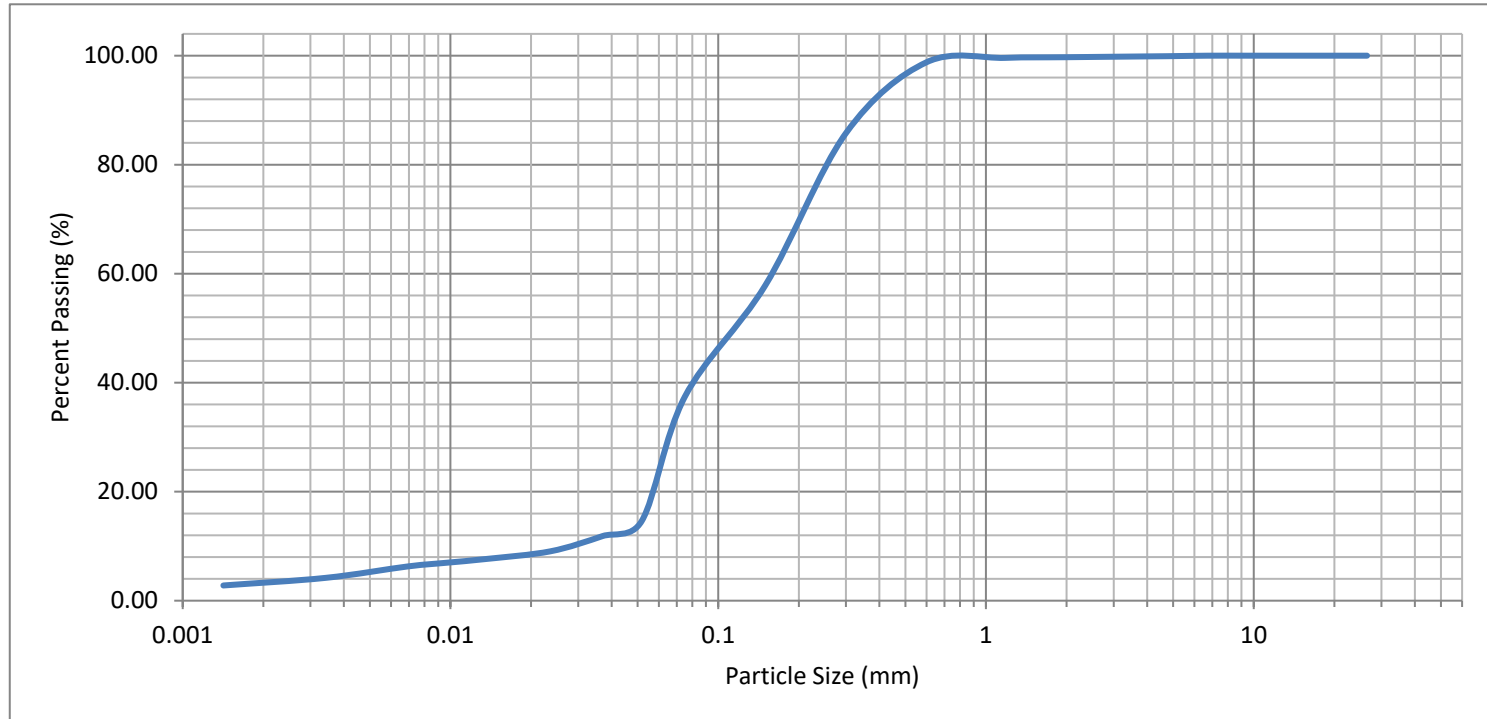
Project Name: Charles St & Washington St, Waterford

Borehole/Sample No.: DRI 1 - 0.9 m (3 ft)

ISSMGE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL		
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE

SIEVE SIZE: 1 2 6 20 60#200 #100 #50 #16 #8 #4 3/8" 3/4" 2-1/2"



Project No.: G2S22008

Lab No.: 22075B

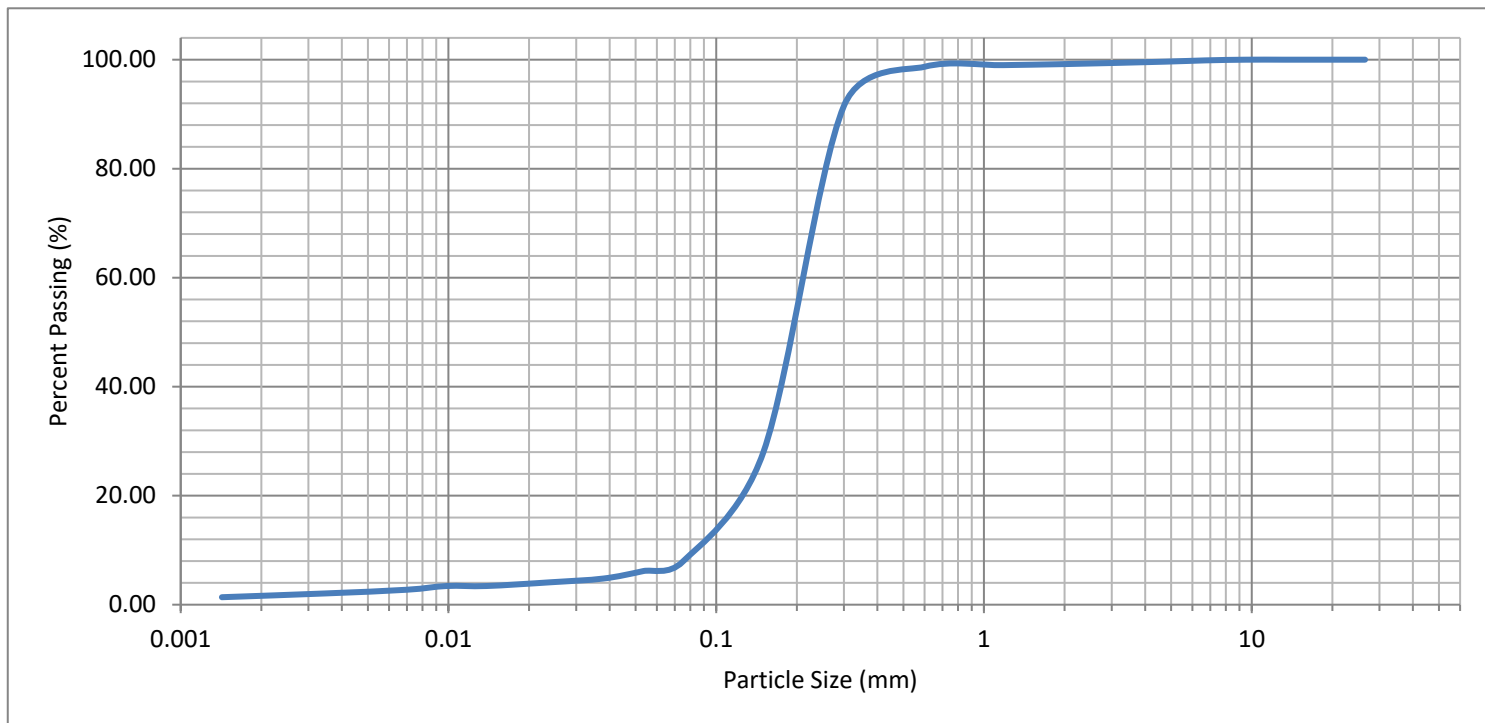
Project Name: Charles St & Washington St, Waterford

Borehole/Sample No.: DRI 2 - 1.0 m (3.3 ft)

ISSMGE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL		
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE

SIEVE SIZE: 1 2 6 20 60#200 #100 #50 #16 #8 #4 3/8" 3/4" 2-1/2"



March 10, 2023

Reference No. G2S22008B

Roger Sharma
2863088 Ontario Inc.
3156 Countess Crescent
Mississauga, Ontario
L5M 0E2

**Soil Sampling and Chemical Testing Program
Charles Street and Washington Street, Waterford, Ontario
Charles Street Subdivision**

G2S Consulting Inc. (G2S) was retained by Roger Sharma of 2863088 Ontario Inc. (the Client) to complete a program of soil sampling and chemical testing for a land parcel comprising four properties included in the proposed Charles Street Subdivision plan located in Waterford, Ontario, hereinafter referred to as the 'Site'. The work was carried out in accordance with our proposal dated February 10, 2022.

The Site is comprised of four properties located on the north side of Charles Street and the west side of Washington Street and covers an approximate plan area of 4.39 ha (10.8 ac.). The property located at 183 Charles Street is vacant undeveloped land, hereinafter referred to as 'Property 1'. The property located at 173 Charles Street is developed with one residential building, hereinafter referred to as 'Property 2'. The property located at 155 Charles Street is developed and occupied by Peter Overdeest and Sons Landscaping and Nursery business, hereinafter referred to as 'Property 3'. Lastly, the property located on the west side of Washington Street (no municipal address) is vacant undeveloped land, hereinafter referred to as 'Property 4'. Refer to Drawing 1 in Appendix A for the Borehole Location Plan showing the general Site location.

1. Introduction

The proposed development plan includes the development of a 63-unit residential subdivision, including single homes, two storey townhouses, bungalow townhouses, and a park block and stormwater management (SWM) pond.

During construction activities, excess soil may be generated, the volume of which is unknown at this time. Therefore, this sampling program was general in nature to provide Site coverage and address the Areas of Potential Environmental Concern (APECs) identified in a previous Assessment of Past Uses (APU) Report completed by G2S.

The purpose of the current assignment was to check the chemical quality of potentially excess soil compared to the O. Reg. 153/04 Site Condition Standards (SCS) for on-site reuse, and O. Reg. 406/19 Excess Soil Quality Standards (ESQS) for various off-site property uses. It is noted that G2S did not assess the ESQS applicable to the receiving site(s), which are unknown at this time.

2. **Background**

The Ministry of the Environment, Conservation and Parks (MECP) has introduced a new On-Site and Excess Soil Management Regulation (O.Reg.406/19). This regulation changes the definition of soil as a waste unless it is being transported for beneficial reuse. Soil quality must meet the new Excess Soil Quality Standards (ESQS) and the quantity of soil must be consistent with the beneficial reuse specified for the reuse site.

As of January 1, 2023, additional requirements including project planning documentation, tracking and registration were put in place. The following steps are required for non-exempt projects:

- **Step 1:** Preparation of an Assessment of Past Uses (APU) Report,
- **Step 2:** Preparation and Implementation of a Sampling and Analysis Plan (SAP),
- **Step 3:** Preparation of a Soil Characterization Report (SCR),
- **Step 4:** Preparation of an Excess Soil Destination Assessment Report (ESDAR), and
- **Step 5:** Development and Implementation of a Tracking System.

It is noted that Steps 1 to 4 must be conducted or supervised by the Source Site Qualified Person (QP) such as G2S. Step 5 can be undertaken or overseen by the Source Site Project Leader.

G2S recently completed an Assessment of Past Uses (APU) report with the findings provided in our report dated March 3, 2023, Ref. No. G2S22008A. Based on information collected from the Project Area site visit, records review, and interviews, Property 2 was first developed with the current single-storey residential building in 1964. Property 3 was first developed with the current landscaping and nursery business in 1967. Property 1 and Property 4 are currently and have historically consisted of vacant undeveloped or agricultural land. The Site has remained the same since initial development.

The APU Report identified two Potentially Contaminating Activities (PCAs) on-Site and one PCA off-Site, which were assessed based on observations of the operations, their location relative to the Site with respect to the inferred groundwater flow direction and/or distance to the Site, their tenure, expected chemical storage amounts and likely excavation depth of the excess soil. Based on review and evaluation of the information gathered, the following APECs have been identified for the Site:

APEC 1 - Northern and central backyard portions of Property 2: Current and historical presence of miscellaneous debris, scrap metal, and derelict automobiles.

APEC 2 – Property 1, 3, and 4 - Potential use of pesticides associated with agricultural use.

In this regard, it was recommended that the excess soil sampling and analysis plan include the following minimum parameters:

- Petroleum Hydrocarbons Fractions F1 to F4 (PHCs F1-F4)
- Benzene, toluene, ethylbenzene and xylenes (BTEX)
- Volatile Organic Compounds (VOCs)
- Metals and pH

- Organochlorine Pesticides (OCPs)

It was noted that despite any chemical testing program, ultimate acceptance of excess soil lies with the receiving site and their written approval to receive the material, based on review of the reports provided. In this regard, additional sampling and testing may be requested depending on the receiving site and volume of excess soil to be generated, if any.

3. Scope of Work

To accomplish the objective, G2S attended the Site on March 15, 16, and 17, 2022, when sixteen boreholes were sampled by London Soil Test Ltd. (LST) under the supervision of G2S staff during a concurrent geotechnical investigation. The boreholes were advanced with a Diedrich D50 Track drill rig to depths between 6.7 and 9.8 m below ground surface (bgs) and were labelled as BH101 to BH116. Of the sixteen boreholes drilled, seven borehole locations were selected for chemical testing.

G2S attended the Project Area on March 23, 2022, when four additional environmental boreholes were sampled by Sonic Soil Sampling Inc. (Sonic) under the supervision of G2S staff. The boreholes were advanced with a Pionjar drill rig to depths of 3.1 m bgs and were labelled as BH117 to BH120. Of the four boreholes drilled, three borehole locations were selected for chemical testing.

The borehole locations were chosen by G2S based on the APECs identified in the APU report completed by G2S, coverage of the possible areas to be excavated and the location of buried utility services. Reference is made to the appended Drawing 1 in Appendix A for a visual depiction of the borehole locations, and Appendix B for the borehole logs.

Representative samples were collected at regular depth intervals. Disposable nitrile gloves (one per sample) were used during sample collection. New laboratory-supplied glass jars with Teflon-lined lids were filled with a portion of each soil sample. The jars and vials were then sealed and placed in a cooler with ice packs for storage and transportation. Sample cores for analysis of volatiles were collected using a 5-gram Terra Core sampler. The soil cores were immediately placed into a methanol vial (pre-filled and weighed with 10mL purge & trap grade methanol). The remaining soil sample was placed in a sealable plastic bag and allowed to reach ambient temperature prior to field screening for the presence of organic vapours.

As part of the environmental procedural protocol, soil samples at each borehole location were also examined for visual and olfactory evidence of potential contamination. Organic vapours were measured in the bagged soil samples, using an RKI Eagle 2 gas detector, equipped with a catalytic combustible gas sensor, calibrated to hexane, and a Photo Ionization Detector (PID) sensor, calibrated to isobutylene.

4. Subsurface Findings

In general, the geotechnical boreholes revealed 100 to 460 mm of topsoil and/or 50 to 75 mm of granular materials underlain by fill materials to depths of 0.6 to 3.8 m, over sand and silt materials extending the full depth of the boreholes (up to depths of 9.8 m bgs).

The four shallow boreholes completed for Property 2 revealed 200 to 225 mm of topsoil or 0.8 to 1.5 m of fill materials comprising dark brown sand. Below the topsoil and fill was native sand extending the full depth of the boreholes (up to depths of 3.1 m bgs). Refer to Appendix B for a summary of the subsurface conditions on the borehole logs.

Organic vapour concentrations were measured in the headspace of the recovered soil samples using an RKI Eagle Portable Gas Detector and PID, which detects a combination of combustible gases in parts per million (ppm). There are no regulatory criteria for soil vapours; however, soil vapours are often used as a screening tool to identify VOC and/or PHC impacted soils. The correlation between combustible vapour concentrations and PHCs in soil is highly dependent on the soil type, moisture content and characteristics of the contaminant of concern. The results of screening are used as a tool in establishing relative organic vapours among samples and sampling locations. No hexane values were observed, and isobutylene (IBL) levels ranged from 0 to 1 ppm. No other visual or olfactory evidence of potential contamination was observed.

5. Chemical Testing Protocol

In accordance with our proposal, soil samples were submitted under Chain of Custody protocols to Paracel Laboratories Ltd. (Paracel), a lab accredited by the Canadian Association for Laboratory Accreditation (CALA) in accordance with ISO/IEC 17025: 2017 – “General Requirements for the Competence of Testing and Calibration Laboratories”.

The samples were submitted for chemical testing for the contaminants of potential concern identified in the APU and included petroleum hydrocarbons fractions F1 to F4 (PHCs F1-F4), including benzene, toluene, ethylbenzene and xylenes (BTEX), volatile organic compounds (VOCs), metals, organochlorine pesticides (OCPs), and pH.

The following table is a summary of the samples submitted.

Table 1: Soil Samples Submitted for Laboratory Analysis

Sample ID	Approx. Depth (m bgs)	Material Description	Chemical Analysis			
			PHCs F1-F4, including BTEX	VOCs	Metals	OCPs
BH101 SS2	0.8 – 1.4	Sand with some silt	✓		✓*	
BH102 SS2	0.8 – 1.4		✓	✓	✓*	
BH103 SS1	0.0 – 0.6					✓
BH107 SS1	0.0 – 0.6					✓
BH111 SS2	0.8 – 1.4		✓	✓	✓*	
BH114 SS1	0.0 – 0.6					✓
BH116 SS1	0.0 – 0.6					✓
BH117 SS1	0.0 – 0.6		✓		✓*	
BH118 SS1	0.0 – 0.6		✓	✓	pH only	
BH119 SS1	0.0 – 0.6		✓	✓	✓*	

Notes: PHCs F1-F4 – Petroleum Hydrocarbons Fractions F1 to F4
BTEX – Benzene, Toluene, Ethylbenzene, Xylene

VOCs – Volatile Organic Compounds
* Including pH

6. Soil Quality Standards

The assessment criteria applicable to a given site in Ontario are provided in the Ministry of Environment, Conservation, and Parks (MECP) document entitled “Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act”, dated April 15, 2011. Standards are provided in Tables 1 to 9 in the document. These standards are based on site sensitivity, groundwater use, property use, soil type and restoration depth.

The MECP has also developed a set of Generic Excess Soil Quality Standards (ESQS) for use with the Rules for Soil Management and Excess Soil Quality Standards (December 2020) under O. Reg. 406/19. The Standards consist of nine tables (Table 1 through Table 9.1) that provide criteria for maximum concentrations of various contaminants. In general, the applicable Table and ESQS depend on the site location, land use, soil texture, bedrock depth, soil pH and source of potable water at the site.

For the option of reusing soil on Site, the O. Reg. 153/04 Table 2 Site Condition Standards (SCS) for Residential/Parkland/Institutional (RPI) property uses were considered applicable.

For off-Site reuse with minimal environmental restrictions, the O. Reg. 406/19, Full Depth Background Table 1 ESQS for Residential/Parkland/Institutional/Industrial/Commercial/Community (RPI/ICC) property uses were considered applicable (Table 1 RPI/ICC), which is the most stringent Standard listed under the Regulations, apart from agriculture use.

For the option of re-using the excess soil at a property (or properties) within a potable groundwater condition, the O. Reg. 406/19 (Table 2.1) Full Depth Generic ESQS were considered applicable for RPI and ICC property uses.

It is noted that a comparison to other tables within O. Reg. 406/19 was outside of our scope for this assignment. If the potential receiving site(s) for excess soil falls within another category, additional evaluation by G2S will be required to confirm conformance.

7. Analytical Findings

The laboratory certificate of analysis compared to the SCS and ESQS are included in Appendix C. The measured values and corresponding SCS/ESQS are shown on the certificate of analysis. In the event of an exceedance of the criteria, the level is shown in highlighted text, where applicable.

When compared to the Table 2 RPI SCS for on-site reuse, the measured concentrations of the tested parameters met the SCS.

When compared to the Table 1 RPI/ICC ESQS for off-Site reuse with no environmental restrictions, the measured concentrations of the tested parameters met the ESQS, with the exception of the following:

- Sample BH118 SS1 – PHC Fraction F4 concentration of 128 µg/g exceeded the ESQS of 120 µg/g.

When compared to the Table 2.1 RPI ESQS for off-Site reuse, the measured concentrations of the tested parameters met the ESQS.

8. Assessment of Analytical Findings and Conclusions

The purpose of the current assignment was to check the chemical quality of potentially excess soil compared to the O. Reg. 153/04 Site Condition Standards (SCS) for on-site reuse, and O. Reg. 406/19 Excess Soil Quality Standards (ESQS) for various off-site property uses. It is noted that G2S did not assess the ESQS applicable to the receiving site(s), which are unknown at this time.

On-site Reuse

When compared to the O. Reg. 153/04 Table 2 RPI SCS, the material tested met the criteria.

Off-site Reuse

When compared to the O. Reg. 406/19 Table 1 RPI/ICC ESQS, the material tested met the criteria except for PHC Fraction F4 in one sample. In this regard, off-site reuse will be subject to certain handling restrictions.

When compared to the O. Reg. 406/19 Table 2.1 RPI ESQS, the material tested met the criteria.

Guidelines for Reuse

If the excess soil is to be removed from the Site for reuse, the following conditions must be met:

- i. The work must be completed in accordance with O. Reg. 406/19 and local by-laws governing soil movement and/or placement at other sites;
- ii. All analytical results and environmental assessment reports must be fully disclosed to the receiving site owners/authorities/Qualified Person (QP) and they have agreed in writing to receive the material. The chemical testing requirements for various receiving sites is site-specific and additional testing may be required, beyond that provided in this report;
- iii. Transportation and placement of the excess soil is monitored by the environmental consultant to check the material is appropriately placed at the pre-approved site;
- iv. The excavation work, for any amount of excess soil, must be completed in accordance with O. Reg. 406/19 to ensure that all excess excavated material is tested and managed appropriately, and that imported fill material is of suitable quality and meets the SCS applicable to the Site. Re-use of excess excavated soil on-Site is also subject to acceptance for re-use by the geotechnical consultant at the time of construction based on geotechnical considerations.

9. Limitations

Any use which a third party makes of this report, or any reliance on decisions made based on it, is the responsibility of such third parties. G2S accepts no responsibility for damages, if any suffered by any third party as a result of decisions made or actions based on this report. The findings in this report are limited to the conditions within the Site at the time of this investigation as described herein. Conclusions presented in this report should not be construed as legal advice. If Site conditions or applicable standards change or if any additional information becomes available at a future date, changes to the findings, conclusions and recommendations in this report may be necessary.

It should be noted that the soil conditions between and beyond the sampled locations may differ from those encountered during this assignment.

10. Closing Remarks

We trust this report is satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.

Yours truly,

G2S Consulting Inc.



Dana Haslett, B.A.
Senior Project Manager



Melissa King, P.Geo., QP_{ESA}
Head of Environmental Services

Enclosures

Appendix A: Drawings
Appendix B: Borehole Logs
Appendix C: Certificate of Analysis

Appendix A: Drawing

Appendix B: Borehole Logs

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-17 **COMPLETED** 22-3-17 **GROUND ELEVATION** 241.89 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
0.10	TOPSOIL: ~100 mm	241.79		SS1	SPT	2	▲			0/0		
0.76	FILL: Silty sand, brown, some silt, trace organics, moist	241.13										
1	SAND: Brown, trace silt, moist, loose, reworked appearance at top portion			SS2	SPT	5	▲			0/0		
2				SS3	SPT	8	▲			0/0		0 94 6
2.3	occasional silty zones, very moist to wet	239.60		SS4	SPT	13	▲			0/0		
3				SS5	SPT	12	▲			0/0		
3.8		238.08		SS6	SPT	22	▲			0/0		
4	SANDY SILT TILL: Brown, some gravel, trace clay, very moist, dense			SS7	SPT	48				0/0		16 47 29 8
5												
6												
6.1	clay seams	235.79		SS8	SPT	30	▲			0/0		
6.7		235.18										
Borehole terminated at 6.7 m.												Upon completion of augering Cave at 5.2 m

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-16 **COMPLETED** 22-3-16 **GROUND ELEVATION** 244.55 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/BL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
0.15	TOPSOIL: ~150 mm	244.40										
0.76	FILL: Silty sand, brown, some organics, rootlets	243.79		SS1	SPT	2	▲			0/0		
1	SAND: Brown, trace to some silt, moist, compact, medium to fine			SS2	SPT	12	▲			0/0		
2				SS3	SPT	12	▲			0/0		
3				SS4	SPT	20	▲			0/0		
3.1	occasional silt seams	241.50		SS5	SPT	18	▲			0/0		
4				SS6	SPT	23	▲			0/0		
5				SS7	SPT	14	▲			0/0		
5.3	becoming greyish brown, fine	239.22		SS8	SPT	22	▲			0/0		
6				SS9	SPT	19	▲			0/0		
6.7		237.84										

Borehole terminated at 6.7 m.

Water Level Readings:

Date	Depth (m)	Elev. (m)
2022-03-23	Dry	--
2023-03-03	Dry	--

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-16 **COMPLETED** 22-3-16 **GROUND ELEVATION** 243.31 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer X Vane +					
							40 80 120 160		PL MC LL	10 20 30		
0.76	FILL: Silty sand, brown, trace gravel, moist	242.55		SS1	SPT	6	▲		●	0/0		
1	SAND: Brown, some silt, very moist, loose to compact, medium to fine			SS2	SPT	5	▲		●	0/0		
2				SS3	SPT	9	▲		●	0/0		
3				SS4	SPT	26		▲	●	0/0		
4				SS5	SPT	12	▲		●	0/0		
4.6	occasional silty zones, compact to dense	238.74		SS6	SPT	22		▲	●	0/0		
6												
6.7		236.60		SS7	SPT	30		▲	●	0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
No cave
No free water

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-16 **COMPLETED** 22-3-16 **GROUND ELEVATION** 242.60 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer X Vane +					
							40 80 120 160		PL MC LL 10 20 30			
0.76	FILL: Silty sand, brown, trace organics, very moist	241.84		SS1	SPT	4	▲		●	0/0		
1	SAND: Brown, trace silt, moist, loose to compact, medium to fine			SS2	SPT	6	▲		●	0/0		
2				SS3	SPT	8	▲		●	0/0		
3				SS4	SPT	13	▲		●	0/0		
3.1	becoming greyish brown	239.55		SS5	SPT	20	▲		●	0/0		
4												
5				SS6	SPT	25	▲		●	0/0		
6												
6.1	becoming fine with occasional silty zones, wet	236.50		SS7	SPT	29	▲		●	0/0		
6.7		235.89										
Borehole terminated at 6.7 m.												Upon completion of augering No cave No free water

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-16 **COMPLETED** 22-3-16 **GROUND ELEVATION** 241.65 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
0.61	FILL: Silty sand, brown, trace organics, wet	241.04		SS1	SPT	4	▲		●	0/0		
1	POSSIBLE FILL: Sand, brown to yellow, some silt, trace organics, wet, very loose			SS2	SPT	3	▲		●	0/0		
2				SS3	SPT	2	▲		●	0/0		
3				SS4	SPT	3	▲		●	0/0		
3.1		238.60										
3.8	SANDY SILT: Brown, trace clay, very moist, loose	237.84		SS5	SPT	6	▲		●	0/0		0 18 79 3
4												
5	SAND: Brown, medium to fine, wet, compact			SS6	SPT	23	▲		●	0/0		
6				SS7	SPT	19	▲		●	0/0		
6.7		234.94		SS8	SPT	23	▲		●	0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
Cave at 5.2 m

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-17 **COMPLETED** 22-3-17 **GROUND ELEVATION** 240.88 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL									
							N values ▲	CPT values △													
							Undrained Shear Strength (kPa)														
							Pocket Penetrometer X	Vane +													
							40	80	120	160											
					</																

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-17 **COMPLETED** 22-3-17 **GROUND ELEVATION** 241.25 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							10 20 30 40	10 20 30 40				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer X Vane +					
							40 80 120 160		PL MC LL			
									10 20 30			
0.05	GRANULAR: ~50 mm	241.20		SS1	SPT	5	▲			0/0		
0.20	TOPSOIL: ~150 mm	241.05		SS2	SPT	3	▲			0/0		
1	FILL: Sand, brown, trace to some silt, moist to very moist											
2				SS3	SPT	4	▲			0/0		
2.1		239.12										
3	SAND: Light brown, some silt, occasional silt seams, very moist, loose to compact			SS4	SPT	13	▲			0/0		
4				SS5	SPT	14	▲			0/0		
4.6		236.68										
5	SANDY SILT: Brown, wet, loose to compact			SS6	SPT	9	▲			0/0		0 42 56 2
6												
6.1		235.15										
7	SAND: Brown, medium to fine, some silt, trace clay, moist, compact			SS7	SPT	18	▲			0/0		
8				SS8	SPT	16	▲			0/0		0 82 16 2
9												
9.8		231.50		SS9	SPT	22	▲			0/0		
Borehole terminated at 9.8 m.												
										Water Level Readings:		
										Date	Depth (m)	Elev. (m)
										2022-03-23	4.24	237.01
										2023-03-03	4.33	236.92

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-16 **COMPLETED** 22-3-16 **GROUND ELEVATION** 241.74 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values	CPT values				
							10 20 30 40	10 20 30 40				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer Vane					
							40 80 120 160	10 20 30				
0.41	TOPSOIL: ~410 mm	241.33		SS1	SPT	19				0/0		
1	FILL: Silty sand, brown to yellow, trace organics, moist, very loose to loose			SS2	SPT	2				0/0		
1.5		240.22										
2	SAND: Brown, trace to some silt, moist, very loose to loose, reworked appearance at top portion			SS3	SPT	5				0/0		
3				SS4	SPT	8				0/0		
4				SS5	SPT	9				0/0		
4.6	SANDY SILT: Brown, wet, compact	237.17		SS6	SPT	11				0/0		
6.1		235.64										
6.7	SAND: Brown, trace to some silt, wet, compact	235.03		SS7	SPT	18				0/0		
Borehole terminated at 6.7 m.												Upon completion of augering Cave at 5.5 m

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-15 **COMPLETED** 22-3-15 **GROUND ELEVATION** 242.29 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer X Vane +					
							40 80 120 160		PL MC LL 10 20 30			
1	FILL: Silty sand, brown to yellow, trace to some organics, moist			SS1	SPT	2	▲		●	0/0		
1.5		240.77		SS2	SPT	2	▲		●	0/0		
2	SAND: Brown, trace to some silt, moist, loose to compact			SS3	SPT	5	▲		●	0/0		
3				SS4	SPT	11	▲		●	0/0		
4				SS5	SPT	13	▲		●	0/0		
4.6		237.72										
5	SANDY SILT: Brown, trace clay, wet, compact			SS6	SPT	14	▲		●	0/0		
6		236.19										
6.1												
6.7	SAND: Brown, trace silt, very moist, compact	235.58		SS7	SPT	14	▲		●	0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
No cave
No free water

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-15 **COMPLETED** 22-3-15 **GROUND ELEVATION** 243.55 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
0.13	TOPSOIL: ~125 mm	243.43		SS1	SPT	3	▲					
0.76	FILL: Silty sand, brown, trace to some organics, moist	242.79										
1	SAND: Light brown, silt seams, moist to very moist, loose to dense			SS2	SPT	9	▲					
2				SS3	SPT	43		▲				
2.3	occasional wet silt seams / zones	241.26										
3				SS4	SPT	19	▲					
				SS5	SPT	14	▲					
3.8		239.74										
4	SILTY SAND: Brown, medium to fine, trace clay, moist to wet, loose to compact			SS6	SPT	9	▲					
5				SS7	SPT	16	▲					
6												
6.7		236.84		SS8	SPT	28	▲					

Borehole terminated at 6.7 m.

Upon completion of augering
No cave
No free water

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-16 **COMPLETED** 22-3-16 **GROUND ELEVATION** 242.24 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							10 20 30 40	10 20 30 40				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer X Vane +					
							40 80 120 160		PL MC LL			
									10 20 30			
1	FILL: Sand, brown to light brown, trace to some silt, trace organics, very moist			SS1	SPT	7	▲		●	0/0		
1.5		240.72		SS2	SPT	0	▲		●	0/0		
2	POSSIBLE FILL: Sand, brown, trace silt, trace organics, moist, very loose			SS3	SPT	2	▲		●	0/0		
3				SS4	SPT	2	▲		●	0/0		
4	some silt inclusions, wet	238.43		SS5	SPT	1	▲		●	0/0		
4.6		237.67		SS6	SPT	5	▲		●	0/0		
5	SAND: Brown, medium to fine, moist to wet, compact			SS7	SPT	24	▲		●	0/0		
6												
6.7		235.53		SS8	SPT	19	▲		●	0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
No cave
No free water

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-17 **COMPLETED** 22-3-17 **GROUND ELEVATION** 241.71 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
0.08	GRANULAR: ~75 mm	241.64		SS1	SPT	3	▲			0/0		
1	FILL: Sand, Dark brown to brown, some silt, very moist			SS2	SPT	2	▲			0/0		
1.5		240.19										
2	SAND: Light brown, trace to some silt, very moist, loose to compact			SS3	SPT	6	▲			0/0		
3				SS4	SPT	19	▲			0/0		
4				SS5	SPT	21	▲			0/0		
3.8	becoming wet, occasional silt seams / zones	237.90		SS6	SPT	17	▲			0/0		
4.6		237.14		SS7	SPT	8	▲			0/0		
5	SANDY SILT: Brown, some clay seams, wet, loose											
6												
6.1		235.61										
6.7	SAND: Brown, trace silt, moist, compact	235.00		SS8	SPT	16	▲			0/0		
Borehole terminated at 6.7 m.												
Upon completion of augering Cave at 4.6 m												

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-16 **COMPLETED** 22-3-16 **GROUND ELEVATION** 241.77 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer X Vane +					
							40 80 120 160		PL MC LL	10 20 30		
0.05	GRANULAR: ~50 mm	241.72		SS1	SPT	6	▲		●	0/0		
0.25	TOPSOIL: ~200 mm	241.52										
	FILL: Sand, brown, some silt, moist											
1				SS2	SPT	2	▲		●	0/0		
2				SS3	SPT	2	▲		●	0/0		
3				SS4	SPT	6	▲		●	0/0		
3.1		238.72										
	SAND: Light brown, trace organics at the top portion, moist to wet, loose to compact, occasional silt seams / zones			SS5	SPT	8	▲		●	0/0		
4				SS6	SPT	13	▲		●	0/0		
5				SS7	SPT	8	▲		●	0/0		
6												
6.7		235.06		SS8	SPT	26	▲		●	0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
Cave at 5.5 m

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-15 **COMPLETED** 22-3-15 **GROUND ELEVATION** 242.89 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
0.23	TOPSOIL: ~225 mm	242.67										
	FILL: Sand, brown, some silt, moist			SS1	SPT	10	▲		●	0/0		
0.76		242.13										
1	becoming wet			SS2	SPT	2	▲		●	0/0		
1.5		241.37										
2	SILTY SAND: Brown to light brown, moist to very moist, compact			SS3	SPT	13	▲		●	0/0		
				SS4	SPT	11	▲		●	0/0		
3				SS5	SPT	16	▲		●	0/0		
4												
5				SS6	SPT	23	▲		●	0/0		
6												
6.7		236.18		SS7	SPT	13	▲		●	0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
No cave
No free water

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-15 **COMPLETED** 22-3-15 **GROUND ELEVATION** 245.01 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values	CPT values				
							10 20 30 40	10 20 30 40				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer Vane					
							40 80 120 160	10 20 30				
0.20	TOPSOIL: ~200 mm	244.81		SS1	SPT	3	▲		●	0/0		
1	FILL: Sand, brown, trace to some silt, some organics, very moist			SS2	SPT	2	▲		●	0/0		
2				SS3	SPT	2	▲		●	0/0		
3				SS4	SPT	2	▲		●	0/0		
3.1		241.96		SS5	SPT	14	▲		●	0/0		
4	SAND: Brown, medium to fine, trace to some silt, moist to very moist, compact to very dense			SS6	SPT	37		▲	●	0/0		
5				SS7	SPT	20	▲		●	0/0		
6												
7				SS8	SPT	17	▲		●	0/0		
8												
8.2		236.78		SS9	SPT	68	>>▲		●	0/0		

Borehole terminated at 8.2 m.

Water Level Readings:

Date	Depth (m)	Elev. (m)
2022-03-23	Dry	--
2023-03-03	Dry	--

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-15 **COMPLETED** 22-3-15 **GROUND ELEVATION** 245.29 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values	CPT values				
							10 20 30 40	10 20 30 40				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer Vane					
							40 80 120 160	10 20 30				
0.25	TOPSOIL: ~250 mm	245.04										
	FILL: Sand, brown to dark brown, some organics, moist	244.53		SS1	SPT	2	▲		●	0/0		
0.76												
1	SAND: Brown, trace to some silt, moist, loose to compact			SS2	SPT	6	▲		●	0/0		
2				SS3	SPT	12	▲		●	0/0		
3				SS4	SPT	17	▲		●	0/0		
3.1	occasional silt seams / zones	242.24										
				SS5	SPT	20	▲		●	0/0		
4												
5				SS6	SPT	21	▲		●	0/0		
6												
6.7		238.58		SS7	SPT	19	▲		●	0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
No cave
No free water

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-23 **COMPLETED** 22-3-23 **GROUND ELEVATION** 240.96 m
DRILLING CONTRACTOR Sonic Soil Sampling Inc. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Pionjar **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/BL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							10 20 30 40					
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer Vane					
							40 80 120 160		PL MC LL			
									10 20 30			
0.20	TOPSOIL: ~200 mm	240.76										
	FILL: Sand, brown, trace to some organics, moist	240.20		SS1	SS					0/0		
1												
	SAND: Brown, trace to some silt, very moist			SS2	SS					0/0		
2												
				SS3	SS					0/0		
3												
				SS4	SS					0/0		
3.1		237.91										

Borehole terminated at 3.1 m.

Upon completion of sampling
No cave
No free water

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-23 **COMPLETED** 22-3-23 **GROUND ELEVATION** 241.02 m
DRILLING CONTRACTOR Sonic Soil Sampling Inc. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Pionjar **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/BL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							10 20 30 40					
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer Vane					
							40 80 120 160		PL MC LL			
									10 20 30			
0.23	TOPSOIL: ~225 mm	240.80										
	FILL: Sand, brown, trace to some organics, moist	240.26		SS1	SS					0/1		
1												
	SAND: Brown, trace to some silt, very moist, reworked appearance at top portion			SS2	SS					0/1		
2												
				SS3	SS					0/1		
3												
				SS4	SS					0/0		
3.1		237.97										

Borehole terminated at 3.1 m.

Upon completion of sampling
No cave
No free water

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-23 **COMPLETED** 22-3-23 **GROUND ELEVATION** 241.12 m
DRILLING CONTRACTOR Sonic Soil Sampling Inc. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Pionjar **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/BL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer X					
							Vane +					
							40	80	120	160		
									PL	MC	LL	
									10	20	30	
1	FILL: Sand, dark brown to brown, some silt, trace organics, moist	240.28		SS1	SS							
1												
2	SAND: Brown, trace to some silt, occasional silt seams, moist, reworked appearance at top portion			SS2	SS							
2												
2				SS3	SS							
2												
3				SS4	SS							
3												
3.1		238.07										

Borehole terminated at 3.1 m.

Upon completion of sampling
No cave
No free water

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-23 **COMPLETED** 22-3-23 **GROUND ELEVATION** 241.15 m
DRILLING CONTRACTOR Sonic Soil Sampling Inc. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Pionjar **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							10 20 30 40					
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer X Vane +					
							40 80 120 160		PL MC LL			
									10 20 30			
1	FILL: Sand, dark brown to brown, some silt, trace organics, very moist			SS1	SS					0/0		
1.5		239.63		SS2	SS					0/0		
2	SAND: Brown, some silt, occasional silt seams / zones, very moist, reworked appearance at top portion			SS3	SS					0/0		
3		238.10		SS4	SS					0/0		
3.1												

Borehole terminated at 3.1 m.

Upon completion of sampling
No cave
No free water

Appendix C: Certificate of Analysis

Certificate of Analysis

G2S Environmental Consulting Inc. (Burlington)

4361 Harvester Road, Unit 12

Burlington, ON L7L 5M4

Attn: Dana Haslett

Client PO: Charles Street

Project: G2S22008B

Custody:

Report Date: 13-Feb-2023

Order Date: 18-Mar-2022

Revised Report

Order #: 2212529

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
2212529-01	BH101 SS2
2212529-02	BH102 SS2
2212529-03	BH103 SS1
2212529-04	BH107 SS1
2212529-05	BH111 SS2
2212529-06	BH114 SS1
2212529-07	BH116 SS1

Approved By:



Alex Enfield, MSc

Lab Manager

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	22-Mar-22	23-Mar-22
PHC F1	CWS Tier 1 - P&T GC-FID	22-Mar-22	23-Mar-22
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	21-Mar-22	23-Mar-22
REG 153: Metals by ICP/MS, soil	EPA 6020 - Digestion - ICP-MS	24-Mar-22	24-Mar-22
REG 153: Pesticides, OC	EPA 8081B - GC-ECD	25-Mar-22	25-Mar-22
REG 153: pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	24-Mar-22	24-Mar-22
REG 153: VOCs by P&T GC-MS	EPA 8260 - P&T GC-MS	22-Mar-22	23-Mar-22
Solids, %	CWS Tier 1 - Gravimetric	22-Mar-22	23-Mar-22

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Summary of Criteria Exceedances

(If this page is blank then there are no exceedances)

Only those criteria that a sample exceeds will be highlighted in red

Regulatory Comparison:

Paracel Laboratories has provided regulatory guidelines on this report for informational purposes only and makes no representations or warranties that the data is accurate or reflects the current regulatory values. The user is advised to consult with the appropriate official regulations to evaluate compliance. Sample results that are highlighted have exceeded the selected regulatory limit. Calculated uncertainty estimations have not been applied for determining regulatory exceedances.

Sample	Analyte	MDL / Units	Result	Reg 153/04 -T2 Res/Park, coarse	-
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Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Client ID:	BH101 SS2	BH102 SS2	BH103 SS1	BH107 SS1	Criteria:
Sample Date:	17-Mar-22 12:00	16-Mar-22 12:00	16-Mar-22 12:00	17-Mar-22 09:00	Reg 153/04 -T2
Sample ID:	2212529-01	2212529-02	2212529-03	2212529-04	Res/Park, coarse
Matrix:	Soil	Soil	Soil	Soil	-
MDL/Units					

Physical Characteristics

% Solids	0.1 % by Wt.	95.0	89.8	88.5	85.6	-	-
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General Inorganics

pH	0.05 pH Units	6.87	7.23	-	-	5.00 - 9.00 pH Units	-
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Metals

Antimony	1 ug/g	<1.0	<1.0	-	-	7.5 ug/g	-
Arsenic	1 ug/g	1.7	1.6	-	-	18 ug/g	-
Barium	1 ug/g	8.0	8.5	-	-	390 ug/g	-
Beryllium	0.5 ug/g	<0.5	<0.5	-	-	4 ug/g	-
Boron	5 ug/g	5.7	<5.0	-	-	120 ug/g	-
Cadmium	0.5 ug/g	<0.5	<0.5	-	-	1.2 ug/g	-
Chromium	5 ug/g	5.6	6.3	-	-	160 ug/g	-
Cobalt	1 ug/g	2.0	2.2	-	-	22 ug/g	-
Copper	5 ug/g	5.6	5.6	-	-	140 ug/g	-
Lead	1 ug/g	3.9	4.1	-	-	120 ug/g	-
Molybdenum	1 ug/g	<1.0	<1.0	-	-	6.9 ug/g	-
Nickel	5 ug/g	<5.0	<5.0	-	-	100 ug/g	-
Selenium	1 ug/g	1.3	<1.0	-	-	2.4 ug/g	-
Silver	0.3 ug/g	<0.3	<0.3	-	-	20 ug/g	-
Thallium	1 ug/g	<1.0	<1.0	-	-	1 ug/g	-
Uranium	1 ug/g	<1.0	<1.0	-	-	23 ug/g	-
Vanadium	10 ug/g	16.0	16.7	-	-	86 ug/g	-
Zinc	20 ug/g	<20.0	<20.0	-	-	340 ug/g	-

Volatiles

Acetone	0.5 ug/g	-	<0.50	-	-	16 ug/g	-
Benzene	0.02 ug/g	-	<0.02	-	-	0.21 ug/g	-

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Client ID:	BH101 SS2	BH102 SS2	BH103 SS1	BH107 SS1	Criteria:
Sample Date:	17-Mar-22 12:00	16-Mar-22 12:00	16-Mar-22 12:00	17-Mar-22 09:00	Reg 153/04 -T2
Sample ID:	2212529-01	2212529-02	2212529-03	2212529-04	Res/Park, coarse
Matrix:	Soil	Soil	Soil	Soil	-
MDL/Units					

Volatiles

Bromodichloromethane	0.05 ug/g	-	<0.05	-	-	1.5 ug/g	-
Bromoform	0.05 ug/g	-	<0.05	-	-	0.27 ug/g	-
Bromomethane	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	-
Carbon Tetrachloride	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	-
Chlorobenzene	0.05 ug/g	-	<0.05	-	-	2.4 ug/g	-
Chloroform	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	-
Dibromochloromethane	0.05 ug/g	-	<0.05	-	-	2.3 ug/g	-
Dichlorodifluoromethane	0.05 ug/g	-	<0.05	-	-	16 ug/g	-
1,2-Dichlorobenzene	0.05 ug/g	-	<0.05	-	-	1.2 ug/g	-
1,3-Dichlorobenzene	0.05 ug/g	-	<0.05	-	-	4.8 ug/g	-
1,4-Dichlorobenzene	0.05 ug/g	-	<0.05	-	-	0.083 ug/g	-
1,1-Dichloroethane	0.05 ug/g	-	<0.05	-	-	0.47 ug/g	-
1,2-Dichloroethane	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	-
1,1-Dichloroethylene	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	-
cis-1,2-Dichloroethylene	0.05 ug/g	-	<0.05	-	-	1.9 ug/g	-
trans-1,2-Dichloroethylene	0.05 ug/g	-	<0.05	-	-	0.084 ug/g	-
1,2-Dichloropropane	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	-
cis-1,3-Dichloropropylene	0.05 ug/g	-	<0.05	-	-	-	-
trans-1,3-Dichloropropylene	0.05 ug/g	-	<0.05	-	-	-	-
1,3-Dichloropropene, total	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	-
Ethylbenzene	0.05 ug/g	-	<0.05	-	-	1.1 ug/g	-
Ethylene dibromide (dibromoethane,	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	-
Hexane	0.05 ug/g	-	<0.05	-	-	2.8 ug/g	-
Methyl Ethyl Ketone (2-Butanone)	0.5 ug/g	-	<0.50	-	-	16 ug/g	-
Methyl Isobutyl Ketone	0.5 ug/g	-	<0.50	-	-	1.7 ug/g	-

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Client ID:	BH101 SS2	BH102 SS2	BH103 SS1	BH107 SS1	Criteria:
Sample Date:	17-Mar-22 12:00	16-Mar-22 12:00	16-Mar-22 12:00	17-Mar-22 09:00	Reg 153/04 -T2
Sample ID:	2212529-01	2212529-02	2212529-03	2212529-04	Res/Park, coarse
Matrix:	Soil	Soil	Soil	Soil	-
MDL/Units					

Volatiles

Methyl tert-butyl ether	0.05 ug/g	-	<0.05	-	-	0.75 ug/g	-
Methylene Chloride	0.05 ug/g	-	<0.05	-	-	0.1 ug/g	-
Styrene	0.05 ug/g	-	<0.05	-	-	0.7 ug/g	-
1,1,1,2-Tetrachloroethane	0.05 ug/g	-	<0.05	-	-	0.058 ug/g	-
1,1,2,2-Tetrachloroethane	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	-
Tetrachloroethylene	0.05 ug/g	-	<0.05	-	-	0.28 ug/g	-
Toluene	0.05 ug/g	-	<0.05	-	-	2.3 ug/g	-
1,1,1-Trichloroethane	0.05 ug/g	-	<0.05	-	-	0.38 ug/g	-
1,1,2-Trichloroethane	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	-
Trichloroethylene	0.05 ug/g	-	<0.05	-	-	0.061 ug/g	-
Trichlorofluoromethane	0.05 ug/g	-	<0.05	-	-	4 ug/g	-
Vinyl chloride	0.02 ug/g	-	<0.02	-	-	0.02 ug/g	-
m,p-Xylenes	0.05 ug/g	-	<0.05	-	-	-	-
o-Xylene	0.05 ug/g	-	<0.05	-	-	-	-
Xylenes, total	0.05 ug/g	-	<0.05	-	-	3.1 ug/g	-
Toluene-d8	Surrogate	-	106%	-	-	-	-
4-Bromofluorobenzene	Surrogate	-	99.9%	-	-	-	-
Dibromofluoromethane	Surrogate	-	91.9%	-	-	-	-
Benzene	0.02 ug/g	<0.02	-	-	-	0.21 ug/g	-
Ethylbenzene	0.05 ug/g	<0.05	-	-	-	1.1 ug/g	-
Toluene	0.05 ug/g	<0.05	-	-	-	2.3 ug/g	-
m,p-Xylenes	0.05 ug/g	<0.05	-	-	-	-	-
o-Xylene	0.05 ug/g	<0.05	-	-	-	-	-
Xylenes, total	0.05 ug/g	<0.05	-	-	-	3.1 ug/g	-
Toluene-d8	Surrogate	104%	-	-	-	-	-

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Client ID:	BH101 SS2	BH102 SS2	BH103 SS1	BH107 SS1	Criteria:
Sample Date:	17-Mar-22 12:00	16-Mar-22 12:00	16-Mar-22 12:00	17-Mar-22 09:00	Reg 153/04 -T2
Sample ID:	2212529-01	2212529-02	2212529-03	2212529-04	Res/Park, coarse
Matrix:	Soil	Soil	Soil	Soil	-
MDL/Units					

Hydrocarbons

F1 PHCs (C6-C10)	7 ug/g	<7	<7	-	-	55 ug/g	-
F2 PHCs (C10-C16)	4 ug/g	<4	<4	-	-	98 ug/g	-
F3 PHCs (C16-C34)	8 ug/g	<8	<8	-	-	300 ug/g	-
F4 PHCs (C34-C50)	6 ug/g	<6	<6	-	-	2800 ug/g	-

Pesticides, OC

Aldrin	0.01 ug/g	-	-	<0.01	<0.01	0.05 ug/g	-
gamma-BHC (Lindane)	0.01 ug/g	-	-	<0.01	<0.01	0.056 ug/g	-
alpha-Chlordane	0.01 ug/g	-	-	<0.01	<0.01	-	-
gamma-Chlordane	0.01 ug/g	-	-	<0.01	0.03	-	-
Chlordane	0.01 ug/g	-	-	<0.01	<0.01	0.05 ug/g	-
o,p'-DDD	0.01 ug/g	-	-	<0.01	<0.01	-	-
p,p'-DDD	0.02 ug/g	-	-	<0.02	<0.02	-	-
DDD	0.02 ug/g	-	-	<0.02	<0.02	3.3 ug/g	-
o,p'-DDE	0.01 ug/g	-	-	<0.01	<0.01	-	-
p,p'-DDE	0.01 ug/g	-	-	<0.01	0.03	-	-
DDE	0.01 ug/g	-	-	<0.01	0.03	0.26 ug/g	-
o,p'-DDT	0.01 ug/g	-	-	<0.01	<0.01	-	-
p,p'-DDT	0.01 ug/g	-	-	<0.01	<0.01	-	-
DDT	0.01 ug/g	-	-	<0.01	<0.01	1.4 ug/g	-
Dieldrin	0.02 ug/g	-	-	<0.02	<0.02	0.05 ug/g	-
Endrin	0.02 ug/g	-	-	<0.02	<0.02	0.04 ug/g	-
Endosulfan I	0.01 ug/g	-	-	<0.01	<0.01	-	-
Endosulfan II	0.02 ug/g	-	-	<0.02	<0.02	-	-
Endosulfan I/II	0.02 ug/g	-	-	<0.02	<0.02	0.04 ug/g	-
Heptachlor	0.01 ug/g	-	-	<0.01	<0.01	0.15 ug/g	-

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Client ID:	BH101 SS2	BH102 SS2	BH103 SS1	BH107 SS1	Criteria:
Sample Date:	17-Mar-22 12:00	16-Mar-22 12:00	16-Mar-22 12:00	17-Mar-22 09:00	Reg 153/04 -T2
Sample ID:	2212529-01	2212529-02	2212529-03	2212529-04	Res/Park, coarse
Matrix:	Soil	Soil	Soil	Soil	-
MDL/Units					

Pesticides, OC

Heptachlor epoxide	0.01 ug/g	-	-	<0.01	<0.01	0.05 ug/g	-
Hexachlorobenzene	0.01 ug/g	-	-	<0.01	<0.01	0.52 ug/g	-
Hexachlorobutadiene	0.01 ug/g	-	-	<0.01	<0.01	0.012 ug/g	-
Hexachloroethane	0.01 ug/g	-	-	<0.01	<0.01	0.089 ug/g	-
Methoxychlor	0.01 ug/g	-	-	<0.01	<0.01	0.13 ug/g	-
Decachlorobiphenyl	Surrogate	-	-	56.6%	55.2%	-	-

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Client ID:	BH111 SS2	BH114 SS1	BH116 SS1		Criteria:
Sample Date:	16-Mar-22 09:00	15-Mar-22 12:00	15-Mar-22 09:00		Reg 153/04 -T2
Sample ID:	2212529-05	2212529-06	2212529-07		Res/Park, coarse
Matrix:	Soil	Soil	Soil		-
MDL/Units					

Physical Characteristics

% Solids	0.1 % by Wt.	96.4	75.6	89.2	-	-
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General Inorganics

pH	0.05 pH Units	7.31	-	-	-	5.00 - 9.00 pH Units
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Metals

Antimony	1 ug/g	<1.0	-	-	-	7.5 ug/g	-
Arsenic	1 ug/g	2.1	-	-	-	18 ug/g	-
Barium	1 ug/g	9.8	-	-	-	390 ug/g	-
Beryllium	0.5 ug/g	<0.5	-	-	-	4 ug/g	-
Boron	5 ug/g	5.3	-	-	-	120 ug/g	-
Cadmium	0.5 ug/g	<0.5	-	-	-	1.2 ug/g	-
Chromium	5 ug/g	6.3	-	-	-	160 ug/g	-
Cobalt	1 ug/g	2.3	-	-	-	22 ug/g	-
Copper	5 ug/g	8.3	-	-	-	140 ug/g	-
Lead	1 ug/g	5.1	-	-	-	120 ug/g	-
Molybdenum	1 ug/g	<1.0	-	-	-	6.9 ug/g	-
Nickel	5 ug/g	<5.0	-	-	-	100 ug/g	-
Selenium	1 ug/g	<1.0	-	-	-	2.4 ug/g	-
Silver	0.3 ug/g	<0.3	-	-	-	20 ug/g	-
Thallium	1 ug/g	<1.0	-	-	-	1 ug/g	-
Uranium	1 ug/g	<1.0	-	-	-	23 ug/g	-
Vanadium	10 ug/g	14.5	-	-	-	86 ug/g	-
Zinc	20 ug/g	31.4	-	-	-	340 ug/g	-

Volatiles

Acetone	0.5 ug/g	<0.50	-	-	-	16 ug/g	-
Benzene	0.02 ug/g	<0.02	-	-	-	0.21 ug/g	-

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Client ID:	BH111 SS2	BH114 SS1	BH116 SS1		Criteria:
Sample Date:	16-Mar-22 09:00	15-Mar-22 12:00	15-Mar-22 09:00		Reg 153/04 -T2
Sample ID:	2212529-05	2212529-06	2212529-07		Res/Park, coarse
Matrix:	Soil	Soil	Soil		-
MDL/Units					

Volatiles

Bromodichloromethane	0.05 ug/g	<0.05	-	-	-	1.5 ug/g	-
Bromoform	0.05 ug/g	<0.05	-	-	-	0.27 ug/g	-
Bromomethane	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	-
Carbon Tetrachloride	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	-
Chlorobenzene	0.05 ug/g	<0.05	-	-	-	2.4 ug/g	-
Chloroform	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	-
Dibromochloromethane	0.05 ug/g	<0.05	-	-	-	2.3 ug/g	-
Dichlorodifluoromethane	0.05 ug/g	<0.05	-	-	-	16 ug/g	-
1,2-Dichlorobenzene	0.05 ug/g	<0.05	-	-	-	1.2 ug/g	-
1,3-Dichlorobenzene	0.05 ug/g	<0.05	-	-	-	4.8 ug/g	-
1,4-Dichlorobenzene	0.05 ug/g	<0.05	-	-	-	0.083 ug/g	-
1,1-Dichloroethane	0.05 ug/g	<0.05	-	-	-	0.47 ug/g	-
1,2-Dichloroethane	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	-
1,1-Dichloroethylene	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	-
cis-1,2-Dichloroethylene	0.05 ug/g	<0.05	-	-	-	1.9 ug/g	-
trans-1,2-Dichloroethylene	0.05 ug/g	<0.05	-	-	-	0.084 ug/g	-
1,2-Dichloropropane	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	-
cis-1,3-Dichloropropylene	0.05 ug/g	<0.05	-	-	-	-	-
trans-1,3-Dichloropropylene	0.05 ug/g	<0.05	-	-	-	-	-
1,3-Dichloropropene, total	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	-
Ethylene dibromide (dibromoethane,	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	-
Ethylbenzene	0.05 ug/g	<0.05	-	-	-	1.1 ug/g	-
Hexane	0.05 ug/g	<0.05	-	-	-	2.8 ug/g	-
Methyl Ethyl Ketone (2-Butanone)	0.5 ug/g	<0.50	-	-	-	16 ug/g	-
Methyl Isobutyl Ketone	0.5 ug/g	<0.50	-	-	-	1.7 ug/g	-

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Client ID:	BH111 SS2	BH114 SS1	BH116 SS1		Criteria:
Sample Date:	16-Mar-22 09:00	15-Mar-22 12:00	15-Mar-22 09:00		Reg 153/04 -T2
Sample ID:	2212529-05	2212529-06	2212529-07		Res/Park, coarse
Matrix:	Soil	Soil	Soil		-
MDL/Units					

Volatiles

Methyl tert-butyl ether	0.05 ug/g	<0.05	-	-	-	0.75 ug/g	-
Methylene Chloride	0.05 ug/g	<0.05	-	-	-	0.1 ug/g	-
Styrene	0.05 ug/g	<0.05	-	-	-	0.7 ug/g	-
1,1,1,2-Tetrachloroethane	0.05 ug/g	<0.05	-	-	-	0.058 ug/g	-
1,1,2,2-Tetrachloroethane	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	-
Tetrachloroethylene	0.05 ug/g	<0.05	-	-	-	0.28 ug/g	-
Toluene	0.05 ug/g	<0.05	-	-	-	2.3 ug/g	-
1,1,1-Trichloroethane	0.05 ug/g	<0.05	-	-	-	0.38 ug/g	-
1,1,2-Trichloroethane	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	-
Trichloroethylene	0.05 ug/g	<0.05	-	-	-	0.061 ug/g	-
Trichlorofluoromethane	0.05 ug/g	<0.05	-	-	-	4 ug/g	-
Vinyl chloride	0.02 ug/g	<0.02	-	-	-	0.02 ug/g	-
m,p-Xylenes	0.05 ug/g	<0.05	-	-	-	-	-
o-Xylene	0.05 ug/g	<0.05	-	-	-	-	-
Xylenes, total	0.05 ug/g	<0.05	-	-	-	3.1 ug/g	-
4-Bromofluorobenzene	Surrogate	102%	-	-	-	-	-
Dibromofluoromethane	Surrogate	91.5%	-	-	-	-	-
Toluene-d8	Surrogate	104%	-	-	-	-	-

Hydrocarbons

F1 PHCs (C6-C10)	7 ug/g	<7	-	-	-	55 ug/g	-
F2 PHCs (C10-C16)	4 ug/g	<4	-	-	-	98 ug/g	-
F3 PHCs (C16-C34)	8 ug/g	<8	-	-	-	300 ug/g	-
F4 PHCs (C34-C50)	6 ug/g	<6	-	-	-	2800 ug/g	-

Pesticides, OC

Aldrin	0.01 ug/g	-	<0.01	<0.01	-	0.05 ug/g	-
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Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Client ID:	BH111 SS2	BH114 SS1	BH116 SS1		Criteria:
Sample Date:	16-Mar-22 09:00	15-Mar-22 12:00	15-Mar-22 09:00		Reg 153/04 -T2
Sample ID:	2212529-05	2212529-06	2212529-07		Res/Park, coarse
Matrix:	Soil	Soil	Soil		-
MDL/Units					

Pesticides, OC

gamma-BHC (Lindane)	0.01 ug/g	-	<0.01	<0.01	-	0.056 ug/g	-
alpha-Chlordane	0.01 ug/g	-	<0.01	<0.01	-	-	-
gamma-Chlordane	0.01 ug/g	-	<0.01	<0.01	-	-	-
Chlordane	0.01 ug/g	-	<0.01	<0.01	-	0.05 ug/g	-
o,p'-DDD	0.01 ug/g	-	<0.01	<0.01	-	-	-
p,p'-DDD	0.02 ug/g	-	<0.02	<0.02	-	-	-
DDD	0.02 ug/g	-	<0.02	<0.02	-	3.3 ug/g	-
o,p'-DDE	0.01 ug/g	-	<0.01	<0.01	-	-	-
p,p'-DDE	0.01 ug/g	-	<0.01	0.01	-	-	-
DDE	0.01 ug/g	-	<0.01	0.01	-	0.26 ug/g	-
o,p'-DDT	0.01 ug/g	-	<0.01	<0.01	-	-	-
p,p'-DDT	0.01 ug/g	-	<0.01	<0.01	-	-	-
DDT	0.01 ug/g	-	<0.01	<0.01	-	1.4 ug/g	-
Dieldrin	0.02 ug/g	-	<0.02	<0.02	-	0.05 ug/g	-
Endrin	0.02 ug/g	-	<0.02	<0.02	-	0.04 ug/g	-
Endosulfan I	0.01 ug/g	-	<0.01	<0.01	-	-	-
Endosulfan II	0.02 ug/g	-	<0.02	<0.02	-	-	-
Endosulfan I/II	0.02 ug/g	-	<0.02	<0.02	-	0.04 ug/g	-
Heptachlor	0.01 ug/g	-	<0.01	<0.01	-	0.15 ug/g	-
Heptachlor epoxide	0.01 ug/g	-	<0.01	<0.01	-	0.05 ug/g	-
Hexachlorobenzene	0.01 ug/g	-	<0.01	<0.01	-	0.52 ug/g	-
Hexachlorobutadiene	0.01 ug/g	-	<0.01	<0.01	-	0.012 ug/g	-
Hexachloroethane	0.01 ug/g	-	<0.01	<0.01	-	0.089 ug/g	-
Methoxychlor	0.01 ug/g	-	<0.01	<0.01	-	0.13 ug/g	-
Decachlorobiphenyl	Surrogate	-	59.3%	61.5%	-	-	-

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons								
F1 PHCs (C6-C10)	ND	7	ug/g					
F2 PHCs (C10-C16)	ND	4	ug/g					
F3 PHCs (C16-C34)	ND	8	ug/g					
F4 PHCs (C34-C50)	ND	6	ug/g					
Metals								
Antimony	ND	1.0	ug/g					
Arsenic	ND	1.0	ug/g					
Barium	ND	1.0	ug/g					
Beryllium	ND	0.5	ug/g					
Boron	ND	5.0	ug/g					
Cadmium	ND	0.5	ug/g					
Chromium	ND	5.0	ug/g					
Cobalt	ND	1.0	ug/g					
Copper	ND	5.0	ug/g					
Lead	ND	1.0	ug/g					
Molybdenum	ND	1.0	ug/g					
Nickel	ND	5.0	ug/g					
Selenium	ND	1.0	ug/g					
Silver	ND	0.3	ug/g					
Thallium	ND	1.0	ug/g					
Uranium	ND	1.0	ug/g					
Vanadium	ND	10.0	ug/g					
Zinc	ND	20.0	ug/g					
Pesticides, OC								
Aldrin	ND	0.01	ug/g					
gamma-BHC (Lindane)	ND	0.01	ug/g					
alpha-Chlordane	ND	0.01	ug/g					
gamma-Chlordane	ND	0.01	ug/g					
Chlordane	ND	0.01	ug/g					
o,p'-DDD	ND	0.01	ug/g					
p,p'-DDD	ND	0.02	ug/g					
DDD	ND	0.02	ug/g					

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
o,p'-DDE	ND	0.01	ug/g					
p,p'-DDE	ND	0.01	ug/g					
DDE	ND	0.01	ug/g					
o,p'-DDT	ND	0.01	ug/g					
p,p'-DDT	ND	0.01	ug/g					
DDT	ND	0.01	ug/g					
Dieldrin	ND	0.02	ug/g					
Endrin	ND	0.02	ug/g					
Endosulfan I	ND	0.01	ug/g					
Endosulfan II	ND	0.02	ug/g					
Endosulfan I/II	ND	0.02	ug/g					
Heptachlor	ND	0.01	ug/g					
Heptachlor epoxide	ND	0.01	ug/g					
Hexachlorobenzene	ND	0.01	ug/g					
Hexachlorobutadiene	ND	0.01	ug/g					
Hexachloroethane	ND	0.01	ug/g					
Methoxychlor	ND	0.01	ug/g					
Surrogate: Decachlorobiphenyl	0.0506		ug/g	50.6	50-140			
Volatiles								
Acetone	ND	0.50	ug/g					
Benzene	ND	0.02	ug/g					
Bromodichloromethane	ND	0.05	ug/g					
Bromoform	ND	0.05	ug/g					
Bromomethane	ND	0.05	ug/g					
Carbon Tetrachloride	ND	0.05	ug/g					
Chlorobenzene	ND	0.05	ug/g					
Chloroform	ND	0.05	ug/g					
Dibromochloromethane	ND	0.05	ug/g					
Dichlorodifluoromethane	ND	0.05	ug/g					
1,2-Dichlorobenzene	ND	0.05	ug/g					
1,3-Dichlorobenzene	ND	0.05	ug/g					
1,4-Dichlorobenzene	ND	0.05	ug/g					

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
1,1-Dichloroethane	ND	0.05	ug/g					
1,2-Dichloroethane	ND	0.05	ug/g					
1,1-Dichloroethylene	ND	0.05	ug/g					
cis-1,2-Dichloroethylene	ND	0.05	ug/g					
trans-1,2-Dichloroethylene	ND	0.05	ug/g					
1,2-Dichloropropane	ND	0.05	ug/g					
cis-1,3-Dichloropropylene	ND	0.05	ug/g					
trans-1,3-Dichloropropylene	ND	0.05	ug/g					
1,3-Dichloropropene, total	ND	0.05	ug/g					
Ethylbenzene	ND	0.05	ug/g					
Ethylene dibromide (dibromoethane, 1,2-)	ND	0.05	ug/g					
Hexane	ND	0.05	ug/g					
Methyl Ethyl Ketone (2-Butanone)	ND	0.50	ug/g					
Methyl Isobutyl Ketone	ND	0.50	ug/g					
Methyl tert-butyl ether	ND	0.05	ug/g					
Methylene Chloride	ND	0.05	ug/g					
Styrene	ND	0.05	ug/g					
1,1,1,2-Tetrachloroethane	ND	0.05	ug/g					
1,1,2,2-Tetrachloroethane	ND	0.05	ug/g					
Tetrachloroethylene	ND	0.05	ug/g					
Toluene	ND	0.05	ug/g					
1,1,1-Trichloroethane	ND	0.05	ug/g					
1,1,2-Trichloroethane	ND	0.05	ug/g					
Trichloroethylene	ND	0.05	ug/g					
Trichlorofluoromethane	ND	0.05	ug/g					
Vinyl chloride	ND	0.02	ug/g					
m,p-Xylenes	ND	0.05	ug/g					
o-Xylene	ND	0.05	ug/g					
Xylenes, total	ND	0.05	ug/g					
Surrogate: 4-Bromofluorobenzene	7.78		ug/g	97.3	50-140			
Surrogate: Dibromofluoromethane	7.56		ug/g	94.6	50-140			
Surrogate: Toluene-d8	8.23		ug/g	103	50-140			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Benzene	ND	0.02	ug/g					
Ethylbenzene	ND	0.05	ug/g					
Toluene	ND	0.05	ug/g					
m,p-Xylenes	ND	0.05	ug/g					
o-Xylene	ND	0.05	ug/g					
Xylenes, total	ND	0.05	ug/g					
Surrogate: Toluene-d8	8.23		ug/g	103	50-140			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
pH	6.17	0.05	pH Units	6.26			1.5	10	
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g	ND			NC	40	
F2 PHCs (C10-C16)	ND	4	ug/g	ND			NC	30	
F3 PHCs (C16-C34)	50	8	ug/g	34			NC	30	
F4 PHCs (C34-C50)	110	6	ug/g	128			14.9	30	
Metals									
Antimony	ND	1.0	ug/g	ND			NC	30	
Arsenic	1.8	1.0	ug/g	1.2			NC	30	
Barium	18.2	1.0	ug/g	15.5			15.8	30	
Beryllium	ND	0.5	ug/g	ND			NC	30	
Boron	9.0	5.0	ug/g	ND			NC	30	
Cadmium	ND	0.5	ug/g	ND			NC	30	
Chromium	7.1	5.0	ug/g	5.8			19.8	30	
Cobalt	2.6	1.0	ug/g	2.1			20.7	30	
Copper	7.2	5.0	ug/g	5.4			28.7	30	
Lead	3.1	1.0	ug/g	2.6			18.4	30	
Molybdenum	ND	1.0	ug/g	ND			NC	30	
Nickel	ND	5.0	ug/g	ND			NC	30	
Selenium	1.2	1.0	ug/g	ND			NC	30	
Silver	ND	0.3	ug/g	ND			NC	30	
Thallium	ND	1.0	ug/g	ND			NC	30	
Uranium	ND	1.0	ug/g	ND			NC	30	
Vanadium	18.0	10.0	ug/g	14.8			19.9	30	
Zinc	ND	20.0	ug/g	ND			NC	30	
Pesticides, OC									
Aldrin	ND	0.01	ug/g	ND			NC	40	
gamma-BHC (Lindane)	ND	0.01	ug/g	ND			NC	40	
alpha-Chlordane	ND	0.01	ug/g	ND			NC	40	
gamma-Chlordane	ND	0.01	ug/g	ND			NC	40	

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
o,p'-DDD	ND	0.01	ug/g	ND			NC	40	
p,p'-DDD	ND	0.02	ug/g	ND			NC	40	
o,p'-DDE	ND	0.01	ug/g	ND			NC	40	
p,p'-DDE	ND	0.01	ug/g	ND			NC	40	
o,p'-DDT	ND	0.01	ug/g	ND			NC	40	
p,p'-DDT	ND	0.01	ug/g	ND			NC	40	
Dieldrin	ND	0.02	ug/g	ND			NC	40	
Endrin	ND	0.02	ug/g	ND			NC	40	
Endosulfan I	ND	0.01	ug/g	ND			NC	40	
Endosulfan II	ND	0.02	ug/g	ND			NC	40	
Heptachlor	ND	0.01	ug/g	ND			NC	40	
Heptachlor epoxide	ND	0.01	ug/g	ND			NC	40	
Hexachlorobenzene	ND	0.01	ug/g	ND			NC	40	
Hexachlorobutadiene	ND	0.01	ug/g	ND			NC	40	
Hexachloroethane	ND	0.01	ug/g	ND			NC	40	
Methoxychlor	ND	0.01	ug/g	ND			NC	40	
Surrogate: Decachlorobiphenyl	0.0702		ug/g		62.2	50-140			
Physical Characteristics									
% Solids	95.0	0.1	% by Wt.	95.0			0.0	25	
Volatiles									
Acetone	ND	0.50	ug/g	ND			NC	50	
Benzene	ND	0.02	ug/g	ND			NC	50	
Bromodichloromethane	ND	0.05	ug/g	ND			NC	50	
Bromoform	ND	0.05	ug/g	ND			NC	50	
Bromomethane	ND	0.05	ug/g	ND			NC	50	
Carbon Tetrachloride	ND	0.05	ug/g	ND			NC	50	
Chlorobenzene	ND	0.05	ug/g	ND			NC	50	
Chloroform	ND	0.05	ug/g	ND			NC	50	
Dibromochloromethane	ND	0.05	ug/g	ND			NC	50	
Dichlorodifluoromethane	ND	0.05	ug/g	ND			NC	50	
1,2-Dichlorobenzene	ND	0.05	ug/g	ND			NC	50	

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
1,3-Dichlorobenzene	ND	0.05	ug/g	ND			NC	50	
1,4-Dichlorobenzene	ND	0.05	ug/g	ND			NC	50	
1,1-Dichloroethane	ND	0.05	ug/g	ND			NC	50	
1,2-Dichloroethane	ND	0.05	ug/g	ND			NC	50	
1,1-Dichloroethylene	ND	0.05	ug/g	ND			NC	50	
cis-1,2-Dichloroethylene	ND	0.05	ug/g	ND			NC	50	
trans-1,2-Dichloroethylene	ND	0.05	ug/g	ND			NC	50	
1,2-Dichloropropane	ND	0.05	ug/g	ND			NC	50	
cis-1,3-Dichloropropylene	ND	0.05	ug/g	ND			NC	50	
trans-1,3-Dichloropropylene	ND	0.05	ug/g	ND			NC	50	
Ethylbenzene	ND	0.05	ug/g	ND			NC	50	
Ethylene dibromide (dibromoethane, 1,2-)	ND	0.05	ug/g	ND			NC	50	
Hexane	ND	0.05	ug/g	ND			NC	50	
Methyl Ethyl Ketone (2-Butanone)	ND	0.50	ug/g	ND			NC	50	
Methyl Isobutyl Ketone	ND	0.50	ug/g	ND			NC	50	
Methyl tert-butyl ether	ND	0.05	ug/g	ND			NC	50	
Methylene Chloride	ND	0.05	ug/g	ND			NC	50	
Styrene	ND	0.05	ug/g	ND			NC	50	
1,1,1,2-Tetrachloroethane	ND	0.05	ug/g	ND			NC	50	
1,1,2,2-Tetrachloroethane	ND	0.05	ug/g	ND			NC	50	
Tetrachloroethylene	ND	0.05	ug/g	ND			NC	50	
Toluene	ND	0.05	ug/g	ND			NC	50	
1,1,1-Trichloroethane	ND	0.05	ug/g	ND			NC	50	
1,1,2-Trichloroethane	ND	0.05	ug/g	ND			NC	50	
Trichloroethylene	ND	0.05	ug/g	ND			NC	50	
Trichlorofluoromethane	ND	0.05	ug/g	ND			NC	50	
Vinyl chloride	ND	0.02	ug/g	ND			NC	50	
m,p-Xylenes	ND	0.05	ug/g	ND			NC	50	
o-Xylene	ND	0.05	ug/g	ND			NC	50	
Surrogate: 4-Bromofluorobenzene	7.80		ug/g		99.0	50-140			
Surrogate: Dibromofluoromethane	7.45		ug/g		94.5	50-140			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Surrogate: Toluene-d8	8.19		ug/g		104	50-140			
Benzene	ND	0.02	ug/g	ND			NC	50	
Ethylbenzene	ND	0.05	ug/g	ND			NC	50	
Toluene	ND	0.05	ug/g	ND			NC	50	
m,p-Xylenes	ND	0.05	ug/g	ND			NC	50	
o-Xylene	ND	0.05	ug/g	ND			NC	50	
Surrogate: Toluene-d8	8.19		ug/g		104	50-140			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	70	7	ug/g	ND	98.4	80-120			
F2 PHCs (C10-C16)	76	4	ug/g	ND	84.6	60-140			
F3 PHCs (C16-C34)	265	8	ug/g	34	115	60-140			
F4 PHCs (C34-C50)	317	6	ug/g	128	130	60-140			
Metals									
Antimony	130	1.0	ug/g	ND	104	70-130			
Arsenic	138	1.0	ug/g	1.2	110	70-130			
Barium	144	1.0	ug/g	15.5	103	70-130			
Beryllium	123	0.5	ug/g	ND	98.6	70-130			
Boron	134	5.0	ug/g	ND	107	70-130			
Cadmium	126	0.5	ug/g	ND	101	70-130			
Chromium	136	5.0	ug/g	5.8	104	70-130			
Cobalt	130	1.0	ug/g	2.1	102	70-130			
Copper	128	5.0	ug/g	5.4	97.9	70-130			
Lead	119	1.0	ug/g	2.6	93.3	70-130			
Molybdenum	133	1.0	ug/g	ND	107	70-130			
Nickel	125	5.0	ug/g	ND	99.9	70-130			
Selenium	130	1.0	ug/g	ND	104	70-130			
Silver	119	0.3	ug/g	ND	95.0	70-130			
Thallium	119	1.0	ug/g	ND	95.1	70-130			
Uranium	129	1.0	ug/g	ND	103	70-130			
Vanadium	149	10.0	ug/g	14.8	107	70-130			
Zinc	136	20.0	ug/g	ND	109	70-130			
Pesticides, OC									
Aldrin	0.22	0.01	ug/g	ND	96.6	50-140			
gamma-BHC (Lindane)	0.21	0.01	ug/g	ND	93.8	50-140			
alpha-Chlordane	0.20	0.01	ug/g	ND	87.0	50-140			
gamma-Chlordane	0.21	0.01	ug/g	ND	94.4	50-140			
o,p'-DDD	0.12	0.01	ug/g	ND	53.7	50-140			
p,p'-DDD	0.15	0.02	ug/g	ND	64.6	50-140			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
o,p'-DDE	0.17	0.01	ug/g	ND	73.3	50-140			
p,p'-DDE	0.20	0.01	ug/g	ND	86.5	50-140			
o,p'-DDT	0.20	0.01	ug/g	ND	86.5	50-140			
p,p'-DDT	0.15	0.01	ug/g	ND	66.5	50-140			
Dieldrin	0.11	0.02	ug/g	ND	52.9	50-140			
Endosulfan I	0.23	0.01	ug/g	ND	102	50-140			
Endosulfan II	0.13	0.02	ug/g	ND	55.5	50-140			
Heptachlor	0.21	0.01	ug/g	ND	95.1	50-140			
Heptachlor epoxide	0.19	0.01	ug/g	ND	83.4	50-140			
Hexachlorobenzene	0.21	0.01	ug/g	ND	94.1	50-140			
Hexachlorobutadiene	0.22	0.01	ug/g	ND	96.7	50-140			
Hexachloroethane	0.23	0.01	ug/g	ND	103	50-140			
Methoxychlor	0.13	0.01	ug/g	ND	58.8	50-140			
Surrogate: Decachlorobiphenyl	0.0640		ug/g		56.6	50-140			
Volatiles									
Acetone	8.56	0.50	ug/g	ND	85.6	50-140			
Benzene	3.26	0.02	ug/g	ND	81.0	60-130			
Bromodichloromethane	3.19	0.05	ug/g	ND	79.4	60-130			
Bromoform	3.45	0.05	ug/g	ND	85.8	60-130			
Bromomethane	3.24	0.05	ug/g	ND	81.1	50-140			
Carbon Tetrachloride	3.05	0.05	ug/g	ND	76.3	60-130			
Chlorobenzene	3.68	0.05	ug/g	ND	91.5	60-130			
Chloroform	3.39	0.05	ug/g	ND	84.4	60-130			
Dibromochloromethane	3.28	0.05	ug/g	ND	82.0	60-130			
Dichlorodifluoromethane	2.91	0.05	ug/g	ND	72.7	50-140			
1,2-Dichlorobenzene	3.58	0.05	ug/g	ND	89.4	60-130			
1,3-Dichlorobenzene	3.64	0.05	ug/g	ND	91.1	60-130			
1,4-Dichlorobenzene	3.70	0.05	ug/g	ND	92.0	60-130			
1,1-Dichloroethane	3.91	0.05	ug/g	ND	97.8	60-130			
1,2-Dichloroethane	3.28	0.05	ug/g	ND	81.7	60-130			
1,1-Dichloroethylene	4.15	0.05	ug/g	ND	104	60-130			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
cis-1,2-Dichloroethylene	3.80	0.05	ug/g	ND	94.5	60-130			
trans-1,2-Dichloroethylene	3.43	0.05	ug/g	ND	85.4	60-130			
1,2-Dichloropropane	3.24	0.05	ug/g	ND	81.0	60-130			
cis-1,3-Dichloropropylene	3.35	0.05	ug/g	ND	83.8	60-130			
trans-1,3-Dichloropropylene	3.45	0.05	ug/g	ND	85.8	60-130			
Ethylbenzene	3.80	0.05	ug/g	ND	94.4	60-130			
Ethylene dibromide (dibromoethane, 1,2-)	3.44	0.05	ug/g	ND	85.5	60-130			
Hexane	3.24	0.05	ug/g	ND	80.9	60-130			
Methyl Ethyl Ketone (2-Butanone)	8.42	0.50	ug/g	ND	84.2	50-140			
Methyl Isobutyl Ketone	8.69	0.50	ug/g	ND	86.9	50-140			
Methyl tert-butyl ether	8.35	0.05	ug/g	ND	83.5	50-140			
Methylene Chloride	4.40	0.05	ug/g	ND	109	60-130			
Styrene	3.99	0.05	ug/g	ND	98.8	60-130			
1,1,1,2-Tetrachloroethane	3.51	0.05	ug/g	ND	87.7	60-130			
1,1,2,2-Tetrachloroethane	3.57	0.05	ug/g	ND	88.8	60-130			
Tetrachloroethylene	3.47	0.05	ug/g	ND	86.4	60-130			
Toluene	3.73	0.05	ug/g	ND	93.2	60-130			
1,1,1-Trichloroethane	3.08	0.05	ug/g	ND	77.0	60-130			
1,1,2-Trichloroethane	3.38	0.05	ug/g	ND	84.0	60-130			
Trichloroethylene	3.15	0.05	ug/g	ND	78.3	60-130			
Trichlorofluoromethane	4.16	0.05	ug/g	ND	104	50-140			
Vinyl chloride	3.59	0.02	ug/g	ND	89.7	50-140			
m,p-Xylenes	7.80	0.05	ug/g	ND	97.3	60-130			
o-Xylene	3.92	0.05	ug/g	ND	97.4	60-130			
Surrogate: 4-Bromofluorobenzene	7.62		ug/g		95.2	50-140			
Surrogate: Dibromofluoromethane	7.78		ug/g		97.3	50-140			
Surrogate: Toluene-d8	8.08		ug/g		101	50-140			
Benzene	3.26	0.02	ug/g	ND	81.0	60-130			
Ethylbenzene	3.80	0.05	ug/g	ND	94.4	60-130			
Toluene	3.73	0.05	ug/g	ND	93.2	60-130			
m,p-Xylenes	7.80	0.05	ug/g	ND	97.3	60-130			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
o-Xylene	3.92	0.05	ug/g	ND	97.4	60-130			
Surrogate: Toluene-d8	8.08		ug/g		101	50-140			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Qualifier Notes:**Login Qualifiers :**

Sample not received in Paracel verified container / media

Applies to Samples: BH102 SS2, BH103 SS1, BH107 SS1, BH111 SS2, BH116 SS1

QC Qualifiers:Sample Data Revisions:

None

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Work Order Revisions / Comments:

Revision-1: Guideline comparisons updated as per client request.

Other Report Notes:

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

Source Result: Data used as source for matrix and duplicate samples

%REC: Percent recovery.

RPD: Relative percent difference.

NC: Not Calculated

Soil results are reported on a dry weight basis unless otherwise noted.

Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.

CCME PHC additional information:

- The method for the analysis of PHCs complies with the Reference Method for the CWS PHC and is validated for use in the laboratory. All prescribed quality criteria identified in the method has been met.
- F1 range corrected for BTEX.
- F2 to F3 ranges corrected for appropriate PAHs where available.
- The gravimetric heavy hydrocarbons (F4G) are not to be added to C6 to C50 hydrocarbons.
- In the case where F4 and F4G are both reported, the greater of the two results is to be used for comparison to CWS PHC criteria.
- When reported, data for F4G has been processed using a silica gel cleanup.

Any use of these results implies your agreement that our total liability in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

Certificate of Analysis

G2S Environmental Consulting Inc. (Burlington)

4361 Harvester Road, Unit 12

Burlington, ON L7L 5M4

Attn: Dana Haslett

Client PO:

Project: G2S22008- Charles St

Custody:

Report Date: 13-Feb-2023

Order Date: 24-Mar-2022

Revised Report

Order #: 2213488

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
2213488-01	BH117 SS1
2213488-02	BH118 SS1
2213488-03	BH119 SS1

Approved By:



Milan Ralitsch, PhD

Senior Technical Manager

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	25-Mar-22	28-Mar-22
PHC F1	CWS Tier 1 - P&T GC-FID	25-Mar-22	28-Mar-22
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	25-Mar-22	28-Mar-22
REG 153: Metals by ICP/MS, soil	EPA 6020 - Digestion - ICP-MS	25-Mar-22	25-Mar-22
REG 153: pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	29-Mar-22	29-Mar-22
REG 153: VOCs by P&T GC-MS	EPA 8260 - P&T GC-MS	25-Mar-22	28-Mar-22
Solids, %	CWS Tier 1 - Gravimetric	25-Mar-22	28-Mar-22

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Summary of Criteria Exceedances

(If this page is blank then there are no exceedances)

Only those criteria that a sample exceeds will be highlighted in red

Regulatory Comparison:

Paracel Laboratories has provided regulatory guidelines on this report for informational purposes only and makes no representations or warranties that the data is accurate or reflects the current regulatory values. The user is advised to consult with the appropriate official regulations to evaluate compliance. Sample results that are highlighted have exceeded the selected regulatory limit. Calculated uncertainty estimations have not been applied for determining regulatory exceedances.

Sample	Analyte	MDL / Units	Result	Reg 153/04 -T2 Res/Park, coarse	-
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Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Client ID:	BH117 SS1	BH118 SS1	BH119 SS1	-	Criteria:
Sample Date:	23-Mar-22 00:00	23-Mar-22 00:00	23-Mar-22 00:00	-	Reg 153/04 -T2
Sample ID:	2213488-01	2213488-02	2213488-03	-	Res/Park, coarse
Matrix:	Soil	Soil	Soil	-	
MDL/Units					

Physical Characteristics

% Solids	0.1 % by Wt.	90.9	79.3	90.0	-	-
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General Inorganics

pH	0.05 pH Units	7.47	7.20	7.09	-	5.00 - 9.00 pH Units
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Metals

Antimony	1 ug/g	<1.0	<1.0	<1.0	-	7.5 ug/g
Arsenic	1 ug/g	1.4	3.0	2.6	-	18 ug/g
Barium	1 ug/g	13.2	53.2	37.3	-	390 ug/g
Beryllium	0.5 ug/g	<0.5	0.6	<0.5	-	4 ug/g
Boron	5 ug/g	<5.0	<5.0	<5.0	-	120 ug/g
Cadmium	0.5 ug/g	<0.5	<0.5	<0.5	-	1.2 ug/g
Chromium	5 ug/g	<5.0	13.5	<5.0	-	160 ug/g
Cobalt	1 ug/g	2.1	4.5	2.5	-	22 ug/g
Copper	5 ug/g	5.6	9.7	<5.0	-	140 ug/g
Lead	1 ug/g	4.4	15.8	11.0	-	120 ug/g
Molybdenum	1 ug/g	<1.0	<1.0	<1.0	-	6.9 ug/g
Nickel	5 ug/g	<5.0	11.0	<5.0	-	100 ug/g
Selenium	1 ug/g	<1.0	<1.0	<1.0	-	2.4 ug/g
Silver	0.3 ug/g	<0.3	<0.3	<0.3	-	20 ug/g
Thallium	1 ug/g	<1.0	<1.0	<1.0	-	1 ug/g
Uranium	1 ug/g	<1.0	<1.0	<1.0	-	23 ug/g
Vanadium	10 ug/g	10.0	21.7	13.3	-	86 ug/g
Zinc	20 ug/g	<20.0	62.9	28.4	-	340 ug/g

Volatiles

Acetone	0.5 ug/g	-	<0.50	<0.50	-	16 ug/g
Benzene	0.02 ug/g	-	<0.02	<0.02	-	0.21 ug/g

Certificate of Analysis

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Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Client ID:	BH117 SS1	BH118 SS1	BH119 SS1	-	Criteria:
Sample Date:	23-Mar-22 00:00	23-Mar-22 00:00	23-Mar-22 00:00	-	Reg 153/04 -T2
Sample ID:	2213488-01	2213488-02	2213488-03	-	Res/Park, coarse
Matrix:	Soil	Soil	Soil	-	
MDL/Units					

Volatiles

Bromodichloromethane	0.05 ug/g	-	<0.05	<0.05	-	1.5 ug/g	-
Bromoform	0.05 ug/g	-	<0.05	<0.05	-	0.27 ug/g	-
Bromomethane	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	-
Carbon Tetrachloride	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	-
Chlorobenzene	0.05 ug/g	-	<0.05	<0.05	-	2.4 ug/g	-
Chloroform	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	-
Dibromochloromethane	0.05 ug/g	-	<0.05	<0.05	-	2.3 ug/g	-
Dichlorodifluoromethane	0.05 ug/g	-	<0.05	<0.05	-	16 ug/g	-
1,2-Dichlorobenzene	0.05 ug/g	-	<0.05	<0.05	-	1.2 ug/g	-
1,3-Dichlorobenzene	0.05 ug/g	-	<0.05	<0.05	-	4.8 ug/g	-
1,4-Dichlorobenzene	0.05 ug/g	-	<0.05	<0.05	-	0.083 ug/g	-
1,1-Dichloroethane	0.05 ug/g	-	<0.05	<0.05	-	0.47 ug/g	-
1,2-Dichloroethane	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	-
1,1-Dichloroethylene	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	-
cis-1,2-Dichloroethylene	0.05 ug/g	-	<0.05	<0.05	-	1.9 ug/g	-
trans-1,2-Dichloroethylene	0.05 ug/g	-	<0.05	<0.05	-	0.084 ug/g	-
1,2-Dichloropropane	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	-
cis-1,3-Dichloropropylene	0.05 ug/g	-	<0.05	<0.05	-	-	-
trans-1,3-Dichloropropylene	0.05 ug/g	-	<0.05	<0.05	-	-	-
1,3-Dichloropropene, total	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	-
Ethylbenzene	0.05 ug/g	-	<0.05	<0.05	-	1.1 ug/g	-
Ethylene dibromide (dibromoethane,	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	-
Hexane	0.05 ug/g	-	<0.05	<0.05	-	2.8 ug/g	-
Methyl Ethyl Ketone (2-Butanone)	0.5 ug/g	-	<0.50	<0.50	-	16 ug/g	-
Methyl Isobutyl Ketone	0.5 ug/g	-	<0.50	<0.50	-	1.7 ug/g	-

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Client ID:	BH117 SS1	BH118 SS1	BH119 SS1	-	Criteria:
Sample Date:	23-Mar-22 00:00	23-Mar-22 00:00	23-Mar-22 00:00	-	Reg 153/04 -T2
Sample ID:	2213488-01	2213488-02	2213488-03	-	Res/Park, coarse
Matrix:	Soil	Soil	Soil	-	
MDL/Units					

Volatiles

Methyl tert-butyl ether	0.05 ug/g	-	<0.05	<0.05	-	0.75 ug/g	-
Methylene Chloride	0.05 ug/g	-	<0.05	<0.05	-	0.1 ug/g	-
Styrene	0.05 ug/g	-	<0.05	<0.05	-	0.7 ug/g	-
1,1,1,2-Tetrachloroethane	0.05 ug/g	-	<0.05	<0.05	-	0.058 ug/g	-
1,1,2,2-Tetrachloroethane	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	-
Tetrachloroethylene	0.05 ug/g	-	<0.05	<0.05	-	0.28 ug/g	-
Toluene	0.05 ug/g	-	<0.05	<0.05	-	2.3 ug/g	-
1,1,1-Trichloroethane	0.05 ug/g	-	<0.05	<0.05	-	0.38 ug/g	-
1,1,2-Trichloroethane	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	-
Trichloroethylene	0.05 ug/g	-	<0.05	<0.05	-	0.061 ug/g	-
Trichlorofluoromethane	0.05 ug/g	-	<0.05	<0.05	-	4 ug/g	-
Vinyl chloride	0.02 ug/g	-	<0.02	<0.02	-	0.02 ug/g	-
m,p-Xylenes	0.05 ug/g	-	<0.05	<0.05	-	-	-
o-Xylene	0.05 ug/g	-	<0.05	<0.05	-	-	-
Xylenes, total	0.05 ug/g	-	<0.05	<0.05	-	3.1 ug/g	-
Dibromofluoromethane	Surrogate	-	102%	90.9%	-	-	-
4-Bromofluorobenzene	Surrogate	-	95.8%	102%	-	-	-
Toluene-d8	Surrogate	-	104%	107%	-	-	-
Benzene	0.02 ug/g	<0.02	-	-	-	0.21 ug/g	-
Ethylbenzene	0.05 ug/g	<0.05	-	-	-	1.1 ug/g	-
Toluene	0.05 ug/g	<0.05	-	-	-	2.3 ug/g	-
m,p-Xylenes	0.05 ug/g	<0.05	-	-	-	-	-
o-Xylene	0.05 ug/g	<0.05	-	-	-	-	-
Xylenes, total	0.05 ug/g	<0.05	-	-	-	3.1 ug/g	-
Toluene-d8	Surrogate	107%	-	-	-	-	-

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Client ID:	BH117 SS1	BH118 SS1	BH119 SS1	-	Criteria:
Sample Date:	23-Mar-22 00:00	23-Mar-22 00:00	23-Mar-22 00:00	-	Reg 153/04 -T2
Sample ID:	2213488-01	2213488-02	2213488-03	-	Res/Park, coarse
Matrix:	Soil	Soil	Soil	-	
MDL/Units					

Hydrocarbons

F1 PHCs (C6-C10)	7 ug/g	<7	<7	<7	-	55 ug/g	-
F2 PHCs (C10-C16)	4 ug/g	<4	<4	<4	-	98 ug/g	-
F3 PHCs (C16-C34)	8 ug/g	<8	64	<8	-	300 ug/g	-
F4 PHCs (C34-C50)	6 ug/g	51	128	39	-	2800 ug/g	-

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons								
F1 PHCs (C6-C10)	ND	7	ug/g					
F2 PHCs (C10-C16)	ND	4	ug/g					
F3 PHCs (C16-C34)	ND	8	ug/g					
F4 PHCs (C34-C50)	ND	6	ug/g					
Metals								
Antimony	ND	1.0	ug/g					
Arsenic	ND	1.0	ug/g					
Barium	ND	1.0	ug/g					
Beryllium	ND	0.5	ug/g					
Boron	ND	5.0	ug/g					
Cadmium	ND	0.5	ug/g					
Chromium	ND	5.0	ug/g					
Cobalt	ND	1.0	ug/g					
Copper	ND	5.0	ug/g					
Lead	ND	1.0	ug/g					
Molybdenum	ND	1.0	ug/g					
Nickel	ND	5.0	ug/g					
Selenium	ND	1.0	ug/g					
Silver	ND	0.3	ug/g					
Thallium	ND	1.0	ug/g					
Uranium	ND	1.0	ug/g					
Vanadium	ND	10.0	ug/g					
Zinc	ND	20.0	ug/g					
Volatiles								
Acetone	ND	0.50	ug/g					
Benzene	ND	0.02	ug/g					
Bromodichloromethane	ND	0.05	ug/g					
Bromoform	ND	0.05	ug/g					
Bromomethane	ND	0.05	ug/g					
Carbon Tetrachloride	ND	0.05	ug/g					
Chlorobenzene	ND	0.05	ug/g					
Chloroform	ND	0.05	ug/g					

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Dibromochloromethane	ND	0.05	ug/g					
Dichlorodifluoromethane	ND	0.05	ug/g					
1,2-Dichlorobenzene	ND	0.05	ug/g					
1,3-Dichlorobenzene	ND	0.05	ug/g					
1,4-Dichlorobenzene	ND	0.05	ug/g					
1,1-Dichloroethane	ND	0.05	ug/g					
1,2-Dichloroethane	ND	0.05	ug/g					
1,1-Dichloroethylene	ND	0.05	ug/g					
cis-1,2-Dichloroethylene	ND	0.05	ug/g					
trans-1,2-Dichloroethylene	ND	0.05	ug/g					
1,2-Dichloropropane	ND	0.05	ug/g					
cis-1,3-Dichloropropylene	ND	0.05	ug/g					
trans-1,3-Dichloropropylene	ND	0.05	ug/g					
1,3-Dichloropropene, total	ND	0.05	ug/g					
Ethylbenzene	ND	0.05	ug/g					
Ethylene dibromide (dibromoethane, 1,2-)	ND	0.05	ug/g					
Hexane	ND	0.05	ug/g					
Methyl Ethyl Ketone (2-Butanone)	ND	0.50	ug/g					
Methyl Isobutyl Ketone	ND	0.50	ug/g					
Methyl tert-butyl ether	ND	0.05	ug/g					
Methylene Chloride	ND	0.05	ug/g					
Styrene	ND	0.05	ug/g					
1,1,1,2-Tetrachloroethane	ND	0.05	ug/g					
1,1,2,2-Tetrachloroethane	ND	0.05	ug/g					
Tetrachloroethylene	ND	0.05	ug/g					
Toluene	ND	0.05	ug/g					
1,1,1-Trichloroethane	ND	0.05	ug/g					
1,1,2-Trichloroethane	ND	0.05	ug/g					
Trichloroethylene	ND	0.05	ug/g					
Trichlorofluoromethane	ND	0.05	ug/g					
Vinyl chloride	ND	0.02	ug/g					
m,p-Xylenes	ND	0.05	ug/g					
o-Xylene	ND	0.05	ug/g					

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Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Xylenes, total	ND	0.05	ug/g					
Surrogate: 4-Bromofluorobenzene	8.28		ug/g	103	50-140			
Surrogate: Dibromofluoromethane	6.56		ug/g	82.0	50-140			
Surrogate: Toluene-d8	8.65		ug/g	108	50-140			
Benzene	ND	0.02	ug/g					
Ethylbenzene	ND	0.05	ug/g					
Toluene	ND	0.05	ug/g					
m,p-Xylenes	ND	0.05	ug/g					
o-Xylene	ND	0.05	ug/g					
Xylenes, total	ND	0.05	ug/g					
Surrogate: Toluene-d8	8.65		ug/g	108	50-140			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
pH	7.43	0.05	pH Units	7.47			0.5	10	
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g	ND			NC	40	
F2 PHCs (C10-C16)	ND	4	ug/g	ND			NC	30	
F3 PHCs (C16-C34)	ND	8	ug/g	ND			NC	30	
F4 PHCs (C34-C50)	ND	6	ug/g	ND			NC	30	
Metals									
Antimony	ND	1.0	ug/g	ND			NC	30	
Arsenic	4.2	1.0	ug/g	3.8			8.2	30	
Barium	28.3	1.0	ug/g	27.7			2.3	30	
Beryllium	ND	0.5	ug/g	ND			NC	30	
Boron	11.1	5.0	ug/g	7.7			NC	30	
Cadmium	ND	0.5	ug/g	ND			NC	30	
Chromium	7.7	5.0	ug/g	7.6			0.7	30	
Cobalt	6.9	1.0	ug/g	6.6			4.1	30	
Copper	18.6	5.0	ug/g	18.3			1.6	30	
Lead	6.7	1.0	ug/g	6.5			3.2	30	
Molybdenum	ND	1.0	ug/g	ND			NC	30	
Nickel	7.4	5.0	ug/g	7.6			2.9	30	
Selenium	1.2	1.0	ug/g	ND			NC	30	
Silver	ND	0.3	ug/g	ND			NC	30	
Thallium	ND	1.0	ug/g	ND			NC	30	
Uranium	ND	1.0	ug/g	ND			NC	30	
Vanadium	18.0	10.0	ug/g	17.8			1.2	30	
Zinc	33.0	20.0	ug/g	32.9			0.1	30	
Physical Characteristics									
% Solids	47.7	0.1	% by Wt.	40.3			16.8	25	
Volatiles									
Acetone	ND	0.50	ug/g	ND			NC	50	
Benzene	ND	0.02	ug/g	ND			NC	50	

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Bromodichloromethane	ND	0.05	ug/g	ND			NC	50	
Bromoform	ND	0.05	ug/g	ND			NC	50	
Bromomethane	ND	0.05	ug/g	ND			NC	50	
Carbon Tetrachloride	ND	0.05	ug/g	ND			NC	50	
Chlorobenzene	ND	0.05	ug/g	ND			NC	50	
Chloroform	ND	0.05	ug/g	ND			NC	50	
Dibromochloromethane	ND	0.05	ug/g	ND			NC	50	
Dichlorodifluoromethane	ND	0.05	ug/g	ND			NC	50	
1,2-Dichlorobenzene	ND	0.05	ug/g	ND			NC	50	
1,3-Dichlorobenzene	ND	0.05	ug/g	ND			NC	50	
1,4-Dichlorobenzene	ND	0.05	ug/g	ND			NC	50	
1,1-Dichloroethane	ND	0.05	ug/g	ND			NC	50	
1,2-Dichloroethane	ND	0.05	ug/g	ND			NC	50	
1,1-Dichloroethylene	ND	0.05	ug/g	ND			NC	50	
cis-1,2-Dichloroethylene	ND	0.05	ug/g	ND			NC	50	
trans-1,2-Dichloroethylene	ND	0.05	ug/g	ND			NC	50	
1,2-Dichloropropane	ND	0.05	ug/g	ND			NC	50	
cis-1,3-Dichloropropylene	ND	0.05	ug/g	ND			NC	50	
trans-1,3-Dichloropropylene	ND	0.05	ug/g	ND			NC	50	
Ethylbenzene	ND	0.05	ug/g	ND			NC	50	
Ethylene dibromide (dibromoethane, 1,2-)	ND	0.05	ug/g	ND			NC	50	
Hexane	ND	0.05	ug/g	ND			NC	50	
Methyl Ethyl Ketone (2-Butanone)	ND	0.50	ug/g	ND			NC	50	
Methyl Isobutyl Ketone	ND	0.50	ug/g	ND			NC	50	
Methyl tert-butyl ether	ND	0.05	ug/g	ND			NC	50	
Methylene Chloride	ND	0.05	ug/g	ND			NC	50	
Styrene	ND	0.05	ug/g	ND			NC	50	
1,1,1,2-Tetrachloroethane	ND	0.05	ug/g	ND			NC	50	
1,1,2,2-Tetrachloroethane	ND	0.05	ug/g	ND			NC	50	
Tetrachloroethylene	ND	0.05	ug/g	ND			NC	50	
Toluene	ND	0.05	ug/g	ND			NC	50	

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
1,1,1-Trichloroethane	ND	0.05	ug/g	ND			NC	50	
1,1,2-Trichloroethane	ND	0.05	ug/g	ND			NC	50	
Trichloroethylene	ND	0.05	ug/g	ND			NC	50	
Trichlorofluoromethane	ND	0.05	ug/g	ND			NC	50	
Vinyl chloride	ND	0.02	ug/g	ND			NC	50	
m,p-Xylenes	ND	0.05	ug/g	ND			NC	50	
o-Xylene	ND	0.05	ug/g	ND			NC	50	
Surrogate: 4-Bromofluorobenzene	8.80		ug/g		105	50-140			
Surrogate: Dibromofluoromethane	6.58		ug/g		78.4	50-140			
Surrogate: Toluene-d8	9.19		ug/g		110	50-140			
Benzene	ND	0.02	ug/g	ND			NC	50	
Ethylbenzene	ND	0.05	ug/g	ND			NC	50	
Toluene	ND	0.05	ug/g	ND			NC	50	
m,p-Xylenes	ND	0.05	ug/g	ND			NC	50	
o-Xylene	ND	0.05	ug/g	ND			NC	50	
Surrogate: Toluene-d8	9.19		ug/g		110	50-140			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	63	7	ug/g	ND	89.7	80-120			
F2 PHCs (C10-C16)	83	4	ug/g	ND	91.9	60-140			
F3 PHCs (C16-C34)	157	8	ug/g	ND	77.7	60-140			
F4 PHCs (C34-C50)	127	6	ug/g	ND	87.2	60-140			
Metals									
Antimony	141	1.0	ug/g	ND	113	70-130			
Arsenic	118	1.0	ug/g	3.8	91.5	70-130			
Barium	146	1.0	ug/g	27.7	95.0	70-130			
Beryllium	121	0.5	ug/g	ND	96.5	70-130			
Boron	133	5.0	ug/g	7.7	100	70-130			
Cadmium	108	0.5	ug/g	ND	86.1	70-130			
Chromium	117	5.0	ug/g	7.6	87.5	70-130			
Cobalt	113	1.0	ug/g	6.6	85.4	70-130			
Copper	125	5.0	ug/g	18.3	85.0	70-130			
Lead	125	1.0	ug/g	6.5	95.2	70-130			
Molybdenum	112	1.0	ug/g	ND	89.4	70-130			
Nickel	111	5.0	ug/g	7.6	83.0	70-130			
Selenium	115	1.0	ug/g	ND	91.7	70-130			
Silver	117	0.3	ug/g	ND	93.4	70-130			
Thallium	118	1.0	ug/g	ND	94.2	70-130			
Uranium	115	1.0	ug/g	ND	92.1	70-130			
Vanadium	127	10.0	ug/g	17.8	87.5	70-130			
Zinc	144	20.0	ug/g	32.9	88.8	70-130			
Volatiles									
Acetone	9.46	0.50	ug/g	ND	94.6	50-140			
Benzene	3.75	0.02	ug/g	ND	93.3	60-130			
Bromodichloromethane	3.68	0.05	ug/g	ND	91.5	60-130			
Bromoform	3.87	0.05	ug/g	ND	96.3	60-130			
Bromomethane	3.53	0.05	ug/g	ND	88.2	50-140			
Carbon Tetrachloride	3.48	0.05	ug/g	ND	86.9	60-130			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Chlorobenzene	4.04	0.05	ug/g	ND	100	60-130			
Chloroform	3.83	0.05	ug/g	ND	95.4	60-130			
Dibromochloromethane	3.62	0.05	ug/g	ND	90.4	60-130			
Dichlorodifluoromethane	3.01	0.05	ug/g	ND	75.3	50-140			
1,2-Dichlorobenzene	3.89	0.05	ug/g	ND	97.2	60-130			
1,3-Dichlorobenzene	3.91	0.05	ug/g	ND	97.7	60-130			
1,4-Dichlorobenzene	3.94	0.05	ug/g	ND	98.0	60-130			
1,1-Dichloroethane	4.38	0.05	ug/g	ND	110	60-130			
1,2-Dichloroethane	3.71	0.05	ug/g	ND	92.2	60-130			
1,1-Dichloroethylene	3.97	0.05	ug/g	ND	99.2	60-130			
cis-1,2-Dichloroethylene	4.30	0.05	ug/g	ND	107	60-130			
trans-1,2-Dichloroethylene	3.85	0.05	ug/g	ND	95.9	60-130			
1,2-Dichloropropane	3.70	0.05	ug/g	ND	92.5	60-130			
cis-1,3-Dichloropropylene	3.81	0.05	ug/g	ND	95.3	60-130			
trans-1,3-Dichloropropylene	3.84	0.05	ug/g	ND	95.5	60-130			
Ethylbenzene	4.12	0.05	ug/g	ND	102	60-130			
Ethylene dibromide (dibromoethane, 1,2-)	3.92	0.05	ug/g	ND	97.4	60-130			
Hexane	3.86	0.05	ug/g	ND	96.6	60-130			
Methyl Ethyl Ketone (2-Butanone)	9.86	0.50	ug/g	ND	98.6	50-140			
Methyl Isobutyl Ketone	10.6	0.50	ug/g	ND	106	50-140			
Methyl tert-butyl ether	9.91	0.05	ug/g	ND	99.1	50-140			
Methylene Chloride	3.62	0.05	ug/g	ND	90.0	60-130			
Styrene	4.30	0.05	ug/g	ND	106	60-130			
1,1,1,2-Tetrachloroethane	4.08	0.05	ug/g	ND	102	60-130			
1,1,2,2-Tetrachloroethane	4.07	0.05	ug/g	ND	101	60-130			
Tetrachloroethylene	3.77	0.05	ug/g	ND	93.8	60-130			
Toluene	4.17	0.05	ug/g	ND	104	60-130			
1,1,1-Trichloroethane	3.68	0.05	ug/g	ND	92.1	60-130			
1,1,2-Trichloroethane	3.94	0.05	ug/g	ND	98.0	60-130			
Trichloroethylene	3.65	0.05	ug/g	ND	90.9	60-130			
Trichlorofluoromethane	3.94	0.05	ug/g	ND	98.4	50-140			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Vinyl chloride	3.42	0.02	ug/g	ND	85.4	50-140			
m,p-Xylenes	8.23	0.05	ug/g	ND	103	60-130			
o-Xylene	4.23	0.05	ug/g	ND	105	60-130			
Surrogate: 4-Bromofluorobenzene	7.64		ug/g		95.5	50-140			
Surrogate: Dibromofluoromethane	7.85		ug/g		98.1	50-140			
Surrogate: Toluene-d8	8.20		ug/g		102	50-140			
Benzene	3.75	0.02	ug/g	ND	93.3	60-130			
Ethylbenzene	4.12	0.05	ug/g	ND	102	60-130			
Toluene	4.17	0.05	ug/g	ND	104	60-130			
m,p-Xylenes	8.23	0.05	ug/g	ND	103	60-130			
o-Xylene	4.23	0.05	ug/g	ND	105	60-130			
Surrogate: Toluene-d8	8.20		ug/g		102	50-140			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Qualifier Notes:**QC Qualifiers:**Sample Data Revisions:

None

Work Order Revisions / Comments:

Revision-1 This report includes an updated parameter list as per the client.

Revision-2: Comparison changed to Reg 153 Table 2 RPI, as per client request.

Revision-3: Guideline comparisons updated as per client request.

Other Report Notes:

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

Source Result: Data used as source for matrix and duplicate samples

%REC: Percent recovery.

RPD: Relative percent difference.

NC: Not Calculated

Soil results are reported on a dry weight basis unless otherwise noted.

Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.

CCME PHC additional information:

- The method for the analysis of PHCs complies with the Reference Method for the CWS PHC and is validated for use in the laboratory. All prescribed quality criteria identified in the method has been met.

- F1 range corrected for BTEX.

- F2 to F3 ranges corrected for appropriate PAHs where available.

- The gravimetric heavy hydrocarbons (F4G) are not to be added to C6 to C50 hydrocarbons.

- In the case where F4 and F4G are both reported, the greater of the two results is to be used for comparison to CWS PHC criteria.

- When reported, data for F4G has been processed using a silica gel cleanup.

Any use of these results implies your agreement that our total liability in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

Certificate of Analysis

G2S Environmental Consulting Inc. (Burlington)

4361 Harvester Road, Unit 12

Burlington, ON L7L 5M4

Attn: Dana Haslett

Client PO: Charles Street

Project: G2S22008B

Custody:

Report Date: 13-Feb-2023

Order Date: 18-Mar-2022

Revised Report

Order #: 2212529

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
2212529-01	BH101 SS2
2212529-02	BH102 SS2
2212529-03	BH103 SS1
2212529-04	BH107 SS1
2212529-05	BH111 SS2
2212529-06	BH114 SS1
2212529-07	BH116 SS1

Approved By:



Alex Enfield, MSc

Lab Manager

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	22-Mar-22	23-Mar-22
PHC F1	CWS Tier 1 - P&T GC-FID	22-Mar-22	23-Mar-22
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	21-Mar-22	23-Mar-22
REG 153: Metals by ICP/MS, soil	EPA 6020 - Digestion - ICP-MS	24-Mar-22	24-Mar-22
REG 153: Pesticides, OC	EPA 8081B - GC-ECD	25-Mar-22	25-Mar-22
REG 153: pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	24-Mar-22	24-Mar-22
REG 153: VOCs by P&T GC-MS	EPA 8260 - P&T GC-MS	22-Mar-22	23-Mar-22
Solids, %	CWS Tier 1 - Gravimetric	22-Mar-22	23-Mar-22

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Summary of Criteria Exceedances

(If this page is blank then there are no exceedances)

Only those criteria that a sample exceeds will be highlighted in red

Regulatory Comparison:

Paracel Laboratories has provided regulatory guidelines on this report for informational purposes only and makes no representations or warranties that the data is accurate or reflects the current regulatory values. The user is advised to consult with the appropriate official regulations to evaluate compliance. Sample results that are highlighted have exceeded the selected regulatory limit. Calculated uncertainty estimations have not been applied for determining regulatory exceedances.

Sample	Analyte	MDL / Units	Result	Reg 406/19 -T1 Res/Park/Ind/Com	Reg 406/19 -T2.1 Res/Park/Inst
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Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Client ID:	BH101 SS2	BH102 SS2	BH103 SS1	BH107 SS1	Criteria:	
Sample Date:	17-Mar-22 12:00	16-Mar-22 12:00	16-Mar-22 12:00	17-Mar-22 09:00	Reg 406/19 -T1	Reg 406/19 -T2.1
Sample ID:	2212529-01	2212529-02	2212529-03	2212529-04	Res/Park/Ind/Com	Res/Park/Inst
Matrix:	Soil	Soil	Soil	Soil		
MDL/Units						

Physical Characteristics

% Solids	0.1 % by Wt.	95.0	89.8	88.5	85.6	-	-
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General Inorganics

pH	0.05 pH Units	6.87	7.23	-	-	5.00 - 9.00 pH Units	5.00 - 9.00 pH Units
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Metals

Antimony	1 ug/g	<1.0	<1.0	-	-	1.3 ug/g	7.5 ug/g
Arsenic	1 ug/g	1.7	1.6	-	-	18 ug/g	18 ug/g
Barium	1 ug/g	8.0	8.5	-	-	220 ug/g	390 ug/g
Beryllium	0.5 ug/g	<0.5	<0.5	-	-	2.5 ug/g	4 ug/g
Boron	5 ug/g	5.7	<5.0	-	-	36 ug/g	120 ug/g
Cadmium	0.5 ug/g	<0.5	<0.5	-	-	1.2 ug/g	1.2 ug/g
Chromium	5 ug/g	5.6	6.3	-	-	70 ug/g	160 ug/g
Cobalt	1 ug/g	2.0	2.2	-	-	21 ug/g	22 ug/g
Copper	5 ug/g	5.6	5.6	-	-	92 ug/g	140 ug/g
Lead	1 ug/g	3.9	4.1	-	-	120 ug/g	120 ug/g
Molybdenum	1 ug/g	<1.0	<1.0	-	-	2 ug/g	6.9 ug/g
Nickel	5 ug/g	<5.0	<5.0	-	-	82 ug/g	100 ug/g
Selenium	1 ug/g	1.3	<1.0	-	-	1.5 ug/g	2.4 ug/g
Silver	0.3 ug/g	<0.3	<0.3	-	-	0.5 ug/g	20 ug/g
Thallium	1 ug/g	<1.0	<1.0	-	-	1 ug/g	1 ug/g
Uranium	1 ug/g	<1.0	<1.0	-	-	2.5 ug/g	23 ug/g
Vanadium	10 ug/g	16.0	16.7	-	-	86 ug/g	86 ug/g
Zinc	20 ug/g	<20.0	<20.0	-	-	290 ug/g	340 ug/g

Volatiles

Acetone	0.5 ug/g	-	<0.50	-	-	0.5 ug/g	0.5 ug/g
Benzene	0.02 ug/g	-	<0.02	-	-	0.02 ug/g	0.02 ug/g

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Client ID:	BH101 SS2	BH102 SS2	BH103 SS1	BH107 SS1	Criteria:	
Sample Date:	17-Mar-22 12:00	16-Mar-22 12:00	16-Mar-22 12:00	17-Mar-22 09:00	Reg 406/19 -T1	Reg 406/19 -T2.1
Sample ID:	2212529-01	2212529-02	2212529-03	2212529-04	Res/Park/Ind/Com	Res/Park/Inst
Matrix:	Soil	Soil	Soil	Soil		
MDL/Units						

Volatiles

Bromodichloromethane	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
Bromoform	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
Bromomethane	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
Carbon Tetrachloride	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
Chlorobenzene	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.083 ug/g
Chloroform	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
Dibromochloromethane	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
Dichlorodifluoromethane	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	1.5 ug/g
1,2-Dichlorobenzene	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	3.4 ug/g
1,3-Dichlorobenzene	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.26 ug/g
1,4-Dichlorobenzene	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
1,1-Dichloroethane	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
1,2-Dichloroethane	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
1,1-Dichloroethylene	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
cis-1,2-Dichloroethylene	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
trans-1,2-Dichloroethylene	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
1,2-Dichloropropane	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
cis-1,3-Dichloropropylene	0.05 ug/g	-	<0.05	-	-	-	-
trans-1,3-Dichloropropylene	0.05 ug/g	-	<0.05	-	-	-	-
1,3-Dichloropropene, total	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
Ethylbenzene	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
Ethylene dibromide (dibromoethane,	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
Hexane	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	2.5 ug/g
Methyl Ethyl Ketone (2-Butanone)	0.5 ug/g	-	<0.50	-	-	0.5 ug/g	0.5 ug/g
Methyl Isobutyl Ketone	0.5 ug/g	-	<0.50	-	-	0.5 ug/g	0.5 ug/g

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Client ID:	BH101 SS2	BH102 SS2	BH103 SS1	BH107 SS1	Criteria:	
Sample Date:	17-Mar-22 12:00	16-Mar-22 12:00	16-Mar-22 12:00	17-Mar-22 09:00	Reg 406/19 -T1	Reg 406/19 -T2.1
Sample ID:	2212529-01	2212529-02	2212529-03	2212529-04	Res/Park/Ind/Com	Res/Park/Inst
Matrix:	Soil	Soil	Soil	Soil		
MDL/Units						

Volatiles

Methyl tert-butyl ether	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
Methylene Chloride	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
Styrene	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
1,1,1,2-Tetrachloroethane	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
1,1,2,2-Tetrachloroethane	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
Tetrachloroethylene	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
Toluene	0.05 ug/g	-	<0.05	-	-	0.2 ug/g	0.2 ug/g
1,1,1-Trichloroethane	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.11 ug/g
1,1,2-Trichloroethane	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
Trichloroethylene	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.05 ug/g
Trichlorofluoromethane	0.05 ug/g	-	<0.05	-	-	0.25 ug/g	0.25 ug/g
Vinyl chloride	0.02 ug/g	-	<0.02	-	-	0.02 ug/g	0.02 ug/g
m,p-Xylenes	0.05 ug/g	-	<0.05	-	-	-	-
o-Xylene	0.05 ug/g	-	<0.05	-	-	-	-
Xylenes, total	0.05 ug/g	-	<0.05	-	-	0.05 ug/g	0.091 ug/g
Toluene-d8	Surrogate	-	106%	-	-	-	-
4-Bromofluorobenzene	Surrogate	-	99.9%	-	-	-	-
Dibromofluoromethane	Surrogate	-	91.9%	-	-	-	-
Benzene	0.02 ug/g	<0.02	-	-	-	0.02 ug/g	0.02 ug/g
Ethylbenzene	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
Toluene	0.05 ug/g	<0.05	-	-	-	0.2 ug/g	0.2 ug/g
m,p-Xylenes	0.05 ug/g	<0.05	-	-	-	-	-
o-Xylene	0.05 ug/g	<0.05	-	-	-	-	-
Xylenes, total	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.091 ug/g
Toluene-d8	Surrogate	104%	-	-	-	-	-

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Client ID:	BH101 SS2	BH102 SS2	BH103 SS1	BH107 SS1	Criteria:	
Sample Date:	17-Mar-22 12:00	16-Mar-22 12:00	16-Mar-22 12:00	17-Mar-22 09:00	Reg 406/19 -T1	Reg 406/19 -T2.1
Sample ID:	2212529-01	2212529-02	2212529-03	2212529-04	Res/Park/Ind/Com	Res/Park/Inst
Matrix:	Soil	Soil	Soil	Soil		
MDL/Units						

Hydrocarbons

F1 PHCs (C6-C10)	7 ug/g	<7	<7	-	-	25 ug/g	25 ug/g
F2 PHCs (C10-C16)	4 ug/g	<4	<4	-	-	10 ug/g	10 ug/g
F3 PHCs (C16-C34)	8 ug/g	<8	<8	-	-	240 ug/g	240 ug/g
F4 PHCs (C34-C50)	6 ug/g	<6	<6	-	-	120 ug/g	2800 ug/g

Pesticides, OC

Aldrin	0.01 ug/g	-	-	<0.01	<0.01	0.05 ug/g	0.05 ug/g
gamma-BHC (Lindane)	0.01 ug/g	-	-	<0.01	<0.01	-	-
alpha-Chlordane	0.01 ug/g	-	-	<0.01	<0.01	-	-
gamma-Chlordane	0.01 ug/g	-	-	<0.01	0.03	-	-
Chlordane	0.01 ug/g	-	-	<0.01	<0.01	0.05 ug/g	0.05 ug/g
o,p'-DDD	0.01 ug/g	-	-	<0.01	<0.01	-	-
p,p'-DDD	0.02 ug/g	-	-	<0.02	<0.02	-	-
DDD	0.02 ug/g	-	-	<0.02	<0.02	0.05 ug/g	3.3 ug/g
o,p'-DDE	0.01 ug/g	-	-	<0.01	<0.01	-	-
p,p'-DDE	0.01 ug/g	-	-	<0.01	0.03	-	-
DDE	0.01 ug/g	-	-	<0.01	0.03	0.05 ug/g	0.26 ug/g
o,p'-DDT	0.01 ug/g	-	-	<0.01	<0.01	-	-
p,p'-DDT	0.01 ug/g	-	-	<0.01	<0.01	-	-
DDT	0.01 ug/g	-	-	<0.01	<0.01	1.4 ug/g	1.4 ug/g
Dieldrin	0.02 ug/g	-	-	<0.02	<0.02	0.05 ug/g	0.05 ug/g
Endrin	0.02 ug/g	-	-	<0.02	<0.02	0.04 ug/g	0.04 ug/g
Endosulfan I	0.01 ug/g	-	-	<0.01	<0.01	-	-
Endosulfan II	0.02 ug/g	-	-	<0.02	<0.02	-	-
Endosulfan I/II	0.02 ug/g	-	-	<0.02	<0.02	0.04 ug/g	0.04 ug/g
Heptachlor	0.01 ug/g	-	-	<0.01	<0.01	0.05 ug/g	0.072 ug/g

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Client ID:	BH101 SS2	BH102 SS2	BH103 SS1	BH107 SS1	Criteria:	
Sample Date:	17-Mar-22 12:00	16-Mar-22 12:00	16-Mar-22 12:00	17-Mar-22 09:00	Reg 406/19 -T1	Reg 406/19 -T2.1
Sample ID:	2212529-01	2212529-02	2212529-03	2212529-04	Res/Park/Ind/Com	Res/Park/Inst
Matrix:	Soil	Soil	Soil	Soil		
MDL/Units						

Pesticides, OC

Heptachlor epoxide	0.01 ug/g	-	-	<0.01	<0.01	0.05 ug/g	0.05 ug/g
Hexachlorobenzene	0.01 ug/g	-	-	<0.01	<0.01	0.01 ug/g	0.034 ug/g
Hexachlorobutadiene	0.01 ug/g	-	-	<0.01	<0.01	0.01 ug/g	0.01 ug/g
Hexachloroethane	0.01 ug/g	-	-	<0.01	<0.01	0.01 ug/g	0.01 ug/g
Methoxychlor	0.01 ug/g	-	-	<0.01	<0.01	0.05 ug/g	0.13 ug/g
Decachlorobiphenyl	Surrogate	-	-	56.6%	55.2%	-	-

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Client ID:	BH111 SS2	BH114 SS1	BH116 SS1		Criteria:	
Sample Date:	16-Mar-22 09:00	15-Mar-22 12:00	15-Mar-22 09:00		Reg 406/19 -T1	Reg 406/19 -T2.1
Sample ID:	2212529-05	2212529-06	2212529-07		Res/Park/Ind/Com	Res/Park/Inst
Matrix:	Soil	Soil	Soil			
MDL/Units						

Physical Characteristics

% Solids	0.1 % by Wt.	96.4	75.6	89.2	-	-	-
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General Inorganics

pH	0.05 pH Units	7.31	-	-	-	5.00 - 9.00 pH Units	5.00 - 9.00 pH Units
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Metals

Antimony	1 ug/g	<1.0	-	-	-	1.3 ug/g	7.5 ug/g
Arsenic	1 ug/g	2.1	-	-	-	18 ug/g	18 ug/g
Barium	1 ug/g	9.8	-	-	-	220 ug/g	390 ug/g
Beryllium	0.5 ug/g	<0.5	-	-	-	2.5 ug/g	4 ug/g
Boron	5 ug/g	5.3	-	-	-	36 ug/g	120 ug/g
Cadmium	0.5 ug/g	<0.5	-	-	-	1.2 ug/g	1.2 ug/g
Chromium	5 ug/g	6.3	-	-	-	70 ug/g	160 ug/g
Cobalt	1 ug/g	2.3	-	-	-	21 ug/g	22 ug/g
Copper	5 ug/g	8.3	-	-	-	92 ug/g	140 ug/g
Lead	1 ug/g	5.1	-	-	-	120 ug/g	120 ug/g
Molybdenum	1 ug/g	<1.0	-	-	-	2 ug/g	6.9 ug/g
Nickel	5 ug/g	<5.0	-	-	-	82 ug/g	100 ug/g
Selenium	1 ug/g	<1.0	-	-	-	1.5 ug/g	2.4 ug/g
Silver	0.3 ug/g	<0.3	-	-	-	0.5 ug/g	20 ug/g
Thallium	1 ug/g	<1.0	-	-	-	1 ug/g	1 ug/g
Uranium	1 ug/g	<1.0	-	-	-	2.5 ug/g	23 ug/g
Vanadium	10 ug/g	14.5	-	-	-	86 ug/g	86 ug/g
Zinc	20 ug/g	31.4	-	-	-	290 ug/g	340 ug/g

Volatiles

Acetone	0.5 ug/g	<0.50	-	-	-	0.5 ug/g	0.5 ug/g
Benzene	0.02 ug/g	<0.02	-	-	-	0.02 ug/g	0.02 ug/g

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Client ID:	BH111 SS2	BH114 SS1	BH116 SS1		Criteria:	
Sample Date:	16-Mar-22 09:00	15-Mar-22 12:00	15-Mar-22 09:00		Reg 406/19 -T1	Reg 406/19 -T2.1
Sample ID:	2212529-05	2212529-06	2212529-07		Res/Park/Ind/Com	Res/Park/Inst
Matrix:	Soil	Soil	Soil			
MDL/Units						

Volatiles

Bromodichloromethane	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
Bromoform	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
Bromomethane	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
Carbon Tetrachloride	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
Chlorobenzene	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.083 ug/g
Chloroform	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
Dibromochloromethane	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
Dichlorodifluoromethane	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	1.5 ug/g
1,2-Dichlorobenzene	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	3.4 ug/g
1,3-Dichlorobenzene	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.26 ug/g
1,4-Dichlorobenzene	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
1,1-Dichloroethane	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
1,2-Dichloroethane	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
1,1-Dichloroethylene	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
cis-1,2-Dichloroethylene	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
trans-1,2-Dichloroethylene	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
1,2-Dichloropropane	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
cis-1,3-Dichloropropylene	0.05 ug/g	<0.05	-	-	-	-	-
trans-1,3-Dichloropropylene	0.05 ug/g	<0.05	-	-	-	-	-
1,3-Dichloropropene, total	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
Ethylene dibromide (dibromoethane,	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
Ethylbenzene	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
Hexane	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	2.5 ug/g
Methyl Ethyl Ketone (2-Butanone)	0.5 ug/g	<0.50	-	-	-	0.5 ug/g	0.5 ug/g
Methyl Isobutyl Ketone	0.5 ug/g	<0.50	-	-	-	0.5 ug/g	0.5 ug/g

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Client ID:	BH111 SS2	BH114 SS1	BH116 SS1		Criteria:	
Sample Date:	16-Mar-22 09:00	15-Mar-22 12:00	15-Mar-22 09:00		Reg 406/19 -T1	Reg 406/19 -T2.1
Sample ID:	2212529-05	2212529-06	2212529-07		Res/Park/Ind/Com	Res/Park/Inst
Matrix:	Soil	Soil	Soil			
MDL/Units						

Volatiles

Methyl tert-butyl ether	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
Methylene Chloride	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
Styrene	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
1,1,1,2-Tetrachloroethane	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
1,1,2,2-Tetrachloroethane	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
Tetrachloroethylene	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
Toluene	0.05 ug/g	<0.05	-	-	-	0.2 ug/g	0.2 ug/g
1,1,1-Trichloroethane	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.11 ug/g
1,1,2-Trichloroethane	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
Trichloroethylene	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
Trichlorofluoromethane	0.05 ug/g	<0.05	-	-	-	0.25 ug/g	0.25 ug/g
Vinyl chloride	0.02 ug/g	<0.02	-	-	-	0.02 ug/g	0.02 ug/g
m,p-Xylenes	0.05 ug/g	<0.05	-	-	-	-	-
o-Xylene	0.05 ug/g	<0.05	-	-	-	-	-
Xylenes, total	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.091 ug/g
4-Bromofluorobenzene	Surrogate	102%	-	-	-	-	-
Dibromofluoromethane	Surrogate	91.5%	-	-	-	-	-
Toluene-d8	Surrogate	104%	-	-	-	-	-

Hydrocarbons

F1 PHCs (C6-C10)	7 ug/g	<7	-	-	-	25 ug/g	25 ug/g
F2 PHCs (C10-C16)	4 ug/g	<4	-	-	-	10 ug/g	10 ug/g
F3 PHCs (C16-C34)	8 ug/g	<8	-	-	-	240 ug/g	240 ug/g
F4 PHCs (C34-C50)	6 ug/g	<6	-	-	-	120 ug/g	2800 ug/g

Pesticides, OC

Aldrin	0.01 ug/g	-	<0.01	<0.01	-	0.05 ug/g	0.05 ug/g
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Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Client ID:	BH111 SS2	BH114 SS1	BH116 SS1		Criteria:	
Sample Date:	16-Mar-22 09:00	15-Mar-22 12:00	15-Mar-22 09:00		Reg 406/19 -T1	Reg 406/19 -T2.1
Sample ID:	2212529-05	2212529-06	2212529-07		Res/Park/Ind/Com	Res/Park/Inst
Matrix:	Soil	Soil	Soil			
MDL/Units						

Pesticides, OC

gamma-BHC (Lindane)	0.01 ug/g	-	<0.01	<0.01	-	-	-
alpha-Chlordane	0.01 ug/g	-	<0.01	<0.01	-	-	-
gamma-Chlordane	0.01 ug/g	-	<0.01	<0.01	-	-	-
Chlordane	0.01 ug/g	-	<0.01	<0.01	-	0.05 ug/g	0.05 ug/g
o,p'-DDD	0.01 ug/g	-	<0.01	<0.01	-	-	-
p,p'-DDD	0.02 ug/g	-	<0.02	<0.02	-	-	-
DDD	0.02 ug/g	-	<0.02	<0.02	-	0.05 ug/g	3.3 ug/g
o,p'-DDE	0.01 ug/g	-	<0.01	<0.01	-	-	-
p,p'-DDE	0.01 ug/g	-	<0.01	0.01	-	-	-
DDE	0.01 ug/g	-	<0.01	0.01	-	0.05 ug/g	0.26 ug/g
o,p'-DDT	0.01 ug/g	-	<0.01	<0.01	-	-	-
p,p'-DDT	0.01 ug/g	-	<0.01	<0.01	-	-	-
DDT	0.01 ug/g	-	<0.01	<0.01	-	1.4 ug/g	1.4 ug/g
Dieldrin	0.02 ug/g	-	<0.02	<0.02	-	0.05 ug/g	0.05 ug/g
Endrin	0.02 ug/g	-	<0.02	<0.02	-	0.04 ug/g	0.04 ug/g
Endosulfan I	0.01 ug/g	-	<0.01	<0.01	-	-	-
Endosulfan II	0.02 ug/g	-	<0.02	<0.02	-	-	-
Endosulfan I/II	0.02 ug/g	-	<0.02	<0.02	-	0.04 ug/g	0.04 ug/g
Heptachlor	0.01 ug/g	-	<0.01	<0.01	-	0.05 ug/g	0.072 ug/g
Heptachlor epoxide	0.01 ug/g	-	<0.01	<0.01	-	0.05 ug/g	0.05 ug/g
Hexachlorobenzene	0.01 ug/g	-	<0.01	<0.01	-	0.01 ug/g	0.034 ug/g
Hexachlorobutadiene	0.01 ug/g	-	<0.01	<0.01	-	0.01 ug/g	0.01 ug/g
Hexachloroethane	0.01 ug/g	-	<0.01	<0.01	-	0.01 ug/g	0.01 ug/g
Methoxychlor	0.01 ug/g	-	<0.01	<0.01	-	0.05 ug/g	0.13 ug/g
Decachlorobiphenyl	Surrogate	-	59.3%	61.5%	-	-	-

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons								
F1 PHCs (C6-C10)	ND	7	ug/g					
F2 PHCs (C10-C16)	ND	4	ug/g					
F3 PHCs (C16-C34)	ND	8	ug/g					
F4 PHCs (C34-C50)	ND	6	ug/g					
Metals								
Antimony	ND	1.0	ug/g					
Arsenic	ND	1.0	ug/g					
Barium	ND	1.0	ug/g					
Beryllium	ND	0.5	ug/g					
Boron	ND	5.0	ug/g					
Cadmium	ND	0.5	ug/g					
Chromium	ND	5.0	ug/g					
Cobalt	ND	1.0	ug/g					
Copper	ND	5.0	ug/g					
Lead	ND	1.0	ug/g					
Molybdenum	ND	1.0	ug/g					
Nickel	ND	5.0	ug/g					
Selenium	ND	1.0	ug/g					
Silver	ND	0.3	ug/g					
Thallium	ND	1.0	ug/g					
Uranium	ND	1.0	ug/g					
Vanadium	ND	10.0	ug/g					
Zinc	ND	20.0	ug/g					
Pesticides, OC								
Aldrin	ND	0.01	ug/g					
gamma-BHC (Lindane)	ND	0.01	ug/g					
alpha-Chlordane	ND	0.01	ug/g					
gamma-Chlordane	ND	0.01	ug/g					
Chlordane	ND	0.01	ug/g					
o,p'-DDD	ND	0.01	ug/g					
p,p'-DDD	ND	0.02	ug/g					
DDD	ND	0.02	ug/g					

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
o,p'-DDE	ND	0.01	ug/g					
p,p'-DDE	ND	0.01	ug/g					
DDE	ND	0.01	ug/g					
o,p'-DDT	ND	0.01	ug/g					
p,p'-DDT	ND	0.01	ug/g					
DDT	ND	0.01	ug/g					
Dieldrin	ND	0.02	ug/g					
Endrin	ND	0.02	ug/g					
Endosulfan I	ND	0.01	ug/g					
Endosulfan II	ND	0.02	ug/g					
Endosulfan I/II	ND	0.02	ug/g					
Heptachlor	ND	0.01	ug/g					
Heptachlor epoxide	ND	0.01	ug/g					
Hexachlorobenzene	ND	0.01	ug/g					
Hexachlorobutadiene	ND	0.01	ug/g					
Hexachloroethane	ND	0.01	ug/g					
Methoxychlor	ND	0.01	ug/g					
Surrogate: Decachlorobiphenyl	0.0506		ug/g	50.6	50-140			
Volatiles								
Acetone	ND	0.50	ug/g					
Benzene	ND	0.02	ug/g					
Bromodichloromethane	ND	0.05	ug/g					
Bromoform	ND	0.05	ug/g					
Bromomethane	ND	0.05	ug/g					
Carbon Tetrachloride	ND	0.05	ug/g					
Chlorobenzene	ND	0.05	ug/g					
Chloroform	ND	0.05	ug/g					
Dibromochloromethane	ND	0.05	ug/g					
Dichlorodifluoromethane	ND	0.05	ug/g					
1,2-Dichlorobenzene	ND	0.05	ug/g					
1,3-Dichlorobenzene	ND	0.05	ug/g					
1,4-Dichlorobenzene	ND	0.05	ug/g					

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
1,1-Dichloroethane	ND	0.05	ug/g					
1,2-Dichloroethane	ND	0.05	ug/g					
1,1-Dichloroethylene	ND	0.05	ug/g					
cis-1,2-Dichloroethylene	ND	0.05	ug/g					
trans-1,2-Dichloroethylene	ND	0.05	ug/g					
1,2-Dichloropropane	ND	0.05	ug/g					
cis-1,3-Dichloropropylene	ND	0.05	ug/g					
trans-1,3-Dichloropropylene	ND	0.05	ug/g					
1,3-Dichloropropene, total	ND	0.05	ug/g					
Ethylbenzene	ND	0.05	ug/g					
Ethylene dibromide (dibromoethane, 1,2-)	ND	0.05	ug/g					
Hexane	ND	0.05	ug/g					
Methyl Ethyl Ketone (2-Butanone)	ND	0.50	ug/g					
Methyl Isobutyl Ketone	ND	0.50	ug/g					
Methyl tert-butyl ether	ND	0.05	ug/g					
Methylene Chloride	ND	0.05	ug/g					
Styrene	ND	0.05	ug/g					
1,1,1,2-Tetrachloroethane	ND	0.05	ug/g					
1,1,2,2-Tetrachloroethane	ND	0.05	ug/g					
Tetrachloroethylene	ND	0.05	ug/g					
Toluene	ND	0.05	ug/g					
1,1,1-Trichloroethane	ND	0.05	ug/g					
1,1,2-Trichloroethane	ND	0.05	ug/g					
Trichloroethylene	ND	0.05	ug/g					
Trichlorofluoromethane	ND	0.05	ug/g					
Vinyl chloride	ND	0.02	ug/g					
m,p-Xylenes	ND	0.05	ug/g					
o-Xylene	ND	0.05	ug/g					
Xylenes, total	ND	0.05	ug/g					
Surrogate: 4-Bromofluorobenzene	7.78		ug/g	97.3	50-140			
Surrogate: Dibromofluoromethane	7.56		ug/g	94.6	50-140			
Surrogate: Toluene-d8	8.23		ug/g	103	50-140			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Benzene	ND	0.02	ug/g					
Ethylbenzene	ND	0.05	ug/g					
Toluene	ND	0.05	ug/g					
m,p-Xylenes	ND	0.05	ug/g					
o-Xylene	ND	0.05	ug/g					
Xylenes, total	ND	0.05	ug/g					
Surrogate: Toluene-d8	8.23		ug/g	103	50-140			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
pH	6.17	0.05	pH Units	6.26			1.5	10	
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g	ND			NC	40	
F2 PHCs (C10-C16)	ND	4	ug/g	ND			NC	30	
F3 PHCs (C16-C34)	50	8	ug/g	34			NC	30	
F4 PHCs (C34-C50)	110	6	ug/g	128			14.9	30	
Metals									
Antimony	ND	1.0	ug/g	ND			NC	30	
Arsenic	1.8	1.0	ug/g	1.2			NC	30	
Barium	18.2	1.0	ug/g	15.5			15.8	30	
Beryllium	ND	0.5	ug/g	ND			NC	30	
Boron	9.0	5.0	ug/g	ND			NC	30	
Cadmium	ND	0.5	ug/g	ND			NC	30	
Chromium	7.1	5.0	ug/g	5.8			19.8	30	
Cobalt	2.6	1.0	ug/g	2.1			20.7	30	
Copper	7.2	5.0	ug/g	5.4			28.7	30	
Lead	3.1	1.0	ug/g	2.6			18.4	30	
Molybdenum	ND	1.0	ug/g	ND			NC	30	
Nickel	ND	5.0	ug/g	ND			NC	30	
Selenium	1.2	1.0	ug/g	ND			NC	30	
Silver	ND	0.3	ug/g	ND			NC	30	
Thallium	ND	1.0	ug/g	ND			NC	30	
Uranium	ND	1.0	ug/g	ND			NC	30	
Vanadium	18.0	10.0	ug/g	14.8			19.9	30	
Zinc	ND	20.0	ug/g	ND			NC	30	
Pesticides, OC									
Aldrin	ND	0.01	ug/g	ND			NC	40	
gamma-BHC (Lindane)	ND	0.01	ug/g	ND			NC	40	
alpha-Chlordane	ND	0.01	ug/g	ND			NC	40	
gamma-Chlordane	ND	0.01	ug/g	ND			NC	40	

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
o,p'-DDD	ND	0.01	ug/g	ND			NC	40	
p,p'-DDD	ND	0.02	ug/g	ND			NC	40	
o,p'-DDE	ND	0.01	ug/g	ND			NC	40	
p,p'-DDE	ND	0.01	ug/g	ND			NC	40	
o,p'-DDT	ND	0.01	ug/g	ND			NC	40	
p,p'-DDT	ND	0.01	ug/g	ND			NC	40	
Dieldrin	ND	0.02	ug/g	ND			NC	40	
Endrin	ND	0.02	ug/g	ND			NC	40	
Endosulfan I	ND	0.01	ug/g	ND			NC	40	
Endosulfan II	ND	0.02	ug/g	ND			NC	40	
Heptachlor	ND	0.01	ug/g	ND			NC	40	
Heptachlor epoxide	ND	0.01	ug/g	ND			NC	40	
Hexachlorobenzene	ND	0.01	ug/g	ND			NC	40	
Hexachlorobutadiene	ND	0.01	ug/g	ND			NC	40	
Hexachloroethane	ND	0.01	ug/g	ND			NC	40	
Methoxychlor	ND	0.01	ug/g	ND			NC	40	
Surrogate: Decachlorobiphenyl	0.0702		ug/g		62.2	50-140			
Physical Characteristics									
% Solids	95.0	0.1	% by Wt.	95.0			0.0	25	
Volatiles									
Acetone	ND	0.50	ug/g	ND			NC	50	
Benzene	ND	0.02	ug/g	ND			NC	50	
Bromodichloromethane	ND	0.05	ug/g	ND			NC	50	
Bromoform	ND	0.05	ug/g	ND			NC	50	
Bromomethane	ND	0.05	ug/g	ND			NC	50	
Carbon Tetrachloride	ND	0.05	ug/g	ND			NC	50	
Chlorobenzene	ND	0.05	ug/g	ND			NC	50	
Chloroform	ND	0.05	ug/g	ND			NC	50	
Dibromochloromethane	ND	0.05	ug/g	ND			NC	50	
Dichlorodifluoromethane	ND	0.05	ug/g	ND			NC	50	
1,2-Dichlorobenzene	ND	0.05	ug/g	ND			NC	50	

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
1,3-Dichlorobenzene	ND	0.05	ug/g	ND			NC	50	
1,4-Dichlorobenzene	ND	0.05	ug/g	ND			NC	50	
1,1-Dichloroethane	ND	0.05	ug/g	ND			NC	50	
1,2-Dichloroethane	ND	0.05	ug/g	ND			NC	50	
1,1-Dichloroethylene	ND	0.05	ug/g	ND			NC	50	
cis-1,2-Dichloroethylene	ND	0.05	ug/g	ND			NC	50	
trans-1,2-Dichloroethylene	ND	0.05	ug/g	ND			NC	50	
1,2-Dichloropropane	ND	0.05	ug/g	ND			NC	50	
cis-1,3-Dichloropropylene	ND	0.05	ug/g	ND			NC	50	
trans-1,3-Dichloropropylene	ND	0.05	ug/g	ND			NC	50	
Ethylbenzene	ND	0.05	ug/g	ND			NC	50	
Ethylene dibromide (dibromoethane, 1,2-)	ND	0.05	ug/g	ND			NC	50	
Hexane	ND	0.05	ug/g	ND			NC	50	
Methyl Ethyl Ketone (2-Butanone)	ND	0.50	ug/g	ND			NC	50	
Methyl Isobutyl Ketone	ND	0.50	ug/g	ND			NC	50	
Methyl tert-butyl ether	ND	0.05	ug/g	ND			NC	50	
Methylene Chloride	ND	0.05	ug/g	ND			NC	50	
Styrene	ND	0.05	ug/g	ND			NC	50	
1,1,1,2-Tetrachloroethane	ND	0.05	ug/g	ND			NC	50	
1,1,2,2-Tetrachloroethane	ND	0.05	ug/g	ND			NC	50	
Tetrachloroethylene	ND	0.05	ug/g	ND			NC	50	
Toluene	ND	0.05	ug/g	ND			NC	50	
1,1,1-Trichloroethane	ND	0.05	ug/g	ND			NC	50	
1,1,2-Trichloroethane	ND	0.05	ug/g	ND			NC	50	
Trichloroethylene	ND	0.05	ug/g	ND			NC	50	
Trichlorofluoromethane	ND	0.05	ug/g	ND			NC	50	
Vinyl chloride	ND	0.02	ug/g	ND			NC	50	
m,p-Xylenes	ND	0.05	ug/g	ND			NC	50	
o-Xylene	ND	0.05	ug/g	ND			NC	50	
Surrogate: 4-Bromofluorobenzene	7.80		ug/g		99.0	50-140			
Surrogate: Dibromofluoromethane	7.45		ug/g		94.5	50-140			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
<i>Surrogate: Toluene-d8</i>	<i>8.19</i>		<i>ug/g</i>		<i>104</i>	<i>50-140</i>			
Benzene	ND	0.02	ug/g	ND			NC	50	
Ethylbenzene	ND	0.05	ug/g	ND			NC	50	
Toluene	ND	0.05	ug/g	ND			NC	50	
m,p-Xylenes	ND	0.05	ug/g	ND			NC	50	
o-Xylene	ND	0.05	ug/g	ND			NC	50	
<i>Surrogate: Toluene-d8</i>	<i>8.19</i>		<i>ug/g</i>		<i>104</i>	<i>50-140</i>			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	70	7	ug/g	ND	98.4	80-120			
F2 PHCs (C10-C16)	76	4	ug/g	ND	84.6	60-140			
F3 PHCs (C16-C34)	265	8	ug/g	34	115	60-140			
F4 PHCs (C34-C50)	317	6	ug/g	128	130	60-140			
Metals									
Antimony	130	1.0	ug/g	ND	104	70-130			
Arsenic	138	1.0	ug/g	1.2	110	70-130			
Barium	144	1.0	ug/g	15.5	103	70-130			
Beryllium	123	0.5	ug/g	ND	98.6	70-130			
Boron	134	5.0	ug/g	ND	107	70-130			
Cadmium	126	0.5	ug/g	ND	101	70-130			
Chromium	136	5.0	ug/g	5.8	104	70-130			
Cobalt	130	1.0	ug/g	2.1	102	70-130			
Copper	128	5.0	ug/g	5.4	97.9	70-130			
Lead	119	1.0	ug/g	2.6	93.3	70-130			
Molybdenum	133	1.0	ug/g	ND	107	70-130			
Nickel	125	5.0	ug/g	ND	99.9	70-130			
Selenium	130	1.0	ug/g	ND	104	70-130			
Silver	119	0.3	ug/g	ND	95.0	70-130			
Thallium	119	1.0	ug/g	ND	95.1	70-130			
Uranium	129	1.0	ug/g	ND	103	70-130			
Vanadium	149	10.0	ug/g	14.8	107	70-130			
Zinc	136	20.0	ug/g	ND	109	70-130			
Pesticides, OC									
Aldrin	0.22	0.01	ug/g	ND	96.6	50-140			
gamma-BHC (Lindane)	0.21	0.01	ug/g	ND	93.8	50-140			
alpha-Chlordane	0.20	0.01	ug/g	ND	87.0	50-140			
gamma-Chlordane	0.21	0.01	ug/g	ND	94.4	50-140			
o,p'-DDD	0.12	0.01	ug/g	ND	53.7	50-140			
p,p'-DDD	0.15	0.02	ug/g	ND	64.6	50-140			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
o,p'-DDE	0.17	0.01	ug/g	ND	73.3	50-140			
p,p'-DDE	0.20	0.01	ug/g	ND	86.5	50-140			
o,p'-DDT	0.20	0.01	ug/g	ND	86.5	50-140			
p,p'-DDT	0.15	0.01	ug/g	ND	66.5	50-140			
Dieldrin	0.11	0.02	ug/g	ND	52.9	50-140			
Endosulfan I	0.23	0.01	ug/g	ND	102	50-140			
Endosulfan II	0.13	0.02	ug/g	ND	55.5	50-140			
Heptachlor	0.21	0.01	ug/g	ND	95.1	50-140			
Heptachlor epoxide	0.19	0.01	ug/g	ND	83.4	50-140			
Hexachlorobenzene	0.21	0.01	ug/g	ND	94.1	50-140			
Hexachlorobutadiene	0.22	0.01	ug/g	ND	96.7	50-140			
Hexachloroethane	0.23	0.01	ug/g	ND	103	50-140			
Methoxychlor	0.13	0.01	ug/g	ND	58.8	50-140			
Surrogate: Decachlorobiphenyl	0.0640		ug/g		56.6	50-140			
Volatiles									
Acetone	8.56	0.50	ug/g	ND	85.6	50-140			
Benzene	3.26	0.02	ug/g	ND	81.0	60-130			
Bromodichloromethane	3.19	0.05	ug/g	ND	79.4	60-130			
Bromoform	3.45	0.05	ug/g	ND	85.8	60-130			
Bromomethane	3.24	0.05	ug/g	ND	81.1	50-140			
Carbon Tetrachloride	3.05	0.05	ug/g	ND	76.3	60-130			
Chlorobenzene	3.68	0.05	ug/g	ND	91.5	60-130			
Chloroform	3.39	0.05	ug/g	ND	84.4	60-130			
Dibromochloromethane	3.28	0.05	ug/g	ND	82.0	60-130			
Dichlorodifluoromethane	2.91	0.05	ug/g	ND	72.7	50-140			
1,2-Dichlorobenzene	3.58	0.05	ug/g	ND	89.4	60-130			
1,3-Dichlorobenzene	3.64	0.05	ug/g	ND	91.1	60-130			
1,4-Dichlorobenzene	3.70	0.05	ug/g	ND	92.0	60-130			
1,1-Dichloroethane	3.91	0.05	ug/g	ND	97.8	60-130			
1,2-Dichloroethane	3.28	0.05	ug/g	ND	81.7	60-130			
1,1-Dichloroethylene	4.15	0.05	ug/g	ND	104	60-130			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
cis-1,2-Dichloroethylene	3.80	0.05	ug/g	ND	94.5	60-130			
trans-1,2-Dichloroethylene	3.43	0.05	ug/g	ND	85.4	60-130			
1,2-Dichloropropane	3.24	0.05	ug/g	ND	81.0	60-130			
cis-1,3-Dichloropropylene	3.35	0.05	ug/g	ND	83.8	60-130			
trans-1,3-Dichloropropylene	3.45	0.05	ug/g	ND	85.8	60-130			
Ethylbenzene	3.80	0.05	ug/g	ND	94.4	60-130			
Ethylene dibromide (dibromoethane, 1,2-)	3.44	0.05	ug/g	ND	85.5	60-130			
Hexane	3.24	0.05	ug/g	ND	80.9	60-130			
Methyl Ethyl Ketone (2-Butanone)	8.42	0.50	ug/g	ND	84.2	50-140			
Methyl Isobutyl Ketone	8.69	0.50	ug/g	ND	86.9	50-140			
Methyl tert-butyl ether	8.35	0.05	ug/g	ND	83.5	50-140			
Methylene Chloride	4.40	0.05	ug/g	ND	109	60-130			
Styrene	3.99	0.05	ug/g	ND	98.8	60-130			
1,1,1,2-Tetrachloroethane	3.51	0.05	ug/g	ND	87.7	60-130			
1,1,2,2-Tetrachloroethane	3.57	0.05	ug/g	ND	88.8	60-130			
Tetrachloroethylene	3.47	0.05	ug/g	ND	86.4	60-130			
Toluene	3.73	0.05	ug/g	ND	93.2	60-130			
1,1,1-Trichloroethane	3.08	0.05	ug/g	ND	77.0	60-130			
1,1,2-Trichloroethane	3.38	0.05	ug/g	ND	84.0	60-130			
Trichloroethylene	3.15	0.05	ug/g	ND	78.3	60-130			
Trichlorofluoromethane	4.16	0.05	ug/g	ND	104	50-140			
Vinyl chloride	3.59	0.02	ug/g	ND	89.7	50-140			
m,p-Xylenes	7.80	0.05	ug/g	ND	97.3	60-130			
o-Xylene	3.92	0.05	ug/g	ND	97.4	60-130			
Surrogate: 4-Bromofluorobenzene	7.62		ug/g		95.2	50-140			
Surrogate: Dibromofluoromethane	7.78		ug/g		97.3	50-140			
Surrogate: Toluene-d8	8.08		ug/g		101	50-140			
Benzene	3.26	0.02	ug/g	ND	81.0	60-130			
Ethylbenzene	3.80	0.05	ug/g	ND	94.4	60-130			
Toluene	3.73	0.05	ug/g	ND	93.2	60-130			
m,p-Xylenes	7.80	0.05	ug/g	ND	97.3	60-130			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
o-Xylene	3.92	0.05	ug/g	ND	97.4	60-130			
Surrogate: Toluene-d8	8.08		ug/g		101	50-140			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Qualifier Notes:**Login Qualifiers :**

Sample not received in Paracel verified container / media

Applies to Samples: BH102 SS2, BH103 SS1, BH107 SS1, BH111 SS2, BH116 SS1

QC Qualifiers:Sample Data Revisions:

None

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 18-Mar-2022

Client PO: Charles Street

Project Description: G2S22008B

Work Order Revisions / Comments:

Revision-1: Guideline comparisons updated as per client request.

Other Report Notes:

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

Source Result: Data used as source for matrix and duplicate samples

%REC: Percent recovery.

RPD: Relative percent difference.

NC: Not Calculated

Soil results are reported on a dry weight basis unless otherwise noted.

Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.

CCME PHC additional information:

- The method for the analysis of PHCs complies with the Reference Method for the CWS PHC and is validated for use in the laboratory. All prescribed quality criteria identified in the method has been met.
- F1 range corrected for BTEX.
- F2 to F3 ranges corrected for appropriate PAHs where available.
- The gravimetric heavy hydrocarbons (F4G) are not to be added to C6 to C50 hydrocarbons.
- In the case where F4 and F4G are both reported, the greater of the two results is to be used for comparison to CWS PHC criteria.
- When reported, data for F4G has been processed using a silica gel cleanup.

Any use of these results implies your agreement that our total liability in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

Certificate of Analysis

G2S Environmental Consulting Inc. (Burlington)

4361 Harvester Road, Unit 12

Burlington, ON L7L 5M4

Attn: Dana Haslett

Client PO:

Project: G2S22008- Charles St

Custody:

Report Date: 13-Feb-2023

Order Date: 24-Mar-2022

Revised Report

Order #: 2213488

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
2213488-01	BH117 SS1
2213488-02	BH118 SS1
2213488-03	BH119 SS1

Approved By:



Milan Ralitsch, PhD

Senior Technical Manager

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	25-Mar-22	28-Mar-22
PHC F1	CWS Tier 1 - P&T GC-FID	25-Mar-22	28-Mar-22
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	25-Mar-22	28-Mar-22
REG 153: Metals by ICP/MS, soil	EPA 6020 - Digestion - ICP-MS	25-Mar-22	25-Mar-22
REG 153: pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	29-Mar-22	29-Mar-22
REG 153: VOCs by P&T GC-MS	EPA 8260 - P&T GC-MS	25-Mar-22	28-Mar-22
Solids, %	CWS Tier 1 - Gravimetric	25-Mar-22	28-Mar-22

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Summary of Criteria Exceedances

(If this page is blank then there are no exceedances)

Only those criteria that a sample exceeds will be highlighted in red

Regulatory Comparison:

Paracel Laboratories has provided regulatory guidelines on this report for informational purposes only and makes no representations or warranties that the data is accurate or reflects the current regulatory values. The user is advised to consult with the appropriate official regulations to evaluate compliance. Sample results that are highlighted have exceeded the selected regulatory limit. Calculated uncertainty estimations have not been applied for determining regulatory exceedances.

Sample	Analyte	MDL / Units	Result	Reg 406/19 -T1 Res/Park/Ind/Com	Reg 406/19 -T2.1 Res/Park/Inst
BH118 SS1	F4 PHCs (C34-C50)	6 ug/g	128	120 ug/g	2800 ug/g

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Client ID: Sample Date: Sample ID: Matrix:	BH117 SS1	BH118 SS1	BH119 SS1	-	Criteria:	
	23-Mar-22 00:00	23-Mar-22 00:00	23-Mar-22 00:00	-	Reg 406/19 -T1	Reg 406/19 -T2.1
	2213488-01	2213488-02	2213488-03	-	Res/Park/Ind/Com	Res/Park/Inst
	Soil	Soil	Soil	-		
MDL/Units						

Physical Characteristics

% Solids	0.1 % by Wt.	90.9	79.3	90.0	-	-	-
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General Inorganics

pH	0.05 pH Units	7.47	7.20	7.09	-	5.00 - 9.00 pH Units	5.00 - 9.00 pH Units
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Metals

Antimony	1 ug/g	<1.0	<1.0	<1.0	-	1.3 ug/g	7.5 ug/g
Arsenic	1 ug/g	1.4	3.0	2.6	-	18 ug/g	18 ug/g
Barium	1 ug/g	13.2	53.2	37.3	-	220 ug/g	390 ug/g
Beryllium	0.5 ug/g	<0.5	0.6	<0.5	-	2.5 ug/g	4 ug/g
Boron	5 ug/g	<5.0	<5.0	<5.0	-	36 ug/g	120 ug/g
Cadmium	0.5 ug/g	<0.5	<0.5	<0.5	-	1.2 ug/g	1.2 ug/g
Chromium	5 ug/g	<5.0	13.5	<5.0	-	70 ug/g	160 ug/g
Cobalt	1 ug/g	2.1	4.5	2.5	-	21 ug/g	22 ug/g
Copper	5 ug/g	5.6	9.7	<5.0	-	92 ug/g	140 ug/g
Lead	1 ug/g	4.4	15.8	11.0	-	120 ug/g	120 ug/g
Molybdenum	1 ug/g	<1.0	<1.0	<1.0	-	2 ug/g	6.9 ug/g
Nickel	5 ug/g	<5.0	11.0	<5.0	-	82 ug/g	100 ug/g
Selenium	1 ug/g	<1.0	<1.0	<1.0	-	1.5 ug/g	2.4 ug/g
Silver	0.3 ug/g	<0.3	<0.3	<0.3	-	0.5 ug/g	20 ug/g
Thallium	1 ug/g	<1.0	<1.0	<1.0	-	1 ug/g	1 ug/g
Uranium	1 ug/g	<1.0	<1.0	<1.0	-	2.5 ug/g	23 ug/g
Vanadium	10 ug/g	10.0	21.7	13.3	-	86 ug/g	86 ug/g
Zinc	20 ug/g	<20.0	62.9	28.4	-	290 ug/g	340 ug/g

Volatiles

Acetone	0.5 ug/g	-	<0.50	<0.50	-	0.5 ug/g	0.5 ug/g
Benzene	0.02 ug/g	-	<0.02	<0.02	-	0.02 ug/g	0.02 ug/g

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Client ID:	BH117 SS1	BH118 SS1	BH119 SS1	-	Criteria:	
Sample Date:	23-Mar-22 00:00	23-Mar-22 00:00	23-Mar-22 00:00	-	Reg 406/19 -T1	Reg 406/19 -T2.1
Sample ID:	2213488-01	2213488-02	2213488-03	-	Res/Park/Ind/Com	Res/Park/Inst
Matrix:	Soil	Soil	Soil	-		
MDL/Units						

Volatiles

Bromodichloromethane	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
Bromoform	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
Bromomethane	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
Carbon Tetrachloride	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
Chlorobenzene	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.083 ug/g
Chloroform	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
Dibromochloromethane	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
Dichlorodifluoromethane	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	1.5 ug/g
1,2-Dichlorobenzene	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	3.4 ug/g
1,3-Dichlorobenzene	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.26 ug/g
1,4-Dichlorobenzene	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
1,1-Dichloroethane	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
1,2-Dichloroethane	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
1,1-Dichloroethylene	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
cis-1,2-Dichloroethylene	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
trans-1,2-Dichloroethylene	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
1,2-Dichloropropane	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
cis-1,3-Dichloropropylene	0.05 ug/g	-	<0.05	<0.05	-	-	-
trans-1,3-Dichloropropylene	0.05 ug/g	-	<0.05	<0.05	-	-	-
1,3-Dichloropropene, total	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
Ethylbenzene	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
Ethylene dibromide (dibromoethane,	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
Hexane	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	2.5 ug/g
Methyl Ethyl Ketone (2-Butanone)	0.5 ug/g	-	<0.50	<0.50	-	0.5 ug/g	0.5 ug/g
Methyl Isobutyl Ketone	0.5 ug/g	-	<0.50	<0.50	-	0.5 ug/g	0.5 ug/g

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Client ID:	BH117 SS1	BH118 SS1	BH119 SS1	-	Criteria:	
Sample Date:	23-Mar-22 00:00	23-Mar-22 00:00	23-Mar-22 00:00	-	Reg 406/19 -T1	Reg 406/19 -T2.1
Sample ID:	2213488-01	2213488-02	2213488-03	-	Res/Park/Ind/Com	Res/Park/Inst
Matrix:	Soil	Soil	Soil	-		
MDL/Units						

Volatiles

Methyl tert-butyl ether	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
Methylene Chloride	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
Styrene	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
1,1,1,2-Tetrachloroethane	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
1,1,2,2-Tetrachloroethane	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
Tetrachloroethylene	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
Toluene	0.05 ug/g	-	<0.05	<0.05	-	0.2 ug/g	0.2 ug/g
1,1,1-Trichloroethane	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.11 ug/g
1,1,2-Trichloroethane	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
Trichloroethylene	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.05 ug/g
Trichlorofluoromethane	0.05 ug/g	-	<0.05	<0.05	-	0.25 ug/g	0.25 ug/g
Vinyl chloride	0.02 ug/g	-	<0.02	<0.02	-	0.02 ug/g	0.02 ug/g
m,p-Xylenes	0.05 ug/g	-	<0.05	<0.05	-	-	-
o-Xylene	0.05 ug/g	-	<0.05	<0.05	-	-	-
Xylenes, total	0.05 ug/g	-	<0.05	<0.05	-	0.05 ug/g	0.091 ug/g
Dibromofluoromethane	Surrogate	-	102%	90.9%	-	-	-
4-Bromofluorobenzene	Surrogate	-	95.8%	102%	-	-	-
Toluene-d8	Surrogate	-	104%	107%	-	-	-
Benzene	0.02 ug/g	<0.02	-	-	-	0.02 ug/g	0.02 ug/g
Ethylbenzene	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.05 ug/g
Toluene	0.05 ug/g	<0.05	-	-	-	0.2 ug/g	0.2 ug/g
m,p-Xylenes	0.05 ug/g	<0.05	-	-	-	-	-
o-Xylene	0.05 ug/g	<0.05	-	-	-	-	-
Xylenes, total	0.05 ug/g	<0.05	-	-	-	0.05 ug/g	0.091 ug/g
Toluene-d8	Surrogate	107%	-	-	-	-	-

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Client ID:	BH117 SS1	BH118 SS1	BH119 SS1	-	Criteria:	
Sample Date:	23-Mar-22 00:00	23-Mar-22 00:00	23-Mar-22 00:00	-	Reg 406/19 -T1	Reg 406/19 -T2.1
Sample ID:	2213488-01	2213488-02	2213488-03	-	Res/Park/Ind/Com	Res/Park/Inst
Matrix:	Soil	Soil	Soil	-		
MDL/Units						

Hydrocarbons

F1 PHCs (C6-C10)	7 ug/g	<7	<7	<7	-	25 ug/g	25 ug/g
F2 PHCs (C10-C16)	4 ug/g	<4	<4	<4	-	10 ug/g	10 ug/g
F3 PHCs (C16-C34)	8 ug/g	<8	64	<8	-	240 ug/g	240 ug/g
F4 PHCs (C34-C50)	6 ug/g	51	128	39	-	120 ug/g	2800 ug/g

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons								
F1 PHCs (C6-C10)	ND	7	ug/g					
F2 PHCs (C10-C16)	ND	4	ug/g					
F3 PHCs (C16-C34)	ND	8	ug/g					
F4 PHCs (C34-C50)	ND	6	ug/g					
Metals								
Antimony	ND	1.0	ug/g					
Arsenic	ND	1.0	ug/g					
Barium	ND	1.0	ug/g					
Beryllium	ND	0.5	ug/g					
Boron	ND	5.0	ug/g					
Cadmium	ND	0.5	ug/g					
Chromium	ND	5.0	ug/g					
Cobalt	ND	1.0	ug/g					
Copper	ND	5.0	ug/g					
Lead	ND	1.0	ug/g					
Molybdenum	ND	1.0	ug/g					
Nickel	ND	5.0	ug/g					
Selenium	ND	1.0	ug/g					
Silver	ND	0.3	ug/g					
Thallium	ND	1.0	ug/g					
Uranium	ND	1.0	ug/g					
Vanadium	ND	10.0	ug/g					
Zinc	ND	20.0	ug/g					
Volatiles								
Acetone	ND	0.50	ug/g					
Benzene	ND	0.02	ug/g					
Bromodichloromethane	ND	0.05	ug/g					
Bromoform	ND	0.05	ug/g					
Bromomethane	ND	0.05	ug/g					
Carbon Tetrachloride	ND	0.05	ug/g					
Chlorobenzene	ND	0.05	ug/g					
Chloroform	ND	0.05	ug/g					

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Dibromochloromethane	ND	0.05	ug/g					
Dichlorodifluoromethane	ND	0.05	ug/g					
1,2-Dichlorobenzene	ND	0.05	ug/g					
1,3-Dichlorobenzene	ND	0.05	ug/g					
1,4-Dichlorobenzene	ND	0.05	ug/g					
1,1-Dichloroethane	ND	0.05	ug/g					
1,2-Dichloroethane	ND	0.05	ug/g					
1,1-Dichloroethylene	ND	0.05	ug/g					
cis-1,2-Dichloroethylene	ND	0.05	ug/g					
trans-1,2-Dichloroethylene	ND	0.05	ug/g					
1,2-Dichloropropane	ND	0.05	ug/g					
cis-1,3-Dichloropropylene	ND	0.05	ug/g					
trans-1,3-Dichloropropylene	ND	0.05	ug/g					
1,3-Dichloropropene, total	ND	0.05	ug/g					
Ethylbenzene	ND	0.05	ug/g					
Ethylene dibromide (dibromoethane, 1,2-)	ND	0.05	ug/g					
Hexane	ND	0.05	ug/g					
Methyl Ethyl Ketone (2-Butanone)	ND	0.50	ug/g					
Methyl Isobutyl Ketone	ND	0.50	ug/g					
Methyl tert-butyl ether	ND	0.05	ug/g					
Methylene Chloride	ND	0.05	ug/g					
Styrene	ND	0.05	ug/g					
1,1,1,2-Tetrachloroethane	ND	0.05	ug/g					
1,1,2,2-Tetrachloroethane	ND	0.05	ug/g					
Tetrachloroethylene	ND	0.05	ug/g					
Toluene	ND	0.05	ug/g					
1,1,1-Trichloroethane	ND	0.05	ug/g					
1,1,2-Trichloroethane	ND	0.05	ug/g					
Trichloroethylene	ND	0.05	ug/g					
Trichlorofluoromethane	ND	0.05	ug/g					
Vinyl chloride	ND	0.02	ug/g					
m,p-Xylenes	ND	0.05	ug/g					
o-Xylene	ND	0.05	ug/g					

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Xylenes, total	ND	0.05	ug/g					
Surrogate: 4-Bromofluorobenzene	8.28		ug/g	103	50-140			
Surrogate: Dibromofluoromethane	6.56		ug/g	82.0	50-140			
Surrogate: Toluene-d8	8.65		ug/g	108	50-140			
Benzene	ND	0.02	ug/g					
Ethylbenzene	ND	0.05	ug/g					
Toluene	ND	0.05	ug/g					
m,p-Xylenes	ND	0.05	ug/g					
o-Xylene	ND	0.05	ug/g					
Xylenes, total	ND	0.05	ug/g					
Surrogate: Toluene-d8	8.65		ug/g	108	50-140			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
pH	7.43	0.05	pH Units	7.47			0.5	10	
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g	ND			NC	40	
F2 PHCs (C10-C16)	ND	4	ug/g	ND			NC	30	
F3 PHCs (C16-C34)	ND	8	ug/g	ND			NC	30	
F4 PHCs (C34-C50)	ND	6	ug/g	ND			NC	30	
Metals									
Antimony	ND	1.0	ug/g	ND			NC	30	
Arsenic	4.2	1.0	ug/g	3.8			8.2	30	
Barium	28.3	1.0	ug/g	27.7			2.3	30	
Beryllium	ND	0.5	ug/g	ND			NC	30	
Boron	11.1	5.0	ug/g	7.7			NC	30	
Cadmium	ND	0.5	ug/g	ND			NC	30	
Chromium	7.7	5.0	ug/g	7.6			0.7	30	
Cobalt	6.9	1.0	ug/g	6.6			4.1	30	
Copper	18.6	5.0	ug/g	18.3			1.6	30	
Lead	6.7	1.0	ug/g	6.5			3.2	30	
Molybdenum	ND	1.0	ug/g	ND			NC	30	
Nickel	7.4	5.0	ug/g	7.6			2.9	30	
Selenium	1.2	1.0	ug/g	ND			NC	30	
Silver	ND	0.3	ug/g	ND			NC	30	
Thallium	ND	1.0	ug/g	ND			NC	30	
Uranium	ND	1.0	ug/g	ND			NC	30	
Vanadium	18.0	10.0	ug/g	17.8			1.2	30	
Zinc	33.0	20.0	ug/g	32.9			0.1	30	
Physical Characteristics									
% Solids	47.7	0.1	% by Wt.	40.3			16.8	25	
Volatiles									
Acetone	ND	0.50	ug/g	ND			NC	50	
Benzene	ND	0.02	ug/g	ND			NC	50	

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Bromodichloromethane	ND	0.05	ug/g	ND			NC	50	
Bromoform	ND	0.05	ug/g	ND			NC	50	
Bromomethane	ND	0.05	ug/g	ND			NC	50	
Carbon Tetrachloride	ND	0.05	ug/g	ND			NC	50	
Chlorobenzene	ND	0.05	ug/g	ND			NC	50	
Chloroform	ND	0.05	ug/g	ND			NC	50	
Dibromochloromethane	ND	0.05	ug/g	ND			NC	50	
Dichlorodifluoromethane	ND	0.05	ug/g	ND			NC	50	
1,2-Dichlorobenzene	ND	0.05	ug/g	ND			NC	50	
1,3-Dichlorobenzene	ND	0.05	ug/g	ND			NC	50	
1,4-Dichlorobenzene	ND	0.05	ug/g	ND			NC	50	
1,1-Dichloroethane	ND	0.05	ug/g	ND			NC	50	
1,2-Dichloroethane	ND	0.05	ug/g	ND			NC	50	
1,1-Dichloroethylene	ND	0.05	ug/g	ND			NC	50	
cis-1,2-Dichloroethylene	ND	0.05	ug/g	ND			NC	50	
trans-1,2-Dichloroethylene	ND	0.05	ug/g	ND			NC	50	
1,2-Dichloropropane	ND	0.05	ug/g	ND			NC	50	
cis-1,3-Dichloropropylene	ND	0.05	ug/g	ND			NC	50	
trans-1,3-Dichloropropylene	ND	0.05	ug/g	ND			NC	50	
Ethylbenzene	ND	0.05	ug/g	ND			NC	50	
Ethylene dibromide (dibromoethane, 1,2-)	ND	0.05	ug/g	ND			NC	50	
Hexane	ND	0.05	ug/g	ND			NC	50	
Methyl Ethyl Ketone (2-Butanone)	ND	0.50	ug/g	ND			NC	50	
Methyl Isobutyl Ketone	ND	0.50	ug/g	ND			NC	50	
Methyl tert-butyl ether	ND	0.05	ug/g	ND			NC	50	
Methylene Chloride	ND	0.05	ug/g	ND			NC	50	
Styrene	ND	0.05	ug/g	ND			NC	50	
1,1,1,2-Tetrachloroethane	ND	0.05	ug/g	ND			NC	50	
1,1,2,2-Tetrachloroethane	ND	0.05	ug/g	ND			NC	50	
Tetrachloroethylene	ND	0.05	ug/g	ND			NC	50	
Toluene	ND	0.05	ug/g	ND			NC	50	

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
1,1,1-Trichloroethane	ND	0.05	ug/g	ND			NC	50	
1,1,2-Trichloroethane	ND	0.05	ug/g	ND			NC	50	
Trichloroethylene	ND	0.05	ug/g	ND			NC	50	
Trichlorofluoromethane	ND	0.05	ug/g	ND			NC	50	
Vinyl chloride	ND	0.02	ug/g	ND			NC	50	
m,p-Xylenes	ND	0.05	ug/g	ND			NC	50	
o-Xylene	ND	0.05	ug/g	ND			NC	50	
Surrogate: 4-Bromofluorobenzene	8.80		ug/g		105	50-140			
Surrogate: Dibromofluoromethane	6.58		ug/g		78.4	50-140			
Surrogate: Toluene-d8	9.19		ug/g		110	50-140			
Benzene	ND	0.02	ug/g	ND			NC	50	
Ethylbenzene	ND	0.05	ug/g	ND			NC	50	
Toluene	ND	0.05	ug/g	ND			NC	50	
m,p-Xylenes	ND	0.05	ug/g	ND			NC	50	
o-Xylene	ND	0.05	ug/g	ND			NC	50	
Surrogate: Toluene-d8	9.19		ug/g		110	50-140			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	63	7	ug/g	ND	89.7	80-120			
F2 PHCs (C10-C16)	83	4	ug/g	ND	91.9	60-140			
F3 PHCs (C16-C34)	157	8	ug/g	ND	77.7	60-140			
F4 PHCs (C34-C50)	127	6	ug/g	ND	87.2	60-140			
Metals									
Antimony	141	1.0	ug/g	ND	113	70-130			
Arsenic	118	1.0	ug/g	3.8	91.5	70-130			
Barium	146	1.0	ug/g	27.7	95.0	70-130			
Beryllium	121	0.5	ug/g	ND	96.5	70-130			
Boron	133	5.0	ug/g	7.7	100	70-130			
Cadmium	108	0.5	ug/g	ND	86.1	70-130			
Chromium	117	5.0	ug/g	7.6	87.5	70-130			
Cobalt	113	1.0	ug/g	6.6	85.4	70-130			
Copper	125	5.0	ug/g	18.3	85.0	70-130			
Lead	125	1.0	ug/g	6.5	95.2	70-130			
Molybdenum	112	1.0	ug/g	ND	89.4	70-130			
Nickel	111	5.0	ug/g	7.6	83.0	70-130			
Selenium	115	1.0	ug/g	ND	91.7	70-130			
Silver	117	0.3	ug/g	ND	93.4	70-130			
Thallium	118	1.0	ug/g	ND	94.2	70-130			
Uranium	115	1.0	ug/g	ND	92.1	70-130			
Vanadium	127	10.0	ug/g	17.8	87.5	70-130			
Zinc	144	20.0	ug/g	32.9	88.8	70-130			
Volatiles									
Acetone	9.46	0.50	ug/g	ND	94.6	50-140			
Benzene	3.75	0.02	ug/g	ND	93.3	60-130			
Bromodichloromethane	3.68	0.05	ug/g	ND	91.5	60-130			
Bromoform	3.87	0.05	ug/g	ND	96.3	60-130			
Bromomethane	3.53	0.05	ug/g	ND	88.2	50-140			
Carbon Tetrachloride	3.48	0.05	ug/g	ND	86.9	60-130			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Chlorobenzene	4.04	0.05	ug/g	ND	100	60-130			
Chloroform	3.83	0.05	ug/g	ND	95.4	60-130			
Dibromochloromethane	3.62	0.05	ug/g	ND	90.4	60-130			
Dichlorodifluoromethane	3.01	0.05	ug/g	ND	75.3	50-140			
1,2-Dichlorobenzene	3.89	0.05	ug/g	ND	97.2	60-130			
1,3-Dichlorobenzene	3.91	0.05	ug/g	ND	97.7	60-130			
1,4-Dichlorobenzene	3.94	0.05	ug/g	ND	98.0	60-130			
1,1-Dichloroethane	4.38	0.05	ug/g	ND	110	60-130			
1,2-Dichloroethane	3.71	0.05	ug/g	ND	92.2	60-130			
1,1-Dichloroethylene	3.97	0.05	ug/g	ND	99.2	60-130			
cis-1,2-Dichloroethylene	4.30	0.05	ug/g	ND	107	60-130			
trans-1,2-Dichloroethylene	3.85	0.05	ug/g	ND	95.9	60-130			
1,2-Dichloropropane	3.70	0.05	ug/g	ND	92.5	60-130			
cis-1,3-Dichloropropylene	3.81	0.05	ug/g	ND	95.3	60-130			
trans-1,3-Dichloropropylene	3.84	0.05	ug/g	ND	95.5	60-130			
Ethylbenzene	4.12	0.05	ug/g	ND	102	60-130			
Ethylene dibromide (dibromoethane, 1,2-)	3.92	0.05	ug/g	ND	97.4	60-130			
Hexane	3.86	0.05	ug/g	ND	96.6	60-130			
Methyl Ethyl Ketone (2-Butanone)	9.86	0.50	ug/g	ND	98.6	50-140			
Methyl Isobutyl Ketone	10.6	0.50	ug/g	ND	106	50-140			
Methyl tert-butyl ether	9.91	0.05	ug/g	ND	99.1	50-140			
Methylene Chloride	3.62	0.05	ug/g	ND	90.0	60-130			
Styrene	4.30	0.05	ug/g	ND	106	60-130			
1,1,1,2-Tetrachloroethane	4.08	0.05	ug/g	ND	102	60-130			
1,1,2,2-Tetrachloroethane	4.07	0.05	ug/g	ND	101	60-130			
Tetrachloroethylene	3.77	0.05	ug/g	ND	93.8	60-130			
Toluene	4.17	0.05	ug/g	ND	104	60-130			
1,1,1-Trichloroethane	3.68	0.05	ug/g	ND	92.1	60-130			
1,1,2-Trichloroethane	3.94	0.05	ug/g	ND	98.0	60-130			
Trichloroethylene	3.65	0.05	ug/g	ND	90.9	60-130			
Trichlorofluoromethane	3.94	0.05	ug/g	ND	98.4	50-140			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Vinyl chloride	3.42	0.02	ug/g	ND	85.4	50-140			
m,p-Xylenes	8.23	0.05	ug/g	ND	103	60-130			
o-Xylene	4.23	0.05	ug/g	ND	105	60-130			
Surrogate: 4-Bromofluorobenzene	7.64		ug/g		95.5	50-140			
Surrogate: Dibromofluoromethane	7.85		ug/g		98.1	50-140			
Surrogate: Toluene-d8	8.20		ug/g		102	50-140			
Benzene	3.75	0.02	ug/g	ND	93.3	60-130			
Ethylbenzene	4.12	0.05	ug/g	ND	102	60-130			
Toluene	4.17	0.05	ug/g	ND	104	60-130			
m,p-Xylenes	8.23	0.05	ug/g	ND	103	60-130			
o-Xylene	4.23	0.05	ug/g	ND	105	60-130			
Surrogate: Toluene-d8	8.20		ug/g		102	50-140			

Certificate of Analysis

Report Date: 13-Feb-2023

Client: G2S Environmental Consulting Inc. (Burlington)

Order Date: 24-Mar-2022

Client PO:

Project Description: G2S22008- Charles St

Qualifier Notes:

QC Qualifiers:

Sample Data Revisions:

None

Work Order Revisions / Comments:

Revision-1 This report includes an updated parameter list as per the client.

Revision-2: Comparison changed to Reg 153 Table 2 RPI, as per client request.

Revision-3: Guideline comparisons updated as per client request.

Other Report Notes:

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

Source Result: Data used as source for matrix and duplicate samples

%REC: Percent recovery.

RPD: Relative percent difference.

NC: Not Calculated

Soil results are reported on a dry weight basis unless otherwise noted.

Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.

CCME PHC additional information:

- The method for the analysis of PHCs complies with the Reference Method for the CWS PHC and is validated for use in the laboratory. All prescribed quality criteria identified in the method has been met.

- F1 range corrected for BTEX.

- F2 to F3 ranges corrected for appropriate PAHs where available.

- The gravimetric heavy hydrocarbons (F4G) are not to be added to C6 to C50 hydrocarbons.

- In the case where F4 and F4G are both reported, the greater of the two results is to be used for comparison to CWS PHC criteria.

- When reported, data for F4G has been processed using a silica gel cleanup.

Any use of these results implies your agreement that our total liability in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

Assessment of Past Uses Report



Charles Street Subdivision
Charles Street and Washington Street, Waterford, Ontario
G2S22008A

Roger Sharma
2863088 Ontario Inc.
3156 Countess Crescent
Mississauga, Ontario
L5M 0E2

Executive Summary

G2S Consulting Inc. (G2S) was retained by Roger Sharma of 2863088 Ontario Inc. (the Client) to complete an Assessment of Past Uses Report for a land parcel comprising four properties included in the proposed Charles Street Subdivision plan located in Waterford, Ontario, hereinafter referred to as the 'Project Area'. Refer to Drawing 1 in Appendix A for the Project Area Location Plan.

The Project Area is comprised of four properties located on the north side of Charles Street and the west side of Washington Street and covers an approximate plan area of 4.39 ha (10.8 ac.). The property located at 183 Charles Street is vacant undeveloped land, hereinafter referred to as 'Property 1'. The property located at 173 Charles Street is developed with one residential building, hereinafter referred to as 'Property 2'. The property located at 155 Charles Street is developed and occupied by Peter Overdevest and Sons Landscaping and Nursery business, hereinafter referred to as 'Property 3'. Lastly, the property located on the west side of Washington Street (no municipal address) is vacant undeveloped land, hereinafter referred to as 'Property 4'.

The proposed development plan includes the development of a 63-unit residential subdivision, including single homes, two storey townhouses, bungalow townhouses, and a park block and stormwater management (SWM) pond. During construction activities, excess soil may be generated, the volume of which is unknown at this time.

An Assessment of Past Uses (APU) report was required to meet the objectives of the Ontario Ministry of the Environment, Conservation and Parks (MECP) document titled "Rules for Soil Management and Excess Soil Quality Standards," December 8, 2020, and Ontario Regulation 406/19, On-Site and Excess Soil Management.

The purpose of this APU report was to:

- i. Develop a preliminary determination of the likelihood that one or more contaminants have affected soil or rock in a location where soil or crushed rock is to be excavated within the Project Area.
- ii. Determine if any location where soil or crushed rock is to be excavated could have been affected by a potentially contaminating activity (PCA) and identify any areas of potential environmental concern (APECs) within the Project Area.
- iii. Identify the contaminants of potential concern (COPCs) to determine the focus of the sampling and analysis plan, if any APECs are identified.

This report incorporates the concept of PCAs, and APECs identified by the MECP as outlined in Schedule D of O. Reg. 153/04.

Based on information collected from the Project Area site visit, records review, and interviews, Property 1 and Property 4 are currently and have historically consisted of vacant undeveloped or agricultural land. Property 2 was first developed with the current single-storey residential building in 1964 and Property 3 was first developed with the current landscaping and nursery business in 1967. The Project Area has remained the same since initial development.

The APU report identified two PCAs within the Project Area and one PCA within the Study Area, which were assessed based on observations of the operations, their location relative to the Project Area with respect to the inferred groundwater flow direction, their tenure, expected chemical storage amounts and proposed excavation depth of the excess soil. Based on review and evaluation of the information gathered, the following APECs have been identified for the Project Area:

APEC 1 - Northern and central backyard portions of Property 2: Current and historical presence of miscellaneous debris, scrap metal, and derelict automobiles.

APEC 2 – Property 1, 3, and 4 - Potential use of pesticides associated with agricultural use.

In this regard, it is recommended that the excess soil sampling and analysis plan include the following parameters:

- Petroleum Hydrocarbons Fractions F1 to F4 (PHCs F1-F4)
- Benzene, toluene, ethylbenzene and xylenes (BTEX)
- Volatile organic compounds (VOCs)
- Metals
- Organochlorine Pesticides (OCPs)
- pH

It is noted that despite any chemical testing program, ultimate acceptance of excess soil lies with the receiving site and their written approval to receive the material, based on review of the reports provided. In this regard, additional sampling and testing may be requested depending on the receiving site and volume of excess soil to be generated.

Should a Record of Site Condition (RSC) be required for the Project Area, additional work will be required.

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1. Introduction

G2S Consulting Inc. (G2S) was retained by Roger Sharma of 2863088 Ontario Inc. (the Client) to complete an Assessment of Past Uses Report for a land parcel comprising four properties included in the proposed Charles Street Subdivision plan located in Waterford, Ontario, hereinafter referred to as the 'Project Area'. Refer to Drawing 1 in Appendix A for the Project Area Location Plan.

The Project Area is comprised of four properties located on the north side of Charles Street and the west side of Washington Street and covers an approximate plan area of 4.39 ha (10.8 ac.). The property located at 183 Charles Street is vacant undeveloped land, hereinafter referred to as 'Property 1'. The property located at 173 Charles Street is developed with one residential building, hereinafter referred to as 'Property 2'. The property located at 155 Charles Street is developed and occupied by Peter Overvest and Sons Landscaping and Nursery business, hereinafter referred to as 'Property 3'. Lastly, the property located on the west side of Washington Street (no municipal address) is vacant undeveloped land, hereinafter referred to as 'Property 4'.

The proposed development plan includes the development of a 63-unit residential subdivision, including single homes, two storey townhouses, bungalow townhouses, and a park block and stormwater management (SWM) pond. During construction activities, excess soil may be generated, the volume of which is unknown at this time.

2. Terms of Reference and Scope of Work

The purpose of this APU report was to:

- i. Develop a preliminary determination of the likelihood that one or more contaminants have affected soil or rock in a location where soil or crushed rock is to be excavated within the Project Area.
- ii. Determine if any location where soil or crushed rock is to be excavated could have been affected by a potentially contaminating activity (PCA) and identify any areas of potential environmental concern (APECs) within the Project Area.
- iii. Identify the contaminants of potential concern (COPCs) to determine the focus of the sampling and analysis plan, if any APECs are identified.

This APU report was completed in accordance with the Ontario Ministry of the Environment, Conservation and Parks (MECP) document titled “Rules for Soil Management and Excess Soil Quality Standards,” December 8, 2020. It incorporates the concept of PCAs and APECs identified by the MECP as outlined in Schedule D of O. Reg. 153/04, as amended.

The APU scope of work involved a records review, a Project Area site visit, interviews, evaluation of the information gathered and preparation of this report.

3. Project Area Information

For the purposes of this report the 'Project Area' is defined as a single property or adjoining properties on which the project is carried out.

Table 1: General Project Area Details

Municipal Address	The Project Area consists of four properties including: Property 1 – 183 Charles Street, Waterford, ON Property 2 – 173 Charles Street, Waterford, ON Property 3 – 155 Charles Street, Waterford, ON Property 4 – Washington Street, Waterford, ON (no municipal address)
General Site Location	Property 1 – Located on the northern side of Charles Street, approximately 185 m west of Washington Street. Property 2 – Located on the northern side of Charles Street, approximately 140 m west of Washington Street. Property 3 – Located on the northern side of Charles Street, approximately 65 m west of Washington street. Property 4 – Located on the western side of Washington Street, approximately 135 m north of Charles Street.
Approximate Plan Area	4.39 ha (10.8 ac.)
Current Project Area Use/Occupant	Property 1 – Vacant undeveloped land Property 2 – Residential building Property 3 – Peter Overdevest and Sons Landscaping and Nursery Property 4 – Vacant undeveloped land
Legal Description	Property 1 – WAT PLAN 19B PT BLK 32 RP; 37R7727 PT 3; IRREG (3.49AC 68.61FR D) Property 2 – WAT PLAN 19B PT BLK 32; REG (0.96AC 121.02FR 344.25D) Property 3 – WAT PLAN 19B BLK 32 PT RP; 37R4822 PART 1, REG (2.32AC 147.16FR D) Property 4 – WAT PLAN 19B PT BLK 32; REG (4.00AC 296.00FR D)
Location of Potential Excess Soil	Locations and volumes to be determined once final design and development approval is obtained.
Current Project Area Owner	2863088 Ontario Inc.

The APU Study Area includes the Project Area and lands within approximately 250 m, hereinafter referred to as the 'Study Area'. The Project Area Location Plan is shown on Drawing 1 and the Study Area is shown on Drawing 2. Refer to Drawing 3 for the Project Area Plan included as Drawing 3 in Appendix A.

4. Records Review

Available public records were reviewed to determine the land use history of the Project Area and pertinent surrounding properties.

4.1 General

4.1.1 Assessment of Past Uses Study Area Determination

In accordance with O. Reg. 153/04, as amended, and adopted by the Rules for Soil Management and Excess Soil Quality Standards, the Assessment of Past Uses Report must include, at a minimum the Project Area and any other property that is located within 250 m of the Project Area boundaries. This is referred to as the Assessment of Past Uses Study Area (Study Area) as depicted on Drawing 2 in Appendix A.

4.1.2 First Developed Use Determination

In accordance with the Regulation, the following definition applies:

“first developed use” means *the earlier of*,

- i. the first use of the site (Project Area) in or after 1875 that resulted in the development of a building or structure on the property, and
- ii. the first potentially contaminating use or activity on the site (Project Area);

Based on information collected from the Project Area site visit, records review, and interviews, the Project Area was vacant undeveloped land until 1964 when a single-storey residential building was developed on Property 2. Therefore, the first developed use was about 1964.

4.1.3 Project Area Ownership

The current owner, 2863088 Ontario Inc., took possession of the four subject properties (Project Area) between July 2021 and January 2022.

4.1.4 Fire Insurance Plans

Fire Insurance Plans (FIPs) were not published for the community of Waterford.

4.1.5 Street Directories

Street directories were not published for the community of Waterford.

4.1.6 Waste Management Records

The Project Area and adjacent properties were searched by company name in the Hazardous Waste Information Network (HWIN) and the Hazardous Waste Information System (HWIS) databases from 1986-1993 and every other year from 2002-2020. No records were found.

4.2 Regulatory Information

Table 2: Environmental Source Information

Document	Source	Pertinent Information
National Pollutant Release Inventory (NPRI) database	NPRI online	-Search for records in the vicinity of the Project Area was conducted in two-year increments for the years 1994-2017. No records were found for the Project Area or Study Area.
Ontario Inventory of Polychlorinated Biphenyl (PCB) Storage Sites (1991 & 1995)	MECP	-No records for Project Area or Study Area
Inventory of Coal Gasification Plant Waste Sites in Ontario	MECP	-No records for Project Area or Study Area
Inventory of Industrial Sites Producing and Using Coal Tar and Related Tars in Ontario	MECP	-No records for Project Area or Study Area
Freedom of Information (FOI) Request	MECP	-Requests generally take several weeks to months to generate a response. Should a response from the government agency change the conclusions or recommendations of this report, an addendum letter will be provided along with the information received.
Waste Disposal Site Inventory, June 1991	MECP	-No records for Project Area or Study Area
Brownfields Environmental Site Registry	MECP online	-No record of RSCs for the Project Area
Technical Standards and Safety Authority (TSSA)	TSSA via email	-The following record was identified within the Study Area: -105 Thompson Road (~130 m southeast) for an active Fuel Safety (FS) Compressed Natural Gas (CNG) – Self-Serve (SS) – Slow Fill.

None of the above databases reviewed have identified a potential PCA for the Project Area. The environmental source information is included in Appendix B.

4.3 Physical Setting Sources

4.3.1 Aerial Photographs

For ease of reference, aerial photographs are included as Drawings 4 through 7 in Appendix A. The following table summarizes the information.

Table 3: Aerial Photographs

Year	Project Area Description	Study Area Description
1954	The Project Area is undeveloped or used for agricultural purposes.	The Study Area is mostly undeveloped land or used for agricultural purposes. Residential development is generally located east of Washington Street. Residential houses are also located north of the Project Area along West Church Street. The Lake Erie and Northern Railway is located to the west of the Project Area (~210 m west).
2003	One residential building has been developed in the southern portion of the Project Area (Property 2). Additionally, a commercial landscaping and nursery business has been developed in the southern portion of the Project Area (Property 3). The remainder of the Project Area appears to be vacant and undeveloped (Property 1 and Property 4). The Project Area is developed similar to present.	North and west of the Project Area remain as agricultural land. A school has been developed southeast of the Project Area located at 250 Washington Street (~10 m southeast). Additional residences have been developed along Charles Street, located south-southwest adjacent to the Project Area. The Lake Erie and Northern Railway has been decommissioned and is now a walking trail, referred to as the 'Lake Erie and Northern Trail.'
2010		
2018		Cottonwood Street has been developed north of the Project Area with residences. The Study Area is developed similar to present.

4.3.2 Ontario Base Maps/Topographic and Other Maps

For ease of reference, selected maps are included as Drawings 8 and 9 in Appendix A. The following table summarizes the information.

Table 4: Topographic and Other Maps

Item	Year	Project Area Description	Study Area Description
Topographic Map	1970	-The Project Area appears to be mostly vacant land, with one building developed along Charles Street. -The surface elevation of the Project Area is approximately 240 m. -The expected direction of groundwater flow is west following surface topography towards the Waterford Ponds, located approximately 820 m west of the Project Area.	-The majority of the Study Area is vacant, undeveloped land. -Residential development is located east of the Project Area. Several single residential houses line Charles Street, Washington Street, and West Church Street. -The Lake Erie and Northern Railway is located west of the Study Area (~210 m west).
Ontario Base Map (OBM)	Reviewed March 2022	-Project Area is developed with one building in the southern portion, along Charles Street. The remainder of the Project Area	-The Study Area consists of residential and undeveloped land. -The Lake Erie and Northern Railway is located west of the

Item	Year	Project Area Description	Study Area Description
	NAD 1983	appears to be undeveloped. The surface elevation of the Project Area is approximately 240 to 245 m.	Study Area (~210 m west) and the Waterford Ponds are also located to the west (820 m west).
Bedrock Geology of Southern Ontario, Southern Sheet, Map 2544	1991	-The bedrock underlying the Project Area is comprised of Lower Devonian sandstone, dolostone and limestone of the Bois Blanc Formation; Oriskany Formation.	
Generalized Soil Map, Regional Municipality of Haldimand-Norfolk Ontario	Published 1985	-Project Area is dominantly gravelly sands of fluvial or till derivation, and is classified as sandy loam of the Fox Grey Brown Podzolic Group.	
MECP Well Records	Reviewed March, 2022	-According to the MECP database, there were multiple well records in the Study Area. The following record is included in Appendix C for reference: -A record from an irrigation well located at 131 Charles Street (~40 m east of the Project Area) identified soil as black topsoil from 0 – 0.9 m below ground surface (bgs), brown sand from 0.9 – 4.6 m bgs, blue clay from 4.6 – 11 m bgs, and grey medium sand from 11 – 14.3 m bgs. The static water level was recorded at 10.7 m bgs.	

4.3.3 Hydrology and Hydrogeology

Surface water from the Project Area is expected to infiltrate through the unpaved surfaces covering the ground surface.

A tributary branching from the Waterford Ponds is located approximately 120 m south of the Project Area and flows west to the Waterford Ponds, located approximately 820 m west. The Waterford ponds are a collection of water bodies surrounded by provincially significant wetlands and woodlands. Surface elevations in the area generally decrease to the west. Based on our observations and review, the regional component of groundwater flow is expected to flow west towards the Waterford Ponds, while a local-scale component may flow south towards the Waterford Ponds tributary.

4.4 Project Area Operating Records and Environmental Reports

No Project Area operating records or previous environmental reports were provided to G2S.

5. Interviews

An interview regarding the Project Area was conducted via email with Norm Merz, the Sales Representative of RE/MAX Real Estate Centre Inc. Brokerage, on March 8, 2022. Based on the information provided the current owner of the Project Area, 2863088 Ontario Inc., took possession of the four subject properties between July 2021 and January 2022.

An interview regarding Property 2 was conducted with Cathy Szymezko, the previous owner and current tenant, during the site visit on March 8, 2022. Based on the information provided, a drain that was observed in the northern yard area was used for stormwater management as the property often floods. An additional interview regarding Property 2 was conducted via email with Richard Szymezko, the previous owner and current tenant, on March 8, 2022. Based on the information provided, Property 2 was purchased by the Szymezko's in 1964, when they first developed the vacant land with the current single-storey residential building. It was confirmed that a plastic tote (~1,200 L) that was observed on the property was filled with water used for the aboveground pool. Woodworking practices are carried out on the property.

An interview regarding Property 3 was conducted with Peter Overdevest, the previous owner and current tenant, on March 9, 2022. Based on the information provided, Overdevest purchased Property 3 in 1967. Prior to 1967, the property was vacant and undeveloped land. Overdevest then developed the property to be used as 'Peter Overdevest and Sons Landscaping and Nursery' business, and it remains as such to present day. Nursery stock is grown, stored, and sold on the property. No pesticides are used or stored on the property, other than the occasional hand spraying when a problem arises.

6. Project Area Site Visit

Observations of the Project Area, adjacent and surrounding properties were conducted by walking over the Project Area. Adjacent and surrounding properties were observed from within the Project Area or by other public means. Refer to Drawing 3 for details of the Project Area site visit and approximate extent of possible excess soil removal. Photographs of the Project Area are included in Appendix D.

Table 5: Project Area Site Visit

Date	March 8, 2022
Time	9:00 am
Weather	Sunny, -2° Celsius
Person who conducted the Project Area visit	Emma Keefe, B.Sc., G.I.T.
Project Area Contact	Norm Merz, Sales Representative, REMAX Real Estate Centre Inc.
Qualified Person	Melissa King, P.Geo.
Facility Operating: Yes/No	Yes
General Observations:	
The Project Area consists of four subject properties: 183 Charles Street – Vacant undeveloped land (Property 1) 173 Charles Street – Residential building (Property 2) 155 Charles Street – Commercial Landscaping and Nursery business (Property 3) Washington Street (no municipal address) – Vacant undeveloped land (Property 4) Property 1: Undeveloped land with tree covered areas to the west and sandy loam covering ground surface. Property 2: Developed with one single-storey residential building, with a basement, located in the southwestern portion of the property. One single-storey wood shed is located in the eastern portion of the property and is used for storage. An above ground swimming pool and multiple small-scale storage sheds are located in the northern portion of the property. A drain is located to the north of the residential building and is used to drain surface water from the property as stormwater management. The north portion of the property contained multiple piles of scrap metal, wood, woodworking equipment, derelict automobiles and other miscellaneous items. Plastic and metal containers and canisters were located throughout the exterior yard area; contents were unknown. Woodworking practices are carried out on the property. The ground surface is covered in gravel and grassed areas. Trees are located throughout the southern and northern portions of the yard. Property 3: Partially developed property occupied by ‘Peter Overdevest and Sons Landscaping and Nursery’ business, which grows, stores, and sells nursery stock (trees, shrubs, etc.). Five plastic covered Quonset huts are located in the western to central portion of the property, used as greenhouses and for miscellaneous storage. A small shed is located in the eastern portion of the property and is used for storage. An irrigation system is located in the southern portion of the property, with multiple sprinkler heads located throughout. One soil pile is located in the northeast corner, which appears to be soil excavated from the property.	

Property 4: Undeveloped land with tree covered areas located in the east and southeast portions of the property, with vegetation covering the ground surface. Two mulch piles are located in the southern to central portion of the property.	
Exterior Observations	
Item	Observations
Structure Exteriors	Property 2 – Southwestern residential building consisted of brick walls and a shingled roof. Eastern shed constructed of wood frame and vinyl siding, and shingled roof. Property 3 – Five Quonset huts located in the west to central portions of the property are constructed from white plastic over a metal frame, with exposed ground floors. The eastern shed is constructed of plastic walls and roof.
Heating/Cooling Systems	Property 2 – Natural gas fired furnace and central air conditioning.
Hazardous Materials	None observed
Storage Tanks and Containers	Property 2 – Plastic tote (~1,200 L) containing water for the above-ground pool located on the property.
Unidentified Substances	Property 2 – Several small containers (<5 L) containing unidentified substances.
Wells	None observed
Drains	Property 2 – One drain is located in the northern exterior portion of the property, used for stormwater management practices.
Sewage Disposal	Municipal sewer
Pits and Lagoons	None observed
Stained Materials	None observed
Stressed Vegetation	None observed
Ground Surface	Property 1 – Sandy loam Property 2 – Grass and gravel Property 3 – Grass and gravel Property 4 – Grass and other vegetation
Fill Materials	Property 3 – A small soil pile approximately 0.6 m in diameter is located in the northern portion of the property. Property 4 – Two mulch piles approximately 1.2 m in diameter are located in the southern to central portion of the property.
Roads, Parking Facilities and Rights of Way	Properties 1, 2, and 3 – Access to the Project Area via Charles Street. Property 4 – Access to the Project Area via Washington Street.
Noises, Odours, Vibrations	Property 3 and 4 – Strong manure odour.
Waste Disposal	None observed

Storage	Property 2 – Multiple wooden storage sheds in the northern portion of the property, containing scrap wood, various power tools, lawn equipment, and other miscellaneous storage. Property 3 – One small plastic storage shed in the eastern portion of the property.
Project Area Limitations	Property 2 – No access to the interior of the residential building.
Adjacent Land Uses	
North	Stormwater management pond and Cottonwood Street – Residential houses
South	250 Washington Street (~10 m south) – St. Bernard's School
East	Washington Street – Residential houses
West	Charles Street – Residential houses and vacant land

7. Review and Evaluation of Information

7.1 Current and Past Uses

Based on the information gathered from the Project Area site visit, records review and interviews, the following is a summary of the current and past uses of the Project Area:

Table 6: Summary of Current and Past Project Area Uses

Year	Name of Owner	Occupant/Description of Property Use	Other Observations
~2021-Present	2863088 Ontario Inc.	Property 1: Vacant, undeveloped land	Based on Aerial Photographs, Site Visit and Interviews
		Property 2: Residential building	
		Property 3: Peter Overdevest and Sons Landscaping and Nursery	
		Property 4: Vacant, undeveloped land	
~1960s-2021	Property 1: Unknown	Property 1: Vacant, undeveloped land	Based on Aerial Photographs, Site Visit and Interviews
	Property 2: Richard and Cathy Szymezko (1964-2021)	Property 2: Residential building	
	Property 3: Peter Overdevest (1967-2021)	Property 3: Peter Overdevest and Sons Landscaping and Nursery	
	Property 4: Unknown	Property 4: Vacant, undeveloped land	
Prior to 1960s	Unknown	Vacant undeveloped land	Based on Aerial Photographs and Interviews

7.2 Potentially Contaminating Activities

The following Potentially Contaminating Activities (PCAs) were identified for the Project Area and/or Study Area. Refer to Drawing 10 in Appendix A.

Table 7: Potentially Contaminating Activities

Address Direction and Distance from Site	Potentially Contaminating Activity Refer to Table 2, Schedule D O. Reg. 153/04	Description	Date(s)	Results in an APEC (yes/no)
173 Charles Street (Project Area)	Other	Current and historical presence of miscellaneous debris, scrap metal, and derelict automobiles within the northern and central backyard portions of Property 2.	~1964- Current	Yes – APEC 1
Project Area (Property 1, 3, 4)	PCA #40 - Pesticides (including Herbicides, Fungicides and Anti-Fouling Agents) Manufacturing, Processing, Bulk Storage and Large-Scale Applications	Potential use of pesticides across agricultural portions of the Project Area.	<1964	Yes – APEC 2
105 Thompson Road West ~130 m southeast	PCA #58 – Waste Disposal and Waste Management, Including Thermal Treatment, Landfilling, and Transfer of Waste, Other than the Use of Biosoils as Soil Conditioners	Current use of the property by the occupant Norfolk Disposal Services Ltd. for the collection and disposal of commercial and residential waste.	Current (prior dates unknown)	No – due to the transgradient hydrogeologic (groundwater flow) direction and distance relative to the Project Area.

7.3 Areas of Potential Environmental Concern

Based on review and evaluation, the following APEC was identified for the Project Area. Refer to Drawing 11 in Appendix A.

Table 8: Area of Potential Environmental Concern

APEC No.	Description of APEC/Rationale	Location of APEC Relative to Project Area	Potentially Contaminating Activity	Location of PCA (Within Project Area, or Outside of Project Area)	Contaminants of Potential Concern	Media Potentially Impacted (Groundwater, Soil, and/or Sediment)
1	Current and historical presence of miscellaneous debris, scrap metal, and derelict automobiles within the northern and central backyard portions of Property 2.	Southern to Central portion	Other	Project Area	PHCs F1-F4, BTEX, VOCs, and metals	Soil
2	Potential use of pesticides across agricultural portions of the Project Area (Property 1, 3, and 4).	North, west, south portions	#40 - Pesticides (including Herbicides, Fungicides and Anti-Fouling Agents) Manufacturing, Processing, Bulk Storage and Large-Scale Applications	Project Area	OCPs, metals	Soil

Notes: PHCs F1-F4 – Petroleum Hydrocarbons Fractions F1 to F4
BTEX – Benzene, Toluene, Ethylbenzene, and Xylenes
VOCs – Volatile Organic Compounds
OCPs – Organochlorine Pesticides

In this regard, the excess soil sampling and analysis plan should include the identified contaminants of potential concern (COPCs). Parameters include Petroleum Hydrocarbons Fractions F1 to F4 (PHC F1-F4), including benzene, toluene, ethylbenzene and xylenes (BTEX), volatile organic compounds (VOCs), metals, pH, and organochlorine pesticides (OCPs).

8. Conclusions and Recommendations

The purpose of this Assessment of Past Uses Report was to:

- i. Develop a preliminary determination of the likelihood that one or more contaminants have affected soil or rock in a location where soil or crushed rock is to be excavated within the project area.
- ii. Determine if any location where soil or crushed rock is to be excavated could have been affected by a potentially contaminating activity (PCA) and identify any areas of potential environmental concern (APECs) within the project area.
- iii. Identify the contaminants of potential concern (COPCs) to determine the focus of the sampling and analysis plan, if any APECs are identified.

The report was completed to meet the objectives of the Ontario Ministry of the Environment, Conservation and Parks (MECP) document titled “Rules for Soil Management and Excess Soil Quality Standards”, December 8, 2020, and Ontario Regulation 406/19, On-Site and Excess Soil Management.

This report incorporates the concept of PCAs and APECs identified by the MECP as outlined in Schedule D of O. Reg. 153/04.

Based on information collected from the Project Area site visit, records review, and interviews, Property 2 was first developed with the current single-storey residential building in 1964. Property 3 was first developed with the current landscaping and nursery business in 1967. Property 1 and Property 4 are currently and have historically consisted of vacant undeveloped or agricultural land. The Project Area has remained the same since initial development.

The APU report identified two PCAs within the Project Area and one PCA within the Study Area, which were assessed based on observations of the operations, their location relative to the Project Area with respect to the inferred groundwater flow direction, their tenure, expected chemical storage amounts and proposed excavation depth of the excess soil. Based on review and evaluation of the information gathered, the following APECs have been identified for the Project Area:

APEC 1 - Northern and central backyard portions of Property 2: Current and historical presence of miscellaneous debris, scrap metal, and derelict automobiles.

APEC 2 – Property 1, 3, and 4 - Potential use of pesticides associated with agricultural use.

In this regard, it is recommended that the excess soil sampling and analysis plan include the following parameters:

- Petroleum hydrocarbons fractions F1 to F4 (PHCs F1-F4)
- Benzene, toluene, ethylbenzene and xylenes (BTEX)
- Volatile organic compounds (VOCs)
- Metals
- Organochlorine pesticides (OCPs)
- pH

It is noted that despite any chemical testing program, ultimate acceptance of excess soil lies with the receiving site and their written approval to receive the material, based on review of the reports provided. In this regard, additional sampling and testing may be requested depending on the receiving site and volume of excess soil to be generated.

Should a Record of Site Condition (RSC) be required for the Project Area, additional work will be required.

9. Qualifications of the Assessor

This Assessment of Past Uses (APU) report was conducted by Ms. Zoe Barth, B.Sc. Ms. Barth is responsible for the successful completion of field work and reporting. Ms. Barth has completed numerous projects on behalf of private and public sector clients for industrial, commercial, institutional and residential sites.

This APU report was reviewed by Ms. Dana Haslett, B.A. Ms. Haslett has been trained to conduct Phase One and Two ESAs in accordance with the CSA and O. Reg. 153/04, as amended. She is a senior project manager with over 9 years of professional experience specializing in environmental investigations and project management. Her main areas of expertise include Phase One and Phase Two ESAs, project management, site cleanup/remediation, UST and AST removals, and site remediation. She has completed numerous projects on behalf of private and public-sector clients for industrial, commercial, and residential sites.

This APU report was prepared under the supervision of, and the report was reviewed by Melissa King, a Professional Geoscientist registered with the Professional Geoscientists of Ontario. Ms. King is a Senior Geoscientist and Head of Environmental Services and is a Qualified Person (QP). She has over 24 years of interdisciplinary professional experience specializing in environmental and hydrogeologic investigations and project management. Her main areas of expertise include Phase One and Phase Two ESAs, site cleanup / remediation planning and supervision, site remediation, Risk Assessment, Records of Site Condition and hydrogeologic investigations. She has completed hundreds of projects for commercial, industrial, and residential clients for a wide variety of project types (industrial complexes, commercial developments, entertainment and institutional buildings, and residential development).

10. References and Supporting Documentation

- a) Canadian Standards Association, Z768-0, Re-affirmed 2016. Phase One Environmental Site Assessment.
- b) Occupational Health and Safety Act - Ministry of Labour (MOL).
- c) Inventory of Coal Gasification Plant Waste Sites in Ontario. Ontario Ministry of the Environment, April 1987.
- d) Waste Disposal Site Inventory. Waste Management Branch Ontario Ministry of the Environment, June 1991.
- e) Hazardous Waste Information Network (HWIN, 1986 – 2005), www.hwin.ca.
- f) Ministry of the Environment, Brownfields Environmental Site Registry, www.ene.gov.on.ca/environet/BESR/index.
- g) National Pollutant Release Inventory, www.ec.gc.ca.
- h) Ontario's Environmental Registry, www.ebr.gov.on.ca.
- i) Bedrock Geology of Ontario, Southern Sheet, Ministry of Northern Development and Mines, Map 2544. Scale 1:1,000,000. Published 1991.
- j) Generalized Soil Map, Regional Municipality of Haldimand-Norfolk, Ontario Report No. 57, Scale 1:100,000. Published by the Cartography Section, Land Resource Research Institute, Research Branch, Agriculture Canada, Ottawa. 1985.
- k) 1954 Aerial Photograph, viewed online through the University of Toronto Libraries, Map and Data Library. 2021.
- l) 2003, 2010 & 2018 Aerial Photographs, viewed online through Google Earth. 2021.
- m) Waterford, Norfolk County, Ontario, Topographic Map, Surveys and Mapping Branch, Department of Energy, Mines and Resources. Scale 1: 25,000. Published 1970.

11. Limitations

This report has been prepared for the sole benefit of 2863088 Ontario Inc. (the Client) and is intended to provide an Assessment of Past Uses (APU) report for the Project Area. The APU Report may not be relied upon by any other person or entity without the expressed written consent of the Client and G2S Consulting Inc. (G2S). Any use which a third party makes of this report, or any reliance on decisions made based on it, is the responsibility of such third parties. G2S accepts no responsibility for any loss, damage, expenses, or penalties suffered by any third parties that may arise or result from the use of any information or recommendations contained in this report.

The report is based solely on the scope of services which are specifically referred to in this report. No physical or intrusive testing has been performed, except as specifically referenced in this report. This report is not a certification of compliance with past or present regulations, codes, guidelines and policies.

The findings in this APU Report are limited to the conditions at the Project Area at the time of this investigation (March-April 2022) and supplemented by a historical review and data obtained by G2S as described herein as well as information provided by the Project Area representative as reported herein. Conclusions presented in this APU Report should not be construed as legal advice.

If Project Area conditions, regulations, codes, guidelines and applicable standards change or if any additional information becomes available at a future date, changes to the findings, conclusions and recommendations in this APU Report may be necessary.

This assessment does not wholly eliminate uncertainty regarding the potential for existing or future costs, hazards or losses in connection with the subject property and must be viewed as a mechanism to reduce risk rather than eliminate the risk of contamination concerns.

12. Closing Remarks

We trust this report is satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.

Yours truly,

G2S Consulting Inc.

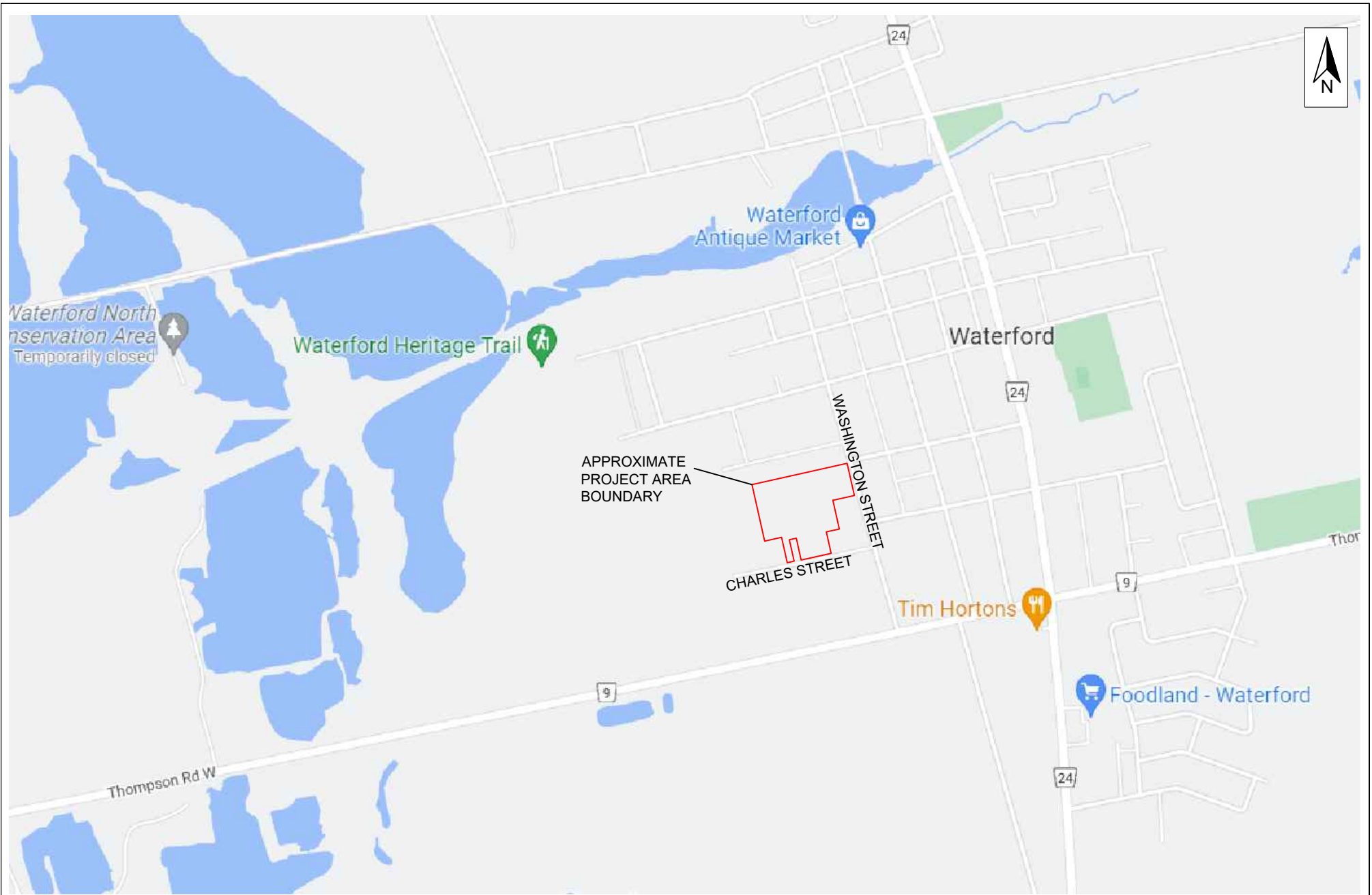


Dana Haslett, B.A.
Senior Project Manager



Melissa King, P.Geo., QP_{ESA}
Head of Environmental Services

Appendix A: Drawing



Scale: N.T.S.
 Project No.: G2S22008A
 Date: MARCH 2023
 Drawn by: DH
 File name: CHARLES.dwg

PROJECT AREA LOCATION PLAN
 CHARLES STREET AND WASHINGTON
 STREET

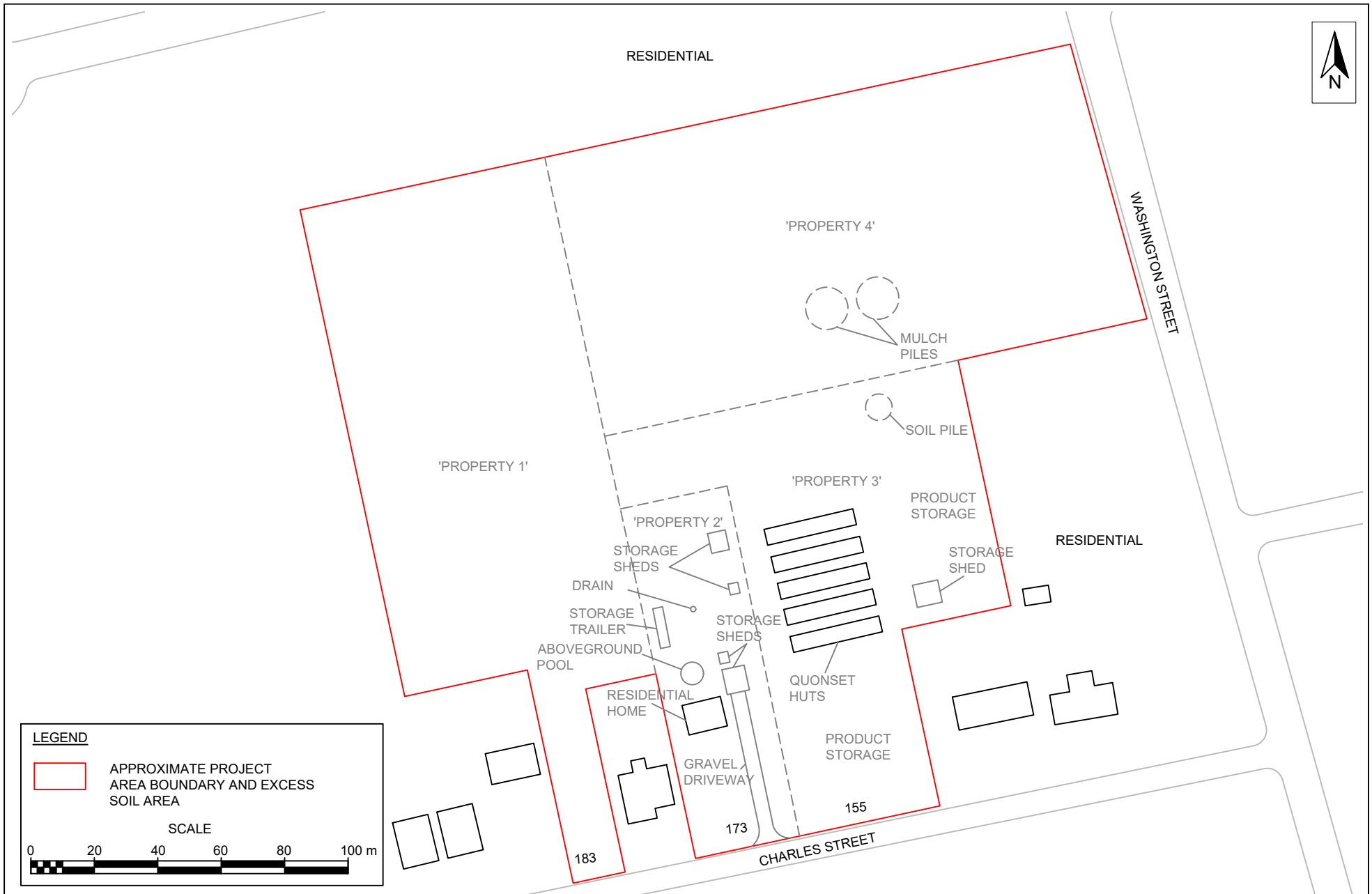
WATERFORD

ONTARIO



Drawing No.

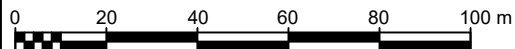
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LEGEND

APPROXIMATE PROJECT AREA BOUNDARY AND EXCESS SOIL AREA

SCALE



Scale: AS SHOWN
 Project No.: G2S22008B
 Date: MARCH 2023
 Drawn by: DH
 File name: CHARLES.dwg

PROJECT AREA PLAN CHARLES STREET AND WASHINGTON STREET

WATERFORD

ONTARIO



Drawing No.

3



Scale: N.T.S.
Project No.: G2S22008A
Date: MARCH 2023
Drawn by: DH
File name: CHARLES.dwg

1954 AERIAL PHOTOGRAPH
CHARLES STREET AND WASHINGTON
STREET

WATERFORD

ONTARIO



Drawing No.

4



Scale: N.T.S.
 Project No.: G2S22008A
 Date: MARCH 2023
 Drawn by: DH
 File name: CHARLES.dwg

2003 AERIAL PHOTOGRAPH
 CHARLES STREET AND WASHINGTON
 STREET

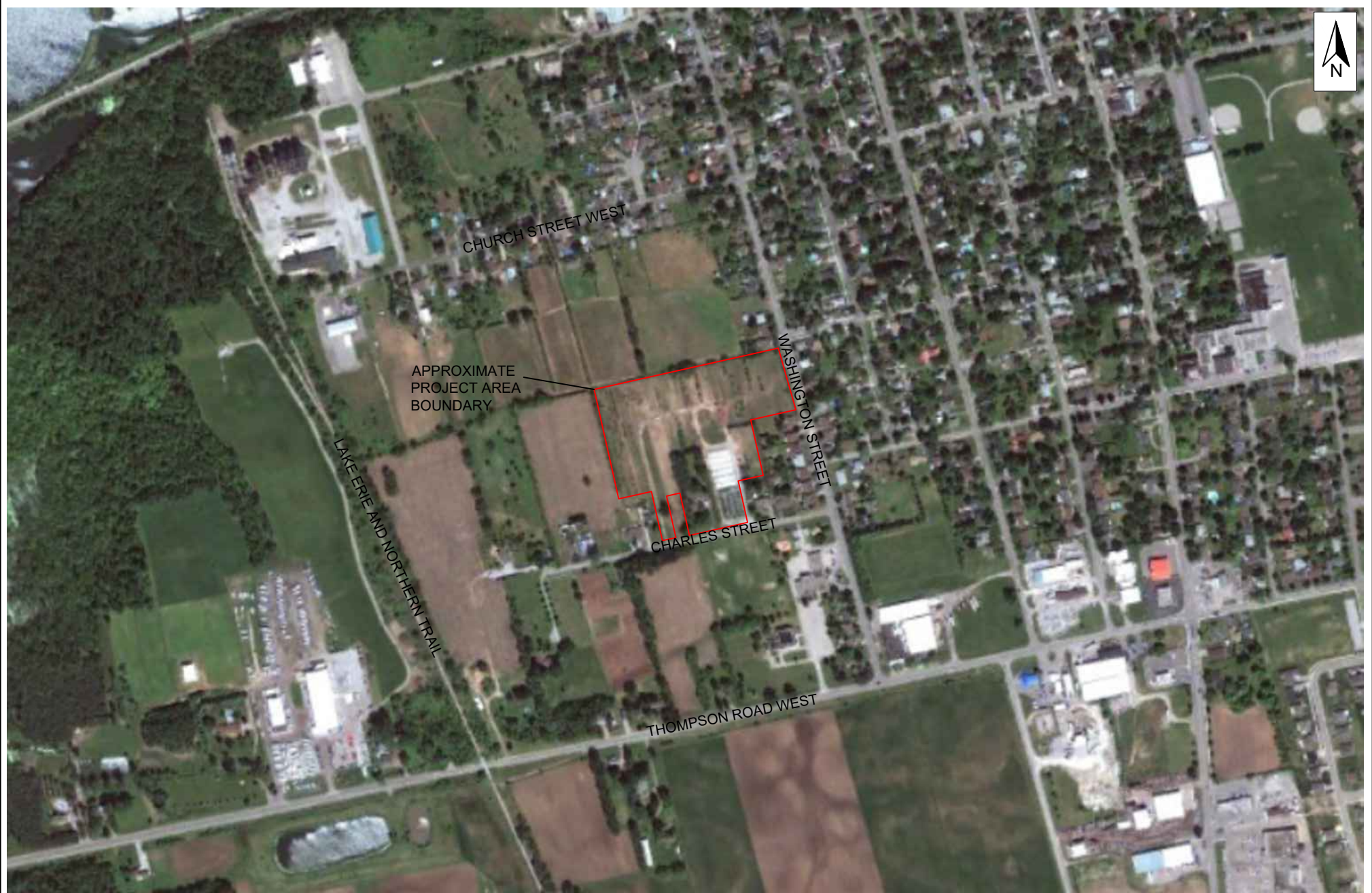
WATERFORD

ONTARIO



Drawing No.

5



Scale: N.T.S.
 Project No.: G2S22008A
 Date: MARCH 2023
 Drawn by: DH
 File name: CHARLES.dwg

2010 AERIAL PHOTOGRAPH
 CHARLES STREET AND WASHINGTON
 STREET

WATERFORD

ONTARIO



Drawing No.

6



Scale: N.T.S.
 Project No.: G2S22008A
 Date: MARCH 2023
 Drawn by: DH
 File name: CHARLES.dwg

2018 AERIAL PHOTOGRAPH
 CHARLES STREET AND WASHINGTON
 STREET

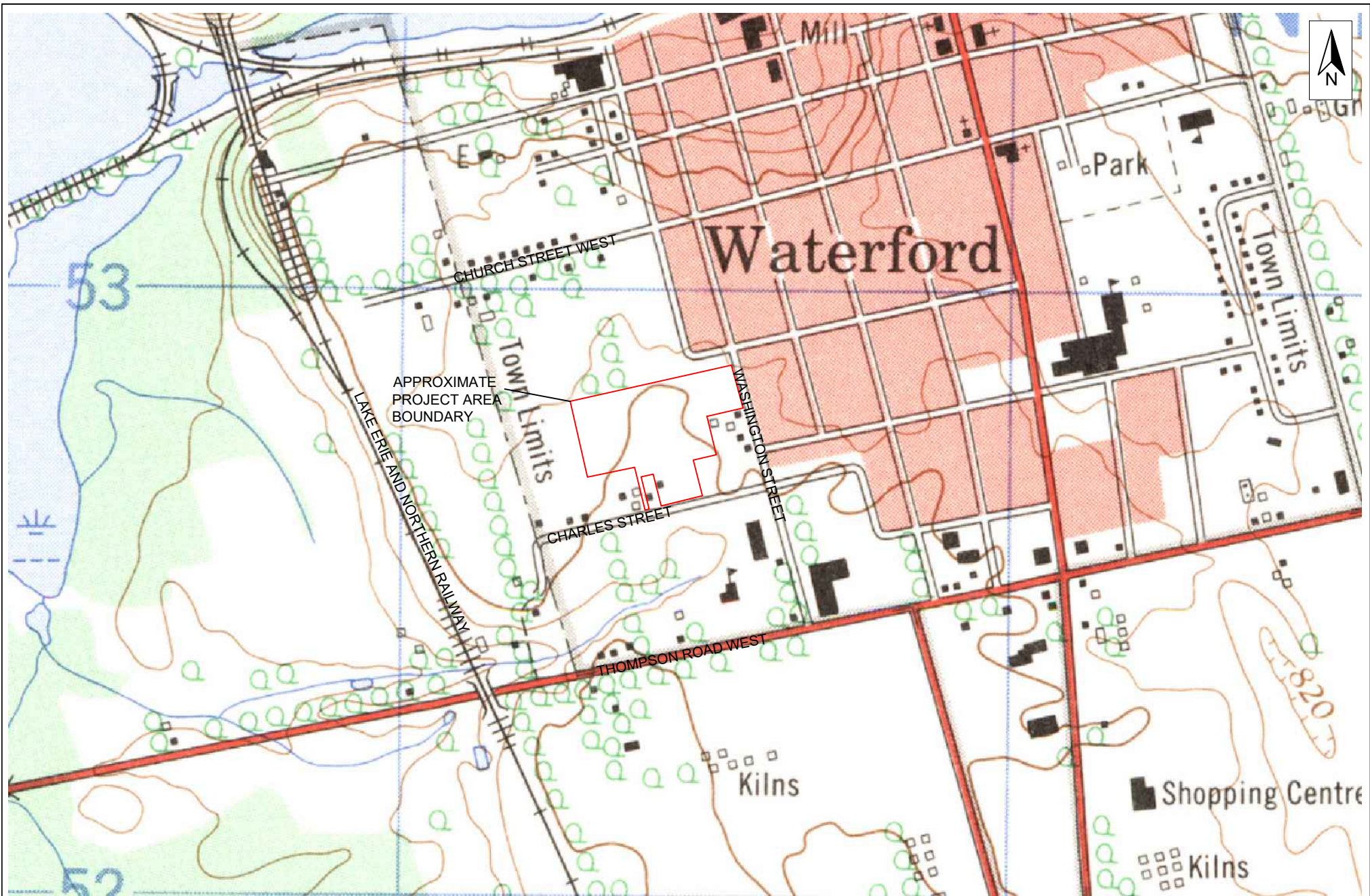
WATERFORD

ONTARIO



Drawing No.

7



Scale: N.T.S.
 Project No.: G2S22008A
 Date: MARCH 2023
 Drawn by: DH
 File name: CHARLES.dwg

1970 TOPOGRAPHIC MAP
 CHARLES STREET AND WASHINGTON
 STREET

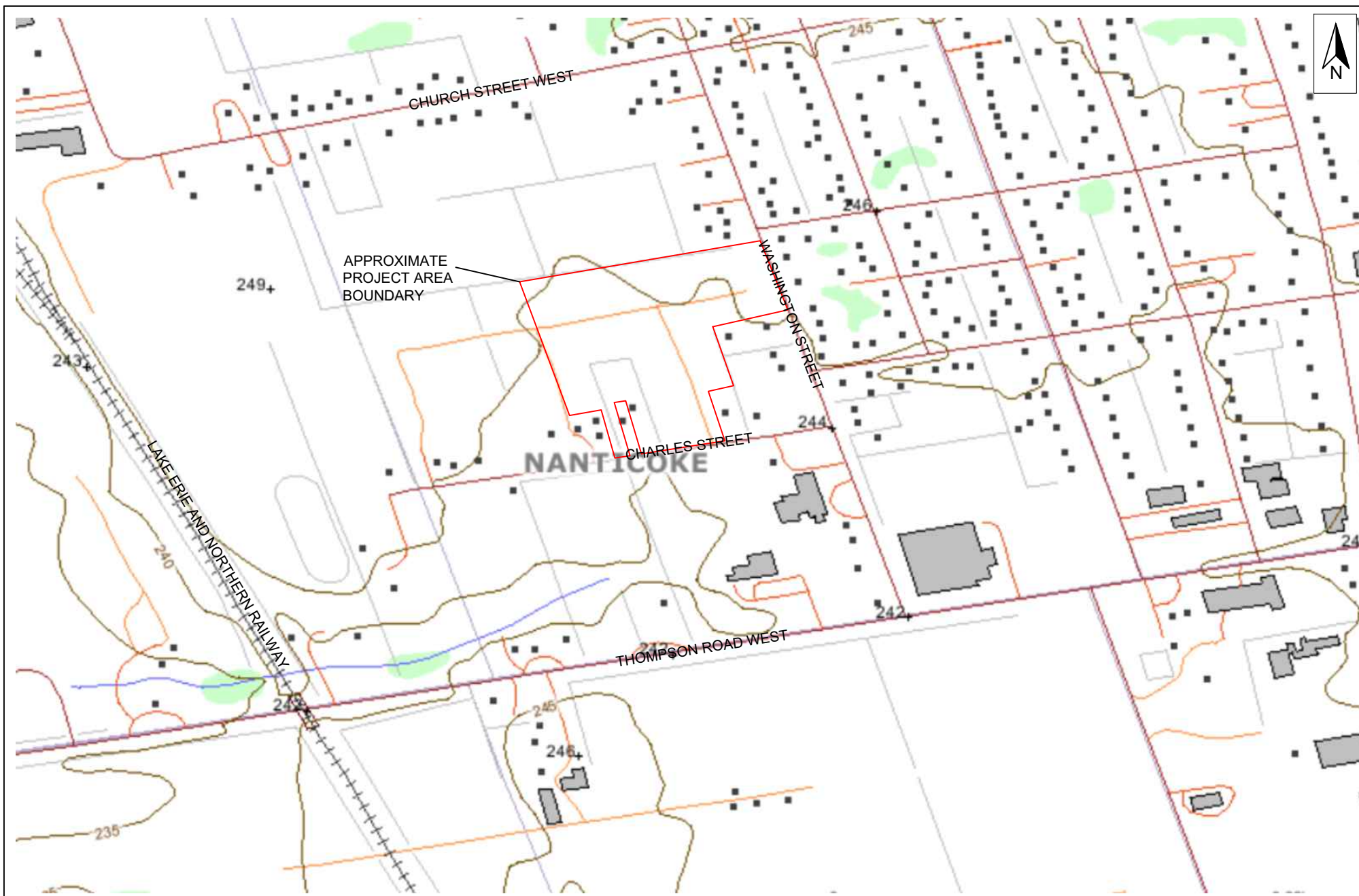
WATERFORD

ONTARIO



Drawing No.

8



Scale: N.T.S.
 Project No.: G2S22008A
 Date: MARCH 2023
 Drawn by: DH
 File name: CHARLES.dwg

ONTARIO BASE MAP
 CHARLES STREET AND WASHINGTON
 STREET

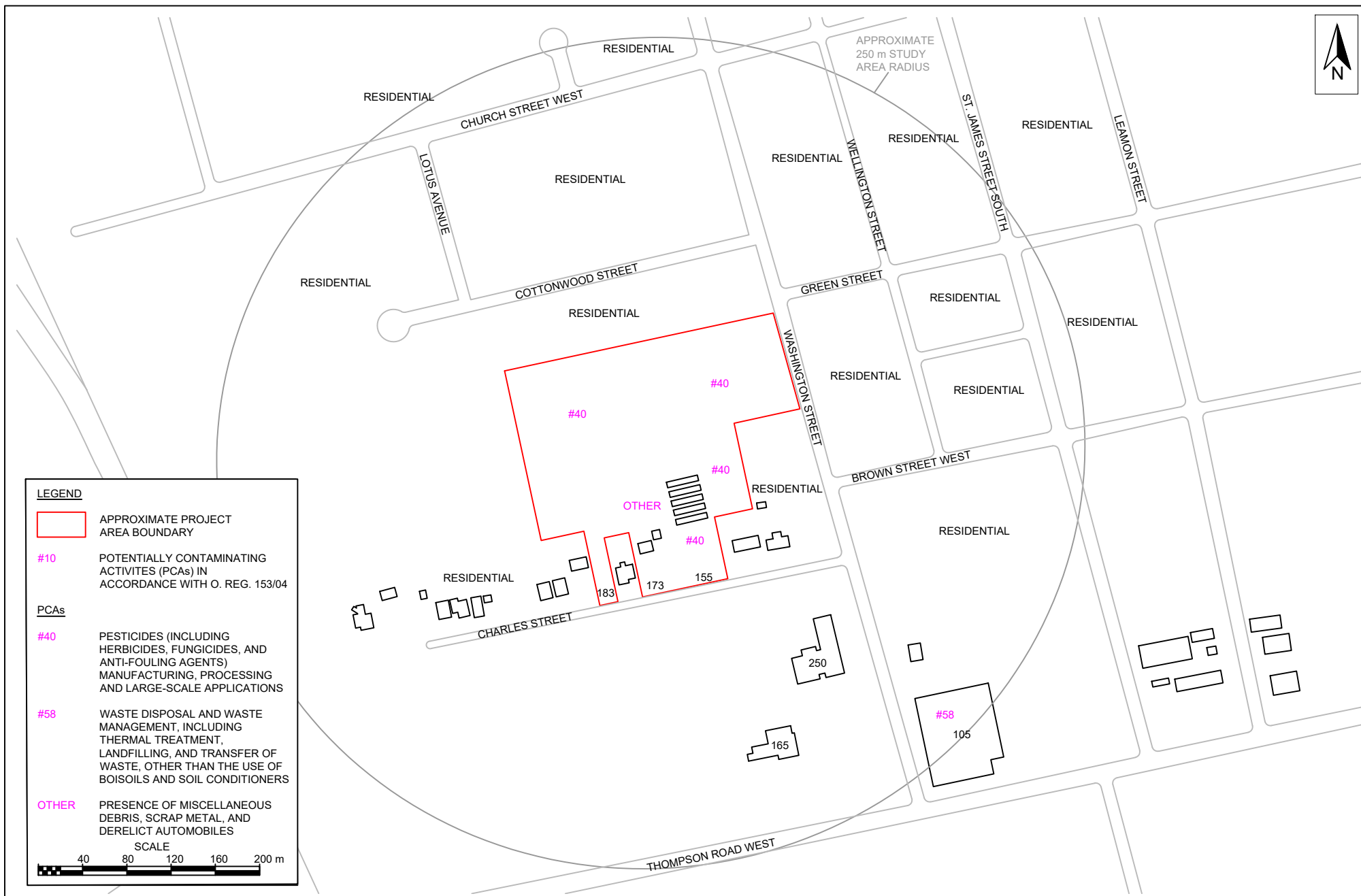
WATERFORD

ONTARIO



Drawing No.

9



Scale: AS SHOWN
 Project No.: G2S22008A
 Date: MARCH 2023
 Drawn by: DH
 File name: CHARLES.dwg

POTENTIALLY CONTAMINATING ACTIVITIES CHARLES STREET AND WASHINGTON STREET

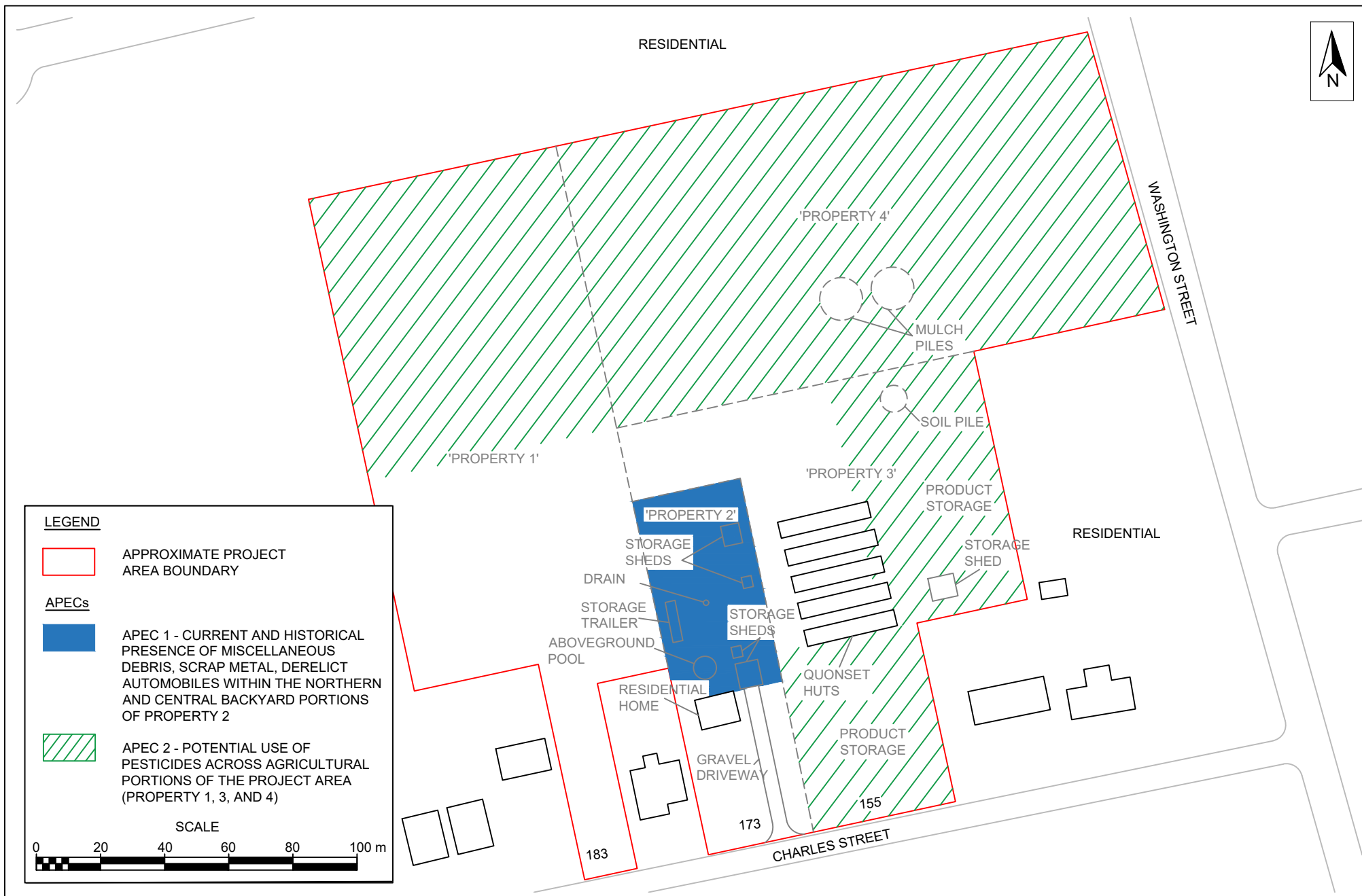
WATERFORD

ONTARIO



Drawing No.

10



Scale: AS SHOWN
 Project No.: G2S22008A
 Date: MARCH 2023
 Drawn by: DH
 File name: CHARLES.dwg

AREAS OF POTENTIAL ENVIRONMENTAL CONCERN CHARLES STREET AND WASHINGTON STREET

WATERFORD

ONTARIO



Drawing No.

11

Appendix B:
Environmental Source Information

Plateau Corporation

Instrument type(s): Approval for discharge into the natural environment other than water (i.e. Air) - EPA s. 9

EBR registry number	IA01E1374
Ministry reference number	4723-52WQKJ
Ministry	Ministry of the Environment
Notice type	Instrument
Act	Environmental Protection Act, R.S.O. 1990
Notice stage	Decision Archive
Date decision loaded to the registry	May 31, 2002
Date proposal loaded to the registry	September 26, 2001

Public consultation on the proposal for this decision was provided for: **30 days**

Comment period start date: **September 26, 2001**

Comment period end date: **October 26, 2001**

Original proposal

Plateau Corporation

Instrument type(s): Approval for discharge into the natural environment other than water (i.e. Air) - EPA s. 9

EBR registry number	IA01E1374
---------------------	-----------

Ministry reference number	4723-52WQKJ
Ministry	Ministry of the Environment
Notice type	Instrument
Act	Environmental Protection Act, R.S.O. 1990
Notice stage	Proposal Archive
Date proposal loaded to the registry	September 26, 2001

The comment period for this proposal is now over.

Zoe Barth

From: Public Information Services <publicinformationsservices@tssa.org>
Sent: March 8, 2022 12:53 PM
To: Zoe Barth
Subject: RE: Fuel Storage Tank Search Request - Waterford, Ontario

Please refrain from sending documents to head office and only submit your requests electronically via email along with credit card payment. We are all working remotely and mailing in applications with cheques will lengthen the overall processing time.

RECORD FOUND

Hello,

Thank you for your request for confirmation of public information.

- We confirm that there are records in our database of fuel storage tanks at the subject addresses (Compressed Natural Gas):

INSTANCE NUMBER	ADDRESS	CITY	PROVIN	POSTAL CO	STATUS	FACILITY/DE
64678304	105 THOMPSON RD	WATERFORD	ON	N0E 1Y0	ACTIVE	FS CNG - SS -

For a further search in our archives please complete our release of public information form found at <https://www.tssa.org/en/about-tssa/release-of-public-information.aspx?mid=392> and email the completed form to publicinformationsservices@tssa.org along with a fee of \$56.50 (including HST) per location. The fee is payable with credit card (Visa or MasterCard).

Although TSSA believes the information provided pursuant to your request is accurate, please note that TSSA does not warrant this information in any way whatsoever.

Kind regards,

Sherees



Public Information Agent

Facilities and Business Services

345 Carlingview Drive

Toronto, Ontario M9W 6N9

Tel: +1-416-734-6222 | Fax: +1-416-734-3568 | E-Mail: publicinformationsservices@tssa.org

www.tssa.org



From: Zoe Barth <zoeb@g2sconsulting.com>
Sent: March 8, 2022 11:41 AM
To: Public Information Services <publicinformationsservices@tssa.org>
Subject: Fuel Storage Tank Search Request - Waterford, Ontario

[CAUTION]: This email originated outside the organisation.

Please do not click links or open attachments unless you recognise the source of this email and know the content is safe.

Hello,

Could you please preform a fuel tank search for the following addresses in Waterford, Ontario:

- 149, 155, 173, 177, 183, 189, 193, 199 Charles Street
- 250 Washington Street
- 105 Thompson Road West

Thank you,

Zoe Barth, B.Sc.

Environmental Technician

G2S Consulting Inc.



12-4361 Harvester Road

Burlington, Ontario L7L 5M4

Cell: 289-795-2727

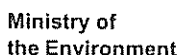
zoeb@g2sconsulting.com

www.g2sconsulting.com

Offices in Burlington and Stouffville

This electronic message and any attached documents are intended only for the named recipients. This communication from the Technical Standards and Safety Authority may contain information that is privileged, confidential or otherwise protected from disclosure and it must not be disclosed, copied, forwarded or distributed without authorization. If you have received this message in error, please notify the sender immediately and delete the original message.

Appendix C: Well Record



Measurements recorded in: ☐ Metric ☒ Imperial

Well Tag No. (Place Sticker and/or Print Below)

Tag#: A143219

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 3

Address of Well Location (Street Number/Name) 131 Charles St.				Township Townsend		Lot #3		Concession #12	
County/District/Municipality Norfolk				City/Town/Village Watersford		Province Ontario		Postal Code 	
UTM Coordinates NAD 83		Zone 17		Easting 557335		Northing 4752807		Municipal Plan and Sublot Number	
						Other			

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

[illegible]

Annular Space			
Depth Set at (m/ft)		Type of Sealant Used (Material and Type)	Volume Placed (m ³ /ft ³)
From	To		
0	20	bent Slurry	3

Method of Construction		Well Use		
☒ Cable Tool	☐ Diamond	☐ Public	☐ Commercial	☐ Not used
☐ Rotary (Conventional)	☐ Jetting	☐ Domestic	☐ Municipal	☐ Dewatering
☐ Rotary (Reverse)	☐ Driving	☐ Livestock	☐ Test Hole	☐ Monitoring
☐ Boring	☐ Digging	☒ Irrigation	☐ Cooling & Air Conditioning	
☐ Air percussion		☐ Industrial		
☐ Other, specify _____		☐ Other, specify _____		

Construction Record - Casing				Status of Well	
Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft)		☐ Water Supply ☐ Replacement Well ☐ Test Hole ☐ Recharge Well ☐ Dewatering Well ☐ Observation and/or Monitoring Hole ☐ Alteration (Construction) ☐ Abandoned,
			From	To	
5 1/8	Steel	1.88	0	39	

Construction Record - Screen				
Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft)	
			From	To
4 1/2	S.S.	#16	39	47

Water Details		Hole Diameter		
Water found at Depth 35 (m/ft) ☐ Gas	Kind of Water: ☒ Fresh ☐ Untested ☐ Other, specify _____	Depth (m/ft)		Diameter (cm/in)
Water found at Depth 47 (m/ft) ☐ Gas	Kind of Water: ☒ Fresh ☐ Untested ☐ Other, specify _____	From	To	
Water found at Depth (m/ft) ☐ Gas	Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify _____			

Well Contractor and Well Technician Information			
Business Name of Well Contractor		Well Contractor's Licence No.	
M+M Pump Service		7049	
Business Address (Street Number/Name)		Municipality	
21 Lampson V. Harris			
Province	Postal Code	Business E-mail Address	

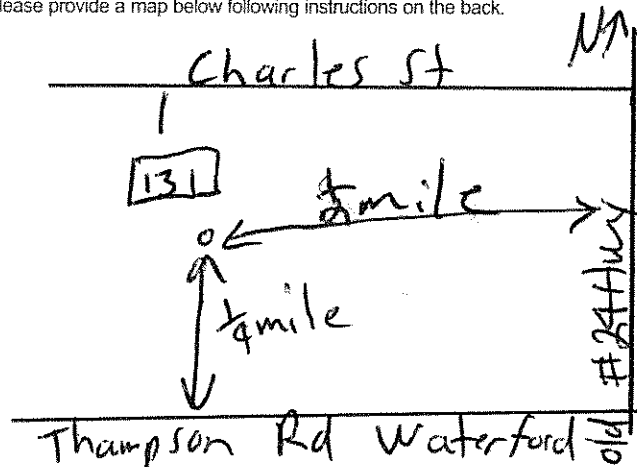
Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)	
	McBair Mike	
Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
05111	M McBair	Y Y Y M M D D

Results of Well Yield Testing

After test of well yield, water was:		Draw Down		Recovery	
☐ Clear and sand free ☐ Other, <i>specify</i>		Time (min)	Water Level (m/ft)	Time (min)	Water Level (m/ft)
If pumping discontinued, give reason:		Static Level	30		35
		1		1	
Pump intake set at (m/ft)		2		2	
Pumping rate (l/min / GPM)		3		3	30
Duration of pumping		4		4	
hrs + min		5	35	5	
Final water level end of pumping (m/ft)		10	35	10	
If flowing give rate (l/min / GPM)		15		15	
		20		20	
Recommended pump depth (m/ft)		25		25	
Recommended pump rate (l/min / GPM)		30		30	
Well production (l/min / GPM)		40		40	
Disinfected?		50		50	
☒ Yes ☐ No		60	35	60	30

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well owner's information package delivered	Date Package Delivered	Ministry Use Only Audit No. Z 164717 Received
	YYYYMMDD Date Work Completed 20130911	

**Appendix D:
Project Area Photos**

Picture and Description	
 A photograph showing a large white plastic tote in the foreground, with an aboveground pool behind it. A brick house is visible in the background under a clear blue sky.	 A photograph showing a cluttered area with various pieces of scrap metal, debris, and a large metal drum in the foreground, with trees and a building in the background.
Photo #1: Property 2 – Aboveground pool and plastic tote located in the central portion of the property.	Photo #2: Property 2 - Storage of miscellaneous debris and scrap metal in the northern/central portions of the property.
 A photograph showing a cluttered area with various pieces of debris, including a large black container and a white container, in the foreground, with a wooden fence and trees in the background.	 A close-up photograph of a stormwater drain cover, which is a square metal grate, partially covered by snow and debris.
Photo #3: Property 2 – Storage of miscellaneous debris located in the northern/western portion of the property.	Photo #4: Property 2 – Stormwater drain located in the northern exterior of the property.
 A photograph showing a cluttered area with various pieces of debris, including a large black container and a white container, in the foreground, with a wooden fence and trees in the background.	 A photograph showing a cluttered area with various pieces of debris, including a large black container and a white container, in the foreground, with a wooden fence and trees in the background.
Photo #5: Property 2 - Storage of miscellaneous debris and scrap metal in the central and northern portions of the property.	Photo #6: Property 2 – Woodworking area located in the central to western portion of the property.



Photo #7: Property 3 – Southern portion of the property located along Charles Street.



Photo #8: Property 3 – Quonset huts located in the western/central portion of the property.



Photo #9: Property 3 – General storage located in the Quonset hut.



Photo #10: Property 3 – Soil pile located in the northern portion of the property.



Photo #11: Property 4 – One of two mulch piles located in the southern/central portions of the property.



Photo #12: Property 4 – Vacant land with tree cover located along the western/central portion of the property.

APPENDIX C

Sanitary Flow Calculations

Charles Street Subdivision Sanitary Report
(R.V. Anderson Associates Limited, October 22, 2022)



vallee

*Consulting Engineers,
Architects & Planners*

Subject:	Legend Tire Waterford		
Date:	4/29/2022	By:	NBN
Project #:	21-169	Page	1
Description:	Entire Subdivision		

Norfolk County Design Criteria Section 9.2 - Sanitary Sewage Flow

9.2.01 Tributary Population

Residential Development:	2.75 persons/unit
Units:	68 Units
Number of Persons:	187 persons
Site Area	4.35 ha

9.2.02 Sewage Flow

Residential Development:	0.45 m ³ /person/day
Average Sewage Flow:	0.974 L/s

9.2.03 Peak Sanitary Flow Factor

Commercial Peaking Factor Formula:
 $M = 1 + (14 / (4 + [14 / \{4 + P^{(0.5)}\}]))$
P =
M =

0.187
4.159

9.2.04 Infiltration Allowance

Infiltration Allowance:	0.28 L/s/ha
Infiltration Allowance:	1.218 L/s

9.2.05 Design Flow

Design Flow:
Design Flow = (Average Sewage Flow * Peak Sanitary Flow Factor) + Infil. Allowance
Design Flow = 5.27 L/s

TECHNICAL MEMORANDUM

TO: Stephen Gradish **RVA:** 215718.39
FROM: David Evans, P.Eng.
DATE: October 22, 2022
SUBJECT: Waterford – Charles Street Subdivision– Sanitary Report

1.0 Introduction

R.V. Anderson Associates Limited (RVA) conducted an analysis of the impact of the proposed development at Charles Street in the Town of Waterford, as requested by Norfolk County (County).

The objective of this report is to summarize the impact of the proposed Subdivision on the wastewater collection system by reviewing the capacity of the existing sewers and pumping stations to convey wastewater flows to the Waterford Wastewater Treatment Plant (WWTP).

2.0 Background

The proposed development consists of 68 residential dwellings. The site is bounded by Charles Street to the south, and Washington Street to the east. It is roughly 4.35 ha with all wastewater flowing to the existing system on Charles Street.

The County provided RVA with the following reports (including drawings and appendices) prepared by G. Douglas Vallee to complete the analysis:

- Charles Street Subdivision – Waterford Planning Justification Report, July 2022

Table 1 below presents the proposed number of serviced units, populations, and peak wastewater discharges, while Figure 1 displays the limits of the development, and the proposed sanitary sewer routing to the WWTP is presented in Figure 2.

Table 1 – Development Design Flows

	Proposed
Residential Units	68
Persons/Unit	2.75 *
Persons	187
Unit Sewage Rate	450 L/capita/day *
Average Daily Flow	0.97 L/s
Peaking Factor	4.16
Peaking Flow	4.04 L/s
Serviced Area	4.35 ha
Infiltration Allowance	0.28 L/s/ha *
Infiltration Flow	1.22 L/s
Peak Design Flow	5.26 L/s

* *Norfolk County Design Criteria, Figure 4-54 in Norfolk County Integrated Sustainable Master Plan (ISMP), last updated in 2016.*

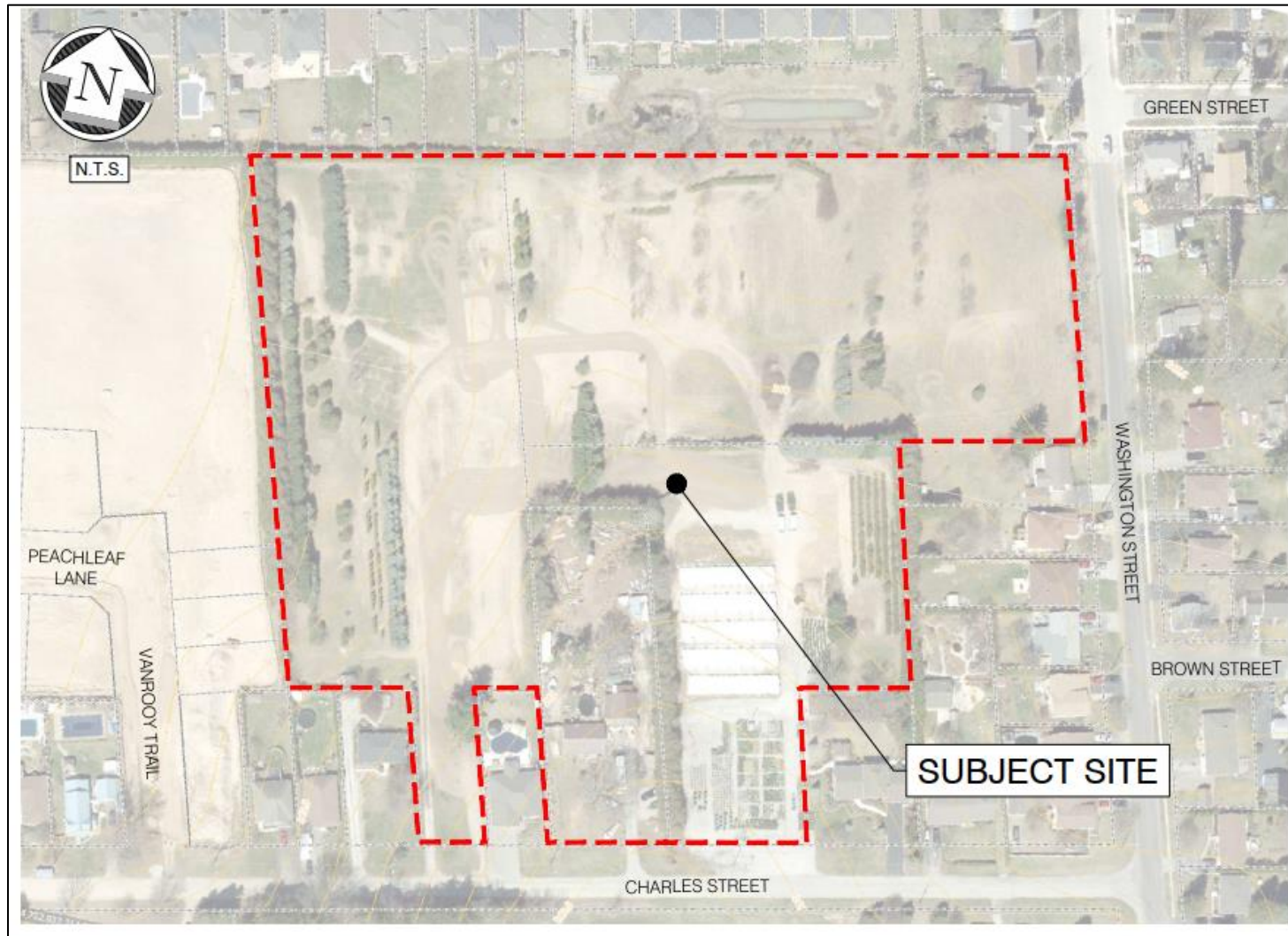


Figure 1 – Limits of the Proposed Development

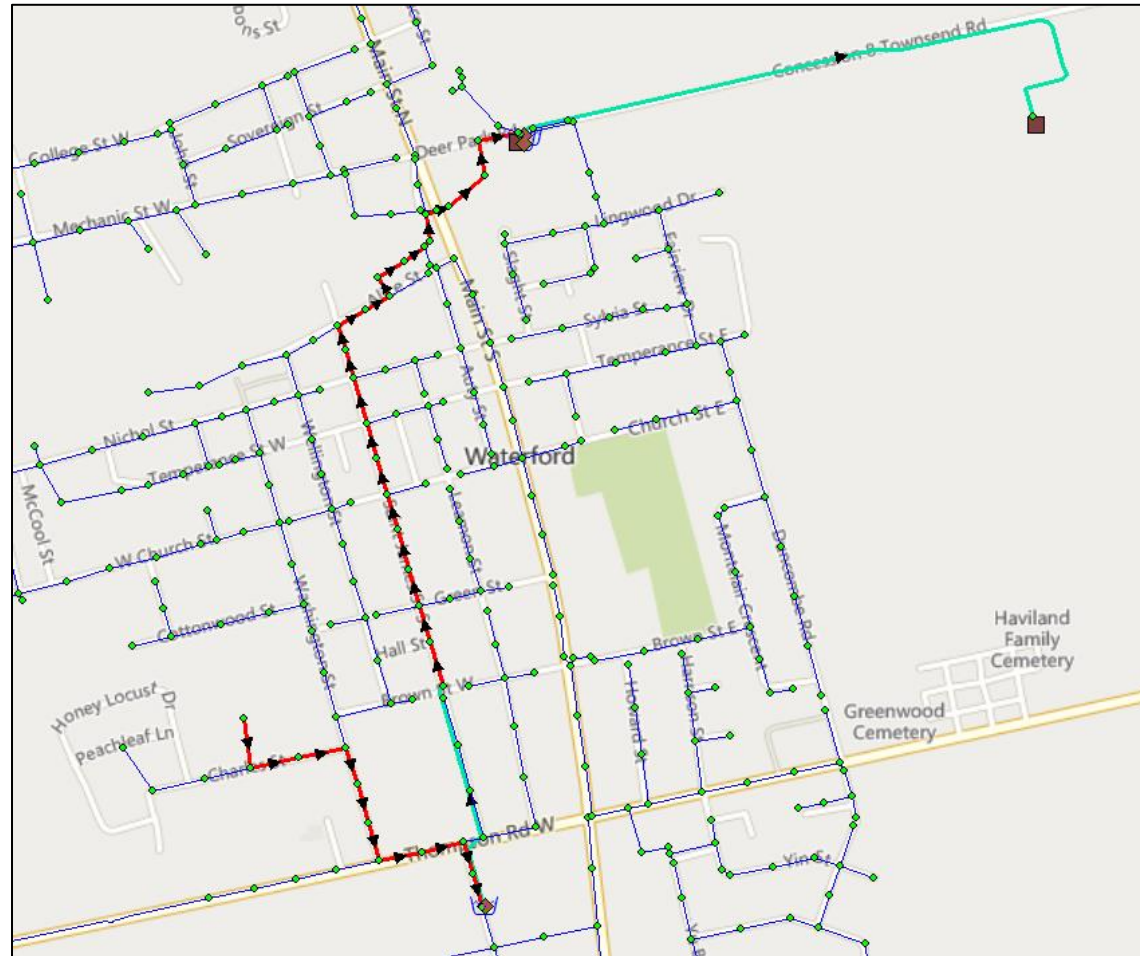


Figure 2 –Sanitary Sewer Route from the proposed development to WWTP

3.0 Summary of the Sanitary Sewer Hydraulic Modelling

An InfoSewer sanitary sewer model was developed using GIS layers provided by the County. These layers included sewer attributes and flows from earlier master planning studies. The InfoSewer model was reviewed and updated to include proposed flows from the subdivision.

The following points summarize the modelling that was performed:

- The existing manholes, sewers and pumps extracted from the County's shape files were reviewed for completeness to ensure the flow path from the proposed development to the Waterford WWTP was represented;
- The current flows extracted from the County's manhole shape file were assigned to the same locations within the model;
- Simulations were performed to assess the capacity to convey existing and proposed flows in the sewers between the proposed development and the WWTP.
- The following proposed water distribution system upgrades are not yet completed; however, they were modeled as completed with the understanding these have been approved by the County and as such, included in the Master Water Model:
 - o Mayberry Homes;
 - o 136 Mechanic Street West Subdivision;
 - o Orchard Square Townhouse Development;
 - o Lam Blvd Stacked Townhouse Development;
 - o 208 Nicole Street Development;
 - o Wellington Street Reconstruction; and
 - o 180-218 Mechanic Street Development.

4.0 Results of the Hydraulic Analysis

Table 1 summarizes the conveyance capacity usage along the flow path to the WWTP, while the attached Figures A1 to A3 and notes, detail the results of the sanitary sewer capacity analysis.

Table 1 – Conveyance Capacity Usage for the Proposed Site

Sewer Sections	Pipe Diam. (mm)	Fraction of Conveyance Capacity Usage	
		Existing Condition	Proposed Site
Charles Street	200	0.62	0.89
Washington Street	250	0.72	0.95
Thompson Rd	250	0.69	0.90
Blue Line Road	300	0.51	0.64
Blueline Rd PS (Firm Capacity 7.6L/s, Total Capacity 11.4L/s)		5.22 (59.6L/s)	5.65 (64.4L/s)
St. James Street S	300	0.91	0.98
Alice Street	450	0.75	0.79
ROW to Main St	450	0.84	0.87
ROW to Deer Park Rd	450	1.15	1.18
Mechanic Street PS (Firm Capacity 98.5 L/s Total Capacity 147.8 L/s)		1.10 (163.3 L/s)	1.14 (168.0 L/s)

- *The capacity analysis is based on future peak flow projections and may include sewage flow estimates that exceed those of current conditions.*

5.0 Conclusion

The proposed development on Charles Street is expected to increase peak wastewater flows by approximately 5.26 L/s along the path to the WWTP.

Hydraulic modelling indicates that the existing sanitary collection system is reaching capacity at peak design flows from Charles Street to Thompson Road. This sewer section needs to be monitored and upgraded as it appears that there are some available developable lands in this area that would further increase the conveyance usage.

The Blueline Road PS has a total operating capacity of 11.4 L/s and cannot accommodate existing peak flows prior to this proposal. The County is aware of the deficiency which is also stated in the ISMP. An improvement to the pumping station before the addition of this proposal is recommended to increase the firm capacity and total capacity for future peak flow. With allowances for Charles Street Subdivision the anticipated flow to the PS becomes 64.4 L/s.

Peak flows are shown to exceed conveyance capacity of ROW to Deer Park Rd and the total capacity of Mechanic Street PS that has a total operating capacity of 147.8 L/s with and without the proposed development. It is likely that higher peaking factor (PF) used to estimate flows in upstream sewer sections (PF generally greater than 4) has been carried through to the end of collection system (where PF should be less than 3). As such, we do not believe that the capacity of this section would be exceeded and do not recommend it be upgraded to accommodate the proposed development.

Yours very truly,

R.V. ANDERSON ASSOCIATES LIMITED

David Evans, P.Eng.
Senior Principal

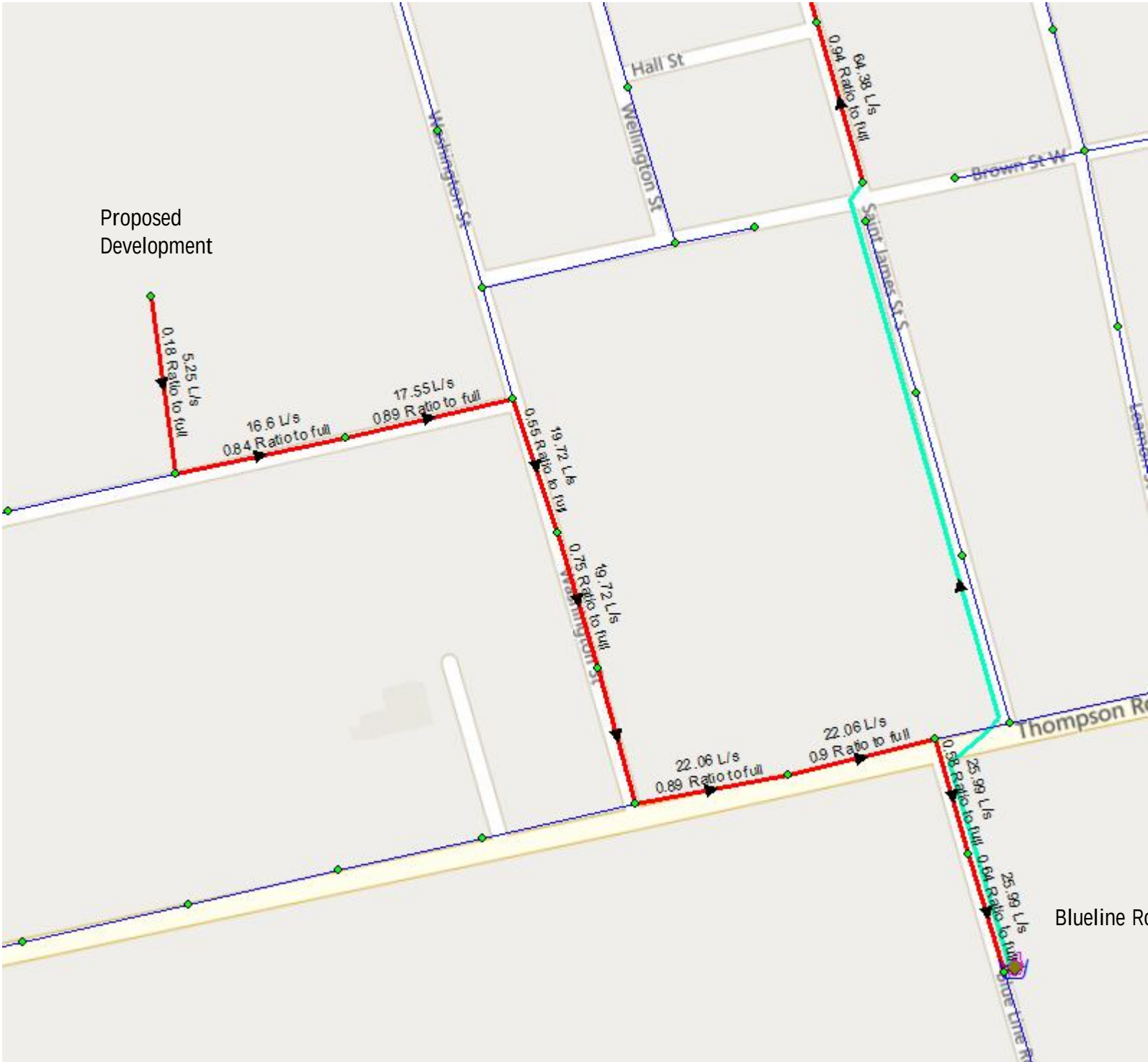
Enclosures:

1. Figure A1 – Capacity Usage Plan – From the proposed development to St. James Street South
2. Figure A2 – Capacity Usage Plan – From St. James Street South to Alice Street
3. Figure A2 – Capacity Usage Plan – From Alice Street to Mechanic Street PS

REVISIONS AND PUBLICATION REGISTER			
Revision #	Date	Details	Distribution
00	October 22, 2022	Tech Memo Issued via email	Stephen Gradish – Norfolk County

LEGEND

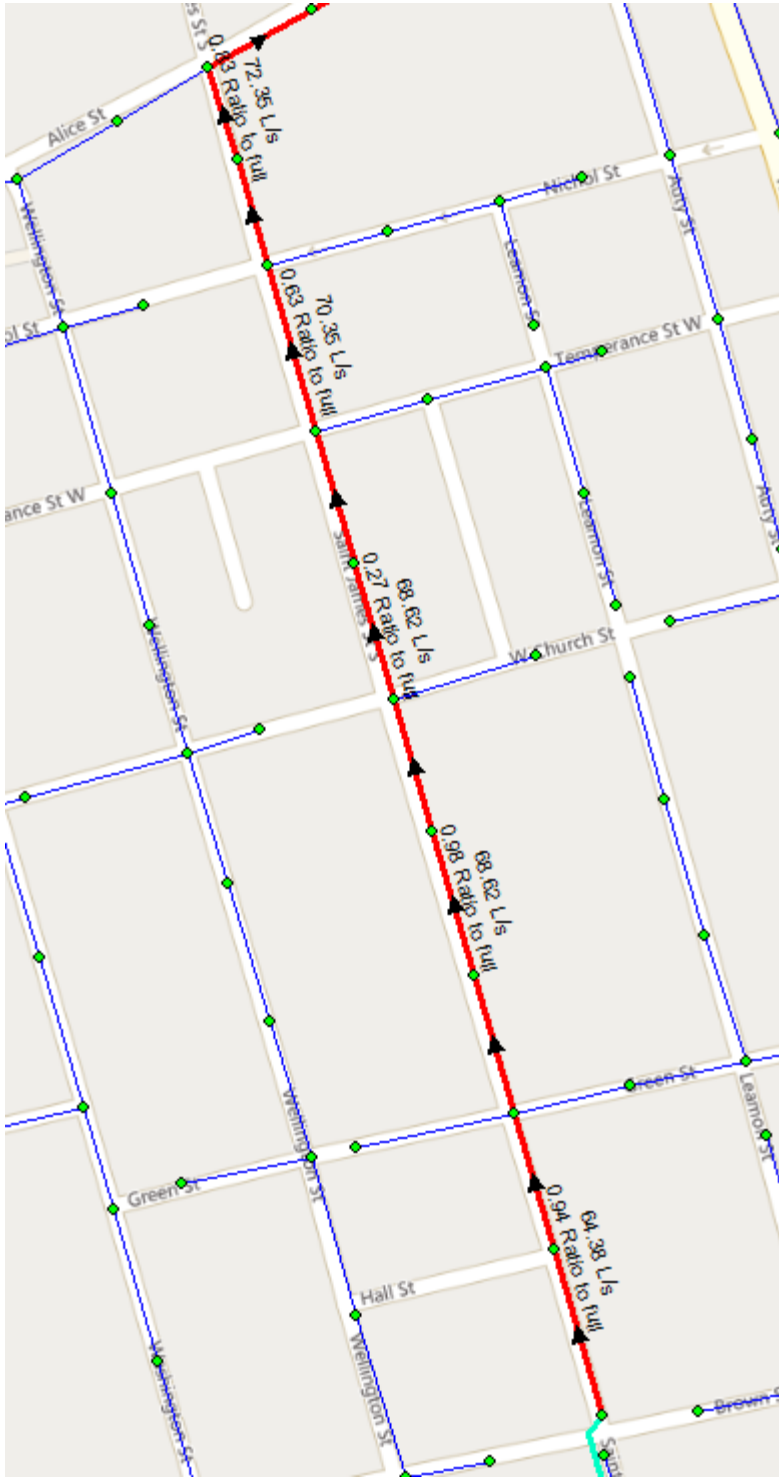
- Manhole
- Sanitary sewer
- Sanitary sewer servicing From proposed subdivision
- Forcemain
- Ratio of full flow capacity (future peak flow)
- Pump station



Waterford Charles Street Subdivision Downstream Sanitary Sewer Capacity Review Sanitary Sewer Flow Path to Waterford WWTP	Date: 2022-10	Scale: NTS	R.V. Anderson Associates Limited engineering • environment • infrastructure
	Project No. 215718.39	Figure: A1	

LEGEND

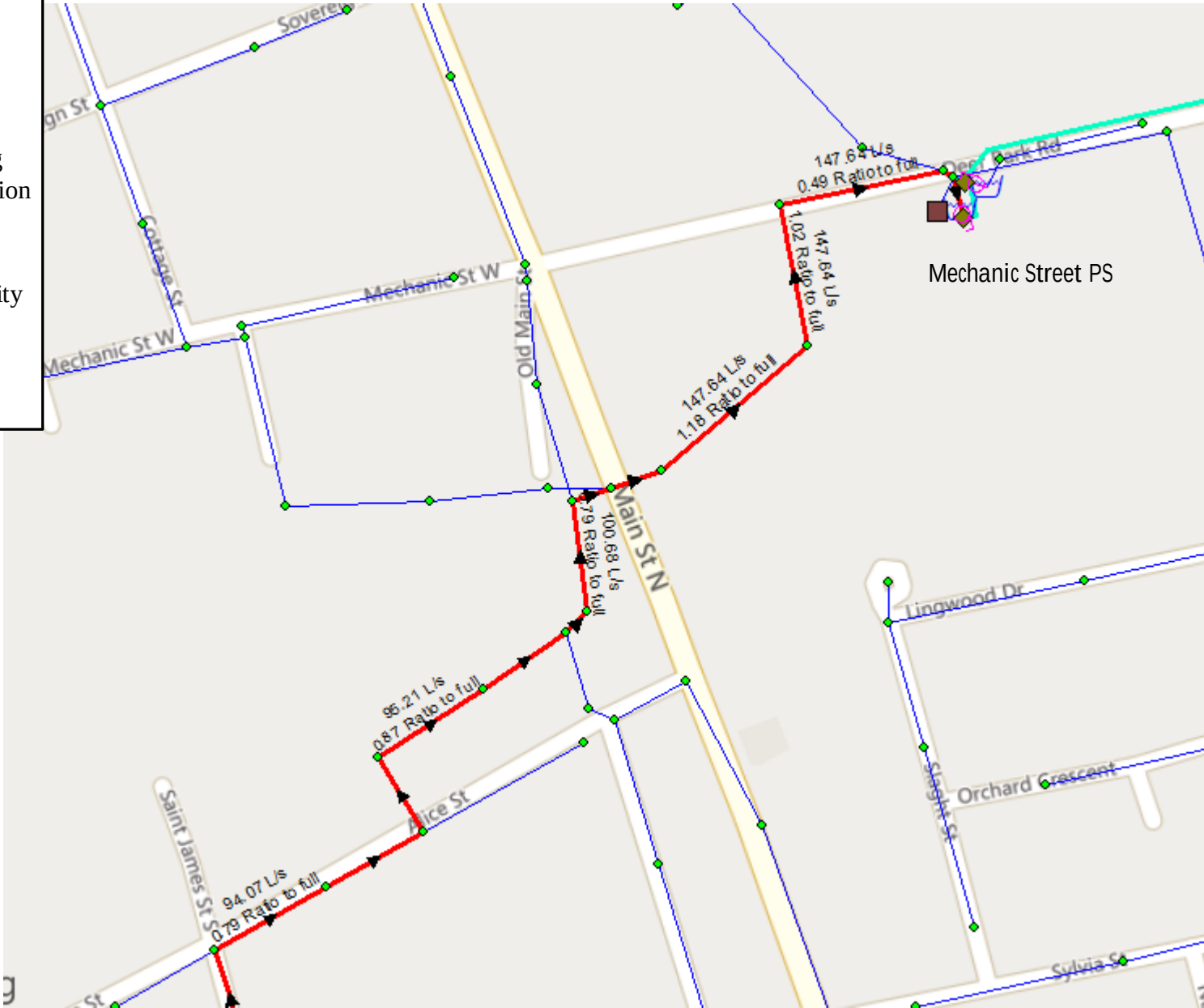
- Manhole
- Sanitary sewer
- Sanitary sewer servicing From proposed subdivision
- Forcemain
- 0.13 Ratio of full flow capacity (future peak flow)
- ⊞ Pump station



Waterford Charles Street Subdivision Downstream Sanitary Sewer Capacity Review Sanitary Sewer Flow Path to Waterford WWTP	Date:	2022-10	Scale:	NTS	 R.V. Anderson Associates Limited engineering • environment • infrastructure
	Project No.	215718.39	Figure:	A2	

LEGEND

- Manhole
- Sanitary sewer
- Sanitary sewer servicing From proposed subdivision
- Forcemain
- Ratio of full flow capacity (future peak flow)
- Pump station



Waterford Charles Street Subdivision Downstream Sanitary Sewer Capacity Review Sanitary Sewer Flow Path to Waterford WWTP	Date:	2022-10	Scale:	NTS	 R.V. Anderson Associates Limited engineering • environment • infrastructure
	Project No.	215718.39	Figure:	A3	

APPENDIX D

Domestic Water Demand Calculations

FUS Calculations

OBC Calculations

Charles Street Subdivision Water Modeling
(R.V. Anderson Associates Limited, October 22, 2022)



Street Townhouses - Block 1

Maximum Daily Demand

Total Number of Units	68 units
Zoning of Land	Residential
Equiv. Population Density	2.75 ppl/unit
Equiv. Population	187
Av. Daily Demand Per Capita	0.45 m ³ /capita/day
Maximum Daily Demand Peaking Factor	2.25
Maximum Daily Demand	189.34 m ³ /day
	2.19 l/s

Maximum Hourly Demand

Total Number of Units	68 units
Zoning of Land	Residential
Equiv. Population Density	2.75 ppl/ha
Equiv. Population	187
Av. Daily Demand Per Capita	0.45 m ³ /capita/day
Maximum Hourly Demand Peaking Factor	4
Maximum Hourly Demand	14.03 m ³ /hour
	3.90 l/s

Units 24-29 (2-Storey Towns)

1) Fire Flow Requirement

$$F_1 = 220C(A^{1/2}) \quad (\text{L/min})$$

C= 1.5 Construction coefficient for wood frame construction

Length= 42 m

Width= 16 m

A= 672.0 Floor Area m²

= Main Floor Area Building

= 1344.0 Fire Area m²

= Main Floor Area Building + 2nd Floor

F₁= 12098 L/min

F₁= 12000 L/min (Round to the nearest 1,000 l/min)

2) Occupancy

Occupancy Type: Residential Occupancy

Reduction: 15%

Surcharge: 0%

$$F_2 = F_1 + (F_1 \times \text{Reduction} / \text{Surcharge}) \quad (\text{L/min})$$

F₂= 10200 L/min

3) Sprinkler System

Sprinkler System: Not Applicable (assumed no sprinkler system in service)

Reduction: 0%

$$F_3 = F_2 \times \text{Reduction} \quad (\text{L/min})$$

F₃= 0 L/min

4) Seperation

Direction	Distance (m)	Surcharge
North	3.0	25%
East	> 30m	0%
South	> 30m	0%
West	> 30m	0%
Total:		25%

Separation Surcharges

0 to 3m	25%
3.1m to 10m	20%
10.1m to 20m	15%
20.1 to 30m	10%
Greater than 30m	0%

$$F_4 = (\text{TOTAL}) \times F_2 \quad (\text{L/min})$$

F₄= 2550 L/min

Total Fire Flow

$$F = F_2 - F_3 + F_4 = 12750 \text{ L/min}$$

$$= 13000 \text{ L/min} \quad (\text{Round to the nearest 1,000 l/min})$$

$$= \mathbf{216.7 \text{ L/s}}$$

Notes: 1) All calculations and factors from Part 2 "Water Supply for Public Fire Protection" by the Fire Underwriters Survey, 2020

Units 35-40 (2-Storey Towns)

1) Fire Flow Requirement

$$F_1 = 220C(A^{1/2}) \quad (\text{L/min})$$

C= 1.5 Construction coefficient for wood frame construction

Length= 42 m

Width= 16 m

A= 672.0 Floor Area m²

= Main Floor Area Building

= 1344.0 Fire Area m²

= Main Floor Area Building + 2nd Floor

F₁= 12098 L/min

F₁= 12000 L/min (Round to the nearest 1,000 l/min)

2) Occupancy

Occupancy Type: Residential Occupancy

Reduction: 15%

Surcharge: 0%

$$F_2 = F_1 + (F_1 \cdot \text{Reduction} / \text{Surcharge}) \quad (\text{L/min})$$

F₂= 10200 L/min

3) Sprinkler System

Sprinkler System: Not Applicable (assumed no sprinkler system in service)

Reduction: 0%

$$F_3 = F_2 \cdot \text{Reduction} \quad (\text{L/min})$$

F₃= 0 L/min

4) Seperation

Direction	Distance (m)	Surcharge
North	> 30m	0%
East	> 30m	0%
South	3	25%
West	> 30m	0%
Total:		25%

Separation Surcharges

0 to 3m	25%
3.1m to 10m	20%
10.1m to 20m	15%
20.1 to 30m	10%
Greater than 30m	0%

$$F_4 = (\text{TOTAL}) \cdot F_2 \quad (\text{L/min})$$

F₄= 2550 L/min

Total Fire Flow

$$F = F_2 + F_3 + F_4 = 12750 \text{ L/min}$$

$$= 13000 \text{ L/min} \quad (\text{Round to the nearest 1,000 l/min})$$

$$= 216.7 \text{ L/s}$$

Notes: 1) All calculations and factors from Part 2 "Water Supply for Public Fire Protection" by the Fire Underwriters Survey, 2020

Units 41-45 (2-Storey Towns)

1) Fire Flow Requirement

$$F_1 = 220C(A^{1/2}) \quad (\text{L/min})$$

C= 1.5 Construction coefficient for wood frame construction

Length= 35 m

Width= 16 m

A= 560.0 Floor Area m²

= Main Floor Area Building

= 1120.0 Fire Area m²

= Main Floor Area Building + 2nd Floor

F₁= 11044 L/min

F₁= 11000 L/min (Round to the nearest 1,000 l/min)

2) Occupancy

Occupancy Type: Residential Occupancy

Reduction: 15%

Surcharge: 0%

$$F_2 = F_1 + (F_1 * \text{Reduction} / \text{Surcharge}) \quad (\text{L/min})$$

F₂= 9350 L/min

3) Sprinkler System

Sprinkler System: Not Applicable (assumed no sprinkler system in service)

Reduction: 0%

$$F_3 = F_2 * \text{Reduction} \quad (\text{L/min})$$

F₃= 0 L/min

4) Seperation

Direction	Distance (m)	Surcharge
North	3	25%
East	> 30m	0%
South	3	25%
West	> 30m	0%
	Total:	50%

Separation Surcharges

0 to 3m	25%
3.1m to 10m	20%
10.1m to 20m	15%
20.1 to 30m	10%
Greater than 30m	0%

$$F_4 = (\text{TOTAL}) * F_2 \quad (\text{L/min})$$

F₄= 4675 L/min

Total Fire Flow

$$F = F_2 - F_3 + F_4 = 14025 \text{ L/min}$$

$$= 14000 \text{ L/min} \quad (\text{Round to the nearest 1,000 l/min})$$

$$= \mathbf{233.3 \text{ L/s}}$$

Notes: 1) All calculations and factors from Part 2 "Water Supply for Public Fire Protection" by the Fire Underwriters Survey, 2020

Units 54-60 (Bungalow Town)

1) Fire Flow Requirement

$$F_1 = 220C(A^{1/2}) \quad (\text{L/min})$$

C= 1.5 Construction coefficient for wood frame construction

Length= 78.5 m

Width= 16 m

A= 1256.0 Floor Area m²

= Main Floor Area Building

= 1256.0 Fire Area m²

= Main Floor Area Building (no 2nd floor)

F₁= 11695 L/min

F₁= 12000 L/min (Round to the nearest 1,000 l/min)

2) Occupancy

Occupancy Type: Residential Occupancy

Reduction: 15%

Surcharge: 0%

$$F_2 = F_1 + (F_1 \times \text{Reduction} / \text{Surcharge}) \quad (\text{L/min})$$

F₂= 10200 L/min

3) Sprinkler System

Sprinkler System: Not Applicable (assumed no sprinkler system in service)

Reduction: 0%

$$F_3 = F_2 \times \text{Reduction} \quad (\text{L/min})$$

F₃= 0 L/min

4) Seperation

Direction	Distance (m)	Surcharge
North	9	20%
East	13	15%
South	25	10%
West	> 30m	0%
	Total:	45%

Separation Surcharges

0 to 3m	25%
3.1m to 10m	20%
10.1m to 20m	15%
20.1 to 30m	10%
Greater than 30m	0%

$$F_4 = (\text{TOTAL}) \times F_2 \quad (\text{L/min})$$

F₄= 4590 L/min

Total Fire Flow

$$F = F_2 - F_3 + F_4 = 14790 \text{ L/min}$$

$$= 15000 \text{ L/min} \quad (\text{Round to the nearest 1,000 l/min})$$

$$= \boxed{250.0 \text{ L/s}}$$

Notes: 1) All calculations and factors from Part 2 "Water Supply for Public Fire Protection" by the Fire Underwriters Survey, 2020

Units 61-68 (Bungalow Town)

1) Fire Flow Requirement

$$F_1 = 220C(A^{1/2}) \quad (\text{L/min})$$

C= 1.5 Construction coefficient for wood frame construction

Length= 82 m

Width= 16 m

A= 1312.0 Floor Area m²

= Main Floor Area Building

= 1312.0 Fire Area m²

= Main Floor Area Building (no 2nd floor)

F₁= 11953 L/min

F₁= 12000 L/min (Round to the nearest 1,000 l/min)

2) Occupancy

Occupancy Type: Residential Occupancy

Reduction: 15%

Surcharge: 0%

$$F_2 = F_1 + (F_1 \times \text{Reduction} / \text{Surcharge}) \quad (\text{L/min})$$

F₂= 10200 L/min

3) Sprinkler System

Sprinkler System: Not Applicable (assumed no sprinkler system in service)

Reduction: 0%

$$F_3 = F_2 \times \text{Reduction} \quad (\text{L/min})$$

F₃= 0 L/min

4) Seperation

Direction	Distance (m)	Surcharge
North	> 30m	0%
East	> 30m	0%
South	9	20%
West	North	0%
	East	20%

Separation Surcharges

0 to 3m	25%
3.1m to 10m	20%
10.1m to 20m	15%
20.1 to 30m	10%
Greater than 30m	0%

$$F_4 = (\text{TOTAL}) \times F_2 \quad (\text{L/min})$$

F₄= 2040 L/min

Total Fire Flow

$$F = F_2 - F_3 + F_4 = 12240 \text{ L/min}$$

$$= 12000 \text{ L/min} \quad (\text{Round to the nearest 1,000 l/min})$$

$$= 200.0 \text{ L/s}$$

Notes: 1) All calculations and factors from Part 2 "Water Supply for Public Fire Protection" by the Fire Underwriters Survey, 2020

Water Supply for Public Fire Protection - Fire Underwriters Survey 2020
Tables & Figures

Method for Determining Required Fire Flows

Fire Underwriters Survey defines **Required Fire Flow** as the amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure. This may include as much as a city block.

To determine the estimated amount of water required to confine and control a fire in a building or group of buildings, Fire Underwriters Survey uses the following base formula:

$$RFF = 220C\sqrt{A}$$

Where:

RFF

= the Required Fire Flow in litres per minutes (LPM)

C

= the Construction Coefficient is related to the type of construction of the building

A

= the Total Effective Floor Area (effective building area) in square metres of the building

Construction Coefficient (C)

Note that the construction typology used by the insurance industry and public fire protection differs from the terms of reference in the National Building Code of Canada (NBC).

The following Construction Types and Coefficients are used in the required fire flow formula:

C

= 1.5 for **Type V** Wood Frame Construction

= 0.8 for **Type IV-A** Mass Timber Construction

= 0.9 for **Type IV-B** Mass Timber Construction

= 1.0 for **Type IV-C** Mass Timber Construction

= 1.5 for **Type IV-D** Mass Timber Construction

= 1.0 for **Type III** Ordinary Construction

= 0.8 for **Type II** Noncombustible Construction

= 0.6 for **Type I** Fire Resistive Construction

Table 3 Recommended Occupancy/Contents Charges by Major Occupancy Examples ¹				
Group	Division	Description of Major Occupancies	Occupancy and Contents	Adjustment Factor
A	1	Assembly occupancies intended for the production and viewing of the performing arts	Combustible	0%
A	2	Assembly occupancies not elsewhere classified in Group A	Limited to Combustible	-15% to 0%
A	3	Assembly occupancies of the arena type	Limited to Combustible	-15% to 0%
A	4	Assembly occupancies in which occupants are gathered in the open air	Limited to Combustible	-15% to 0%
B	1	Detention occupancies	Noncombustible to Limited	-25% to -15%
B	2	Care and treatment occupancies	Noncombustible to Limited	-25% to -15%
B	3	Care occupancies	Limited	-15%
C	---	Residential occupancies	Limited	-15%
D	---	Business and personal services occupancies		
D	---	• Police stations without detention quarters	Non-combustible	-20%
D	---	• Banks, Barber and hairdressing shops, Beauty parlours, Dental offices, Laundries (self-service), Medical offices, Offices, Radio stations	Limited	-15%
D	---	• Dry cleaning establishments (self-service, not using flammable or explosive solvents or cleaners), Small tool and appliance rental and service establishments	Combustible	0%
E	---	Mercantile occupancies		
E	---	• Exhibition halls	Limited	-15%
E	---	• Supermarkets	Limited	-15%
E	---	• Shops/Stores	Limited to Combustible	-15% to 0%
E	---	• Markets	Combustible	0
E	---	• Department stores	Free Burning	15%
F	1	High hazard industrial occupancies	Rapid Burning	+25%
F	2	Medium hazard industrial occupancies		
F	2	• Television studios not admitting a viewing audience	Limited	-15%
F	2	• Cold storage plants	Combustible	0%
F	2	• Electrical substations	Combustible	0%
F	2	• Helicopter landing areas on roofs	Limited	-15%

¹ The values presented in this table are intended as a guideline and the occupancy/contents adjustment should be based on the actual severity of conditions within the risk structure.

Exposure Adjustment Charge

A percentage of water for the exposures should be added to the required fire flow for the subject building to provide adequate flow rates for hose streams used to reduce the spreading of fire from the subject building to exposed risks (ex. structures, stored materials, forest, etc.). The required fire flow of a subject building may be increased depending on the severity of exposed risks to the subject building and the distance between the exposed risks and the subject building. This charge considers the usage of water supplies to prevent exposed risks from igniting or being damaged during a major fire incident in the subject building.

The maximum Exposure Adjustment Charge to be applied to a subject building is 75% when summing the percentages for all sides of the building. Table 5 outlines the maximum Exposure Adjustment Charge to apply for any one side of the subject building based on the following separation distances between the subject building and the exposed risk (aka. exposure):

Table 5 Exposure Charges

Separation Distance	Maximum Exposure Adjustment Charge
0 m to 3 m	25%
3.1 m to 10 m	20%
10.1 m to 20 m	15%
20.1 m to 30 m	10%
Greater than 30	0%

Occupancy and Contents Adjustment Factor

The required fire flow may be reduced by as much as -25% for occupancies having contents with a very low fire hazard or may be increased by up to 25% for occupancies having contents with a high fire hazard. The Occupancy and Contents Adjustment Factor should not be made at greater than 25% or less than -25%.

• Noncombustible Contents

-25%

○ Includes merchandise or materials, including stock, or equipment, which in permissible quantities does not in themselves constitute an active fuel for the spread of fire.

○ May include limited or controlled amounts of combustible material, not exceeding 5% of the Total Effective Area of the occupancy. Combustible components of construction (ex. interior walls, finishes, etc.) should be included in the limit on combustible materials.

• Limited Combustible Contents

-15%

○ Includes merchandise or materials, including furniture, stock, or equipment, of low combustibility, with limited concentrations of combustible materials.

• Combustible Contents

0% no adjustment

○ Includes merchandise or materials, including furniture, stock, or equipment, of moderate combustibility.

• Free Burning Contents

+15%

○ Includes merchandise or materials, including furniture, stock, or equipment, which burn freely, constituting an active fuel.

• Rapid Burning Contents

+25%

○ Includes merchandise or materials, including furniture, stock, or equipment, which either

▪ Burn with great intensity

▪ spontaneously ignite and are difficult to extinguish

▪ give off flammable or explosive vapors at ordinary temperatures

▪ as a result of an industrial processing, produce large quantities of dust or other finely divided debris subject to flash fire or explosion

Total Effective Area (A)

To determine a required fire flow for an individual building, the Total Effective Area that would be affected during the design fire must be determined. The Total Effective Area is the largest Floor Area (in square metres) plus the following percentages of the total area of the other floors:

1) For a building classified with a Construction Coefficient from 1.0 to 1.5:

a) 100% of all Floor Areas are considered in determining the Total Effective Area to be used in the formula.

2) For a building classified with a Construction Coefficient below 1.0:

a) if any vertical openings in the building (ex. interconnected floor spaces, atria, elevators, escalators, etc.) are unprotected, consider the two largest adjoining floor areas plus 50% of all floors immediately above them up to a maximum of eight; or

b) if all vertical openings and exterior vertical communications are properly protected in accordance with the National Building Code, consider only the single largest Floor Area plus 25% of each of the two immediately adjoining floors.

Automatic Sprinkler Protection

The required fire flow may be reduced by up to 50 percent for complete Automatic Sprinkler Protection depending upon adequacy of the system. Where only part of a building is protected by Automatic Sprinkler Protection, credit should be interpolated by determining the percentage of the Total Floor Area being protected by the automatic sprinkler system.

To be able to apply the full 50 percent reduction, the following areas should be reviewed to determine the appropriate level of credit for having Automatic Sprinkler Protection as per the table below:

Table 4 Sprinkler Credits

Automatic Sprinkler System Design	Credit	
	With complete building coverage	With partial building coverage of %
Automatic sprinkler protection designed and installed in accordance with NFPA 13	30%	30% × Percentage of Total Floor Area Served by Sprinkler System
Water supply is standard for both the system and Fire Department hose lines	10%	10% × Percentage of Total Floor Area Served by Sprinkler System
Fully supervised system	10%	10% × Percentage of Total Floor Area Served by Sprinkler System

Table 6 Exposure Adjustment Charges for Subject Building considering Construction type of Exposed Building Face

Distance (m) to the Exposure	Length-height factor of exposing building face	Type				
		Type V	Type III-IV ²	Type III-IV ³	Type I-II ²	Type I-I ³
0 to 3	0-20	20%	15%	5%	10%	0%
	21-40	21%	16%	6%	11%	1%
	41-60	22%	17%	7%	12%	2%
	61-80	23%	18%	8%	13%	3%
	81-100	24%	19%	9%	14%	4%
	Over 100	25%	20%	10%	15%	5%
3.1 to 10	0-20	15%	10%	3%	6%	0%
	21-40	16%	11%	4%	7%	0%
	41-60	17%	12%	5%	8%	1%
	61-80	18%	13%	6%	9%	2%
	81-100	19%	14%	7%	10%	3%
	Over 100	20%	15%	8%	11%	4%
10.1 to 20	0-20	10%	5%	0%	3%	0%
	21-40	11%	6%	1%	4%	0%
	41-60	12%	7%	2%	5%	0%
	61-80	13%	8%	3%	6%	1%
	81-100	14%	9%	4%	7%	2%
	Over 100	15%	10%	5%	8%	3%
20.1 to 30	0-20	0%	0%	0%	0%	0%
	21-40	2%	1%	0%	0%	0%
	41-60	4%	2%	0%	1%	0%
	61-80	6%	3%	1%	2%	0%
	81-100	8%	4%	2%	3%	0%
	Over 100	10%	5%	3%	4%	0%
Over 30 m	all sizes	0%	0%	0%	0%	0%

ON-SITE FIRE PROTECTION SUPPLY CALCULATION

Per Fire Protection Water Supply Guideline, Ontario Building Code Division 3, Part B, 3.2.5.7

Project:	21-169 Legend Tire Waterford	Building/Block #:	Units 24-29 (2-Storey Towns)
Project Location:	Waterford, ON	Firewalls/Sprinkler:	

Conditions not requiring On-Site Fire Protection:

Building area is Less than 200 m ² or Less	☐
Building height is 2 Storeys or Less	☒
Building does not have a Group B Occupancy (Care or Detention)	☒
Building does not require a sprinkler system or standpipe and hose system	☒
Limiting distance from the property line is at least 13 m if the building has an F-1 (high hazard industrial) occupancy	☒
Building constitutes no significant environmental contamination potential under fire conditions	☒

On-Site Supply Required? **YES**

Calculation Information:

$$Q = K * V * S_{Tot}$$

where: Q = Minimum supply of water in litres (L)
V = Total Building Volume in cubic metres
K = Water supply coefficient from Table 1
S_{Tot} = total of spatial coefficient values from property line exposures on all sides, as obtained from the formula:

$$S_{Tot} = 1.0 + [(S_{Side1}) + (S_{Side2}) + (S_{Side3}) + ... etc.]$$

where: S_{Side} = values are obtained from Figure 1, as modified by Sections 6.3 (e) and 6.3 (f) of the OBC Guideline
S_{Tot} = need not exceed 2.0 (see Section 7.0 of the OBC Guideline)

Determining K Value:

Major Occupancy Classification	Residential Occupancies	
Group	C	
Division	-	
Building is of combustible construction. Roof assemblies, mezzanines, loadbearing walls, columns and arches do not have a fire resistance rating.		
K Factor		23

Determining Building Volume:

Average Length (m)	42.0	
Average Width (m)	16.0	
Height, including basements (m)	11.0	
Building Volume (m³)		7392

Total Spatial Coefficient:

	Exposure Distance (m)	Factor	
North Side	3	0.7	
East Side	>10	0	
South Side	>10	0	
West Side	>10	0	
S_{Tot} Factor			1.7

Minimum Water Supply Flow:

Q (L) 289,027

Minimum Water Supply Flow Rate OBC:

9000 L/min
150.0 L/sec

Table 2: Minimum Water Supply Flow Rates	
Building Code, Part 3 Buildings	Required Minimum Water Supply Flow Rate (L/min.)
One-storey building with building area not exceeding 600m ² (excluding F-1 occupancies)	1800
All other buildings	2700 (If Q ≤ 108,000L) ⁽¹⁾ 3600 (If Q > 108,000L and ≤ 135,000L) ⁽¹⁾ 4500 (If Q > 135,000L and ≤ 162,000L) ⁽¹⁾ 5400 (If Q > 162,000L and ≤ 190,000L) ⁽¹⁾ 6300 (If Q > 190,000L and ≤ 270,000L) ⁽¹⁾ 9000 (If Q > 270,000L) ⁽¹⁾

Note: ⁽¹⁾ Q=KVS_{Tot} as referenced in Section 3(a)

ON-SITE FIRE PROTECTION SUPPLY CALCULATION

Per Fire Protection Water Supply Guideline, Ontario Building Code Division 3, Part B, 3.2.5.7

Project:	21-169 Legend Tire Waterford	Building/Block #:	Units 35-40 (2-Storey Towns)
Project Location:	Waterford, ON	Firewalls/Sprinkler:	

Conditions not requiring On-Site Fire Protection:

Building area is Less than 200 m ² or Less	☐
Building height is 2 Storeys or Less	☒
Building does not have a Group B Occupancy (Care or Detention)	☒
Building does not require a sprinkler system or standpipe and hose system	☒
Limiting distance from the property line is at least 13 m if the building has an F-1 (high hazard industrial) occupancy	☒
Building constitutes no significant environmental contamination potential under fire conditions	☒
On-Site Supply Required?	YES

Calculation Information:

$$Q = K * V * S_{Tot}$$

where: Q = Minimum supply of water in litres (L)
V = Total Building Volume in cubic metres
K = Water supply coefficient from Table 1
S_{Tot} = total of spatial coefficient values from property line exposures on all sides, as obtained from the formula:

$$S_{Tot} = 1.0 + [(S_{Side1}) + (S_{Side2}) + (S_{Side3}) + ... etc.]$$

where: S_{Side} = values are obtained from Figure 1, as modified by Sections 6.3 (e) and 6.3 (f) of the OBC Guideline
S_{Tot} = need not exceed 2.0 (see Section 7.0 of the OBC Guideline)

Determining K Value:

Major Occupancy Classification	Residential Occupancies	
Group	C	
Division	-	
Building is of combustible construction. Roof assemblies, mezzanines, loadbearing walls, columns and arches do not have a fire resistance rating.		
	K Factor	23

Determining Building Volume:

Average Length (m)	42.0	
Average Width (m)	16.0	
Height, including basements (m)	11.0	
	Building Volume (m³)	7392

Total Spatial Coefficient:

	Exposure Distance (m)	Factor	
North Side	>10	0	
East Side	>10	0	
South Side	3	0.7	
West Side	>10	0	
		S_{Tot} Factor	1.7

Minimum Water Supply Flow:

	Q (L)	289,027
--	--------------	----------------

Minimum Water Supply Flow Rate OBC:

9000	L/min
150.0	L/sec

Table 2: Minimum Water Supply Flow Rates	
Building Code, Part 3 Buildings	Required Minimum Water Supply Flow Rate (L/min.)
One-storey building with building area not exceeding 600m ² (excluding F-1 occupancies)	1800
All other buildings	2700 (If Q ≤ 108,000L) ⁽¹⁾ 3600 (If Q > 108,000L and ≤ 135,000L) ⁽¹⁾ 4500 (If Q > 135,000L and ≤ 162,000L) ⁽¹⁾ 5400 (If Q > 162,000L and ≤ 190,000L) ⁽¹⁾ 6300 (If Q > 190,000L and ≤ 270,000L) ⁽¹⁾ 9000 (If Q > 270,000L) ⁽¹⁾

Note: ⁽¹⁾ Q=KVS_{Tot} as referenced in Section 3(a)

ON-SITE FIRE PROTECTION SUPPLY CALCULATION

Per Fire Protection Water Supply Guideline, Ontario Building Code Division 3, Part B, 3.2.5.7

Project:	21-169 Legend Tire Waterford	Building/Block #:	Units 41-45 (2-Storey Towns)
Project Location:	Waterford, ON	Firewalls/Sprinkler:	

Conditions not requiring On-Site Fire Protection:

Building area is Less than 200 m ² or Less	☐
Building height is 2 Storeys or Less	☒
Building does not have a Group B Occupancy (Care or Detention)	☒
Building does not require a sprinkler system or standpipe and hose system	☒
Limiting distance from the property line is at least 13 m if the building has an F-1 (high hazard industrial) occupancy	☒
Building constitutes no significant environmental contamination potential under fire conditions	☒
On-Site Supply Required?	YES

Calculation Information:

$$Q = K * V * S_{Tot}$$

where: Q = Minimum supply of water in litres (L)
V = Total Building Volume in cubic metres
K = Water supply coefficient from Table 1
S_{Tot} = total of spatial coefficient values from property line exposures on all sides, as obtained from the formula:

$$S_{Tot} = 1.0 + [(S_{Side1}) + (S_{Side2}) + (S_{Side3}) + ... etc.]$$

where: S_{Side} = values are obtained from Figure 1, as modified by Sections 6.3 (e) and 6.3 (f) of the OBC Guideline
S_{Tot} = need not exceed 2.0 (see Section 7.0 of the OBC Guideline)

Determining K Value:

Major Occupancy Classification	Residential Occupancies	
Group	C	
Division	-	
Building is of combustible construction. Roof assemblies, mezzanines, loadbearing walls, columns and arches do not have a fire resistance rating.		
	K Factor	23

Determining Building Volume:

Average Length (m)	35.0	
Average Width (m)	16.0	
Height, including basements (m)	11.0	
	Building Volume (m³)	6160

Total Spatial Coefficient:

	Exposure Distance (m)	Factor	
North Side	3	0.7	
East Side	>10	0	
South Side	3	0.7	
West Side	>10	0	
		S_{Tot} Factor	2.4

Minimum Water Supply Flow:

	Q (L)	340,032
--	--------------	----------------

Minimum Water Supply Flow Rate OBC:

9000	L/min
150.0	L/sec

Table 2: Minimum Water Supply Flow Rates	
Building Code, Part 3 Buildings	Required Minimum Water Supply Flow Rate (L/min.)
One-storey building with building area not exceeding 600m ² (excluding F-1 occupancies)	1800
All other buildings	2700 (If Q ≤ 108,000L) ⁽¹⁾ 3600 (If Q > 108,000L and ≤ 135,000L) ⁽¹⁾ 4500 (If Q > 135,000L and ≤ 162,000L) ⁽¹⁾ 5400 (If Q > 162,000L and ≤ 190,000L) ⁽¹⁾ 6300 (If Q > 190,000L and ≤ 270,000L) ⁽¹⁾ 9000 (If Q > 270,000L) ⁽¹⁾

Note: ⁽¹⁾ Q=KVS_{Tot} as referenced in Section 3(a)

ON-SITE FIRE PROTECTION SUPPLY CALCULATION

Per Fire Protection Water Supply Guideline, Ontario Building Code Division 3, Part B, 3.2.5.7

Project:	21-169 Legend Tire Waterford	Building/Block #:	Units 54-60 (Bungalow Town)
Project Location:	Waterford, ON	Firewalls/Sprinkler:	

Conditions not requiring On-Site Fire Protection:

Building area is Less than 200 m ² or Less	☐
Building height is 2 Storeys or Less	☒
Building does not have a Group B Occupancy (Care or Detention)	☒
Building does not require a sprinkler system or standpipe and hose system	☒
Limiting distance from the property line is at least 13 m if the building has an F-1 (high hazard industrial) occupancy	☒
Building constitutes no significant environmental contamination potential under fire conditions	☒
On-Site Supply Required?	YES

Calculation Information:

$$Q = K * V * S_{Tot}$$

where: Q = Minimum supply of water in litres (L)
V = Total Building Volume in cubic metres
K = Water supply coefficient from Table 1
S_{Tot} = total of spatial coefficient values from property line exposures on all sides, as obtained from the formula:

$$S_{Tot} = 1.0 + [(S_{Side1}) + (S_{Side2}) + (S_{Side3}) + ... etc.]$$

where: S_{Side} = values are obtained from Figure 1, as modified by Sections 6.3 (e) and 6.3 (f) of the OBC Guideline
S_{Tot} = need not exceed 2.0 (see Section 7.0 of the OBC Guideline)

Determining K Value:

Major Occupancy Classification	Residential Occupancies	
Group	C	
Division	-	
Building is of combustible construction. Roof assemblies, mezzanines, loadbearing walls, columns and arches do not have a fire resistance rating.		
	K Factor	23

Determining Building Volume:

Average Length (m)	78.5	
Average Width (m)	16.0	
Height, including basements (m)	9.0	
	Building Volume (m³)	11304

Total Spatial Coefficient:

	Exposure Distance (m)	Factor	
North Side	9	0.1	
East Side	>10	0	
South Side	>10	0	
West Side	>10	0	
		S_{Tot} Factor	1.1

Minimum Water Supply Flow:

	Q (L)	285,991
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Minimum Water Supply Flow Rate OBC:

9000	L/min
150.0	L/sec

Table 2: Minimum Water Supply Flow Rates	
Building Code, Part 3 Buildings	Required Minimum Water Supply Flow Rate (L/min.)
One-storey building with building area not exceeding 600m ² (excluding F-1 occupancies)	1800
All other buildings	2700 (If Q ≤ 108,000L) ⁽¹⁾ 3600 (If Q > 108,000L and ≤ 135,000L) ⁽¹⁾ 4500 (If Q > 135,000L and ≤ 162,000L) ⁽¹⁾ 5400 (If Q > 162,000L and ≤ 190,000L) ⁽¹⁾ 6300 (If Q > 190,000L and ≤ 270,000L) ⁽¹⁾ 9000 (If Q > 270,000L) ⁽¹⁾

Note: ⁽¹⁾ Q=KVS_{Tot} as referenced in Section 3(a)

ON-SITE FIRE PROTECTION SUPPLY CALCULATION

Per Fire Protection Water Supply Guideline, Ontario Building Code Division 3, Part B, 3.2.5.7

Project:	21-169 Legend Tire Waterford	Building/Block #:	Units 61-68 (Bungalow Town)
Project Location:	Waterford, ON	Firewalls/Sprinkler:	

Conditions not requiring On-Site Fire Protection:

Building area is Less than 200 m ² or Less	☐
Building height is 2 Storeys or Less	☒
Building does not have a Group B Occupancy (Care or Detention)	☒
Building does not require a sprinkler system or standpipe and hose system	☒
Limiting distance from the property line is at least 13 m if the building has an F-1 (high hazard industrial) occupancy	☒
Building constitutes no significant environmental contamination potential under fire conditions	☒
On-Site Supply Required?	YES

Calculation Information:

$$Q = K * V * S_{Tot}$$

where: Q = Minimum supply of water in litres (L)
V = Total Building Volume in cubic metres
K = Water supply coefficient from Table 1
S_{Tot} = total of spatial coefficient values from property line exposures on all sides, as obtained from the formula:

$$S_{Tot} = 1.0 + [(S_{Side1}) + (S_{Side2}) + (S_{Side3}) + ... etc.]$$

where: S_{Side} = values are obtained from Figure 1, as modified by Sections 6.3 (e) and 6.3 (f) of the OBC Guideline
S_{Tot} = need not exceed 2.0 (see Section 7.0 of the OBC Guideline)

Determining K Value:

Major Occupancy Classification	Residential Occupancies	
Group	C	
Division	-	
Building is of combustible construction. Roof assemblies, mezzanines, loadbearing walls, columns and arches do not have a fire resistance rating.		
K Factor		23

Determining Building Volume:

Average Length (m)	82.0	
Average Width (m)	16.0	
Height, including basements (m)	9.0	
Building Volume (m³)		11808

Total Spatial Coefficient:

	Exposure Distance (m)	Factor	
North Side	>10	0	
East Side	>10	0	
South Side	9	0.1	
West Side	>10	0	
S_{Tot} Factor			1.1

Minimum Water Supply Flow:

	Q (L)	298,742
--	--------------	----------------

Minimum Water Supply Flow Rate OBC:

9000	L/min
150.0	L/sec

Table 2: Minimum Water Supply Flow Rates	
Building Code, Part 3 Buildings	Required Minimum Water Supply Flow Rate (L/min.)
One-storey building with building area not exceeding 600m ² (excluding F-1 occupancies)	1800
All other buildings	2700 (If Q ≤ 108,000L) ⁽¹⁾ 3600 (If Q > 108,000L and ≤ 135,000L) ⁽¹⁾ 4500 (If Q > 135,000L and ≤ 162,000L) ⁽¹⁾ 5400 (If Q > 162,000L and ≤ 190,000L) ⁽¹⁾ 6300 (If Q > 190,000L and ≤ 270,000L) ⁽¹⁾ 9000 (If Q > 270,000L) ⁽¹⁾

Note: ⁽¹⁾ Q=KVS_{Tot} as referenced in Section 3(a)

Ontario Building Code Tables and Figures

XX

Table 3.1.2.1.
Major Occupancy Classification

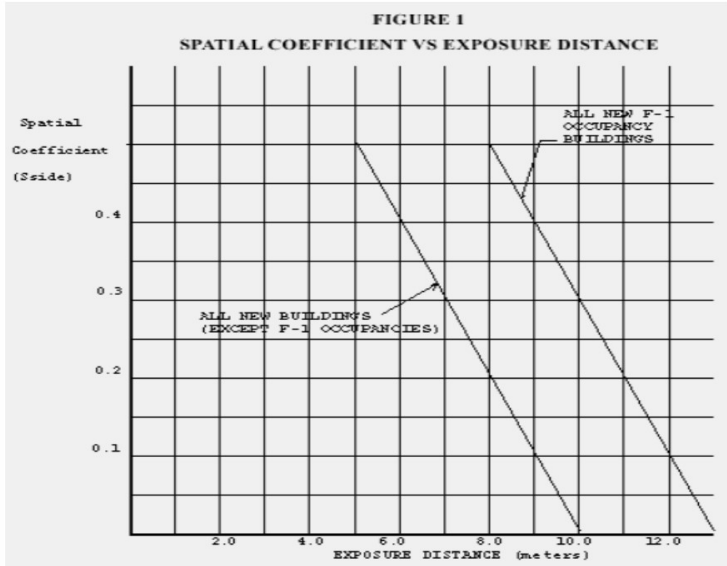
Forming Part of Sentences 3.1.2.1.(1), 3.1.2.2.(1) and 3.11.2.1.(3)

Item	Column 1 Group	Column 2 Division	Column 3 Description of Major Occupancies
1.	A	1	Assembly occupancies intended for the production and viewing of the performing arts
2.	A	2	Assembly occupancies not elsewhere classified in Group A
3.	A	3	Assembly occupancies of the arena type
4.	A	4	Assembly occupancies in which occupants are gathered in the open air
5.	B	1	Detention occupancies
6.	B	2	Care and treatment occupancies
7.	B	3	Care occupancies
8.	C	---	Residential occupancies
9.	D	---	Business and personal services occupancies
10.	E	---	Mercantile occupancies
11.	F	1	High hazard industrial occupancies
12.	F	2	Medium hazard industrial occupancies
13.	F	3	Low hazard industrial occupancies

Table 2: Minimum Water Supply Flow Rates	
Building Code, Part 3 Buildings	Required Minimum Water Supply Flow Rate (L/min.)
One-storey building with building area not exceeding 600m² (excluding F-1 occupancies)	1800
All other buildings	2700 (If Q ≤ 108,000L) ⁽¹⁾ 3600 (If Q > 108,000L and ≤ 135,000L) ⁽¹⁾ 4500 (If Q > 135,000L and ≤ 162,000L) ⁽¹⁾ 5400 (If Q > 162,000L and ≤ 190,000L) ⁽¹⁾ 6300 (If Q > 190,000L and ≤ 270,000L) ⁽¹⁾ 9000 (If Q > 270,000L) ⁽¹⁾

Note: ⁽¹⁾ Q=KVS_{Tot} as referenced in Section 3(a)

Table 1: Water Supply Coefficient - K					
TYPE OF CONSTRUCTION	Classification by Group or Division in Accordance with Table 3.1.2.1 of the Ontario Building Code				
	A-2 B-1 B-2 B-3 C D	A-4 F-3	A-1 A-3<	E-2	F-1
Building is of noncombustible construction with fire separations and fire-resistance ratings provided in accordance with Subsection 3.2.2. of the OBC, including loadbearing walls, columns and arches.	10	12	14	17	23
Building is of noncombustible construction or of heavy timber construction conforming to Article 3.1.4.6. of the OBC. Floor assemblies are fire separations but with no fire-resistance rating. Roof assemblies, mezzanines, loadbearing walls, columns and arches do not have a fire-resistance rating.	16	19	22	27	37
Building is of combustible construction with fire separations and fire-resistance ratings provided in accordance with Subsection 3.2.2. of the OBC, including loadbearing walls, columns and arches. Noncombustible construction may be used in lieu of fire-resistance rating where permitted in Subsection 3.2.2. of the OBC.	18	22	25	31	41
Building is of combustible construction. Floor assemblies are fire separations but with no fire-resistance rating. Roof assemblies, mezzanines, loadbearing walls, columns and arches do not have a fire-resistance rating.	23	28	32	39	53
Column 1	2	3	4	5	6



TECHNICAL MEMORANDUM

TO: Stephen Gradish **RVA:** 215718.39
FROM: David Evans, P.Eng.
DATE: October 22, 2022
SUBJECT: Waterford – Charles Street Subdivision – Water Modeling

1.0 INTRODUCTION

R.V. Anderson Associates Limited (RVA) conducted a watermain hydraulic assessment of the proposed development at Charles Street in the Town of Waterford, as requested by Norfolk County (County).

2.0 Background

The proposed development consists of 68 residential dwellings. The site is bounded by Charles Street to the south, and Washington Street to the east.

The objective of this report is to determine the impact of the proposed development on the existing distribution system and evaluate the ability to deliver sufficient water flow under Maximum Daily Demand (MDD) plus Fire Flow (FF) scenario and provide adequate pressures in the system under a Peak Hour Demand (PHD) scenario.

The County provided RVA with the following reports (including drawings and appendices) prepared by G. Douglas Vallee to complete the analysis:

- Charles Street Subdivision – Waterford Planning Justification Report, July 2022

3.0 Summary of the Water Distribution Hydraulic Modelling

RVA used the Waterford Water Distribution Model that was calibrated in 2022 to review the impact of the proposed development on the water distribution system.

The following points summarize the assumptions and analysis that were completed:

- Based on the Norfolk County Design Criteria, the population density is 2.75 persons per residential unit. The average daily flow is based upon 450 litres per person per day. Average Flow is estimated to be 0.97 L/s. PHD factor is 3.00 as per the Norfolk ISMP. MDD factor is 1.61 as per the Norfolk ISMP update TM dated April 2022;
- The proposed development including new nodes, pipe segments, and Average Day Demands (ADDs) were added to the water model. Node elevation data was obtained from Google Earth;
- Simulations were completed to estimate the pressure in the system during PHD and available FF during MDD. The simulations were completed using the scenarios in the existing Waterford Water Distribution Model;
- Minimum residual pressures of 40 psi under Peak Hour Demand (PHD);
- Minimum residual pressure of 20 psi under Max Day Demand (MDD) + Fire Flow (FF);
- According to the FUS Fire Flow Calculation, the required FF with MDD is estimated to be 233 L/s;
- The following proposed water distribution system upgrades are not yet completed; however, they were modeled as completed with the understanding these have been approved by the County and as such, included in the Master Water Model:
 - o Mayberry Homes;
 - o 136 Mechanic Street West Subdivision;
 - o Orchard Square Townhouse Development;
 - o Lam Blvd Stacked Townhouse Development;
 - o 208 Nicole Street Development;
 - o Wellington Street Reconstruction; and
 - o 180-218 Mechanic Street.

4.0 Results of the hydraulic analysis

The following points summarize the results of the analysis completed by RVA.

4.1 Existing Conditions

- Figure A-1 – The pressures in the vicinity of the development area are approximately 57 psi.

- Figure A-2 – The existing water system can provide a FF of 200 L/s during MDD prior to the development.

4.2 Proposed 150mm Watermain

According to the site plan, the water network for the proposed development is designed to connect to the existing 300mm diameter watermain on Charles Street at two locations. The internal water network would be 150mm.

- Figure B-1 – The pressures during PHD would be 56 – 59 psi, which is within the MECP recommended pressure range of 40 – 100 psi. The proposed upgrade would have negligible impact on the pressure to the vicinity.
- Figure B-2 – The available FF during MDD would be from 77 to 124 L/s within the development, which is lower than the required FF of 233 L/s. It would have minimal impact on the FF to the vicinity.

4.3 Proposed 200mm Watermain

To increase FF, the internal watermain was upsized to 200mm for the simulations below.

- Figure C-1 – The pressures during PHD would be 56 – 59 psi which is similar to the scenario when the internal watermain is 150mm since it is mostly dictated by topography and the supply pressure of the system.
- Figure C-2 – The available FF during MDD would be from 134 to 173 L/s within the development, which is lower than the required FF of 233 L/s. It would have minimal impact on the FF to the vicinity.

4.4 Third Development Connection

The water network would require a third connection to the existing 300mm watermain along Washington Street to further increase the FF.

- Figure C-3 – the model indicates that the FF during MDD would greatly increase to 179 – 193 L/s. However, it is still less than the required FF of 233 L/s.

5.0 Conclusions and Recommendations

The water distribution network would provide enough pressure to the proposed development. However, even with 200mm internal network and a third connection to the existing system, the FF during MDD does not meet the desired requirement.

Yours very truly,

R.V. ANDERSON ASSOCIATES LIMITED

David Evans, P.Eng.
Senior Principal

Enclosures:

1. Figure A-1 – Existing: Pressure During Peak Hour Demand
2. Figure A-2 – Existing: Available Fire Flow During Max Day Demand + Fire Flow
3. Figure B-1 – Proposed: Pressures During Peak Hour Demand (150mm)
4. Figure B-2 – Proposed: Available Fire Flow During Max Day Demand + Fire Flow (150mm)
5. Figure C-1 – Proposed: Pressures During Peak Hour Demand (200mm)
6. Figure C-2 – Proposed: Available Fire Flow During Max Day Demand + Fire Flow (200mm)
7. Figure C-3 – Proposed: Available Fire Flow During Max Day Demand + Fire Flow (200mm+3rd connection)

REVISIONS AND PUBLICATION REGISTER			
Revision #	Date	Details	Distribution
00	October 22, 2022	Tech Memo Issued via email	Stephen Gradish – Norfolk County

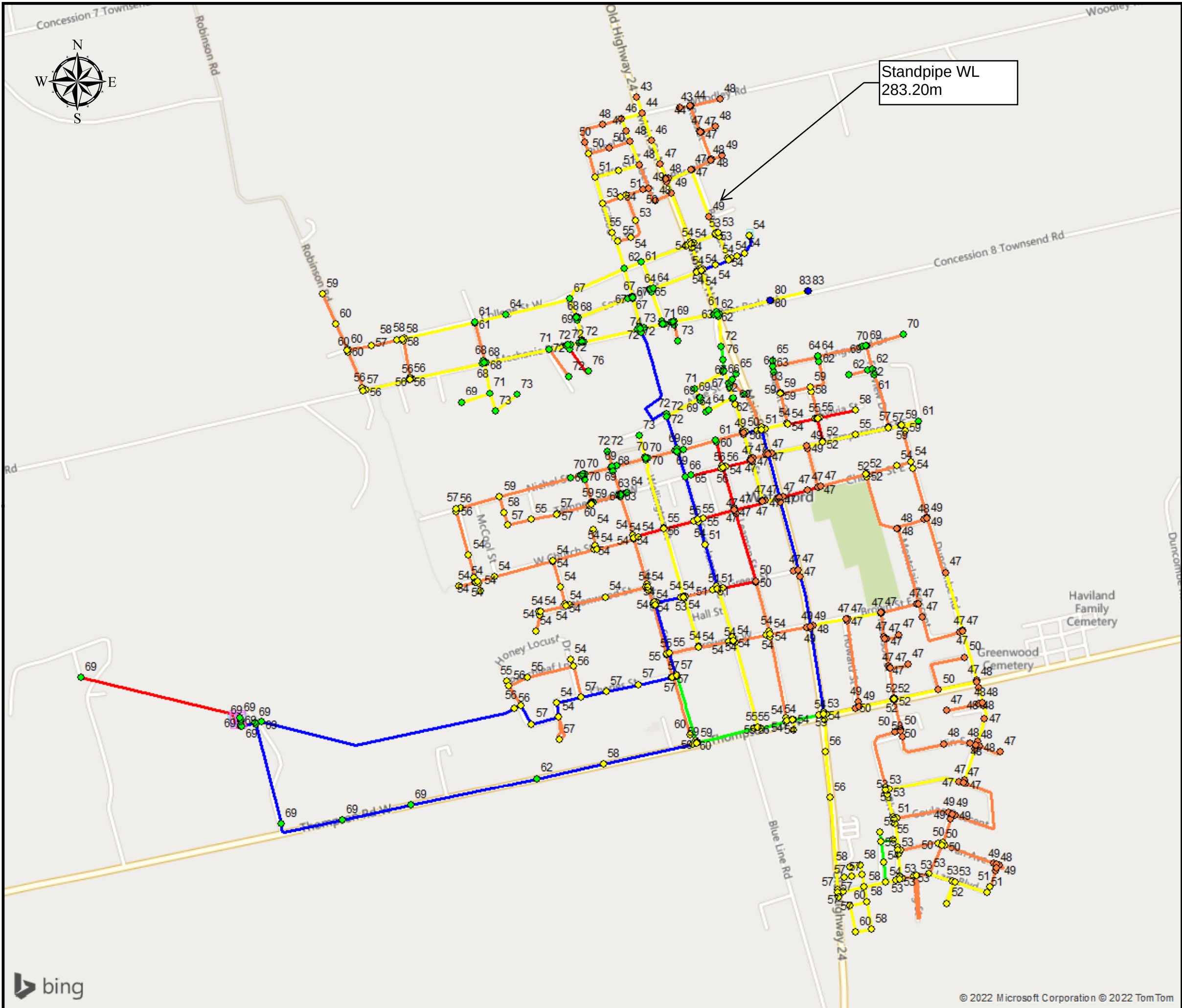


Figure A-1
Pressure during PHD
Existing

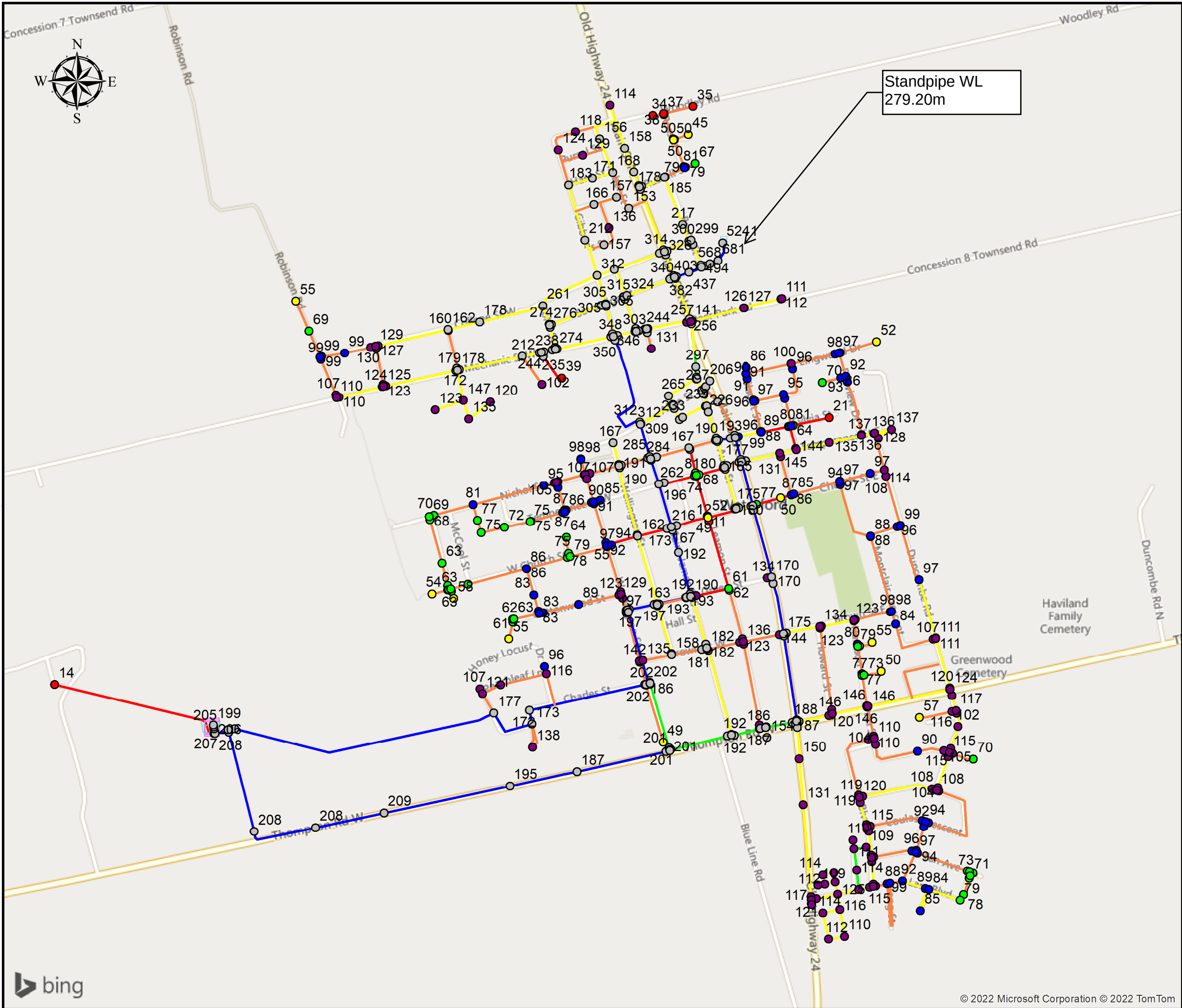
Legends

Node Pressure (psi)

- < 40
- 40 ~ 50
- 50 ~ 60
- 60 ~ 80
- 80 ~ 90
- 90 ~ 100

Watermains (mm)

- =<100
- 150
- 200
- 250
- 300
- 400



Waterford Charles Street Subdivision

Figure A-2
Available FF During MDD
Existing

Legends

Node Flow (L/s)

- < 40
- 40 ~ 60
- 60 ~ 80
- 80 ~ 100
- 100 ~ 150
- >150

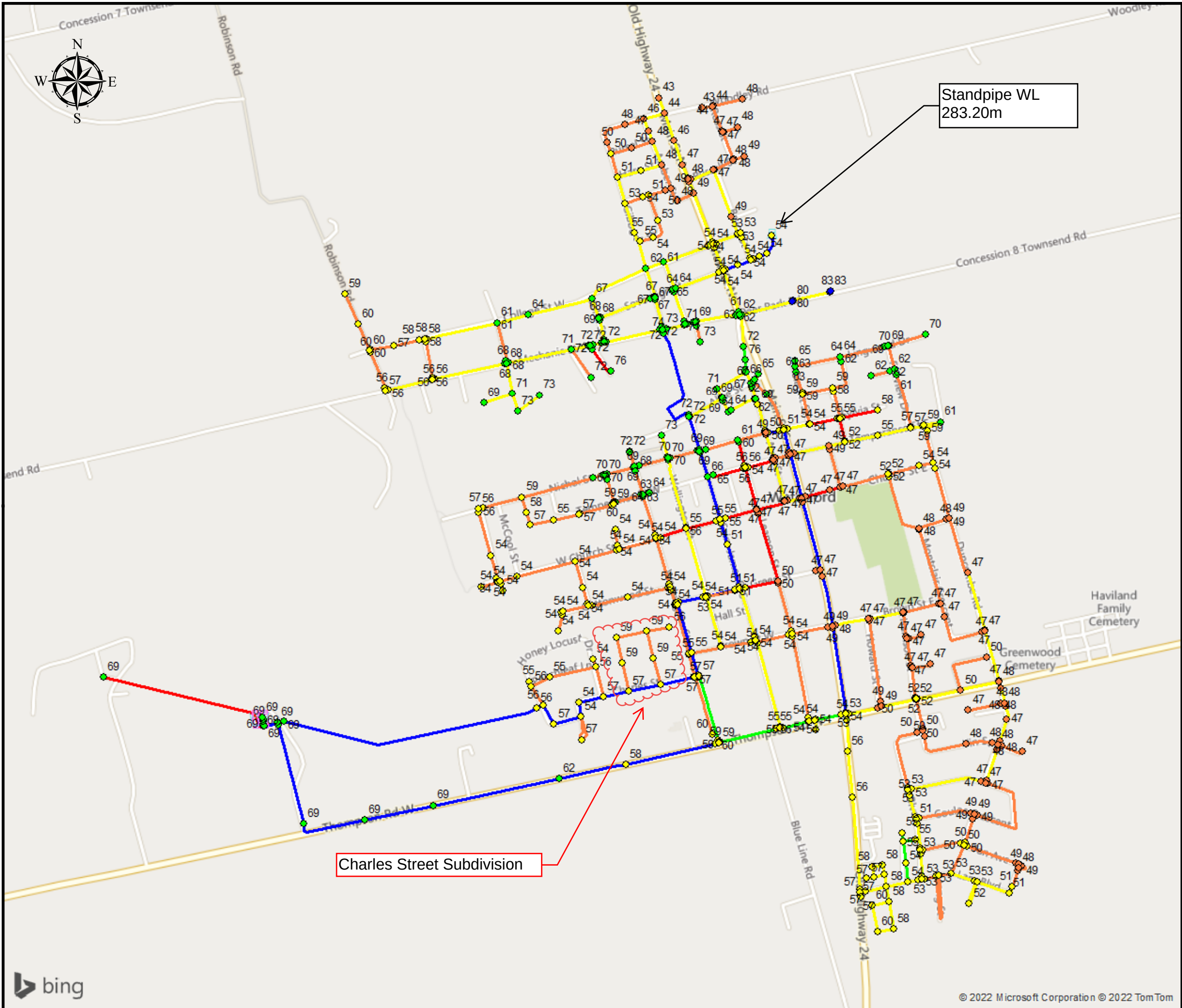
Watermains (mm)

- =<100
- 150
- 200
- 250
- 300
- 400



RVA Project Number: 215724.39
Date: 2022-10





Waterford Charles Street Subdivision

Figure B-1
Pressure during PHD
150mm internal WM

Legends

Node Pressure (psi)

- < 40
- 40 ~ 50
- 50 ~ 60
- 60 ~ 80
- 80 ~ 90
- 90 ~ 100

Watermains (mm)

- =<100
- 150
- 200
- 250
- 300
- 400



RVA Project Number: 215724.39
Date: 2022.10

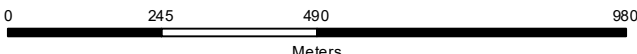


Figure B-2
Available FF During MDD
150mm Internal WM

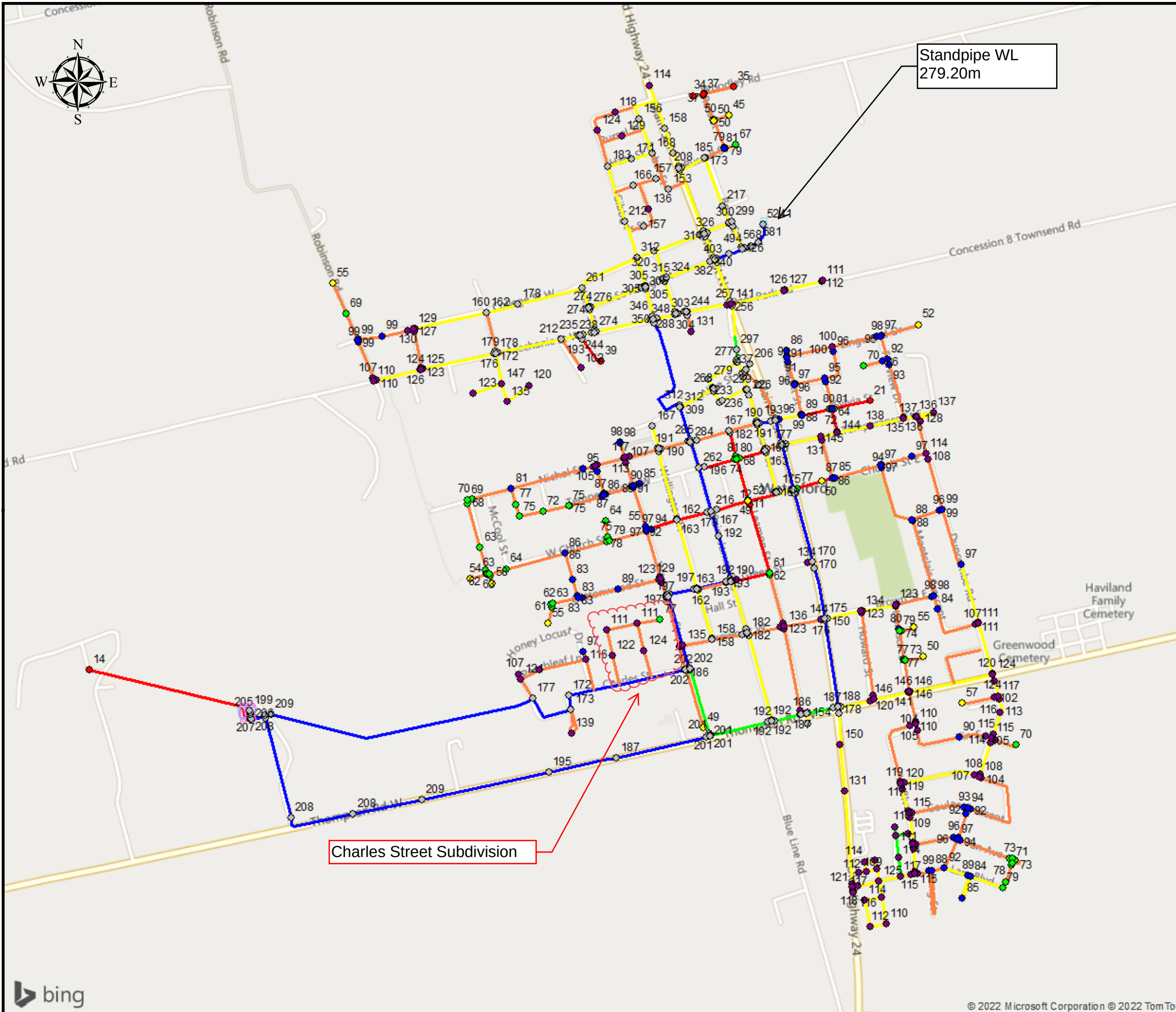
Legends

Node Flow (L/s)

- < 40
- 40 ~ 60
- 60 ~ 80
- 80 ~ 100
- 100 ~ 150
- >150

Watermains (mm)

- =<100
- 150
- 200
- 250
- 300
- 400



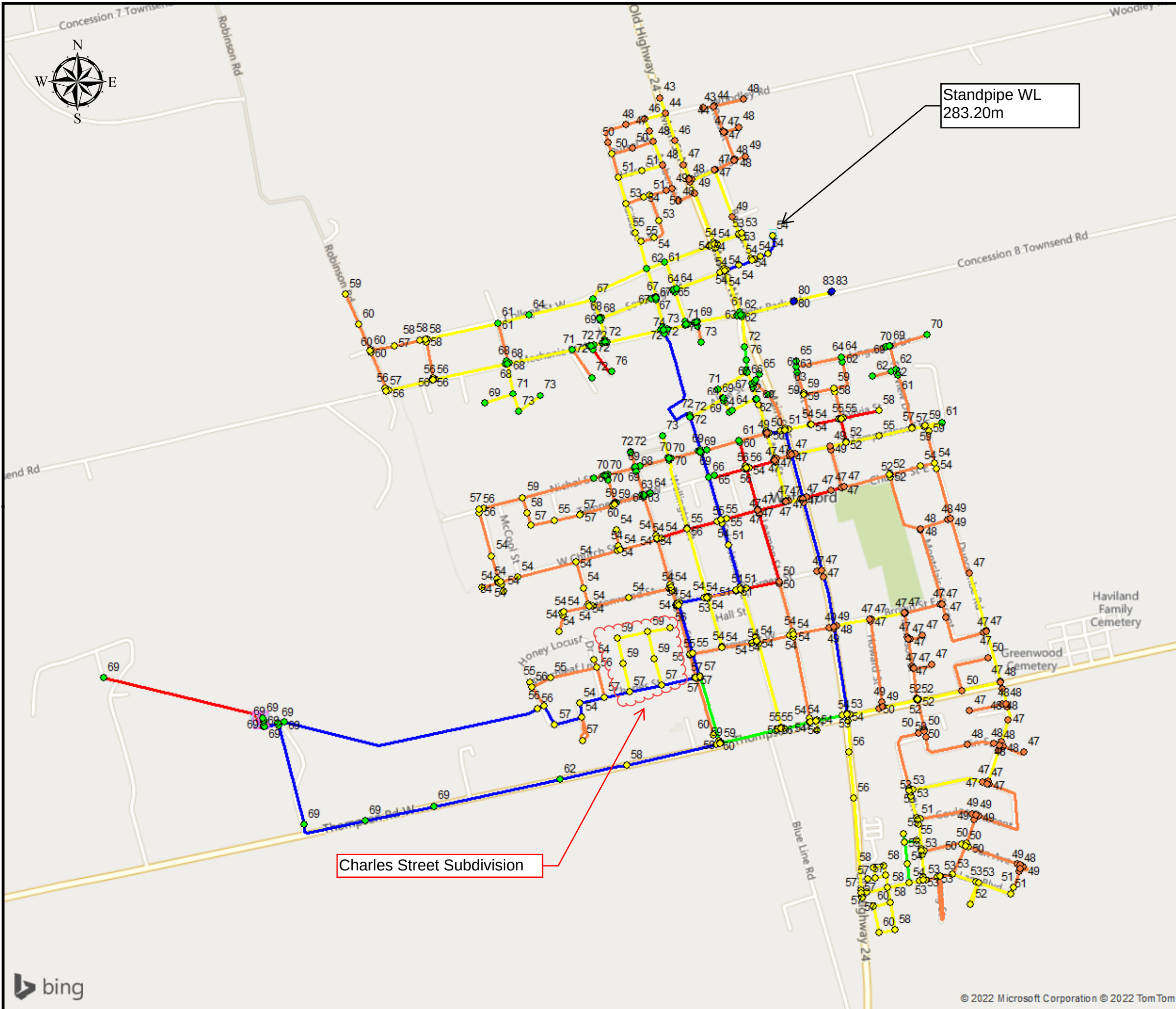


Figure C-1
Pressure during PHD
200mm internal WM

Legends

Node Pressure (psi)

- < 40
- 40 ~ 50
- 50 ~ 60
- 60 ~ 80
- 80 ~ 90
- 90 ~ 100

Watermains (mm)

- =<100
- 150
- 200
- 250
- 300
- 400

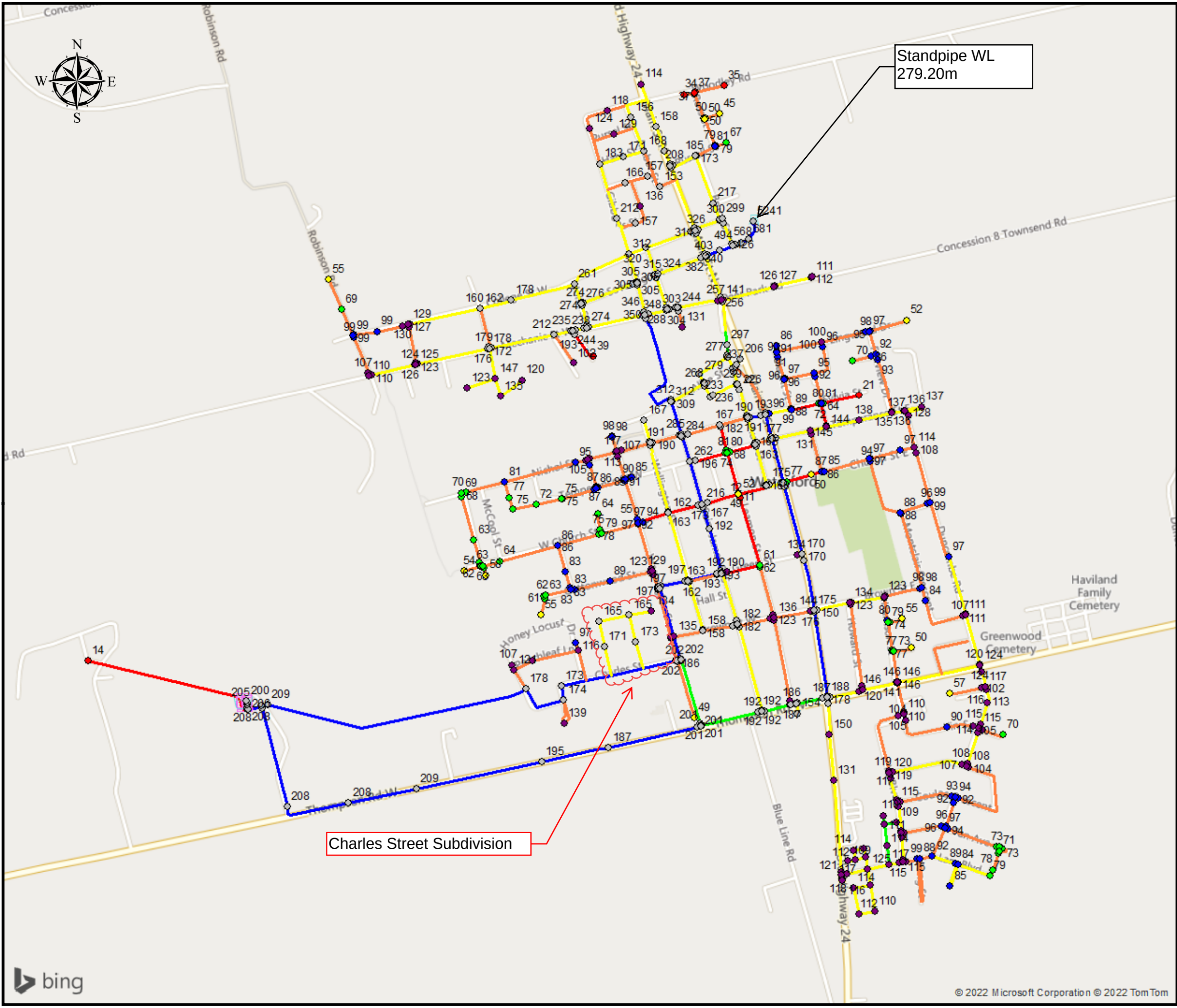


Figure C-2
Available FF During MDD
200mm Internal WM

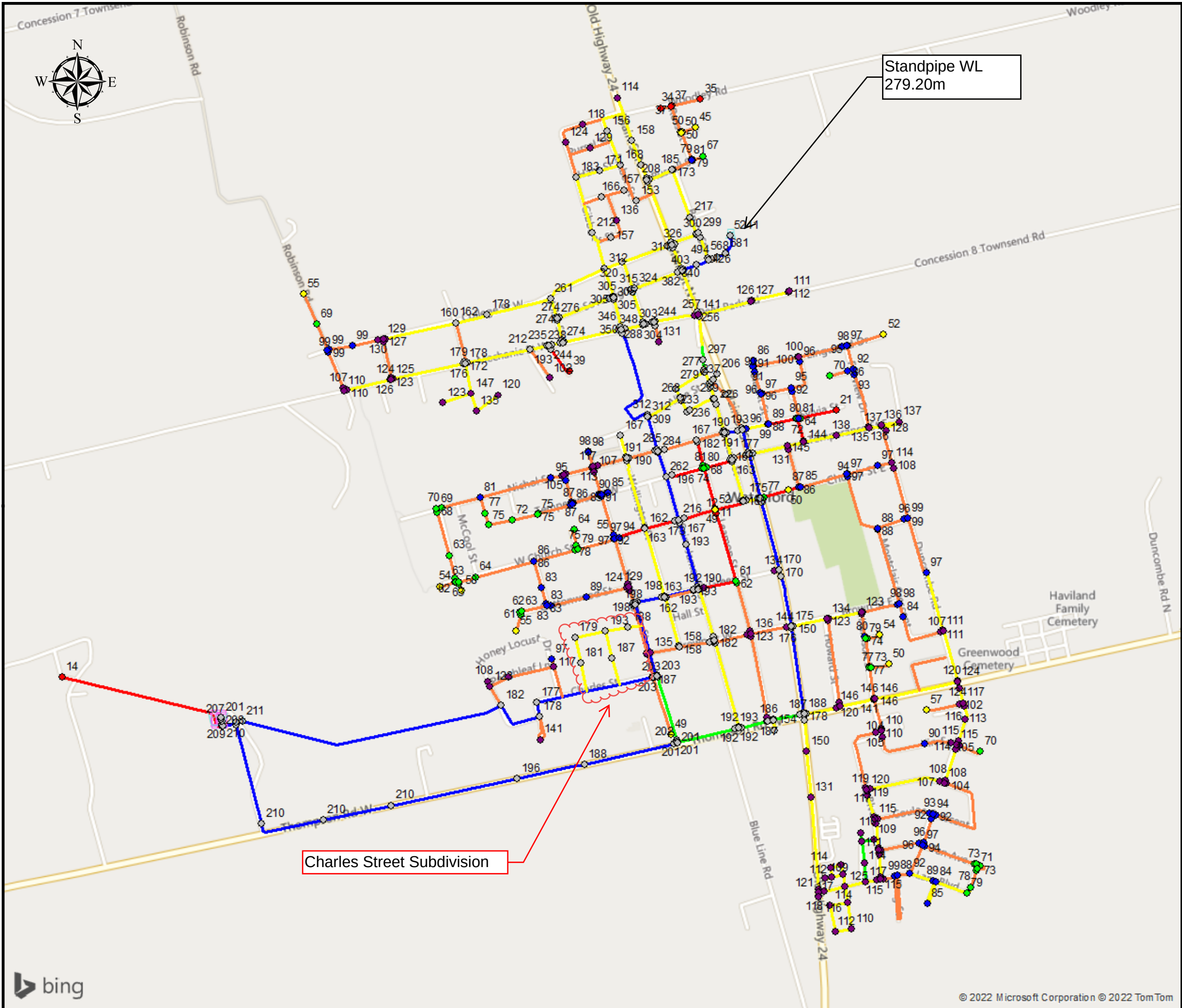
Legends

Node Flow (L/s)

- < 40
- 40 ~ 60
- 60 ~ 80
- 80 ~ 100
- 100 ~ 150
- >150

Watermains (mm)

- =<100
- 150
- 200
- 250
- 300
- 400



Waterford Charles Street Subdivision

Figure C-3
Available FF During MDD
200mm Internal WM + 3 Connections

Legends

Node Flow (L/s)

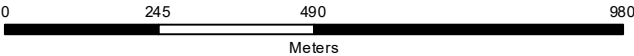
- < 40
- 40 ~ 60
- 60 ~ 80
- 80 ~ 100
- 100 ~ 150
- >150

Watermains (mm)

- =<100
- 150
- 200
- 250
- 300
- 400



RVA Project Number: 215724.39
Date: 2022-10





vallee

*Consulting Engineers,
Architects & Planners*

December 12, 2023

2863088 Ontario Inc
3156 Countess Crescent
Mississauga, ON
L5M 0E2

Attention: Mr. Roger Sharma

**Reference: Charles Street - Stormwater Management Report
Waterford – Norfolk County
Our Project #21-169**

Introduction

This Stormwater Management Report (SWM) has been prepared in support of the detailed design for the proposed Charles Street Subdivision located in Waterford – Norfolk County. This report outlines the detailed stormwater design for the proposed development. It is the intention to submit this report to Norfolk County and the Long Point Region Conservation Authority for review and approval.

The proposed Charles Street Subdivision is a mixed-density residential development located on the western side of Waterford that is generally bordered by Washington Street to the east, Charles Street to the south, and residential areas to the west and north. The development covers approximately 4.35 ha and includes 68 dwelling units, comprised of 23 single-family dwellings and 45 townhouse units. Refer to Figure 1 in Appendix A for the site location.

Stormwater Management Design Criteria

There is an existing 1500mm diameter municipal storm sewer system known as 'Waterford South Municipal Drain' (WSMD) located along Thompson Road allowance, approximately 240m south of the proposed development. The WSMD flows to the west and outlets downstream to an existing Stormwater Management (SWM) pond. It is the intention to utilize the 1500mm diameter Thompson Road storm sewer as the outlet for the proposed development.

The proposed Charles Street Subdivision site is located just outside of the original WSMD drainage area. However, as per the Revised Waterford South Municipal Drain Design Brief, the proposed Charles Street development has been added to the WSMD drainage system with the assumption that the site will feature an on-site stormwater management facility that will reduce the post-development peaks flows, and ensure that the capacity of the Thompson Road storm sewer is not exceeded. The site was given a peak flow allowance corresponding to the 2-year pre-development peak flow rate.

Consequently, the design criteria for the proposed development are as follows:

- Quantity Control: Reduce or control the post-development peak flow rates from the site to levels that do not exceed the 2-year pre-development flow rate, for all storm events up to and including the 100-year storm event.
- Quality Control: Stormwater to be treated to the Enhanced Protection Level as defined in the Ministry of the Environment's *Stormwater Management Practices Planning and Design Manual* (March 2003).

A Visual Otthymo computer model has been used to simulate the drainage areas under pre and post-development conditions. The simulations were conducted using the 4-hour Chicago Distribution design storm of the 2-year, 5-year, 10-year, 25-year, 50-year and 100-year storm events. The Norfolk County rainfall IDF curve data has been used for the storm analysis using the parameters in Table 1 below.

Table 1			
Norfolk County Rainfall IDF Parameters			
Event	A	B	C
2-year	529.711	4.501	0.745
5-year	583.017	3.007	0.703
10-year	670.324	3.007	0.698
25-year	721.533	2.253	0.679
50-year	766.038	1.898	0.668
100-year	801.041	1.501	0.657

Pre-Development

Under existing conditions, the subject site features the Peter Overdevest and Sons Landscaping and Nursery, agricultural land and open grassed area. Runoff from the site drains overland in a southerly direction towards Charles Street. Runoff is then conveyed under Charles Street via an existing culvert at #177, where it continues to flow overland across the St. Bernard's School and Church properties, and ultimately discharges to the Waterford South Municipal Drain (WSMD) watercourse.

The development site catchment area encompasses an area of 4.35 ha, as shown on Drawing SWM – Stormwater Drainage Areas in Appendix B. A Visual Otthymo computer model was used to simulate pre-development conditions for this area. The model uses a modified SCS procedure to estimate losses that occur naturally during a rainfall event such as evaporation and infiltration. Table 2 summarizes the input parameters with complete details included in Appendix B and C.

Table 2 Visual Otthymo Model Input – Pre-Development	
Parameter	Pre-Development Site
Are	4.35 ha
Soil Type	Sand & Sandy Silt
Hydrologic Soil Group	AB
SCS Curve Number	Pasture & Other Unimproved Land - 62
Initial Abstraction	13.6 mm ($IA/S_{0.05} = 0.05$, with $S_{0.05} = 1.33 * S_{0.20}^{1.15}$ in inches and $S_{0.20} = 1000/CN-10$ in inches)
Longest Flow Path	230 m
Average Slope	2.17 %
Runoff Coefficient	0.31
Time to Peak	0.30 hr

Table 3 summarizes the pre-development peak runoff from the development site based on the pre-development drainage patterns identified above.

Table 3 Peak Pre-Development Runoff	
Event	Pre-Dev Peak Flows (m ³ /s)
2-year	0.023
5-year	0.052
10-year	0.080
25-year	0.119
50-year	0.168
100-year	0.229

The 2-year pre-development peak flow of 0.023 m³/s will represent the target release rate from the proposed SWM facility for the Charles Street Subdivision for all storm events up to and including the 100-year storm event.

Post-Development

The overall SWM strategy is to reduce post-development peak flow rates from the site to less than or equal to the 2-year pre-development flow rate for all storm events up to and including the 100-year storm event. To meet this quantity control target, runoff from minor storm events will be conveyed via the proposed storm sewer system, and major storm events will flow overland along the roadways to the proposed SWM system. The proposed SWM system includes an infiltration basin at the center of the development and a stormwater management pond at the southern end of the site.

For the purposes of the analysis, the post-development drainage areas are shown in Drawing SWM – Stormwater Drainage Areas in Appendix A. Based on existing the contours and with some reasonable assumptions for the external lands, the post-development drainage areas can generally be described as follows:

- Area POST 1: Approximately 1.52 ha of the development site. Flows from this area will be directed to the proposed infiltration basin. Impervious land area introduced has been assumed based on the following assumptions:
 - Dwelling Area – total 0.40 ha.
 - Driveway Area – total 0.13 ha.
 - 185 of road at 10.5m² per m of road. Includes sidewalk on one side. – Total 0.19 ha.
 - Total Impervious Area 0.72 ha or 48% of the total contributing area to the infiltration basin.
 - Total Impervious Area Directly Connected to the storm system (ie roads and driveways) 0.32 ha or 21% of the total contributing area to the infiltration basin.
- Area POST 2: Approximately 2.83 ha of the development site. Flows from this area will be directed to the proposed stormwater management pond. Impervious land area introduced has been assumed based on the following assumptions:
 - Dwelling Area – total 0.60 ha.
 - Driveway Area – total 0.19 ha.
 - 350 of road at 10.5m² per m of road. Includes sidewalk on one side. – Total 0.37 ha.
 - Total Impervious Area 1.16 ha or 41% of the total contributing area to the pond.
 - Total Impervious Area Directly Connected to the storm system (ie roads and driveways) 0.56 ha or 20% of the total contributing area to the pond.
- Area EXT 1: Approximately 0.60 ha of external drainage is located on the east side of the subject lands. Flows from this area will be collected via rear yard swales behind units 54-60 and will be directed to the proposed stormwater management pond.

Table 4 summarizes the post-development input parameters for the Visual OTTHYMO computer model with complete details included in Appendix B and C.

Table 4			
Visual Otthymo Model Input – Post-Development			
Parameter	POST 1	POST 2	EXT 1
Area	1.52 ha	2.83 ha	0.60 ha
Soil Type	Sand & Sandy Silt		
Hydrologic Soil Group	AB		
SCS Curve Number	Pasture & Other Unimproved Land - 62		
Initial Abstraction	13.6 mm ($IA/S_{0.05} = 0.05$, with $S_{0.05} = 1.33 * S_{0.20}^{1.15}$ in inches and $S_{0.20} = 1000/CN-10$ in inches)		
Longest Flow Path	N/A	N/A	60m
Average Slope	N/A	N/A	1.67%
Runoff Coeff	N/A	N/A	0.45
Time to Peak (hrs)	N/A	N/A	0.14
Impervious Percentage (%)	48%	21%	N/A
Directly Connected Impervious Percentage (%)	41%	20%	N/A

Infiltration Basin

Runoff from post-development drainage Area 1 will be directly conveyed to the proposed infiltration basin in the center of the development. The infiltration basin will reduce the storage volume required in the pond by providing additional storage capacity and allowing soil infiltration. Infiltration basins provide not only water quantity benefits by reducing the required storage volume but also provide water quality benefits by promoting natural groundwater recharge.

The depth of an infiltration basin is governed by the native soil infiltration rate, porosity of the aggregate material used in the stone reservoir and the targeted time period to achieve complete drainage between storm events. As presented in the geotechnical investigation by G2S Consulting (refer to Appendix F), the infiltration rate of the native soil ranged between 62 and 142mm/hr. Taking the lower infiltration rate and applying a safety factor of 2.5, the design infiltration rate was taken as 25mm/hr. Therefore, the maximum allowable stone depth was determined to be 5.95m based on the design infiltration rate of 25 mm/hr, a void ratio of 0.4 and a drainage time of 96 hours, as defined in the Norfolk County Design Criteria (2012). A depth of 1.5m has been used for the proposed infiltration basin. A perforated pipe will run along the length of the infiltration basin to facilitate drainage and act as an overflow to the pond. Refer to the complete design calculations in Appendix C.

Stormwater Management Pond

A dry pond facility is proposed for the Charles Street Subdivision. To determine the storage volume required, the relationship between the storage volume of the pond and the discharge is defined by a pond-rating curve. This rating curve is determined by calculating the volume of the proposed pond facility up to a proposed contour elevation and then calculating the expected discharge from the facility based on the water level at this contour elevation and the proposed outlet control configuration.

Generally, orifices or weirs can control discharge from SWM facilities. Each of these control methods can be used by the singular control or they can be used in combination depending on the discharge characteristics desired. For this facility, a single orifice is proposed to control outflow with the following equation used to estimate discharge.

$$Q = C * A * \sqrt{2 * g * h}$$

where: Q = Discharge in cms

C = constant, 0.63

A = orifice area in m²

g = gravitational constant, 9.81 m/s²

h = height above orifice, m

For this facility, a 100mm orifice at elevation 239.50m will be used for flow control. The maximum active storage of the proposed facility is 1281m³ at an elevation of 240.70m and the total maximum storage of this facility is 1760m³ at freeboard elevation 241.00m. The complete discharge-to-storage rating curve is appended to this report as part of Appendix C. Table 5 summarizes the peak post-development runoff for all storm events and compares them to the allowable release rate for the development site. Table 5 also summarizes the impact on the WSMD. Complete details of the Visual OTTHYMO model are outlined in Appendix D.

Table 5 Peak Post-Development Development Runoff & Storage						
Event	Allowable Release Rate (m ³ /s)	Post-Dev Peak Flows (m ³ /s)	Storage Used (ha*m)	Ponding Elevation (m)	WSMD Sewer Upstream of Charles (m ³ /s)	WSMD Sewer Downstream of Charles (m ³ /s)
2-year	0.023	0.012	0.0258	239.85	3.20	3.20
5-year		0.014	0.0386	239.98	3.27	3.28
10-year		0.016	0.0508	240.11	3.27	3.28
25-year		0.018	0.0685	240.26	3.27	3.29
50-year		0.020	0.0818	240.40	3.28	3.29
100-year		0.022	0.1096	240.60	3.28	3.30

For all storm events, the post-development discharge is controlled to less than the target 2-yr pre-development discharge of the development site of 0.023 cms. Furthermore, the performance of the WSMD storm sewer is assessed by comparing the anticipated flows upstream and downstream of the connection of the proposed Charles Street Subdivision SWM Facility. The maximum capacity of the WSMD storm sewer along Thompson Road is 3.56 m³/s, as outlined in the Revised WSMD Design Brief. The maximum flow downstream of the Charles Street Subdivision was found to be 3.30 m³/s during the 100-year storm event, therefore it can be concluded that the WSMD storm sewer has adequate capacity to accept the post-development flows from the proposed development. The results generally show that the flow in the WSMD will remain unchanged with a nominal, less than 0.1% to 0.6%, increase.

Emergency Overflow Weir

A minimum 0.3m freeboard is provided above the 100-year storage elevation. In the event that a storm in excess of the 100-year storm event occurs, or if the primary outlet is blocked, a 6m emergency spillway is provided at 241.00 to safely convey the peak inflow rate from the 100-year storm event to the proposed outlet. The following equation is used to estimate discharge over the emergency overflow weir.

$$Q = 1.67 * w * h^{3/2}$$

where: Q = Discharge in cms
w = width of the weir, m
h = height above weir, m

Quality Control

The Ministry of the Environment's *Stormwater Management Practices Planning and Design Manual* (March 2003) was used in conjunction with requirements of the Norfolk County to determine the quality control design for the proposed SWM facility. For the proposed development, stormwater shall be treated to the Enhanced Protection Level, corresponding to a removal of 80% of total suspended solids.

Oil-Grit Separator

An EFO8 Stormceptor, or approved oil-grit separator equivalent, shall be provided after the outlet of the stormwater management facility to provide the required level of water quality control. The Stormceptor Sizing Report can be found in Appendix E.

Inspection and maintenance are fundamental to the long-term performance of any stormwater quality treatment device. Imbrium Stormwater Systems recommends that a Stormceptor be inspected every six months for the first year to determine the pollutant accumulation rate. In subsequent years, inspections can be based on observations or local requirements. The unit should be inspected immediately after an oil, fuel or chemical spill, and a licensed waste management company should remove oil and sediment for proper disposal.

Minimum Orifice Size

A minimum orifice of 75mm is recommended as per the MOE guidelines. For this facility, a 100mm orifice is proposed.

Active Storage Depth

The MOE guidelines and Norfolk Design Criteria recommend a maximum active storage depth of 2.0m. The active storage depth ranges between 0.35m +/- during the 2yr event and 1.10m +/- during the 100yr event.

Maintenance Access

Maintenance access to the proposed SWM facility is provided from Street A, Street B and from Charles Street. As per Norfolk County Design Criteria, a minimum 3.0 wide access route is provided, and the slope of the maintenance access route does not exceed 10:1.

Slopes

The Norfolk Design Criteria and MOE guidelines specify a maximum side slope of 5:1 and 4:1, respectively in a dry pond facility. A side slope of 4:1 shall be utilized in the proposed SWM facility.

Erosion and Sediment Control

During construction, the contractor is required to protect the worksite and all adjacent lands from sediment and erosion regardless of the source, to the satisfaction of all applicable parties. The measures installed by the contractor are to remain in place until such time as there is no further threat of damage and all vegetation is established. Measures that are to be put into place as an absolute minimum include silt fences, mud mats, and filter cloths over catch basins onsite.

Proposed SWM Facility Summary

The following summarizes the proposed SWM Facility for the Charles Street Subdivision:

- A 1.5m deep infiltration basin with an overflow connection to the stormwater management pond.
- A dry pond facility with a pond bottom of elevation of 239.50m, a top of freeboard elevation of 241.00m.
- Active storage depth of 1.2m.
- Total active storage volume provided for the 100-year storm event is 1096 m³.
- Discharge from the proposed facility controlled by a 100mm diameter orifice at elevation 239.50m.
- A 6.0m emergency overflow spillway is provided at 241.00m to safely convey the peak inflow rate from the 100-year storm event to the existing watercourse.
- An EFO8 Stormceptor unit, or approved equal, shall be utilized to achieve an enhanced level of water quality protection.

Charles Street / Washington Street Storm Extension

Under current conditions, there are no storm sewers located on Charles Street or Washington Street. Therefore, it is proposed that a storm sewer be constructed along Charles Street and Washington Street to connect the proposed SWM facility to the existing 1500mm diameter storm sewer along Thompson Road. Refer to the detailed plan and profile drawings for Charles Street and Washington Street for complete details. This storm sewer has been designed to convey the 2-year design storm flow rates, plus the 100-year post-development flow rate from the Charles Street SWM facility, as specified in the Revised Waterford South Municipal Drain Design Brief.

Conclusions and Recommendations

Based on the review presented by this Stormwater Management Report, it is concluded that:

- Post-development flows from the development site have been controlled to less than the 2-year pre-development allowable release rate for all storm events up to and including the 100-year storm event.
- The proposed SWM design meets the design guidelines outlined by the MOE's *Stormwater Management Practices Planning and Design Manual* (March 2003) for enhanced water quality protection.

It is recommended that this report be provided to Norfolk County and the Long Point Region Conservation Authority in support of the detailed design for the proposed development.

Respectfully submitted,



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List of Appendices

Appendix A

- 21-169 SWM - Stormwater Drainage Areas

Appendix B

- Soil Parameters

Appendix C

- Catchment Parameters
- Target Volumes
- Stage-Storage Infiltration Basin
- Pond Rating Curve
- Post Flows and Storage Volumes

Appendix D

- Visual OTTHYMO Summary Outputs

Appendix E

- Stormceptor Sizing Report

Appendix F

- Geotechnical Investigation Charles Street & Washington Street
(G2S Consulting Inc dated March 6, 2023)

APPENDIX A

21-169 SWM - Stormwater Drainage Areas

APPENDIX B

Soil Parameters

CHART C2-8 - SOIL/LAND USE CURVE NUMBERS

Land Use	Hydrologic Soil Group						
	A	AB	B	BC	C	CD	D
Fallow (special cases only)	77	82	86	89	91	93	94
Crop and other improved land	66*	70	74	78	82	84	86
Pasture & other unimproved land	58*	62*	65	71	76	79	81
Woodlots and forest	50*	54*	58	65	71	74	77
Impervious areas (paved)	98						
Bare rock draining <u>directly</u> to stream	98						
Bare rock draining <u>indirectly</u> to stream	70						
Water surfaces	100 (use in special cases only)						

Notes

- Figures are based on average antecedent moisture condition (AMC II) except those marked *, which are initially wet (AMC III) or an intermediate condition. For definition of AMC's see Chart C2-10.
- Table is not applicable to frozen soils or to periods in which snowmelt contributes to runoff.
- For detailed values in urban areas see Table 2.2 of ref. 14.
- Source: SCS Handbook of Hydrology, Chapter 9 (9), with modifications.

CHART C2-9 - PERCENT IMPERVIOUSNESS OF URBAN AREAS

Urban Land Use	% Imperviousness
Business - Commercial	40 - 90
Industrial - Light	45 - 65
Industrial - Heavy	50 - 70
Residential - Low density	20 - 30
Residential - Medium density	25 - 35
Residential - High density	30 - 40

Source: SCS Handbook of Hydrology, Chapter 15 (9)

CHART C2-2 - HYDROLOGIC SOIL GROUPS FOR GENERAL SOIL TYPES

<u>Sands, sandy loams, and gravels</u> - overlying sand, gravel or limestone bedrock, very well drained - ditto, imperfectly drained - Shallow, overlying precambrian bedrock or clay subsoil	A AB B
<u>Coarse loams</u> - overlying sand, gravel or limestone, well drained - shallow, overlying precambrian bedrock or clay subsoil	AB B
<u>Medium textured loams</u> - shallow, overlying limestone bedrock - overlying medium textured subsoil	B BC
<u>Silt loams, some loams</u> - with good internal drainage - with slow internal drainage and good external drainage	BC C
<u>Clays, clay loams, silty clay loams</u> - with good internal drainage - with imperfect or poor external drainage - with slow internal drainage and good external drainage	C C D

Note: Soils are classified on the basis of bare soil having maximum swelling at the end of a long storm whose rainfall exceeds infiltration into soil. Classifications shown are subject to modification as experience dictates.

Classifications are based on S.C.S. definitions (9) modified to suit Ontario conditions.

APPENDIX C

Catchment Parameters

Target Volumes

Stage-Storage Infiltration Basin

Pond Rating Curve

Post Flows and Storage Volumes

SOIL PARAMETERS

Soil Type	AB - Sandy & Sandy Silt	Soil parameters obtained from:
CN	62	Geotechnical Investigation Charles Street & Washington Street, Waterford
Ia	13.6 mm	(March 2023, G2S Consulting Inc)
Infiltration Rate	62 mm/hr	
Safety Correction Factor	2.5	
Design Infiltration Rate (i)	25 mm/hr	
Design Infiltration Rate (i)	0.025 m/hr	

BMP Sizing

The depth of the soakaway or infiltration trench is dependent on the native soil infiltration rate, porosity (void space ratio) of the gravel storage layer media (i.e., aggregate material used in the stone reservoir) and the targeted time period to achieve complete drainage between storm events. The maximum allowable depth of the stone reservoir for designs without an underdrain can be calculated using the following equation:

$$d_{r \max} = i \cdot t_d / V_r$$

Where:

$d_{r \max}$ = Maximum stone reservoir depth (mm)
 i = Infiltration rate for native soils (mm/hr)
 V_r = Void space ratio for aggregate used (typically 0.4 for 50 mm clear stone)
 t_d = Time to drain (design for 48 hour time to drain is recommended)

Airport Formula

$$T_c = 3.26 \cdot (1.1 - C) \cdot L^{0.5} / Sw^{0.33}$$

T_c = Time of Concentration (minutes)
 C = Runoff Coefficient (dimensionless)
 L = Watershed Length (metres)
 Sw = Watershed Slope % (m/m)

Maximum Infiltration Trench Depth

Void Ratio (Vr)	0.4
Drawdown Time (ts)	96 hr
Max allowable stone depth (drmax)	5.95 m

EXTERNAL AREA ASSUMPTIONS:

Area No.	Total Area (ha)	Area per Runoff Coeff. 0.25	Area per Runoff Coeff. 0.45	Composite Runoff Coeff.	Drainage Length (m)	Upstream Elev. (m)	Downstream Elev. (m)	Slope (%)	Time of Concentration (min)	Time to Peak (0.6*tc) (hr)
EXT 1	0.60	0.00	0.6	0.45	60.00	243.00	242.00	1.67	13.87	0.14

PRE-DEVELOPMENT SITE AREA ASSUMPTIONS:

Area No.	Total Area (ha)	Area per Runoff Coeff. 0.25	Area per Runoff Coeff. 0.45	Composite Runoff Coeff.	Drainage Length (m)	Upstream Elev. (m)	Downstream Elev. (m)	Slope (%)	Time of Concentration (min)	Time to Peak (0.6*tc) (hr)
PRE-SITE	4.35	3.04	1.31	0.31	230.00	245.50	240.50	2.17	30.22	0.30

POST-DEVELOPMENT SITE AREA ASSUMPTIONS:

AVERAGE SINGLE FAMILY DWELLING ROOF AREA:	176 m2
AVERAGE SINGLE FAMILY DRIVEWAY AREA (6m x 10m):	60 m2
AVERAGE SINGLE CAR BUNGALOW TOWN DWELLING ROOF AREA:	152 m2
AVERAGE SINGLE CAR BUNGALOW TOWN DRIVEWAY AREA (3m x 12m):	36 m2
AVERAGE DOUBLE CAR BUNGALOW TOWN DWELLING ROOF AREA:	200 m2
AVERAGE DOUBLE CAR BUNGALOW TOWN DRIVEWAY AREA (6m x 12m):	72 m2
AVERAGE 2-STOREY TOWN DWELLING ROOF AREA:	112 m2
AVERAGE 2-STOREY TOWN DRIVEWAY AREA (3m x 12m):	36 m2
ROADWAY AND ONE SIDE SIDEWALK AREA (8m road, 1m of curb, 1.5m sidewalk) PER METRE LENGTH OF ROAD:	10.5 m2

	POST 1	POST 2
Number of Single Family Dwellings Roofs	12	11
Number of Single Car Bungalow Town Dwellings Roofs	3	6
Number of Double Car Bungalow Town Dwellings Roofs	1	5
Number of 2-Storey Town Dwellings Roofs	11	19
Number of Single Family Driveways	12	11
Number of Single Car Bungalow Town Driveways	6	3
Number of Double Car Bungalow Town Driveways	2	4
Number of 2-Storey Town Driveways	0	30
Length of Road (m)	185	350
Dwelling Area	4000	5976 m2
Driveway Area	1296	1920 m2
Road Area	1943	3675 m2
TOTAL IMPERVIOUS AREA	7239	11571 m2
TOTAL DIRECTLY CONNECTED IMPERVIOUS	3239	5595 m2

Area No.	Total Area (ha)	Total Imp Area (ha)	Imp Area Ratio	Dir Conn Imp Area (ha)	Dir Conn Ratio
POST 1	1.52	0.72	48%	0.32	21%
POST 2	2.83	1.16	41%	0.56	20%

Pre-Development Flow Rates

Design Storm	Q (m3/s)	= Allowable Release Rate
2	0.023	
5	0.052	
10	0.080	
25	0.119	
50	0.168	
100	0.229	

Pre-Development Rainfall Volumes

Return Period	Pre-Development		
	Area (ha.)	Vol. (mm)	Vol. (cm)
2	4.35	3.662	159.3

Post-Development Rainfall Volumes

Return Period	Post-Development			
	Area	Area (ha.)	Vol. (mm)	Vol. (cm)
100	EXT 1	0.6	21.707	130.2
	POST 1	1.52	44.604	678.0
	POST 2	2.83	38.467	1088.6
TOTAL				1896.84

Target Storage (cm)	1738	(based on 100 year storm - 2 pre-dev volume)
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Pond Parameters

Top of Infiltration Storage	240.70	m
Depth of Infiltration Storage	1.5	m
Bottom of Infiltration Storage	239.20	m
Bottom Area of Pond	900	m ²

Stage-Storage-Discharge

Description	Elevation (m)	Stage (m)	Ponding Depth (m)	Infiltration Storage (m ³)	Pond Volume (m ³)	Total Volume (m ³)
Bottom of Infiltration Storage	239.20	0.0	0.0	0	0	0
	239.30	0.1	0.0	36	0	36
	239.40	0.2	0.0	72	0	72
	239.50	0.3	0.0	108	0	108
	239.60	0.4	0.0	144	0	144
	239.70	0.5	0.0	180	0	180
	239.80	0.6	0.0	216	0	216
	239.90	0.7	0.0	252	0	252
	240.00	0.8	0.0	288	0	288
	240.10	0.9	0.0	324	0	324
	240.20	1.0	0.0	360	0	360
	240.30	1.1	0.0	396	0	396
	240.40	1.2	0.0	432	0	432
	240.50	1.3	0.0	468	0	468
	240.60	1.4	0.0	504	0	504
Top of Infiltration Storage	240.70	1.5	0.0	540	0	540

*Storage volumes obtained from AutoCAD Civil 3D

Pond Parameters

Bottom of Pond	239.50 m
Active Storage Depth	1.20 m
Top of Active Storage	240.70 m
Top of Freeboard	241.00 m

Orifice Parameters

	Diameter	0.100 m
	Area	0.0079 m ²
Orifice #1	Invert Elevation	239.50 m
	CL Elevation	239.55 m

$$Q = CA\sqrt{2gh}$$

C = 0.63

Active Storage Rating Curve

Description	Elevation (m)	Stage (m)	Total Volume (m ³)	Total Volume (ha.m)	Orifice 1 Q (m ³ /s)
Bottom of Pond	239.50	0.0	0	0.000	0.000
	239.60	0.1	70	0.007	0.005
	239.70	0.2	147	0.015	0.008
	239.80	0.3	230	0.023	0.011
	239.90	0.4	320	0.032	0.013
	240.00	0.5	416	0.042	0.015
	240.10	0.6	519	0.052	0.016
	240.20	0.7	628	0.063	0.018
	240.30	0.8	745	0.075	0.019
	240.40	0.9	868	0.087	0.020
	240.50	1.0	999	0.100	0.021
Top of Active Storage	240.60	1.1	1136	0.114	0.022
	240.70	1.2	1281	0.128	0.024
	240.80	1.3	1433	0.143	0.025
	240.90	1.4	1593	0.159	0.025
Top of Freeboard	241.00	1.5	1760	0.176	0.026

*Storage volumes obtained from AutoCAD Civil 3D

Pre to Post-Development Flow Rates

Return Period	Q (m3/s)						
	Pre-Dev	Allowable Release Rate	Post-Dev	Allowable to Post Net Change	WSMD Sewer Upstream of Charles Subdivision	WSMD Sewer Downstream Charles Subdivision	WSMD Percentage Net Change
2	0.023	0.023	0.012	✓ -0.011	3.20	3.20	0.1%
5	0.052	0.023	0.014	✓ -0.009	3.27	3.28	0.3%
10	0.080	0.023	0.016	✓ -0.007	3.27	3.28	0.3%
25	0.119	0.023	0.018	✓ -0.005	3.27	3.29	0.6%
50	0.168	0.023	0.020	✓ -0.003	3.28	3.29	0.3%
100	0.229	0.023	0.022	✓ -0.001	3.28	3.30	0.6%

Stage-Storage

Description	Elevation (m)	Ponding Depth (m)	Total Volume (m3)
Bottom of Pond	239.50	0.0	0.0
	239.60	0.1	70.0
	239.70	0.2	147.0
	239.80	0.3	230.0
	239.90	0.4	320.0
	240.00	0.5	416.0
	240.10	0.6	519.0
	240.20	0.7	628.0
	240.30	0.8	745.0
	240.40	0.9	868.0
Top of Active Storage	240.50	1.0	999.0
	240.60	1.1	1136.0
	240.70	1.2	1281.0
	240.80	1.3	1433.0
Top of Freeboard	240.90	1.4	1593.0
	241.00	1.5	1760.0

*Storage volumes obtained from AutoCAD Civil 3D

Approximate Pond Stages from OTTHYMO Model

Return Period	Utilized Storage (m3)	Ponding Depth (m)	Elev. (m)
2	258	0.35	239.85
5	386	0.48	239.98
10	508	0.61	240.11
25	685	0.76	240.26
50	818	0.90	240.40
100	1096	1.10	240.60

Emergency Overflow Weir: An emergency overflow weir is proposed to safely convey the inflow of the 100-year event

100-year Inflow Rate

0.541 m³/s

C = 1.67

L = 6.0 m

H = 0.15 m (max height before spilling onto road)

Q = 0.582 m³/s

$$Q = CLH^{1.5}$$



APPENDIX D

Visual OTTHYMO Summary Outputs

21-169 CHARLES STREET SUBDIVISION

PRE-DEVELOPMENT

OTTHYMO MODEL



1

CHARLES - PRE-DEV

2-YEAR STORM - PRE-DEVELOPMENT

```
V V I SSSS U U A L (v 6.2.2015)
V V I SS U U A A L
V V I SS U U A A A L
V V I SS U U A A L
VV I SSSS UUUU A A LLLL

OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO

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```

***** D E T A I L E D O U T P U T *****

```
Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\Natalie\AppData\Local\Civica\XH5\2b61f5e3-29d9-
4c68-a5ec-7ff64ecb31ab\el014796-3a8a-4b8f-a906-6dd8bb7feb72\scen
Summary filename: C:\Users\Natalie\AppData\Local\Civica\XH5\2b61f5e3-29d9-
4c68-a5ec-7ff64ecb31ab\el014796-3a8a-4b8f-a906-6dd8bb7feb72\scen
```

DATE: 10/19/2023 TIME: 03:43:51

USER:

COMMENTS: _____

```
*****
** SIMULATION : Norfolk 2yr 4hr **
*****
```

```
-----
| READ STORM | Filename: C:\Users\Natalie\AppData
| | ata\Local\Temp\
| | aa824349-258c-4f88-9458-e0e5369f0801\e53d15c3
| Ptotal= 39.38 mm | Comments: Norfolk 2yr 4hr
-----
```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	0.00	1.17	8.94	2.33	7.01	3.50	3.89
0.17	3.25	1.33	16.92	2.50	6.20	3.67	3.68
0.33	3.56	1.50	78.82	2.67	5.59	3.83	3.51
0.50	3.96	1.67	21.89	2.83	5.11	4.00	3.35
0.67	4.52	1.83	13.00	3.00	4.72		
0.83	5.31	2.00	9.88	3.17	4.39		
1.00	6.55	2.17	8.15	3.33	4.11		

```
-----
| CALIB |
| NASHYD ( 0001) | Area (ha)= 4.35 Curve Number (CN)= 62.0
| ID= 1 DT= 5.0 min | Ia (mm)= 13.60 # of Linear Res.(N)= 3.00
|-----
| U.H. Tp(hrs)= 0.30
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083 0.00 | 1.167 6.55 | 2.250 8.15 | 3.33 4.39
0.167 0.00 | 1.250 8.94 | 2.333 8.15 | 3.42 4.11
0.250 3.25 | 1.333 8.94 | 2.417 7.01 | 3.50 4.11
0.333 3.25 | 1.417 16.92 | 2.500 7.01 | 3.58 3.89
0.417 3.56 | 1.500 16.92 | 2.583 6.20 | 3.67 3.89
0.500 3.56 | 1.583 78.82 | 2.667 6.20 | 3.75 3.68
0.583 3.96 | 1.667 78.82 | 2.750 5.59 | 3.83 3.68
0.667 3.96 | 1.750 21.89 | 2.833 5.59 | 3.92 3.51
0.750 4.52 | 1.833 21.89 | 2.917 5.11 | 4.00 3.51
0.833 4.52 | 1.917 13.00 | 3.000 5.11 | 4.08 3.35
0.917 5.31 | 2.000 13.00 | 3.083 4.72 | 4.17 3.35
1.000 5.31 | 2.083 9.88 | 3.167 4.72 |
1.083 6.55 | 2.167 9.88 | 3.250 4.39 |
```

Unit Hyd Qpeak (cms) = 0.554

PEAK FLOW (cms) = 0.023 (i)
TIME TO PEAK (hrs) = 2.167
RUNOFF VOLUME (mm) = 3.662
TOTAL RAINFALL (mm) = 39.385
RUNOFF COEFFICIENT = 0.093

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

5-YEAR STORM - PRE-DEVELOPMENT

V V I SSSS U U A L (v 6.2.2015)
V V I SS U U A A L
V V I SS U U AAAAA L
V V I SS U U A A L
VV I SSSS UUUU A A LLLL

OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO
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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\Natalie\AppData\Local\Civica\XH5\2b61f5e3-29d9-4c68-a5ec-7ff64ecb31ab\3d5eafab-c127-47c8-af01-7a4b1ccc7ab8\scen
Summary filename: C:\Users\Natalie\AppData\Local\Civica\XH5\2b61f5e3-29d9-4c68-a5ec-7ff64ecb31ab\3d5eafab-c127-47c8-af01-7a4b1ccc7ab8\scen

DATE: 10/19/2023 TIME: 03:43:51
USER:

COMMENTS: _____

** SIMULATION : Norfolk 5yr 4hr **

READ STORM		Filename: C:\Users\Natalie\AppData							
		ata\Local\Temp\							
		aa824349-258c-4f88-9458-e0e5369f0801\d0509639							
Ptotal= 48.48 mm		Comments: Norfolk 5yr 4hr							

TIME	RAIN	TIME	RAIN	'	TIME	RAIN	TIME	RAIN	
hrs	mm/hr	hrs	mm/hr		hrs	mm/hr	hrs	mm/hr	
0.00	0.00	1.17	10.19		2.33	7.70	3.50	3.96	
0.17	3.53	1.33	21.62		2.50	6.68	3.67	3.73	
0.33	3.66	1.50	112.37		2.67	5.94	3.83	3.53	
0.50	4.04	1.67	27.76		2.83	5.39	4.00	3.35	
0.67	4.67	1.83	15.75		3.00	4.93			
0.83	5.61	2.00	11.43		3.17	4.55			
1.00	7.11	2.17	9.15		3.33	4.22			

CALIB			
NASHYD (0001)		Area (ha)= 4.35	Curve Number (CN)= 62.0
ID= 1 DT= 5.0 min		Ia (mm)= 13.60	# of Linear Res. (N)= 3.00

		U.H. Tp (hrs)= 0.30	

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083	0.00	1.167	7.11	2.250	9.15	3.33	4.55
0.167	0.00	1.250	10.19	2.333	9.15	3.42	4.22
0.250	3.53	1.333	10.19	2.417	7.70	3.50	4.22
0.333	3.53	1.417	21.62	2.500	7.70	3.58	3.96
0.417	3.66	1.500	21.62	2.583	6.68	3.67	3.96
0.500	3.66	1.583	112.37	2.667	6.68	3.75	3.73
0.583	4.04	1.667	112.37	2.750	5.94	3.83	3.73
0.667	4.04	1.750	27.76	2.833	5.94	3.92	3.53
0.750	4.67	1.833	27.76	2.917	5.39	4.00	3.53
0.833	4.67	1.917	15.75	3.000	5.39	4.08	3.35
0.917	5.61	2.000	15.75	3.083	4.93	4.17	3.35
1.000	5.61	2.083	11.43	3.167	4.93		
1.083	7.11	2.167	11.43	3.250	4.55		

Unit Hyd Qpeak (cms)= 0.554

PEAK FLOW (cms)= 0.052 (i)
TIME TO PEAK (hrs)= 2.083
RUNOFF VOLUME (mm)= 6.381
TOTAL RAINFALL (mm)= 48.478
RUNOFF COEFFICIENT = 0.132

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

FINISH
=====

10-YEAR STORM - PRE-DEVELOPMENT

V V I SSSS U U A L (v 6.2.2015)
V V I SS U U A A L
V V I SS U U A A A A L
V V I SS U U A A L
VV I SSSS UUUU A A LLLL

OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO
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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO
6.2\VO2\voind.dat
Output filename: C:\Users\Natalie\AppData\Local\Civica\XH5\2b61f5e3-29d9-4c68-a5ec-7ff64ecb31ab\7ceef007-5b96-4edb-828d-e699703d52a0\scen
Summary filename: C:\Users\Natalie\AppData\Local\Civica\XH5\2b61f5e3-29d9-4c68-a5ec-7ff64ecb31ab\7ceef007-5b96-4edb-828d-e699703d52a0\scen

DATE: 10/19/2023 TIME: 03:43:51

USER:

COMMENTS:

** SIMULATION : Norfolk 10yr 4hr **

| READ STORM | Filename: C:\Users\Natalie\AppData
| | ata\Local\Temp\
| | aa824349-258c-4f88-9458-e0e5369f0801\18a961b8
| Ptotal= 56.08 mm | Comments: Norfolk 10yr 4hr

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	0.00	1.17	11.51	2.33	8.66	3.50	4.39
0.17	3.58	1.33	25.32	2.50	7.52	3.67	4.14
0.33	3.99	1.50	133.60	2.67	6.65	3.83	3.91
0.50	4.50	1.67	32.00	2.83	5.38	4.00	3.63
0.67	5.21	1.83	19.73	3.00	5.49		
0.83	6.27	2.00	12.95	3.17	5.05		
1.00	8.00	2.17	10.31	3.33	4.70		

| CALIB |
| NASHYD (0001) | Area (ha)= 4.35 Curve Number (CN)= 62.0
| ID= 1 DT= 5.0 min | Ia (mm)= 13.60 # of Linear Res. (N)= 3.00

U.H. Tp (hrs)= 0.30

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083	0.00	1.167	8.00	2.250	10.31	3.33	5.05
0.167	0.00	1.250	11.51	2.333	10.31	3.42	4.70
0.250	3.58	1.333	11.51	2.417	8.66	3.50	4.70
0.333	3.58	1.417	25.32	2.500	8.66	3.58	4.39
0.417	3.99	1.500	25.32	2.583	7.52	3.67	4.39
0.500	3.99	1.583	133.60	2.667	7.52	3.75	4.14
0.583	4.50	1.667	133.60	2.750	6.65	3.83	4.14
0.667	4.50	1.750	32.00	2.833	6.65	3.92	3.91
0.750	5.21	1.833	32.00	2.917	5.38	4.00	3.91
0.833	5.21	1.917	19.73	3.000	5.38	4.08	3.63
0.917	6.27	2.000	19.73	3.083	5.49	4.17	3.63
1.000	6.27	2.083	12.95	3.167	5.49		
1.083	8.00	2.167	12.95	3.250	5.05		

Unit Hyd Qpeak (cms)= 0.554

PEAK FLOW (cms)= 0.080 (i)
TIME TO PEAK (hrs)= 2.000
RUNOFF VOLUME (mm)= 9.104
TOTAL RAINFALL (mm)= 56.083
RUNOFF COEFFICIENT = 0.162

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

25-YEAR STORM - PRE-DEVELOPMENT

V V I SSSS U U A L (v 6.2.2015)
V V I SS U U A A L
V V I SS U U AAAAA L
V V I SS U U A A L
VV I SSSS UUUU A A LLLL

OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO
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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voindat
Output filename: C:\Users\Natalie\AppData\Local\Civica\XH5\2b61f5e3-29d9-4c68-a5ec-7ff64ecb3lab\3dle00ce-4492-4ee7-9ed5-e5e9f436bf70\scen
Summary filename: C:\Users\Natalie\AppData\Local\Civica\XH5\2b61f5e3-29d9-4c68-a5ec-7ff64ecb3lab\3dle00ce-4492-4ee7-9ed5-e5e9f436bf70\scen

DATE: 10/19/2023 TIME: 03:43:51
USER:

COMMENTS:

** SIMULATION : Norfolk 25yr 4hr **

| READ STORM | Filename: C:\Users\Natalie\AppData
| | ata\Local\Temp\
| | aa824349-258c-4f88-9458-e0e5369f0801\5e9e153d
| Ptotal= 66.10 mm | Comments: Norfolk 25yr 4hr

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	0.00	1.17	13.67	2.33	10.44	3.50	5.48
0.17	4.50	1.33	27.69	2.50	9.14	3.67	5.18
0.33	4.98	1.50	158.85	2.67	8.15	3.83	4.90
0.50	5.61	1.67	35.08	2.83	7.39	4.00	4.65
0.67	6.45	1.83	20.60	3.00	6.78		
0.83	7.70	2.00	15.24	3.17	6.27		
1.00	9.70	2.17	12.32	3.33	5.84		

| CALIB |
| NASHYD (0001) | Area (ha)= 4.35 Curve Number (CN)= 62.0
| ID= 1 DT= 5.0 min | Ia (mm)= 13.60 # of Linear Res. (N)= 3.00

U.H. Tp (hrs)= 0.30

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083	0.00	1.167	9.70	2.250	12.32	3.33	6.27
0.167	0.00	1.250	13.67	2.333	12.32	3.42	5.84
0.250	4.50	1.333	13.67	2.417	10.44	3.50	5.84
0.333	4.50	1.417	27.69	2.500	10.44	3.58	5.48
0.417	4.98	1.500	27.69	2.583	9.14	3.67	5.48
0.500	4.98	1.583	158.85	2.667	9.14	3.75	5.18
0.583	5.61	1.667	158.85	2.750	8.15	3.83	5.18
0.667	5.61	1.750	35.08	2.833	8.15	3.92	4.90
0.750	6.45	1.833	35.08	2.917	7.39	4.00	4.90
0.833	6.45	1.917	20.60	3.000	7.39	4.08	4.65
0.917	7.70	2.000	20.60	3.083	6.78	4.17	4.65
1.000	7.70	2.083	15.24	3.167	6.78		
1.083	9.70	2.167	15.24	3.250	6.27		

Unit Hyd Qpeak (cms)= 0.554

PEAK FLOW (cms)= 0.119 (i)
TIME TO PEAK (hrs)= 2.000
RUNOFF VOLUME (mm)= 13.236
TOTAL RAINFALL (mm)= 66.103
RUNOFF COEFFICIENT = 0.200

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

50-YEAR STORM - PRE-DEVELOPMENT

V V I SSSS U U A L (v 6.2.2015)
V V I SS U U A A L
V V I SS U U AAAAA L
V V I SS U U A A L
VV I SSSS UUUU A A LLLLL

OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO
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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\Natalie\AppData\Local\Civica\XH5\2b61f5e3-29d9-4c68-a5ec-7ff64ecb31ab\all01970-c7e9-45c2-8bff-7da6d88d6bc4\scen
Summary filename: C:\Users\Natalie\AppData\Local\Civica\XH5\2b61f5e3-29d9-4c68-a5ec-7ff64ecb31ab\all01970-c7e9-45c2-8bff-7da6d88d6bc4\scen

DATE: 10/19/2023 TIME: 03:43:51

USER:

COMMENTS: _____

** SIMULATION : Norfolk 50yr 4hr **

| READ STORM | Filename: C:\Users\Natalie\AppData
| | ata\Local\Temp\
| | aa824349-258c-4f88-9458-e0e5369f0801\5ef9f9bd
| Ptotal= 72.96 mm | Comments: Norfolk 50yr 4hr

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	0.00	1.17	14.27	2.33	10.39	3.50	4.98
0.17	3.99	1.33	33.90	2.50	8.89	3.67	4.65
0.33	4.45	1.50	186.56	2.67	7.80	3.83	4.37
0.50	5.08	1.67	44.81	2.83	6.96	4.00	4.14
0.67	5.97	1.83	23.44	3.00	6.30		
0.83	7.29	2.00	16.26	3.17	5.79		
1.00	9.53	2.17	12.62	3.33	5.33		

| CALIB |
| NASHYD (0001) | Area (ha)= 4.35 Curve Number (CN)= 62.0
| ID= 1 DT= 5.0 min | Ia (mm)= 13.60 # of Linear Res. (N)= 3.00

U.H. Tp(hrs)= 0.30

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083	0.00	1.167	9.53	2.250	12.62	3.33	5.79
0.167	0.00	1.250	14.27	2.333	12.62	3.42	5.33
0.250	3.99	1.333	14.27	2.417	10.39	3.50	5.33
0.333	3.99	1.417	33.90	2.500	10.39	3.58	4.98
0.417	4.45	1.500	33.90	2.583	8.89	3.67	4.98
0.500	4.45	1.583	186.56	2.667	8.89	3.75	4.65
0.583	5.08	1.667	186.56	2.750	7.80	3.83	4.65
0.667	5.08	1.750	44.81	2.833	7.80	3.92	4.37
0.750	5.97	1.833	44.81	2.917	6.96	4.00	4.37
0.833	5.97	1.917	23.44	3.000	6.96	4.08	4.14
0.917	7.29	2.000	23.44	3.083	6.30	4.17	4.14
1.000	7.29	2.083	16.26	3.167	6.30		
1.083	9.53	2.167	16.26	3.250	5.79		

Unit Hyd Qpeak (cms)= 0.554

PEAK FLOW (cms)= 0.168 (i)
TIME TO PEAK (hrs)= 2.000
RUNOFF VOLUME (mm)= 16.380
TOTAL RAINFALL (mm)= 72.962
RUNOFF COEFFICIENT = 0.225

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

100-YEAR STORM - PRE-DEVELOPMENT

V V I SSSS U U A L (v 6.2.2015)
V V I SS U U A A L
V V I SS U U A A A A L
V V I SS U U A A L
VV I SSSS UUUU A A LLLL

OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO
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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO
6.2\VO2\voind.dat
Output filename: C:\Users\Natalie\AppData\Local\Civica\XH5\2b61f5e3-29d9-4c68-a5ec-7ff64ecb31ab\9015a3d8-f13a-4dd4-b776-6271c2339f4e\scen
Summary filename: C:\Users\Natalie\AppData\Local\Civica\XH5\2b61f5e3-29d9-4c68-a5ec-7ff64ecb31ab\9015a3d8-f13a-4dd4-b776-6271c2339f4e\scen

DATE: 10/19/2023 TIME: 03:43:51

USER:

COMMENTS: _____

** SIMULATION : Norfolk 100 yr 4hr **

READ STORM	Filename: C:\Users\Natalie\AppData\Local\Temp\aa824349-258c-4f88-9458-e0e5369f0801\el1495e0d
Ptotal= 83.90 mm	Comments: Norfolk 100 yr 4hr

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	0.00	1.17	16.86	2.33	12.12	3.50	5.66
0.17	4.50	1.33	41.07	2.50	10.31	3.67	5.28
0.33	5.05	1.50	205.92	2.67	9.02	3.83	4.98
0.50	5.82	1.67	54.56	2.83	8.03	4.00	4.70
0.67	6.83	1.83	29.17	3.00	7.24		
0.83	8.41	2.00	19.28	3.17	6.60		
1.00	11.07	2.17	14.83	3.33	6.10		

CALIB	
NASHYD (0001)	Area (ha)= 4.35 Curve Number (CN)= 62.0
ID= 1 DT= 5.0 min	Ia (mm)= 13.60 # of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.30

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

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	1.167	11.07	2.250	14.83	3.33	6.60
0.167	0.00	1.250	16.86	2.333	14.83	3.42	6.10
0.250	4.50	1.333	16.86	2.417	12.12	3.50	6.10
0.333	4.50	1.417	41.07	2.500	12.12	3.58	5.66
0.417	5.05	1.500	41.07	2.583	10.31	3.67	5.66
0.500	5.05	1.583	205.92	2.667	10.31	3.75	5.28
0.583	5.82	1.667	205.92	2.750	9.02	3.83	5.28
0.667	5.82	1.750	54.56	2.833	9.02	3.92	4.98
0.750	6.83	1.833	54.56	2.917	8.03	4.00	4.98
0.833	6.83	1.917	29.17	3.000	8.03	4.08	4.70
0.917	8.41	2.000	29.17	3.083	7.24	4.17	4.70
1.000	8.41	2.083	19.28	3.167	7.24		
1.083	11.07	2.167	19.28	3.250	6.60		

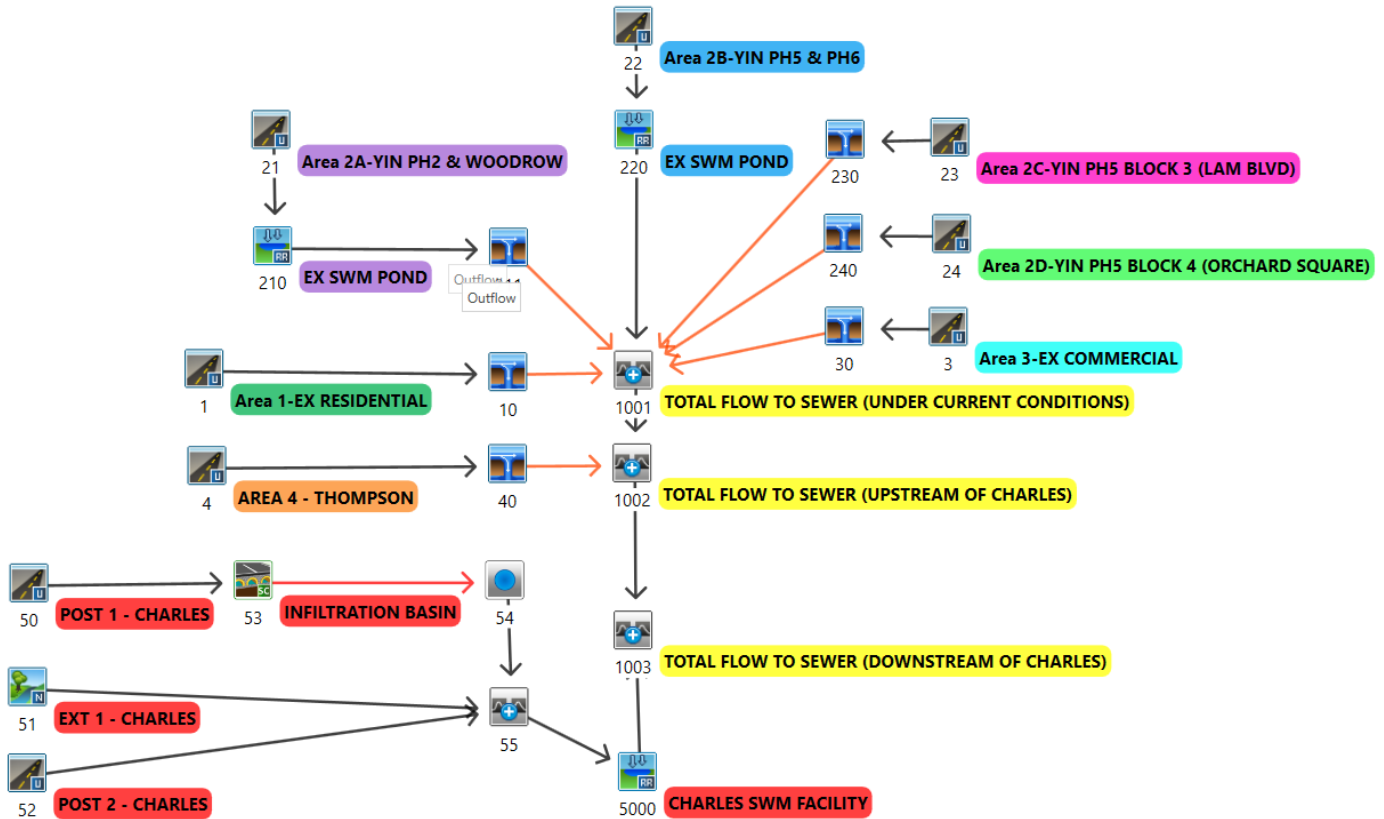
Unit Hyd Qpeak (cms)= 0.554

PEAK FLOW (cms)= 0.229 (i)
TIME TO PEAK (hrs)= 2.000
RUNOFF VOLUME (mm)= 21.862
TOTAL RAINFALL (mm)= 83.902
RUNOFF COEFFICIENT = 0.261

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

FINISH

21-169 CHARLES STREET SUBDIVISION
POST-DEVELOPMENT
OTTHYMO MODEL



2-YEAR STORM - POST-DEVELOPMENT

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V V I SSSS U U A L (v 6.2.2015)
V V I SS U U A A L
V V I SS U U A A A A L
V V I SS U U A A L
VV I SSSS UUUU A A LLLL

OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO
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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voindat
Output filename: C:\Users\Natalie\AppData\Local\Civica\539dale3-248d-4187-b290-2694abdf28b0\scen
Summary filename: C:\Users\Natalie\AppData\Local\Civica\539dale3-248d-4187-b290-2694abdf28b0\scen

DATE: 10/19/2023 TIME: 03:51:46

USER:

COMMENTS:

** SIMULATION : Norfolk 2yr 4hr

READ STORM	Filename: C:\Users\Natalie\AppData\Local\Temp\ata\Local\Temp\539dale3-248d-4187-b290-2694abdf28b0\scen
Ptotal= 39.38 mm	Comments: Norfolk 2yr 4hr

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	0.00	1.17	8.94	2.33	7.01	3.50	3.89
0.17	3.25	1.33	16.92	2.50	6.20	3.67	3.68
0.33	3.56	1.50	78.82	2.67	5.59	3.83	3.51
0.50	3.96	1.67	21.89	2.83	5.11	4.00	3.35

0.67	4.52	1.83	13.00	3.00	4.72
0.83	5.31	2.00	9.88	3.17	4.39
1.00	6.55	2.17	8.15	3.33	4.11

CALIB	Area (ha)	Curve Number (CN)
NASHYD (0051)	0.60	62.0
ID= 1 DT= 5.0 min	Ia (mm)= 13.60	# of Linear Res.(N)= 3.00
U.H. Tp(hrs)= 0.14		

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

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	1.167	6.55	2.250	8.15	3.33	4.39
0.167	0.00	1.250	8.94	2.333	8.15	3.42	4.11
0.250	3.25	1.333	8.94	2.417	7.01	3.50	4.11
0.333	3.25	1.417	16.92	2.500	7.01	3.58	3.89
0.417	3.56	1.500	16.92	2.583	6.20	3.67	3.89
0.500	3.56	1.583	78.82	2.667	6.20	3.75	3.68
0.583	3.96	1.667	78.82	2.750	5.59	3.83	3.68
0.667	3.96	1.750	21.89	2.833	5.59	3.92	3.51
0.750	4.52	1.833	21.89	2.917	5.11	4.00	3.51
0.833	4.52	1.917	13.00	3.000	5.11	4.08	3.35
0.917	5.31	2.000	13.00	3.083	4.72	4.17	3.35
1.000	5.31	2.083	9.88	3.167	4.72		
1.083	6.55	2.167	9.88	3.250	4.39		

Unit Hyd Qpeak (cms)= 0.164

PEAK FLOW (cms)=	0.004 (i)
TIME TO PEAK (hrs)=	1.833
RUNOFF VOLUME (mm)=	3.636
TOTAL RAINFALL (mm)=	39.385
RUNOFF COEFFICIENT	= 0.092

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

CALIB	Area (ha)	Total Imp(%)	Dir. Conn.(%)
STANDHYD (0052)	2.83	41.00	20.00
ID= 1 DT= 5.0 min			

Surface Area	IMPERVIOUS	PERVIOUS (i)
(ha)=		
1.16	1.67	
Dep. Storage (mm)=	1.00	13.60
Average Slope (%)=	1.00	2.00

Length (m)= 137.36 40.00
Mannings n = 0.013 0.250

NATIVE SOIL LAYER:
Infiltration (m/hr) = 0.0250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083	0.00	1.167	6.55	2.250	8.15	3.33	4.39
0.167	0.00	1.250	8.94	2.333	8.15	3.42	4.11
0.250	3.25	1.333	8.94	2.417	7.01	3.50	4.11
0.333	3.25	1.417	16.92	2.500	7.01	3.58	3.89
0.417	3.56	1.500	16.92	2.583	6.20	3.67	3.89
0.500	3.56	1.583	78.82	2.667	6.20	3.75	3.68
0.583	3.96	1.667	78.82	2.750	5.59	3.83	3.68
0.667	3.96	1.750	21.89	2.833	5.59	3.92	3.51
0.750	4.52	1.833	21.89	2.917	5.11	4.00	3.51
0.833	4.52	1.917	13.00	3.000	5.11	4.08	3.35
0.917	5.31	2.000	13.00	3.083	4.72	4.17	3.35
1.000	5.31	2.083	9.88	3.167	4.72		
1.083	6.55	2.167	9.88	3.250	4.39		

Max.Eff.Inten.(mm/hr)= 78.82 7.62
over (min) 5.00 25.00
Storage Coeff. (min)= 3.40 (ii) 23.16 (ii)
Unit Hyd. Tpeak (min)= 5.00 25.00
Unit Hyd. peak (cms)= 0.26 0.05

PEAK FLOW (cms)= 0.12 0.02 0.122 (iii)
TIME TO PEAK (hrs)= 1.67 2.17 1.67
RUNOFF VOLUME (mm)= 38.38 5.98 12.45
TOTAL RAINFALL (mm)= 39.39 39.39 39.39
RUNOFF COEFFICIENT = 0.97 0.15 0.32

***** 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* = 62.0 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 (0050) |
ID= 1 DT= 5.0 min
Area (ha)= 1.52
Total Imp(%)= 48.00 Dir. Conn.(%)= 21.00

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 0.73 0.79
Dep. Storage (mm)= 1.00 13.60
Average Slope (%)= 1.00 2.00
Length (m)= 100.66 40.00
Mannings n = 0.013 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083	0.00	1.167	6.55	2.250	8.15	3.33	4.39
0.167	0.00	1.250	8.94	2.333	8.15	3.42	4.11
0.250	3.25	1.333	8.94	2.417	7.01	3.50	4.11
0.333	3.25	1.417	16.92	2.500	7.01	3.58	3.89
0.417	3.56	1.500	16.92	2.583	6.20	3.67	3.89
0.500	3.56	1.583	78.82	2.667	6.20	3.75	3.68
0.583	3.96	1.667	78.82	2.750	5.59	3.83	3.68
0.667	3.96	1.750	21.89	2.833	5.59	3.92	3.51
0.750	4.52	1.833	21.89	2.917	5.11	4.00	3.51
0.833	4.52	1.917	13.00	3.000	5.11	4.08	3.35
0.917	5.31	2.000	13.00	3.083	4.72	4.17	3.35
1.000	5.31	2.083	9.88	3.167	4.72		
1.083	6.55	2.167	9.88	3.250	4.39		

Max.Eff.Inten.(mm/hr)= 78.82 10.63
over (min) 5.00 25.00
Storage Coeff. (min)= 2.82 (ii) 20.12 (ii)
Unit Hyd. Tpeak (min)= 5.00 25.00
Unit Hyd. peak (cms)= 0.28 0.05

PEAK FLOW (cms)= 0.07 0.01 0.071 (iii)
TIME TO PEAK (hrs)= 1.67 2.08 1.67
RUNOFF VOLUME (mm)= 38.38 6.97 13.56
TOTAL RAINFALL (mm)= 39.39 39.39 39.39
RUNOFF COEFFICIENT = 0.97 0.18 0.34

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

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 62.0 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.

| CHAMBER(0053) |
| IN= 2--> OUT= 3 |
DT= 5.0 min
OUTFLOW: OFF, UNDERDRAIN: OFF, INFIL: ON
CHAMBER:
MAX STO VOL (cu.m.)= 540.00 Bottom Area(m2) = 500.00

DEPTH	STORAGE	DEPTH	STORAGE
(mm)	(cu.m.)	(mm)	(cu.m.)
0.00	0.00	800.00	288.00
100.00	36.00	900.00	324.00
200.00	72.00	1000.00	360.00
300.00	108.00	1100.00	396.00
400.00	144.00	1200.00	432.00
500.00	180.00	1300.00	468.00
600.00	216.00	1400.00	504.00
700.00	252.00	1500.00	540.00

AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW:ID= 2 1.52 0.071 1.67 13.56
OVERFLOW:ID= 3 0.00 0.000 0.00 0.00

Volume Reduction Rate[(RVin-RVout)/RVin] (%)= 100.00
Time to reach Max storage (Hr)= 4.42
Volume of water for drawdown in LID (cu.m.)= 140.25
Volume of maximum water storage (cu.m.)= 152.47
Calculated Drawdown Time (Hr)= 11.17

Junction Command(0054)

AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW : ID= 3(0053) 0.00 0.00 0.00 0.00
OUTFLOW: ID= 2(0054) 0.00 0.00 0.00 0.00

| ADD HYD (0055) |
1 + 2 = 3
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
ID1= 1 (0051): 0.60 0.004 1.83 3.64
+ ID2= 2 (0052): 2.83 0.122 1.67 12.45
=====

ID = 3 (0055): 3.43 0.124 1.67 10.91

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| ADD HYD (0055) |
3 + 2 = 1
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
*** W A R N I N G : HYDROGRAPH 0054 <ID= 2> IS DRY.
*** W A R N I N G : HYDROGRAPH 0001 = HYDROGRAPH 0003
ID1= 3 (0055): 3.43 0.124 1.67 10.91
+ ID2= 2 (0054): 0.00 0.000 0.00 0.00
=====

ID = 1 (0055): 3.43 0.124 1.67 10.91

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| RESERVOIR(5000) |
| IN= 2--> OUT= 1 |
DT= 5.0 min
OVERFLOW IS ON

OUTFLOW STORAGE | OUTFLOW STORAGE
(cms) (ha.m.) | (cms) (ha.m.)
0.0000 0.0000 | 0.0177 0.0628
0.0049 0.0070 | 0.0190 0.0745
0.0085 0.0147 | 0.0202 0.0868
0.0110 0.0230 | 0.0214 0.0999
0.0130 0.0320 | 0.0225 0.1136
0.0147 0.0416 | 0.0235 0.1281
0.0163 0.0519 | 0.0000 0.0000

AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW : ID= 2 (0055) 3.430 0.124 1.67 10.91
OUTFLOW: ID= 1 (5000) 3.430 0.012 4.25 10.81
OVERFLOW:ID= 3 (0003) 0.000 0.000 0.00 0.00

TOTAL NUMBER OF SIMULATION OVERFLOW = 0
CUMULATIVE TIME OF OVERFLOW (HOURS) = 0.00
PERCENTAGE OF TIME OVERFLOWING (%) = 0.00

PEAK FLOW REDUCTION [Qout/Qin] (%)= 9.37
TIME SHIFT OF PEAK FLOW (min)=155.00
MAXIMUM STORAGE USED (ha.m.)= 0.0258

| CALIB |
| STANDHYD (0001) |
ID= 1 DT= 1.0 min
Area (ha)= 41.00
Total Imp(%)= 30.00 Dir. Conn.(%)= 15.00

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 12.30 28.70
Dep. Storage (mm)= 0.80 23.90
Average Slope (%)= 2.00 2.00
Length (m)= 522.81 40.00
Mannings n = 0.013 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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
0.017	0.00	1.067	6.55	2.117	9.88	3.17	4.72
0.033	0.00	1.083	6.55	2.133	9.88	3.18	4.39
0.050	0.00	1.100	6.55	2.150	9.88	3.20	4.39
0.067	0.00	1.117	6.55	2.167	9.88	3.22	4.39
0.083	0.00	1.133	6.55	2.183	9.88	3.23	4.39
0.100	0.00	1.150	6.55	2.200	8.15	3.25	4.39
0.117	0.00	1.167	6.55	2.217	8.15	3.27	4.39
0.133	0.00	1.183	8.94	2.233	8.15	3.28	4.39
0.150	0.00	1.200	8.94	2.250	8.15	3.30	4.39
0.167	0.00	1.217	8.94	2.267	8.15	3.32	4.39
0.183	3.25	1.233	8.94	2.283	8.15	3.33	4.39
0.200	3.25	1.250	8.94	2.300	8.15	3.35	4.11
0.217	3.25	1.267	8.94	2.317	8.15	3.37	4.11
0.233	3.25	1.283	8.94	2.333	8.15	3.38	4.11
0.250	3.25	1.300	8.94	2.350	7.01	3.40	4.11
0.267	3.25	1.317	8.94	2.367	7.01	3.42	4.11

0.283	3.25	1.333	8.94	2.383	7.01	3.43	4.11
0.300	3.25	1.350	16.92	2.400	7.01	3.45	4.11
0.317	3.25	1.367	16.92	2.417	7.01	3.47	4.11
0.333	3.25	1.383	16.92	2.433	7.01	3.48	4.11
0.350	3.56	1.400	16.92	2.450	7.01	3.50	4.11
0.367	3.56	1.417	16.92	2.467	7.01	3.52	3.89
0.383	3.56	1.433	16.92	2.483	7.01	3.53	3.89
0.400	3.56	1.450	16.92	2.500	7.01	3.55	3.89
0.417	3.56	1.467	16.92	2.517	6.20	3.57	3.89
0.433	3.56	1.483	16.92	2.533	6.20	3.58	3.89
0.450	3.56	1.500	16.92	2.550	6.20	3.60	3.89
0.467	3.56	1.517	78.82	2.567	6.20	3.62	3.89
0.483	3.56	1.533	78.82	2.583	6.20	3.63	3.89
0.500	3.56	1.550	78.82	2.600	6.20	3.65	3.89
0.517	3.96	1.567	78.82	2.617	6.20	3.67	3.89
0.533	3.96	1.583	78.82	2.633	6.20	3.68	3.68
0.550	3.96	1.600	78.82	2.650	6.20	3.70	3.68
0.567	3.96	1.617	78.82	2.667	6.20	3.72	3.68
0.583	3.96	1.633	78.82	2.683	5.59	3.73	3.68
0.600	3.96	1.650	78.82	2.700	5.59	3.75	3.68
0.617	3.96	1.667	78.82	2.717	5.59	3.77	3.68
0.633	3.96	1.683	21.89	2.733	5.59	3.78	3.68
0.650	3.96	1.700	21.89	2.750	5.59	3.80	3.68
0.667	3.96	1.717	21.89	2.767	5.59	3.82	3.68
0.683	4.52	1.733	21.89	2.783	5.59	3.83	3.68
0.700	4.52	1.750	21.89	2.800	5.59	3.85	3.51
0.717	4.52	1.767	21.89	2.817	5.59	3.87	3.51
0.733	4.52	1.783	21.89	2.833	5.59	3.88	3.51
0.750	4.52	1.800	21.89	2.850	5.11	3.90	3.51
0.767	4.52	1.817	21.89	2.867	5.11	3.92	3.51
0.783	4.52	1.833	21.89	2.883	5.11	3.93	3.51
0.800	4.52	1.850	13.00	2.900	5.11	3.95	3.51
0.817	4.52	1.867	13.00	2.917	5.11	3.97	3.51
0.833	4.52	1.883	13.00	2.933	5.11	3.98	3.51
0.850	5.31	1.900	13.00	2.950	5.11	4.00	3.51
0.867	5.31	1.917	13.00	2.967	5.11	4.02	3.35
0.883	5.31	1.933	13.00	2.983	5.11	4.03	3.35
0.900	5.31	1.950	13.00	3.000	5.11	4.05	3.35
0.917	5.31	1.967	13.00	3.017	4.72	4.07	3.35
0.933	5.31	1.983	13.00	3.033	4.72	4.08	3.35
0.950	5.31	2.000	13.00	3.050	4.72	4.10	3.35
0.967	5.31	2.017	9.88	3.067	4.72	4.12	3.35
0.983	5.31	2.033	9.88	3.083	4.72	4.13	3.35
1.000	5.31	2.050	9.88	3.100	4.72	4.15	3.35
1.017	6.55	2.067	9.88	3.117	4.72	4.17	3.35
1.033	6.55	2.083	9.88	3.133	4.72		
1.050	6.55	2.100	9.88	3.150	4.72		

Max.Eff.Inten.(mm/hr)= 78.82 0.98
over (min) 6.00 52.00
Storage Coeff.(min)= 6.16 (ii) 51.13 (ii)
Unit Hyd. Tpeak (min)= 6.00 52.00
Unit Hyd. peak (cms)= 0.19 0.02

TOTALS
PEAK FLOW (cms)= 1.04 0.06 1.040 (iii)
TIME TO PEAK (hrs)= 1.70 4.02 1.70
RUNOFF VOLUME (mm)= 38.58 1.70 7.23
TOTAL RAINFALL (mm)= 39.39 39.39 39.39
RUNOFF COEFFICIENT = 0.98 0.04 0.18

***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 50.0 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.

| DUHYD (0010) |
| Inlet Cap.= 1.040 |
| #of Inlets= 1 |
| Total(cms)= 1.01 |

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
TOTAL HYD.(ID= 1):	41.00	1.04	1.70	7.23
MAJOR SYS.(ID= 2):	0.00	0.00	1.70	7.23
MINOR SYS.(ID= 3):	41.00	1.04	1.70	7.23

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| CALIB |
| STANDHYD (0022) |
| ID= 1 DT= 1.0 min |

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	5.56	6.26
Dep. Storage (mm)=	0.80	16.50
Average Slope (%)=	1.00	1.00
Length (m)=	280.71	40.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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
0.017	0.00	1.067	6.55	2.117	9.88	3.17	4.72
0.033	0.00	1.083	6.55	2.133	9.88	3.18	4.39
0.050	0.00	1.100	6.55	2.150	9.88	3.20	4.39
0.067	0.00	1.117	6.55	2.167	9.88	3.22	4.39
0.083	0.00	1.133	6.55	2.183	8.15	3.23	4.39
0.100	0.00	1.150	6.55	2.200	8.15	3.25	4.39
0.117	0.00	1.167	6.55	2.217	8.15	3.27	4.39
0.133	0.00	1.183	8.94	2.233	8.15	3.28	4.39
0.150	0.00	1.200	8.94	2.250	8.15	3.30	4.39
0.167	0.00	1.217	8.94	2.267	8.15	3.32	4.39
0.183	3.25	1.233	8.94	2.283	8.15	3.33	4.39
0.200	3.25	1.250	8.94	2.300	8.15	3.35	4.11

0.217	3.25	1.267	8.94	2.317	8.15	3.37	4.11
0.233	3.25	1.283	8.94	2.333	8.15	3.38	4.11
0.250	3.25	1.300	8.94	2.350	7.01	3.40	4.11
0.267	3.25	1.317	8.94	2.367	7.01	3.42	4.11
0.283	3.25	1.333	8.94	2.383	7.01	3.43	4.11
0.300	3.25	1.350	16.92	2.400	7.01	3.45	4.11
0.317	3.25	1.367	16.92	2.417	7.01	3.47	4.11
0.333	3.25	1.383	16.92	2.433	7.01	3.48	4.11
0.350	3.56	1.400	16.92	2.450	7.01	3.50	4.11
0.367	3.56	1.417	16.92	2.467	7.01	3.52	3.89
0.383	3.56	1.433	16.92	2.483	7.01	3.53	3.89
0.400	3.56	1.450	16.92	2.500	7.01	3.55	3.89
0.417	3.56	1.467	16.92	2.517	6.20	3.57	3.89
0.433	3.56	1.483	16.92	2.533	6.20	3.58	3.89
0.450	3.56	1.500	16.92	2.550	6.20	3.60	3.89
0.467	3.56	1.517	78.82	2.567	6.20	3.62	3.89
0.483	3.56	1.533	78.82	2.583	6.20	3.63	3.89
0.500	3.56	1.550	78.82	2.600	6.20	3.65	3.89
0.517	3.96	1.567	78.82	2.617	6.20	3.67	3.89
0.533	3.96	1.583	78.82	2.633	6.20	3.68	3.68
0.550	3.96	1.600	78.82	2.650	6.20	3.70	3.68
0.567	3.96	1.617	78.82	2.667	6.20	3.72	3.68
0.583	3.96	1.633	78.82	2.683	5.59	3.73	3.68
0.600	3.96	1.650	78.82	2.700	5.59	3.75	3.68
0.617	3.96	1.667	78.82	2.717	5.59	3.77	3.68
0.633	3.96	1.683	21.89	2.733	5.59	3.78	3.68
0.650	3.96	1.700	21.89	2.750	5.59	3.80	3.68
0.667	3.96	1.717	21.89	2.767	5.59	3.82	3.68
0.683	4.52	1.733	21.89	2.783	5.59	3.83	3.68
0.700	4.52	1.750	21.89	2.800	5.59	3.85	3.51
0.717	4.52	1.767	21.89	2.817	5.59	3.87	3.51
0.733	4.52	1.783	21.89	2.833	5.59	3.88	3.51
0.750	4.52	1.800	21.89	2.850	5.11	3.90	3.51
0.767	4.52	1.817	21.89	2.867	5.11	3.92	3.51
0.783	4.52	1.833	21.89	2.883	5.11	3.93	3.51
0.800	4.52	1.850	13.00	2.900	5.11	3.95	3.51
0.817	4.52	1.867	13.00	2.917	5.11	3.97	3.51
0.833	4.52	1.883	13.00	2.933	5.11	3.98	3.51
0.850	5.31	1.900	13.00	2.950	5.11	4.00	3.51
0.867	5.31	1.917	13.00	2.967	5.11	4.02	3.35
0.883	5.31	1.933	13.00	2.983	5.11	4.03	3.35
0.900	5.31	1.950	13.00	3.000	5.11	4.05	3.35
0.917	5.31	1.967	13.00	3.017	4.72	4.07	3.35
0.933	5.31	1.983	13.00	3.033	4.72	4.08	3.35
0.950	5.31	2.000	13.00	3.050	4.72	4.10	3.35
0.967	5.31	2.017	9.88	3.067	4.72	4.12	3.35
0.983	5.31	2.033	9.88	3.083	4.72	4.13	3.35
1.000	5.31	2.050	9.88	3.100	4.72	4.15	3.35
1.017	6.55	2.067	9.88	3.117	4.72	4.17	3.35
1.033	6.55	2.083	9.88	3.133	4.72		
1.050	6.55	2.100	9.88	3.150	4.72		

Max.Eff.Inten.(mm/hr)= 78.82 6.28
over (min) 5.00 32.00
Storage Coeff.(min)= 5.22 (ii) 31.50 (ii)
Unit Hyd. Tpeak (min)= 5.00 32.00
Unit Hyd. peak (cms)= 0.22 0.04

TOTALS
PEAK FLOW (cms)= 0.47 0.06 0.474 (iii)
TIME TO PEAK (hrs)= 1.68 2.43 1.68
RUNOFF VOLUME (mm)= 38.58 5.18 12.53
TOTAL RAINFALL (mm)= 39.39 39.39 39.39
RUNOFF COEFFICIENT = 0.98 0.13 0.32

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

| RESERVOIR(0220) |
| IN= 2---> OUT= 1 |
| DT= 1.0 min |

OVERFLOW IS OFF

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	0.0251	0.3540
0.0066	0.0550	0.0273	0.4180
0.0127	0.1120	0.0294	0.4840
0.0167	0.1700	0.0313	0.5510
0.0199	0.2300	0.0332	0.6200
0.0226	0.2910	0.0000	0.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0022)	11.820	0.474	1.68	12.53
OUTFLOW: ID= 1 (0220)	11.820	0.014	4.90	9.08

PEAK FLOW REDUCTION [Qout/Qin](%)= 2.96
TIME SHIFT OF PEAK FLOW (min)=193.00
MAXIMUM STORAGE USED (ha.m.)= 0.1316

| CALIB |
| STANDHYD (0003) |
| ID= 1 DT= 1.0 min |

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	15.36	3.84
Dep. Storage (mm)=	0.80	23.90
Average Slope (%)=	2.00	2.00
Length (m)=	357.77	40.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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
0.017	0.00	1.067	6.55	2.117	9.88	3.17	4.72
0.033	0.00	1.083	6.55	2.133	9.88	3.18	4.39

0.050	0.00	1.100	6.55	2.150	9.88	3.20	4.39
0.067	0.00	1.117	6.55	2.167	9.88	3.22	4.39
0.083	0.00	1.133	6.55	2.183	8.15	3.23	4.39
0.100	0.00	1.150	6.55	2.200	8.15	3.25	4.39
0.117	0.00	1.167	6.55	2.217	8.15	3.27	4.39
0.133	0.00	1.183	8.94	2.233	8.15	3.28	4.39
0.150	0.00	1.200	8.94	2.250	8.15	3.30	4.39
0.167	0.00	1.217	8.94	2.267	8.15	3.32	4.39
0.183	3.25	1.233	8.94	2.283	8.15	3.33	4.39
0.200	3.25	1.250	8.94	2.300	8.15	3.35	4.11
0.217	3.25	1.267	8.94	2.317	8.15	3.37	4.11
0.233	3.25	1.283	8.94	2.333	8.15	3.38	4.11
0.250	3.25	1.300	8.94	2.350	7.01	3.40	4.11
0.267	3.25	1.317	8.94	2.367	7.01	3.42	4.11
0.283	3.25	1.333	8.94	2.383	7.01	3.43	4.11
0.300	3.25	1.350	16.92	2.400	7.01	3.45	4.11
0.317	3.25	1.367	16.92	2.417	7.01	3.47	4.11
0.333	3.25	1.383	16.92	2.433	7.01	3.48	4.11
0.350	3.56	1.400	16.92	2.450	7.01	3.50	4.11
0.367	3.56	1.417	16.92	2.467	7.01	3.52	3.89
0.383	3.56	1.433	16.92	2.483	7.01	3.53	3.89
0.400	3.56	1.450	16.92	2.500	7.01	3.55	3.89
0.417	3.56	1.467	16.92	2.517	6.20	3.57	3.89
0.433	3.56	1.483	16.92	2.533	6.20	3.58	3.89
0.450	3.56	1.500	16.92	2.550	6.20	3.60	3.89
0.467	3.56	1.517	78.82	2.567	6.20	3.62	3.89
0.483	3.56	1.533	78.82	2.583	6.20	3.63	3.89
0.500	3.56	1.550	78.82	2.600	6.20	3.65	3.89
0.517	3.96	1.567	78.82	2.617	6.20	3.67	3.89
0.533	3.96	1.583	78.82	2.633	6.20	3.68	3.68
0.550	3.96	1.600	78.82	2.650	6.20	3.70	3.68
0.567	3.96	1.617	78.82	2.667	6.20	3.72	3.68
0.583	3.96	1.633	78.82	2.683	5.59	3.73	3.68
0.600	3.96	1.650	78.82	2.700	5.59	3.75	3.68
0.617	3.96	1.667	78.82	2.717	5.59	3.77	3.68
0.633	3.96	1.683	21.89	2.733	5.59	3.78	3.68
0.650	3.96	1.700	21.89	2.750	5.59	3.80	3.68
0.667	3.96	1.717	21.89	2.767	5.59	3.82	3.68
0.683	4.52	1.733	21.89	2.783	5.59	3.83	3.68
0.700	4.52	1.750	21.89	2.800	5.59	3.85	3.51
0.717	4.52	1.767	21.89	2.817	5.59	3.87	3.51
0.733	4.52	1.783	21.89	2.833	5.59	3.88	3.51
0.750	4.52	1.800	21.89	2.850	5.11	3.90	3.51
0.767	4.52	1.817	21.89	2.867	5.11	3.92	3.51
0.783	4.52	1.833	21.89	2.883	5.11	3.93	3.51
0.800	4.52	1.850	13.00	2.900	5.11	3.95	3.51
0.817	4.52	1.867	13.00	2.917	5.11	3.97	3.51
0.833	4.52	1.883	13.00	2.933	5.11	3.98	3.51
0.850	5.31	1.900	13.00	2.950	5.11	4.00	3.51
0.867	5.31	1.917	13.00	2.967	5.11	4.02	3.35
0.883	5.31	1.933	13.00	2.983	5.11	4.03	3.35
0.900	5.31	1.950	13.00	3.000	5.11	4.05	3.35
0.917	5.31	1.967	13.00	3.017	4.72	4.07	3.35
0.933	5.31	1.983	13.00	3.033	4.72	4.08	3.35
0.950	5.31	2.000	13.00	3.050	4.72	4.10	3.35
0.967	5.31	2.017	9.88	3.067	4.72	4.12	3.35
0.983	5.31	2.033	9.88	3.083	4.72	4.13	3.35
1.000	5.31	2.050	9.88	3.100	4.72	4.15	3.35
1.017	6.55	2.067	9.88	3.117	4.72	4.17	3.35
1.033	6.55	2.083	9.88	3.133	4.72		
1.050	6.55	2.100	9.88	3.150	4.72		

Max.Eff.Inten.(mm/hr)= 78.82 22.29
over (min) 5.00 11.00
Storage Coeff. (min)= 4.90 (ii) 10.28 (ii)
Unit Hyd. Tpeak (min)= 5.00 11.00
Unit Hyd. peak (cms)= 0.23 0.11

PEAK FLOW (cms)= 1.77 0.15 1.827 (iii)
TIME TO PEAK (hrs)= 1.68 1.83 1.68
RUNOFF VOLUME (mm)= 38.58 6.77 22.68
TOTAL RAINFALL (mm)= 39.39 39.39 39.39
RUNOFF COEFFICIENT = 0.98 0.17 0.58

(i) CN PROCEDURE SELECTED FOR PVIOUS LOSSES:
CN* = 50.0 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.

DUHYD (0030)				
Inlet Cap.= 1.827				
#of Inlets= 1				
Total(cms)= 1.8	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
TOTAL HYD.(ID= 1):	19.20	1.83	1.68	22.68
MAJOR SYS.(ID= 2):	0.00	0.00	0.00	0.00
MINOR SYS.(ID= 3):	19.20	1.83	1.68	22.68

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB				
STANDHYD (0021)	Area (ha)= 16.90			
ID= 1 DT= 5.0 min	Total Imp(%)= 38.00	Dir. Conn.(%)= 16.00		
	IMPERVIOUS	PERVIOUS (i)		
Surface Area (ha)=	6.42	10.48		
Dep. Storage (mm)=	0.80	23.90		
Average Slope (%)=	2.00	2.00		
Length (m)=	335.66	40.00		
Mannings n	=	0.013	0.250	

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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

0.083	0.00	1.167	6.55	2.250	8.15	3.33	4.39
0.167	0.00	1.250	8.94	2.333	8.15	3.42	4.11
0.250	3.25	1.333	8.94	2.417	7.01	3.50	4.11
0.333	3.25	1.417	16.92	2.500	7.01	3.58	3.89
0.417	3.56	1.500	16.92	2.583	6.20	3.67	3.89
0.500	3.56	1.583	78.82	2.667	6.20	3.75	3.68
0.583	3.96	1.667	78.82	2.750	5.59	3.83	3.68
0.667	3.96	1.750	21.89	2.833	5.59	3.92	3.51
0.750	4.52	1.833	21.89	2.917	5.11	4.00	3.51
0.833	4.52	1.917	13.00	3.000	5.11	4.08	3.35
0.917	5.31	2.000	13.00	3.083	4.72	4.17	3.35
1.000	5.31	2.083	9.88	3.167	4.72		
1.083	6.55	2.167	9.88	3.250	4.39		

Max.Eff.Inten.(mm/hr)= 78.82 1.58
over (min) 5.00 45.00
Storage Coeff. (min)= 4.72 (ii) 41.80 (ii)
Unit Hyd. Tpeak (min)= 5.00 45.00
Unit Hyd. peak (cms)= 0.22 0.03

PEAK FLOW (cms)= 0.54 0.03 0.536 (iii)
TIME TO PEAK (hrs)= 1.67 3.33 1.67
RUNOFF VOLUME (mm)= 38.58 2.26 8.07
TOTAL RAINFALL (mm)= 39.39 39.39 39.39
RUNOFF COEFFICIENT = 0.98 0.06 0.20

***** 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 PVIOUS LOSSES:
CN* = 50.0 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.

RESERVOIR(0210)				OVERFLOW IS OFF			
IN= 2----> OUT= 1							
DT= 5.0 min				OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
				0.0000	0.0000	0.3900	0.0820
				0.0200	0.0000	0.4300	0.1090
				0.0800	0.0020	0.5800	0.2670
				0.2100	0.0160	0.6360	0.3420
				0.3000	0.0330	0.0000	0.0000
				AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0021)				16.900	0.536	1.67	8.07
OUTFLOW: ID= 1 (0210)				16.900	0.246	1.83	8.07

PEAK FLOW REDUCTION [Qout/Qin](%)= 45.85
TIME SHIFT OF PEAK FLOW (min)= 10.00
MAXIMUM STORAGE USED (ha.m.)= 0.0232

DUHYD (0211)				AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
Inlet Cap.= 0.280							
#of Inlets= 1							
Total(cms)= 0.3							
TOTAL HYD.(ID= 1):				16.90	0.25	1.83	8.07
MAJOR SYS.(ID= 2):				0.00	0.00	0.00	0.00
MINOR SYS.(ID= 3):				16.90	0.25	1.83	8.07

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB				Area (ha)= 0.80			
STANDHYD (0023)				Total Imp(%)= 90.00	Dir. Conn.(%)= 45.00		
ID= 1 DT= 1.0 min							
				IMPERVIOUS	PERVIOUS (i)		
Surface Area (ha)=				0.72	0.08		
Dep. Storage (mm)=				0.80	16.50		
Average Slope (%)=				1.00	1.00		
Length (m)=				73.03	40.00		
Mannings n				=	0.013	0.250	

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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
0.017	0.00	1.067	6.55	2.117	9.88	3.17	4.72
0.033	0.00	1.083	6.55	2.133	9.88	3.18	4.39
0.050	0.00	1.100	6.55	2.150	9.88	3.20	4.39
0.067	0.00	1.117	6.55	2.167	9.88	3.22	4.39
0.083	0.00	1.133	6.55	2.183	8.15	3.23	4.39
0.100	0.00	1.150	6.55	2.200	8.15	3.25	4.39
0.117	0.00	1.167	6.55	2.217	8.15	3.27	4.39
0.133	0.00	1.183	8.94	2.233	8.15	3.28	4.39
0.150	0.00	1.200	8.94	2.250	8.15	3.30	4.39
0.167	0.00	1.217	8.94	2.267	8.15	3.32	4.39
0.183	3.25	1.233	8.94	2.283	8.15	3.33	4.39
0.200	3.25	1.250	8.94	2.300	8.15	3.35	4.11
0.217	3.25	1.267	8.94	2.317	8.15	3.37	4.11
0.233	3.25	1.283	8.94	2.333	8.15	3.38	4.11
0.250	3.25	1.300	8.94	2.350	7.01	3.40	4.11
0.267	3.25	1.317	8.94	2.367	7.01	3.42	4.11
0.283	3.25	1.333	8.94	2.383	7.01	3.43	4.11
0.300	3.25	1.350	16.92	2.400	7.01	3.45	4.11
0.317	3.25	1.367	16.92	2.417	7.01	3.47	4.11
0.333	3.25	1.383	16.92	2.433	7.01	3.48	4.11
0.350	3.56	1.400	16.92	2.450	7.01	3.50	4.11
0.367	3.56	1.417	16.92	2.467	7.01	3.52	3.89
0.383	3.56	1.433	16.92	2.483	7.01	3.53	3.89
0.400	3.56	1.450	16.92	2.500	7.01	3.55	3.89

0.417	3.56	1.467	16.92	2.517	6.20	3.57	3.89
0.433	3.56	1.483	16.92	2.533	6.20	3.58	3.89
0.450	3.56	1.500	16.92	2.550	6.20	3.60	3.89
0.467	3.56	1.517	78.82	2.567	6.20	3.62	3.89
0.483	3.56	1.533	78.82	2.583	6.20	3.63	3.89
0.500	3.56	1.550	78.82	2.600	6.20	3.65	3.89
0.517	3.96	1.567	78.82	2.617	6.20	3.67	3.89
0.533	3.96	1.583	78.82	2.633	6.20	3.68	3.68
0.550	3.96	1.600	78.82	2.650	6.20	3.70	3.68
0.567	3.96	1.617	78.82	2.667	6.20	3.72	3.68
0.583	3.96	1.633	78.82	2.683	5.59	3.73	3.68
0.600	3.96	1.650	78.82	2.700	5.59	3.75	3.68
0.617	3.96	1.667	78.82	2.717	5.59	3.77	3.68
0.633	3.96	1.683	21.89	2.733	5.59	3.78	3.68
0.650	3.96	1.700	21.89	2.750	5.59	3.80	3.68
0.667	3.96	1.717	21.89	2.767	5.59	3.82	3.68
0.683	4.52	1.733	21.89	2.783	5.59	3.83	3.68
0.700	4.52	1.750	21.89	2.800	5.59	3.85	3.51
0.717	4.52	1.767	21.89	2.817	5.59	3.87	3.51
0.733	4.52	1.783	21.89	2.833	5.59	3.88	3.51
0.750	4.52	1.800	21.89	2.850	5.11	3.90	3.51
0.767	4.52	1.817	21.89	2.867	5.11	3.92	3.51
0.783	4.52	1.833	21.89	2.883	5.11	3.93	3.51
0.800	4.52	1.850	13.00	2.900	5.11	3.95	3.51
0.817	4.52	1.867	13.00	2.917	5.11	3.97	3.51
0.833	4.52	1.883	13.00	2.933	5.11	3.98	3.51
0.850	5.31	1.900	13.00	2.950	5.11	4.00	3.51
0.867	5.31	1.917	13.00	2.967	5.11	4.02	3.35
0.883	5.31	1.933	13.00	2.983	5.11	4.03	3.35
0.900	5.31	1.950	13.00	3.000	5.11	4.05	3.35
0.917	5.31	1.967	13.00	3.017	4.72	4.07	3.35
0.933	5.31	1.983	13.00	3.033	4.72	4.08	3.35
0.950	5.31	2.000	13.00	3.050	4.72	4.10	3.35
0.967	5.31	2.017	9.88	3.067	4.72	4.12	3.35
0.983	5.31	2.033	9.88	3.083	4.72	4.13	3.35
1.000	5.31	2.050	9.88	3.100	4.72	4.15	3.35
1.017	6.55	2.067	9.88	3.117	4.72	4.17	3.35
1.033	6.55	2.083	9.88	3.133	4.72		
1.050	6.55	2.100	9.88	3.150	4.72		

Max.Eff.Inten.(mm/hr)= 78.82 198.00
over (min) 5.00 8.00
Storage Coeff. (min)= 2.33 (ii) 7.56 (ii)
Unit Hyd. Tpeak (min)= 5.00 8.00
Unit Hyd. peak (cms)= 0.35 0.15

TOTALS
PEAK FLOW (cms)= 0.08 0.03 0.101 (iii)
TIME TO PEAK (hrs)= 1.67 1.75 1.68
RUNOFF VOLUME (mm)= 38.58 18.96 27.79
TOTAL RAINFALL (mm)= 39.39 39.39 39.39
RUNOFF COEFFICIENT = 0.98 0.48 0.71

(i) CN PROCEDURE SELECTED FOR PVIOUS LOSSES:
CN* = 58.0 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.

```

DUHYD ( 0230) |
| Inlet Cap.= 0.015 |
| #of Inlets= 1 |
| Total(cms)= 0.0 |
-----
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
TOTAL HYD.(ID= 1): 0.80 0.10 1.68 27.79
=====
MAJOR SYS.(ID= 2): 0.31 0.09 1.68 27.79
MINOR SYS.(ID= 3): 0.49 0.01 1.42 27.79

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

CALIB |
| STANDHYD ( 0024) |
|ID= 1 DT= 1.0 min |
-----
Area (ha)= 1.40
Total Imp(%)= 90.00 Dir. Conn.(%)= 45.00

```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	1.26	0.14
Dep. Storage (mm)=	0.80	16.50
Average Slope (%)=	1.00	1.00
Length (m)=	96.61	40.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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		
0.017	0.00	1.067	6.55	2.117	9.88	3.17	4.72		
0.033	0.00	1.083	6.55	2.133	9.88	3.18	4.39		
0.050	0.00	1.100	6.55	2.150	9.88	3.20	4.39		
0.067	0.00	1.117	6.55	2.167	9.88	3.22	4.39		
0.083	0.00	1.133	6.55	2.183	8.15	3.23	4.39		
0.100	0.00	1.150	6.55	2.200	8.15	3.25	4.39		
0.117	0.00	1.167	6.55	2.217	8.15	3.27	4.39		
0.133	0.00	1.183	8.94	2.233	8.15	3.28	4.39		
0.150	0.00	1.200	8.94	2.250	8.15	3.30	4.39		
0.167	0.00	1.217	8.94	2.267	8.15	3.32	4.39		
0.183	3.25	1.233	8.94	2.283	8.15	3.33	4.39		
0.200	3.25	1.250	8.94	2.300	8.15	3.35	4.11		
0.217	3.25	1.267	8.94	2.317	8.15	3.37	4.11		
0.233	3.25	1.283	8.94	2.333	8.15	3.38	4.11		
0.250	3.25	1.300	8.94	2.350	7.01	3.40	4.11		
0.267	3.25	1.317	8.94	2.367	7.01	3.42	4.11		
0.283	3.25	1.333	8.94	2.383	7.01	3.43	4.11		
0.300	3.25	1.350	16.92	2.400	7.01	3.45	4.11		
0.317	3.25	1.367	16.92	2.417	7.01	3.47	4.11		
0.333	3.25	1.383	16.92	2.433	7.01	3.48	4.11		
0.350	3.56	1.400	16.92	2.450	7.01	3.50	4.11		
0.367	3.56	1.417	16.92	2.467	7.01	3.52	3.89		

0.383	3.56	1.433	16.92	2.483	7.01	3.53	3.89
0.400	3.56	1.450	16.92	2.500	7.01	3.55	3.89
0.417	3.56	1.467	16.92	2.517	6.20	3.57	3.89
0.433	3.56	1.483	16.92	2.533	6.20	3.58	3.89
0.450	3.56	1.500	16.92	2.550	6.20	3.60	3.89
0.467	3.56	1.517	78.82	2.567	6.20	3.62	3.89
0.483	3.56	1.533	78.82	2.583	6.20	3.63	3.89
0.500	3.56	1.550	78.82	2.600	6.20	3.65	3.89
0.517	3.96	1.567	78.82	2.617	6.20	3.67	3.89
0.533	3.96	1.583	78.82	2.633	6.20	3.68	3.68
0.550	3.96	1.600	78.82	2.650	6.20	3.70	3.68
0.567	3.96	1.617	78.82	2.667	6.20	3.72	3.68
0.583	3.96	1.633	78.82	2.683	5.59	3.73	3.68
0.600	3.96	1.650	78.82	2.700	5.59	3.75	3.68
0.617	3.96	1.667	78.82	2.717	5.59	3.77	3.68
0.633	3.96	1.683	21.89	2.733	5.59	3.78	3.68
0.650	3.96	1.700	21.89	2.750	5.59	3.80	3.68
0.667	3.96	1.717	21.89	2.767	5.59	3.82	3.68
0.683	4.52	1.733	21.89	2.783	5.59	3.83	3.68
0.700	4.52	1.750	21.89	2.800	5.59	3.85	3.51
0.717	4.52	1.767	21.89	2.817	5.59	3.87	3.51
0.733	4.52	1.783	21.89	2.833	5.59	3.88	3.51
0.750	4.52	1.800	21.89	2.850	5.11	3.90	3.51
0.767	4.52	1.817	21.89	2.867	5.11	3.92	3.51
0.783	4.52	1.833	21.89	2.883	5.11	3.93	3.51
0.800	4.52	1.850	13.00	2.900	5.11	3.95	3.51
0.817	4.52	1.867	13.00	2.917	5.11	3.97	3.51
0.833	4.52	1.883	13.00	2.933	5.11	3.98	3.51
0.850	5.31	1.900	13.00	2.950	5.11	4.00	3.51
0.867	5.31	1.917	13.00	2.967	5.11	4.02	3.35
0.883	5.31	1.933	13.00	2.983	5.11	4.03	3.35
0.900	5.31	1.950	13.00	3.000	5.11	4.05	3.35
0.917	5.31	1.967	13.00	3.017	4.72	4.07	3.35
0.933	5.31	1.983	13.00	3.033	4.72	4.08	3.35
0.950	5.31	2.000	13.00	3.050	4.72	4.10	3.35
0.967	5.31	2.017	9.88	3.067	4.72	4.12	3.35
0.983	5.31	2.033	9.88	3.083	4.72	4.13	3.35
1.000	5.31	2.050	9.88	3.100	4.72	4.15	3.35
1.017	6.55	2.067	9.88	3.117	4.72	4.17	3.35
1.033	6.55	2.083	9.88	3.133	4.72		
1.050	6.55	2.100	9.88	3.150	4.72		

Max.Eff.Inten.(mm/hr)= 78.82 198.00
over (min) 5.00 8.00
Storage Coeff. (min)= 2.75 (ii) 7.99 (ii)
Unit Hyd. Tpeak (min)= 5.00 8.00
Unit Hyd. peak (cms)= 0.32 0.14

TOTALS
PEAK FLOW (cms)= 0.13 0.05 0.173 (iii)
TIME TO PEAK (hrs)= 1.67 1.75 1.68
RUNOFF VOLUME (mm)= 38.58 18.96 27.79
TOTAL RAINFALL (mm)= 39.39 39.39 39.39
RUNOFF COEFFICIENT = 0.98 0.48 0.71

(i) CN PROCEDURE SELECTED FOR PVIOUS LOSSES:
CN* = 58.0 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.

```

DUHYD ( 0240) |
| Inlet Cap.= 0.015 |
| #of Inlets= 1 |
| Total(cms)= 0.0 |
-----
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
TOTAL HYD.(ID= 1): 1.40 0.17 1.68 27.79
=====
MAJOR SYS.(ID= 2): 0.75 0.16 1.68 27.79
MINOR SYS.(ID= 3): 0.65 0.01 1.27 27.79

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

ADD HYD ( 1001) |
| 1 + 2 = 3 |
-----
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
ID1= 1 ( 0010): 41.00 1.040 1.70 7.23
+ ID2= 2 ( 0211): 16.90 0.246 1.83 8.07
=====
ID = 3 ( 1001): 57.90 1.267 1.70 7.47

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

ADD HYD ( 1001) |
| 3 + 2 = 1 |
-----
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
ID1= 3 ( 1001): 57.90 1.267 1.70 7.47
+ ID2= 2 ( 0220): 11.82 0.014 4.90 9.08
=====
ID = 1 ( 1001): 69.72 1.271 1.70 7.75

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

ADD HYD ( 1001) |
| 1 + 2 = 3 |
-----
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
ID1= 1 ( 1001): 69.72 1.271 1.70 7.75
+ ID2= 2 ( 0230): 0.49 0.015 1.42 27.79
=====
ID = 3 ( 1001): 70.21 1.286 1.70 7.89

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

| ADD HYD ( 1001)|
| 3 + 2 = 1 |
-----
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
ID1= 3 ( 1001): 70.21 1.286 1.70 7.89
+ ID2= 2 ( 0240): 0.65 0.015 1.27 27.79
=====
ID = 1 ( 1001): 70.86 1.301 1.70 8.07

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| ADD HYD ( 1001)|
| 1 + 2 = 3 |
-----
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
ID1= 1 ( 1001): 70.86 1.301 1.70 8.07
+ ID2= 2 ( 0030): 19.20 1.827 1.68 22.68
=====
ID = 3 ( 1001): 90.06 3.114 1.70 11.18

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| CALIB |
| STANDHYD ( 0004)| Area (ha)= 7.85
| ID= 1 DT= 5.0 min | Total Imp(%)= 46.00 Dir. Conn.(%)= 22.00
-----

```

```

IMPervIOUS PERVIOUS (i)
Surface Area (ha)= 3.61 4.24
Dep. Storage (mm)= 1.00 8.10
Average Slope (%)= 1.00 2.00
Length (m)= 228.76 40.00
Mannings n = 0.013 0.250

```

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

```

-----
TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.083 0.00 | 1.167 6.55 | 2.250 8.15 | 3.33 4.39
0.167 0.00 | 1.250 8.94 | 2.333 8.15 | 3.42 4.11
0.250 3.25 | 1.333 8.94 | 2.417 7.01 | 3.50 4.11
0.333 3.25 | 1.417 16.92 | 2.500 7.01 | 3.58 3.89
0.417 3.56 | 1.500 16.92 | 2.583 6.20 | 3.67 3.89
0.500 3.56 | 1.583 78.82 | 2.667 6.20 | 3.75 3.68
0.583 3.96 | 1.667 78.82 | 2.750 5.59 | 3.83 3.68
0.667 3.96 | 1.750 21.89 | 2.833 5.59 | 3.92 3.51
0.750 4.52 | 1.833 21.89 | 2.917 5.11 | 4.00 3.51
0.833 4.52 | 1.917 13.00 | 3.000 5.11 | 4.08 3.35
0.917 5.31 | 2.000 13.00 | 3.083 4.72 | 4.17 3.35
1.000 5.31 | 2.083 9.88 | 3.167 4.72 |
1.083 6.55 | 2.167 9.88 | 3.250 4.39 |

```

```

Max.Eff.Inten.(mm/hr)= 78.82 21.24
over (min)= 5.00 20.00
Storage Coeff. (min)= 4.62 (ii) 17.73 (ii)
Unit Hyd. Tpeak (min)= 5.00 20.00
Unit Hyd. peak (cms)= 0.22 0.06
*TOTALS*
PEAK FLOW (cms)= 0.34 0.14 0.385 (iii)
TIME TO PEAK (hrs)= 1.67 1.92 1.67
RUNOFF VOLUME (mm)= 38.38 11.17 17.15
TOTAL RAINFALL (mm)= 39.39 39.39 39.39
RUNOFF COEFFICIENT = 0.97 0.28 0.44

```

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

```

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 72.0 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.

```

```

-----
| DUHYD ( 0040)|
| Inlet Cap.= 0.084|
| #of Inlets= 1|
| Total(cms)= 0.1|
-----
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
TOTAL HYD.(ID= 1): 7.85 0.39 1.67 17.15
=====
MAJOR SYS.(ID= 2): 2.70 0.30 1.67 17.15
MINOR SYS.(ID= 3): 5.15 0.08 1.58 17.15

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| ADD HYD ( 1002)|
| 1 + 2 = 3 |
-----
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
ID1= 1 ( 1001): 90.06 3.114 1.70 11.18
+ ID2= 2 ( 0040): 5.15 0.084 1.58 17.15
=====
ID = 3 ( 1002): 95.21 3.198 1.70 11.51

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| ADD HYD ( 1003)|
| 1 + 2 = 3 |
-----
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
ID1= 1 ( 1002): 95.21 3.198 1.70 11.51
+ ID2= 2 ( 5000): 3.43 0.012 4.25 10.81
=====
ID = 3 ( 1003): 98.64 3.204 1.70 11.48

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

5-YEAR STORM - POST-DEVELOPMENT

V	V	I	SSSSS	U	U	A	L	(v 6.2.2015)
V	V	I	SS	U	U	A	L	
V	V	I	SS	U	U	AAAAA	L	
V	V	I	SS	U	U	A	L	
VV	V	I	SSSSS	UUUUU	A	A	LLLLL	

OOO	TTTT	TTTT	H	H	Y	Y	M	M	OOO	TM
O O	T	T	H	H	Y Y		MM	MM	O O	
O O	T	T	H	H	Y		M	M	O O	
OOO	T	T	H	H	Y		M	M	OOO	

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***** D E T A I L E D O U T P U T *****

```
Input filename: C:\Program Files (x86)\Visual OTHMYMO 6.2\VO2\vo.in.dat
Output filename: C:\Users\Natalie\AppData\Local\Civica\VH5\2b61f5e3-29d9-4c68-a5ec-7ff64ecb31ab\82dd71d3-3409-4c69-996d-4160eb78ab34\scen
Summary filename: C:\Users\Natalie\AppData\Local\Civica\VH5\2b61f5e3-29d9-4c68-a5ec-7ff64ecb31ab\82dd71d3-3409-4c69-996d-4160eb78ab34\scen
```

TIME: 03:51:46

USER:

COMMENTS:

```
*****
** SIMULATION : Norfolk 5yr 4hr                               **
*****
```

READ STORM	Filename: C:\Users\Natalie\AppData
	ata\Local\Temp\
	b7db1222-786f-4fa1-9026-76a41ee37elf\d0509639
Ptotal= 48.48 mm	Comments: Norfolk 5yr 4hr

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	0.00	1.17	10.19	2.33	7.70	3.50	3.96
0.17	3.53	1.33	21.62	2.50	6.68	3.67	3.73
0.33	3.66	1.50	112.37	2.67	5.94	4.00	3.53
0.50	4.04	1.67	27.76	2.83	5.39	3.83	3.53
0.67	4.83	1.83	15.75	3.00	4.93		
0.83	5.61	2.00	11.43	3.17	4.55		
1.00	7.11	2.17	9.15	3.33	4.22		

```
| CALIB |
| NASHYD ( 0051) | Area (ha)= 0.60 Curve Number (CN)= 62.0
| ID= 1 DT= 5.0 min | Ia (mm)= 13.60 # of Linear Res.(N)= 3.00
|-----|
| U.H. Tp(hrs)= 0.14
```

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

--- TRANSFORMED HETEROGRAPH ---							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	1.167	7.11	2.250	9.15	3.33	4.55
0.167	0.00	1.250	10.19	2.333	9.15	3.42	4.22
0.250	3.53	1.333	10.19	2.417	7.70	3.50	4.22
0.333	3.53	1.417	21.62	2.500	7.70	3.58	3.96
0.417	3.66	1.500	21.62	2.583	6.68	3.67	3.96
0.500	3.66	1.583	112.37	2.667	6.68	3.75	3.73
0.583	4.04	1.667	112.37	2.750	5.94	3.83	3.73
0.667	4.04	1.750	27.76	2.833	5.94	3.92	3.53
0.750	4.67	1.833	27.76	2.917	5.39	4.00	3.53
0.833	4.67	1.917	15.75	3.000	5.39	4.08	3.35
0.917	5.61	2.000	15.75	3.083	4.93	4.17	3.35
1.000	5.61	2.083	11.43	3.167	4.93		
1.083	7.11	2.167	11.43	3.250	4.55		

Unit Hyd Q_{peak} (cms) = 0.164

PEAK FLOW	(cms)=	0.010	(i)
TIME TO PEAK	(hrs)=	1.833	
RUNOFF VOLUME	(mm)=	6.336	
TOTAL RAINFALL	(mm)=	48.478	
RUNOFF COEFFICIENT	=	0.131	

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

```
| CALIB |
| STANDHYD ( 0052) | Area (ha)= 2.83
| ID= 1 DT= 5.0 min | Total Imp(%)= 41.00 Dir. Conn.(%)= 20.00
```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha) =	1.16	1.67
Dep. Storage	(mm) =	1.00	13.60
Average Slope	(%) =	1.00	2.00
Length	(m) =	137.36	40.00
Mannings n	=	0.013	0.250

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

--- TRANSFORMED HYGTOGRAPH ---							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	1.167	7.11	2.250	9.15	3.33	4.55
0.167	0.00	1.250	10.19	2.333	9.15	3.42	4.22
0.250	3.53	1.333	10.19	2.417	7.70	3.50	4.22
0.333	3.53	1.417	21.62	2.500	7.70	3.58	3.96
0.417	3.66	1.500	21.62	2.583	6.68	3.67	3.96
0.500	3.66	1.583	112.37	2.667	6.68	3.75	3.73
0.583	4.04	1.667	112.37	2.750	5.94	3.83	3.73
0.667	4.04	1.750	27.76	2.833	5.94	3.92	3.53
0.750	4.67	1.833	27.76	2.917	5.39	4.00	3.53
0.833	4.67	1.917	15.75	3.000	5.39	4.08	3.35
0.917	5.61	2.000	15.75	3.083	4.93	4.17	3.35
1.000	5.61	2.083	11.43	3.167	4.93		
1.083	7.11	2.167	11.43	3.250	4.55		

Max.Eff.Inten.(mm/hr)=	112.37	17.74
over (min)	5.00	20.00
Storage Coeff. (min)=	2.95 (ii)	17.05 (ii)
Unit Hyd. Tpeak (min)=	5.00	20.00
Unit Hyd. peak (cms)=	0.28	0.06

PEAK FLOW	(cms) =	0.17	0.05	0.183 (iii)
TIME TO PEAK	(hrs) =	1.67	1.92	1.67
RUNOFF VOLUME	(mm) =	47.48	9.65	17.21
TOTAL RAINFALL	(mm) =	48.48	48.48	48.48
RUNOFF COEFFICIENT	=	0.98	0.20	0.35

```
***** 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* = 62.0 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 (0050)		Area	(ha)=	1.52
ID= 1 DT= 5.0 min		Total Imp(%)=	48.00	Dir. Conn.(%)= 21.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha) =	0.73	0.79
Dep. Storage (mm) =	1.00	13.60
Average Slope (%) =	1.00	2.00
Length (m) =	100.66	40.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083	0.00	1.167	7.11	2.250	9.15	3.33	4.55
0.167	0.00	1.250	10.19	2.333	9.15	3.42	4.22
0.250	3.53	1.333	10.19	2.417	7.70	3.50	4.22
0.333	3.53	1.417	21.62	2.500	7.70	3.58	3.96
0.417	3.66	1.500	21.62	2.583	6.68	3.67	3.96
0.500	3.66	1.583	112.37	2.667	6.68	3.75	3.73
0.583	4.04	1.667	112.37	2.750	5.94	3.83	3.73
0.667	4.04	1.750	27.76	2.833	5.94	3.92	3.53
0.750	4.67	1.833	27.76	2.917	5.39	4.00	3.53
0.833	4.67	1.917	15.75	3.000	5.39	4.08	3.35
0.917	5.61	2.000	15.75	3.083	4.93	4.17	3.35
1.000	5.61	2.083	11.43	3.167	4.93		
1.083	7.11	2.167	11.43	3.250	4.55		

Max.Eff.Inten.(mm/hr)=	112.37	23.87
over (min)	5.00	15.00
Storage Coeff. (min)=	2.45 (ii)	14.97 (ii)
Unit Hyd. Tpeak (min)=	5.00	15.00
Unit Hyd. peak (cms)=	0.30	0.08

PEAK FLOW	(cms) =	0.10	0.03	0.111 (iii)
TIME TO PEAK	(hrs) =	1.67	1.83	1.67
RUNOFF VOLUME	(mm) =	47.48	11.00	18.66
TOTAL RAINFALL	(mm) =	48.48	48.48	48.48
RUNOFF COEFFICIENT	=	0.98	0.23	0.38

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

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 62.0 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.

```
| CHAMBER( 0053) | OUTFLOW: OFF, UNDERDRAIN: OFF, INFIL: ON
| IN= 2--> OUT= 3 | CHAMBER:
| DT= 5.0 min | MAX STO VOL (cu.m.)= 540.00 Bottom Area(m2) = 500.00
```

DEPTH (mm)	STORAGE (cu. m.)	DEPTH (mm)	STORAGE (cu. m.)
0 00	0 00	800 00	288 00
100 00	36 00	900 00	324 00
200 00	72 00	1000 00	360 00
300 00	108 00	1100 00	396 00
400 00	144 00	1200 00	432 00
500 00	180 00	1300 00	468 00
600 00	216 00	1400 00	504 00
700 00	252 00	1500 00	540 00

NATIVE SOIL LAYER:
Infiltration (m/hr) = 0.0250

AREA	OPEAK	TPEAK	R.V.
------	-------	-------	------

(ha) (cms) (hrs) (mm)

INFLOW:ID= 2 1.52 0.111 1.67 18.66

OVERFLOW:ID= 3 0.00 0.000 0.00 0.00

Volume Reduction Rate[(RVin-RVout)/RVin](%)= 100.00

Time to reach Max storage (Hr)= 4.33

Volume of water for drawdown in LID (cu.m.)= 222.67

Volume of maximum water storage (cu.m.)= 231.94

Calculated Drawdown Time (Hr)= 17.75

| Junction Command(0054) |

AREA QPEAK TPEAK R.V.

(ha) (cms) (hrs) (mm)

INFLOW : ID= 3(0053) 0.00 0.00 0.00 0.00

OUTFLOW: ID= 2(0054) 0.00 0.00 0.00 0.00

| ADD HYD (0055) |

| 1 + 2 = 3 |

AREA QPEAK TPEAK R.V.

(ha) (cms) (hrs) (mm)

ID1= 1 (0051): 0.60 0.010 1.83 6.34

+ ID2= 2 (0052): 2.83 0.183 1.67 17.21

=====

ID = 3 (0055): 3.43 0.191 1.67 15.31

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| ADD HYD (0055) |

| 3 + 2 = 1 |

AREA QPEAK TPEAK R.V.

(ha) (cms) (hrs) (mm)

*** W A R N I N G : HYDROGRAPH 0054 <ID= 2> IS DRY.

*** W A R N I N G : HYDROGRAPH 0001 = HYDROGRAPH 0003

ID1= 3 (0055): 3.43 0.191 1.67 15.31

+ ID2= 2 (0054): 0.00 0.000 0.00 0.00

=====

ID = 1 (0055): 3.43 0.191 1.67 15.31

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| RESERVOIR(5000) |

| IN= 2---> OUT= 1 |

| DT= 5.0 min |

OVERFLOW IS ON

OUTFLOW STORAGE | OUTFLOW STORAGE

(cms) (ha.m.) | (cms) (ha.m.)

0.0000 0.0000 | 0.0177 0.0628

0.0049 0.0070 | 0.0190 0.0745

0.0085 0.0147 | 0.0202 0.0868

0.0110 0.0230 | 0.0214 0.0999

0.0130 0.0320 | 0.0225 0.1136

0.0147 0.0416 | 0.0235 0.1281

0.0163 0.0519 | 0.0000 0.0000

AREA QPEAK TPEAK R.V.

(ha) (cms) (hrs) (mm)

INFLOW : ID= 2 (0055) 3.430 0.191 1.67 15.31

OUTFLOW: ID= 1 (5000) 3.430 0.014 4.25 15.20

OVERFLOW:ID= 3 (0003) 0.000 0.000 0.00 0.00

TOTAL NUMBER OF SIMULATION OVERFLOW = 0

CUMULATIVE TIME OF OVERFLOW (HOURS) = 0.00

PERCENTAGE OF TIME OVERFLOWING (%) = 0.00

PEAK FLOW REDUCTION [Qout/Qin](%)= 7.43

TIME SHIFT OF PEAK FLOW (min)=155.00

MAXIMUM STORAGE USED (ha.m.)= 0.0386

| CALIB |

| STANDHYD (0001) |

| ID= 1 DT= 1.0 min |

Area (ha)= 41.00

Total Imp(%)= 30.00 Dir. Conn.(%)= 15.00

IMPERVIOUS PERVIOUS (i)

Surface Area (ha)= 12.30 28.70

Dep. Storage (mm)= 0.80 23.90

Average Slope (%)= 2.00 2.00

Length (m)= 522.81 40.00

Mannings n = 0.013 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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

0.017 0.00 | 1.067 7.11 | 2.117 11.43 | 3.17 4.93

0.033 0.00 | 1.083 7.11 | 2.133 11.43 | 3.18 4.55

0.050 0.00 | 1.100 7.11 | 2.150 11.43 | 3.20 4.55

0.067 0.00 | 1.117 7.11 | 2.167 11.43 | 3.22 4.55

0.083 0.00 | 1.133 7.11 | 2.183 9.15 | 3.23 4.55

0.100 0.00 | 1.150 7.11 | 2.200 9.15 | 3.25 4.55

0.117 0.00 | 1.167 7.11 | 2.217 9.15 | 3.27 4.55

0.133 0.00 | 1.183 10.19 | 2.233 9.15 | 3.28 4.55

0.150 0.00 | 1.200 10.19 | 2.250 9.15 | 3.30 4.55

0.167 0.00 | 1.217 10.19 | 2.267 9.15 | 3.32 4.55

0.183 3.53 | 1.233 10.19 | 2.283 9.15 | 3.33 4.55

0.200 3.53 | 1.250 10.19 | 2.300 9.15 | 3.35 4.22

0.217 3.53 | 1.267 10.19 | 2.317 9.15 | 3.37 4.22

0.233 3.53 | 1.283 10.19 | 2.333 9.15 | 3.38 4.22

0.250 3.53 | 1.300 10.19 | 2.350 7.70 | 3.40 4.22

0.267 3.53 | 1.317 10.19 | 2.367 7.70 | 3.42 4.22

0.283 3.53 | 1.333 10.19 | 2.383 7.70 | 3.43 4.22

0.300 3.53 | 1.350 21.62 | 2.400 7.70 | 3.45 4.22

0.317 3.53 | 1.367 21.62 | 2.417 7.70 | 3.47 4.22

0.333 3.53 | 1.383 21.62 | 2.433 7.70 | 3.48 4.22

0.350 3.66 | 1.400 21.62 | 2.450 7.70 | 3.50 4.22

0.367 3.66 | 1.417 21.62 | 2.467 7.70 | 3.52 3.96

0.383 3.66 | 1.433 21.62 | 2.483 7.70 | 3.53 3.96

0.400 3.66 | 1.450 21.62 | 2.500 7.70 | 3.55 3.96

0.417 3.66 | 1.467 21.62 | 2.517 6.68 | 3.57 3.96

0.433 3.66 | 1.483 21.62 | 2.533 6.68 | 3.58 3.96

0.450 3.66 | 1.500 21.62 | 2.550 6.68 | 3.60 3.96

0.467 3.66 | 1.517 112.37 | 2.567 6.68 | 3.62 3.96

0.483 3.66 | 1.533 112.37 | 2.583 6.68 | 3.63 3.96

0.500 3.66 | 1.550 112.37 | 2.600 6.68 | 3.65 3.96

0.517 4.04 | 1.567 112.37 | 2.617 6.68 | 3.67 3.96

0.533 4.04 | 1.583 112.37 | 2.633 6.68 | 3.68 3.73

0.550 4.04 | 1.600 112.37 | 2.650 6.68 | 3.70 3.73

0.567 4.04 | 1.617 112.37 | 2.667 6.68 | 3.72 3.73

0.583 4.04 | 1.633 112.37 | 2.683 5.94 | 3.73 3.73

0.600 4.04 | 1.650 112.37 | 2.700 5.94 | 3.75 3.73

0.617 4.04 | 1.667 112.37 | 2.717 5.94 | 3.77 3.73

0.633 4.04 | 1.683 27.76 | 2.733 5.94 | 3.78 3.73

0.650 4.04 | 1.700 27.76 | 2.750 5.94 | 3.80 3.73

0.667 4.04 | 1.717 27.76 | 2.767 5.94 | 3.82 3.73

0.683 4.67 | 1.733 27.76 | 2.783 5.94 | 3.83 3.73

0.700 4.67 | 1.750 27.76 | 2.800 5.94 | 3.85 3.53

0.717 4.67 | 1.767 27.76 | 2.817 5.94 | 3.87 3.53

0.733 4.67 | 1.783 27.76 | 2.833 5.94 | 3.88 3.53

0.750 4.67 | 1.800 27.76 | 2.850 5.39 | 3.90 3.53

0.767 4.67 | 1.817 27.76 | 2.867 5.39 | 3.92 3.53

0.783 4.67 | 1.833 27.76 | 2.883 5.39 | 3.93 3.53

0.800 4.67 | 1.850 15.75 | 2.900 5.39 | 3.95 3.53

0.817 4.67 | 1.867 15.75 | 2.917 5.39 | 3.97 3.53

0.833 4.67 | 1.883 15.75 | 2.933 5.39 | 3.98 3.53

0.850 5.61 | 1.900 15.75 | 2.950 5.39 | 4.00 3.53

0.867 5.61 | 1.917 15.75 | 2.967 5.39 | 4.02 3.35

0.883 5.61 | 1.933 15.75 | 2.983 5.39 | 4.03 3.35

0.900 5.61 | 1.950 15.75 | 3.000 5.39 | 4.05 3.35

0.917 5.61 | 1.967 15.75 | 3.017 4.93 | 4.07 3.35

0.933 5.61 | 1.983 15.75 | 3.033 4.93 | 4.08 3.35

0.950 5.61 | 2.000 15.75 | 3.050 4.93 | 4.10 3.35

0.967 5.61 | 2.017 11.43 | 3.067 4.93 | 4.12 3.35

0.983 5.61 | 2.033 11.43 | 3.083 4.93 | 4.13 3.35

1.000 5.61 | 2.050 11.43 | 3.100 4.93 | 4.15 3.35

1.017 7.11 | 2.067 11.43 | 3.117 4.93 | 4.17 3.35

1.033 7.11 | 2.083 11.43 | 3.133 4.93 |

1.050 7.11 | 2.100 11.43 | 3.150 4.93 |

Max.Eff.Inten.(mm/hr)= 112.37 3.34

over (min)= 5.00 33.00

Storage Coeff. (min)= 5.34 (ii) 32.83 (ii)

Unit Hyd. Tpeak (min)= 5.00 33.00

Unit Hyd. peak (cms)= 0.22 0.03

PEAK FLOW (cms)= 1.56 0.14

TIME TO PEAK (hrs)= 1.68 2.55

RUNOFF VOLUME (mm)= 47.68 3.48

TOTAL RAINFALL (mm)= 48.48 48.48

RUNOFF COEFFICIENT = 0.98 0.07

TOTALS

1,569 (iii)

1.68

10.11

48.48

0.21

***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20% YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:

CN* = 50.0 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.

| DUHYD (0010) |

| Inlet Cap.= 1.040 |

| #of Inlets= 1 |

| Total(cms)= 1.0 |

AREA QPEAK TPEAK R.V.

(ha) (cms) (hrs) (mm)

TOTAL HYD.(ID= 1): 41.00 1.57 1.68 10.11

=====

MAJOR SYS.(ID= 2): 2.14 0.53 1.68 10.11

MINOR SYS.(ID= 3): 38.86 1.04 1.60 10.11

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| CALIB |

| STANDHYD (0022) |

| ID= 1 DT= 1.0 min |

Area (ha)= 11.82

Total Imp(%)= 47.00 Dir. Conn.(%)= 22.00

IMPERVIOUS PERVIOUS (i)

Surface Area (ha)= 5.56 6.26

Dep. Storage (mm)= 0.80 16.50

Average Slope (%)= 1.00 1.00

Length (m)= 280.71 40.00

Mannings n = 0.013 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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

0.017 0.00 | 1.067 7.11 | 2.117 11.43 | 3.17 4.93

0.033 0.00 | 1.083 7.11 | 2.133 11.43 | 3.18 4.55

0.050 0.00 | 1.100 7.11 | 2.150 11.43 | 3.20 4.55

0.067 0.00 | 1.117 7.11 | 2.167 11.43 | 3.22 4.55

0.083 0.00 | 1.133 7.11 | 2.183 9.15 | 3.23 4.55

0.100 0.00 | 1.150 7.11 | 2.200 9.15 | 3.25 4.55

0.117 0.00 | 1.167 7.11 | 2.217 9.15 | 3.27 4.55

0.133 0.00 | 1.183 10.19 | 2.233 9.15 | 3.28 4.55

0.150 0.00 | 1.200 10.19 | 2.250 9.15 | 3.30 4.55

0.167 0.00 | 1.217 10.19 | 2.267 9.15 | 3.32 4.55

0.183 0.00 | 1.233 10.19 | 2.283 9.15 | 3.33 4.55

0.200 0.00 | 1.250 10.19 | 2.300 9.15 | 3.35 4.22

0.217 0.00 | 1.267 10.19 | 2.317 9.15 | 3.37 4.22

0.233 0.00 | 1.283 10.19 | 2.333 9.15 | 3.38 4.22

0.250 3.53 | 1.300 10.19 | 2.350 7.70 | 3.40 4.22

0.267 3.53 | 1.317 10.19 | 2.367 7.70 | 3.42 4.22

0.283 3.53 | 1.333 10.19 | 2.383 7.70 | 3.43 4.22

0.300	3.53	1.350	21.62	2.400	7.70	3.45	4.22
0.317	3.53	1.367	21.62	2.417	7.70	3.47	4.22
0.333	3.53	1.383	21.62	2.433	7.70	3.48	4.22
0.350	3.66	1.400	21.62	2.450	7.70	3.50	4.22
0.367	3.66	1.417	21.62	2.467	7.70	3.52	3.96
0.383	3.66	1.433	21.62	2.483	7.70	3.53	3.96
0.400	3.66	1.450	21.62	2.500	7.70	3.55	3.96
0.417	3.66	1.467	21.62	2.517	6.68	3.57	3.96
0.433	3.66	1.483	21.62	2.533	6.68	3.58	3.96
0.450	3.66	1.500	21.62	2.550	6.68	3.60	3.96
0.467	3.66	1.517	112.37	2.567	6.68	3.62	3.96
0.483	3.66	1.533	112.37	2.583	6.68	3.63	3.96
0.500	3.66	1.550	112.37	2.600	6.68	3.65	3.96
0.517	4.04	1.567	112.37	2.617	6.68	3.67	3.96
0.533	4.04	1.583	112.37	2.633	6.68	3.68	3.73
0.550	4.04	1.600	112.37	2.650	6.68	3.70	3.73
0.567	4.04	1.617	112.37	2.667	6.68	3.72	3.73
0.583	4.04	1.633	112.37	2.683	5.94	3.73	3.73
0.600	4.04	1.650	112.37	2.700	5.94	3.75	3.73
0.617	4.04	1.667	112.37	2.717	5.94	3.77	3.73
0.633	4.04	1.683	27.76	2.733	5.94	3.78	3.73
0.650	4.04	1.700	27.76	2.750	5.94	3.80	3.73
0.667	4.04	1.717	27.76	2.767	5.94	3.82	3.73
0.683	4.67	1.733	27.76	2.783	5.94	3.83	3.73
0.700	4.67	1.750	27.76	2.800	5.94	3.85	3.53
0.717	4.67	1.767	27.76	2.817	5.94	3.87	3.53
0.733	4.67	1.783	27.76	2.833	5.94	3.88	3.53
0.750	4.67	1.800	27.76	2.850	5.39	3.90	3.53
0.767	4.67	1.817	27.76	2.867	5.39	3.92	3.53
0.783	4.67	1.833	27.76	2.883	5.39	3.93	3.53
0.800	4.67	1.850	15.75	2.900	5.39	3.95	3.53
0.817	4.67	1.867	15.75	2.917	5.39	3.97	3.53
0.833	4.67	1.883	15.75	2.933	5.39	3.98	3.53
0.850	5.61	1.900	15.75	2.950	5.39	4.00	3.53
0.867	5.61	1.917	15.75	2.967	5.39	4.02	3.35
0.883	5.61	1.933	15.75	2.983	5.39	4.03	3.35
0.900	5.61	1.950	15.75	3.000	5.39	4.05	3.35
0.917	5.61	1.967	15.75	3.017	4.93	4.07	3.35
0.933	5.61	1.983	15.75	3.033	4.93	4.08	3.35
0.950	5.61	2.000	15.75	3.050	4.93	4.10	3.35
0.967	5.61	2.017	11.43	3.067	4.93	4.12	3.35
0.983	5.61	2.033	11.43	3.083	4.93	4.13	3.35
1.000	5.61	2.050	11.43	3.100	4.93	4.15	3.35
1.017	7.11	2.067	11.43	3.117	4.93	4.17	3.35
1.033	7.11	2.083	11.43	3.133	4.93		
1.050	7.11	2.100	11.43	3.150	4.93		

Max.Eff.Inten.(mm/hr)= 112.37 15.68
over (min) 5.00 23.00
Storage Coeff. (min)= 4.53 (ii) 22.76 (ii)
Unit Hyd. Tpeak (min)= 5.00 23.00
Unit Hyd. peak (cms)= 0.24 0.05

PEAK FLOW (cms)= 0.69 0.14 0.713 (iii)
TIME TO PEAK (hrs)= 1.68 2.08 1.68
RUNOFF VOLUME (mm)= 47.68 8.56 17.16
TOTAL RAINFALL (mm)= 48.48 48.48 48.48
RUNOFF COEFFICIENT = 0.98 0.18 0.35

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

RESERVOIR (0220)
IN= 2---> OUT= 1
DT= 1.0 min

OVERFLOW IS OFF

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	0.0251	0.3540
0.0066	0.0550	0.0273	0.4180
0.0127	0.1120	0.0294	0.4840
0.0167	0.1700	0.0313	0.5510
0.0199	0.2300	0.0332	0.6200
0.0226	0.2910	0.0000	0.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0022)	11.820	0.713	1.68	17.16
OUTFLOW: ID= 1 (0220)	11.820	0.017	4.68	12.09

PEAK FLOW REDUCTION [Qout/Qin](%)= 2.44
TIME SHIFT OF PEAK FLOW (min)=180.00
MAXIMUM STORAGE USED (ha.m.)= 0.1839

CALIB
STANDHYD (0003)
ID= 1 DT= 1.0 min

Area (ha)= 19.20
Total Imp(%)= 80.00 Dir. Conn.(%)= 50.00

	IMPERVIOUS (ha)	PERVIOUS (i)
Surface Area	15.36	3.84
Dep. Storage	0.80	23.90
Average Slope	2.00	2.00
Length	357.77	40.00
Mannings n	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.017	0.00	1.067	7.11	2.117	11.43	3.17	4.93
0.033	0.00	1.083	7.11	2.133	11.43	3.18	4.55
0.050	0.00	1.100	7.11	2.150	11.43	3.20	4.55
0.067	0.00	1.117	7.11	2.167	11.43	3.22	4.55
0.083	0.00	1.133	7.11	2.183	9.15	3.23	4.55
0.100	0.00	1.150	7.11	2.200	9.15	3.25	4.55
0.117	0.00	1.167	7.11	2.217	9.15	3.27	4.55

0.133	0.00	1.183	10.19	2.233	9.15	3.28	4.55
0.150	0.00	1.200	10.19	2.250	9.15	3.30	4.55
0.167	0.00	1.217	10.19	2.267	9.15	3.32	4.55
0.183	3.53	1.233	10.19	2.283	9.15	3.33	4.55
0.200	3.53	1.250	10.19	2.300	9.15	3.35	4.22
0.217	3.53	1.267	10.19	2.317	9.15	3.37	4.22
0.233	3.53	1.283	10.19	2.333	9.15	3.38	4.22
0.250	3.53	1.300	10.19	2.350	7.70	3.40	4.22
0.267	3.53	1.317	10.19	2.367	7.70	3.42	4.22
0.283	3.53	1.333	10.19	2.383	7.70	3.43	4.22
0.300	3.53	1.350	21.62	2.400	7.70	3.45	4.22
0.317	3.53	1.367	21.62	2.417	7.70	3.47	4.22
0.333	3.53	1.383	21.62	2.433	7.70	3.48	4.22
0.350	3.66	1.400	21.62	2.450	7.70	3.50	4.22
0.367	3.66	1.417	21.62	2.467	7.70	3.52	3.96
0.383	3.66	1.433	21.62	2.483	7.70	3.53	3.96
0.400	3.66	1.450	21.62	2.500	7.70	3.55	3.96
0.417	3.66	1.467	21.62	2.517	6.68	3.57	3.96
0.433	3.66	1.483	21.62	2.533	6.68	3.58	3.96
0.450	3.66	1.500	21.62	2.550	6.68	3.60	3.96
0.467	3.66	1.517	112.37	2.567	6.68	3.62	3.96
0.483	3.66	1.533	112.37	2.583	6.68	3.63	3.96
0.500	3.66	1.550	112.37	2.600	6.68	3.65	3.96
0.517	4.04	1.567	112.37	2.617	6.68	3.67	3.96
0.533	4.04	1.583	112.37	2.633	6.68	3.68	3.73
0.550	4.04	1.600	112.37	2.650	6.68	3.70	3.73
0.567	4.04	1.617	112.37	2.667	6.68	3.72	3.73
0.583	4.04	1.633	112.37	2.683	5.94	3.73	3.73
0.600	4.04	1.650	112.37	2.700	5.94	3.75	3.73
0.617	4.04	1.667	112.37	2.717	5.94	3.77	3.73
0.633	4.04	1.683	27.76	2.733	5.94	3.78	3.73
0.650	4.04	1.700	27.76	2.750	5.94	3.80	3.73
0.667	4.04	1.717	27.76	2.767	5.94	3.82	3.73
0.683	4.67	1.733	27.76	2.783	5.94	3.83	3.73
0.700	4.67	1.750	27.76	2.800	5.94	3.85	3.53
0.717	4.67	1.767	27.76	2.817	5.94	3.87	3.53
0.733	4.67	1.783	27.76	2.833	5.94	3.88	3.53
0.750	4.67	1.800	27.76	2.850	5.39	3.90	3.53
0.767	4.67	1.817	27.76	2.867	5.39	3.92	3.53
0.783	4.67	1.833	27.76	2.883	5.39	3.93	3.53
0.800	4.67	1.850	15.75	2.900	5.39	3.95	3.53
0.817	4.67	1.867	15.75	2.917	5.39	3.97	3.53
0.833	4.67	1.883	15.75	2.933	5.39	3.98	3.53
0.850	5.61	1.900	15.75	2.950	5.39	4.00	3.53
0.867	5.61	1.917	15.75	2.967	5.39	4.02	3.35
0.883	5.61	1.933	15.75	2.983	5.39	4.03	3.35
0.900	5.61	1.950	15.75	3.000	5.39	4.05	3.35
0.917	5.61	1.967	15.75	3.017	4.93	4.07	3.35
0.933	5.61	1.983	15.75	3.033	4.93	4.08	3.35
0.950	5.61	2.000	15.75	3.050	4.93	4.10	3.35
0.967	5.61	2.017	11.43	3.067	4.93	4.12	3.35
0.983	5.61	2.033	11.43	3.083	4.93	4.13	3.35
1.000	5.61	2.050	11.43	3.100	4.93	4.15	3.35
1.017	7.11	2.067	11.43	3.117	4.93	4.17	3.35
1.033	7.11	2.083	11.43	3.133	4.93		
1.050	7.11	2.100	11.43	3.150	4.93		

Max.Eff.Inten.(mm/hr)= 112.37 47.52
over (min) 5.00 9.00
Storage Coeff. (min)= 4.26 (ii) 8.92 (ii)
Unit Hyd. Tpeak (min)= 5.00 9.00
Unit Hyd. peak (cms)= 0.25 0.13

PEAK FLOW (cms)= 2.60 0.34 2.799 (iii)
TIME TO PEAK (hrs)= 1.68 1.78 1.68
RUNOFF VOLUME (mm)= 47.68 10.78 29.23
TOTAL RAINFALL (mm)= 48.48 48.48 48.48
RUNOFF COEFFICIENT = 0.98 0.22 0.60

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 50.0 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.

DUHYD (0030)
Inlet Cap.= 1.827
#of Inlets= 1
Total(cms)= 1.8

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
TOTAL HYD. (ID= 1):	19.20	2.80	1.68	29.23
MAJOR SYS. (ID= 2):	1.36	0.97	1.68	29.23
MINOR SYS. (ID= 3):	17.84	1.83	1.60	29.23

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB
STANDHYD (0021)
ID= 1 DT= 5.0 min

Area (ha)= 16.90
Total Imp(%)= 38.00 Dir. Conn.(%)= 16.00

	IMPERVIOUS (ha)	PERVIOUS (i)
Surface Area	6.42	10.48
Dep. Storage	0.80	23.90
Average Slope	2.00	2.00
Length	335.66	40.00
Mannings n	0.013	0.250

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	0.00	1.167	7.11	2.250	9.15	3.33	4.55
0.167	0.00	1.250	10.19	2.333	9.15	3.42	4.22
0.250	3.53	1.333	10.19	2.417	7.70	3.50	4.22
0.333							

0.500 3.66 | 1.583 112.37 | 2.667 6.68 | 3.75 3.73
0.583 4.04 | 1.667 112.37 | 2.750 5.94 | 3.83 3.73
0.667 4.04 | 1.750 27.76 | 2.833 5.94 | 3.92 3.53
0.750 4.67 | 1.833 27.76 | 2.917 5.39 | 4.00 3.53
0.833 4.67 | 1.917 15.75 | 3.000 5.39 | 4.08 3.35
0.917 5.61 | 2.000 15.75 | 3.083 4.93 | 4.17 3.35
1.000 5.61 | 2.083 11.43 | 3.167 4.93 |
1.083 7.11 | 2.167 11.43 | 3.250 4.55 |

Max.Eff.Inten.(mm/hr)= 112.37 5.30
over (min) 5.00 30.00
Storage Coeff. (min)= 4.10 (ii) 26.95 (ii)
Unit Hyd. Tpeak (min)= 5.00 30.00
Unit Hyd. peak (cms)= 0.24 0.04

TOTALS
PEAK FLOW (cms)= 0.78 0.08 0.790 (iii)
TIME TO PEAK (hrs)= 1.67 2.33 1.67
RUNOFF VOLUME (mm)= 47.68 4.36 11.29
TOTAL RAINFALL (mm)= 48.48 48.48 48.48
RUNOFF COEFFICIENT = 0.98 0.09 0.23

***** 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* = 50.0 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.

RESERVOIR(0210) |
IN= 2----> OUT= 1 |
DT= 5.0 min |

OVERFLOW IS OFF

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	0.3900	0.0820
0.0200	0.0000	0.4300	0.1090
0.0800	0.0020	0.5800	0.2670
0.2100	0.0160	0.6360	0.3420
0.3000	0.0330	0.0000	0.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0021)	16.900	0.790	1.67	11.29
OUTFLOW: ID= 1 (0210)	16.900	0.307	1.83	11.29

PEAK FLOW REDUCTION [Qout/Qin](%) = 38.88
TIME SHIFT OF PEAK FLOW (min)= 10.00
MAXIMUM STORAGE USED (ha.m.)= 0.0373

DUHYD (0211) |
Inlet Cap.= 0.280 |
#of Inlets= 1 |
Total(cms)= 0.3 |

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
TOTAL HYD.(ID= 1):	16.90	0.31	1.83	11.29
MAJOR SYS.(ID= 2):	0.24	0.03	1.83	11.29
MINOR SYS.(ID= 3):	16.66	0.28	1.75	11.29

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB |
STANDHYD (0023) |
ID= 1 DT= 1.0 min |

Area (ha)= 0.80
Total Imp(%)= 90.00 Dir. Conn.(%)= 45.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.72	0.08
Dep. Storage (mm)=	0.80	16.50
Average Slope (%)=	1.00	1.00
Length (m)=	73.03	40.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 MIN. TIME STEP.

--- TRANSFORMED HYETOGRAPH ---

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.017	0.00	1.067	7.11	2.117	11.43	3.17	4.93
0.033	0.00	1.083	7.11	2.133	11.43	3.18	4.55
0.050	0.00	1.100	7.11	2.150	11.43	3.20	4.55
0.067	0.00	1.117	7.11	2.167	11.43	3.22	4.55
0.083	0.00	1.133	7.11	2.183	9.15	3.23	4.55
0.100	0.00	1.150	7.11	2.200	9.15	3.25	4.55
0.117	0.00	1.167	7.11	2.217	9.15	3.27	4.55
0.133	0.00	1.183	10.19	2.233	9.15	3.28	4.55
0.150	0.00	1.200	10.19	2.250	9.15	3.30	4.55
0.167	0.00	1.217	10.19	2.267	9.15	3.32	4.55
0.183	3.53	1.233	10.19	2.283	9.15	3.33	4.55
0.200	3.53	1.250	10.19	2.300	9.15	3.35	4.22
0.217	3.53	1.267	10.19	2.317	9.15	3.37	4.22
0.233	3.53	1.283	10.19	2.333	9.15	3.38	4.22
0.250	3.53	1.300	10.19	2.350	7.70	3.40	4.22
0.267	3.53	1.317	10.19	2.367	7.70	3.42	4.22
0.283	3.53	1.333	10.19	2.383	7.70	3.43	4.22
0.300	3.53	1.350	21.62	2.400	7.70	3.45	4.22
0.317	3.53	1.367	21.62	2.417	7.70	3.47	4.22
0.333	3.53	1.383	21.62	2.433	7.70	3.48	4.22
0.350	3.66	1.400	21.62	2.450	7.70	3.50	4.22
0.367	3.66	1.417	21.62	2.467	7.70	3.52	3.96
0.383	3.66	1.433	21.62	2.483	7.70	3.53	3.96
0.400	3.66	1.450	21.62	2.500	7.70	3.55	3.96
0.417	3.66	1.467	21.62	2.517	6.68	3.57	3.96
0.433	3.66	1.483	21.62	2.533	6.68	3.58	3.96
0.450	3.66	1.500	21.62	2.550	6.68	3.60	3.96
0.467	3.66	1.517	112.37	2.567	6.68	3.62	3.96
0.483	3.66	1.533	112.37	2.583	6.68	3.63	3.96

0.500 3.66 | 1.550 112.37 | 2.600 6.68 | 3.65 3.96
0.517 4.04 | 1.567 112.37 | 2.617 6.68 | 3.67 3.96
0.533 4.04 | 1.583 112.37 | 2.633 6.68 | 3.68 3.73
0.550 4.04 | 1.600 112.37 | 2.650 6.68 | 3.70 3.73
0.567 4.04 | 1.617 112.37 | 2.667 6.68 | 3.72 3.73
0.583 4.04 | 1.633 112.37 | 2.683 5.94 | 3.73 3.73
0.600 4.04 | 1.650 112.37 | 2.700 5.94 | 3.75 3.73
0.617 4.04 | 1.667 112.37 | 2.717 5.94 | 3.77 3.73
0.633 4.04 | 1.683 27.76 | 2.733 5.94 | 3.78 3.73
0.650 4.04 | 1.700 27.76 | 2.750 5.94 | 3.80 3.73
0.667 4.04 | 1.717 27.76 | 2.767 5.94 | 3.82 3.73
0.683 4.67 | 1.733 27.76 | 2.783 5.94 | 3.83 3.73
0.700 4.67 | 1.750 27.76 | 2.800 5.94 | 3.85 3.53
0.717 4.67 | 1.767 27.76 | 2.817 5.94 | 3.87 3.53
0.733 4.67 | 1.783 27.76 | 2.833 5.94 | 3.88 3.53
0.750 4.67 | 1.800 27.76 | 2.850 5.39 | 3.90 3.53
0.767 4.67 | 1.817 27.76 | 2.867 5.39 | 3.92 3.53
0.783 4.67 | 1.833 27.76 | 2.883 5.39 | 3.93 3.53
0.800 4.67 | 1.850 15.75 | 2.900 5.39 | 3.95 3.53
0.817 4.67 | 1.867 15.75 | 2.917 5.39 | 3.97 3.53
0.833 4.67 | 1.883 15.75 | 2.933 5.39 | 3.98 3.53
0.850 5.61 | 1.900 15.75 | 2.950 5.39 | 4.00 3.53
0.867 5.61 | 1.917 15.75 | 2.967 5.39 | 4.02 3.35
0.883 5.61 | 1.933 15.75 | 2.983 5.39 | 4.03 3.35
0.900 5.61 | 1.950 15.75 | 3.000 5.39 | 4.05 3.35
0.917 5.61 | 1.967 15.75 | 3.017 4.93 | 4.07 3.35
0.933 5.61 | 1.983 15.75 | 3.033 4.93 | 4.08 3.35
0.950 5.61 | 2.000 15.75 | 3.050 4.93 | 4.10 3.35
0.967 5.61 | 2.017 11.43 | 3.067 4.93 | 4.12 3.35
0.983 5.61 | 2.033 11.43 | 3.083 4.93 | 4.13 3.35
1.000 5.61 | 2.050 11.43 | 3.100 4.93 | 4.15 3.35
1.017 7.11 | 2.067 11.43 | 3.117 4.93 | 4.17 3.35
1.033 7.11 | 2.083 11.43 | 3.133 4.93 |
1.050 7.11 | 2.100 11.43 | 3.150 4.93 |

Max.Eff.Inten.(mm/hr)= 112.37 330.04
over (min) 5.00 7.00
Storage Coeff. (min)= 2.02 (ii) 6.56 (ii)
Unit Hyd. Tpeak (min)= 5.00 7.00
Unit Hyd. peak (cms)= 0.37 0.17

TOTALS
PEAK FLOW (cms)= 0.11 0.05 0.157 (iii)
TIME TO PEAK (hrs)= 1.67 1.73 1.68
RUNOFF VOLUME (mm)= 47.68 26.21 35.86
TOTAL RAINFALL (mm)= 48.48 48.48 48.48
RUNOFF COEFFICIENT = 0.98 0.54 0.74

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

DUHYD (0230) |
Inlet Cap.= 0.015 |
#of Inlets= 1 |
Total(cms)= 0.0 |

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
TOTAL HYD.(ID= 1):	0.80	0.16	1.68	35.86
MAJOR SYS.(ID= 2):	0.40	0.14	1.68	35.86
MINOR SYS.(ID= 3):	0.40	0.01	1.40	35.86

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB |
STANDHYD (0024) |
ID= 1 DT= 1.0 min |

Area (ha)= 1.40
Total Imp(%)= 90.00 Dir. Conn.(%)= 45.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	1.26	0.14
Dep. Storage (mm)=	0.80	16.50
Average Slope (%)=	1.00	1.00
Length (m)=	96.61	40.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 MIN. TIME STEP.

--- TRANSFORMED HYETOGRAPH ---

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.017	0.00	1.067	7.11	2.117	11.43	3.17	4.93
0.033	0.00	1.083	7.11	2.133	11.43	3.18	4.55
0.050	0.00	1.100	7.11	2.150	11.43	3.20	4.55
0.067	0.00	1.117	7.11	2.167	11.43	3.22	4.55
0.083	0.00	1.133	7.11	2.183	9.15	3.23	4.55
0.100	0.00	1.150	7.11	2.200	9.15	3.25	4.55
0.117	0.00	1.167	7.11	2.217	9.15	3.27	4.55
0.133	0.00	1.183	10.19	2.233	9.15	3.28	4.55
0.150	0.00	1.200	10.19	2.250	9.15	3.30	4.55
0.167	0.00	1.217	10.19	2.267	9.15	3.32	4.55
0.183	3.53	1.233	10.19	2.283	9.15	3.33	4.55
0.200	3.53	1.250	10.19	2.300	9.15	3.35	4.22
0.217	3.53	1.267	10.19	2.317	9.15	3.37	4.22
0.233	3.53	1.283	10.19	2.333	9.15	3.38	4.22
0.250	3.53	1.300	10.19	2.350	7.70	3.40	4.22
0.267	3.53	1.317	10.19	2.367	7.70	3.42	4.22
0.283	3.53	1.333	10.19	2.383	7.70	3.43	4.22
0.300	3.53	1.350	21.62	2.400	7.70	3.45	4.22
0.317	3.53	1.367	21.62	2.417	7.70	3.47	4.22
0.333	3.53	1.383	21.62	2.433	7.70	3.48	4.22
0.350	3.66	1.400	21.62	2.450	7.70	3.50	4.22
0.367	3.66	1.417	21.62	2.467	7.70	3.52	3.96
0.383	3.66	1.433	21.62	2.483	7.70	3.53	3.96
0.400	3.66	1.450	21.62	2.500	7.70	3.55	3.96
0.417	3.66	1.467	21.62	2.517	6.68	3.57	3.96
0.433	3.66	1.483	21.62	2.533	6.68	3.58	3.96
0.450	3.66	1.500	21.62	2.550	6.68	3.60	3.96
0.467	3.66	1.517	112.37	2.567	6.68	3.62	3.96
0.483	3.66	1.533	112.37	2.583	6.68	3.63	3.96

0.467	3.66	1.517	112.37	2.567	6.68	3.62	3.96
0.483	3.66	1.533	112.37	2.583	6.68	3.63	3.96
0.500	3.66	1.550	112.37	2.600	6.68	3.65	3.96
0.517	4.04	1.567	112.37	2.617	6.68	3.67	3.96
0.533	4.04	1.583	112.37	2.633	6.68	3.68	3.73
0.550	4.04	1.600	112.37	2.650	6.68	3.70	3.73
0.567	4.04	1.617	112.37	2.667	6.68	3.72	3.73
0.583	4.04	1.633	112.37	2.683	5.94	3.73	3.73
0.600	4.04	1.650	112.37	2.700	5.94	3.75	3.73
0.617	4.04	1.667	112.37	2.717	5.94	3.77	3.73
0.633	4.04	1.683	27.76	2.733	5.94	3.78	3.73
0.650	4.04	1.700	27.76	2.750	5.94	3.80	3.73
0.667	4.04	1.717	27.76	2.767	5.94	3.82	3.73
0.683	4.67	1.733	27.76	2.783	5.94	3.83	3.73
0.700	4.67	1.750	27.76	2.800	5.94	3.85	3.53
0.717	4.67	1.767	27.76	2.817	5.94	3.87	3.53
0.733	4.67	1.783	27.76	2.833	5.94	3.88	3.53
0.750	4.67	1.800	27.76	2.850	5.39	3.90	3.53
0.767	4.67	1.817	27.76	2.867	5.39	3.92	3.53
0.783	4.67	1.833	27.76	2.883	5.39	3.93	3.53
0.800	4.67	1.850	15.75	2.900	5.39	3.95	3.53
0.817	4.67	1.867	15.75	2.917	5.39	3.97	3.53
0.833	4.67	1.883	15.75	2.933	5.39	3.98	3.53
0.850	5.61	1.900	15.75	2.950	5.39	4.00	3.53
0.867	5.61	1.917	15.75	2.967	5.39	4.02	3.35
0.883	5.61	1.933	15.75	2.983	5.39	4.03	3.35
0.900	5.61	1.950	15.75	3.000	5.39	4.05	3.35
0.917	5.61	1.967	15.75	3.017	4.93	4.07	3.35
0.933	5.61	1.983	15.75	3.033	4.93	4.08	3.35
0.950	5.61	2.000	15.75	3.050	4.93	4.10	3.35
0.967	5.61	2.017	11.43	3.067	4.93	4.12	3.35
0.983	5.61	2.033	11.43	3.083	4.93	4.13	3.35
1.000	5.61	2.050	11.43	3.100	4.93	4.15	3.35
1.017	7.11	2.067	11.43	3.117	4.93	4.17	3.35
1.033	7.11	2.083	11.43	3.133	4.93		
1.050	7.11	2.100	11.43	3.150	4.93		

Max.Eff.Inten.(mm/hr)= 112.37 330.04
over (min) 5.00 7.00
Storage Coeff. (min)= 2.39 (ii) 6.93 (ii)
Unit Hyd. Tpeak (min)= 5.00 7.00
Unit Hyd. peak (cms)= 0.35 0.16

PEAK FLOW (cms)= 0.19 0.09 0.270 (iii)
TIME TO PEAK (hrs)= 1.67 1.73 1.68
RUNOFF VOLUME (mm)= 47.68 26.21 35.87
TOTAL RAINFALL (mm)= 48.48 48.48 48.48
RUNOFF COEFFICIENT = 0.98 0.54 0.74

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

DUHYD (0240)				
Inlet Cap.= 0.015				
#of Inlets= 1				
Total(cms)= 0.0				

TOTAL HYD.(ID= 1):	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
	1.40	0.27	1.68	35.87
=====				
MAJOR SYS.(ID= 2):	0.89	0.26	1.68	35.87
MINOR SYS.(ID= 3):	0.51	0.01	1.23	35.87

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)				
1 + 2 = 3				

ID1= 1 (0010):	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
	38.86	1.040	1.60	10.11
+ ID2= 2 (0211):	16.66	0.280	1.75	11.29
=====				
ID = 3 (1001):	55.52	1.320	1.77	10.47

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)				
3 + 2 = 1				

ID1= 3 (1001):	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
	55.52	1.320	1.77	10.47
+ ID2= 2 (0220):	11.82	0.017	4.68	12.09
=====				
ID = 1 (1001):	67.34	1.328	1.77	10.75

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)				
1 + 2 = 3				

ID1= 1 (1001):	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
	67.34	1.328	1.77	10.75
+ ID2= 2 (0230):	0.40	0.015	1.40	35.86
=====				
ID = 3 (1001):	67.74	1.343	1.77	10.90

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)				
3 + 2 = 1				

ID1= 3 (1001):	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
	67.74	1.343	1.77	10.90
+ ID2= 2 (0240):	0.51	0.015	1.23	35.87

=====

ID = 1 (1001):	68.26	1.358	1.77	11.09
-----------------	-------	-------	------	-------

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)				
1 + 2 = 3				

ID1= 1 (1001):	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
	68.26	1.358	1.77	11.09
+ ID2= 2 (0030):	17.84	1.827	1.60	29.23
=====				
ID = 3 (1001):	86.09	3.185	1.77	14.85

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB			
STANDHYD (0004)			
ID= 1 DT= 5.0 min			

Area (ha)=	7.85		
Total Imp(%)=	46.00	Dir. Conn.(%)=	22.00

		IMPERVIOUS		PERVIOUS (i)	
Surface Area	(ha)=	3.61		4.24	
Dep. Storage	(mm)=	1.00		8.10	
Average Slope	(%)=	1.00		2.00	
Length	(m)=	228.76		40.00	
Mannings n	=	0.013		0.250	

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	0.00	1.167	7.11	2.250	9.15	3.33	4.55
0.167	0.00	1.250	10.19	2.333	9.15	3.42	4.22
0.250	3.53	1.333	10.19	2.417	7.70	3.50	4.22
0.333	3.53	1.417	21.62	2.500	7.70	3.58	3.96
0.417	3.66	1.500	21.62	2.583	6.68	3.67	3.96
0.500	3.66	1.583	112.37	2.667	6.68	3.75	3.73
0.583	4.04	1.667	112.37	2.750	5.94	3.83	3.73
0.667	4.04	1.750	27.76	2.833	5.94	3.92	3.53
0.750	4.67	1.833	27.76	2.917	5.39	4.00	3.53
0.833	4.67	1.917	15.75	3.000	5.39	4.08	3.35
0.917	5.61	2.000	15.75	3.083	4.93	4.17	3.35
1.000	5.61	2.083	11.43	3.167	4.93		
1.083	7.11	2.167	11.43	3.250	4.55		

Max.Eff.Inten.(mm/hr)= 112.37 48.53
over (min) 5.00 15.00
Storage Coeff. (min)= 4.01 (ii) 13.43 (ii)
Unit Hyd. Tpeak (min)= 5.00 15.00
Unit Hyd. peak (cms)= 0.24 0.08

PEAK FLOW (cms)= 0.50 0.30 0.638 (iii)
TIME TO PEAK (hrs)= 1.67 1.83 1.67
RUNOFF VOLUME (mm)= 47.48 16.52 23.33
TOTAL RAINFALL (mm)= 48.48 48.48 48.48
RUNOFF COEFFICIENT = 0.98 0.34 0.48

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 72.0 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.

DUHYD (0040)				
Inlet Cap.= 0.084				
#of Inlets= 1				
Total(cms)= 0.1				

TOTAL HYD.(ID= 1):	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
	7.85	0.64	1.67	23.33
=====				
MAJOR SYS.(ID= 2):	3.94	0.55	1.67	23.33
MINOR SYS.(ID= 3):	3.91	0.08	1.42	23.33

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1002)				
1 + 2 = 3				

ID1= 1 (1001):	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
	86.09	3.185	1.77	14.85
+ ID2= 2 (0040):	3.91	0.084	1.42	23.33
=====				
ID = 3 (1002):	90.01	3.269	1.77	15.21

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1003)				
1 + 2 = 3				

ID1= 1 (1002):	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
	90.01	3.269	1.77	15.21
+ ID2= 2 (5000):	3.43	0.014	4.25	15.20
=====				
ID = 3 (1003):	93.44	3.278	1.77	15.21

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

10-YEAR STORM - POST-DEVELOPMENT

=====

V V I SSSSS U U A L (v 6.2.2015)

V V I SS U U A A L

V V I SS U U AAAAA L

V V I SS U U A A L

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OOO TTTT TTTT H H Y Y M M OOO TM

O O T T H H Y Y MM MM O O

O O T T H H Y M M O O

OOO T T H H Y M M OOO

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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat

Output filename: C:\Users\Natalie\AppData\Local\Civica\XH5\2b61f5e3-29d9-4c68-a5ec-7ff64ecb31ab\b2ce1350-4e5a-4f2f-91bc-2512d1982376\scen

Summary filename: C:\Users\Natalie\AppData\Local\Civica\XH5\2b61f5e3-29d9-4c68-a5ec-7ff64ecb31ab\b2ce1350-4e5a-4f2f-91bc-2512d1982376\scen

DATE: 10/19/2023 TIME: 03:51:48

USER:

COMMENTS: _____

***** SIMULATION : Norfolk 10yr 4hr *****

| READ STORM | File: C:\Users\Natalie\AppData\Local\Temp\

| | b7db1222-786f-4fa1-9026-76a41ee37e1f\18a961b8

| | Ptotal= 56.08 mm | Comments: Norfolk 10yr 4hr

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	0.00	1.17	11.51	2.33	8.66	3.50	4.39
0.17	3.58	1.33	25.32	2.50	7.52	3.67	4.14
0.33	3.99	1.50	133.60	2.67	6.65	3.83	3.91
0.50	4.50	1.67	32.00	2.83	5.38	4.00	3.63
0.67	5.21	1.83	19.73	3.00	5.49		
0.83	6.27	2.00	12.95	3.17	5.05		
1.00	8.00	2.17	10.31	3.33	4.70		

| CALIB |

| STANDHYD (0051) | Area (ha)= 0.60 Curve Number (CN)= 62.0

| ID= 1 DT= 5.0 min | Ia (mm)= 13.60 # of Linear Res. (N)= 3.00

U.H. Tp (hrs)= 0.14

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083	0.00	1.167	8.00	2.250	10.31	3.33	5.05
0.167	0.00	1.250	11.51	2.333	10.31	3.42	4.70
0.250	3.58	1.333	11.51	2.417	8.66	3.50	4.70
0.333	3.58	1.417	25.32	2.500	8.66	3.58	4.39
0.417	3.99	1.500	25.32	2.583	7.52	3.67	4.39
0.500	3.99	1.583	133.60	2.667	7.52	3.75	4.14
0.583	4.50	1.667	133.60	2.750	6.65	3.83	4.14
0.667	4.50	1.750	32.00	2.833	6.65	3.92	3.91
0.750	5.21	1.833	32.00	2.917	5.38	4.00	3.91
0.833	5.21	1.917	19.73	3.000	5.38	4.08	3.63
0.917	6.27	2.000	19.73	3.083	5.49	4.17	3.63
1.000	6.27	2.083	12.95	3.167	5.49		
1.083	8.00	2.167	12.95	3.250	5.05		

Unit Hyd Qpeak (cms)= 0.164

PEAK FLOW (cms)= 0.016 (i)

TIME TO PEAK (hrs)= 1.750

RUNOFF VOLUME (mm)= 9.039

TOTAL RAINFALL (mm)= 56.083

RUNOFF COEFFICIENT = 0.161

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

| CALIB |

| STANDHYD (0052) | Area (ha)= 2.83

| ID= 1 DT= 5.0 min | Total Imp(%)= 41.00 Dir. Conn.(%)= 20.00

IMPERVIOUS PERVIOUS (i)

Surface Area (ha)= 1.16 1.67

Dep. Storage (mm)= 1.00 13.60

Average Slope (%)= 1.00 2.00

Length (m)= 137.36 40.00

Mannings n = 0.013 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083	0.00	1.167	8.00	2.250	10.31	3.33	5.05
0.167	0.00	1.250	11.51	2.333	10.31	3.42	4.70
0.250	3.58	1.333	11.51	2.417	8.66	3.50	4.70
0.333	3.58	1.417	25.32	2.500	8.66	3.58	4.39
0.417	3.99	1.500	25.32	2.583	7.52	3.67	4.39
0.500	3.99	1.583	133.60	2.667	7.52	3.75	4.14
0.583	4.50	1.667	133.60	2.750	6.65	3.83	4.14
0.667	4.50	1.750	32.00	2.833	6.65	3.92	3.91
0.750	5.21	1.833	32.00	2.917	5.38	4.00	3.91
0.833	5.21	1.917	19.73	3.000	5.38	4.08	3.63
0.917	6.27	2.000	19.73	3.083	5.49	4.17	3.63
1.000	6.27	2.083	12.95	3.167	5.49		
1.083	8.00	2.167	12.95	3.250	5.05		

Max.Eff.Inten.(mm/hr)= 133.60 26.50

over (min)= 5.00 15.00

Storage Coeff. (min)= 2.75 (ii) 14.76 (ii)

Unit Hyd. Tpeak (min)= 5.00 15.00

Unit Hyd. peak (cms)= 0.28 0.08

PEAK FLOW (cms)= 0.21 0.08

TIME TO PEAK (hrs)= 1.67 1.83

RUNOFF VOLUME (mm)= 55.08 13.18

TOTAL RAINFALL (mm)= 56.08 56.08

RUNOFF COEFFICIENT = 0.98 0.24

TOTALS

0.235 (iii)

1.67

21.56

56.08

0.38

***** 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* = 62.0 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 (0050) | Area (ha)= 1.52

| ID= 1 DT= 5.0 min | Total Imp(%)= 48.00 Dir. Conn.(%)= 21.00

IMPERVIOUS PERVIOUS (i)

Surface Area (ha)= 0.73 0.79

Dep. Storage (mm)= 1.00 13.60

Average Slope (%)= 1.00 2.00

Length (m)= 100.66 40.00

Mannings n = 0.013 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083	0.00	1.167	8.00	2.250	10.31	3.33	5.05
0.167	0.00	1.250	11.51	2.333	10.31	3.42	4.70
0.250	3.58	1.333	11.51	2.417	8.66	3.50	4.70
0.333	3.58	1.417	25.32	2.500	8.66	3.58	4.39
0.417	3.99	1.500	25.32	2.583	7.52	3.67	4.39
0.500	3.99	1.583	133.60	2.667	7.52	3.75	4.14
0.583	4.50	1.667	133.60	2.750	6.65	3.83	4.14
0.667	4.50	1.750	32.00	2.833	6.65	3.92	3.91
0.750	5.21	1.833	32.00	2.917	5.38	4.00	3.91
0.833	5.21	1.917	19.73	3.000	5.38	4.08	3.63
0.917	6.27	2.000	19.73	3.083	5.49	4.17	3.63
1.000	6.27	2.083	12.95	3.167	5.49		
1.083	8.00	2.167	12.95	3.250	5.05		

Max.Eff.Inten.(mm/hr)= 133.60 43.25

over (min)= 5.00 15.00

Storage Coeff. (min)= 2.28 (ii) 12.15 (ii)

Unit Hyd. Tpeak (min)= 5.00 15.00

Unit Hyd. peak (cms)= 0.30 0.09

PEAK FLOW (cms)= 0.12 0.05

TIME TO PEAK (hrs)= 1.67 1.83

RUNOFF VOLUME (mm)= 55.08 14.85

TOTAL RAINFALL (mm)= 56.08 56.08

RUNOFF COEFFICIENT = 0.98 0.26

0.42

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:

CN* = 62.0 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.

| CHAMBER(0053) |

| IN= 2--> OUT= 3 |

| DT= 5.0 min |

OUTFLOW: OFF, UNDERDRAIN: OFF, INFIL: ON

CHAMBER:

MAX STO VOL (cu.m.)= 540.00 Bottom Area(m2) = 500.00

DEPTH	STORAGE	DEPTH	STORAGE
(mm)	(cu.m.)	(mm)	(cu.m.)
0.00	0.00	800.00	288.00
100.00	36.00	900.00	324.00
200.00	72.00	1000.00	360.00
300.00	108.00	1100.00	396.00
400.00	144.00	1200.00	432.00
500.00	180.00	1300.00	468.00
600.00	216.00	1400.00	504.00
700.00	252.00	1500.00	540.00

NATIVE SOIL LAYER:

Infiltration (m/hr) = 0.0250

AREA QPEAK TPEAK R.V.

0.300	3.58	1.350	25.32	2.400	8.66	3.45	4.70
0.317	3.58	1.367	25.32	2.417	8.66	3.47	4.70
0.333	3.58	1.383	25.32	2.433	8.66	3.48	4.70
0.350	3.99	1.400	25.32	2.450	8.66	3.50	4.70
0.367	3.99	1.417	25.32	2.467	8.66	3.52	4.39
0.383	3.99	1.433	25.32	2.483	8.66	3.53	4.39
0.400	3.99	1.450	25.32	2.500	8.66	3.55	4.39
0.417	3.99	1.467	25.32	2.517	7.52	3.57	4.39
0.433	3.99	1.483	25.32	2.533	7.52	3.58	4.39
0.450	3.99	1.500	25.32	2.550	7.52	3.60	4.39
0.467	3.99	1.517	133.60	2.567	7.52	3.62	4.39
0.483	3.99	1.533	133.60	2.583	7.52	3.63	4.39
0.500	3.99	1.550	133.60	2.600	7.52	3.65	4.39
0.517	4.50	1.567	133.60	2.617	7.52	3.67	4.39
0.533	4.50	1.583	133.60	2.633	7.52	3.68	4.14
0.550	4.50	1.600	133.60	2.650	7.52	3.70	4.14
0.567	4.50	1.617	133.60	2.667	7.52	3.72	4.14
0.583	4.50	1.633	133.60	2.683	6.65	3.73	4.14
0.600	4.50	1.650	133.60	2.700	6.65	3.75	4.14
0.617	4.50	1.667	133.60	2.717	6.65	3.77	4.14
0.633	4.50	1.683	32.01	2.733	6.65	3.78	4.14
0.650	4.50	1.700	32.00	2.750	6.65	3.80	4.14
0.667	4.50	1.717	32.00	2.767	6.65	3.82	4.14
0.683	5.21	1.733	32.00	2.783	6.65	3.83	4.14
0.700	5.21	1.750	32.00	2.800	6.65	3.85	3.91
0.717	5.21	1.767	32.00	2.817	6.65	3.87	3.91
0.733	5.21	1.783	32.00	2.833	6.65	3.88	3.91
0.750	5.21	1.800	32.00	2.850	5.38	3.90	3.91
0.767	5.21	1.817	32.00	2.867	5.38	3.92	3.91
0.783	5.21	1.833	32.00	2.883	5.38	3.93	3.91
0.800	5.21	1.850	19.73	2.900	5.38	3.95	3.91
0.817	5.21	1.867	19.73	2.917	5.38	3.97	3.91
0.833	5.21	1.883	19.73	2.933	5.38	3.98	3.91
0.850	6.27	1.900	19.73	2.950	5.38	4.00	3.91
0.867	6.27	1.917	19.73	2.967	5.38	4.02	3.63
0.883	6.27	1.933	19.73	2.983	5.38	4.03	3.63
0.900	6.27	1.950	19.73	3.000	5.38	4.05	3.63
0.917	6.27	1.967	19.73	3.017	5.49	4.07	3.63
0.933	6.27	1.983	19.73	3.033	5.49	4.08	3.63
0.950	6.27	2.000	19.73	3.050	5.49	4.10	3.63
0.967	6.27	2.017	12.95	3.067	5.49	4.12	3.63
0.983	6.27	2.033	12.95	3.083	5.49	4.13	3.63
1.000	6.27	2.050	12.95	3.100	5.49	4.15	3.63
1.017	8.00	2.067	12.95	3.117	5.49	4.17	3.63
1.033	8.00	2.083	12.95	3.133	5.49		
1.050	8.00	2.100	12.95	3.150	5.49		

Max.Eff.Inten.(mm/hr)= 133.60 25.72
over (min) 5.00 20.00
Storage Coeff. (min)= 4.23 (ii) 19.18 (ii)
Unit Hyd. Tpeak (min)= 5.00 20.00
Unit Hyd. peak (cms)= 0.25 0.06

PEAK FLOW (cms)= 0.84 0.23 0.882 (iii)
TIME TO PEAK (hrs)= 1.68 1.98 1.68
RUNOFF VOLUME (mm)= 55.28 11.85 21.41
TOTAL RAINFALL (mm)= 56.08 56.08 56.08
RUNOFF COEFFICIENT = 0.99 0.21 0.38

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

RESERVOIR (0220)					OVERFLOW IS OFF				
IN= 2---> OUT= 1									
DT= 1.0 min									
					OUTFLOW	STORAGE	OUTFLOW	STORAGE	
					(cms)	(ha.m.)	(cms)	(ha.m.)	
					0.0000	0.0000	0.0251	0.3540	
					0.0066	0.0550	0.0273	0.4180	
					0.0127	0.1120	0.0294	0.4840	
					0.0167	0.1700	0.0313	0.5510	
					0.0199	0.2300	0.0332	0.6200	
					0.0226	0.2910	0.0000	0.0000	
					AREA	QPEAK	TPEAK	R.V.	
					(ha)	(cms)	(hrs)	(mm)	
INFLOW : ID= 2 (0022)					11.820	0.882	1.68	21.41	
OUTFLOW: ID= 1 (0220)					11.820	0.020	4.63	14.58	

PEAK FLOW REDUCTION [Qout/Qin](%)= 2.26
TIME SHIFT OF PEAK FLOW (min)=177.00
MAXIMUM STORAGE USED (ha.m.)= 0.2318

CALIB				Area (ha)= 19.20			
STANDHYD (0003)				Total Imp(%)= 80.00 Dir. Conn.(%)= 50.00			
ID= 1 DT= 1.0 min							

				IMPERVIOUS	PERVIOUS (i)
Surface Area				(ha)= 15.36	3.84
Dep. Storage				(mm)= 0.80	23.90
Average Slope				(%)= 2.00	2.00
Length				(m)= 357.77	40.00
Mannings n				= 0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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
0.017	0.00	1.067	8.00	2.117	12.95	3.17	5.49
0.033	0.00	1.083	8.00	2.133	12.95	3.18	5.05
0.050	0.00	1.100	8.00	2.150	12.95	3.20	5.05
0.067	0.00	1.117	8.00	2.167	12.95	3.22	5.05
0.083	0.00	1.133	8.00	2.183	10.31	3.23	5.05
0.100	0.00	1.150	8.00	2.200	10.31	3.25	5.05
0.117	0.00	1.167	8.00	2.217	10.31	3.27	5.05

0.133	0.00	1.183	11.51	2.233	10.31	3.28	5.05
0.150	0.00	1.200	11.51	2.250	10.31	3.30	5.05
0.167	0.00	1.217	11.51	2.267	10.31	3.32	5.05
0.183	3.58	1.233	11.51	2.283	10.31	3.33	5.05
0.200	3.58	1.250	11.51	2.300	10.31	3.35	4.70
0.217	3.58	1.267	11.51	2.317	10.31	3.37	4.70
0.233	3.58	1.283	11.51	2.333	10.31	3.38	4.70
0.250	3.58	1.300	11.51	2.350	8.66	3.40	4.70
0.267	3.58	1.317	11.51	2.367	8.66	3.42	4.70
0.283	3.58	1.333	11.51	2.383	8.66	3.43	4.70
0.300	3.58	1.350	25.32	2.400	8.66	3.45	4.70
0.317	3.58	1.367	25.32	2.417	8.66	3.47	4.70
0.333	3.58	1.383	25.32	2.433	8.66	3.48	4.70
0.350	3.99	1.400	25.32	2.450	8.66	3.50	4.70
0.367	3.99	1.417	25.32	2.467	8.66	3.52	4.39
0.383	3.99	1.433	25.32	2.483	8.66	3.53	4.39
0.400	3.99	1.450	25.32	2.500	8.66	3.55	4.39
0.417	3.99	1.467	25.32	2.517	7.52	3.57	4.39
0.433	3.99	1.483	25.32	2.533	7.52	3.58	4.39
0.450	3.99	1.500	25.32	2.550	7.52	3.60	4.39
0.467	3.99	1.517	133.60	2.567	7.52	3.62	4.39
0.483	3.99	1.533	133.60	2.583	7.52	3.63	4.39
0.500	3.99	1.550	133.60	2.600	7.52	3.65	4.39
0.517	4.50	1.567	133.60	2.617	7.52	3.67	4.39
0.533	4.50	1.583	133.60	2.633	7.52	3.68	4.14
0.550	4.50	1.600	133.60	2.650	7.52	3.70	4.14
0.567	4.50	1.617	133.60	2.667	7.52	3.72	4.14
0.583	4.50	1.633	133.60	2.683	6.65	3.73	4.14
0.600	4.50	1.650	133.60	2.700	6.65	3.75	4.14
0.617	4.50	1.667	133.60	2.717	6.65	3.77	4.14
0.633	4.50	1.683	32.01	2.733	6.65	3.78	4.14
0.650	4.50	1.700	32.00	2.750	6.65	3.80	4.14
0.667	4.50	1.717	32.00	2.767	6.65	3.82	4.14
0.683	5.21	1.733	32.00	2.783	6.65	3.83	4.14
0.700	5.21	1.750	32.00	2.800	6.65	3.85	3.91
0.717	5.21	1.767	32.00	2.817	6.65	3.87	3.91
0.733	5.21	1.783	32.00	2.833	6.65	3.88	3.91
0.750	5.21	1.800	32.00	2.850	5.38	3.90	3.91
0.767	5.21	1.817	32.00	2.867	5.38	3.92	3.91
0.783	5.21	1.833	32.00	2.883	5.38	3.93	3.91
0.800	5.21	1.850	19.73	2.900	5.38	3.95	3.91
0.817	5.21	1.867	19.73	2.917	5.38	3.97	3.91
0.833	5.21	1.883	19.73	2.933	5.38	3.98	3.91
0.850	6.27	1.900	19.73	2.950	5.38	4.00	3.91
0.867	6.27	1.917	19.73	2.967	5.38	4.02	3.63
0.883	6.27	1.933	19.73	2.983	5.38	4.03	3.63
0.900	6.27	1.950	19.73	3.000	5.38	4.05	3.63
0.917	6.27	1.967	19.73	3.017	5.49	4.07	3.63
0.933	6.27	1.983	19.73	3.033	5.49	4.08	3.63
0.950	6.27	2.000	19.73	3.050	5.49	4.10	3.63
0.967	6.27	2.017	12.95	3.067	5.49	4.12	3.63
0.983	6.27	2.033	12.95	3.083	5.49	4.13	3.63
1.000	6.27	2.050	12.95	3.100	5.49	4.15	3.63
1.017	8.00	2.067	12.95	3.117	5.49	4.17	3.63
1.033	8.00	2.083	12.95	3.133	5.49		
1.050	8.00	2.100	12.95	3.150	5.49		

Max.Eff.Inten.(mm/hr)= 133.60 69.78
over (min) 5.00 9.00
Storage Coeff. (min)= 3.97 (ii) 8.33 (ii)
Unit Hyd. Tpeak (min)= 5.00 9.00
Unit Hyd. peak (cms)= 0.26 0.13

PEAK FLOW (cms)= 3.13 0.51 3.460 (iii)
TIME TO PEAK (hrs)= 1.68 1.78 1.68
RUNOFF VOLUME (mm)= 55.28 14.61 34.95
TOTAL RAINFALL (mm)= 56.08 56.08 56.08
RUNOFF COEFFICIENT = 0.99 0.26 0.62

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 50.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT

0.500 3.99 | 1.583 133.60 | 2.667 7.52 | 3.75 4.14
0.583 4.50 | 1.667 133.60 | 2.750 6.65 | 3.83 4.14
0.667 4.50 | 1.750 32.00 | 2.833 6.65 | 3.92 3.91
0.750 5.21 | 1.833 32.00 | 2.917 5.38 | 4.00 3.91
0.833 5.21 | 1.917 19.73 | 3.000 5.38 | 4.08 3.63
0.917 6.27 | 2.000 19.73 | 3.083 5.49 | 4.17 3.63
1.000 6.27 | 2.083 12.95 | 3.167 5.49 |
1.083 8.00 | 2.167 12.95 | 3.250 5.05 |

Max.Eff.Inten.(mm/hr)= 133.60 9.71
over (min) 5.00 25.00
Storage Coeff. (min)= 3.82 (ii) 21.76 (ii)
Unit Hyd. Tpeak (min)= 5.00 25.00
Unit Hyd. peak (cms)= 0.25 0.05

TOTALS
PEAK FLOW (cms)= 0.94 0.15 0.963 (iii)
TIME TO PEAK (hrs)= 1.67 2.17 1.67
RUNOFF VOLUME (mm)= 55.28 6.54 14.34
TOTAL RAINFALL (mm)= 56.08 56.08 56.08
RUNOFF COEFFICIENT = 0.99 0.12 0.26

***** 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* = 50.0 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.

| RESERVOIR(0210) | OVERFLOW IS OFF
| IN= 2----> OUT= 1 |
DT= 5.0 min
OUTFLOW STORAGE OUTFLOW STORAGE
(cms) (ha.m.) (cms) (ha.m.)
0.0000 0.0000 | 0.3900 0.0820
0.0200 0.0000 | 0.4300 0.1090
0.0800 0.0020 | 0.5800 0.2670
0.2100 0.0160 | 0.6360 0.3420
0.3000 0.0330 | 0.0000 0.0000

AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW : ID= 2 (0021) 16.900 0.963 1.67 14.34
OUTFLOW: ID= 1 (0210) 16.900 0.329 1.92 14.34

PEAK FLOW REDUCTION [Qout/Qin](%) = 34.15
TIME SHIFT OF PEAK FLOW (min)= 15.00
MAXIMUM STORAGE USED (ha.m.) = 0.0492

| DUHYD (0211) |
| Inlet Cap.= 0.280 |
| #of Inlets= 1 |
Total(cms)= 0.3
TOTAL HYD.(ID= 1): 16.90 0.33 1.92 14.34
=====

MAJOR SYS.(ID= 2): 0.88 0.05 1.92 14.34

MINOR SYS.(ID= 3): 16.02 0.28 1.67 14.34

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| CALIB |
| STANDHYD (0023) |
ID= 1 DT= 1.0 min
Area (ha)= 0.80
Total Imp(%)= 90.00 Dir. Conn.(%)= 45.00

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 0.72 0.08
Dep. Storage (mm)= 0.80 16.50
Average Slope (%)= 1.00 1.00
Length (m)= 73.03 40.00
Mannings n = 0.013 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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
0.017 0.00 | 1.067 8.00 | 2.117 12.95 | 3.17 5.49
0.033 0.00 | 1.083 8.00 | 2.133 12.95 | 3.18 5.05
0.050 0.00 | 1.100 8.00 | 2.150 12.95 | 3.20 5.05
0.067 0.00 | 1.117 8.00 | 2.167 12.95 | 3.22 5.05
0.083 0.00 | 1.133 8.00 | 2.183 10.31 | 3.23 5.05
0.100 0.00 | 1.150 8.00 | 2.200 10.31 | 3.25 5.05
0.117 0.00 | 1.167 8.00 | 2.217 10.31 | 3.27 5.05
0.133 0.00 | 1.183 11.51 | 2.233 10.31 | 3.28 5.05
0.150 0.00 | 1.200 11.51 | 2.250 10.31 | 3.30 5.05
0.167 0.00 | 1.217 11.51 | 2.267 10.31 | 3.32 5.05
0.183 3.58 | 1.233 11.51 | 2.283 10.31 | 3.33 5.05
0.200 3.58 | 1.250 11.51 | 2.300 10.31 | 3.35 4.70
0.217 3.58 | 1.267 11.51 | 2.317 10.31 | 3.37 4.70
0.233 3.58 | 1.283 11.51 | 2.333 10.31 | 3.38 4.70
0.250 3.58 | 1.300 11.51 | 2.350 8.66 | 3.40 4.70
0.267 3.58 | 1.317 11.51 | 2.367 8.66 | 3.42 4.70
0.283 3.58 | 1.333 11.51 | 2.383 8.66 | 3.43 4.70
0.300 3.58 | 1.350 25.32 | 2.400 8.66 | 3.45 4.70
0.317 3.58 | 1.367 25.32 | 2.417 8.66 | 3.47 4.70
0.333 3.58 | 1.383 25.32 | 2.433 8.66 | 3.48 4.70
0.350 3.99 | 1.400 25.32 | 2.450 8.66 | 3.50 4.70
0.367 3.99 | 1.417 25.32 | 2.467 8.66 | 3.52 4.39
0.383 3.99 | 1.433 25.32 | 2.483 8.66 | 3.53 4.39
0.400 3.99 | 1.450 25.32 | 2.500 8.66 | 3.55 4.39
0.417 3.99 | 1.467 25.32 | 2.517 7.52 | 3.57 4.39
0.433 3.99 | 1.483 25.32 | 2.533 7.52 | 3.58 4.39
0.450 3.99 | 1.500 25.32 | 2.550 7.52 | 3.60 4.39
0.467 3.99 | 1.517 133.60 | 2.567 7.52 | 3.62 4.39
0.483 3.99 | 1.533 133.60 | 2.583 7.52 | 3.63 4.39

0.500 3.99 | 1.550 133.60 | 2.600 7.52 | 3.65 4.39
0.517 4.50 | 1.567 133.60 | 2.617 7.52 | 3.67 4.39
0.533 4.50 | 1.583 133.60 | 2.633 7.52 | 3.68 4.14
0.550 4.50 | 1.600 133.60 | 2.650 7.52 | 3.70 4.14
0.567 4.50 | 1.617 133.60 | 2.667 7.52 | 3.72 4.14
0.583 4.50 | 1.633 133.60 | 2.683 6.65 | 3.73 4.14
0.600 4.50 | 1.650 133.60 | 2.700 6.65 | 3.75 4.14
0.617 4.50 | 1.667 133.60 | 2.717 6.65 | 3.77 4.14
0.633 4.50 | 1.683 32.01 | 2.733 6.65 | 3.78 4.14
0.650 4.50 | 1.700 32.00 | 2.750 6.65 | 3.80 4.14
0.667 4.50 | 1.717 32.00 | 2.767 6.65 | 3.82 4.14
0.683 5.21 | 1.733 32.00 | 2.783 6.65 | 3.83 4.14
0.700 5.21 | 1.750 32.00 | 2.800 6.65 | 3.85 3.91
0.717 5.21 | 1.767 32.00 | 2.817 6.65 | 3.87 3.91
0.733 5.21 | 1.783 32.00 | 2.833 6.65 | 3.88 3.91
0.750 5.21 | 1.800 32.00 | 2.850 5.38 | 3.90 3.91
0.767 5.21 | 1.817 32.00 | 2.867 5.38 | 3.92 3.91
0.783 5.21 | 1.833 32.00 | 2.883 5.38 | 3.93 3.91
0.800 5.21 | 1.850 19.73 | 2.900 5.38 | 3.95 3.91
0.817 5.21 | 1.867 19.73 | 2.917 5.38 | 3.97 3.91
0.833 5.21 | 1.883 19.73 | 2.933 5.38 | 3.98 3.91
0.850 6.27 | 1.900 19.73 | 2.950 5.38 | 4.00 3.91
0.867 6.27 | 1.917 19.73 | 2.967 5.38 | 4.02 3.63
0.883 6.27 | 1.933 19.73 | 2.983 5.38 | 4.03 3.63
0.900 6.27 | 1.950 19.73 | 3.000 5.38 | 4.05 3.63
0.917 6.27 | 1.967 19.73 | 3.017 5.49 | 4.07 3.63
0.933 6.27 | 1.983 19.73 | 3.033 5.49 | 4.08 3.63
0.950 6.27 | 2.000 19.73 | 3.050 5.49 | 4.10 3.63
0.967 6.27 | 2.017 12.95 | 3.067 5.49 | 4.12 3.63
0.983 6.27 | 2.033 12.95 | 3.083 5.49 | 4.13 3.63
1.000 6.27 | 2.050 12.95 | 3.100 5.49 | 4.15 3.63
1.017 8.00 | 2.067 12.95 | 3.117 5.49 | 4.17 3.63
1.033 8.00 | 2.083 12.95 | 3.133 5.49 |
1.050 8.00 | 2.100 12.95 | 3.150 5.49 |

Max.Eff.Inten.(mm/hr)= 133.60 428.40
over (min) 5.00 7.00
Storage Coeff. (min)= 1.88 (ii) 6.12 (ii)
Unit Hyd. Tpeak (min)= 5.00 7.00
Unit Hyd. peak (cms)= 0.38 0.18

PEAK FLOW (cms)= 0.13 0.07 0.194 (iii)
TIME TO PEAK (hrs)= 1.67 1.73 1.68
RUNOFF VOLUME (mm)= 55.28 32.57 42.78
TOTAL RAINFALL (mm)= 56.08 56.08 56.08
RUNOFF COEFFICIENT = 0.99 0.58 0.76

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

| DUHYD (0230) |
| Inlet Cap.= 0.015 |
| #of Inlets= 1 |
Total(cms)= 0.0
TOTAL HYD.(ID= 1): 0.80 0.19 1.68 42.78
=====

MAJOR SYS.(ID= 2): 0.45 0.18 1.68 42.78

MINOR SYS.(ID= 3): 0.35 0.01 1.37 42.78

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| CALIB |
| STANDHYD (0024) |
ID= 1 DT= 1.0 min
Area (ha)= 1.40
Total Imp(%)= 90.00 Dir. Conn.(%)= 45.00

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 1.26 0.14
Dep. Storage (mm)= 0.80 16.50
Average Slope (%)= 1.00 1.00
Length (m)= 96.61 40.00
Mannings n = 0.013 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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
0.017 0.00 | 1.067 8.00 | 2.117 12.95 | 3.17 5.49
0.033 0.00 | 1.083 8.00 | 2.133 12.95 | 3.18 5.05
0.050 0.00 | 1.100 8.00 | 2.150 12.95 | 3.20 5.05
0.067 0.00 | 1.117 8.00 | 2.167 12.95 | 3.22 5.05
0.083 0.00 | 1.133 8.00 | 2.183 10.31 | 3.23 5.05
0.100 0.00 | 1.150 8.00 | 2.200 10.31 | 3.25 5.05
0.117 0.00 | 1.167 8.00 | 2.217 10.31 | 3.27 5.05
0.133 0.00 | 1.183 11.51 | 2.233 10.31 | 3.28 5.05
0.150 0.00 | 1.200 11.51 | 2.250 10.31 | 3.30 5.05
0.167 0.00 | 1.217 11.51 | 2.267 10.31 | 3.32 5.05
0.183 3.58 | 1.233 11.51 | 2.283 10.31 | 3.33 5.05
0.200 3.58 | 1.250 11.51 | 2.300 10.31 | 3.35 4.70
0.217 3.58 | 1.267 11.51 | 2.317 10.31 | 3.37 4.70
0.233 3.58 | 1.283 11.51 | 2.333 10.31 | 3.38 4.70
0.250 3.58 | 1.300 11.51 | 2.350 8.66 | 3.40 4.70
0.267 3.58 | 1.317 11.51 | 2.367 8.66 | 3.42 4.70
0.283 3.58 | 1.333 11.51 | 2.383 8.66 | 3.43 4.70
0.300 3.58 | 1.350 25.32 | 2.400 8.66 | 3.45 4.70
0.317 3.58 | 1.367 25.32 | 2.417 8.66 | 3.47 4.70
0.333 3.58 | 1.383 25.32 | 2.433 8.66 | 3.48 4.70
0.350 3.99 | 1.400 25.32 | 2.450 8.66 | 3.50 4.70
0.367 3.99 | 1.417 25.32 | 2.467 8.66 | 3.52 4.39
0.383 3.99 | 1.433 25.32 | 2.483 8.66 | 3.53 4.39
0.400 3.99 | 1.450 25.32 | 2.500 8.66 | 3.55 4.39
0.417 3.99 | 1.467 25.32 | 2.517 7.52 | 3.57 4.39
0.433 3.99 | 1.483 25.32 | 2.533 7.52 | 3.58 4.39
0.450 3.99 | 1.500 25.32 | 2.550 7.52 | 3.60 4.39

0.467	3.99	1.517	133.60	2.567	7.52	3.62	4.39
0.483	3.99	1.533	133.60	2.583	7.52	3.63	4.39
0.500	3.99	1.550	133.60	2.600	7.52	3.65	4.39
0.517	4.50	1.567	133.60	2.617	7.52	3.67	4.39
0.533	4.50	1.583	133.60	2.633	7.52	3.68	4.14
0.550	4.50	1.600	133.60	2.650	7.52	3.70	4.14
0.567	4.50	1.617	133.60	2.667	7.52	3.72	4.14
0.583	4.50	1.633	133.60	2.683	6.65	3.73	4.14
0.600	4.50	1.650	133.60	2.700	6.65	3.75	4.14
0.617	4.50	1.667	133.60	2.717	6.65	3.77	4.14
0.633	4.50	1.683	32.01	2.733	6.65	3.78	4.14
0.650	4.50	1.700	32.00	2.750	6.65	3.80	4.14
0.667	4.50	1.717	32.00	2.767	6.65	3.82	4.14
0.683	5.21	1.733	32.00	2.783	6.65	3.83	4.14
0.700	5.21	1.750	32.00	2.800	6.65	3.85	3.91
0.717	5.21	1.767	32.00	2.817	6.65	3.87	3.91
0.733	5.21	1.783	32.00	2.833	6.65	3.88	3.91
0.750	5.21	1.800	32.00	2.850	5.38	3.90	3.91
0.767	5.21	1.817	32.00	2.867	5.38	3.92	3.91
0.783	5.21	1.833	32.00	2.883	5.38	3.93	3.91
0.800	5.21	1.850	19.73	2.900	5.38	3.95	3.91
0.817	5.21	1.867	19.73	2.917	5.38	3.97	3.91
0.833	5.21	1.883	19.73	2.933	5.38	3.98	3.91
0.850	6.27	1.900	19.73	2.950	5.38	4.00	3.91
0.867	6.27	1.917	19.73	2.967	5.38	4.02	3.63
0.883	6.27	1.933	19.73	2.983	5.38	4.03	3.63
0.900	6.27	1.950	19.73	3.000	5.38	4.05	3.63
0.917	6.27	1.967	19.73	3.017	5.49	4.07	3.63
0.933	6.27	1.983	19.73	3.033	5.49	4.08	3.63
0.950	6.27	2.000	19.73	3.050	5.49	4.10	3.63
0.967	6.27	2.017	12.95	3.067	5.49	4.12	3.63
0.983	6.27	2.033	12.95	3.083	5.49	4.13	3.63
1.000	6.27	2.050	12.95	3.100	5.49	4.15	3.63
1.017	8.00	2.067	12.95	3.117	5.49	4.17	3.63
1.033	8.00	2.083	12.95	3.133	5.49		
1.050	8.00	2.100	12.95	3.150	5.49		

Max.Eff.Inten.(mm/hr)= 133.60 428.40
over (min) 5.00 7.00
Storage Coeff. (min)= 2.23 (ii) 6.47 (ii)
Unit Hyd. Tpeak (min)= 5.00 7.00
Unit Hyd. peak (cms)= 0.36 0.17

PEAK FLOW (cms)= 0.23 0.12 0.335 (iii)
TIME TO PEAK (hrs)= 1.67 1.73 1.68
RUNOFF VOLUME (mm)= 55.28 32.57 42.79
TOTAL RAINFALL (mm)= 56.08 56.08 56.08
RUNOFF COEFFICIENT = 0.99 0.58 0.76

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

DUHYD (0240)				
Inlet Cap.= 0.015				
#of Inlets= 1				
Total(cms)= 0.0	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
TOTAL HYD.(ID= 1):	1.40	0.34	1.68	42.79
MAJOR SYS.(ID= 2):	0.95	0.32	1.68	42.79
MINOR SYS.(ID= 3):	0.45	0.01	1.18	42.79

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)				
1 + 2 = 3	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (0010):	37.64	1.040	1.58	12.88
+ ID2= 2 (0211):	16.02	0.280	1.67	14.34
ID = 3 (1001):	53.66	1.320	1.68	13.31

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)				
3 + 2 = 1	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 3 (1001):	53.66	1.320	1.68	13.31
+ ID2= 2 (0220):	11.82	0.020	4.63	14.58
ID = 1 (1001):	65.48	1.330	1.80	13.54

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)				
1 + 2 = 3	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (1001):	65.48	1.330	1.80	13.54
+ ID2= 2 (0230):	0.35	0.015	1.37	42.78
ID = 3 (1001):	65.83	1.345	1.80	13.70

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)				
3 + 2 = 1	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 3 (1001):	65.83	1.345	1.80	13.70
+ ID2= 2 (0240):	0.45	0.015	1.18	42.79

ID = 1 (1001): 66.28 1.360 1.80 13.90

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)				
1 + 2 = 3	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (1001):	66.28	1.360	1.80	13.90
+ ID2= 2 (0030):	16.87	1.827	1.58	34.95
ID = 3 (1001):	83.15	3.187	1.80	18.17

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB				
STANDHYD (0004)	Area	(ha)=	7.85	
ID= 1 DT= 5.0 min	Total Imp(%)=	46.00	Dir. Conn.(%)=	22.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.61	4.24
Dep. Storage (mm)=	1.00	8.10
Average Slope (%)=	1.00	2.00
Length (m)=	228.76	40.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083	0.00	1.167	8.00	2.250	10.31	3.33	5.05
0.167	0.00	1.250	11.51	2.333	10.31	3.42	4.70
0.250	3.58	1.333	11.51	2.417	8.66	3.50	4.70
0.333	3.58	1.417	25.32	2.500	8.66	3.58	4.39
0.417	3.99	1.500	25.32	2.583	7.52	3.67	4.39
0.500	3.99	1.583	133.60	2.667	7.52	3.75	4.14
0.583	4.50	1.667	133.60	2.750	6.65	3.83	4.14
0.667	4.50	1.750	32.00	2.833	6.65	3.92	3.91
0.750	5.21	1.833	32.00	2.917	5.38	4.00	3.91
0.833	5.21	1.917	19.73	3.000	5.38	4.08	3.63
0.917	6.27	2.000	19.73	3.083	5.49	4.17	3.63
1.000	6.27	2.083	12.95	3.167	5.49		
1.083	8.00	2.167	12.95	3.250	5.05		

Max.Eff.Inten.(mm/hr)= 133.60 66.82
over (min) 5.00 15.00
Storage Coeff. (min)= 3.74 (ii) 12.03 (ii)
Unit Hyd. Tpeak (min)= 5.00 15.00
Unit Hyd. peak (cms)= 0.25 0.09

PEAK FLOW (cms)= 0.60 0.43 0.808 (iii)
TIME TO PEAK (hrs)= 1.67 1.83 1.67
RUNOFF VOLUME (mm)= 55.08 21.44 28.84
TOTAL RAINFALL (mm)= 56.08 56.08 56.08
RUNOFF COEFFICIENT = 0.98 0.38 0.51

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 72.0 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.

DUHYD (0040)				
Inlet Cap.= 0.084				
#of Inlets= 1				
Total(cms)= 0.1	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
TOTAL HYD.(ID= 1):	7.85	0.81	1.67	28.84

MAJOR SYS.(ID= 2): 4.51 0.72 1.67 28.84
MINOR SYS.(ID= 3): 3.34 0.08 1.42 28.84

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1002)				
1 + 2 = 3	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (1001):	83.15	3.187	1.80	18.17
+ ID2= 2 (0040):	3.34	0.084	1.42	28.84
ID = 3 (1002):	86.49	3.271	1.80	18.58

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1003)				
1 + 2 = 3	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (1002):	86.49	3.271	1.80	18.58
+ ID2= 2 (5000):	3.43	0.016	4.25	19.30
ID = 3 (1003):	89.92	3.282	1.80	18.61

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
=====
V      V      I      SSSSS      U      U      A      L      (v 6.2.2015)
V      V      I      SS      U      U      A      A      L
V      V      I      SS      U      U      AAAAA      L
V      V      I      SS      U      U      A      A      L
      VV      I      SSSSS      UUUUU      A      A      LLLLL

      OOO      TTTT      TTTT      H      H      Y      Y      M      M      OOO      TM
      O      O      T      T      H      H      Y      Y      MM      MM      O      O
      O      O      T      T      H      H      Y      M      M      O      O
      OOO      T      T      H      H      Y      M      M      OOO

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***** D E T A I L E D O U T P U T *****

```
Input      filename: C:\Program Files (x86)\Visual OTHMMYO 6.2\VO2\vo.in.dat
Output     filename: C:\Users\Natalie\AppData\Local\Civica\VH5\Zb61f5e3-29d9-4c68-a5ec-7ff64ecb31ab\95d3c04b-817c-4704-a208-93fcb6c128c9\scen
Summary    filename: C:\Users\Natalie\AppData\Local\Civica\VH5\Zb61f5e3-29d9-4c68-a5ec-7ff64ecb31ab\95d3c04b-817c-4704-a208-93fcb6c128c9\scen
```

DATE: 10/19/2023 TIME: 03:51:47

USER:

COMMENTS: _____

```
*****
** SIMULATION : Norfolk 25yr 4hr **
*****
```

READ STORM	Filename: C:\Users\Natalie\AppData
	ata\Local\Temp\
	b7db1222-786f-4fal-9026-76a4lee37elf\5e9e153d
Ptotal= 66.10 mm	Comments: Norfolk 25yr 4hr

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	0.00	1.17	13.67	2.33	10.44	3.50	5.48
0.17	4.50	1.33	27.69	2.50	9.14	3.67	5.18
0.33	4.98	1.50	158.85	2.67	8.15	3.83	4.90
0.50	1.67	1.67	35.50	2.83	6.78	4.00	4.65
0.67	6.45	1.83	20.60	3.00	6.18		
0.83	7.70	2.00	15.24	3.17	6.27		
1.00	9.70	2.17	12.32	3.33	5.84		

```
| CALIB |
| NASHYD ( 0051) | Area (ha)= 0.60 Curve Number (CN)= 62.0
| ID= 1 DT= 5.0 min | Ia (mm)= 13.60 # of Linear Res.(N)= 3.00
|-----| U.H. Tp(hrs)= 0.14
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083	0.00	1.167	9.70	2.250	12.32	3.33	6.27
0.167	0.00	1.250	13.67	2.333	12.32	3.42	5.84
0.250	4.50	1.333	13.67	2.417	10.44	3.50	5.84
0.333	4.50	1.417	27.69	2.500	10.44	3.58	5.48
0.417	4.98	1.500	27.69	2.583	9.14	3.67	5.48
0.500	4.98	1.583	158.85	2.667	9.14	3.75	5.18
0.583	5.61	1.667	158.85	2.750	8.15	3.83	5.18
0.667	5.61	1.750	35.08	2.833	8.15	3.92	4.90
0.750	6.45	1.833	35.08	2.917	7.39	4.00	4.90
0.833	6.45	1.917	20.60	3.000	7.39	4.08	4.65
0.917	7.70	2.000	20.60	3.083	6.78	4.17	4.65
1.000	7.70	2.083	15.24	3.167	6.78		
1.083	9.70	2.167	15.24	3.250	6.27		

Unit Hyd Qpeak (cms) = 0.164

```

PEAK FLOW      (cms) = 0.026 (i)
TIME TO PEAK   (hrs) = 1.750
RUNOFF VOLUME   (mm) = 13.141
TOTAL RAINFALL  (mm) = 66.103
RUNOFF COEFFICIENT = 0.199

```

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

CALIB				
STANDHYD (0052)		Area (ha)=	2.83	
ID= 1 DT= 5.0 min		Total Imp(%)=	41.00	Dir. Conn.(%)= 20.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha) =	1.16	1.67
Dep. Storage	(mm) =	1.00	13.60
Average Slope	(%) =	1.00	2.00
Length	(m) =	137.36	40.00
Mannings n	=	0.013	0.250

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

--- TRANSFORMED HYPOTGRAPH ---							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	1.167	9.70	2.250	12.32	3.33	6.27
0.167	0.00	1.250	13.67	2.333	12.32	3.42	5.84
0.250	4.50	1.333	13.67	2.417	10.44	3.50	5.84
0.333	4.50	1.417	27.69	2.500	10.44	3.58	5.48
0.417	4.98	1.500	27.69	2.583	9.14	3.67	5.48
0.500	4.98	1.583	158.85	2.667	9.14	3.75	5.18
0.583	5.61	1.667	158.85	2.750	8.15	3.83	5.18
0.667	5.61	1.750	35.08	2.833	8.15	3.92	4.90
0.750	6.45	1.833	35.08	2.917	7.39	4.00	4.90
0.833	6.45	1.917	20.60	3.000	7.39	4.08	4.65
0.917	7.70	2.000	20.60	3.083	6.78	4.17	4.65
1.000	7.70	2.083	15.24	3.167	6.78		
1.083	9.70	2.167	15.24	3.250	6.27		

Max.Eff.Inten.(mm/hr)=	158.85	49.27	
over (min)	5.00	15.00	
Storage Coeff. (min)	2.57 (ii)	11.94 (ii)	
Unit Hyd. Tpeak (min)	5.00	15.00	
Unit Hyd. peak (cms)	0.29	0.09	
			TOTALS
PEAK FLOW (cms)	0.25	0.13	0.299 (iii)
TIME TO PEAK (hrs)	1.67	1.83	1.67
RUNOFF VOLUME (mm)	65.10	18.40	27.74
TOTAL RAINFALL (mm)	66.10	66.10	66.10
RUNOFF COEFFICIENT	0.98	0.28	0.42

```
***** 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* = 62.0 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 (0050)		Area (ha)=	1.52	
ID= 1 DT= 5.0 min		Total Imp(%)=	48.00	Dir. Conn.(%)= 21.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha) =	0.73	0.79
Dep. Storage (mm) =	1.00	13.60
Average Slope (%) =	1.00	2.00
Length (m) =	100.66	40.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083	0.00	1.167	9.70	2.250	12.32	3.33	6.27
0.167	0.00	1.250	13.67	2.333	12.32	3.42	5.84
0.250	4.50	1.333	13.67	2.417	10.44	3.50	5.84
0.333	4.50	1.417	27.69	2.500	10.44	3.58	5.48
0.417	4.98	1.500	27.69	2.583	9.14	3.67	5.48
0.500	4.98	1.583	158.85	2.667	9.14	3.75	5.18
0.583	5.61	1.667	158.85	2.750	8.15	3.83	5.18
0.667	5.61	1.750	35.08	2.833	8.15	3.92	4.90
0.750	6.45	1.833	35.08	2.917	7.39	4.00	4.90
0.833	6.45	1.917	20.60	3.000	7.39	4.08	4.65
0.917	7.70	2.000	20.60	3.083	6.78	4.17	4.65
1.000	7.70	2.083	15.24	3.167	6.78		
1.083	9.70	2.167	15.24	3.250	6.27		

Max.Eff.Inten.(mm/hr)=	158.85	63.61	
over (min)	5.00	15.00	
Storage Coeff. (min)=	2.13 (ii)	10.59 (ii)	
Unit Hyd. Tpeak (min)=	5.00	15.00	
Unit Hyd. peak (cms)=	0.31	0.09	
			TOTALS
PEAK FLOW (cms)=	0.14	0.08	0.176 (iii)
TIME TO PEAK (hrs)=	1.67	1.83	1.67
RUNOFF VOLUME (mm)	65.10	20.46	29.83
TOTAL RAINFALL (mm)	66.10	66.10	66.10
RUNOFF COEFFICIENT =	0.98	0.31	0.45

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

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 62.0 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.

```
| CHAMBER( 0053) | OUTFLOW: OFF, UNDERDRAIN: OFF, INFIL: ON
| IN= 2--> OUT= 3 | CHAMBER:
| DT= 5.0 min | MAX STO VOL (cu.m.)= 540.00 Bottom Area(m2) = 500.00
```

DEPTH (mm)	STORAGE (cu. m.)	DEPTH (mm)	STORAGE (cu. m.)
0 00	0 00	800 00	288 00
100 00	36 00	900 00	324 00
200 00	72 00	1000 00	360 00
300 00	108 00	1100 00	396 00
400 00	144 00	1200 00	432 00
500 00	180 00	1300 00	468 00
600 00	216 00	1400 00	504 00
700 00	252 00	1500 00	540 00

NATIVE SOIL LAYER:
Infiltration (m/hr) = 0.0250

```

AREA      QPEAK      TPEAK      R.V.
(ha)      (cms)      (hrs)      (mm)
INFLOW:ID= 2      1.52      0.176      1.67      29.83
OVERFLOW:ID= 3      0.00      0.000      0.00      0.00

Volume Reduction Rate[(RVin-RVout)/RVin] (%)=      100.00
Time to reach Max storage (Hr)=      4.42
Volume of water for drawdown in LID (cu.m.)=      394.66
Volume of maximum water storage (cu.m.)=      400.95
Calculated Drawdown Time (Hr)=      31.50

-----
| Junction Command(0054) |
-----

AREA      QPEAK      TPEAK      R.V.
(ha)      (cms)      (hrs)      (mm)
INFLOW : ID= 3( 0053)      0.00      0.00      0.00      0.00
OUTFLOW: ID= 2( 0054)      0.00      0.00      0.00      0.00

-----

-----
| ADD HYD ( 0055) |
| 1 + 2 = 3 |
-----
AREA      QPEAK      TPEAK      R.V.
(ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0051):      0.60      0.026      1.75      13.14
+ ID2= 2 ( 0052):      2.83      0.299      1.67      27.74
=====
ID = 3 ( 0055):      3.43      0.320      1.67      25.18

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-----

| ADD HYD ( 0055) |
| 3 + 2 = 1 |
-----
AREA      QPEAK      TPEAK      R.V.
(ha)      (cms)      (hrs)      (mm)
*** W A R N I N G : HYDROGRAPH 0054 <ID= 2> IS DRY.
*** W A R N I N G : HYDROGRAPH 0001 = HYDROGRAPH 0003
ID1= 3 ( 0055):      3.43      0.320      1.67      25.18
+ ID2= 2 ( 0054):      0.00      0.000      0.00      0.00
=====
ID = 1 ( 0055):      3.43      0.320      1.67      25.18

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-----

| RESERVOIR( 5000) |
| IN= 2--> OUT= 1 |
| DT= 5.0 min |
-----
OVERFLOW IS ON
OUTFLOW      STORAGE      |      OUTFLOW      STORAGE
(cms)      (ha.m.)      |      (cms)      (ha.m.)
0.0000      0.0000      |      0.0177      0.0628
0.0049      0.0070      |      0.0190      0.0745
0.0085      0.0147      |      0.0202      0.0868
0.0110      0.0230      |      0.0214      0.0999
0.0130      0.0320      |      0.0225      0.1136
0.0147      0.0416      |      0.0235      0.1281
0.0163      0.0519      |      0.0000      0.0000

AREA      QPEAK      TPEAK      R.V.
(ha)      (cms)      (hrs)      (mm)
INFLOW : ID= 2 ( 0055)      3.430      0.320      1.67      25.18
OUTFLOW: ID= 1 ( 5000)      3.430      0.018      4.25      25.16
OVERFLOW:ID= 3 ( 0003)      0.000      0.000      0.00      0.00

TOTAL NUMBER OF SIMULATION OVERFLOW =      0
CUMULATIVE TIME OF OVERFLOW (HOURS) =      0.00
PERCENTAGE OF TIME OVERFLOWING (%) =      0.00

PEAK FLOW REDUCTION [Qout/Qin] (%) =      5.74
TIME SHIFT OF PEAK FLOW (min)=155.00
MAXIMUM STORAGE USED (ha.m.)= 0.0685

-----

| CALIB |
| STANDHYD ( 0001) |
| ID= 1 DT= 1.0 min |
-----
Area (ha)= 41.00
Total Imp(%)= 30.00 Dir. Conn.(%)= 15.00

IMPERVIOUS      PERVIOUS (i)
Surface Area (ha)= 12.30      28.70
Dep. Storage (mm)= 0.80      23.90
Average Slope (%)= 2.00      2.00
Length (m)= 522.81      40.00
Mannings n = 0.013      0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 MIN. TIME STEP.

-----
TIME      RAIN | TIME      RAIN | TIME      RAIN | TIME      RAIN
hrs      mm/hr | hrs      mm/hr | ' hrs      mm/hr | hrs      mm/hr
0.017      0.00 | 1.067      9.70 | 2.117      15.24 | 3.17      6.78
0.033      0.00 | 1.083      9.70 | 2.133      15.24 | 3.18      6.27
0.050      0.00 | 1.100      9.70 | 2.150      15.24 | 3.20      6.27
0.067      0.00 | 1.117      9.70 | 2.167      15.24 | 3.22      6.27
0.083      0.00 | 1.133      9.70 | 2.183      12.32 | 3.23      6.27
0.100      0.00 | 1.150      9.70 | 2.200      12.32 | 3.25      6.27
0.117      0.00 | 1.167      9.70 | 2.217      12.32 | 3.27      6.27
0.133      0.00 | 1.183      13.67 | 2.233      12.32 | 3.28      6.27
0.150      0.00 | 1.200      13.67 | 2.250      12.32 | 3.30      6.27
0.167      0.00 | 1.217      13.67 | 2.267      12.32 | 3.32      6.27
0.183      4.50 | 1.233      13.67 | 2.283      12.32 | 3.33      6.27
0.200      4.50 | 1.250      13.67 | 2.300      12.32 | 3.35      5.84
0.217      4.50 | 1.267      13.67 | 2.317      12.32 | 3.37      5.84
0.233      4.50 | 1.283      13.67 | 2.333      12.32 | 3.38      5.84
0.250      4.50 | 1.300      13.67 | 2.350      10.44 | 3.40      5.84
0.267      4.50 | 1.317      13.67 | 2.367      10.44 | 3.42      5.84
0.283      4.50 | 1.333      13.67 | 2.383      10.44 | 3.43      5.84
0.300      4.50 | 1.350      27.69 | 2.400      10.44 | 3.45      5.84
0.317      4.50 | 1.367      27.69 | 2.417      10.44 | 3.47      5.84
0.333      4.50 | 1.383      27.69 | 2.433      10.44 | 3.48      5.84

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0.350      4.98 | 1.400      27.69 | 2.450      10.44 | 3.50      5.84
0.367      4.98 | 1.417      27.69 | 2.467      10.44 | 3.52      5.48
0.383      4.98 | 1.433      27.69 | 2.483      10.44 | 3.53      5.48
0.400      4.98 | 1.450      27.69 | 2.500      10.44 | 3.55      5.48
0.417      4.98 | 1.467      27.69 | 2.517      9.14      3.57      5.48
0.433      4.98 | 1.483      27.69 | 2.533      9.14      3.58      5.48
0.450      4.98 | 1.500      27.69 | 2.550      9.14      3.60      5.48
0.467      4.98 | 1.517      158.84 | 2.567      9.14      3.62      5.48
0.483      4.98 | 1.533      158.85 | 2.583      9.14      3.63      5.48
0.500      4.98 | 1.550      158.85 | 2.600      9.14      3.65      5.48
0.517      5.61 | 1.567      158.85 | 2.617      9.14      3.67      5.48
0.533      5.61 | 1.583      158.85 | 2.633      9.14      3.68      5.18
0.550      5.61 | 1.600      158.85 | 2.650      9.14      3.70      5.18
0.567      5.61 | 1.617      158.85 | 2.667      9.14      3.72      5.18
0.583      5.61 | 1.633      158.85 | 2.683      8.15      3.73      5.18
0.600      5.61 | 1.650      158.85 | 2.700      8.15      3.75      5.18
0.617      5.61 | 1.667      158.85 | 2.717      8.15      3.77      5.18
0.633      5.61 | 1.683      35.09 | 2.733      8.15      3.78      5.18
0.650      5.61 | 1.700      35.08 | 2.750      8.15      3.80      5.18
0.667      5.61 | 1.717      35.08 | 2.767      8.15      3.82      5.18
0.683      6.45 | 1.733      35.08 | 2.783      8.15      3.83      5.18
0.700      6.45 | 1.750      35.08 | 2.800      8.15      3.85      4.90
0.717      6.45 | 1.767      35.08 | 2.817      8.15      3.87      4.90
0.733      6.45 | 1.783      35.08 | 2.833      8.15      3.88      4.90
0.750      6.45 | 1.800      35.08 | 2.850      7.39      3.90      4.90
0.767      6.45 | 1.817      35.08 | 2.867      7.39      3.92      4.90
0.783      6.45 | 1.833      35.08 | 2.883      7.39      3.93      4.90
0.800      6.45 | 1.850      20.60 | 2.900      7.39      3.95      4.90
0.817      6.45 | 1.867      20.60 | 2.917      7.39      3.97      4.90
0.833      6.45 | 1.883      20.60 | 2.933      7.39      3.98      4.90
0.850      7.70 | 1.900      20.60 | 2.950      7.39      4.00      4.90
0.867      7.70 | 1.917      20.60 | 2.967      7.39      4.02      4.65
0.883      7.70 | 1.933      20.60 | 2.983      7.39      4.03      4.65
0.900      7.70 | 1.950      20.60 | 3.000      7.39      4.05      4.65
0.917      7.70 | 1.967      20.60 | 3.017      6.78      4.07      4.65
0.933      7.70 | 1.983      20.60 | 3.033      6.78      4.08      4.65
0.950      7.70 | 2.000      20.60 | 3.050      6.78      4.10      4.65
0.967      7.70 | 2.017      15.24 | 3.067      6.78      4.12      4.65
0.983      7.70 | 2.033      15.24 | 3.083      6.78      4.13      4.65
1.000      7.70 | 2.050      15.24 | 3.100      6.78      4.15      4.65
1.017      9.70 | 2.067      15.24 | 3.117      6.78      4.17      4.65
1.033      9.70 | 2.083      15.24 | 3.133      6.78      |
1.050      9.70 | 2.100      15.24 | 3.150      6.78      |

Max.Eff.Inten.(mm/hr)=      158.85      12.28
over (min) =      5.00      21.00
Storage Coeff. (min)=      4.65 (ii)      20.98 (ii)
Unit Hyd. Tpeak (min)=      5.00      21.00
Unit Hyd. peak (cms)=      0.24      0.05

PEAK FLOW (cms)=      2.29      0.49      *TOTALS*
TIME TO PEAK (hrs)=      1.68      2.08      2,356 (iii)
RUNOFF VOLUME (mm)=      65.30      8.43      16.96
TOTAL RAINFALL (mm)=      66.10      66.10      66.10
RUNOFF COEFFICIENT =      0.99      0.13      0.26

***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 50.0 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.

-----

| DUHYD ( 0010) |
| Inlet Cap.= 1.040 |
| #of Inlets= 1 |
| Total(cms)= 1.0 |
-----
AREA      QPEAK      TPEAK      R.V.
(ha)      (cms)      (hrs)      (mm)
TOTAL HYD.(ID= 1):      41.00      2.36      1.68      16.96
=====
MAJOR SYS.(ID= 2):      4.56      1.32      1.68      16.96
MINOR SYS.(ID= 3):      36.44      1.04      1.57      16.96

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-----

| CALIB |
| STANDHYD ( 0022) |
| ID= 1 DT= 1.0 min |
-----
Area (ha)= 11.82
Total Imp(%)= 47.00 Dir. Conn.(%)= 22.00

IMPERVIOUS      PERVIOUS (i)
Surface Area (ha)= 5.56      6.26
Dep. Storage (mm)= 0.80      16.50
Average Slope (%)= 1.00      1.00
Length (m)= 280.71      40.00
Mannings n = 0.013      0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 MIN. TIME STEP.

-----
TIME      RAIN | TIME      RAIN | TIME      RAIN | TIME      RAIN
hrs      mm/hr | hrs      mm/hr | ' hrs      mm/hr | hrs      mm/hr
0.017      0.00 | 1.067      9.70 | 2.117      15.24 | 3.17      6.78
0.033      0.00 | 1.083      9.70 | 2.133      15.24 | 3.18      6.27
0.050      0.00 | 1.100      9.70 | 2.150      15.24 | 3.20      6.27
0.067      0.00 | 1.117      9.70 | 2.167      15.24 | 3.22      6.27
0.083      0.00 | 1.133      9.70 | 2.183      12.32 | 3.23      6.27
0.100      0.00 | 1.150      9.70 | 2.200      12.32 | 3.25      6.27
0.117      0.00 | 1.167      9.70 | 2.217      12.32 | 3.27      6.27
0.133      0.00 | 1.183      13.67 | 2.233      12.32 | 3.28      6.27
0.150      0.00 | 1.200      13.67 | 2.250      12.32 | 3.30      6.27
0.167      0.00 | 1.217      13.67 | 2.267      12.32 | 3.32      6.27
0.183      4.50 | 1.233      13.67 | 2.283      12.32 | 3.33      6.27
0.200      4.50 | 1.250      13.67 | 2.300      12.32 | 3.35      5.84
0.217      4.50 | 1.267      13.67 | 2.317      12.32 | 3.37      5.84
0.233      4.50 | 1.283      13.67 | 2.333      12.32 | 3.38      5.84
0.250      4.50 | 1.300      13.67 | 2.350      10.44 | 3.40      5.84
0.267      4.50 | 1.317      13.67 | 2.367      10.44 | 3.42      5.84
0.283      4.50 | 1.333      13.67 | 2.383      10.44 | 3.43      5.84
0.300      4.50 | 1.350      27.69 | 2.400      10.44 | 3.45      5.84
0.317      4.50 | 1.367      27.69 | 2.417      10.44 | 3.47      5.84
0.333      4.50 | 1.383      27.69 | 2.433      10.44 | 3.48      5.84

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0.283	4.50	1.333	13.67	2.383	10.44	3.43	5.84
0.300	4.50	1.350	27.69	2.400	10.44	3.45	5.84
0.317	4.50	1.367	27.69	2.417	10.44	3.47	5.84
0.333	4.50	1.383	27.69	2.433	10.44	3.48	5.84
0.350	4.98	1.400	27.69	2.450	10.44	3.50	5.84
0.367	4.98	1.417	27.69	2.467	10.44	3.52	5.48
0.383	4.98	1.433	27.69	2.483	10.44	3.53	5.48
0.400	4.98	1.450	27.69	2.500	10.44	3.55	5.48
0.417	4.98	1.467	27.69	2.517	9.14	3.57	5.48
0.433	4.98	1.483	27.69	2.533	9.14	3.58	5.48
0.450	4.98	1.500	27.69	2.550	9.14	3.60	5.48
0.467	4.98	1.517	158.84	2.567	9.14	3.62	5.48
0.483	4.98	1.533	158.85	2.583	9.14	3.63	5.48
0.500	4.98	1.550	158.85	2.600	9.14	3.65	5.48
0.517	5.61	1.567	158.85	2.617	9.14	3.67	5.48
0.533	5.61	1.583	158.85	2.633	9.14	3.68	5.18
0.550	5.61	1.600	158.85	2.650	9.14	3.70	5.18
0.567	5.61	1.617	158.85	2.667	9.14	3.72	5.18
0.583	5.61	1.633	158.85	2.683	8.15	3.73	5.18
0.600	5.61	1.650	158.85	2.700	8.15	3.75	5.18
0.617	5.61	1.667	158.85	2.717	8.15	3.77	5.18
0.633	5.61	1.683	35.09	2.733	8.15	3.78	5.18
0.650	5.61	1.700	35.08	2.750	8.15	3.80	5.18
0.667	5.61	1.717	35.08	2.767	8.15	3.82	5.18
0.683	6.45	1.733	35.08	2.783	8.15	3.83	5.18
0.700	6.45	1.750	35.08	2.800	8.15	3.85	4.90
0.717	6.45	1.767	35.08	2.817	8.15	3.87	4.90
0.733	6.45	1.783	35.08	2.833	8.15	3.88	4.90
0.750	6.45	1.800	35.08	2.850	7.39	3.90	4.90
0.767	6.45	1.817	35.08	2.867	7.39	3.92	4.90
0.783	6.45	1.833	35.08	2.883	7.39	3.93	4.90
0.800	6.45	1.850	20.60	2.900	7.39	3.95	4.90
0.817	6.45	1.867	20.60	2.917	7.39	3.97	4.90
0.833	6.45	1.883	20.60	2.933	7.39	3.98	4.90
0.850	7.70	1.900	20.60	2.950	7.39	4.00	4.90
0.867	7.70	1.917	20.60	2.967	7.39	4.02	4.65
0.883	7.70	1.933	20.60	2.983	7.39	4.03	4.65
0.900	7.70	1.950	20.60	3.000	7.39	4.05	4.65
0.917	7.70	1.967	20.60	3.017	6.78	4.07	4.65
0.933	7.70	1.983	20.60	3.033	6.78	4.08	4.65
0.950	7.70	2.000	20.60	3.050	6.78	4.10	4.65
0.967	7.70	2.017	15.24	3.067	6.78	4.12	4.65
0.983	7.70	2.033	15.24	3.083	6.78	4.13	4.65
1.000	7.70	2.050	15.24	3.100	6.78	4.15	4.65
1.017	9.70	2.067	15.24	3.117	6.78	4.17	4.65
1.033	9.70	2.083	15.24	3.133	6.78		
1.050	9.70	2.100	15.24	3.150	6.78		

Max.Eff.Inten.(mm/hr)= 158.85 40.60
over (min) 5.00 17.00
Storage Coeff. (min)= 3.94 (ii) 16.41 (ii)
Unit Hyd. Tpeak (min)= 5.00 17.00
Unit Hyd. peak (cms)= 0.26 0.07

TOTALS
PEAK FLOW (cms)= 1.01 0.37 1.112 (iii)
TIME TO PEAK (hrs)= 1.68 1.92 1.68
RUNOFF VOLUME (mm)= 65.30 16.75 27.43
TOTAL RAINFALL (mm)= 66.10 66.10 66.10
RUNOFF COEFFICIENT = 0.99 0.25 0.41

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

RESERVOIR (0220)				
IN= 2---> OUT= 1				
DT= 1.0 min				
OVERFLOW IS OFF				
OUTFLOW STORAGE OUTFLOW STORAGE				
(cms) (ha.m.) (cms) (ha.m.)				
0.0000 0.0000 0.0251 0.3540				
0.0066 0.0550 0.0273 0.4180				
0.0127 0.1120 0.0294 0.4840				
0.0167 0.1700 0.0313 0.5510				
0.0199 0.2300 0.0332 0.6200				
0.0226 0.2910 0.0000 0.0000				
AREA QPEAK TPEAK R.V.				
(ha) (cms) (hrs) (mm)				
INFLOW : ID= 2 (0022) 11.820 1.112 1.68 27.43				
OUTFLOW: ID= 1 (0220) 11.820 0.023 4.62 17.64				

PEAK FLOW REDUCTION [Qout/Qin](%)= 2.07
TIME SHIFT OF PEAK FLOW (min)=176.00
MAXIMUM STORAGE USED (ha.m.)= 0.3001

CALIB |
STANDHYD (0003) | Area (ha)= 19.20
ID= 1 DT= 1.0 min | Total Imp(%)= 80.00 Dir. Conn.(%)= 50.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	15.36	3.84
Dep. Storage	(mm)=	0.80	23.90
Average Slope	(%)=	2.00	2.00
Length	(m)=	357.77	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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
0.017	0.00	1.067	9.70	2.117	15.24	3.17	6.78
0.033	0.00	1.083	9.70	2.133	15.24	3.18	6.27
0.050	0.00	1.100	9.70	2.150	15.24	3.20	6.27
0.067	0.00	1.117	9.70	2.167	15.24	3.22	6.27
0.083	0.00	1.133	9.70	2.183	12.32	3.23	6.27
0.100	0.00	1.150	9.70	2.200	12.32	3.25	6.27

0.117	0.00	1.167	9.70	2.217	12.32	3.27	6.27
0.133	0.00	1.183	13.67	2.233	12.32	3.28	6.27
0.150	0.00	1.200	13.67	2.250	12.32	3.30	6.27
0.167	0.00	1.217	13.67	2.267	12.32	3.32	6.27
0.183	4.50	1.233	13.67	2.283	12.32	3.33	6.27
0.200	4.50	1.250	13.67	2.300	12.32	3.35	5.84
0.217	4.50	1.267	13.67	2.317	12.32	3.37	5.84
0.233	4.50	1.283	13.67	2.333	12.32	3.38	5.84
0.250	4.50	1.300	13.67	2.350	10.44	3.40	5.84
0.267	4.50	1.317	13.67	2.367	10.44	3.42	5.84
0.283	4.50	1.333	13.67	2.383	10.44	3.43	5.84
0.300	4.50	1.350	27.69	2.400	10.44	3.45	5.84
0.317	4.50	1.367	27.69	2.417	10.44	3.47	5.84
0.333	4.50	1.383	27.69	2.433	10.44	3.48	5.84
0.350	4.98	1.400	27.69	2.450	10.44	3.50	5.84
0.367	4.98	1.417	27.69	2.467	10.44	3.52	5.48
0.383	4.98	1.433	27.69	2.483	10.44	3.53	5.48
0.400	4.98	1.450	27.69	2.500	10.44	3.55	5.48
0.417	4.98	1.467	27.69	2.517	9.14	3.57	5.48
0.433	4.98	1.483	27.69	2.533	9.14	3.58	5.48
0.450	4.98	1.500	27.69	2.550	9.14	3.60	5.48
0.467	4.98	1.517	158.84	2.567	9.14	3.62	5.48
0.483	4.98	1.533	158.85	2.583	9.14	3.63	5.48
0.500	4.98	1.550	158.85	2.600	9.14	3.65	5.48
0.517	5.61	1.567	158.85	2.617	9.14	3.67	5.48
0.533	5.61	1.583	158.85	2.633	9.14	3.68	5.18
0.550	5.61	1.600	158.85	2.650	9.14	3.70	5.18
0.567	5.61	1.617	158.85	2.667	9.14	3.72	5.18
0.583	5.61	1.633	158.85	2.683	8.15	3.73	5.18
0.600	5.61	1.650	158.85	2.700	8.15	3.75	5.18
0.617	5.61	1.667	158.85	2.717	8.15	3.77	5.18
0.633	5.61	1.683	35.09	2.733	8.15	3.78	5.18
0.650	5.61	1.700	35.08	2.750	8.15	3.80	5.18
0.667	5.61	1.717	35.08	2.767	8.15	3.82	5.18
0.683	6.45	1.733	35.08	2.783	8.15	3.83	5.18
0.700	6.45	1.750	35.08	2.800	8.15	3.85	4.90
0.717	6.45	1.767	35.08	2.817	8.15	3.87	4.90
0.733	6.45	1.783	35.08	2.833	8.15	3.88	4.90
0.750	6.45	1.800	35.08	2.850	7.39	3.90	4.90
0.767	6.45	1.817	35.08	2.867	7.39	3.92	4.90
0.783	6.45	1.833	35.08	2.883	7.39	3.93	4.90
0.800	6.45	1.850	20.60	2.900	7.39	3.95	4.90
0.817	6.45	1.867	20.60	2.917	7.39	3.97	4.90
0.833	6.45	1.883	20.60	2.933	7.39	3.98	4.90
0.850	7.70	1.900	20.60	2.950	7.39	4.00	4.90
0.867	7.70	1.917	20.60	2.967	7.39	4.02	4.65
0.883	7.70	1.933	20.60	2.983	7.39	4.03	4.65
0.900	7.70	1.950	20.60	3.000	7.39	4.05	4.65
0.917	7.70	1.967	20.60	3.017	6.78	4.07	4.65
0.933	7.70	1.983	20.60	3.033	6.78	4.08	4.65
0.950	7.70	2.000	20.60	3.050	6.78	4.10	4.65
0.967	7.70	2.017	15.24	3.067	6.78	4.12	4.65
0.983	7.70	2.033	15.24	3.083	6.78	4.13	4.65
1.000	7.70	2.050	15.24	3.100	6.78	4.15	4.65
1.017	9.70	2.067	15.24	3.117	6.78	4.17	4.65
1.033	9.70	2.083	15.24	3.133	6.78		
1.050	9.70	2.100	15.24	3.150	6.78		

Max.Eff.Inten.(mm/hr)= 158.85 102.32
over (min) 5.00 8.00
Storage Coeff. (min)= 3.71 (ii) 7.77 (ii)
Unit Hyd. Tpeak (min)= 5.00 8.00
Unit Hyd. peak (cms)= 0.27 0.14

TOTALS
PEAK FLOW (cms)= 3.77 0.77 4.348 (iii)
TIME TO PEAK (hrs)= 1.68 1.77 1.68
RUNOFF VOLUME (mm)= 65.30 20.22 42.76
TOTAL RAINFALL (mm)= 66.10 66.10 66.10
RUNOFF COEFFICIENT = 0.99 0.31 0.65

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 50.0 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.

DUHYD (0030)				
Inlet Cap.= 1.827				
#of Inlets= 1				
Total(cms)= 1.8				

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
TOTAL HYD. (ID= 1):	19.20	4.35	1.68	42.76
=====				
MAJOR SYS. (ID= 2):	3.32	2.52	1.68	42.76
MINOR SYS. (ID= 3):	15.88	1.83	1.57	42.76

0.417 4.98 | 1.500 27.69 | 2.583 9.14 | 3.67 5.48
0.500 4.98 | 1.583 158.85 | 2.667 9.14 | 3.75 5.18
0.583 5.61 | 1.667 158.85 | 2.750 8.15 | 3.83 5.18
0.667 5.61 | 1.750 35.08 | 2.833 8.15 | 3.92 4.90
0.750 6.45 | 1.833 35.08 | 2.917 7.39 | 4.00 4.90
0.833 6.45 | 1.917 20.60 | 3.000 7.39 | 4.08 4.65
0.917 7.70 | 2.000 20.60 | 3.083 6.78 | 4.17 4.65
1.000 7.70 | 2.083 15.24 | 3.167 6.78 |
1.083 9.70 | 2.167 15.24 | 3.250 6.27 |

Max.Eff.Inten.(mm/hr)= 158.85 17.58
over (min) 5.00 20.00
Storage Coeff. (min)= 3.57 (ii) 17.71 (ii)
Unit Hyd. Tpeak (min)= 5.00 20.00
Unit Hyd. peak (cms)= 0.26 0.06

TOTALS
PEAK FLOW (cms)= 1.13 0.27 1.192 (iii)
TIME TO PEAK (hrs)= 1.67 1.92 1.67
RUNOFF VOLUME (mm)= 65.30 9.95 18.81
TOTAL RAINFALL (mm)= 66.10 66.10 66.10
RUNOFF COEFFICIENT = 0.99 0.15 0.28

***** 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* = 50.0 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.

| RESERVOIR(0210) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
DT= 5.0 min
OUTFLOW STORAGE | OUTFLOW STORAGE
(cms) (ha.m.) | (cms) (ha.m.)
0.0000 0.0000 | 0.3900 0.0820
0.0200 0.0000 | 0.4300 0.1090
0.0800 0.0020 | 0.5800 0.2670
0.2100 0.0160 | 0.6360 0.3420
0.3000 0.0330 | 0.0000 0.0000

AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW : ID= 2 (0021) 16.900 1.192 1.67 18.81
OUTFLOW: ID= 1 (0210) 16.900 0.373 2.17 18.81

PEAK FLOW REDUCTION [Qout/Qin](%)= 31.33
TIME SHIFT OF PEAK FLOW (min)= 30.00
MAXIMUM STORAGE USED (ha.m.)= 0.0732

| DUHYD (0211) |
| Inlet Cap.= 0.280 |
| #of Inlets= 1 |
Total(cms)= 0.3
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
TOTAL HYD. (ID= 1): 16.90 0.37 2.17 18.81
=====

MAJOR SYS. (ID= 2): 2.05 0.09 2.17 18.81
MINOR SYS. (ID= 3): 14.85 0.28 1.67 18.81

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| CALIB |
| STANDHYD (0023) | Area (ha)= 0.80
| ID= 1 DT= 1.0 min | Total Imp(%)= 90.00 Dir. Conn.(%)= 45.00

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 0.72 0.08
Dep. Storage (mm)= 0.80 16.50
Average Slope (%)= 1.00 1.00
Length (m)= 73.03 40.00
Mannings n = 0.013 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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
0.017 0.00 | 1.067 9.70 | 2.117 15.24 | 3.17 6.78
0.033 0.00 | 1.083 9.70 | 2.133 15.24 | 3.18 6.27
0.050 0.00 | 1.100 9.70 | 2.150 15.24 | 3.20 6.27
0.067 0.00 | 1.117 9.70 | 2.167 15.24 | 3.22 6.27
0.083 0.00 | 1.133 9.70 | 2.183 12.32 | 3.23 6.27
0.100 0.00 | 1.150 9.70 | 2.200 12.32 | 3.25 6.27
0.117 0.00 | 1.167 9.70 | 2.217 12.32 | 3.27 6.27
0.133 0.00 | 1.183 13.67 | 2.233 12.32 | 3.28 6.27
0.150 0.00 | 1.200 13.67 | 2.250 12.32 | 3.30 6.27
0.167 0.00 | 1.217 13.67 | 2.267 12.32 | 3.32 6.27
0.183 4.50 | 1.233 13.67 | 2.283 12.32 | 3.33 6.27
0.200 4.50 | 1.250 13.67 | 2.300 12.32 | 3.35 5.84
0.217 4.50 | 1.267 13.67 | 2.317 12.32 | 3.37 5.84
0.233 4.50 | 1.283 13.67 | 2.333 12.32 | 3.38 5.84
0.250 4.50 | 1.300 13.67 | 2.350 10.44 | 3.40 5.84
0.267 4.50 | 1.317 13.67 | 2.367 10.44 | 3.42 5.84
0.283 4.50 | 1.333 13.67 | 2.383 10.44 | 3.43 5.84
0.300 4.50 | 1.350 27.69 | 2.400 10.44 | 3.45 5.84
0.317 4.50 | 1.367 27.69 | 2.417 10.44 | 3.47 5.84
0.333 4.50 | 1.383 27.69 | 2.433 10.44 | 3.48 5.84
0.350 4.98 | 1.400 27.69 | 2.450 10.44 | 3.50 5.84
0.367 4.98 | 1.417 27.69 | 2.467 10.44 | 3.52 5.48
0.383 4.98 | 1.433 27.69 | 2.483 10.44 | 3.53 5.48
0.400 4.98 | 1.450 27.69 | 2.500 10.44 | 3.55 5.48
0.417 4.98 | 1.467 27.69 | 2.517 9.14 | 3.57 5.48
0.433 4.98 | 1.483 27.69 | 2.533 9.14 | 3.58 5.48
0.450 4.98 | 1.500 27.69 | 2.550 9.14 | 3.60 5.48
0.467 4.98 | 1.517 158.84 | 2.567 9.14 | 3.62 5.48

0.483 4.98 | 1.533 158.85 | 2.583 9.14 | 3.63 5.48
0.500 4.98 | 1.550 158.85 | 2.600 9.14 | 3.65 5.48
0.517 5.61 | 1.567 158.85 | 2.617 9.14 | 3.67 5.48
0.533 5.61 | 1.583 158.85 | 2.633 9.14 | 3.68 5.18
0.550 5.61 | 1.600 158.85 | 2.650 9.14 | 3.70 5.18
0.567 5.61 | 1.617 158.85 | 2.667 9.14 | 3.72 5.18
0.583 5.61 | 1.633 158.85 | 2.683 8.15 | 3.73 5.18
0.600 5.61 | 1.650 158.85 | 2.700 8.15 | 3.75 5.18
0.617 5.61 | 1.667 158.85 | 2.717 8.15 | 3.77 5.18
0.633 5.61 | 1.683 35.09 | 2.733 8.15 | 3.78 5.18
0.650 5.61 | 1.700 35.08 | 2.750 8.15 | 3.80 5.18
0.667 5.61 | 1.717 35.08 | 2.767 8.15 | 3.82 5.18
0.683 6.45 | 1.733 35.08 | 2.783 8.15 | 3.83 5.18
0.700 6.45 | 1.750 35.08 | 2.800 8.15 | 3.85 4.90
0.717 6.45 | 1.767 35.08 | 2.817 8.15 | 3.87 4.90
0.733 6.45 | 1.783 35.08 | 2.833 8.15 | 3.88 4.90
0.750 6.45 | 1.800 35.08 | 2.850 7.39 | 3.90 4.90
0.767 6.45 | 1.817 35.08 | 2.867 7.39 | 3.92 4.90
0.783 6.45 | 1.833 35.08 | 2.883 7.39 | 3.93 4.90
0.800 6.45 | 1.850 20.60 | 2.900 7.39 | 3.95 4.90
0.817 6.45 | 1.867 20.60 | 2.917 7.39 | 3.97 4.90
0.833 6.45 | 1.883 20.60 | 2.933 7.39 | 3.98 4.90
0.850 7.70 | 1.900 20.60 | 2.950 7.39 | 4.00 4.90
0.867 7.70 | 1.917 20.60 | 2.967 7.39 | 4.02 4.65
0.883 7.70 | 1.933 20.60 | 2.983 7.39 | 4.03 4.65
0.900 7.70 | 1.950 20.60 | 3.000 7.39 | 4.05 4.65
0.917 7.70 | 1.967 20.60 | 3.017 6.78 | 4.07 4.65
0.933 7.70 | 1.983 20.60 | 3.033 6.78 | 4.08 4.65
0.950 7.70 | 2.000 20.60 | 3.050 6.78 | 4.10 4.65
0.967 7.70 | 2.017 15.24 | 3.067 6.78 | 4.12 4.65
0.983 7.70 | 2.033 15.24 | 3.083 6.78 | 4.13 4.65
1.000 7.70 | 2.050 15.24 | 3.100 6.78 | 4.15 4.65
1.017 9.70 | 2.067 15.24 | 3.117 6.78 | 4.17 4.65
1.033 9.70 | 2.083 15.24 | 3.133 6.78 |
1.050 9.70 | 2.100 15.24 | 3.150 6.78 |

Max.Eff.Inten.(mm/hr)= 158.85 556.54
over (min) 5.00 6.00
Storage Coeff. (min)= 1.76 (ii) 5.71 (ii)
Unit Hyd. Tpeak (min)= 5.00 6.00
Unit Hyd. peak (cms)= 0.39 0.19

TOTALS
PEAK FLOW (cms)= 0.16 0.10 0.246 (iii)
TIME TO PEAK (hrs)= 1.67 1.72 1.68
RUNOFF VOLUME (mm)= 65.30 41.24 52.07
TOTAL RAINFALL (mm)= 66.10 66.10 66.10
RUNOFF COEFFICIENT = 0.99 0.62 0.79

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

| DUHYD (0230) |
| Inlet Cap.= 0.015 |
| #of Inlets= 1 |
Total(cms)= 0.0
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
TOTAL HYD. (ID= 1): 0.80 0.25 1.68 52.07
=====

MAJOR SYS. (ID= 2): 0.47 0.23 1.68 52.07
MINOR SYS. (ID= 3): 0.33 0.01 1.27 52.07

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| CALIB |
| STANDHYD (0024) | Area (ha)= 1.40
| ID= 1 DT= 1.0 min | Total Imp(%)= 90.00 Dir. Conn.(%)= 45.00

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 1.26 0.14
Dep. Storage (mm)= 0.80 16.50
Average Slope (%)= 1.00 1.00
Length (m)= 96.61 40.00
Mannings n = 0.013 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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
0.017 0.00 | 1.067 9.70 | 2.117 15.24 | 3.17 6.78
0.033 0.00 | 1.083 9.70 | 2.133 15.24 | 3.18 6.27
0.050 0.00 | 1.100 9.70 | 2.150 15.24 | 3.20 6.27
0.067 0.00 | 1.117 9.70 | 2.167 15.24 | 3.22 6.27
0.083 0.00 | 1.133 9.70 | 2.183 12.32 | 3.23 6.27
0.100 0.00 | 1.150 9.70 | 2.200 12.32 | 3.25 6.27
0.117 0.00 | 1.167 9.70 | 2.217 12.32 | 3.27 6.27
0.133 0.00 | 1.183 13.67 | 2.233 12.32 | 3.28 6.27
0.150 0.00 | 1.200 13.67 | 2.250 12.32 | 3.30 6.27
0.167 0.00 | 1.217 13.67 | 2.267 12.32 | 3.32 6.27
0.183 4.50 | 1.233 13.67 | 2.283 12.32 | 3.33 6.27
0.200 4.50 | 1.250 13.67 | 2.300 12.32 | 3.35 5.84
0.217 4.50 | 1.267 13.67 | 2.317 12.32 | 3.37 5.84
0.233 4.50 | 1.283 13.67 | 2.333 12.32 | 3.38 5.84
0.250 4.50 | 1.300 13.67 | 2.350 10.44 | 3.40 5.84
0.267 4.50 | 1.317 13.67 | 2.367 10.44 | 3.42 5.84
0.283 4.50 | 1.333 13.67 | 2.383 10.44 | 3.43 5.84
0.300 4.50 | 1.350 27.69 | 2.400 10.44 | 3.45 5.84
0.317 4.50 | 1.367 27.69 | 2.417 10.44 | 3.47 5.84
0.333 4.50 | 1.383 27.69 | 2.433 10.44 | 3.48 5.84
0.350 4.98 | 1.400 27.69 | 2.450 10.44 | 3.50 5.84
0.367 4.98 | 1.417 27.69 | 2.467 10.44 | 3.52 5.48
0.383 4.98 | 1.433 27.69 | 2.483 10.44 | 3.53 5.48
0.400 4.98 | 1.450 27.69 | 2.500 10.44 | 3.55 5.48
0.417 4.98 | 1.467 27.69 | 2.517 9.14 | 3.57 5.48
0.433 4.98 | 1.483 27.69 | 2.533 9.14 | 3.58 5.48

0.450	4.98	1.500	27.69	2.550	9.14	3.60	5.48
0.467	4.98	1.517	158.84	2.567	9.14	3.62	5.48
0.483	4.98	1.533	158.85	2.583	9.14	3.63	5.48
0.500	4.98	1.550	158.85	2.600	9.14	3.65	5.48
0.517	5.61	1.567	158.85	2.617	9.14	3.67	5.48
0.533	5.61	1.583	158.85	2.633	9.14	3.68	5.18
0.550	5.61	1.600	158.85	2.650	9.14	3.70	5.18
0.567	5.61	1.617	158.85	2.667	9.14	3.72	5.18
0.583	5.61	1.633	158.85	2.683	8.15	3.73	5.18
0.600	5.61	1.650	158.85	2.700	8.15	3.75	5.18
0.617	5.61	1.667	158.85	2.717	8.15	3.77	5.18
0.633	5.61	1.683	35.09	2.733	8.15	3.78	5.18
0.650	5.61	1.700	35.08	2.750	8.15	3.80	5.18
0.667	5.61	1.717	35.08	2.767	8.15	3.82	5.18
0.683	6.45	1.733	35.08	2.783	8.15	3.83	5.18
0.700	6.45	1.750	35.08	2.800	8.15	3.85	4.90
0.717	6.45	1.767	35.08	2.817	8.15	3.87	4.90
0.733	6.45	1.783	35.08	2.833	8.15	3.88	4.90
0.750	6.45	1.800	35.08	2.850	7.39	3.90	4.90
0.767	6.45	1.817	35.08	2.867	7.39	3.92	4.90
0.783	6.45	1.833	35.08	2.883	7.39	3.93	4.90
0.800	6.45	1.850	20.60	2.900	7.39	3.95	4.90
0.817	6.45	1.867	20.60	2.917	7.39	3.97	4.90
0.833	6.45	1.883	20.60	2.933	7.39	3.98	4.90
0.850	7.70	1.900	20.60	2.950	7.39	4.00	4.90
0.867	7.70	1.917	20.60	2.967	7.39	4.02	4.65
0.883	7.70	1.933	20.60	2.983	7.39	4.03	4.65
0.900	7.70	1.950	20.60	3.000	7.39	4.05	4.65
0.917	7.70	1.967	20.60	3.017	6.78	4.07	4.65
0.933	7.70	1.983	20.60	3.033	6.78	4.08	4.65
0.950	7.70	2.000	20.60	3.050	6.78	4.10	4.65
0.967	7.70	2.017	15.24	3.067	6.78	4.12	4.65
0.983	7.70	2.033	15.24	3.083	6.78	4.13	4.65
1.000	7.70	2.050	15.24	3.100	6.78	4.15	4.65
1.017	9.70	2.067	15.24	3.117	6.78	4.17	4.65
1.033	9.70	2.083	15.24	3.133	6.78		
1.050	9.70	2.100	15.24	3.150	6.78		

Max.Eff.Inten.(mm/hr)=	158.85	556.54
over (min)	5.00	7.00
Storage Coeff. (min)=	2.08 (ii)	6.04 (ii)
Unit Hyd. Tpeak (min)=	5.00	7.00
Unit Hyd. peak (cms)=	0.37	0.18
TOTALS		
PEAK FLOW (cms)=	0.27	0.16
TIME TO PEAK (hrs)=	1.67	1.72
RUNOFF VOLUME (mm)=	65.30	41.24
TOTAL RAINFALL (mm)=	66.10	66.10
RUNOFF COEFFICIENT =	0.99	0.62
		0.79

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

DUHYD (0240)	AREA	QPEAK	TPEAK	R.V.
Inlet Cap.= 0.015	(ha)	(cms)	(hrs)	(mm)
#of Inlets= 1				
Total(cms)= 0.0				
=====				
TOTAL HYD.(ID= 1):	1.40	0.42	1.68	52.07
=====				
MAJOR SYS.(ID= 2):	1.02	0.40	1.68	52.07
MINOR SYS.(ID= 3):	0.38	0.01	1.05	52.07

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)	AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (0010):	36.44	1.040	1.57	16.96
+ ID2= 2 (0211):	14.85	0.280	1.67	18.81
=====				
ID = 3 (1001):	51.29	1.320	1.68	17.50

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)	AREA	QPEAK	TPEAK	R.V.
3 + 2 = 1	(ha)	(cms)	(hrs)	(mm)
ID1= 3 (1001):	51.29	1.320	1.68	17.50
+ ID2= 2 (0220):	11.82	0.023	4.62	17.64
=====				
ID = 1 (1001):	63.11	1.334	1.90	17.52

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)	AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (1001):	63.11	1.334	1.90	17.52
+ ID2= 2 (0230):	0.33	0.015	1.27	52.07
=====				
ID = 3 (1001):	63.44	1.349	1.90	17.70

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)	AREA	QPEAK	TPEAK	R.V.
3 + 2 = 1	(ha)	(cms)	(hrs)	(mm)
ID1= 3 (1001):	63.44	1.349	1.90	17.70

+ ID2= 2 (0240):	0.38	0.015	1.05	52.07
=====				
ID = 1 (1001):	63.82	1.364	1.90	17.91

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)	AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (1001):	63.82	1.364	1.90	17.91
+ ID2= 2 (0030):	15.88	1.827	1.57	42.76
=====				
ID = 3 (1001):	79.71	3.190	1.85	22.86

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB	Area (ha)=	7.85
STANDHYD (0004)	Total Imp(%)=	46.00
ID= 1 DT= 5.0 min	Dir. Conn.(%)=	22.00
=====		
Surface Area (ha)=	IMPERVIOUS	PERVIOUS (i)
Dep. Storage (mm)=	3.61	4.24
Average Slope (%)=	1.00	8.10
Length (m)=	1.00	2.00
Mannings n =	228.76	40.00
	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083	0.00	1.167	9.70	2.250	12.32	3.33	6.27
0.167	0.00	1.250	13.67	2.333	12.32	3.42	5.84
0.250	4.50	1.333	13.67	2.417	10.44	3.50	5.84
0.333	4.50	1.417	27.69	2.500	10.44	3.58	5.48
0.417	4.98	1.500	27.69	2.583	9.14	3.67	5.48
0.500	4.98	1.583	158.85	2.667	9.14	3.75	5.18
0.583	5.61	1.667	158.85	2.750	8.15	3.83	5.18
0.667	5.61	1.750	35.08	2.833	8.15	3.92	4.90
0.750	6.45	1.833	35.08	2.917	7.39	4.00	4.90
0.833	6.45	1.917	20.60	3.000	7.39	4.08	4.65
0.917	7.70	2.000	20.60	3.083	6.78	4.17	4.65
1.000	7.70	2.083	15.24	3.167	6.78		
1.083	9.70	2.167	15.24	3.250	6.27		

Max.Eff.Inten.(mm/hr)=	158.85	92.18
over (min)	5.00	15.00
Storage Coeff. (min)=	3.49 (ii)	10.78 (ii)
Unit Hyd. Tpeak (min)=	5.00	15.00
Unit Hyd. peak (cms)=	0.26	0.09

TOTALS		
PEAK FLOW (cms)=	0.73	0.61
TIME TO PEAK (hrs)=	1.67	1.83
RUNOFF VOLUME (mm)=	65.10	28.40
TOTAL RAINFALL (mm)=	66.10	66.10
RUNOFF COEFFICIENT =	0.98	0.43
		0.55

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

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 72.0 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.

DUHYD (0040)	AREA	QPEAK	TPEAK	R.V.
Inlet Cap.= 0.084	(ha)	(cms)	(hrs)	(mm)
#of Inlets= 1				
Total(cms)= 0.1				
=====				
TOTAL HYD.(ID= 1):	7.85	1.03	1.67	36.47
=====				
MAJOR SYS.(ID= 2):	5.00	0.95	1.67	36.47
MINOR SYS.(ID= 3):	2.85	0.08	1.42	36.47

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1002)	AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (1001):	79.71	3.190	1.85	22.86
+ ID2= 2 (0040):	2.85	0.084	1.42	36.47
=====				
ID = 3 (1002):	82.56	3.274	1.85	23.33

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1003)	AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (1002):	82.56	3.274	1.85	23.33
+ ID2= 2 (5000):	3.43	0.018	4.25	25.16
=====				
ID = 3 (1003):	85.99	3.287	1.85	23.40

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

50-YEAR STORM - POST-DEVELOPMENT

V V I SSSS U U A L (v 6.2.2015)
V V I SS U U A A L
V V I SS U U AAAAA L
V V I SS U U A A L
VV I SSSS UUUU A A LLLL

OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO

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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voain.dat
Output filename: C:\Users\Natalie\AppData\Local\Civica\XH5\2b61f5e3-29d9-4c68-a5ec-7ff64ecb31ab\37027a0-5487-4200-aa3d-f269e4f88239\scen
Summary filename: C:\Users\Natalie\AppData\Local\Civica\XH5\2b61f5e3-29d9-4c68-a5ec-7ff64ecb31ab\37027a0-5487-4200-aa3d-f269e4f88239\scen

DATE: 10/19/2023 TIME: 03:51:47
USER:

COMMENTS: _____

** SIMULATION : Norfolk 50yr 4hr **

File: READ STORM File: C:\Users\Natalie\AppData\Local\Temp\ata\Local\Temp\ b7db1222-786f-4fa1-9026-76a41ee37e1f\5ef9f9bd
Ptotal= 72.96 mm Comments: Norfolk 50yr 4hr

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	0.00	1.17	14.27	2.33	10.39	3.50	4.98
0.17	3.99	1.33	33.90	2.50	8.89	3.67	4.65
0.33	4.45	1.50	186.56	2.67	7.80	3.83	4.37
0.50	5.08	1.67	44.81	2.83	6.96	4.00	4.14
0.67	5.97	1.83	23.44	3.00	6.30		
0.83	7.29	2.00	16.26	3.17	5.79		
1.00	9.53	2.17	12.62	3.33	5.33		

CALIB
NASHYD (0051) | Area (ha)= 0.60 Curve Number (CN)= 62.0
ID= 1 DT= 5.0 min | Ia (mm)= 13.60 # of Linear Res. (N)= 3.00
U.H. Tp(hrs)= 0.14

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

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	1.167	9.53	2.250	12.62	3.33	5.79
0.167	0.00	1.250	14.27	2.333	12.62	3.42	5.33
0.250	3.99	1.333	14.27	2.417	10.39	3.50	5.33
0.333	3.99	1.417	33.90	2.500	10.39	3.58	4.98
0.417	4.45	1.500	33.90	2.583	8.89	3.67	4.98
0.500	4.45	1.583	186.56	2.667	8.89	3.75	4.65
0.583	5.08	1.667	186.56	2.750	7.80	3.83	4.65
0.667	5.08	1.750	44.81	2.833	7.80	3.92	4.37
0.750	5.97	1.833	44.81	2.917	6.96	4.00	4.37
0.833	5.97	1.917	23.44	3.000	6.96	4.08	4.14
0.917	7.29	2.000	23.44	3.083	6.30	4.17	4.14
1.000	7.29	2.083	16.26	3.167	6.30		
1.083	9.53	2.167	16.26	3.250	5.79		

Unit Hyd Qpeak (cms)= 0.164

PEAK FLOW (cms)= 0.036 (i)
TIME TO PEAK (hrs)= 1.750
RUNOFF VOLUME (mm)= 16.263
TOTAL RAINFALL (mm)= 72.962
RUNOFF COEFFICIENT = 0.223

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

CALIB
STANDHYD (0052) | Area (ha)= 2.83
ID= 1 DT= 5.0 min | Total Imp(%)= 41.00 Dir. Conn.(%)= 20.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	1.16	1.67
Dep. Storage (mm)=	1.00	13.60
Average Slope (%)=	1.00	2.00
Length (m)=	137.36	40.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083	0.00	1.167	9.53	2.250	12.62	3.33	5.79
0.167	0.00	1.250	14.27	2.333	12.62	3.42	5.33
0.250	3.99	1.333	14.27	2.417	10.39	3.50	5.33
0.333	3.99	1.417	33.90	2.500	10.39	3.58	4.98
0.417	4.45	1.500	33.90	2.583	8.89	3.67	4.98
0.500	4.45	1.583	186.56	2.667	8.89	3.75	4.65
0.583	5.08	1.667	186.56	2.750	7.80	3.83	4.65
0.667	5.08	1.750	44.81	2.833	7.80	3.92	4.37
0.750	5.97	1.833	44.81	2.917	6.96	4.00	4.37
0.833	5.97	1.917	23.44	3.000	6.96	4.08	4.14
0.917	7.29	2.000	23.44	3.083	6.30	4.17	4.14
1.000	7.29	2.083	16.26	3.167	6.30		
1.083	9.53	2.167	16.26	3.250	5.79		

Max.Eff.Inten.(mm/hr)= 186.56 65.88
over (min)= 5.00 15.00
Storage Coeff. (min)= 2.41 (ii) 10.75 (ii)
Unit Hyd. Tpeak (min)= 5.00 15.00
Unit Hyd. peak (cms)= 0.30 0.09

TOTALS

PEAK FLOW (cms)= 0.29 0.18 0.366 (iii)
TIME TO PEAK (hrs)= 1.67 1.83 1.67
RUNOFF VOLUME (mm)= 71.96 22.28 32.22
TOTAL RAINFALL (mm)= 72.96 72.96 72.96
RUNOFF COEFFICIENT = 0.99 0.31 0.44

***** 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* = 62.0 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 (0050) | Area (ha)= 1.52
ID= 1 DT= 5.0 min | Total Imp(%)= 48.00 Dir. Conn.(%)= 21.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.73	0.79
Dep. Storage (mm)=	1.00	13.60
Average Slope (%)=	1.00	2.00
Length (m)=	100.66	40.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083	0.00	1.167	9.53	2.250	12.62	3.33	5.79
0.167	0.00	1.250	14.27	2.333	12.62	3.42	5.33
0.250	3.99	1.333	14.27	2.417	10.39	3.50	5.33
0.333	3.99	1.417	33.90	2.500	10.39	3.58	4.98
0.417	4.45	1.500	33.90	2.583	8.89	3.67	4.98
0.500	4.45	1.583	186.56	2.667	8.89	3.75	4.65
0.583	5.08	1.667	186.56	2.750	7.80	3.83	4.65
0.667	5.08	1.750	44.81	2.833	7.80	3.92	4.37
0.750	5.97	1.833	44.81	2.917	6.96	4.00	4.37
0.833	5.97	1.917	23.44	3.000	6.96	4.08	4.14
0.917	7.29	2.000	23.44	3.083	6.30	4.17	4.14
1.000	7.29	2.083	16.26	3.167	6.30		
1.083	9.53	2.167	16.26	3.250	5.79		

Max.Eff.Inten.(mm/hr)= 186.56 84.00
over (min)= 5.00 10.00
Storage Coeff. (min)= 2.00 (ii) 9.57 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.31 0.11

TOTALS

PEAK FLOW (cms)= 0.16 0.12 0.251 (iii)
TIME TO PEAK (hrs)= 1.67 1.75 1.67
RUNOFF VOLUME (mm)= 71.96 24.61 34.55
TOTAL RAINFALL (mm)= 72.96 72.96 72.96
RUNOFF COEFFICIENT = 0.99 0.34 0.47

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 62.0 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.

CHAMBER(0053) | OUTFLOW: OFF, UNDERDRAIN: OFF, INFIL: ON

|IN= 2--> OUT= 3 | CHAMBER:
| DT= 5.0 min | MAX STO VOL (cu.m.)= 540.00 Bottom Area(m2) = 500.00

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 MIN. TIME STEP.

DEPTH (mm)	STORAGE (cu.m.)	DEPTH (mm)	STORAGE (cu.m.)
0.00	0.00	800.00	288.00
100.00	36.00	900.00	324.00
200.00	72.00	1000.00	360.00
300.00	108.00	1100.00	396.00
400.00	144.00	1200.00	432.00
500.00	180.00	1300.00	468.00
600.00	216.00	1400.00	504.00
700.00	252.00	1500.00	540.00

NATIVE SOIL LAYER:
Infiltration (m/hr) = 0.0250

AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW:ID= 2	1.52	0.251	1.67
OVERFLOW:ID= 3	0.00	0.000	0.00

Volume Reduction Rate[(RVin-RVout)/RVin] (%)= 100.00
Time to reach Max storage (Hr)= 4.33
Volume of water for drawdown in LID (cu.m.)= 467.81
Volume of maximum water storage (cu.m.)= 474.29
Calculated Drawdown Time (Hr)= 37.42

| Junction Command(0054) |

AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 3 (0053)	0.00	0.00	0.00
OUTFLOW: ID= 2 (0054)	0.00	0.00	0.00

AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0051):	0.60	0.036	1.75
+ ID2= 2 (0052):	2.83	0.366	1.67
=====			
ID = 3 (0055):	3.43	0.395	1.67

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 3 (0055):	3.43	0.395	1.67
+ ID2= 2 (0054):	0.00	0.000	0.00
=====			
ID = 1 (0055):	3.43	0.395	1.67

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	0.0177	0.0628
0.0049	0.0070	0.0190	0.0745
0.0085	0.0147	0.0202	0.0868
0.0110	0.0230	0.0214	0.0999
0.0130	0.0320	0.0225	0.1136
0.0147	0.0416	0.0235	0.1281
0.0163	0.0519	0.0000	0.0000
AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0055)	3.430	0.395	1.67
OUTFLOW: ID= 1 (5000)	3.430	0.020	4.25
OVERFLOW:ID= 3 (0003)	0.000	0.000	0.00

TOTAL NUMBER OF SIMULATION OVERFLOW = 0
CUMULATIVE TIME OF OVERFLOW (HOURS) = 0.00
PERCENTAGE OF TIME OVERFLOWING (%) = 0.00

PEAK FLOW REDUCTION [Qout/Qin] (%) = 4.99
TIME SHIFT OF PEAK FLOW (min)=155.00
MAXIMUM STORAGE USED (ha.m.)= 0.0818

Area (ha)	Dir. Conn.(%)
CALIB	15.00
STANDHYD (0001)	30.00
ID= 1 DT= 1.0 min	

IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	12.30
Dep. Storage (mm)=	0.80
Average Slope (%)=	2.00
Length (m)=	522.81
Mannings n =	0.013

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.017	0.00	1.067	9.53	2.117	16.26	3.17	6.30
0.033	0.00	1.083	9.53	2.133	16.26	3.18	5.79
0.050	0.00	1.100	9.53	2.150	16.26	3.20	5.79
0.067	0.00	1.117	9.53	2.167	16.26	3.22	5.79
0.083	0.00	1.133	9.53	2.183	12.62	3.23	5.79
0.100	0.00	1.150	9.53	2.200	12.62	3.25	5.79
0.117	0.00	1.167	9.53	2.217	12.62	3.27	5.79
0.133	0.00	1.183	14.27	2.233	12.62	3.28	5.79
0.150	0.00	1.200	14.27	2.250	12.62	3.30	5.79
0.167	0.00	1.217	14.27	2.267	12.62	3.32	5.79
0.183	3.99	1.233	14.27	2.283	12.62	3.33	5.79
0.200	3.99	1.250	14.27	2.300	12.62	3.35	5.33
0.217	3.99	1.267	14.27	2.317	12.62	3.37	5.33
0.233	3.99	1.283	14.27	2.333	12.62	3.38	5.33
0.250	3.99	1.300	14.27	2.350	10.39	3.40	5.33
0.267	3.99	1.317	14.27	2.367	10.39	3.42	5.33
0.283	3.99	1.333	14.27	2.383	10.39	3.43	5.33
0.300	3.99	1.350	33.90	2.400	10.39	3.45	5.33
0.317	3.99	1.367	33.90	2.417	10.39	3.47	5.33
0.333	3.99	1.383	33.90	2.433	10.39	3.48	5.33
0.350	4.45	1.400	33.90	2.450	10.39	3.50	5.33
0.367	4.45	1.417	33.90	2.467	10.39	3.52	4.98
0.383	4.45	1.433	33.90	2.483	10.39	3.53	4.98
0.400	4.45	1.450	33.90	2.500	10.39	3.55	4.98
0.417	4.45	1.467	33.90	2.517	8.89	3.57	4.98
0.433	4.45	1.483	33.90	2.533	8.89	3.58	4.98
0.450	4.45	1.500	33.90	2.550	8.89	3.60	4.98
0.467	4.45	1.517	186.55	2.567	8.89	3.62	4.98
0.483	4.45	1.533	186.55	2.583	8.89	3.63	4.98
0.500	4.45	1.550	186.55	2.600	8.89	3.65	4.98
0.517	5.08	1.567	186.55	2.617	8.89	3.67	4.98
0.533	5.08	1.583	186.55	2.633	8.89	3.68	4.65
0.550	5.08	1.600	186.55	2.650	8.89	3.70	4.65
0.567	5.08	1.617	186.55	2.667	8.89	3.72	4.65
0.583	5.08	1.633	186.55	2.683	7.80	3.73	4.65
0.600	5.08	1.650	186.55	2.700	7.80	3.75	4.65
0.617	5.08	1.667	186.55	2.717	7.80	3.77	4.65
0.633	5.08	1.683	44.82	2.733	7.80	3.78	4.65
0.650	5.08	1.700	44.81	2.750	7.80	3.80	4.65
0.667	5.08	1.717	44.81	2.767	7.80	3.82	4.65
0.683	5.97	1.733	44.81	2.783	7.80	3.83	4.65
0.700	5.97	1.750	44.81	2.800	7.80	3.85	4.37
0.717	5.97	1.767	44.81	2.817	7.80	3.87	4.37
0.733	5.97	1.783	44.81	2.833	7.80	3.88	4.37
0.750	5.97	1.800	44.81	2.850	6.96	3.90	4.37
0.767	5.97	1.817	44.81	2.867	6.96	3.92	4.37
0.783	5.97	1.833	44.81	2.883	6.96	3.93	4.37
0.800	5.97	1.850	23.44	2.900	6.96	3.95	4.37
0.817	5.97	1.867	23.44	2.917	6.96	3.97	4.37
0.833	5.97	1.883	23.44	2.933	6.96	3.98	4.37
0.850	7.29	1.900	23.44	2.950	6.96	4.00	4.37
0.867	7.29	1.917	23.44	2.967	6.96	4.02	4.14
0.883	7.29	1.933	23.44	2.983	6.96	4.03	4.14
0.900	7.29	1.950	23.44	3.000	6.96	4.05	4.14
0.917	7.29	1.967	23.44	3.017	6.30	4.07	4.14
0.933	7.29	1.983	23.44	3.033	6.30	4.08	4.14
0.950	7.29	2.000	23.44	3.050	6.30	4.10	4.14
0.967	7.29	2.017	16.26	3.067	6.30	4.12	4.14
0.983	7.29	2.033	16.26	3.083	6.30	4.13	4.14
1.000	7.29	2.050	16.26	3.100	6.30	4.15	4.14
1.017	9.53	2.067	16.26	3.117	6.30	4.17	4.14
1.033	9.53	2.083	16.26	3.133	6.30		
1.050	9.53	2.100	16.26	3.150	6.30		

Max.Eff.Inten.(mm/hr)=	186.56	20.29
over (min)	5.00	18.00
Storage Coeff. (min)=	4.36 (ii)	17.72 (ii)
Unit Hyd. Tpeak (min)=	5.00	18.00
Unit Hyd. peak (cms)=	0.25	0.06
=====		
PEAK FLOW (cms)=	2.74	0.82
TIME TO PEAK (hrs)=	1.68	1.98
RUNOFF VOLUME (mm)=	72.16	10.82
TOTAL RAINFALL (mm)=	72.96	72.96
RUNOFF COEFFICIENT =	0.99	0.15

TOTALS

***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 50.0 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 (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
TOTAL HYD.(ID= 1):	41.00	2.89	1.68
MAJOR SYS.(ID= 2):	7.83	1.85	1.68
MINOR SYS.(ID= 3):	33.17	1.04	1.57

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| CALIB |
| STANDHYD (0022) |
ID= 1 DT= 1.0 min

Area (ha)= 11.82
Total Imp(%)= 47.00 Dir. Conn.(%)= 22.00

IMPERVIOUS PVIOUS (i)
Surface Area (ha)= 5.56 6.26
Dep. Storage (mm)= 0.80 16.50
Average Slope (%)= 1.00 1.00
Length (m)= 280.71 40.00
Mannings n = 0.013 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 MIN. TIME STEP.

IN= 2---> OUT= 1 |
DT= 1.0 min

OUTFLOW STORAGE | OUTFLOW STORAGE
(cms) (ha.m.) | (cms) (ha.m.)
0.0000 0.0000 | 0.0251 0.3540
0.0066 0.0550 | 0.0273 0.4180
0.0127 0.1120 | 0.0294 0.4840
0.0167 0.1700 | 0.0313 0.5510
0.0199 0.2300 | 0.0332 0.6200
0.0226 0.2910 | 0.0000 0.0000

AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW : ID= 2 (0022) 11.820 1.386 1.68 31.80
OUTFLOW: ID= 1 (0220) 11.820 0.025 4.53 19.59

PEAK FLOW REDUCTION [Qout/Qin](%)= 1.80
TIME SHIFT OF PEAK FLOW (min)=171.00
MAXIMUM STORAGE USED (ha.m.)= 0.3504

----- TRANSFORMED HYETOGRAPH -----
TIME RAIN | TIME RAIN | ' TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | ' hrs mm/hr | hrs mm/hr
0.017 0.00 | 1.067 9.53 | 2.117 16.26 | 3.17 6.30
0.033 0.00 | 1.083 9.53 | 2.133 16.26 | 3.18 5.79
0.050 0.00 | 1.100 9.53 | 2.150 16.26 | 3.20 5.79
0.067 0.00 | 1.117 9.53 | 2.167 16.26 | 3.22 5.79
0.083 0.00 | 1.133 9.53 | 2.183 12.62 | 3.23 5.79
0.100 0.00 | 1.150 9.53 | 2.200 12.62 | 3.25 5.79
0.117 0.00 | 1.167 9.53 | 2.217 12.62 | 3.27 5.79
0.133 0.00 | 1.183 14.27 | 2.233 12.62 | 3.28 5.79
0.150 0.00 | 1.200 14.27 | 2.250 12.62 | 3.30 5.79
0.167 0.00 | 1.217 14.27 | 2.267 12.62 | 3.32 5.79
0.183 3.99 | 1.233 14.27 | 2.283 12.62 | 3.33 5.79
0.200 3.99 | 1.250 14.27 | 2.300 12.62 | 3.35 5.33
0.217 3.99 | 1.267 14.27 | 2.317 12.62 | 3.37 5.33
0.233 3.99 | 1.283 14.27 | 2.333 12.62 | 3.38 5.33
0.250 3.99 | 1.300 14.27 | 2.350 10.39 | 3.40 5.33
0.267 3.99 | 1.317 14.27 | 2.367 10.39 | 3.42 5.33
0.283 3.99 | 1.333 14.27 | 2.383 10.39 | 3.43 5.33
0.300 3.99 | 1.350 33.90 | 2.400 10.39 | 3.45 5.33
0.317 3.99 | 1.367 33.90 | 2.417 10.39 | 3.47 5.33
0.333 3.99 | 1.383 33.90 | 2.433 10.39 | 3.48 5.33
0.350 4.45 | 1.400 33.90 | 2.450 10.39 | 3.50 5.33
0.367 4.45 | 1.417 33.90 | 2.467 10.39 | 3.52 4.98
0.383 4.45 | 1.433 33.90 | 2.483 10.39 | 3.53 4.98
0.400 4.45 | 1.450 33.90 | 2.500 10.39 | 3.55 4.98
0.417 4.45 | 1.467 33.90 | 2.517 8.89 | 3.57 4.98
0.433 4.45 | 1.483 33.90 | 2.533 8.89 | 3.58 4.98
0.450 4.45 | 1.500 33.90 | 2.550 8.89 | 3.60 4.98
0.467 4.45 | 1.517 186.55 | 2.567 8.89 | 3.62 4.98
0.483 4.45 | 1.533 186.56 | 2.583 8.89 | 3.63 4.98
0.500 4.45 | 1.550 186.56 | 2.600 8.89 | 3.65 4.98
0.517 5.08 | 1.567 186.56 | 2.617 8.89 | 3.67 4.98
0.533 5.08 | 1.583 186.56 | 2.633 8.89 | 3.68 4.65
0.550 5.08 | 1.600 186.56 | 2.650 8.89 | 3.70 4.65
0.567 5.08 | 1.617 186.56 | 2.667 8.89 | 3.72 4.65
0.583 5.08 | 1.633 186.56 | 2.683 7.80 | 3.73 4.65
0.600 5.08 | 1.650 186.56 | 2.700 7.80 | 3.75 4.65
0.617 5.08 | 1.667 186.56 | 2.717 7.80 | 3.77 4.65
0.633 5.08 | 1.683 44.82 | 2.733 7.80 | 3.78 4.65
0.650 5.08 | 1.700 44.81 | 2.750 7.80 | 3.80 4.65
0.667 5.08 | 1.717 44.81 | 2.767 7.80 | 3.82 4.65
0.683 5.97 | 1.733 44.81 | 2.783 7.80 | 3.83 4.65
0.700 5.97 | 1.750 44.81 | 2.800 7.80 | 3.85 4.37
0.717 5.97 | 1.767 44.81 | 2.817 7.80 | 3.87 4.37
0.733 5.97 | 1.783 44.81 | 2.833 7.80 | 3.88 4.37
0.750 5.97 | 1.800 44.81 | 2.850 6.96 | 3.90 4.37
0.767 5.97 | 1.817 44.81 | 2.867 6.96 | 3.92 4.37
0.783 5.97 | 1.833 44.81 | 2.883 6.96 | 3.93 4.37
0.800 5.97 | 1.850 23.44 | 2.900 6.96 | 3.95 4.37
0.817 5.97 | 1.867 23.44 | 2.917 6.96 | 3.97 4.37
0.833 5.97 | 1.883 23.44 | 2.933 6.96 | 3.98 4.37
0.850 7.29 | 1.900 23.44 | 2.950 6.96 | 4.00 4.37
0.867 7.29 | 1.917 23.44 | 2.967 6.96 | 4.02 4.14
0.883 7.29 | 1.933 23.44 | 2.983 6.96 | 4.03 4.14
0.900 7.29 | 1.950 23.44 | 3.000 6.96 | 4.05 4.14
0.917 7.29 | 1.967 23.44 | 3.017 6.30 | 4.07 4.14
0.933 7.29 | 1.983 23.44 | 3.033 6.30 | 4.08 4.14
0.950 7.29 | 2.000 23.44 | 3.050 6.30 | 4.10 4.14
0.967 7.29 | 2.017 16.26 | 3.067 6.30 | 4.12 4.14
0.983 7.29 | 2.033 16.26 | 3.083 6.30 | 4.13 4.14
1.000 7.29 | 2.050 16.26 | 3.100 6.30 | 4.15 4.14
1.017 9.53 | 2.067 16.26 | 3.117 6.30 | 4.17 4.14
1.033 9.53 | 2.083 16.26 | 3.133 6.30 | 4.17 4.14
1.050 9.53 | 2.100 16.26 | 3.150 6.30 | 4.17 4.14

Max.Eff.Inten.(mm/hr)= 186.56 60.71
over (min) 5.00 15.00
Storage Coeff. (min)= 3.70 (ii) 14.31 (ii)
Unit Hyd. Tpeak (min)= 5.00 15.00
Unit Hyd. peak (cms)= 0.27 0.08

TOTALS
PEAK FLOW (cms)= 1.20 0.55 1.386 (iii)
TIME TO PEAK (hrs)= 1.68 1.88 1.68
RUNOFF VOLUME (mm)= 72.16 20.42 31.80
TOTAL RAINFALL (mm)= 72.96 72.96 72.96
RUNOFF COEFFICIENT = 0.99 0.28 0.44

(i) CN PROCEDURE SELECTED FOR PVIOUS LOSSES:
CN* = 58.0 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.

| RESERVOIR(0220) | OVERFLOW IS OFF

Max.Eff.Inten.(mm/hr)= 186.56 135.76
over (min) 5.00 8.00
Storage Coeff. (min)= 3.47 (ii) 7.29 (ii)

----- TRANSFORMED HYETOGRAPH -----
TIME RAIN | TIME RAIN | ' TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | ' hrs mm/hr | hrs mm/hr
0.017 0.00 | 1.067 9.53 | 2.117 16.26 | 3.17 6.30
0.033 0.00 | 1.083 9.53 | 2.133 16.26 | 3.18 5.79
0.050 0.00 | 1.100 9.53 | 2.150 16.26 | 3.20 5.79
0.067 0.00 | 1.117 9.53 | 2.167 16.26 | 3.22 5.79
0.083 0.00 | 1.133 9.53 | 2.183 12.62 | 3.23 5.79
0.100 0.00 | 1.150 9.53 | 2.200 12.62 | 3.25 5.79
0.117 0.00 | 1.167 9.53 | 2.217 12.62 | 3.27 5.79
0.133 0.00 | 1.183 14.27 | 2.233 12.62 | 3.28 5.79
0.150 0.00 | 1.200 14.27 | 2.250 12.62 | 3.30 5.79
0.167 0.00 | 1.217 14.27 | 2.267 12.62 | 3.32 5.79
0.183 3.99 | 1.233 14.27 | 2.283 12.62 | 3.33 5.79
0.200 3.99 | 1.250 14.27 | 2.300 12.62 | 3.35 5.33
0.217 3.99 | 1.267 14.27 | 2.317 12.62 | 3.37 5.33
0.233 3.99 | 1.283 14.27 | 2.333 12.62 | 3.38 5.33
0.250 3.99 | 1.300 14.27 | 2.350 10.39 | 3.40 5.33
0.267 3.99 | 1.317 14.27 | 2.367 10.39 | 3.42 5.33
0.283 3.99 | 1.333 14.27 | 2.383 10.39 | 3.43 5.33
0.300 3.99 | 1.350 33.90 | 2.400 10.39 | 3.45 5.33
0.317 3.99 | 1.367 33.90 | 2.417 10.39 | 3.47 5.33
0.333 3.99 | 1.383 33.90 | 2.433 10.39 | 3.48 5.33
0.350 4.45 | 1.400 33.90 | 2.450 10.39 | 3.50 5.33
0.367 4.45 | 1.417 33.90 | 2.467 10.39 | 3.52 4.98
0.383 4.45 | 1.433 33.90 | 2.483 10.39 | 3.53 4.98
0.400 4.45 | 1.450 33.90 | 2.500 10.39 | 3.55 4.98
0.417 4.45 | 1.467 33.90 | 2.517 8.89 | 3.57 4.98
0.433 4.45 | 1.483 33.90 | 2.533 8.89 | 3.58 4.98
0.450 4.45 | 1.500 33.90 | 2.550 8.89 | 3.60 4.98
0.467 4.45 | 1.517 186.55 | 2.567 8.89 | 3.62 4.98
0.483 4.45 | 1.533 186.56 | 2.583 8.89 | 3.63 4.98
0.500 4.45 | 1.550 186.56 | 2.600 8.89 | 3.65 4.98
0.517 5.08 | 1.567 186.56 | 2.617 8.89 | 3.67 4.98
0.533 5.08 | 1.583 186.56 | 2.633 8.89 | 3.68 4.65
0.550 5.08 | 1.600 186.56 | 2.650 8.89 | 3.70 4.65
0.567 5.08 | 1.617 186.56 | 2.667 8.89 | 3.72 4.65
0.583 5.08 | 1.633 186.56 | 2.683 7.80 | 3.73 4.65
0.600 5.08 | 1.650 186.56 | 2.700 7.80 | 3.75 4.65
0.617 5.08 | 1.667 186.56 | 2.717 7.80 | 3.77 4.65
0.633 5.08 | 1.683 44.82 | 2.733 7.80 | 3.78 4.65
0.650 5.08 | 1.700 44.81 | 2.750 7.80 | 3.80 4.65
0.667 5.08 | 1.717 44.81 | 2.767 7.80 | 3.82 4.65
0.683 5.97 | 1.733 44.81 | 2.783 7.80 | 3.83 4.65
0.700 5.97 | 1.750 44.81 | 2.800 7.80 | 3.85 4.37
0.717 5.97 | 1.767 44.81 | 2.817 7.80 | 3.87 4.37
0.733 5.97 | 1.783 44.81 | 2.833 7.80 | 3.88 4.37
0.750 5.97 | 1.800 44.81 | 2.850 6.96 | 3.90 4.37
0.767 5.97 | 1.817 44.81 | 2.867 6.96 | 3.92 4.37
0.783 5.97 | 1.833 44.81 | 2.883 6.96 | 3.93 4.37
0.800 5.97 | 1.850 23.44 | 2.900 6.96 | 3.95 4.37
0.817 5.97 | 1.867 23.44 | 2.917 6.96 | 3.97 4.37
0.833 5.97 | 1.883 23.44 | 2.933 6.96 | 3.98 4.37
0.850 7.29 | 1.900 23.44 | 2.950 6.96 | 4.00 4.37
0.867 7.29 | 1.917 23.44 | 2.967 6.96 | 4.02 4.14
0.883 7.29 | 1.933 23.44 | 2.983 6.96 | 4.03 4.14
0.900 7.29 | 1.950 23.44 | 3.000 6.96 | 4.05 4.14
0.917 7.29 | 1.967 23.44 | 3.017 6.30 | 4.07 4.14
0.933 7.29 | 1.983 23.44 | 3.033 6.30 | 4.08 4.14
0.950 7.29 | 2.000 23.44 | 3.050 6.30 | 4.10 4.14
0.967 7.29 | 2.017 16.26 | 3.067 6.30 | 4.12 4.14
0.983 7.29 | 2.033 16.26 | 3.083 6.30 | 4.13 4.14
1.000 7.29 | 2.050 16.26 | 3.100 6.30 | 4.15 4.14
1.017 9.53 | 2.067 16.26 | 3.117 6.30 | 4.17 4.14
1.033 9.53 | 2.083 16.26 | 3.133 6.30 | 4.17 4.14
1.050 9.53 | 2.100 16.26 | 3.150 6.30 | 4.17 4.14

Unit Hyd. Tpeak (min)= 5.00 8.00
Unit Hyd. peak (cms)= 0.28 0.15

TOTALS
PEAK FLOW (cms)= 4.49 1.05 5.287 (iii)
TIME TO PEAK (hrs)= 1.67 1.75 1.68
RUNOFF VOLUME (mm)= 72.16 24.36 48.26
TOTAL RAINFALL (mm)= 72.96 72.96 72.96
RUNOFF COEFFICIENT = 0.99 0.33 0.66

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 50.0 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.

DUHYD (0211) |
Inlet Cap.= 0.280 |
#of Inlets= 1 |
Total(cms)= 0.3 | AREA (ha) QPEAK (cms) TPEAK (hrs) R.V. (mm)
TOTAL HYD. (ID= 1): 16.90 0.43 2.25 22.13
MAJOR SYS. (ID= 2): 3.39 0.15 2.25 22.13
MINOR SYS. (ID= 3): 13.51 0.28 1.67 22.13

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB |
STANDHYD (0023) | Area (ha)= 0.80
ID= 1 DT= 1.0 min | Total Imp(%)= 90.00 Dir. Conn.(%)= 45.00

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 0.72 0.08
Dep. Storage (mm)= 0.80 16.50
Average Slope (%)= 1.00 1.00
Length (m)= 73.03 40.00
Mannings n = 0.013 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 MIN. TIME STEP.

DUHYD (0030) |
Inlet Cap.= 1.827 |
#of Inlets= 1 |
Total(cms)= 1.8 | AREA (ha) QPEAK (cms) TPEAK (hrs) R.V. (mm)
TOTAL HYD. (ID= 1): 19.20 5.29 1.68 48.26
MAJOR SYS. (ID= 2): 4.58 3.46 1.68 48.26
MINOR SYS. (ID= 3): 14.62 1.83 1.57 48.26
NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB |
STANDHYD (0021) | Area (ha)= 16.90
ID= 1 DT= 5.0 min | Total Imp(%)= 38.00 Dir. Conn.(%)= 16.00

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 6.42 10.48
Dep. Storage (mm)= 0.80 23.90
Average Slope (%)= 2.00 2.00
Length (m)= 335.66 40.00
Mannings n = 0.013 0.250

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

TIME RAIN | TIME RAIN | ' TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | ' hrs mm/hr | hrs mm/hr
0.083 0.00 | 1.167 9.53 | 2.250 12.62 | 3.33 5.79
0.167 0.00 | 1.250 14.27 | 2.333 12.62 | 3.42 5.33
0.250 3.99 | 1.333 14.27 | 2.417 10.39 | 3.50 5.33
0.333 3.99 | 1.417 33.90 | 2.500 10.39 | 3.58 4.98
0.417 4.45 | 1.500 33.90 | 2.583 8.89 | 3.67 4.98
0.500 4.45 | 1.583 186.56 | 2.667 8.89 | 3.75 4.65
0.583 5.08 | 1.667 186.56 | 2.750 7.80 | 3.83 4.65
0.667 5.08 | 1.750 44.81 | 2.833 7.80 | 3.92 4.37
0.750 5.97 | 1.833 44.81 | 2.917 6.96 | 4.00 4.37
0.833 5.97 | 1.917 23.44 | 3.000 6.96 | 4.08 4.14
0.917 7.29 | 2.000 23.44 | 3.083 6.30 | 4.17 4.14
1.000 7.29 | 2.083 16.26 | 3.167 6.30 |
1.083 9.53 | 2.167 16.26 | 3.250 5.79 |

Max.Eff.Inten.(mm/hr)= 186.56 25.94
over (min)= 5.00 20.00
Storage Coeff. (min)= 3.34 (ii) 15.45 (ii)
Unit Hyd. Tpeak (min)= 5.00 20.00
Unit Hyd. peak (cms)= 0.26 0.07

TOTALS
PEAK FLOW (cms)= 1.34 0.43 1.441 (iii)
TIME TO PEAK (hrs)= 1.67 1.92 1.67
RUNOFF VOLUME (mm)= 72.16 12.60 22.13
TOTAL RAINFALL (mm)= 72.96 72.96 72.96
RUNOFF COEFFICIENT = 0.99 0.17 0.30

***** 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* = 50.0 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.

RESERVOIR(0210) |
IN= 2---> OUT= 1 |
DT= 5.0 min |
OVERFLOW IS OFF
OUTFLOW STORAGE | OUTFLOW STORAGE
(cms) (ha.m.) | (cms) (ha.m.)
0.0000 0.0000 | 0.3900 0.0820
0.0200 0.0000 | 0.4300 0.1090
0.0800 0.0020 | 0.5800 0.2670
0.2100 0.0160 | 0.6360 0.3420
0.3000 0.0330 | 0.0000 0.0000
AREA (ha) QPEAK (cms) TPEAK (hrs) R.V. (mm)
INFLOW : ID= 2 (0021) 16.900 1.441 1.67 22.13
OUTFLOW: ID= 1 (0210) 16.900 0.430 2.25 22.13

PEAK FLOW REDUCTION [Qout/Qin](%)= 29.84
TIME SHIFT OF PEAK FLOW (min)= 35.00
MAXIMUM STORAGE USED (ha.m.)= 0.1093

TIME RAIN | TIME RAIN | ' TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | ' hrs mm/hr | hrs mm/hr
0.017 0.00 | 1.067 9.53 | 2.117 16.26 | 3.17 6.30
0.033 0.00 | 1.083 9.53 | 2.133 16.26 | 3.18 5.79
0.050 0.00 | 1.100 9.53 | 2.150 16.26 | 3.20 5.79
0.067 0.00 | 1.117 9.53 | 2.167 16.26 | 3.22 5.79
0.083 0.00 | 1.133 9.53 | 2.183 12.62 | 3.23 5.79
0.100 0.00 | 1.150 9.53 | 2.200 12.62 | 3.25 5.79
0.117 0.00 | 1.167 9.53 | 2.217 12.62 | 3.27 5.79
0.133 0.00 | 1.183 14.27 | 2.233 12.62 | 3.28 5.79
0.150 0.00 | 1.200 14.27 | 2.250 12.62 | 3.30 5.79
0.167 0.00 | 1.217 14.27 | 2.267 12.62 | 3.32 5.79
0.183 3.99 | 1.233 14.27 | 2.283 12.62 | 3.33 5.79
0.200 3.99 | 1.250 14.27 | 2.300 12.62 | 3.35 5.33
0.217 3.99 | 1.267 14.27 | 2.317 12.62 | 3.37 5.33
0.233 3.99 | 1.283 14.27 | 2.333 12.62 | 3.38 5.33
0.250 3.99 | 1.300 14.27 | 2.350 10.39 | 3.40 5.33
0.267 3.99 | 1.317 14.27 | 2.367 10.39 | 3.42 5.33
0.283 3.99 | 1.333 14.27 | 2.383 10.39 | 3.43 5.33
0.300 3.99 | 1.350 33.90 | 2.400 10.39 | 3.45 5.33
0.317 3.99 | 1.367 33.90 | 2.417 10.39 | 3.47 5.33
0.333 3.99 | 1.383 33.90 | 2.433 10.39 | 3.48 5.33
0.350 4.45 | 1.400 33.90 | 2.450 10.39 | 3.50 5.33
0.367 4.45 | 1.417 33.90 | 2.467 10.39 | 3.52 4.98
0.383 4.45 | 1.433 33.90 | 2.483 10.39 | 3.53 4.98
0.400 4.45 | 1.450 33.90 | 2.500 10.39 | 3.55 4.98
0.417 4.45 | 1.467 33.90 | 2.517 8.89 | 3.57 4.98
0.433 4.45 | 1.483 33.90 | 2.533 8.89 | 3.58 4.98
0.450 4.45 | 1.500 33.90 | 2.550 8.89 | 3.60 4.98
0.467 4.45 | 1.517 186.55 | 2.567 8.89 | 3.62 4.98
0.483 4.45 | 1.533 186.56 | 2.583 8.89 | 3.63 4.98
0.500 4.45 | 1.550 186.56 | 2.600 8.89 | 3.65 4.98
0.517 5.08 | 1.567 186.56 | 2.617 8.89 | 3.67 4.98
0.533 5.08 | 1.583 186.56 | 2.633 8.89 | 3.68 4.65
0.550 5.08 | 1.600 186.56 | 2.650 8.89 | 3.70 4.65
0.567 5.08 | 1.617 186.56 | 2.667 8.89 | 3.72 4.65
0.583 5.08 | 1.633 186.56 | 2.683 7.80 | 3.73 4.65
0.600 5.08 | 1.650 186.56 | 2.700 7.80 | 3.75 4.65
0.617 5.08 | 1.667 186.56 | 2.717 7.80 | 3.77 4.65
0.633 5.08 | 1.683 44.82 | 2.733 7.80 | 3.78 4.65
0.650 5.08 | 1.700 44.81 | 2.750 7.80 | 3.80 4.65
0.667 5.08 | 1.717 44.81 | 2.767 7.80 | 3.82 4.65
0.683 5.97 | 1.733 44.81 | 2.783 7.80 | 3.83 4.65
0.700 5.97 | 1.750 44.81 | 2.800 7.80 | 3.85 4.37
0.717 5.97 | 1.767 44.81 | 2.817 7.80 | 3.87 4.37
0.733 5.97 | 1.783 44.81 | 2.833 7.80 | 3.88 4.37
0.750 5.97 | 1.800 44.81 | 2.850 6.96 | 3.90 4.37
0.767 5.97 | 1.817 44.81 | 2.867 6.96 | 3.92 4.37
0.783 5.97 | 1.833 44.81 | 2.883 6.96 | 3.93 4.37
0.800 5.97 | 1.850 23.44 | 2.900 6.96 | 3.95 4.37
0.817 5.97 | 1.867 23.44 | 2.917 6.96 | 3.97 4.37
0.833 5.97 | 1.883 23.44 | 2.933 6.96 | 3.98 4.37
0.850 7.29 | 1.900 23.44 | 2.950 6.96 | 4.00 4.37
0.867 7.29 | 1.917 23.44 | 2.967 6.96 | 4.02 4.14
0.883 7.29 | 1.933 23.44 | 2.983 6.96 | 4.03 4.14
0.900 7.29 | 1.950 23.44 | 3.000 6.96 | 4.05 4.14
0.917 7.29 | 1.967 23.44 | 3.017 6.30 | 4.07 4.14
0.933 7.29 | 1.983 23.44 | 3.033 6.30 | 4.08 4.14
0.950 7.29 | 2.000 23.44 | 3.050 6.30 | 4.10 4.14
0.967 7.29 | 2.017 16.26 | 3.067 6.30 | 4.12 4.14
0.983 7.29 | 2.033 16.26 | 3.083 6.30 | 4.13 4.14
1.000 7.29 | 2.050 16.26 | 3.100 6.30 | 4.15 4.14
1.017 9.53 | 2.067 16.26 | 3.117 6.30 | 4.17 4.14
1.033 9.53 | 2.083 16.26 | 3.133 6.30 |
1.050 9.53 | 2.100 16.26 | 3.150 6.30 |

Max.Eff.Inten.(mm/hr)= 186.56 685.21
over (min)= 5.00 6.00
Storage Coeff. (min)= 1.65 (ii) 5.36 (ii)
Unit Hyd. Tpeak (min)= 5.00 6.00
Unit Hyd. peak (cms)= 0.40 0.20

TOTALS
PEAK FLOW (cms)= 0.18 0.12 0.298 (iii)

TIME TO PEAK (hrs)= 1.67 1.70 1.68 1.017 9.53 | 2.067 16.26 | 3.117 6.30 | 4.17 4.14
RUNOFF VOLUME (mm)= 72.16 47.33 58.50 1.033 9.53 | 2.083 16.26 | 3.133 6.30 |
TOTAL RAINFALL (mm)= 72.96 72.96 72.96 1.050 9.53 | 2.100 16.26 | 3.150 6.30 |
RUNOFF COEFFICIENT = 0.99 0.65 0.80

(i) CN PROCEDURE SELECTED FOR PVIOUS LOSSES:
CN* = 58.0 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.

Max.Eff.Inten.(mm/hr)= 186.56 685.21
over (min)= 5.00 6.00
Storage Coeff. (min)= 1.95 (ii) 5.66 (ii)
Unit Hyd. Tpeak (min)= 5.00 6.00
Unit Hyd. peak (cms)= 0.38 0.20

PEAK FLOW (cms)= 0.32 0.21 0.516 (iii)
TIME TO PEAK (hrs)= 1.67 1.72 1.68
RUNOFF VOLUME (mm)= 72.16 47.34 58.50
TOTAL RAINFALL (mm)= 72.96 72.96 72.96
RUNOFF COEFFICIENT = 0.99 0.65 0.80

(i) CN PROCEDURE SELECTED FOR PVIOUS LOSSES:
CN* = 58.0 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.

DUHYD (0230) |
Inlet Cap.= 0.015 |
#of Inlets= 1 |
Total(cms)= 0.0 |
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
TOTAL HYD.(ID= 1): 0.80 0.30 1.68 58.50
MAJOR SYS.(ID= 2): 0.52 0.28 1.68 58.50
MINOR SYS.(ID= 3): 0.28 0.01 1.27 58.50

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB |
STANDHYD (0024) | Area (ha)= 1.40
ID= 1 DT= 1.0 min | Total Imp(%)= 90.00 Dir. Conn.(%)= 45.00

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 1.26 0.14
Dep. Storage (mm)= 0.80 16.50
Average Slope (%)= 1.00 1.00
Length (m)= 96.61 40.00
Mannings n = 0.013 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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
0.017 0.00 | 1.067 9.53 | 2.117 16.26 | 3.17 6.30
0.033 0.00 | 1.083 9.53 | 2.133 16.26 | 3.18 5.79
0.050 0.00 | 1.100 9.53 | 2.150 16.26 | 3.20 5.79
0.067 0.00 | 1.117 9.53 | 2.167 16.26 | 3.22 5.79
0.083 0.00 | 1.133 9.53 | 2.183 12.62 | 3.23 5.79
0.100 0.00 | 1.150 9.53 | 2.200 12.62 | 3.25 5.79
0.117 0.00 | 1.167 9.53 | 2.217 12.62 | 3.27 5.79
0.133 0.00 | 1.183 14.27 | 2.233 12.62 | 3.28 5.79
0.150 0.00 | 1.200 14.27 | 2.250 12.62 | 3.30 5.79
0.167 0.00 | 1.217 14.27 | 2.267 12.62 | 3.32 5.79
0.183 3.99 | 1.233 14.27 | 2.283 12.62 | 3.33 5.79
0.200 3.99 | 1.250 14.27 | 2.300 12.62 | 3.35 5.33
0.217 3.99 | 1.267 14.27 | 2.317 12.62 | 3.37 5.33
0.233 3.99 | 1.283 14.27 | 2.333 12.62 | 3.38 5.33
0.250 3.99 | 1.300 14.27 | 2.350 10.39 | 3.40 5.33
0.267 3.99 | 1.317 14.27 | 2.367 10.39 | 3.42 5.33
0.283 3.99 | 1.333 14.27 | 2.383 10.39 | 3.43 5.33
0.300 3.99 | 1.350 33.90 | 2.400 10.39 | 3.45 5.33
0.317 3.99 | 1.367 33.90 | 2.417 10.39 | 3.47 5.33
0.333 3.99 | 1.383 33.90 | 2.433 10.39 | 3.48 5.33
0.350 4.45 | 1.400 33.90 | 2.450 10.39 | 3.50 5.33
0.367 4.45 | 1.417 33.90 | 2.467 10.39 | 3.52 4.98
0.383 4.45 | 1.433 33.90 | 2.483 10.39 | 3.53 4.98
0.400 4.45 | 1.450 33.90 | 2.500 10.39 | 3.55 4.98
0.417 4.45 | 1.467 33.90 | 2.517 8.89 | 3.57 4.98
0.433 4.45 | 1.483 33.90 | 2.533 8.89 | 3.58 4.98
0.450 4.45 | 1.500 33.90 | 2.550 8.89 | 3.60 4.98
0.467 4.45 | 1.517 186.56 | 2.567 8.89 | 3.62 4.98
0.483 4.45 | 1.533 186.56 | 2.583 8.89 | 3.63 4.98
0.500 4.45 | 1.550 186.56 | 2.600 8.89 | 3.65 4.98
0.517 5.08 | 1.567 186.56 | 2.617 8.89 | 3.67 4.98
0.533 5.08 | 1.583 186.56 | 2.633 8.89 | 3.68 4.65
0.550 5.08 | 1.600 186.56 | 2.650 8.89 | 3.70 4.65
0.567 5.08 | 1.617 186.56 | 2.667 8.89 | 3.72 4.65
0.583 5.08 | 1.633 186.56 | 2.683 7.80 | 3.73 4.65
0.600 5.08 | 1.650 186.56 | 2.700 7.80 | 3.75 4.65
0.617 5.08 | 1.667 186.56 | 2.717 7.80 | 3.77 4.65
0.633 5.08 | 1.683 44.82 | 2.733 7.80 | 3.78 4.65
0.650 5.08 | 1.700 44.81 | 2.750 7.80 | 3.80 4.65
0.667 5.08 | 1.717 44.81 | 2.767 7.80 | 3.82 4.65
0.683 5.97 | 1.733 44.81 | 2.783 7.80 | 3.83 4.65
0.700 5.97 | 1.750 44.81 | 2.800 7.80 | 3.85 4.37
0.717 5.97 | 1.767 44.81 | 2.817 7.80 | 3.87 4.37
0.733 5.97 | 1.783 44.81 | 2.833 7.80 | 3.88 4.37
0.750 5.97 | 1.800 44.81 | 2.850 6.96 | 3.90 4.37
0.767 5.97 | 1.817 44.81 | 2.867 6.96 | 3.92 4.37
0.783 5.97 | 1.833 44.81 | 2.883 6.96 | 3.93 4.37
0.800 5.97 | 1.850 23.44 | 2.900 6.96 | 3.95 4.37
0.817 5.97 | 1.867 23.44 | 2.917 6.96 | 3.97 4.37
0.833 5.97 | 1.883 23.44 | 2.933 6.96 | 3.98 4.37
0.850 7.29 | 1.900 23.44 | 2.950 6.96 | 4.00 4.37
0.867 7.29 | 1.917 23.44 | 2.967 6.96 | 4.02 4.14
0.883 7.29 | 1.933 23.44 | 2.983 6.96 | 4.03 4.14
0.900 7.29 | 1.950 23.44 | 3.000 6.96 | 4.05 4.14
0.917 7.29 | 1.967 23.44 | 3.017 6.30 | 4.07 4.14
0.933 7.29 | 1.983 23.44 | 3.033 6.30 | 4.08 4.14
0.950 7.29 | 2.000 23.44 | 3.050 6.30 | 4.10 4.14
0.967 7.29 | 2.017 16.26 | 3.067 6.30 | 4.12 4.14
0.983 7.29 | 2.033 16.26 | 3.083 6.30 | 4.13 4.14
1.000 7.29 | 2.050 16.26 | 3.100 6.30 | 4.15 4.14

DUHYD (0240) |
Inlet Cap.= 0.015 |
#of Inlets= 1 |
Total(cms)= 0.0 |
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
TOTAL HYD.(ID= 1): 1.40 0.52 1.68 58.50
MAJOR SYS.(ID= 2): 1.06 0.50 1.68 58.50
MINOR SYS.(ID= 3): 0.34 0.01 1.07 58.50

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001) |
1 + 2 = 3 |
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
ID1= 1 (0010): 33.17 1.040 1.57 20.02
+ ID2= 2 (0211): 13.51 0.280 1.67 22.13
ID = 3 (1001): 46.67 1.320 1.68 20.63

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001) |
3 + 2 = 1 |
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
ID1= 3 (1001): 46.67 1.320 1.68 20.63
+ ID2= 2 (0220): 11.82 0.025 4.53 19.59
ID = 1 (1001): 58.49 1.340 2.17 20.42

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001) |
1 + 2 = 3 |
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
ID1= 1 (1001): 58.49 1.340 2.17 20.42
+ ID2= 2 (0230): 0.28 0.015 1.27 58.50
ID = 3 (1001): 58.78 1.355 2.17 20.60

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001) |
3 + 2 = 1 |
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
ID1= 3 (1001): 58.78 1.355 2.17 20.60
+ ID2= 2 (0240): 0.34 0.015 1.07 58.50
ID = 1 (1001): 59.11 1.370 2.17 20.82

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001) |
1 + 2 = 3 |
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
ID1= 1 (1001): 59.11 1.370 2.17 20.82
+ ID2= 2 (0030): 14.62 1.827 1.57 48.26
ID = 3 (1001): 73.73 3.193 1.90 26.26

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB |
STANDHYD (0004) | Area (ha)= 7.85
ID= 1 DT= 5.0 min | Total Imp(%)= 46.00 Dir. Conn.(%)= 22.00
IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 3.61 4.24

Dep. Storage (mm)= 1.00 8.10
Average Slope (%)= 1.00 2.00
Length (m)= 228.76 40.00
Mannings n = 0.013 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083	0.00	1.167	9.53	2.250	12.62	3.33	5.79
0.167	0.00	1.250	14.27	2.333	12.62	3.42	5.33
0.250	3.99	1.333	14.27	2.417	10.39	3.50	5.33
0.333	3.99	1.417	33.90	2.500	10.39	3.58	4.98
0.417	4.45	1.500	33.90	2.583	8.89	3.67	4.98
0.500	4.45	1.583	186.56	2.667	8.89	3.75	4.65
0.583	5.08	1.667	186.56	2.750	7.80	3.83	4.65
0.667	5.08	1.750	44.81	2.833	7.80	3.92	4.37
0.750	5.97	1.833	44.81	2.917	6.96	4.00	4.37
0.833	5.97	1.917	23.44	3.000	6.96	4.08	4.14
0.917	7.29	2.000	23.44	3.083	6.30	4.17	4.14
1.000	7.29	2.083	16.26	3.167	6.30		
1.083	9.53	2.167	16.26	3.250	5.79		

Max.Eff.Inten.(mm/hr)= 186.56 117.59
over (min) 5.00 10.00
Storage Coeff. (min)= 3.27 (ii) 9.89 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.27 0.11

TOTALS

PEAK FLOW (cms)= 0.86 0.87 1.528 (iii)
TIME TO PEAK (hrs)= 1.67 1.75 1.67
RUNOFF VOLUME (mm)= 71.96 33.42 41.90
TOTAL RAINFALL (mm)= 72.96 72.96 72.96
RUNOFF COEFFICIENT = 0.99 0.46 0.57

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 72.0 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.

| DUHYD (0040) |
| Inlet Cap.= 0.084 |
| #of Inlets= 1 |
| Total(cms)= 0.1 |

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
TOTAL HYD.(ID= 1):	7.85	1.53	1.67	41.90
MAJOR SYS.(ID= 2):	5.44	1.44	1.67	41.90
MINOR SYS.(ID= 3):	2.41	0.08	1.42	41.90

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| ADD HYD (1002) |
| 1 + 2 = 3 |

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (1001):	73.73	3.193	1.90	26.26
+ ID2= 2 (0040):	2.41	0.084	1.42	41.90
ID = 3 (1002):	76.14	3.277	1.90	26.76

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| ADD HYD (1003) |
| 1 + 2 = 3 |

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (1002):	76.14	3.277	1.90	26.76
+ ID2= 2 (5000):	3.43	0.020	4.25	29.42
ID = 3 (1003):	79.57	3.292	1.90	26.87

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

100-YEAR STORM - POST-DEVELOPMENT

V V I SSSS U U A L (v 6.2.2015)
V V I SS U U A A L
V V I SS U U AAAAA L
V V I SS U U A A L
VV I SSSS UUUU A A LLLL
OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO
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***** D E T A I L E D O U T P U T *****
Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\Natalie\AppData\Local\Civica\XH5\2b61f5e3-29d9-4c68-a5ec-7ff64ecb31ab\5512a5ee-8774-4cfe-80ac-e9d284df5229\scen
Summary filename: C:\Users\Natalie\AppData\Local\Civica\XH5\2b61f5e3-29d9-4c68-a5ec-7ff64ecb31ab\5512a5ee-8774-4cfe-80ac-e9d284df5229\scen
DATE: 10/19/2023 TIME: 03:51:46
USER:
COMMENTS:

***** SIMULATION : Norfolk 100 yr 4hr *****
| READ STORM | Filename: C:\Users\Natalie\AppData
| | ata\Local\Temp\
| | b7db1222-786f-4fa1-9026-76a41ee37e1f\el1495e0d
| Ptotal= 83.90 mm | Comments: Norfolk 100 yr 4hr
TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.00 0.00 | 1.17 16.86 | 2.33 12.12 | 3.50 5.66
0.17 4.50 | 1.33 41.07 | 2.50 10.31 | 3.67 5.28
0.33 5.05 | 1.50 205.92 | 2.67 9.02 | 3.83 4.98
0.50 5.82 | 1.67 54.56 | 2.83 8.03 | 4.00 4.70
0.67 6.83 | 1.83 29.17 | 3.00 7.24 |
0.83 8.41 | 2.00 19.28 | 3.17 6.60 |
1.00 11.07 | 2.17 14.83 | 3.33 6.10 |

| CALIB |
| STANDHYD (0051) | Area (ha)= 0.60 Curve Number (CN)= 62.0
| ID= 1 DT= 5.0 min | Ia (mm)= 13.60 # of Linear Res. (N)= 3.00

U.H. Tp (hrs)= 0.14
NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083 0.00 | 1.167 11.07 | 2.250 14.83 | 3.33 6.60
0.167 0.00 | 1.250 16.86 | 2.333 14.83 | 3.42 6.10
0.250 4.50 | 1.333 16.86 | 2.417 12.12 | 3.50 6.10
0.333 4.50 | 1.417 41.07 | 2.500 12.12 | 3.58 5.66
0.417 5.05 | 1.500 41.07 | 2.583 10.31 | 3.67 5.66
0.500 5.05 | 1.583 205.92 | 2.667 10.31 | 3.75 5.28
0.583 5.82 | 1.667 205.92 | 2.750 9.02 | 3.83 5.28
0.667 5.82 | 1.750 54.56 | 2.833 9.02 | 3.92 4.98
0.750 6.83 | 1.833 54.56 | 2.917 8.03 | 4.00 4.98
0.833 6.83 | 1.917 29.17 | 3.000 8.03 | 4.08 4.70
0.917 8.41 | 2.000 29.17 | 3.083 7.24 | 4.17 4.70
1.000 8.41 | 2.083 19.28 | 3.167 7.24 |
1.083 11.07 | 2.167 19.28 | 3.250 6.60 |
Unit Hyd Qpeak (cms)= 0.164
PEAK FLOW (cms)= 0.049 (i)
TIME TO PEAK (hrs)= 1.750
RUNOFF VOLUME (mm)= 21.707
TOTAL RAINFALL (mm)= 83.902
RUNOFF COEFFICIENT = 0.259
(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| STANDHYD (0052) | Area (ha)= 2.83
| ID= 1 DT= 5.0 min | Total Imp(%)= 41.00 Dir. Conn.(%)= 20.00

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 1.16 1.67
Dep. Storage (mm)= 1.00 13.60
Average Slope (%)= 1.00 2.00
Length (m)= 137.36 40.00
Mannings n = 0.013 0.250
NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083 0.00 | 1.167 11.07 | 2.250 14.83 | 3.33 6.60
0.167 0.00 | 1.250 16.86 | 2.333 14.83 | 3.42 6.10
0.250 4.50 | 1.333 16.86 | 2.417 12.12 | 3.50 6.10
0.333 4.50 | 1.417 41.07 | 2.500 12.12 | 3.58 5.66
0.417 5.05 | 1.500 41.07 | 2.583 10.31 | 3.67 5.66
0.500 5.05 | 1.583 205.92 | 2.667 10.31 | 3.75 5.28
0.583 5.82 | 1.667 205.92 | 2.750 9.02 | 3.83 5.28
0.667 5.82 | 1.750 54.56 | 2.833 9.02 | 3.92 4.98
0.750 6.83 | 1.833 54.56 | 2.917 8.03 | 4.00 4.98
0.833 6.83 | 1.917 29.17 | 3.000 8.03 | 4.08 4.70
0.917 8.41 | 2.000 29.17 | 3.083 7.24 | 4.17 4.70
1.000 8.41 | 2.083 19.28 | 3.167 7.24 |
1.083 11.07 | 2.167 19.28 | 3.250 6.60 |
Max.Eff.Inten.(mm/hr)= 205.92 84.47
over (min)= 5.00 10.00
Storage Coeff. (min)= 2.32 (ii) 9.87 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.30 0.11
PEAK FLOW (cms)= 0.32 0.25 *TOTALS*
TIME TO PEAK (hrs)= 1.67 1.75 0.502 (iii)
RUNOFF VOLUME (mm)= 82.90 28.92 39.72
TOTAL RAINFALL (mm)= 83.90 83.90 83.90
RUNOFF COEFFICIENT = 0.99 0.34 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* = 62.0 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 (0050) | Area (ha)= 1.52
| ID= 1 DT= 5.0 min | Total Imp(%)= 48.00 Dir. Conn.(%)= 21.00

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 0.73 0.79
Dep. Storage (mm)= 1.00 13.60
Average Slope (%)= 1.00 2.00
Length (m)= 100.66 40.00
Mannings n = 0.013 0.250
NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083 0.00 | 1.167 11.07 | 2.250 14.83 | 3.33 6.60
0.167 0.00 | 1.250 16.86 | 2.333 14.83 | 3.42 6.10
0.250 4.50 | 1.333 16.86 | 2.417 12.12 | 3.50 6.10
0.333 4.50 | 1.417 41.07 | 2.500 12.12 | 3.58 5.66
0.417 5.05 | 1.500 41.07 | 2.583 10.31 | 3.67 5.66
0.500 5.05 | 1.583 205.92 | 2.667 10.31 | 3.75 5.28
0.583 5.82 | 1.667 205.92 | 2.750 9.02 | 3.83 5.28
0.667 5.82 | 1.750 54.56 | 2.833 9.02 | 3.92 4.98
0.750 6.83 | 1.833 54.56 | 2.917 8.03 | 4.00 4.98
0.833 6.83 | 1.917 29.17 | 3.000 8.03 | 4.08 4.70
0.917 8.41 | 2.000 29.17 | 3.083 7.24 | 4.17 4.70
1.000 8.41 | 2.083 19.28 | 3.167 7.24 |
1.083 11.07 | 2.167 19.28 | 3.250 6.60 |
Max.Eff.Inten.(mm/hr)= 205.92 106.32
over (min)= 5.00 10.00
Storage Coeff. (min)= 1.92 (ii) 8.81 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.31 0.12 *TOTALS*
PEAK FLOW (cms)= 0.18 0.16 0.299 (iii)
TIME TO PEAK (hrs)= 1.67 1.75 1.67
RUNOFF VOLUME (mm)= 82.90 31.66 42.42
TOTAL RAINFALL (mm)= 83.90 83.90 83.90
RUNOFF COEFFICIENT = 0.99 0.38 0.51

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 62.0 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.

| CHAMBER(0053) |
| IN= 2--> OUT= 3 | CHAMBER:
| DT= 5.0 min | MAX STO VOL (cu.m.)= 540.00 Bottom Area(m2) = 500.00

DEPTH STORAGE | DEPTH STORAGE
(mm) (cu.m.) | (mm) (cu.m.)
0.00 0.00 | 800.00 288.00
100.00 36.00 | 900.00 324.00
200.00 72.00 | 1000.00 360.00
300.00 108.00 | 1100.00 396.00
400.00 144.00 | 1200.00 432.00
500.00 180.00 | 1300.00 468.00
600.00 216.00 | 1400.00 504.00
700.00 252.00 | 1500.00 540.00
NATIVE SOIL LAYER:
Infiltration (m/hr) = 0.0250
AREA QPEAK TPEAK R.V.

0.333	4.50	1.383	41.07	2.433	12.12	3.48	6.10
0.350	5.05	1.400	41.07	2.450	12.12	3.50	6.10
0.367	5.05	1.417	41.07	2.467	12.12	3.52	5.66
0.383	5.05	1.433	41.07	2.483	12.12	3.53	5.66
0.400	5.05	1.450	41.07	2.500	12.12	3.55	5.66
0.417	5.05	1.467	41.07	2.517	10.31	3.57	5.66
0.433	5.05	1.483	41.07	2.533	10.31	3.58	5.66
0.450	5.05	1.500	41.07	2.550	10.31	3.60	5.66
0.467	5.05	1.517	205.91	2.567	10.31	3.62	5.66
0.483	5.05	1.533	205.92	2.583	10.31	3.63	5.66
0.500	5.05	1.550	205.92	2.600	10.31	3.65	5.66
0.517	5.82	1.567	205.92	2.617	10.31	3.67	5.66
0.533	5.82	1.583	205.92	2.633	10.31	3.68	5.28
0.550	5.82	1.600	205.92	2.650	10.31	3.70	5.28
0.567	5.82	1.617	205.92	2.667	10.31	3.72	5.28
0.583	5.82	1.633	205.92	2.683	9.02	3.73	5.28
0.600	5.82	1.650	205.92	2.700	9.02	3.75	5.28
0.617	5.82	1.667	205.92	2.717	9.02	3.77	5.28
0.633	5.82	1.683	54.57	2.733	9.02	3.78	5.28
0.650	5.82	1.700	54.56	2.750	9.02	3.80	5.28
0.667	5.82	1.717	54.56	2.767	9.02	3.82	5.28
0.683	6.83	1.733	54.56	2.783	9.02	3.83	5.28
0.700	6.83	1.750	54.56	2.800	9.02	3.85	4.98
0.717	6.83	1.767	54.56	2.817	9.02	3.87	4.98
0.733	6.83	1.783	54.56	2.833	9.02	3.88	4.98
0.750	6.83	1.800	54.56	2.850	8.03	3.90	4.98
0.767	6.83	1.817	54.56	2.867	8.03	3.92	4.98
0.783	6.83	1.833	54.56	2.883	8.03	3.93	4.98
0.800	6.83	1.850	29.17	2.900	8.03	3.95	4.98
0.817	6.83	1.867	29.17	2.917	8.03	3.97	4.98
0.833	6.83	1.883	29.17	2.933	8.03	3.98	4.98
0.850	8.41	1.900	29.17	2.950	8.03	4.00	4.98
0.867	8.41	1.917	29.17	2.967	8.03	4.02	4.70
0.883	8.41	1.933	29.17	2.983	8.03	4.03	4.70
0.900	8.41	1.950	29.17	3.000	8.03	4.05	4.70
0.917	8.41	1.967	29.17	3.017	7.24	4.07	4.70
0.933	8.41	1.983	29.17	3.033	7.24	4.08	4.70
0.950	8.41	2.000	29.17	3.050	7.24	4.10	4.70
0.967	8.41	2.017	19.28	3.067	7.24	4.12	4.70
0.983	8.41	2.033	19.28	3.083	7.24	4.13	4.70
1.000	8.41	2.050	19.28	3.100	7.24	4.15	4.70
1.017	11.07	2.067	19.28	3.117	7.24	4.17	4.70
1.033	11.07	2.083	19.28	3.133	7.24		
1.050	11.07	2.100	19.28	3.150	7.24		

Max.Eff.Inten.(mm/hr)= 205.92 82.84
over (min) 5.00 13.00
Storage Coeff. (min)= 3.55 (ii) 12.92 (ii)
Unit Hyd. Tpeak (min)= 5.00 13.00
Unit Hyd. peak (cms)= 0.28 0.09

TOTALS

PEAK FLOW (cms)= 1.34 0.78 1.685 (iii)
TIME TO PEAK (hrs)= 1.68 1.85 1.70
RUNOFF VOLUME (mm)= 83.10 26.73 39.13
TOTAL RAINFALL (mm)= 83.90 83.90 83.90
RUNOFF COEFFICIENT = 0.99 0.32 0.47

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

RESERVOIR (0220) OVERFLOW IS OFF				
IN= 2----> OUT= 1				
DT= 1.0 min				

	OUTFLOW	STORAGE	OUTFLOW	STORAGE
	(cms)	(ha.m.)	(cms)	(ha.m.)
	0.0000	0.0000	0.0251	0.3540
	0.0066	0.0550	0.0273	0.4180
	0.0127	0.1120	0.0294	0.4840
	0.0167	0.1700	0.0313	0.5510
	0.0199	0.2300	0.0332	0.6200
	0.0226	0.2910	0.0000	0.0000

INFLOW : ID= 2 (0022) AREA (ha) 11.820 QPEAK (cms) 1.685 TPEAK (hrs) 1.70 R.V. (mm) 39.13
OUTFLOW: ID= 1 (0220) AREA (ha) 11.820 QPEAK (cms) 0.028 TPEAK (hrs) 4.50 R.V. (mm) 22.49

PEAK FLOW REDUCTION [Qout/Qin](%) = 1.65
TIME SHIFT OF PEAK FLOW (min)=168.00
MAXIMUM STORAGE USED (ha.m.) = 0.4343

| CALIB |
| STANDHYD (0003) | Area (ha)= 19.20
| ID= 1 DT= 1.0 min | Total Imp(%)= 80.00 Dir. Conn.(%)= 50.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	15.36	3.84
Dep. Storage (mm)=	0.80	23.90
Average Slope (%)=	2.00	2.00
Length (m)=	357.77	40.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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		
0.017	0.00	1.067	11.07	2.117	19.28	3.17	7.24		
0.033	0.00	1.083	11.07	2.133	19.28	3.18	6.60		
0.050	0.00	1.100	11.07	2.150	19.28	3.20	6.60		
0.067	0.00	1.117	11.07	2.167	19.28	3.22	6.60		
0.083	0.00	1.133	11.07	2.183	14.83	3.23	6.60		
0.100	0.00	1.150	11.07	2.200	14.83	3.25	6.60		
0.117	0.00	1.167	11.07	2.217	14.83	3.27	6.60		
0.133	0.00	1.183	16.86	2.233	14.83	3.28	6.60		
0.150	0.00	1.200	16.86	2.250	14.83	3.30	6.60		

0.167	0.00	1.217	16.86	2.267	14.83	3.32	6.60
0.183	4.50	1.233	16.86	2.283	14.83	3.33	6.60
0.200	4.50	1.250	16.86	2.300	14.83	3.35	6.10
0.217	4.50	1.267	16.86	2.317	14.83	3.37	6.10
0.233	4.50	1.283	16.86	2.333	14.83	3.38	6.10
0.250	4.50	1.300	16.86	2.350	12.12	3.40	6.10
0.267	4.50	1.317	16.86	2.367	12.12	3.42	6.10
0.283	4.50	1.333	16.86	2.383	12.12	3.43	6.10
0.300	4.50	1.350	41.07	2.400	12.12	3.45	6.10
0.317	4.50	1.367	41.07	2.417	12.12	3.47	6.10
0.333	4.50	1.383	41.07	2.433	12.12	3.48	6.10
0.350	5.05	1.400	41.07	2.450	12.12	3.50	6.10
0.367	5.05	1.417	41.07	2.467	12.12	3.52	5.66
0.383	5.05	1.433	41.07	2.483	12.12	3.53	5.66
0.400	5.05	1.450	41.07	2.500	12.12	3.55	5.66
0.417	5.05	1.467	41.07	2.517	10.31	3.57	5.66
0.433	5.05	1.483	41.07	2.533	10.31	3.58	5.66
0.450	5.05	1.500	41.07	2.550	10.31	3.60	5.66
0.467	5.05	1.517	205.91	2.567	10.31	3.62	5.66
0.483	5.05	1.533	205.92	2.583	10.31	3.63	5.66
0.500	5.05	1.550	205.92	2.600	10.31	3.65	5.66
0.517	5.82	1.567	205.92	2.617	10.31	3.67	5.66
0.533	5.82	1.583	205.92	2.633	10.31	3.68	5.28
0.550	5.82	1.600	205.92	2.650	10.31	3.70	5.28
0.567	5.82	1.617	205.92	2.667	10.31	3.72	5.28
0.583	5.82	1.633	205.92	2.683	9.02	3.73	5.28
0.600	5.82	1.650	205.92	2.700	9.02	3.75	5.28
0.617	5.82	1.667	205.92	2.717	9.02	3.77	5.28
0.633	5.82	1.683	54.57	2.733	9.02	3.78	5.28
0.650	5.82	1.700	54.56	2.750	9.02	3.80	5.28
0.667	5.82	1.717	54.56	2.767	9.02	3.82	5.28
0.683	6.83	1.733	54.56	2.783	9.02	3.83	5.28
0.700	6.83	1.750	54.56	2.800	9.02	3.85	4.98
0.717	6.83	1.767	54.56	2.817	9.02	3.87	4.98
0.733	6.83	1.783	54.56	2.833	9.02	3.88	4.98
0.750	6.83	1.800	54.56	2.850	8.03	3.90	4.98
0.767	6.83	1.817	54.56	2.867	8.03	3.92	4.98
0.783	6.83	1.833	54.56	2.883	8.03	3.93	4.98
0.800	6.83	1.850	29.17	2.900	8.03	3.95	4.98
0.817	6.83	1.867	29.17	2.917	8.03	3.97	4.98
0.833	6.83	1.883	29.17	2.933	8.03	3.98	4.98
0.850	8.41	1.900	29.17	2.950	8.03	4.00	4.98
0.867	8.41	1.917	29.17	2.967	8.03	4.02	4.70
0.883	8.41	1.933	29.17	2.983	8.03	4.03	4.70
0.900	8.41	1.950	29.17	3.000	8.03	4.05	4.70
0.917	8.41	1.967	29.17	3.017	7.24	4.07	4.70
0.933	8.41	1.983	29.17	3.033	7.24	4.08	4.70
0.950	8.41	2.000	29.17	3.050	7.24	4.10	4.70
0.967	8.41	2.017	19.28	3.067	7.24	4.12	4.70
0.983	8.41	2.033	19.28	3.083	7.24	4.13	4.70
1.000	8.41	2.050	19.28	3.100	7.24	4.15	4.70
1.017	11.07	2.067	19.28	3.117	7.24	4.17	4.70
1.033	11.07	2.083	19.28	3.133	7.24		
1.050	11.07	2.100	19.28	3.150	7.24		

Max.Eff.Inten.(mm/hr)= 205.92 172.65
over (min) 5.00 8.00
Storage Coeff. (min)= 3.34 (ii) 7.00 (ii)
Unit Hyd. Tpeak (min)= 5.00 8.00
Unit Hyd. peak (cms)= 0.29 0.15

TOTALS

PEAK FLOW (cms)= 5.01 1.36 6.063 (iii)
TIME TO PEAK (hrs)= 1.67 1.75 1.68
RUNOFF VOLUME (mm)= 83.10 31.41 57.26
TOTAL RAINFALL (mm)= 83.90 83.90 83.90
RUNOFF COEFFICIENT = 0.99 0.37 0.68

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 50.0 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.

| DUHYD (0030) |
| Inlet Cap.= 1.827 |
| #of Inlets= 1 |
| Total(cms)= 1.8 | AREA (ha) QPEAK (cms) TPEAK (hrs) R.V. (mm)

TOTAL HYD. (ID= 1): 19.20 6.06 1.68 57.26
=====

MAJOR SYS. (ID= 2): 5.24 4.24 1.68 57.26
MINOR SYS. (ID= 3): 13.96 1.83 1.55 57.26

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| CALIB |
| STANDHYD (0021) | Area (ha)= 16.90
| ID= 1 DT= 5.0 min | Total Imp(%)= 38.00 Dir. Conn.(%)= 16.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	6.42	10.48
Dep. Storage (mm)=	0.80	23.90
Average Slope (%)=	2.00	2.00
Length (m)=	335.66	40.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083	0.00	1.167	11.07	2.250	14.83	3.33	6.60
0.167	0.00	1.250	16.86	2.333	14.83	3.42	6.10
0.250	4.50	1.333	16.86	2.417	12.12	3.50	6.10
0.333	4.50	1.417	41.07	2.500	12.12	3.58	5.66
0.417	5.05	1.500	41.07	2.583	10.31	3.67	5.66
0.500	5.05	1.583	205.92	2.667	10.31	3.75	5.28
0.583	5.82	1.667	205.92	2.750	9.02	3.83	5.28

0.667 5.82 | 1.750 54.56 | 2.833 9.02 | 3.92 4.98
0.750 6.83 | 1.833 54.56 | 2.917 8.03 | 4.00 4.98
0.833 6.83 | 1.917 29.17 | 3.000 8.03 | 4.08 4.70
0.917 8.41 | 2.000 29.17 | 3.083 7.24 | 4.17 4.70
1.000 8.41 | 2.083 19.28 | 3.167 7.24 |
1.083 11.07 | 2.167 19.28 | 3.250 6.60 |

Max.Eff.Inten.(mm/hr)= 205.92 35.42
over (min) 5.00 15.00
Storage Coeff. (min)= 3.21 (ii) 13.90 (ii)
Unit Hyd. Tpeak (min)= 5.00 15.00
Unit Hyd. peak (cms)= 0.27 0.08

TOTALS
PEAK FLOW (cms)= 1.49 0.66 1.721 (iii)
TIME TO PEAK (hrs)= 1.67 1.83 1.67
RUNOFF VOLUME (mm)= 83.10 17.30 27.83
TOTAL RAINFALL (mm)= 83.90 83.90 83.90
RUNOFF COEFFICIENT = 0.99 0.21 0.33

***** 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* = 50.0 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.

| RESERVOIR(0210) | OVERFLOW IS OFF
| IN= 2----> OUT= 1 |
DT= 5.0 min
OUTFLOW STORAGE OUTFLOW STORAGE
(cms) (ha.m.) (cms) (ha.m.)
0.0000 0.0000 | 0.3900 0.0820
0.0200 0.0000 | 0.4300 0.1090
0.0800 0.0020 | 0.5800 0.2670
0.2100 0.0160 | 0.6360 0.3420
0.3000 0.0330 | 0.0000 0.0000

AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW : ID= 2 (0021) 16.900 1.721 1.67 27.83
OUTFLOW: ID= 1 (0210) 16.900 0.482 2.33 27.83

PEAK FLOW REDUCTION [Qout/Qin](%)= 27.97
TIME SHIFT OF PEAK FLOW (min)= 40.00
MAXIMUM STORAGE USED (ha.m.)= 0.1634

| DUHYD (0211) |
| Inlet Cap.= 0.280 |
| #of Inlets= 1 |
Total(cms)= 0.3
TOTAL HYD.(ID= 1): 16.90 0.48 2.33 27.83
MAJOR SYS.(ID= 2): 4.71 0.20 2.33 27.83
MINOR SYS.(ID= 3): 12.19 0.28 1.67 27.83

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| CALIB |
| STANDHYD (0023) |
ID= 1 DT= 1.0 min
Area (ha)= 0.80
Total Imp(%)= 90.00 Dir. Conn.(%)= 45.00

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 0.72 0.08
Dep. Storage (mm)= 0.80 16.50
Average Slope (%)= 1.00 1.00
Length (m)= 73.03 40.00
Mannings n = 0.013 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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
0.017 0.00 | 1.067 11.07 | 2.117 19.28 | 3.17 7.24
0.033 0.00 | 1.083 11.07 | 2.133 19.28 | 3.18 6.60
0.050 0.00 | 1.100 11.07 | 2.150 19.28 | 3.20 6.60
0.067 0.00 | 1.117 11.07 | 2.167 19.28 | 3.22 6.60
0.083 0.00 | 1.133 11.07 | 2.183 14.83 | 3.23 6.60
0.100 0.00 | 1.150 11.07 | 2.200 14.83 | 3.25 6.60
0.117 0.00 | 1.167 11.07 | 2.217 14.83 | 3.27 6.60
0.133 0.00 | 1.183 16.86 | 2.233 14.83 | 3.28 6.60
0.150 0.00 | 1.200 16.86 | 2.250 14.83 | 3.30 6.60
0.167 0.00 | 1.217 16.86 | 2.267 14.83 | 3.32 6.60
0.183 4.50 | 1.233 16.86 | 2.283 14.83 | 3.33 6.60
0.200 4.50 | 1.250 16.86 | 2.300 14.83 | 3.35 6.10
0.217 4.50 | 1.267 16.86 | 2.317 14.83 | 3.37 6.10
0.233 4.50 | 1.283 16.86 | 2.333 14.83 | 3.38 6.10
0.250 4.50 | 1.300 16.86 | 2.350 12.12 | 3.40 6.10
0.267 4.50 | 1.317 16.86 | 2.367 12.12 | 3.42 6.10
0.283 4.50 | 1.333 16.86 | 2.383 12.12 | 3.43 6.10
0.300 4.50 | 1.350 41.07 | 2.400 12.12 | 3.45 6.10
0.317 4.50 | 1.367 41.07 | 2.417 12.12 | 3.47 6.10
0.333 4.50 | 1.383 41.07 | 2.433 12.12 | 3.48 6.10
0.350 5.05 | 1.400 41.07 | 2.450 12.12 | 3.50 6.10
0.367 5.05 | 1.417 41.07 | 2.467 12.12 | 3.52 5.66
0.383 5.05 | 1.433 41.07 | 2.483 12.12 | 3.53 5.66
0.400 5.05 | 1.450 41.07 | 2.500 12.12 | 3.55 5.66
0.417 5.05 | 1.467 41.07 | 2.517 10.31 | 3.57 5.66
0.433 5.05 | 1.483 41.07 | 2.533 10.31 | 3.58 5.66
0.450 5.05 | 1.500 41.07 | 2.550 10.31 | 3.60 5.66
0.467 5.05 | 1.517 205.91 | 2.567 10.31 | 3.62 5.66
0.483 5.05 | 1.533 205.92 | 2.583 10.31 | 3.63 5.66
0.500 5.05 | 1.550 205.92 | 2.600 10.31 | 3.65 5.66
0.517 5.82 | 1.567 205.92 | 2.617 10.31 | 3.67 5.66

0.533 5.82 | 1.583 205.92 | 2.633 10.31 | 3.68 5.28
0.550 5.82 | 1.600 205.92 | 2.650 10.31 | 3.70 5.28
0.567 5.82 | 1.617 205.92 | 2.667 10.31 | 3.72 5.28
0.583 5.82 | 1.633 205.92 | 2.683 9.02 | 3.73 5.28
0.600 5.82 | 1.650 205.92 | 2.700 9.02 | 3.75 5.28
0.617 5.82 | 1.667 205.92 | 2.717 9.02 | 3.77 5.28
0.633 5.82 | 1.683 54.57 | 2.733 9.02 | 3.78 5.28
0.650 5.82 | 1.700 54.56 | 2.750 9.02 | 3.80 5.28
0.667 5.82 | 1.717 54.56 | 2.767 9.02 | 3.82 5.28
0.683 6.83 | 1.733 54.56 | 2.783 9.02 | 3.83 5.28
0.700 6.83 | 1.750 54.56 | 2.800 9.02 | 3.85 4.98
0.717 6.83 | 1.767 54.56 | 2.817 9.02 | 3.87 4.98
0.733 6.83 | 1.783 54.56 | 2.833 9.02 | 3.88 4.98
0.750 6.83 | 1.800 54.56 | 2.850 8.03 | 3.90 4.98
0.767 6.83 | 1.817 54.56 | 2.867 8.03 | 3.92 4.98
0.783 6.83 | 1.833 54.56 | 2.883 8.03 | 3.93 4.98
0.800 6.83 | 1.850 29.17 | 2.900 8.03 | 3.95 4.98
0.817 6.83 | 1.867 29.17 | 2.917 8.03 | 3.97 4.98
0.833 6.83 | 1.883 29.17 | 2.933 8.03 | 3.98 4.98
0.850 8.41 | 1.900 29.17 | 2.950 8.03 | 4.00 4.98
0.867 8.41 | 1.917 29.17 | 2.967 8.03 | 4.02 4.70
0.883 8.41 | 1.933 29.17 | 2.983 8.03 | 4.03 4.70
0.900 8.41 | 1.950 29.17 | 3.000 8.03 | 4.05 4.70
0.917 8.41 | 1.967 29.17 | 3.017 7.24 | 4.07 4.70
0.933 8.41 | 1.983 29.17 | 3.033 7.24 | 4.08 4.70
0.950 8.41 | 2.000 29.17 | 3.050 7.24 | 4.10 4.70
0.967 8.41 | 2.017 19.28 | 3.067 7.24 | 4.12 4.70
0.983 8.41 | 2.033 19.28 | 3.083 7.24 | 4.13 4.70
1.000 8.41 | 2.050 19.28 | 3.100 7.24 | 4.15 4.70
1.017 11.07 | 2.067 19.28 | 3.117 7.24 | 4.17 4.70
1.033 11.07 | 2.083 19.28 | 3.133 7.24 |
1.050 11.07 | 2.100 19.28 | 3.150 7.24 |

Max.Eff.Inten.(mm/hr)= 205.92 801.64
over (min) 5.00 6.00
Storage Coeff. (min)= 1.58 (ii) 5.15 (ii)
Unit Hyd. Tpeak (min)= 5.00 6.00
Unit Hyd. peak (cms)= 0.41 0.21
TOTALS
PEAK FLOW (cms)= 0.20 0.15 0.340 (iii)
TIME TO PEAK (hrs)= 1.67 1.70 1.68
RUNOFF VOLUME (mm)= 83.10 57.24 68.87
TOTAL RAINFALL (mm)= 83.90 83.90 83.90
RUNOFF COEFFICIENT = 0.99 0.68 0.82

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

| DUHYD (0230) |
| Inlet Cap.= 0.015 |
| #of Inlets= 1 |
Total(cms)= 0.0
TOTAL HYD.(ID= 1): 0.80 0.34 1.68 68.87
MAJOR SYS.(ID= 2): 0.54 0.33 1.68 68.87
MINOR SYS.(ID= 3): 0.26 0.01 1.22 68.87

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| CALIB |
| STANDHYD (0024) |
ID= 1 DT= 1.0 min
Area (ha)= 1.40
Total Imp(%)= 90.00 Dir. Conn.(%)= 45.00

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 1.26 0.14
Dep. Storage (mm)= 0.80 16.50
Average Slope (%)= 1.00 1.00
Length (m)= 96.61 40.00
Mannings n = 0.013 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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
0.017 0.00 | 1.067 11.07 | 2.117 19.28 | 3.17 7.24
0.033 0.00 | 1.083 11.07 | 2.133 19.28 | 3.18 6.60
0.050 0.00 | 1.100 11.07 | 2.150 19.28 | 3.20 6.60
0.067 0.00 | 1.117 11.07 | 2.167 19.28 | 3.22 6.60
0.083 0.00 | 1.133 11.07 | 2.183 14.83 | 3.23 6.60
0.100 0.00 | 1.150 11.07 | 2.200 14.83 | 3.25 6.60
0.117 0.00 | 1.167 11.07 | 2.217 14.83 | 3.27 6.60
0.133 0.00 | 1.183 16.86 | 2.233 14.83 | 3.28 6.60
0.150 0.00 | 1.200 16.86 | 2.250 14.83 | 3.30 6.60
0.167 0.00 | 1.217 16.86 | 2.267 14.83 | 3.32 6.60
0.183 4.50 | 1.233 16.86 | 2.283 14.83 | 3.33 6.60
0.200 4.50 | 1.250 16.86 | 2.300 14.83 | 3.35 6.10
0.217 4.50 | 1.267 16.86 | 2.317 14.83 | 3.37 6.10
0.233 4.50 | 1.283 16.86 | 2.333 14.83 | 3.38 6.10
0.250 4.50 | 1.267 16.86 | 2.317 14.83 | 3.37 6.10
0.267 4.50 | 1.283 16.86 | 2.333 14.83 | 3.38 6.10
0.283 4.50 | 1.300 16.86 | 2.350 12.12 | 3.40 6.10
0.300 4.50 | 1.317 16.86 | 2.367 12.12 | 3.42 6.10
0.317 4.50 | 1.333 16.86 | 2.383 12.12 | 3.43 6.10
0.333 4.50 | 1.350 41.07 | 2.400 12.12 | 3.45 6.10
0.350 5.05 | 1.367 41.07 | 2.417 12.12 | 3.47 6.10
0.367 5.05 | 1.383 41.07 | 2.433 12.12 | 3.48 6.10
0.383 5.05 | 1.400 41.07 | 2.450 12.12 | 3.50 6.10
0.400 5.05 | 1.417 41.07 | 2.467 12.12 | 3.52 5.66
0.417 5.05 | 1.433 41.07 | 2.483 12.12 | 3.53 5.66
0.433 5.05 | 1.450 41.07 | 2.500 12.12 | 3.55 5.66
0.450 5.05 | 1.467 41.07 | 2.517 10.31 | 3.57 5.66
0.467 5.05 | 1.483 41.07 | 2.533 10.31 | 3.58 5.66
0.483 5.05 | 1.500 41.07 | 2.550 10.31 | 3.60 5.66
0.500 5.05 | 1.517 205.91 | 2.567 10.31 | 3.62 5.66
0.517 5.82 | 1.533 205.92 | 2.583 10.31 | 3.63 5.66

0.500	5.05	1.550	205.92	2.600	10.31	3.65	5.66
0.517	5.82	1.567	205.92	2.617	10.31	3.67	5.66
0.533	5.82	1.583	205.92	2.633	10.31	3.68	5.28
0.550	5.82	1.600	205.92	2.650	10.31	3.70	5.28
0.567	5.82	1.617	205.92	2.667	10.31	3.72	5.28
0.583	5.82	1.633	205.92	2.683	9.02	3.73	5.28
0.600	5.82	1.650	205.92	2.700	9.02	3.75	5.28
0.617	5.82	1.667	205.92	2.717	9.02	3.77	5.28
0.633	5.82	1.683	54.56	2.733	9.02	3.78	5.28
0.650	5.82	1.700	54.56	2.750	9.02	3.80	5.28
0.667	5.82	1.717	54.56	2.767	9.02	3.82	5.28
0.683	6.83	1.733	54.56	2.783	9.02	3.83	5.28
0.700	6.83	1.750	54.56	2.800	9.02	3.85	4.98
0.717	6.83	1.767	54.56	2.817	9.02	3.87	4.98
0.733	6.83	1.783	54.56	2.833	9.02	3.88	4.98
0.750	6.83	1.800	54.56	2.850	8.03	3.90	4.98
0.767	6.83	1.817	54.56	2.867	8.03	3.92	4.98
0.783	6.83	1.833	54.56	2.883	8.03	3.93	4.98
0.800	6.83	1.850	29.17	2.900	8.03	3.95	4.98
0.817	6.83	1.867	29.17	2.917	8.03	3.97	4.98
0.833	6.83	1.883	29.17	2.933	8.03	3.98	4.98
0.850	8.41	1.900	29.17	2.950	8.03	4.00	4.98
0.867	8.41	1.917	29.17	2.967	8.03	4.02	4.70
0.883	8.41	1.933	29.17	2.983	8.03	4.03	4.70
0.900	8.41	1.950	29.17	3.000	8.03	4.05	4.70
0.917	8.41	1.967	29.17	3.017	7.24	4.07	4.70
0.933	8.41	1.983	29.17	3.033	7.24	4.08	4.70
0.950	8.41	2.000	29.17	3.050	7.24	4.10	4.70
0.967	8.41	2.017	19.28	3.067	7.24	4.12	4.70
0.983	8.41	2.033	19.28	3.083	7.24	4.13	4.70
1.000	8.41	2.050	19.28	3.100	7.24	4.15	4.70
1.017	11.07	2.067	19.28	3.117	7.24	4.17	4.70
1.033	11.07	2.083	19.28	3.133	7.24		
1.050	11.07	2.100	19.28	3.150	7.24		

Max.Eff.Inten.(mm/hr)=	205.92	801.64	
over (min)	5.00	6.00	
Storage Coeff. (min)=	1.87 (ii)	5.44 (ii)	
Unit Hyd. Tpeak (min)=	5.00	6.00	
Unit Hyd. peak (cms)=	0.38	0.20	
PEAK FLOW (cms)=	0.35	0.25	0.589 (iii)
TIME TO PEAK (hrs)=	1.67	1.70	1.68
RUNOFF VOLUME (mm)=	83.10	57.24	68.88
TOTAL RAINFALL (mm)=	83.90	83.90	83.90
RUNOFF COEFFICIENT =	0.99	0.68	0.82

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

DUHYD (0240)				
Inlet Cap.= 0.015				
#of Inlets= 1				
Total(cms)= 0.0				
-----	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
TOTAL HYD.(ID= 1):	1.40	0.59	1.68	68.88

MAJOR SYS.(ID= 2):	1.11	0.57	1.68	68.88
MINOR SYS.(ID= 3):	0.29	0.01	0.95	68.88

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)				
1 + 2 = 3				
-----	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (0010):	29.88	1.040	1.55	25.29
+ ID2= 2 (0211):	12.19	0.280	1.67	27.83

ID = 3 (1001):	42.07	1.320	1.68	26.03

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)				
3 + 2 = 1				
-----	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 3 (1001):	42.07	1.320	1.68	26.03
+ ID2= 2 (0220):	11.82	0.028	4.50	22.49

ID = 1 (1001):	53.89	1.344	2.38	25.25

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)				
1 + 2 = 3				
-----	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (1001):	53.89	1.344	2.38	25.25
+ ID2= 2 (0230):	0.26	0.015	1.22	68.87

ID = 3 (1001):	54.15	1.359	2.38	25.46

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)				
3 + 2 = 1				
-----	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 3 (1001):	54.15	1.359	2.38	25.46
+ ID2= 2 (0240):	0.29	0.015	0.95	68.88

ID = 1 (1001):	54.44	1.374	2.38	25.69

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)				
1 + 2 = 3				
-----	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (1001):	54.44	1.374	2.38	25.69
+ ID2= 2 (0030):	13.96	1.827	1.55	57.26

ID = 3 (1001):	68.40	3.196	1.93	32.13

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB				
STANDHYD (0004)	Area	(ha)=	7.85	
ID= 1 DT= 5.0 min	Total Imp(%)=	46.00	Dir. Conn.(%)=	22.00

	IMPERVIOUS	PERVIOUS (i)		
Surface Area	(ha)=	3.61	4.24	
Dep. Storage	(mm)=	1.00	8.10	
Average Slope	(%)=	1.00	2.00	
Length	(m)=	228.76	40.00	
Mannings n	=	0.013	0.250	

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083	0.00	1.167	11.07	2.250	14.83	3.33	6.60
0.167	0.00	1.250	16.86	2.333	14.83	3.42	6.10
0.250	4.50	1.333	16.86	2.417	12.12	3.50	6.10
0.333	4.50	1.417	41.07	2.500	12.12	3.58	5.66
0.417	5.05	1.500	41.07	2.583	10.31	3.67	5.66
0.500	5.05	1.583	205.92	2.667	10.31	3.75	5.28
0.583	5.82	1.667	205.92	2.750	9.02	3.83	5.28
0.667	5.82	1.750	54.56	2.833	9.02	3.92	4.98
0.750	6.83	1.833	54.56	2.917	8.03	4.00	4.98
0.833	6.83	1.917	29.17	3.000	8.03	4.08	4.70
0.917	8.41	2.000	29.17	3.083	7.24	4.17	4.70
1.000	8.41	2.083	19.28	3.167	7.24		
1.083	11.07	2.167	19.28	3.250	6.60		

Max.Eff.Inten.(mm/hr)=	205.92	143.32
over (min)	5.00	10.00
Storage Coeff. (min)=	3.14 (ii)	9.26 (ii)
Unit Hyd. Tpeak (min)=	5.00	10.00
Unit Hyd. peak (cms)=	0.27	0.12

PEAK FLOW (cms)=	0.95	1.10	1.820 (iii)
TIME TO PEAK (hrs)=	1.67	1.75	1.67
RUNOFF VOLUME (mm)=	82.90	41.79	50.84
TOTAL RAINFALL (mm)=	83.90	83.90	83.90
RUNOFF COEFFICIENT =	0.99	0.50	0.61

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

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 72.0 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.

DUHYD (0040)				
Inlet Cap.= 0.084				
#of Inlets= 1				
Total(cms)= 0.1				
-----	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
TOTAL HYD.(ID= 1):	7.85	1.82	1.67	50.84

MAJOR SYS.(ID= 2):	5.79	1.74	1.67	50.84
MINOR SYS.(ID= 3):	2.06	0.08	1.33	50.84

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1002)				
1 + 2 = 3				
-----	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (1001):	68.40	3.196	1.93	32.13
+ ID2= 2 (0040):	2.06	0.084	1.33	50.84

ID = 3 (1002):	70.46	3.280	1.93	32.68

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1003)				
1 + 2 = 3				
-----	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (1002):	70.46	3.280	1.93	32.68
+ ID2= 2 (5000):	4.95	0.022	4.25	26.41

ID = 3 (1003):	75.41	3.298	1.93	32.26

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

FINISH				
=====				

APPENDIX E

Stormceptor Sizing Report

Stormceptor®EF Sizing Report

Imbrium® Systems

ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

10/18/2023

Province:	Ontario	Project Name:	Charles Street Subdivision
City:	Waterford	Project Number:	21-169
Nearest Rainfall Station:	BRANTFORD MOE	Designer Name:	Natalie Biesinger
Climate Station Id:	6140954	Designer Company:	G. Douglas Vallee Limited
Years of Rainfall Data:	41	Designer Email:	nataliebiesinger@gdvallee.ca
		Designer Phone:	519-501-6278
Site Name:	Charles Street Subdivision	EOR Name:	
		EOR Company:	
Drainage Area (ha):	4.35	EOR Email:	
% Imperviousness:	43.00	EOR Phone:	
Runoff Coefficient 'c': 0.55			

Particle Size Distribution:	Fine
Target TSS Removal (%):	80.0

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	17.95
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	Yes
Upstream Orifice Control Flow Rate to Stormceptor (L/s):	23.00
Peak Conveyance (maximum) Flow Rate (L/s):	
Influent TSS Concentration (mg/L):	100
Estimated Average Annual Sediment Load (kg/yr):	1128
Estimated Average Annual Sediment Volume (L/yr):	917

**Net Annual Sediment
(TSS) Load Reduction
Sizing Summary**

Stormceptor Model	TSS Removal Provided (%)
EFO4	67
EFO6	79
EFO8	87
EFO10	93
EFO12	98

Recommended Stormceptor EFO Model: EFO8
Estimated Net Annual Sediment (TSS) Load Reduction (%): 87
Water Quality Runoff Volume Capture (%): > 90

Stormceptor® EF Sizing Report

THIRD-PARTY TESTING AND VERIFICATION

► **Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

► **Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

► The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

Stormceptor®EF Sizing Report

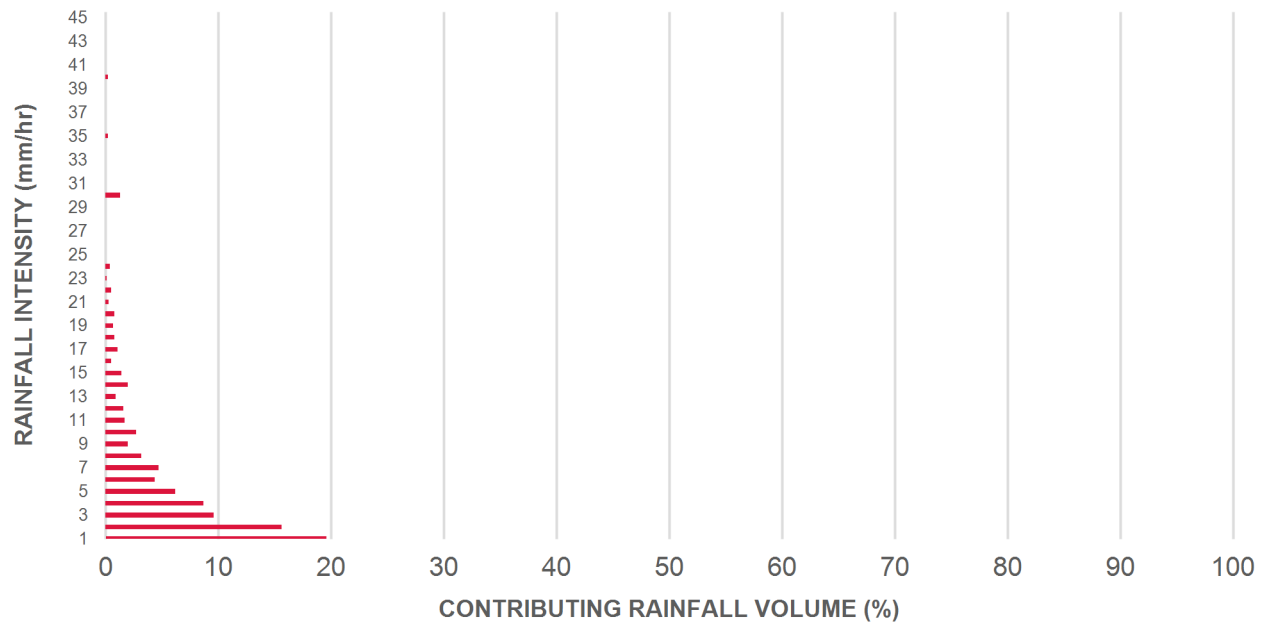
Upstream Flow Controlled Results

Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	9.1	9.1	3.37	202.0	43.0	100	9.1	9.1
1.00	19.6	28.8	6.75	405.0	86.0	98	19.3	28.5
2.00	15.6	44.4	13.50	810.0	172.0	87	13.6	42.0
3.00	55.6	100.0	20.24	1215.0	258.0	81	44.9	87.0
4.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
5.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
6.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
7.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
8.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
9.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
10.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
11.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
12.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
13.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
14.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
15.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
16.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
17.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
18.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
19.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
20.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
21.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
22.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
23.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
24.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
25.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
30.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
35.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
40.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
45.00	0.0	100.0	23.00	1380.0	294.0	79	0.0	87.0
Estimated Net Annual Sediment (TSS) Load Reduction =								87 %

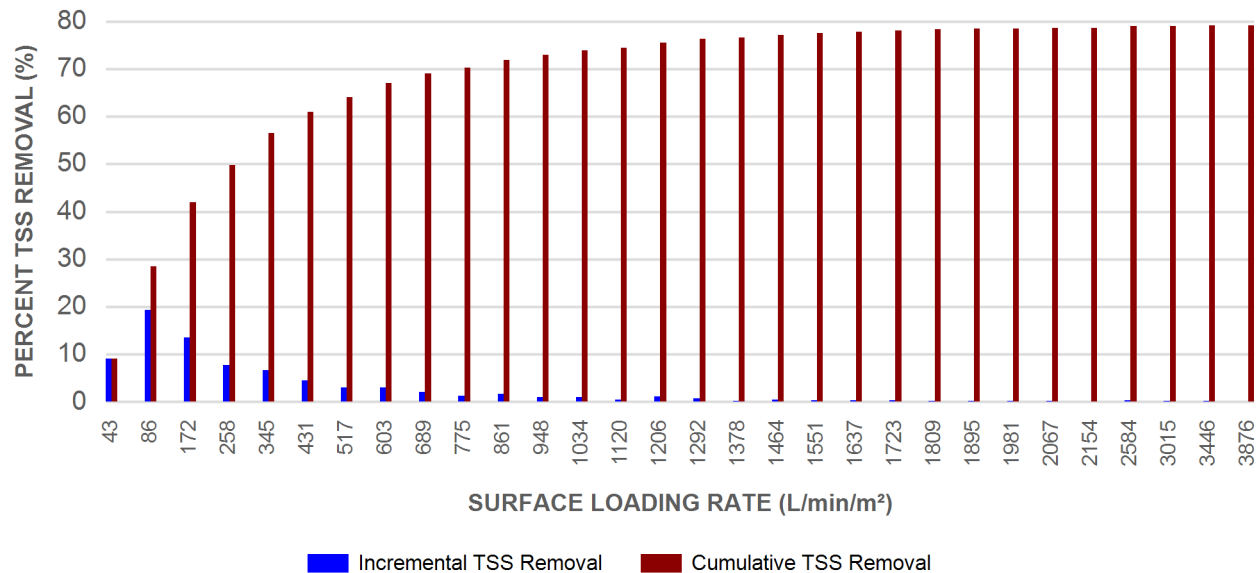
Climate Station ID: 6140954 Years of Rainfall Data: 41

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RAINFALL DATA FROM BRANTFORD MOE RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



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Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

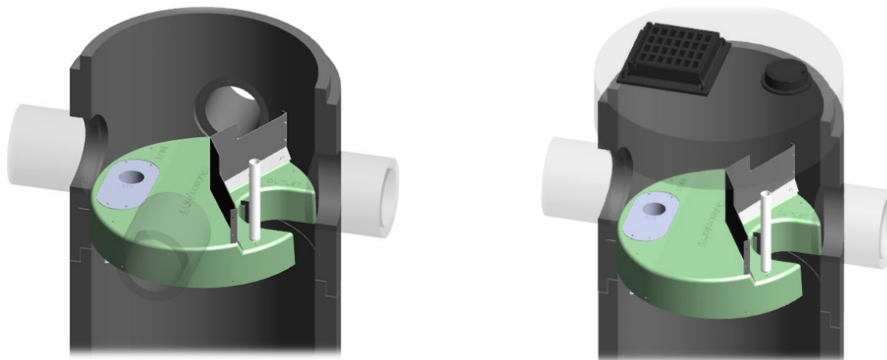
► Stormceptor® EF and EFO feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

DESIGN FLEXIBILITY

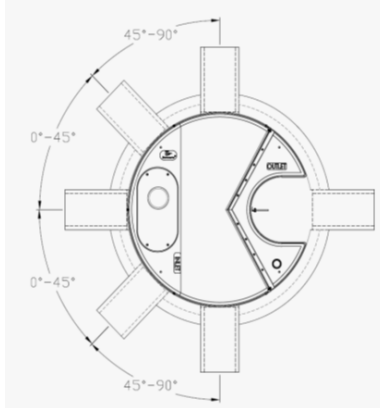
► Stormceptor® EF and EFO offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

► While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, Stormceptor® EFO has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.



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INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1.

For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft³)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit <http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef>

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit <http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef>

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STANDARD PERFORMANCE SPECIFICATION FOR “OIL GRIT SEPARATOR” (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m ³ sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m ³ sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m ³ sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m ³ sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m ³ sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall

Stormceptor®EF Sizing Report

remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m² to 1400 L/min/m², and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m² and 1400 L/min/m² shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m² shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m². No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m².

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m² shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m², and shall be calculated using a simple proportioning formula, with 1400 L/min/m² in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m².

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**.

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m².

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators**, with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to

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assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m² to 2600 L/min/m²) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**. However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

APPENDIX F

Geotechnical Investigation Charles Street & Washington Street
(G2S Consulting Inc dated March 6, 2023)

Geotechnical Investigation Proposed Residential Development



Charles Street & Washington Street, Waterford, Ontario
G2S22008

2863088 Ontario Inc.
3156 Countess Crescent
Mississauga, Ontario
L5M 0E2

Attention: Roger Sharma

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Appendices

- Appendix A: Drawings
- Appendix B: Borehole Logs, & Grain Size Analysis Graphs
- Appendix C: Soil Infiltration Assessment

1. Introduction

G2S Consulting Inc. (G2S) was retained by Roger Sharma, 2863088 Ontario Inc. (the Client) to complete a geotechnical investigation for a land parcel comprising four properties included in the proposed Charles Street Subdivision plan located in Waterford, Ontario, hereinafter referred to as the 'Site'. The irregularly shaped Site is located on the north side of Charles Street and west of Washington Street and covers an approximate plan area of 4.39 ha (10.8 ac.). Refer to the Borehole Location Plan in Appendix A, Drawing 1, for a layout of the Site location.

The irregularly shaped Site is currently a mix of agricultural and residential land. It is understood that the current structures will be demolished to make way for the proposed residential development. This geotechnical investigation was carried out as outlined in G2S' Proposal No. PROP-G2S22008, dated February 10, 2022.

2. Site and Project Overview

2.1 Site Description

The Site is an irregular shaped property covering an approximate plan area of 4.39 hectares (10.8 acres). At the time of the investigation, the proposed development area was occupied by a former landscape and nursery supply business at the centre of the Site, residential property located at the southeast corner, and the remaining portion of the Site is vacant agricultural land with municipal addresses of 183 Charles Street, 173 Charles Street, and 155 Charles Street. The Site is bound to the north by a row of single-family residential properties fronting onto Cottonwood Street, and to the west by agricultural land. The east side of the Site has a broken frontage along Washington Street, jogging west to the rear property line of existing residential properties at 210 to 226 Washington Street. On its southern side, the Site borders Charles Street with a broken frontage jogging to the north around existing residential properties at 145 and 177 Charles Street. The ground surface is undulating with elevations at the borehole locations ranging between Elev. 240.9 and 245.3 metres.

2.2 Proposed Development

Based on G2S's correspondence with the Client, it is understood that consideration is presently being given to developing the following structures on the Site:

- 23 single family residential dwellings abutting the north and west property lines,
- 5 blocks with a total of 25 two-storey town units at the centre of the Site,
- 2 blocks with a total of 15 bungalow town units at the southeast portion of the Site,
- Park Block for outdoor activities with an area of approximately 0.22 ha (0.54 acres) at the southern centre of the Site,
- Stormwater Management Pond block at the southern edge of the Site; and
- The associated access roads and municipal services.

The purpose of this geotechnical investigation was to determine the subsurface conditions at a total of twenty (20) borehole locations (16 geotechnical boreholes and 4 shallow environmental boreholes) and to interpret these findings with respect to the design and construction of the underground services, foundations, and related earthworks for this project from a geotechnical point-of-view.

This report is based on the above summarized project description, and on the assumption that the design and construction will be performed in accordance with applicable codes and standards. Any significant deviations from the proposed project design may void the recommendations given in this report. If significant changes are made to the proposed design, then G2S must be consulted to review the new design with respect to the results of this investigation. The information contained in this report does not reflect upon the environmental aspects of the Site and therefore have not been addressed in this document.

3. Investigation Methodology

A total of twenty (20) sampled boreholes were advanced at the locations illustrated in the attached Drawing 1, Borehole Location Plan in Appendix A. Prior to ground disturbance, underground services were located and marked. G2S coordinated the public utility locates through Ontario One-Call and retained the services of a private locator to locate and mark private utilities.

The geotechnical boreholes BH101 to BH116 were put down uncased using continuous flight hollow stem auger equipment while boreholes BH117 to BH120, which were advanced on Site for environmental purposes, were put down using Pionjar sampling equipment. This report will discuss the information from the geotechnical boreholes only. The drilling and sampling operations were carried out under the direction and supervision of a G2S staff member. The boreholes were advanced to depths of between approximately 6.7 to 9.8 metres below the existing grade (mbeg). On completion of drilling, the boreholes were backfilled in general accordance with Ontario Regulation 903.

Representative samples of the subsoils were recovered at specified intervals using a 51 mm (2 inch) outside diameter split-barrel sampler at depths noted on the attached borehole logs in Appendix B. Boreholes BH101 to BH116 were driven in accordance with the Standard Penetration Test procedure (ASTM D1586). After undergoing a general field examination, the soil samples were preserved and transported to the soil laboratory for visual, tactile, and olfactory classifications. Moisture content tests were performed on the soil samples recovered from the borings. Grain size analysis determination was carried out on selective soil samples.

Details of the conditions encountered in the boreholes, together with the results of the field and laboratory tests, are presented in Borehole (BH) Logs BH101 to BH116, inclusive, included in Appendix B. It is noted that the boundaries of soil types indicated on the borehole logs are inferred from non-continuous soil sampling and observations made during drilling. These boundaries are intended to reflect transition zones for the purpose of geotechnical design and therefore should not be construed as the exact plans of geological change.

Elevations at the ground surface of the borehole locations were interpolated from the provided Topographic Survey No. 21-3286-TOPO, file entitled "*Topographic Site Plan of Part of Block 32 Registered Plan 19-B Town of Waterford in the Norfolk County*", by Jewitt and Dixon LTD., dated June 10, 2022. This topographic survey plan was later utilized to produce the Borehole Location Plan, Drawing 1, in Appendix A.

4. Subsurface Conditions

The subsurface soil conditions have been evaluated in sixteen (16) boreholes (BH101 to BH116) investigated by G2S at the Site for the purpose of this report. It should be considered that the subsurface conditions may not be consistent between and beyond the locations investigated at the Site. The soil descriptions outlined in the following stratigraphic summary are based on our interpretation of non-continuous samples of soil obtained from the boreholes.

The subsurface conditions encountered at the borehole locations are summarized as follows:

4.1 Granular

A granular layer was encountered at the surface in BH107, BH112, and BH113 with thicknesses ranging from approximately 50 to 75 mm.

4.2 Topsoil

Topsoil veneer was contacted at the surface in BH101, BH102, BH106, BH108, BH110, BH114, BH115 and BH116, and beneath the surficial granular layer in BH107 and BH113 (150 to 200 mm). The thicknesses of the topsoil veneer ranged between 100 and 460 mm.

The depth of topsoil must be expected to vary across the Site from the depths encountered at the borehole locations. In this report the term “topsoil” has been used from a geotechnical point of view and does not necessarily reflect the suitability of the material to support plant growth. If it is to be used for landscaping or agricultural purposes, its suitability should be confirmed by tests on representative samples for organic and nutrient content and therefore its ability to support plant growth.

4.3 Fill/Possible Fill

Below the topsoil in boreholes BH101, BH102, BH106 to BH108, BH110, and BH113 to BH116, below the granular in BH112, and at the surface in the remaining boreholes, fill material was encountered. This layer extended to depths ranging between 0.6 and 3.8 mbeg. The fill material consisted mainly of brown to dark brown sand/silty sand and contained traces to some organics. The moisture content for the fill layer ranged between 5 and 26%, indicating moist to wet conditions.

Below the fill layer in BH105 and BH111, possible fill material was encountered and extended to depths of approximately 3.1 and 4.6 mbeg, respectively. With SPT N-values ranging between 1 and 5 blows per 300 mm of penetration, the possible fill was classified as very loose to loose in compactness. The moisture content for the possible fill layer ranged between 3 and 18%, indicating moist to very moist conditions.

4.4 Upper Sand/Silty Sand

Underlying the fill/possible fill in BH101 to BH104, and BH106 to BH116, a native deposit of sand/silty sand was encountered. The sand/silty sand deposit extended to depths ranging between 3.8 and 8.2 (~Elev. 238.1 – 234.8 m) mbeg. Boreholes BH102 to BH104, BH110, BH111, and BH113 to BH116 were terminated in this deposit. The sand/silty sand deposit was generally brown in color and contained traces to some silt.

The SPT N-values for the sand/silty sand ranged between 5 and in excess of 68 blows per 300 mm of penetration, indicating loose to very dense compactness. The moisture content for the sand/silty sand deposit ranged from 3 to 22% indicating moist to wet conditions. Grain size analysis was carried out on selected soil samples of the sand/silty sand deposit. Based on the laboratory testing, the sand/silty sand consisted of 78 to 94% sand, and 6 to 22% fines (silt & clay). The results of the grain size analyses are indicated on the borehole logs and the grain size distribution graphs, included in Appendix B.

4.5 Sandy Silt / Sandy Silt Till

Sandy silt/sandy silt till deposit was encountered below the sand/silty sand in BH101, BH106 to BH109, and BH112, below the possible fill in BH105, and extended to depths ranging between 3.8 and 9.8 mbeg (~Elev. 237.8 – 231.1 m). BH101 and BH106 were terminated in this deposit. The sandy silt/sandy silt till deposit was generally brown in color and contained numerous sand and clay seams as well as traces to some gravel.

The SPT N-values for the sandy silt/sandy silt till ranged between 6 and in excess of 50 blows per 300 mm of penetration, indicating loose to very dense compactness. The moisture content for the sand/silty sand deposit ranged from 7 to 27% indicating moist to wet conditions. Grain size analysis was carried out on a selected soil sample of sandy silt/sandy silt till deposit. Based on the laboratory testing, the sandy silt/sandy silt till consisted of 0 to 22% gravel, 18 to 47% sand, 29 to 79% silt, and 1 to 8% clay. The results of the grain size analysis are indicated on the borehole logs and the grain size distribution graphs, included in Appendix B.

4.6 Lower Sand

Underlying the sandy silt/sandy silt till in BH105, BH107, BH108, BH109, and BH112, lower sand deposit was encountered and extended to depths ranging between approximately 6.7 and 9.8 mbeg, (~Elev. 235.6 – 231.5 m). The lower sand/silty sand deposit was generally brown in color and contained traces to some silt.

The SPT N-values for the lower sand ranged between 14 and 23 blows per 300 mm of penetration, indicating compact condition. The moisture content for the sand deposit ranged from 6 to 20% indicating moist to wet conditions. Grain size analysis was carried out on a selected soil sample of the lower sand deposit. Based on the laboratory testing, the sand consisted of 82% sand, 16% silt, and 2% clay. The results of the grain size analysis are indicated on the borehole logs and the grain size distribution graphs, included in Appendix B.

4.7 Groundwater Observations

Groundwater level observations in the open boreholes were recorded during the drilling operation. All boreholes were found dry upon completion of the drilling. Boreholes BH101, BH105, BH106, BH108, BH112, and BH113, were caved in at depths of approximately 5.2, 5.2, 3.8, 5.5, and 4.6 mbeg, respectively. Further, groundwater monitoring wells were installed in boreholes BH102, BH107, and BH115. Results of our groundwater monitoring to date are presented below:

Table 1:Groundwater Observations

BH/MW ID	Ground Surface Elevation (m)	Well Depth (m begs)	March 23, 2022		March 3, 2023	
			Depth (m)	Elevation (m)	Depth (m)	Elevation (m)
BH/MW102	244.55	6.1	Dry	-	Dry	-
BH/MW 107	241.25	6.1	4.24	237.0	4.33	236.9
BH/MW 115	245.01	7.6	Dry	-	Dry	-

Some infiltration of groundwater through the fill layer and from surface runoff should be anticipated during the excavation operations. Surface water should be directed away from the excavations. It is noted that the static groundwater level fluctuates based on seasonal conditions experienced during the wet and dry periods of the year. Refer to Appendix B for the list of abbreviations and borehole logs.

5. Geotechnical Considerations

5.1 Site Preparation

At the time of the investigation the grading plan for the Site was not yet available to G2S, however the following recommendations are based on the development plans as outlined in Section 2.2. above.

Prior to any earthworks, it will be necessary to remove any unacceptable fill (i.e., organics, excessively wet, debris, etc.) from the areas to be developed. Due to the depth of the fill material on Site, some engineered fill placement may be required in order to develop the Site.

The engineered fill required must consist of clean earth materials, free of topsoil, organics, rubble, wood, plant materials, etc. and be at a suitable placement water content for compaction. Selective re-use of excavated soil consisting of the existing fill material and near surface sand from the Site for engineered fill may be feasible provided adequate sorting for the fill material is carried out and subject to the weather conditions at the time of construction. For this reason, pre-grading activities should not be undertaken during wet weather conditions.

Engineered fill must be placed and uniformly compacted in maximum lift thicknesses of 300 mm for earth fill and 200 mm for commercially sourced granular material. Each lift of the engineered fill must be uniformly compacted to at least 98 percent of Standard Proctor Maximum Dry Density (SPMDD). The placement water content of the engineered fill material should be maintained within ± 3 percent of the laboratory optimum water content in order to achieve an acceptable degree of compaction.

The limits of any engineered fill placed during this operation can best be determined by the geotechnical engineer at the time of construction. If engineered fill will be used to support foundations or pavements, it must extend laterally at sufficient distance to develop adequate lateral resistance.

All aspects of engineered fill construction including final excavation, material selection, placement and compaction must be tested by the geotechnical engineer at the time of placement and compaction. In-situ density (compaction) testing is required during construction for all engineered fill placement.

It should be noted that extensive placement of engineered fill (i.e., more than 2 to 3 metres) may experience some form of post-earthwork settlement by as much as about 1 to 2 percent of the total thickness depending on the material used. Assessment of this type of geotechnical analysis was considered outside of the scope of this investigation.

5.2 Foundation Recommendations

The soil conditions encountered in the boreholes are generally considered suitable for supporting the proposed structures on conventional spread footings, founded on the native sand/silty sand and sandy silt till. Spread footings founded in the native sand/silty sand, and sandy silt till deposits may be designed using a factored Ultimate Limit State (ULS) bearing resistance ranging between 150 and 300 kPa and a Serviceability Limit State (SLS) bearing resistance ranging between 100 and 200 kPa, based on total and differential settlements being well within 25 and 20 mm, respectively.

Alternatively, the proposed structures can be founded on engineered fill utilizing factored Ultimate Limit State (ULS) bearing resistance of 225 kPa and a Serviceability Limit State (SLS) bearing resistance of 150 kPa.

It is noted that the SLS value represents the Serviceability Limit State, which is governed by the tolerable deflection (settlement) based on the proposed building type, using unfactored load combinations. The ULS value represents the Ultimate Limit State and is intended to reflect an upper limit of the available bearing capacity of the founding soils in terms of geotechnical design, using factored load combinations. There is no direct relationship between ULS and SLS, rather they are a function of the soil type and the tolerable deflections for serviceability, respectively. The above dissertation assumes a typical building. Evidently, the bearing capacity values would be lower for very settlement sensitive structures and larger for more flexible buildings.

The available bearing resistance and the relevant approximate founding elevations are presented in **Table No. 2** below:

Table 2: Bearing Resistance for Conventional Spread Footings

Borehole ID	Material	Bearing Resistance (kPa)	Recommended Founding Depth (m)	Approximate Founding Elevation (m)
BH 101	Sandy Silt Till	200 SLS/300 ULS	4.1	237.8
BH 102	Sand	100 SLS/150 ULS	1.5	243.1
		200 SLS/300 ULS	3.5	241.1
BH 103	Sand	100 SLS/150 ULS	1.5	241.8
		200 SLS/300 ULS	3.8	239.5
BH 104	Sand	100 SLS/150 ULS	1.5	241.1
		200 SLS/300 ULS	3.5	239.1
BH 105	Sand	200 SLS/300 ULS	3.8	237.9
BH 106	Sand	150 SLS/225 ULS	4.1	236.8
BH 107	Sand	100 SLS/150 ULS	2.4	238.9
		150 SLS/225 ULS	3.5	237.8

Borehole ID	Material	Bearing Resistance (kPa)	Recommended Founding Depth (m)	Approximate Founding Elevation (m)
BH 108	Sand	100 SLS/150 ULS	2.1	239.6
		100 SLS/150 ULS	3.5	238.2
BH 109	Sand	100 SLS/150 ULS	2.1	240.2
		150 SLS/225 ULS	3.5	238.8
BH 110	Sand	200 SLS/300 ULS	1.5	242.1
		150 SLS/225 ULS	3.5	240.1
BH 111	Sand	200 SLS/300 ULS	4.6	237.6
BH 112	Sand	200 SLS/300 ULS	2.1	239.6
		200 SLS/300 ULS	3.5	238.2
BH 113	Sand	150 SLS/225 ULS	3.8	238.0
BH 114	Silty Sand	150 SLS/225 ULS	1.8	241.1
		150 SLS/225 ULS	3.5	239.4
BH 115	Sand	200 SLS/300 ULS	3.5	241.5
BH 116	Sand	100 SLS/150 ULS	1.5	243.8
		200 SLS/300 ULS	3.5	241.8

5.3 Foundation Construction

The footings beds in the sand/silty sand will be prone to disturbance from construction, foot traffic and precipitation. It would be prudent to consider the placement of a 50 mm concrete 'mud' slab over the footing bases once evaluated and confirmed. This will protect the footing beds from disturbance and provide a clean working surface for the placement of formwork and reinforcing steel.

In areas where it will be necessary to provide adjacent footings at different founding elevations, the lower footing should be constructed before the higher footing, if possible. To limit stress transfer from higher footings to lower footings, the higher footing should be set below a line drawn up from the edge of the lower footing at 10 horizontal to 7 vertical.

All footings exposed to the environment must be provided with a minimum of 1.2 m of earth cover or equivalent insulation, which is generally the frost depth in southern Ontario, to protect against frost damage. This frost protection would also be required if construction were undertaken during the winter months. All footings and foundations should be designed and constructed in accordance with the current Ontario Building Code. We would recommend, where applicable, the placement of a 50 mm thick high-density sheet of Styrofoam insulation against the exterior of the foundation walls, followed by the placement of a 10-mil sheet of 'double' polyethylene ('fold' placed at 'top') to prevent frost heaving/adfreezing action.

With foundations designed as outlined above and as required by the current Ontario Building Code, and with careful attention paid to construction detail, total and differential settlements should be well within normally tolerated limits of 25 and 20 mm, respectively. However, as is typical in most commercial/residential construction, 'cosmetic' cracking of plasterboard, foundation walls, etc. may occur within the first year of construction because of shrinkage, minor settlement, etc. Subsequent to repair, additional cracking should be minimal.

It is imperative that an engineer be retained from this office to provide geotechnical engineering services during the excavation and foundation construction phases of the project. This is to observe compliance with the design concepts and recommendations of this report and to allow changes to be made if subsurface conditions differ from the conditions identified at the borehole locations.

5.4 Seismic Design Parameters

The structures shall be designed according to Section 4.1.8 of the Ontario Building Code, Ontario Regulation 332/12. Based on the subsurface soil conditions encountered in this investigation the applicable Site Classification for the seismic design is Site Class D- Stiff soils, based on the average soil characteristics for the Site. The conducting of site specific shear wave velocity testing may be considered to confirm the site class.

The seismic data as per the 2015 National Building Code interpolated seismic hazard values, based on the acceleration and velocity-based site coefficients, F_a and F_v , are as follows.

$S_a[0.2]$	$S_a[0.5]$	$S_a[1.0]$	$S_a[2.0]$	$S_a[5.0]$	$S_a[10.0]$	PGA	PGV
0.185	0.109	0.066	0.030	0.008	0.003	0.123	0.094

It should be noted that the F_a and F_v values are determined from Tables 4.1.8.4.B. and 4.1.8.4.C of the Building Code, respectively. The structural engineer responsible for the project should review the earthquake loads and effects.

5.5 Floor Slab Considerations

The slab-on-grade for the proposed building is expected to be constructed on the sand, sandy silt, silty sand material. The exposed subgrade should be prepared by carefully examining the surface for any loose or unsuitable material. All unsuitable and loose material should be removed and replaced with approved suitable material and be compacted to at least 98 percent of its

Standard Proctor Maximum Dry Density (SPMDD), in the presence of a representative of G2S. Oversized particles in excess of 4 inches (100 mm) in diameter should not be permitted in the backfilling operations. Imported granular fill is preferred due to its relative insensitivity to weather conditions, its relative ease in achieving the required degree of compaction, and its quick response to applied stresses. Based on the conditions encountered in the boreholes, backfill recommendations, and the floor slab considerations as included in our report, a modulus of sub-grade reaction, k_s , of 25 MPa/m (based on a loaded area of 300 mm x 300 mm) can be used for the design of the slab-on-grade floor slab.

As with all concrete floor slabs, there is a tendency for the floor slabs to crack. The slab thickness, concrete mix design, and/or wire mesh placed into the concrete slab, if any, will therefore be a function of the owner's tolerance for cracks in, and movements of, the slabs-on-grade, etc. The 'saw-cuts' in the concrete floors, for crack control, should extend a minimum of 1/3 the thickness of the slab.

A moisture barrier will be required under the floor slabs, such as the placement of at least 200 mm of well-compacted 19 mm clear crushed stone. At a minimum, the moisture barrier material should contain less than 10 percent passing the No. 4 sieve.

Curing of the slab-on-grade must be carefully specified to ensure that slab curl is minimized. This is especially critical during the hot summer months of the year when the surface of the slab tends to dry out quickly while high moisture conditions in the moisture barrier or water trapped on top of any 'poly' sheet at the saw cut joints and cracks, and at the edges of the slabs, maintains the underside of the slab in a moist condition.

It is also important that excess free water not be added to the concrete during its placement as this could increase the potential for shrinkage, cracking and curling of the slab.

5.6 Lateral Earth Pressure and Perimeter Drainage

The following soil properties, provided in **Table 3**, may be considered for the design of structures subject to an unbalanced earth loading. These properties have been estimated based on our review and laboratory testing of the soil samples, which were recovered during the geotechnical investigation, as well as type of backfill material, which is expected to be used in construction.

Table 3: Soil Properties for Design of Earth Retaining Structures

Material	ϕ	γ	K_a	K_o	K_p
Fill: Earth fill – Stiff to very stiff/ compact	28	19.0	0.35	0.53	2.78
Fill: OPSS 1010 Granular B - compact	32	21.0	0.27	0.47	3.25
Sand /Silty Sand – Compact to dense	34	19.5	0.28	0.44	3.54

Φ = Angle of Internal Friction (degrees), γ = Bulk Unit Weight of Soil (kN/m^3), K_a = Active Earth Pressure Coefficient, K_o = At-rest Earth Pressure Coefficient, K_p = Passive Earth Pressure Coefficient.

Lateral earth pressures on the basement foundation walls can be calculated as per the following:

$$p = K (\gamma h + q)$$

Where,

- p = Lateral earth pressure, in kPa acting at depth h
- K = Coefficient of earth pressure
- γ = Unit weight of backfill (kN/m^3)
- h = Depth to point of interest (m)
- q = Surcharge load acting adjacent to the wall at the ground surface (kPa)

The above formula is based on the assumption that a perimeter drainage system prevents hydrostatic pressure build-up behind the wall and free-draining granular material will be used for backfilling behind the wall.

The following equation can be used to calculate the earth pressure acting on the retaining walls including the effects of groundwater pressure:

$$p = K (h_1 + \gamma' h_2 + q) + \gamma_w h_2$$

Where,

- h_1 = depth in meters above the water table
- γ' = effective unit weight of soil, a value of 11 kN/m^3 may be assumed
- h_2 = depth in metres below the water table
- q = equivalent value of surcharge on the ground surface in kPa
- γ_w = unit weight of water (10 kN/m^3)

The hydraulic uplift pressure, P , below the waterproofed structure can be calculated using the following formula:

$$p = \gamma_w h_w$$

Where,

- γ_w = unit weight of water (10 kN/m^3)
- h_w = depth in metres below the water table

A permanent perimeter drainage system should be provided around the structure to prevent the build-up of water against the basement walls. As a minimum, it is recommended that the perimeter weeping tile consist of a 150 mm diameter perforated pipe with a geofabric 'sock', surrounded with 200 mm of 19 mm clear stone, with the stone in turn encased by a heavy geotextile filter fabric. The suppliers of the geotextile filter fabric should be consulted as to the type best suited for this project.

The perimeter drainage system should outlet to a gravity storm sewer connection, fitted with a suitable back-flow prevention valve. In the event that a sump pump system is required, it should be constructed with an 'oversized' reservoir to limit pumping intervals and include an alarm in the

event that the system fails to operate as per design, with a municipal water operated backup pump to operate during power outages and when maintenance of the main pump is required.

If the structure is not designed as a watertight structure, it is recommended to install an underfloor drain. The underfloor drain should be connected to a positive outlet.

G2S should examine the installation of the perimeter and subfloor drains. Even a small break in the filtering materials could result in loss of 'fines' into the drains with attendant performance difficulties, including settlements of the ground surface. The exterior grade around the structure should be sloped away from the structure to prevent water ponding against the foundation walls.

Additional well graded granular material should be placed and compacted in exterior sidewalk and accessibility ramp areas to reduce the effects of frost heaving. Alternatively, insulation could be placed in these areas, or a structural 'frost' slab should be constructed at the doorways.

5.7 Excavations and Groundwater Control

It is understood that the excavation for the proposed structures is expected to extend below depths ranging between 3.0 m and 4.0 m bgl. Based on the investigation findings, excavation for basements and foundations will be carried out through the fill/possible fill and native sand, silty sand/sandy silt, and sandy silt till.

The excavation must be completed in accordance with the current OHSA regulations. For guidance, soft soils and soils below the groundwater level are classified as Type 4. The fill material is classified as Type 3 soil. The native loose to compact sand, silty sand/sandy silt, and sandy silt till is classified as Type 3 soil. The dense to very dense soils can be classified as Type 2 soil. If the excavation contains more than one type of soil, the soil shall be classified as the type with the highest number.

Excavation slopes steeper than those required in the Safety Act must be supported or a trench box must be provided, and a senior Geotechnical Engineer from G2S should supervise the work. We note that the rate of excavation may be slowed when existing buried services and foundations, and floor slabs of the existing structures are encountered by the contractor.

Where workers must enter excavations extending deeper than 1.2 m below grade, the excavation sidewalls must be suitably sloped and/or braced in accordance with the Occupational Health and Safety Act and Regulation for Construction Projects. It should be noted that the glacial tills are non-sorted sediments and therefore may contain boulders. Provisions must be made in any excavation or drilling contract for the removal of possible boulders.

Based on the monitoring wells which were installed during the current investigation, infiltration of groundwater as well as surface runoff should be anticipated, and localized dewatering will likely be required to facilitate the excavation. Filtered sumps, trenches, and oversized excavations, can be used to mitigate this issue. However, if these techniques fail to control the groundwater seepage, an adequate dewatering technique, which should be carried out by a specialized contractor, should be considered. G2S will be pleased to review and comment on the contractor's proposed dewatering system. Techniques such as a series of ditching and sump pumps may be used, however the method of dewatering is the responsibility of the contractor.

Ontario Regulation 387/04 requires authorization from the Ministry of the Environment, Conservation, and Parks (MECP) for all water takings over 50,000 L/day. Ontario Regulation 63/16 specifies that for temporary construction dewatering at rates between 50,000 and 400,000 L/day an Environmental Activity and Sector Registry (EASR) may be obtained in lieu of a Permit to Take Water (PTTW). Dewatering at rates of more than 400,000 L/day require a PTTW to authorize groundwater withdrawal.

5.8 Temporary Shoring

A temporary shoring system may be required for the underground utility installation or foundation excavation. Trench boxes may be used to reduce the lateral extent of the excavations for portions of the utility installation. However, in Type 4 soil or in trenches with a depth exceeding 6 m or a width exceeding 3.6 m, prefabricated support systems cannot be used. Consequently, a designed engineered support system will be required.

If a shoring system is required, we would recommend an active coefficient of lateral earth pressure, $K_a = 0.35$ if small lateral deformations are acceptable, or 0.5 in fill against rigid walls. Any additional pressures due to surcharge loading must be included in the design. A unit weight of retained soil of 22 kN/m³ can be used. The shoring wall must be designed and constructed as a rigid shoring system. The shoring system must be designed by a professional engineer experienced in shoring design and should be based on the procedure detailed in the latest edition of the Canadian Foundation Engineering Manual. The shoring system should be constructed by an experienced contractor. Any surcharge loads must be incorporated into the shoring design. The structural member stiffness and stability is the responsibility of the shoring design engineer and the shoring contractor. The excavation must provide 'space' for the construction of the footings and foundation walls, with an allowance for access by workers. In the event that a shoring system is required for this project, we would recommend that this office be retained to review the selected design and provide monitoring during installation.

5.9 Pipe Bedding

For underground services installation, no bearing capacity issues are anticipated for pipes founded in dewatered native soils. A minimum 150 mm bedding thickness of OPSS Granular 'A' crusher-run limestone is recommended under the pipes. The bedding material should be compacted to 98 percent SPMDD. For pipes founded in wet native soils, the pipe bedding should consist of 19 mm clear stone completely wrapped in geotextile filter fabric to prevent the migration of fines into the void spaces of the bedding material. High performance aggregate can also be used in excessively wet areas.

Granular material should be extended upward as trench backfill for at least 300 mm above the top of the pipe. The remaining trench to final subgrade level should be backfilled in 300 mm thick lifts with approved excavated material compacted to at least 98 percent SPMDD.

Frequent inspection by G2S geotechnical personnel should be carried out to examine and approve backfill materials, to carefully inspect placement, and to verify that the specified degree of compaction has been obtained.

5.10 Thrust Block

Thrust blocks in the native sand, silty sand/sandy silt, and sandy silt till may be sized as recommended by the applicable Ontario Provincial Standard Specification (OPSS). A design allowable bearing pressure of 200 kPa may conservatively be used in the design of thrust blocks. Any backfill required behind the blocks should be granular and should be compacted to 100 percent of their standard Proctor Density.

5.11 Backfill Considerations

Most of the excavated material will consist of the fill and the native sand, silty sand/sandy silt, and sandy silt till. We expect that most of the excavated material will be removed from the Site to accommodate the basement level. The remaining material is considered suitable for use as service trench backfill and as engineered fill, provided that the moisture content can be controlled to within 3 percent of the standard Proctor optimum value and that it is free of soft soils and/or organic matter. Some moisture content conditioning of the excavated material may be required, depending upon weather conditions experienced at the time of construction, to achieve acceptable compaction densities and minimize long-term settlements. Dusting could be a problem in the 'dry' summer months.

We note that where backfill material is placed near or slightly above its optimum content, the potential for long-term settlements due to the ingress of groundwater and collapse of the fill structure is reduced. Correspondingly, the shear strength of 'wet' backfill material is also lowered, thereby reducing its ability to support construction traffic, and therefore impacting roadway construction. If the soil is well 'dry' of its optimum value, it will appear to be very strong when compacted, but will tend to settle with time as the moisture content in the fill increases to equilibrium condition. The soils may require high compaction energy to achieve acceptable densities if the moisture content is not close to their standard Proctor optimum value. It is therefore very important that the placement moisture content of the backfill soils be within 3 percent of its standard Proctor optimum moisture content during placement and compaction.

Any imported fill required in service trenches or to raise the subgrade elevation should have its moisture content within 3 percent of its optimum moisture content and meet the necessary environmental guidelines.

The backfilling and compaction operations should be monitored by a representative of G2S to monitor uniform compaction of the backfill material to project specification requirements. Close supervision is prudent in areas that are not readily accessible to compaction equipment, for instance, near the end of compaction 'runs', and around the foundation walls. Any engineered fill should be compacted to 100 percent SPMDD. A method should be developed to assess compaction efficiency, employing the on-site compaction equipment and backfill materials during construction.

5.12 Pavement Consideration

The pavement areas should be stripped of all topsoil, organic, and other unsuitable materials. The exposed subgrade should be proof rolled with 3 to 4 passes of a loaded tandem truck in the presence of a representative of G2S, prior to the placement of the sub-base material. Any areas of distress revealed by this, or any other means must be sub-excavated and replaced with suitable backfill material. Alternatively, the soft areas may be repaired by the placement of coarse aggregate, such as 50 mm clear crushed stone.

The need for sub-excavations of a softened subgrade will be reduced if construction is undertaken during periods of dry weather and careful attention is paid to the compaction operations. At areas of weak subgrade, suitable geogrid product such as Tensar TriAx (TX) geogrid or equivalent can be used to stabilize the subgrade. The fill placed over shallow utilities that cut into or across the paved areas must also be compacted to 100 percent of its SPMDD.

Good draining provisions will optimise the long-term performance of the pavement structure. The subgrade must be properly crowned and shaped to promote drainage to the subdrain system. Subdrains should be installed to intercept excess subsurface water and to prevent softening of the subgrade material. Surface water should not be allowed to pond adjacent to the outer limits of the paved area.

The most severe loading conditions on the subgrade typically occur during the course of construction, therefore, precautionary measures may have to be taken to ensure that the subgrade is not unduly disturbed by construction traffic. These measures would include minimizing the amount of heavy traffic travelling over the subgrade, such as during the placement of granular base layers.

If construction is conducted under adverse weather conditions, additional subgrade preparation may be required. During wet weather conditions, such as typically experienced during the fall and spring months, it should be anticipated that the additional subgrade preparation would be required, such as the provision of an additional depth of Granular B sub-base coarse material. It is also important that the sub-base and base coarse granular layers of the pavement structure be placed as soon after exposure and preparation of the subgrade level as practical.

The suggested pavement structures for the pavement areas outlined in **Table 4** are based on subgrade parameters estimated based on visual and tactile examinations of the on-Site soils and past experience. The outlined pavement structures may be expected to have an approximate ten-year life, assuming that regular maintenance is performed. Should a more detailed pavement structure design be required, Site specific traffic information would be needed, together with detailed laboratory testing of the subgrade soils.

Table 4: Suggested Pavement Structure

Layer Description	Compaction Requirements	Light Duty Sections	Heavy Duty (Truck Route)
Asphaltic Concrete Wearing course OPSS HL 3 or HL 3A	Min 92.0 % *MRD	65 mm	40 mm
Binder Course OPSS HL 8	Min 92.0 % *MRD	--	65 mm
Base Course OPSS Granular A	100% **SPMDD	150 mm	150 mm
Sub-base Course OPSS Granular B Type II	100% **SPMDD	200 mm	350 mm

* MRD denotes maximum relative density, MTO LS-264

** SPMDD denotes Standard Proctor Maximum Dry Density, ASTM-D698.

Depending on the arrangement of light duty and heavy-duty pavement sections, the transition between sections may present some difficulty for contractors. In this regard, consideration might be given to a slightly increased light duty pavement structure consisting of 50 mm of HL8 binder course and 40 millimetres of HL3 surface course asphaltic concrete. This structure will provide for a continuous depth of surface course asphalt allowing for ease of construction. As well, such a structure would have an improved performance over an increased design life. Such an arrangement of asphalt layers would also allow for future rehabilitation with a 'mill and pave' type operation.

6. SWM Facility Recommendations

It is understood that the proposed stormwater management facility will be an offline wet pond with forebay for settlement of suspended solids. The proposed SWM block has an area of 0.21 ha and is bounded to the east and south by road right of ways, to the north by a proposed park block, and to the west by a residential property. It is assumed that the facility will be designed per provincial recommendations as outlined in the *2003 MOE Stormwater Management Design Guidelines*, including maximum depths, side slopes, etc.

6.1 Soil Conditions

Boreholes BH106 and BH107 are located within the proposed SWM block and revealed the presence of fill material extending to depths ranging from 2.1 to 3.8 mbeg, underlain by sand, sandy silt, and sandy silt till. The groundwater level at the time of the investigation was in the order of 4.2 to 4.3 mbeg (~Elev. 236.9 to 237.0 m). It should be noted that the base elevation for the proposed pond was not available at the time of the investigation.

6.2 Soil Coefficient of Permeability

G2S retained Hydrogeology Consulting Services Inc. (HCS) to assess the near-surface soil infiltration capacity within the SWM facility through the completion of Double Ring Infiltrometer (DRI) testing. The findings were provided in a report dated December 1, 2022, which is included in Appendix C.

6.3 Side Slope Stability

The pond side walls are recommended to be constructed with a side slope of 3 horizontal to 1 vertical or flatter. However, for the section of the sidewalls which are located within the groundwater seasonal fluctuation area, it is recommended that the side slopes be flattened to 4 horizontal to 1 vertical to resist erosion by wavelet action. It is also recommended that the side slopes be vegetated and additional measures to stabilize the surface and reduce the risk of surficial erosion (i.e. rip rap stone, erosion mats) be installed, as needed.

6.4 Impermeable Liner

Based on the subsoil conditions at the Site and in order to facilitate construction of a wet pond capable of maintaining standing water, avoiding groundwater infiltration and the potential contamination, which may result from the collected surface water being in direct contact with the groundwater, the pond will require the installation of an impermeable liner. There are different options available for impermeable liners including a solid clay liner, a geosynthetic clay liner, or a plastic liner such as PVC or HDPE liner. Considerations relevant to different liner options should be evaluated depending on the project design requirements. Regardless of its type, the liner should be impermeable and shall extend at minimum to the top of the design maximum water level. As the liner extends up the sides of the facility the thickness of the liner or liner overburden may be decreased proportional to the decreasing depth.

The following sections will discuss the various available options to construct or install the pond liner. Marker/ballast layer with a minimum thickness of 200 mm consisting of 150 mm diameter stones should be installed on top of the liner material to serve as a marker for the maintenance crew to avoid damaging the liner material during maintenance operations.

6.4.1 *Compacted Clay Liner*

A compacted clay liner with a minimum thickness of 600 mm should be installed. The liner should be compacted to a minimum of 95% of the material Standard Proctor Maximum Dry Density (SPMDD). The material to be used in the liner construction should be analyzed as per LS 702/703, (ASTM D4318 and ASTM D7928) and the grain size distribution and the Atterberg Limits for this material should meet the following criteria:

1. Percent of fine particles passing Sieve Size 0.075 mm $\geq$ 50 percent
2. Percent of particles passing Sieve Size 0.002 mm (clay content) $\geq$ 20 percent
3. Percent of particles between passing 2.0 mm and retained on 0.06 mm $\leq$ 45 percent
4. Plasticity Index $\geq$ 20 percent
5. Liquid Limit LL $\geq$ 50 percent

Based on the grain size analysis results for the material encountered on Site, the on-Site material is not considered suitable for use in the construction of the clay liner. Clay liner can be accepted based on the results of hydraulic conductivity laboratory testing to be completed for at least three soil samples taken from the already placed material, which should be compacted to a minimum of 95% of the material SPMDD. The hydraulic conductivity for the liner material based on the as built conditions should be in the order of 1×10^{-8} or less. Alternatively, a mixture of 1 part bentonite to 3.5 parts by volume of Granular 'A' conforming with the OPSS.MUNI 1010 requirements, could be used to produce the clay liner material, provided that an approved mechanical mixer is used in the production of the liner material.

The subgrade at the pond area should be proofrolled and approved by a representative of G2S geotechnical staff prior to the placement of the liner material. The material should be placed in loose lifts not exceeding 150 mm in thickness or 25 mm less than the tamping foot length of the compaction equipment and be compacted to a minimum of 95% of its SPMDD. The moisture content for the liner material should be within 90 and 120% of its Optimum Moisture Content as determined by the laboratory Standard Proctor testing (ASTM D698). The surface of the material during placement and compaction operation must be free of any of tree branches, organics, foreign debris, oversized gravel in excess of 75 mm in diameter, or any otherwise deleterious material. The operations should be carried out during favorable weather conditions to avoid frost penetration at the surface between the lifts during cold weather, or surface cracking and material shrinkage of the materials due to moisture loss during hot weather.

6.4.2 *Synthetic Liner*

Geosynthetic clay liner such as AGRU GeoClay liner or equivalent can be used. AGRU GeoClay is a reinforced needle-punched geosynthetic clay liner that consists of a uniform layer of natural granular sodium bentonite encapsulated between a woven and a nonwoven geotextile, or between scrim reinforced woven and nonwoven geotextiles. The subgrade should be prepared by removing all organics and unacceptable materials, proofrolled and approved by a representative of G2S geotechnical staff prior to the placement of the liner material. The groundwater level must be lowered to at least 0.5 m below the pond base level during installation. The synthetic liner should be installed as per the manufacturer recommendations.

6.4.3 Hydraulic Uplift

Groundwater was noted in BH/MW107 at elevation of 237.00 m (4.24 m begs) as shown in **Table 1** above, however it is noted that the static groundwater level fluctuates based on seasonal conditions experienced during the wet and dry periods of the year. It is recommended that further evaluation of groundwater levels be completed to assess an average annual groundwater level. Should the proposed bottom of the SWM pond or liner extend below the groundwater table it should be designed to resist hydraulic uplift in the most conservative condition; that being when the pond is empty. This scenario is possible during construction, depending on implementation of dewatering practices, as well as in the case of dewatering of the facility for maintenance purposes. In order to resist uplift pressure under the proposed liner, the weight of the liner plus any cover material such as the marker stone/ballast must be greater than the uplift force acting on the bottom of the liner. Drainage blanket consisting of a 150 mm diameter perforated pipes, wrapped in geotextile fabric (i.e., Terrafix 270R or equivalent), and topped with a leveling blanket consisting of 150 mm of leveling sand should be installed below the liner.

The hydraulic uplift pressure, P , below the pond liner can be calculated using the following formula:

$$P = \gamma_w h_w$$

Where:

P = The hydraulic pressure acting on the base of the structure (kPa)

γ_w = Unit weight of water (10 kN/m³)

h_w = Depth in metres of the liner below the water table

And the corresponding required liner thickness can be calculated as follows:

$$h_L = P / \gamma_L$$

Where:

γ_L = Unit weight of liner in kN/m³

h_L = Thickness in metres of the liner and any overburden material

7. General Comments

The comments provided in this document are intended only for the guidance of the design team. The subsoil descriptions and borehole information are only intended to describe conditions at the borehole locations. Contractors undertaking this project should carry out due diligence to verify the results of this investigation and to determine how the subsurface conditions will affect their operations.

The action of stripping topsoil and unsuitable near-surficial soils as well as the selection and placement of engineered fill should be tested by the geotechnical engineer at the time of construction. In-situ density testing should be carried out on any engineered fill placed at the Site.

All foundations should be reviewed on Site by the geotechnical engineer as they are constructed, as required by Section 4.2.2.2 of the Ontario Building Code (2012). If G2S is not retained to review the foundation bearing conditions or the construction of the foundations in the field, then G2S assumes no responsibility for the performance of the foundations as constructed.

The long-term performance of slabs-on-grade is dependent on the subgrade support conditions. Subgrades to support slabs-on-grade should be inspected by the geotechnical engineer prior to final construction. It is important that any engineered fill constructed beneath slabs on grade is carried out as outlined in this report.

8. Limitations

The geotechnical engineering advice and recommendations provided in this report are considered preliminary and were based on the factual information obtained during this investigation.

It may be possible that the subsurface conditions vary between and beyond the investigated borehole locations. For the purpose of this report, it is assumed that the conditions outside of and between the exact borehole locations are similar to the conditions observed in the boreholes. The change in subsurface stratigraphy reported on the borehole logs has also been interpreted based on non-continuous sampling, therefore, changes in stratigraphy as shown on the borehole logs and as discussed in this report should not be regarded as exact lines of geological change. The subsurface conditions at the Site may change with the passage of time and/or by human intervention.

The findings along with the geotechnical engineering advice and recommendations provided in this report are limited to the conditions at the Site at the time of this investigation as described herein. Conclusions presented in this report should not be construed as legal advice. If Site conditions or applicable standards change or if any additional information becomes available at a future date, changes to the findings, conclusions and recommendations in this report may be necessary.

Through any subsurface investigation by boreholes, it may not be possible to identify all aspects of the subsurface conditions at the Site that could affect construction costs, techniques, equipment, and scheduling. Contractors bidding on or undertaking work on the project must be directed to draw their own conclusions as to how the subsurface conditions may affect them, based on their interpretation of the subsurface conditions and/or their own investigations.

This report has been prepared for the sole benefit of the Client and is intended to provide geotechnical engineering advice and recommendations based on the subsurface conditions investigated at the subject Site. This report is the copyright of G2S Consulting Inc. (G2S) and may not be used by any other person or entity without the expressed written consent of the Client and G2S. Any use which a third party makes of this report, or any reliance on decisions made based on it, is the responsibility of such third parties. G2S accepts no responsibility for damages, if any suffered by any third party as a result of decisions made or actions based on this report. It is recognized that The Town of Waterford in their capacity as the planning and building authority under Provincial statutes, may make use of and rely upon this report cognizant of the limitations thereof, both as are expressed and implied.

Secondary review of this report was completed for general QA/QC and adherence to company standards and does not include a detailed technical review of engineering conclusions and recommendations. This report does not address any environmental conditions such as soil and groundwater chemical quality and suitability of excess soils for off-site re-use.

9. Closing Remarks

We trust this report is satisfactory for your present purposes. Should you have any questions, please do not hesitate to contact this office.

Yours truly,

G2S Consulting Inc.

Secondary Review:



Ashraf Abass, P. Eng.
Senior Geotechnical Engineer

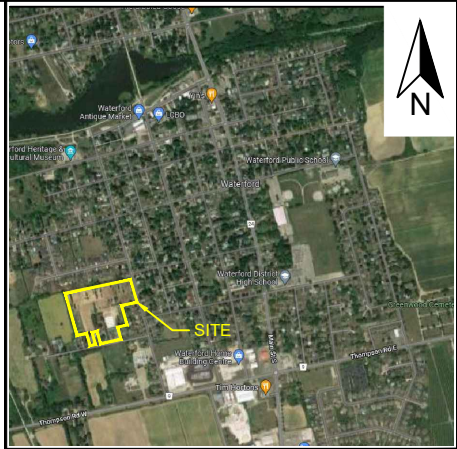


Melissa King, P.Geo.
Head of Environmental Services

Appendix A:

Drawings





LEGEND	
	BOREHOLE LOCATION
	MONITORING WELL LOCATION
245.01	GROUND SURFACE ELEVATION (m)
236.92	GROUNDWATER ELEVATION (2023-03-03)
	PROPOSED BUILDING LOCATION
	PROPOSED PARK LOCATION
	PROPOSED SWM POND LOCATION

TITLE:	
BOREHOLE LOCATION PLAN	
CLIENT:	
2863088 ONTARIO INC.	
LOCATION:	
CHARLES STREET WATERFORD, ONTARIO	
PROJECT:	
G2S22008	
DRAWING:	1
SCALE:	AS SHOWN
DATE:	MARCH 2023
DRAWN BY:	DB
FILE NAME:	G2S22008 BH Location Plan



Appendix B:

Borehole Logs
Grain Size Analysis Graphs



LIST OF ABBREVIATIONS

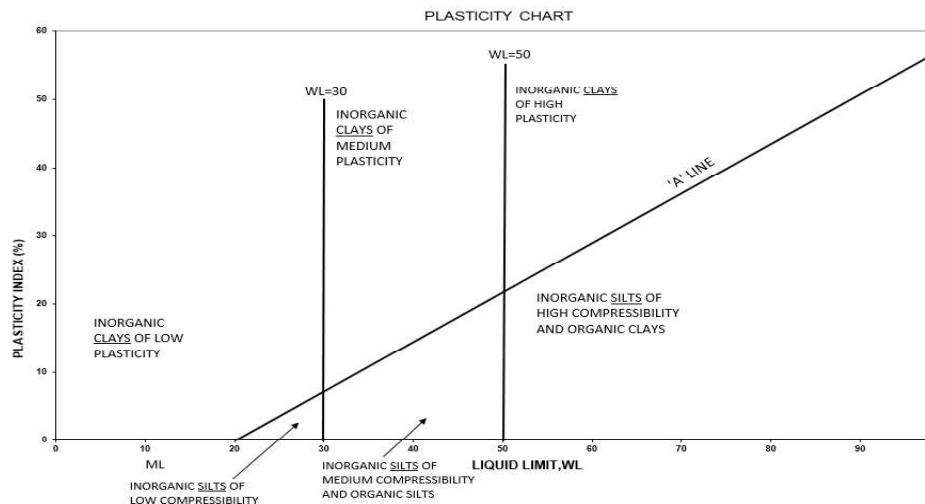
Description of Soil

The consistency of cohesive soils and the relative density or compactness of cohesionless soils are described in the following terms:

COHESIVE SOIL			COHESIONLESS SOIL	
CONSISTENCY	N (blows/0.3 m)	C (kPa)	DENSENESS	N (blows/0.3 m)
Very Soft	0 – 2	0 – 12	Very Loose	0 – 4
Soft	2 – 4	12 – 25	Loose	4 – 10
Firm	4 – 8	25 – 50	Compact	10 – 30
Stiff	8 – 15	50 – 100	Dense	30 – 50
Very Stiff	15 – 30	100 – 200	Very Dense	>50
Hard	>30	>200		
Moisture conditions				
Moist: dark or greyish color, may feel cool upon				
Wet: same as moist with free water seepage when handled				

Abbreviations

SS	Split Spoon Sample
AS	Auger Sample
GS	Grab Sample
DP	Direct Push
S	Sample
RC	Rock Core
SPT	Standard Penetration Test
N	Blow counts per 300mm of penetration. (ASTMD1586)
MC	Moisture Content
PL	Plastic Limits
LL	Liquid Limits
PI	Plasticity Index



Penetration Resistance

Standard Penetration Resistance N: The number of blows required to advance a standard split spoon sampler 0.3 m into the subsoil. Driven by means of a 63.5 kg hammer falling freely a distance of 0.76 m. The value reported are as noted in the field without corrections.

Soil Classification Dynamic Penetration Resistance: The number of blows required to advance a 51 mm, 60-degree cone, fitted to the end of drill rods, 0.3 m into the subsoil. The driving energy being 475 J per blow. Soils descriptions are made in accordance with the Canadian Foundations Engineering Manual (CFEM), following the International Society for Soil Mechanics and Foundation Engineering. (ISSMFE)

Notes

Soil samples will be discarded after three months unless directed otherwise by the Client.

Unless the grain size analysis is performed in our lab, soil samples are classified based on visual, tactile, and olfactory examinations, which may not be sufficient for accurate classification or precise grain sizing.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse		
	0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	200

EQUIVALENT GRAIN DIAMETER IN MILLIMETERS

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-17 **COMPLETED** 22-3-17 **GROUND ELEVATION** 241.89 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
0.10	TOPSOIL: ~100 mm	241.79		SS1	SPT	2	▲			0/0		
0.76	FILL: Silty sand, brown, some silt, trace organics, moist	241.13										
1	SAND: Brown, trace silt, moist, loose, reworked appearance at top portion			SS2	SPT	5	▲			0/0		
2				SS3	SPT	8	▲			0/0		0 94 6
2.3	occasional silty zones, very moist to wet	239.60		SS4	SPT	13	▲			0/0		
3				SS5	SPT	12	▲			0/0		
3.8		238.08		SS6	SPT	22	▲			0/0		
4	SANDY SILT TILL: Brown, some gravel, trace clay, very moist, dense			SS7	SPT	48				0/0		16 47 29 8
5												
6												
6.1	clay seams	235.79		SS8	SPT	30	▲			0/0		
6.7		235.18										

Borehole terminated at 6.7 m.

Upon completion of augering
Cave at 5.2 m

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-16 **COMPLETED** 22-3-16 **GROUND ELEVATION** 244.55 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/BL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
0.15	TOPSOIL: ~150 mm	244.40		SS1	SPT	2	▲		●	0/0		
0.76	FILL: Silty sand, brown, some organics, rootlets	243.79										
1	SAND: Brown, trace to some silt, moist, compact, medium to fine			SS2	SPT	12	▲		●	0/0		
2				SS3	SPT	12	▲		●	0/0		
3				SS4	SPT	20	▲		●	0/0		
3.1	occasional silt seams	241.50										
4				SS5	SPT	18	▲		●	0/0		
5				SS6	SPT	23	▲		●	0/0		
5.3	becoming greyish brown, fine	239.22										
6				SS7	SPT	14	▲		●	0/0		
				SS8	SPT	22	▲		●	0/0		
6.7		237.84		SS9	SPT	19	▲		●	0/0		

Borehole terminated at 6.7 m.

Water Level Readings:

Date	Depth (m)	Elev. (m)
2022-03-23	Dry	--
2023-03-03	Dry	--

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-16 **COMPLETED** 22-3-16 **GROUND ELEVATION** 243.31 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer X Vane +					
							40 80 120 160		PL MC LL	10 20 30		
0.76	FILL: Silty sand, brown, trace gravel, moist	242.55		SS1	SPT	6	▲		●	0/0		
1	SAND: Brown, some silt, very moist, loose to compact, medium to fine			SS2	SPT	5	▲		●	0/0		
2				SS3	SPT	9	▲		●	0/0		
3				SS4	SPT	26		▲	●	0/0		
4				SS5	SPT	12	▲		●	0/0		
4.6	occasional silty zones, compact to dense	238.74		SS6	SPT	22		▲	●	0/0		
6												
6.7		236.60		SS7	SPT	30		▲	●	0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
No cave
No free water

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-16 **COMPLETED** 22-3-16 **GROUND ELEVATION** 242.60 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer X Vane +					
							40 80 120 160		PL MC LL 10 20 30			
0.76	FILL: Silty sand, brown, trace organics, very moist	241.84		SS1	SPT	4	▲		●	0/0		
1	SAND: Brown, trace silt, moist, loose to compact, medium to fine			SS2	SPT	6	▲		●	0/0		
2				SS3	SPT	8	▲		●	0/0		
3				SS4	SPT	13	▲		●	0/0		
3.1	becoming greyish brown	239.55		SS5	SPT	20	▲		●	0/0		
4												
5				SS6	SPT	25	▲		●	0/0		
6												
6.1	becoming fine with occasional silty zones, wet	236.50		SS7	SPT	29	▲		●	0/0		
6.7		235.89										
Borehole terminated at 6.7 m.												Upon completion of augering No cave No free water

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-16 **COMPLETED** 22-3-16 **GROUND ELEVATION** 241.65 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
0.61	FILL: Silty sand, brown, trace organics, wet	241.04		SS1	SPT	4	▲		●	0/0		
1	POSSIBLE FILL: Sand, brown to yellow, some silt, trace organics, wet, very loose			SS2	SPT	3	▲		●	0/0		
2				SS3	SPT	2	▲		●	0/0		
3				SS4	SPT	3	▲		●	0/0		
3.1		238.60										
3.8	SANDY SILT: Brown, trace clay, very moist, loose	237.84		SS5	SPT	6	▲		●	0/0		0 18 79 3
4												
5	SAND: Brown, medium to fine, wet, compact			SS6	SPT	23	▲		●	0/0		
6				SS7	SPT	19	▲		●	0/0		
6.7		234.94		SS8	SPT	23	▲		●	0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
Cave at 5.2 m

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-17 **COMPLETED** 22-3-17 **GROUND ELEVATION** 240.88 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
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CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-17 **COMPLETED** 22-3-17 **GROUND ELEVATION** 241.25 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
0.05	GRANULAR: ~50 mm	241.20		SS1	SPT	5	▲			0/0		
0.20	TOPSOIL: ~150 mm	241.05		SS2	SPT	3	▲			0/0		
1	FILL: Sand, brown, trace to some silt, moist to very moist											
2				SS3	SPT	4	▲			0/0		
2.1		239.12										
3	SAND: Light brown, some silt, occasional silt seams, very moist, loose to compact			SS4	SPT	13	▲			0/0		
4				SS5	SPT	14	▲			0/0		
4.6		236.68										
5	SANDY SILT: Brown, wet, loose to compact			SS6	SPT	9	▲			0/0		0 42 56 2
6												
6.1		235.15										
7	SAND: Brown, medium to fine, some silt, trace clay, moist, compact			SS7	SPT	18	▲			0/0		
8				SS8	SPT	16	▲			0/0		0 82 16 2
9												
9.8		231.50		SS9	SPT	22	▲			0/0		

Borehole terminated at 9.8 m.

Water Level Readings:

Date	Depth (m)	Elev. (m)
2022-03-23	4.24	237.01
2023-03-03	4.33	236.92

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-16 **COMPLETED** 22-3-16 **GROUND ELEVATION** 241.74 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values	CPT values				
							10 20 30 40	10 20 30 40				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer Vane					
							40 80 120 160	10 20 30				
0.41	TOPSOIL: ~410 mm	241.33		SS1	SPT	19				0/0		
1	FILL: Silty sand, brown to yellow, trace organics, moist, very loose to loose			SS2	SPT	2				0/0		
1.5		240.22										
2	SAND: Brown, trace to some silt, moist, very loose to loose, reworked appearance at top portion			SS3	SPT	5				0/0		
3				SS4	SPT	8				0/0		
4				SS5	SPT	9				0/0		
4.6	SANDY SILT: Brown, wet, compact	237.17		SS6	SPT	11				0/0		
6												
6.1	SAND: Brown, trace to some silt, wet, compact	235.64		SS7	SPT	18				0/0		
6.7		235.03										

Borehole terminated at 6.7 m.

Upon completion of augering
Cave at 5.5 m

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-15 **COMPLETED** 22-3-15 **GROUND ELEVATION** 242.29 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/BL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer X Vane +					
							40 80 120 160		PL MC LL	10 20 30		
1	FILL: Silty sand, brown to yellow, trace to some organics, moist			SS1	SPT	2	▲		●	0/0		
1.5		240.77		SS2	SPT	2	▲		●	0/0		
2	SAND: Brown, trace to some silt, moist, loose to compact			SS3	SPT	5	▲		●	0/0		
3				SS4	SPT	11	▲		●	0/0		
4				SS5	SPT	13	▲		●	0/0		
4.6		237.72										
5	SANDY SILT: Brown, trace clay, wet, compact			SS6	SPT	14	▲		●	0/0		
6		236.19										
6.1												
6.7	SAND: Brown, trace silt, very moist, compact	235.58		SS7	SPT	14	▲		●	0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
No cave
No free water

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-15 **COMPLETED** 22-3-15 **GROUND ELEVATION** 243.55 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer X Vane +					
							40 80 120 160		PL MC LL	10 20 30		
0.13	TOPSOIL: ~125 mm	243.43		SS1	SPT	3	▲			0/0		
0.76	FILL: Silty sand, brown, trace to some organics, moist	242.79										
1	SAND: Light brown, silt seams, moist to very moist, loose to dense			SS2	SPT	9	▲			0/0		
2				SS3	SPT	43		▲		0/0		
2.3	occasional wet silt seams / zones	241.26		SS4	SPT	19	▲			0/0		
3				SS5	SPT	14	▲			0/0		
3.8		239.74		SS6	SPT	9	▲			0/0		
4	SILTY SAND: Brown, medium to fine, trace clay, moist to wet, loose to compact			SS7	SPT	16	▲			0/0		
5												
6												
6.7		236.84		SS8	SPT	28	▲			0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
No cave
No free water

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-16 **COMPLETED** 22-3-16 **GROUND ELEVATION** 242.24 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							Undrained Shear Strength (kPa) Pocket Penetrometer X Vane + 40 80 120 160		PL MC LL 10 20 30			
1	FILL: Sand, brown to light brown, trace to some silt, trace organics, very moist			SS1	SPT	7	▲		●	0/0		
1.5		240.72		SS2	SPT	0	▲		●	0/0		
2	POSSIBLE FILL: Sand, brown, trace silt, trace organics, moist, very loose			SS3	SPT	2	▲		●	0/0		
3				SS4	SPT	2	▲		●	0/0		
4	some silt inclusions, wet	238.43		SS5	SPT	1	▲		●	0/0		
4.6		237.67		SS6	SPT	5	▲		●	0/0		
5	SAND: Brown, medium to fine, moist to wet, compact			SS7	SPT	24	▲		●	0/0		
6												
6.7		235.53		SS8	SPT	19	▲		●	0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
No cave
No free water

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-17 **COMPLETED** 22-3-17 **GROUND ELEVATION** 241.71 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
0.08	GRANULAR: ~75 mm	241.64		SS1	SPT	3	▲			0/0		
1	FILL: Sand, Dark brown to brown, some silt, very moist			SS2	SPT	2	▲			0/0		
1.5		240.19										
2	SAND: Light brown, trace to some silt, very moist, loose to compact			SS3	SPT	6	▲			0/0		
3				SS4	SPT	19	▲			0/0		
4				SS5	SPT	21	▲			0/0		
3.8	becoming wet, occasional silt seams / zones	237.90		SS6	SPT	17	▲			0/0		
4.6		237.14		SS7	SPT	8	▲			0/0		
5	SANDY SILT: Brown, some clay seams, wet, loose											
6												
6.1		235.61		SS8	SPT	16	▲			0/0		
6.7	SAND: Brown, trace silt, moist, compact	235.00										
Borehole terminated at 6.7 m.												Upon completion of augering Cave at 4.6 m

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-16 **COMPLETED** 22-3-16 **GROUND ELEVATION** 241.77 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer X					
							Vane +					
							40	80	120	160		
									PL	MC	LL	
									10	20	30	
0.05	GRANULAR: ~50 mm	241.72		SS1	SPT	6	▲		●	0/0		
0.25	TOPSOIL: ~200 mm	241.52										
	FILL: Sand, brown, some silt, moist											
1				SS2	SPT	2	▲		●	0/0		
2				SS3	SPT	2	▲		●	0/0		
3				SS4	SPT	6	▲		●	0/0		
3.1		238.72										
	SAND: Light brown, trace organics at the top portion, moist to wet, loose to compact, occasional silt seams / zones			SS5	SPT	8	▲		●	0/0		
4				SS6	SPT	13	▲		●	0/0		
5				SS7	SPT	8	▲		●	0/0		
6												
6.7		235.06		SS8	SPT	26	▲		●	0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
Cave at 5.5 m

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-15 **COMPLETED** 22-3-15 **GROUND ELEVATION** 242.89 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values ▲	CPT values △				
0.23	TOPSOIL: ~225 mm	242.67										
	FILL: Sand, brown, some silt, moist			SS1	SPT	10	▲		●	0/0		
0.76		242.13										
1	becoming wet			SS2	SPT	2	▲		●	0/0		
1.5		241.37										
2	SILTY SAND: Brown to light brown, moist to very moist, compact			SS3	SPT	13	▲		●	0/0		
				SS4	SPT	11	▲		●	0/0		
3				SS5	SPT	16	▲		●	0/0		
4												
5				SS6	SPT	23	▲		●	0/0		
6												
6.7		236.18		SS7	SPT	13	▲		●	0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
No cave
No free water

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-15 **COMPLETED** 22-3-15 **GROUND ELEVATION** 245.01 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values	CPT values				
							10 20 30 40	10 20 30 40				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer Vane					
							40 80 120 160	10 20 30				
0.20	TOPSOIL: ~200 mm	244.81		SS1	SPT	3	▲		●	0/0		
1	FILL: Sand, brown, trace to some silt, some organics, very moist			SS2	SPT	2	▲		●	0/0		
2				SS3	SPT	2	▲		●	0/0		
3				SS4	SPT	2	▲		●	0/0		
3.1		241.96		SS5	SPT	14	▲		●	0/0		
4	SAND: Brown, medium to fine, trace to some silt, moist to very moist, compact to very dense			SS6	SPT	37		▲	●	0/0		
5				SS7	SPT	20	▲		●	0/0		
6												
7				SS8	SPT	17	▲		●	0/0		
8												
8.2		236.78		SS9	SPT	68	>>▲		●	0/0		

Borehole terminated at 8.2 m.

Water Level Readings:

Date	Depth (m)	Elev. (m)
2022-03-23	Dry	--
2023-03-03	Dry	--

CLIENT 2863088 Ontario Inc. **PROJECT NAME** Proposed Residential Development - Sharma Subdivision
PROJECT NUMBER G2S22008 **PROJECT LOCATION** Charles Street and Washington Street, Waterford, ON
DATE STARTED 22-3-15 **COMPLETED** 22-3-15 **GROUND ELEVATION** 245.29 m
DRILLING CONTRACTOR London Soil Test Ltd. **LOGGED BY** DB **CHECKED BY** AA
DRILLING METHOD Diedrich D50 Track **NOTES**

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (m)	GRAPHIC LOG	NUMBER	TYPE	N VALUE	SPT N VALUES		MOISTURE / PLASTICITY	SOIL GAS READINGS HEX/IBL (ppm)	WELL CONSTRUCTION	GRAIN SIZE DISTRIBUTION % GR SA SI & CL
							N values	CPT values				
							10 20 30 40	10 20 30 40				
							Undrained Shear Strength (kPa)					
							Pocket Penetrometer Vane					
							40 80 120 160	10 20 30				
0.25	TOPSOIL: ~250 mm	245.04										
	FILL: Sand, brown to dark brown, some organics, moist	244.53		SS1	SPT	2	▲		●	0/0		
0.76												
1	SAND: Brown, trace to some silt, moist, loose to compact			SS2	SPT	6	▲		●	0/0		
2				SS3	SPT	12	▲		●	0/0		
3				SS4	SPT	17	▲		●	0/0		
3.1	occasional silt seams / zones	242.24										
				SS5	SPT	20	▲		●	0/0		
4												
5				SS6	SPT	21	▲		●	0/0		
6												
6.7		238.58		SS7	SPT	19	▲		●	0/0		

Borehole terminated at 6.7 m.

Upon completion of augering
No cave
No free water

Project No.: G2S22008

Lab No.: 23006A

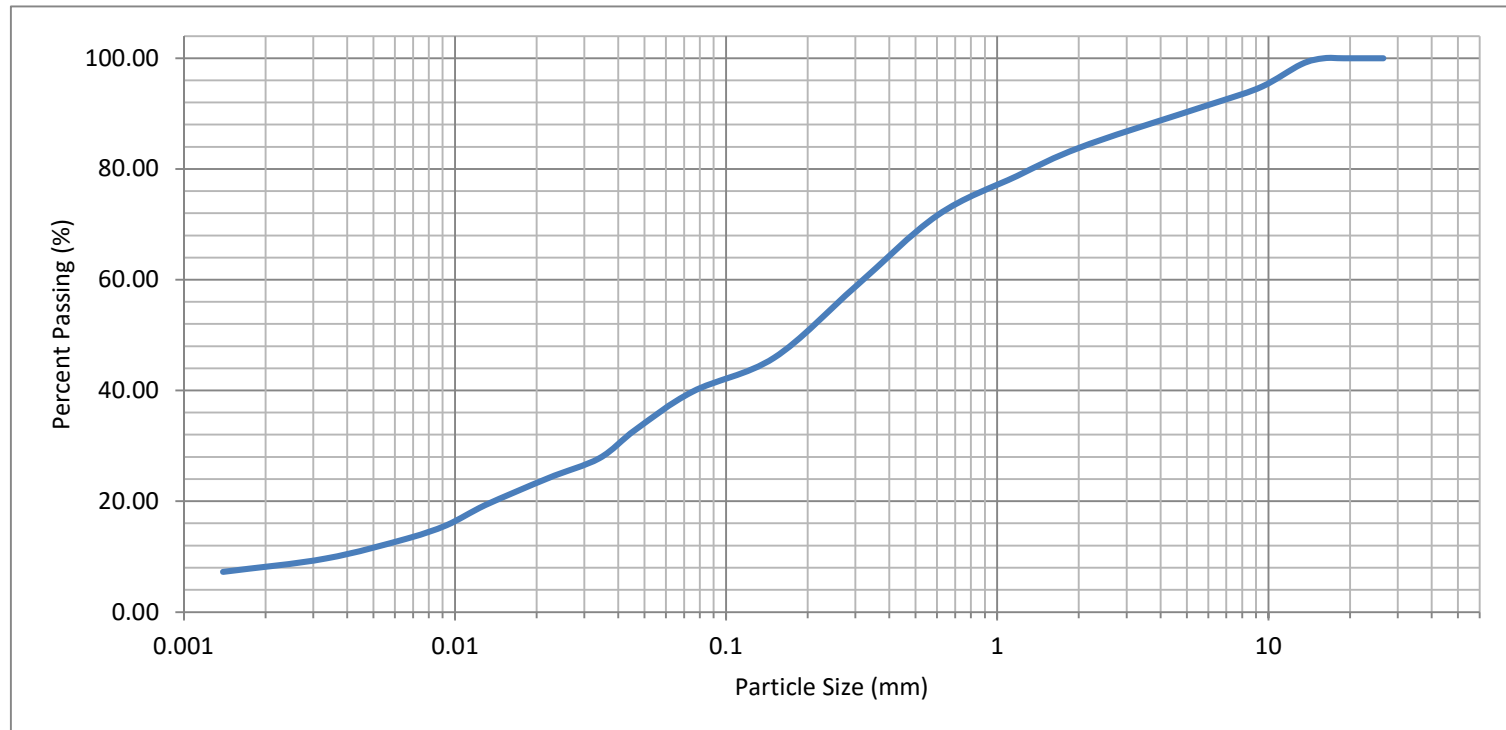
Project Name: Charles St. & Washington St., Waterford, ON

Borehole/Sample No.: BH101-SS7

ISSMGE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL		
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE

SIEVE SIZE: 1 2 6 20 60#200 #100 #50 #16 #8 #4 3/8" 3/4" 2-1/2"



Project No.: 23002A

Lab No.: 23002A

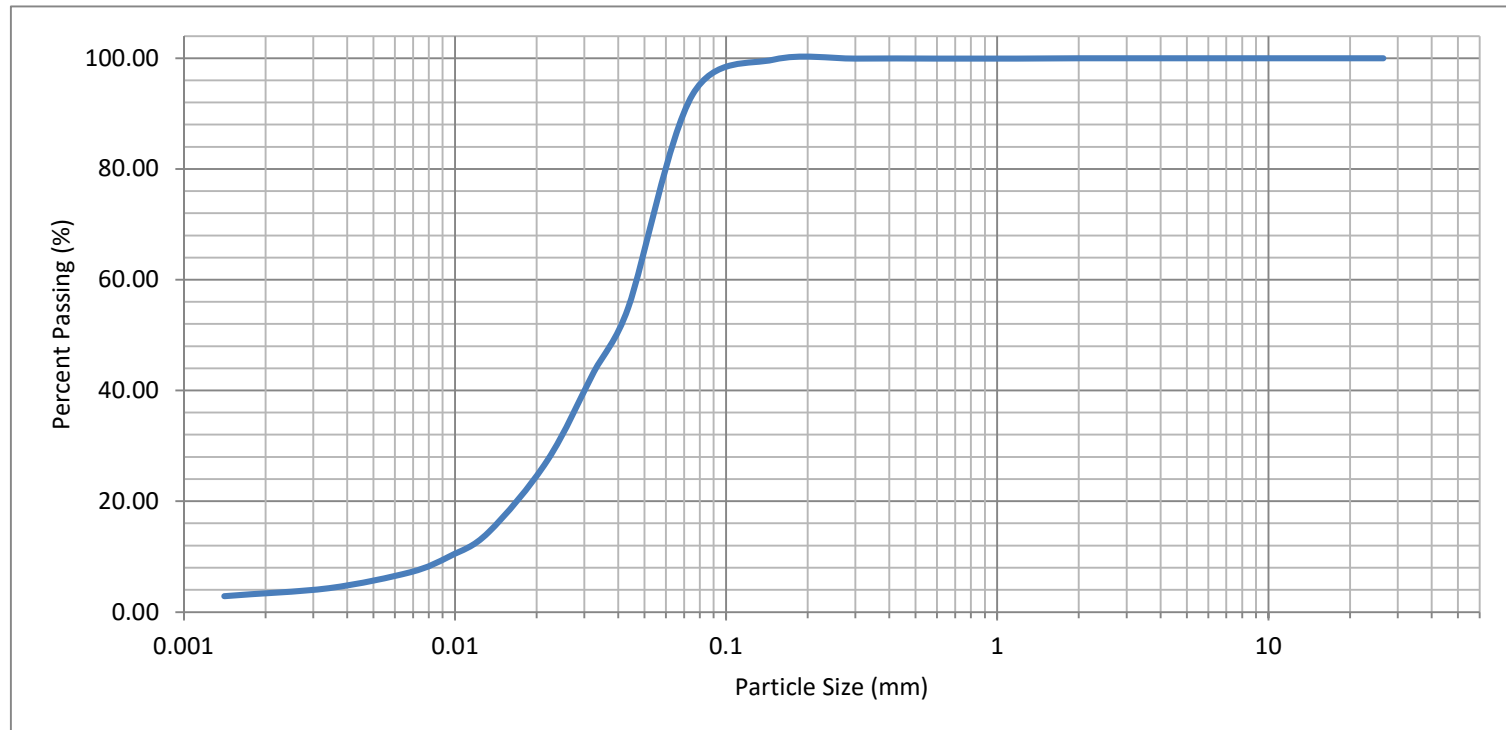
Project Name: Charles St. & Washington St., Waterford, ON

Borehole/Sample No.: BH105-SS5

ISSMGE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL		
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE

SIEVE SIZE: 1 2 6 20 60#200 #100 #50 #16 #8 #4 3/8" 3/4" 2-1/2"



Project No.: G2S22008

Lab No.: 22019E

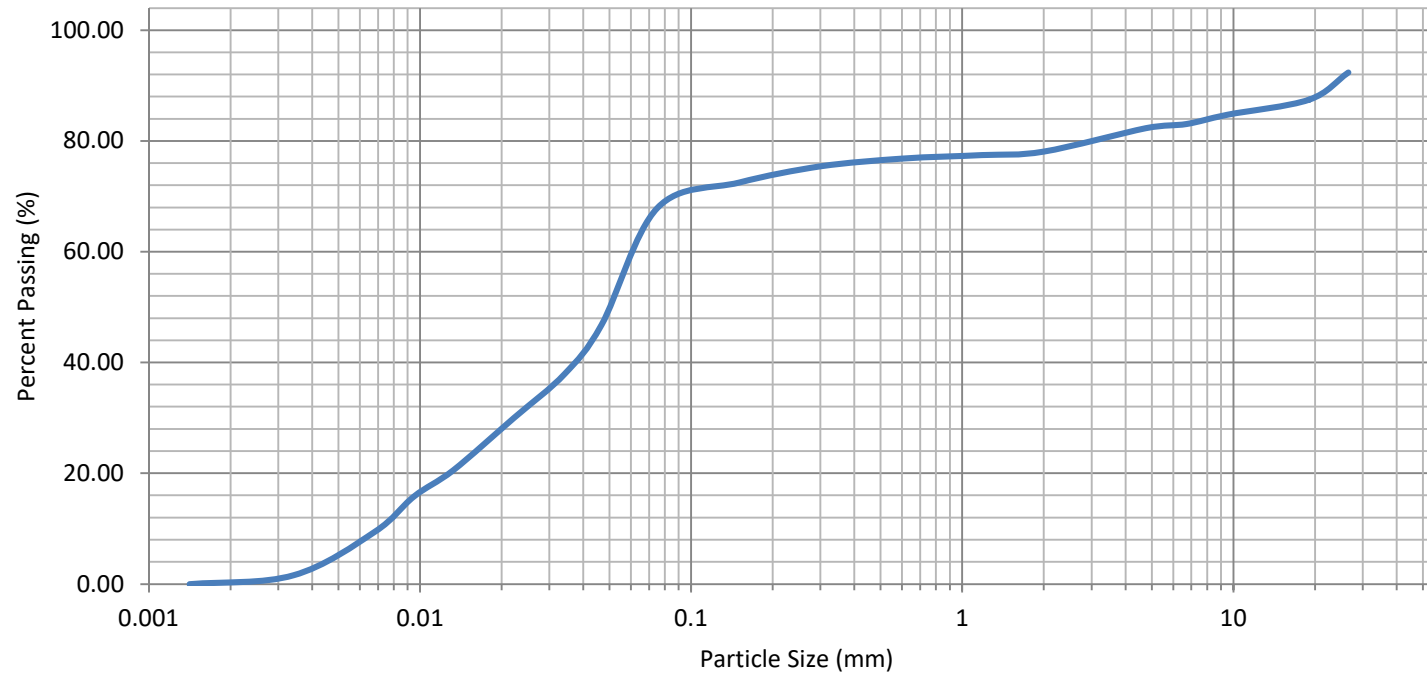
Project Name: Charles St. & Washington St., Waterford, ON

Borehole/Sample No.: BH106-SS8

ISSMGE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL		
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE

SIEVE SIZE: 1 2 6 20 60#200 #100 #50 #16 #8 #4 3/8" 3/4" 2-1/2"



Project No.: G2S22008

Lab No.: 23002B

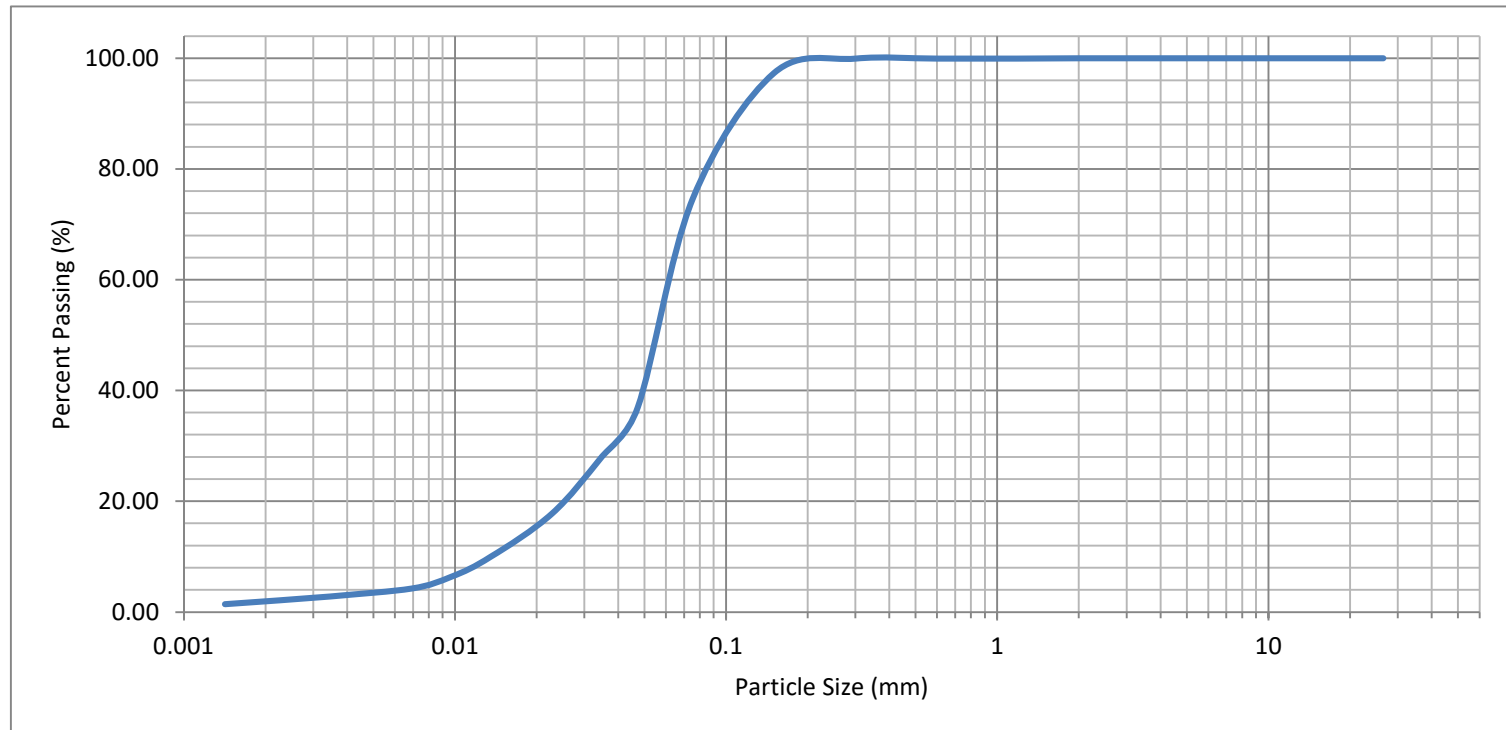
Project Name: Charles St. & Washington St., Waterford, ON

Borehole/Sample No.: BH107-SS6

ISSMGE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL		
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE

SIEVE SIZE: 1 2 6 20 60#200 #100 #50 #16 #8 #4 3/8" 3/4" 2-1/2"



Project No.: G2S22008

Lab No.: 23006B

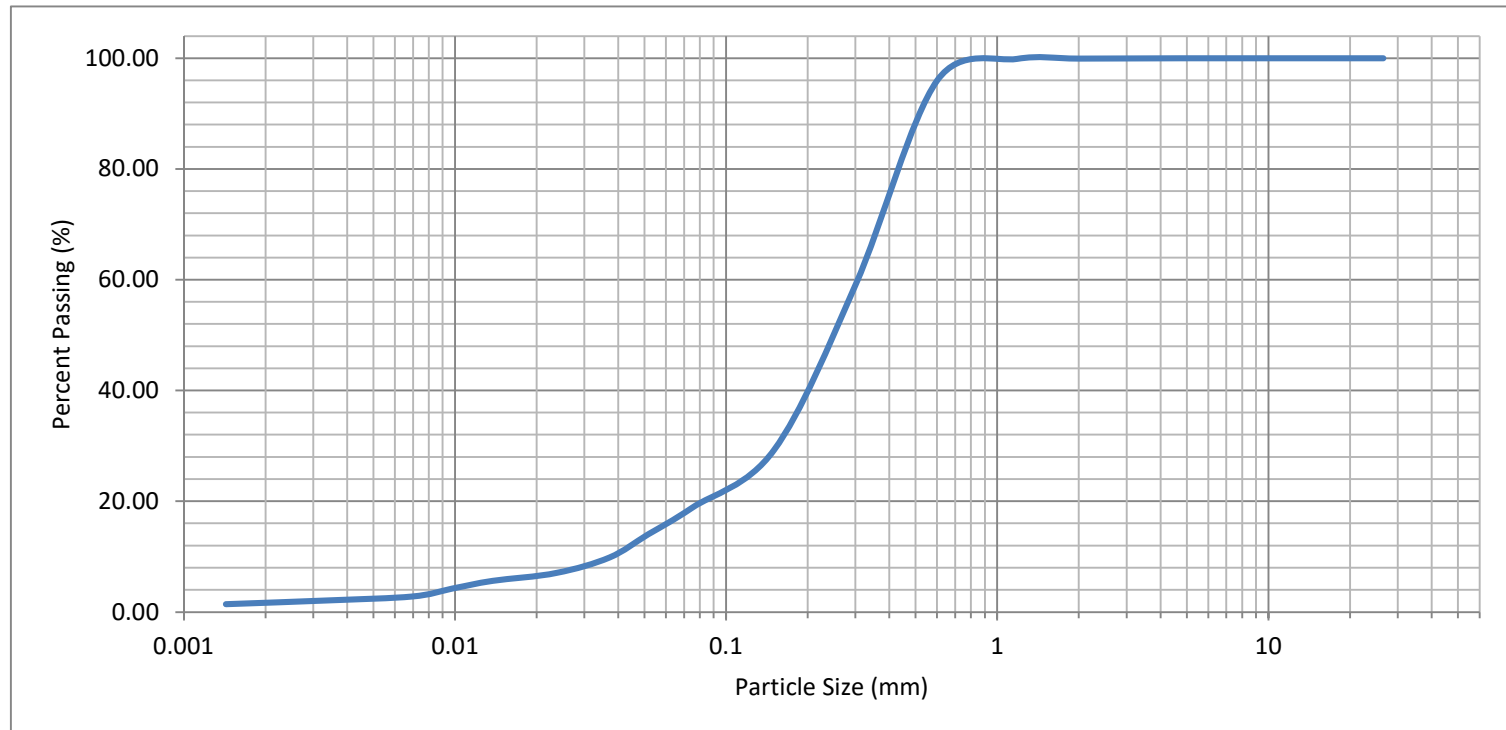
Project Name: Charles St. & Washington St., Waterford, ON

Borehole/Sample No.: BH107-S8

ISSMGE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL		
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE

SIEVE SIZE: 1 2 6 20 60#200 #100 #50 #16 #8 #4 3/8" 3/4" 2-1/2"



Project No.: G2S22008

Lab No.: 23006C

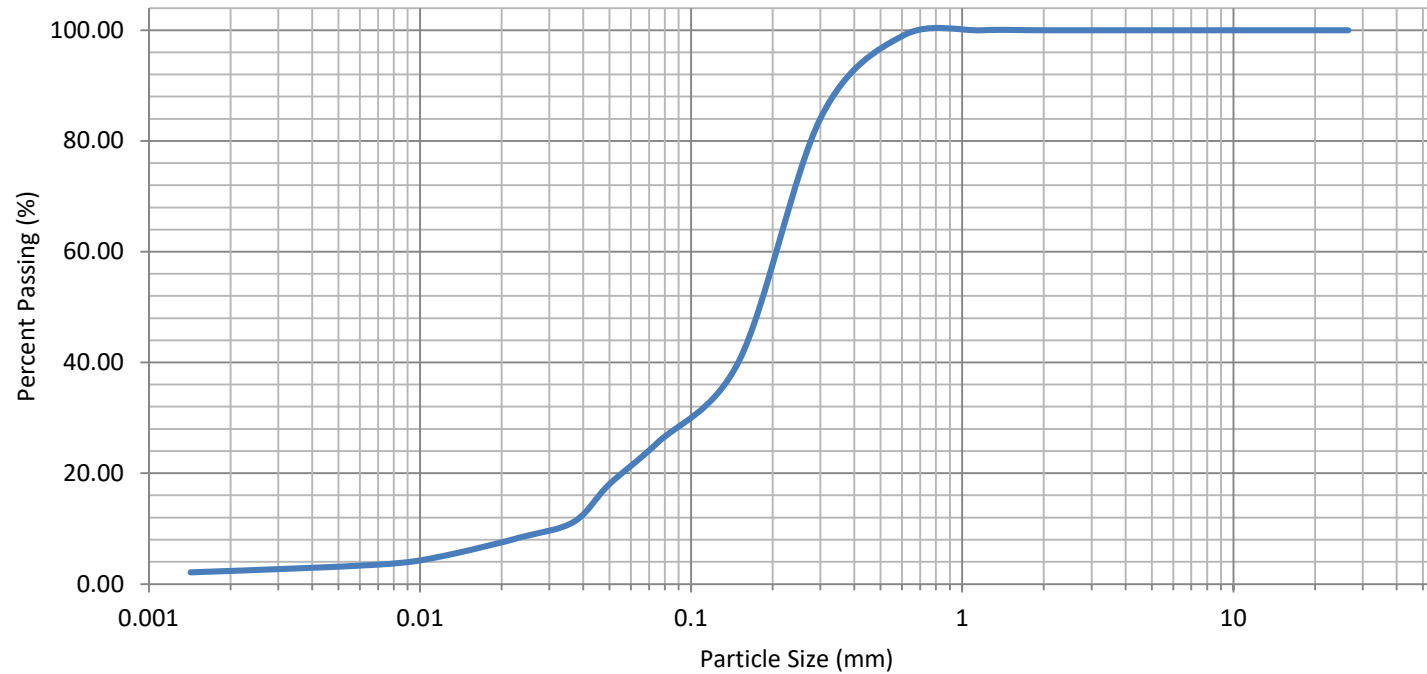
Project Name: Charles St. & Washington St., Waterford, ON

Borehole/Sample No.: BH110-S6

ISSMGE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL		
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE

SIEVE SIZE: 1 2 6 20 60#200 #100 #50 #16 #8 #4 3/8" 3/4" 2-1/2"



Project No.: G2S22008

Lab No.: 23006D

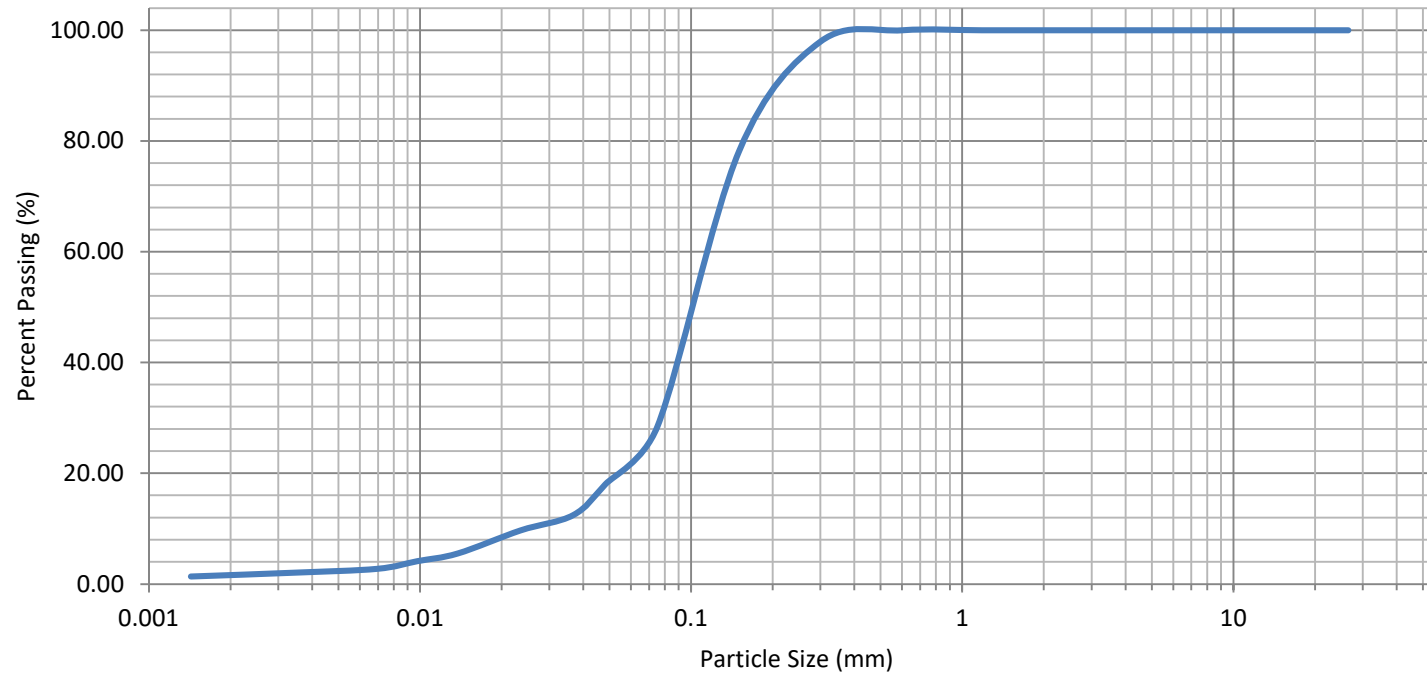
Project Name: Charles St. & Washington St., Waterford, ON

Borehole/Sample No.: BH114-S5

ISSMGE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL		
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE

SIEVE SIZE: 1 2 6 20 60#200 #100 #50 #16 #8 #4 3/8" 3/4" 2-1/2"

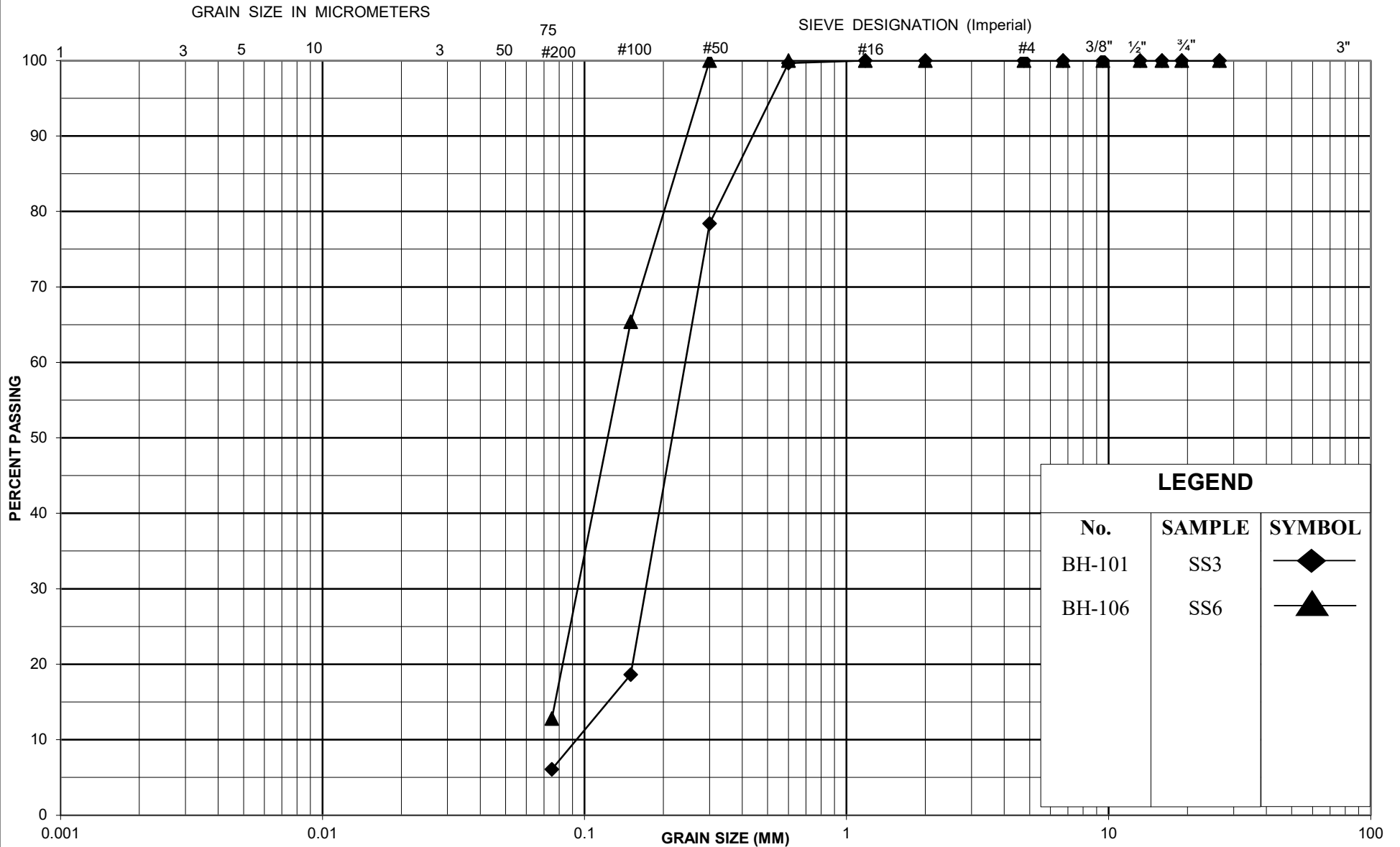


Project No.: G2S22008
Project Name: Charles St. & Washington St., Waterford, ON

Lab No.: 22019 A,D

ISSMFE SOIL CLASSIFICATION SYSTEM

CLAY	SILT			SAND			GRAVEL			Cobbles
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	



Appendix C:

Soil Infiltration Assessment



December 1, 2022

G2S Environmental Consulting Inc.
4361 Harvester Road, Unit 12
Burlington, ON
L7L 5M4
ATTN: Melissa King

Re: Sharma Subdivision,
155-183 Charles Street, Waterford
Soil Infiltration Assessment
Project 10193

Hydrogeology Consulting Services Inc. (HCS) was retained by G2S Environmental Consulting Inc. to assess the near-surface soil infiltration capacity at the above-referenced property.

Double Ring Infiltrometer Results

A double ring infiltrometer (DRI) from AMS Samplers was used to assess the surficial soil infiltration rate at the two locations shown on the attached Drawing 1 on November 18, 2022. At the time of testing the ground was not frozen as a thaw had recently occurred. Surface vegetation, topsoil, and overburden material was excavated at the test locations to a depth of approximately 0.9-1.0 mBGS using a tracked excavator to allow the DRI to seat into the native sandy soils. It is important to consider that factors such as roots and wormholes (which create preferential pathways for infiltrating water), and rocks and debris (which can prevent a proper seal of the infiltrometer rings into the soil and cause escape of water under the bottom of the ring) can result in erroneously high measured infiltration rates.

Water was added to the outer ring of the DRI during the test to maintain a vertical “curtain” of saturated soil around the inner ring. This curtain of saturated soil ensured that the DRI test only measured vertical percolation of water through the soil matrix beneath the inner ring. The water level of the outer ring was monitored to ensure it remained similar to the water level in the inner ring during the test. Water was added to the inner ring and the rate of infiltration timed with a stopwatch at regular intervals by measuring the drop in water level inside the inner ring. When the rate of change of water level reached an equilibrium, the test was considered complete.

The Toronto Region Conservation Authority (TRCA) and Credit Valley Conservation (CVC) provide a method of assessing soil infiltration rate in the Low Impact Development (LID) Stormwater Management (SWM) Planning and Design Guide (TRCA and CVC, 2010). Following the methodology outlined in Appendix C of the Guide the measured infiltration rates from the DRI tests were factored. Additionally, an estimated soil “T-Time” value based on the Ontario Building Code (OBC) classifications for major soil types is provided. The measured and estimated factored soil infiltration rates, plus OBC T-Time values, are included in Table 1 below.

Table 1: Calculated Estimated Soil Infiltration Rates and T-Times

DRI Test Location	Measured Soil Infiltration Rate – <u>Unfactored</u> (mm/hr)	Estimated Soil T-Time (mins/cm) (OBC)	Estimated Soil Infiltration Rate – Factored * (mm/hr)
DRI-01-22 (sand, trace-some silt)	225	15-20	90
DRI-02-22 (sand, trace-some silt)	150	17-22	60

* - Factor of 2.5 applied

As shown in Table 1 it is important to consider that the LID SWM Planning and Design Guide requires implementation a Safety Correction factor to calculate “Design Infiltration Rates” (e.g. for subdivision soakaway pits and infiltration galleries). The measured unfactored rates listed in the table are considered reasonable for comparative purposes and for design of sewage effluent leaching beds, while the factored rates would be applicable for design of high volume infiltration facilities.

The factored infiltration values show the near-surface native sandy deposits underlying topsoil beneath the subject property have a relatively high infiltration rate.

Grain Size Analysis Results

Samples of soil from the DRI test pits collected during excavation, and from on-site boreholes previously drilled on the subject property as part of a geotechnical investigation at the locations shown on the attached Drawing 2 (G2S Environmental Consulting Inc., April 2022) were submitted for analysis of particle size distribution (grain size). As shown on the appended grain size analysis graphs, the near-surface soils consist of silty sand to sand with trace-some silt. The grain size analysis results were used to estimate soil hydraulic conductivity (K) values by applying the Kaubisch, Breyer, Hazen, and Kozeny-Carman formulae where appropriate based on the limitations of each formula. The hydraulic conductivity estimates are summarized in Table 2 below:

Table 2: Calculated soil hydraulic conductivity values

Location	Sample Depth (mBGS)	Analysis Method	Hydraulic Conductivity (m/sec)
DRI-01-22	0.9	Kozeny Carman	5.2×10^{-6}
DRI-02-22	1.0	Breyer	6.5×10^{-5}
BH 107	(ss-8)	Breyer	8.6×10^{-5}

It is noted two borehole soil samples (BH 101 ss-3 and BH 114 ss-5) had no D_{10} values due to the high percentage of fine sand grains in the samples; therefore, hydraulic conductivity estimates could not be generated.

The hydraulic conductivity values of 5.2×10^{-6} – 8.6×10^{-5} m/sec indicate a relatively moderate to moderately high permeability.

The hydraulic conductivity estimates from the grain size analyses correlate well with published ranges for major soil types (Freeze and Cherry, 1979).

Soil Infiltration Rate and T-Time Calculations – Grain Size Analysis Results

The Toronto Region Conservation Authority (TRCA) and Credit Valley Conservation (CVC) provide a method of assessing soil infiltration rate in the Low Impact Development (LID) Stormwater Management (SWM) Planning and Design Guide (TRCA and CVC, 2010). Following the methodology outlined in Appendix C of the Guide the estimated soil hydraulic conductivity values from Table 2 above were converted into the infiltration rates listed in Table 3 below. Additionally, estimated soil “T-Time” values based on the Ontario Building Code (OBC) classifications for major soil types are provided.

Table 3: Estimated Soil Infiltration Rates from Grain Size Analysis Hydraulic Conductivity Values

Borehole Location and Sample Depth (m)	Estimated Soil Infiltration Rate – <u>Unfactored</u> (mm/hr)	Estimated Soil T-Time (mins/cm) (OBC)	Estimated Soil Infiltration Rate – Factored * (mm/hr)
DRI-01-22 (sand, trace-some silt)	62	15-20	25
DRI-02-22 (sand, trace-some silt)	128	17-22	51
BH 107 (fine-medium sand)	142	10	57

* - Factor of 2.5 applied

As discussed previously it is important to consider that the LID SWM Planning and Design Guide requires implementation a Safety Correction factor to calculate “Design Infiltration Rates” (e.g. for subdivision soakaway pits and infiltration galleries). The measured unfactored rates listed in the table are considered reasonable for comparative purposes and for design of sewage effluent leaching beds, while the factored rates would be applicable for design of high volume infiltration facilities.

The factored infiltration values show the near-surface native sandy deposits underlying topsoil beneath the subject property have a relatively moderate to moderately-high infiltration rate, somewhat lower than the DRI-estimated infiltration rates. The rates listed in Table 3 can be considered more conservative for the purposes of infiltration facility design.

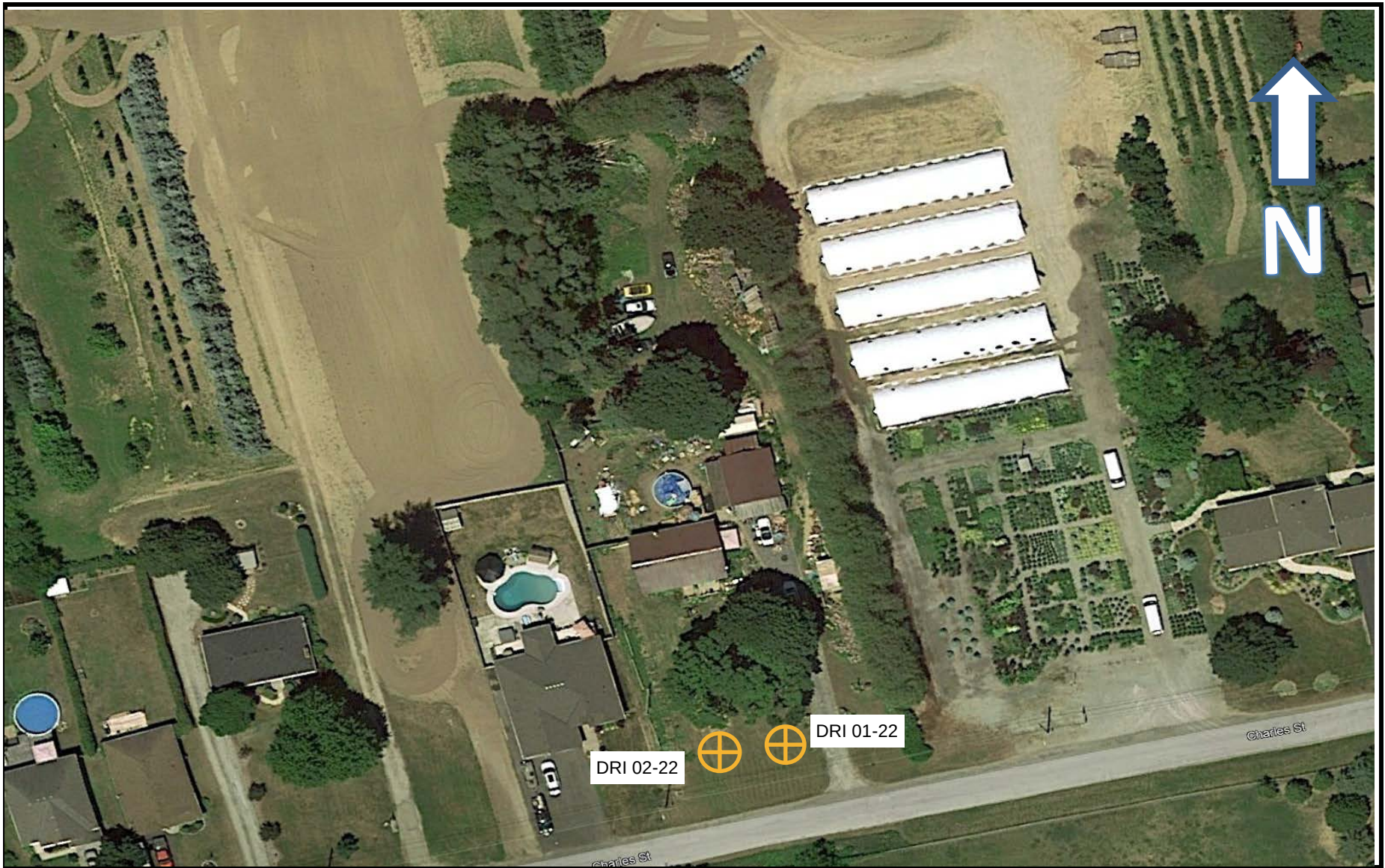
I trust this information is sufficient for your present requirements. If any further questions or comments arise, please feel free to contact me directly.

Respectfully submitted,

A handwritten signature in blue ink, appearing to read 'Chris Helmer', is written over a circular professional seal.A circular professional seal for a geoscientist in Ontario. The outer ring contains the text 'PROFESSIONAL GEOSCIENTIST' at the top and 'ONTARIO' at the bottom. The center features a stylized flower logo. Overlaid on the seal is the date '01-Dec-2022' and the text 'CHRIS HELMER PRACTISING MEMBER 2285'.

Chris Helmer, B.Sc., P.Geo.
Senior Hydrogeologist
MECP Licensed Well Contractor and Class 5 Well Technician
www.hydrog.ca

- encl. Drawing 1 – DRI Test Locations
- encl. Drawing 2 – Borehole Location Plan (G2S Environmental Consultants Inc.)
- encl. Grain Size Analysis Graphs



LEGEND



Double Ring
Infiltrator Test
Location
(approximate)

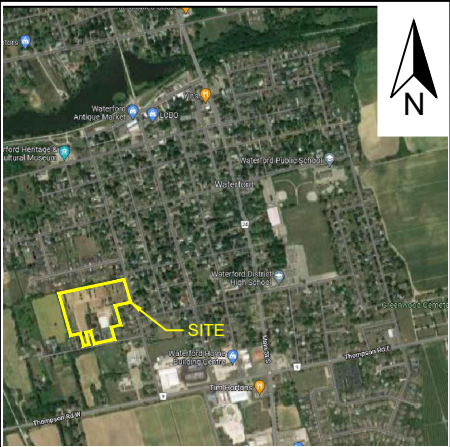
Drawing 1 - Site Plan
155-183 Charles Street, Waterford



HCS
HYDROGEOLOGY
CONSULTING
SERVICES INC

imagery from Google Earth © 2022

Drawn:	CFH
Date:	2022-11-29



KEY PLAN

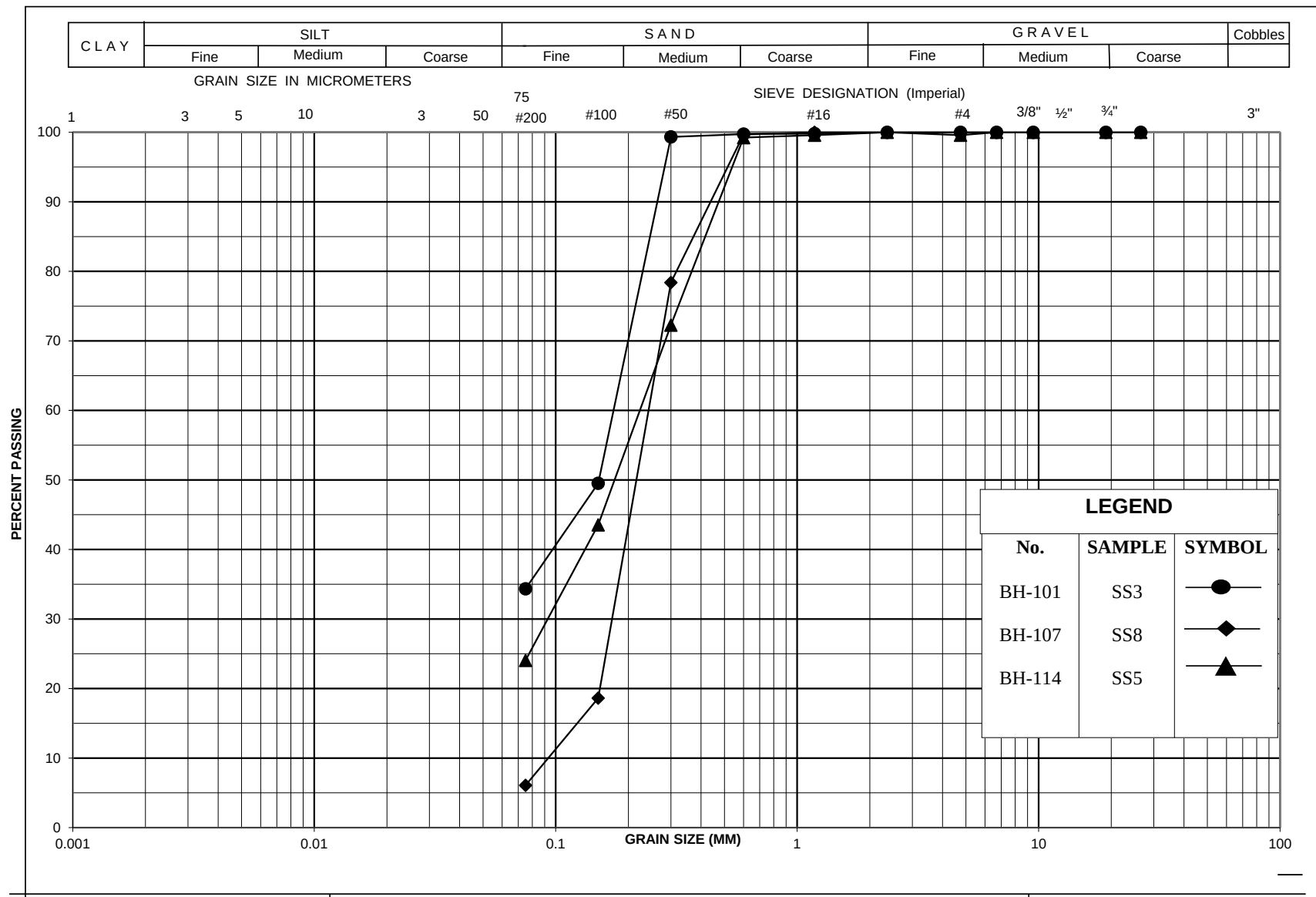
LEGEND

- BOREHOLE LOCATION
- MONITORING WELL LOCATION
- TEMPORARY BENCHMARK (TBM)
- XXX.XX GROUND SURFACE ELEVATION (m)
- XXX.XX GROUNDWATER ELEVATION (DATE)
- PROPOSED BUILDING LOCATION
- PROPOSED PARK LOCATION
- PROPOSED SWM POND LOCATION

TITLE:	
BOREHOLE LOCATION PLAN	
CLIENT:	
2863088 ONTARIO INC.	
LOCATION:	
CHARLES STREET	
WATERFORD, ONTARIO	
PROJECT:	
G2S22008	
DRAWING:	2
SCALE:	AS SHOWN
DATE:	APRIL 2022
DRAWN BY:	DB
FILE NAME:	G2S22008 BH Location Plan



ISSMFE SOIL CLASSIFICATION SYSTEM



Project No.: G2S22008

Lab No.: 22075A

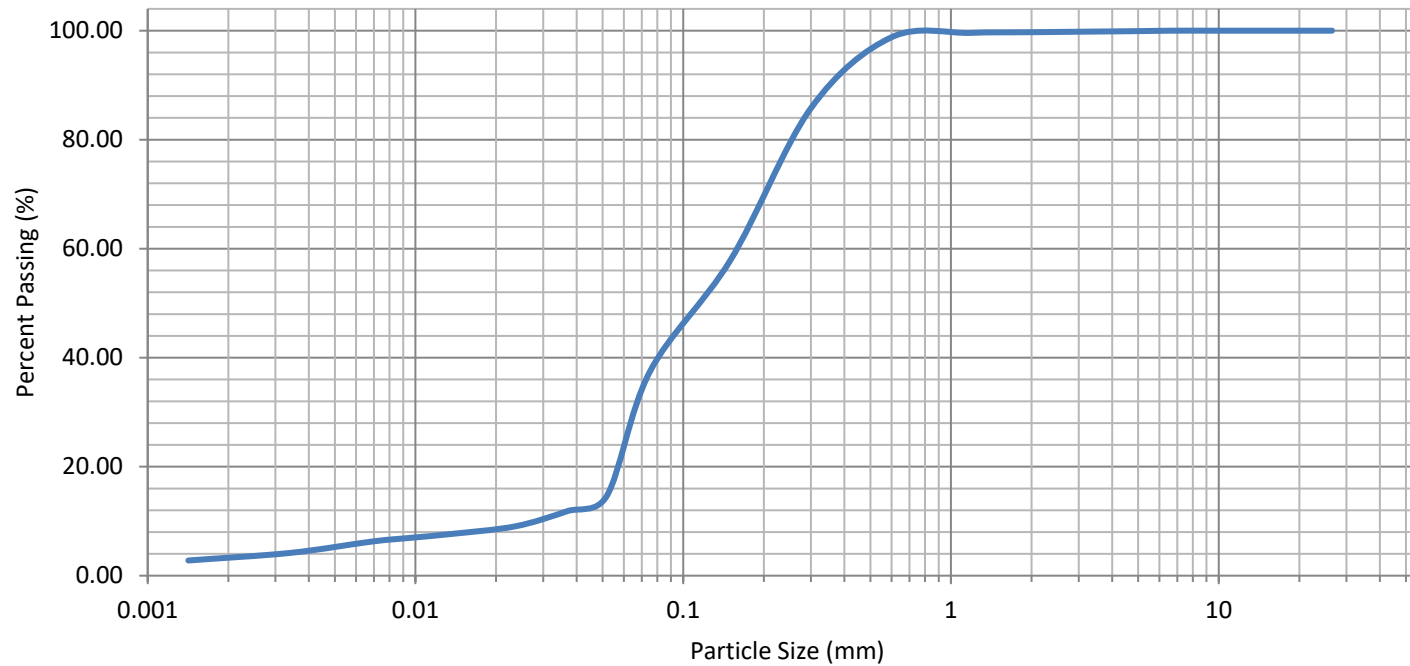
Project Name: Charles St & Washington St, Waterford

Borehole/Sample No.: DRI 1 - 0.9 m (3 ft)

ISSMGE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL		
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE

SIEVE SIZE: 1 2 6 20 60#200 #100 #50 #16 #8 #4 3/8" 3/4" 2-1/2"



Project No.: G2S22008

Lab No.: 22075B

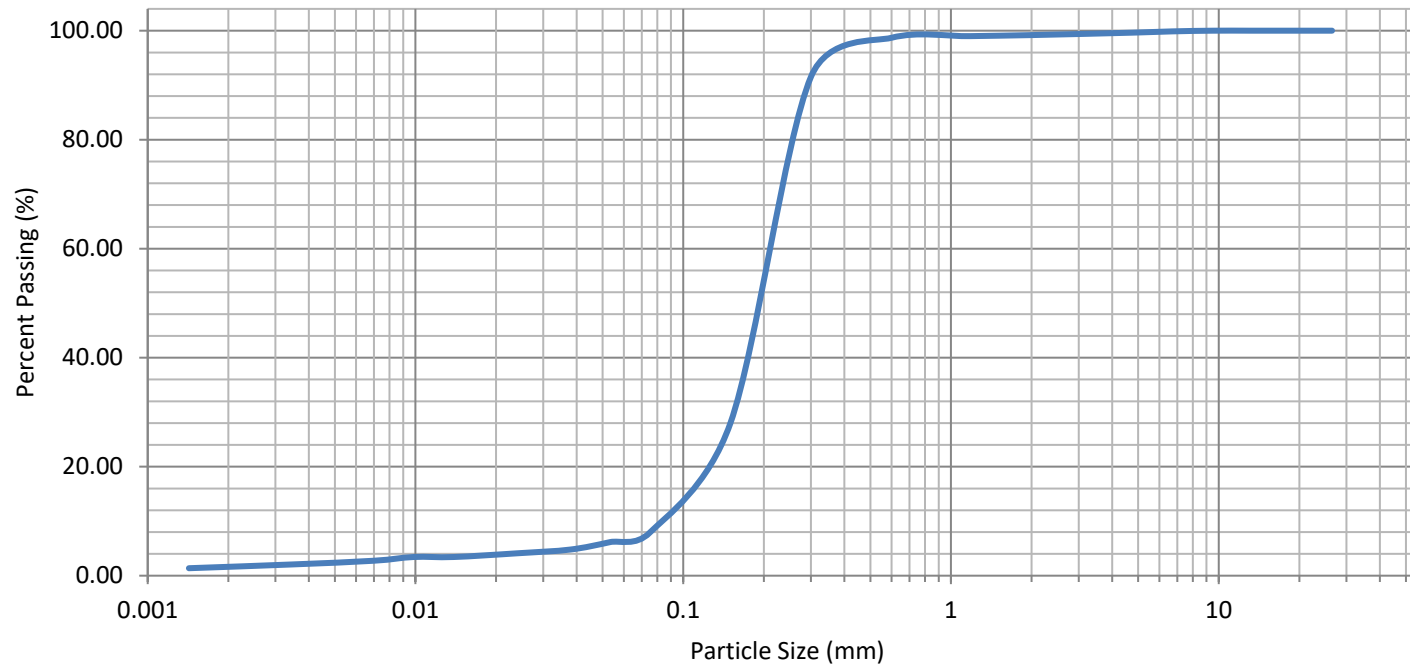
Project Name: Charles St & Washington St, Waterford

Borehole/Sample No.: DRI 2 - 1.0 m (3.3 ft)

ISSMGE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL		
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE

SIEVE SIZE: 1 2 6 20 60#200 #100 #50 #16 #8 #4 3/8" 3/4" 2-1/2"





vallee

*Consulting Engineers,
Architects & Planners*

Rev 0 – May 24, 2022

Rev 1 – December 12, 2023

Revised Waterford South Municipal Drain Design Brief

Waterford – Norfolk County

Introduction

This report has been prepared as a revision to the original “*Waterford South Municipal Drain Design Brief*”, dated August 14, 1996, which outlines the design of the Waterford South Municipal Drain (WSMD) in Waterford, Norfolk County.

Since the completion of the original WSMD Design Brief, various road reconstruction projects have occurred, and multiple residential areas have been developed within the limits of WSMD drainage areas. In addition, two proposed residential developments (the Thompson Subdivision and the Charles Street Subdivision) require a legal stormwater outlet. This design brief will present a revised WSMD design, which includes updating the original drainage areas to reflect current conditions and adding the proposed residential developments to the WSMD system.

The intention is to submit this updated design brief to Norfolk County and the Long Point Region Conservation Authority (LPRCA) for review and approval of the revised design conditions and proposed functional storm servicing for the prospective residential developments. It is not intended to outline a detailed design for the proposed residential developments, but rather to confirm that each proposed site can be serviced with respect to stormwater management (SWM).

Background

The Waterford South Municipal Drain system was constructed to provide a legal stormwater outlet for the southern portion of Waterford, Norfolk County. The system included three components, the Thompson Road storm sewer, a stormwater management facility, and the outlet which ultimately connects the system to the existing Waterford Ponds. Refer to the “*Waterford South Municipal Drain Design Brief*” dated August 14th 1996 in Appendix A for complete details of the original WSMD design.

The Thompson Road storm sewer was designed as a trunk sewer to collect stormwater from various future storm sewer connections and was designed to have hydraulic capacity to accept design flows from the 2-year storm event. Excess flows caused by larger storm events would continue to flow overland as they did prior to the construction of the sewer. The storm sewer was designed to begin at the intersection of Main Street and Thompson Road and flow west along Thompson Road for approximately 1045 metres before discharging into the proposed WSMD stormwater management facility. Along the length of the storm sewer, multiple storm sewer stubs were installed at intersection streets to allow for future connection to the WSMD outlet.

The WSMD stormwater management facility was designed to reduce the peak flows entering the Waterford Ponds during the 2-year and 5-year storm event. In addition, the SWM facility provides water quality treatment of stormwater to prevent excess sediment and pollutants from entering the receiving watercourse and Waterford Ponds.

Original Drainage Areas

Per the original WSMD design, three drainage areas were considered in the design of the Thompson Road storm sewer and WSMD SWM facility, which included an existing residential area, a rural area allocated for future residential development, and an existing commercial area. Refer to the drainage area figure in the original “*Waterford South Municipal Drain Design Brief*” dated August 14th 1996 in Appendix A. Using OTTHYMO’89 modelling software, stormwater flow rates from each of the three drainage areas, and the total peak flow to the storm sewer were determined. Table 1 summarizes the input parameters and the modelled 2-year peak flow associated with each drainage area.

Table 1 Input Parameters and Modelled Peak Flows			
Parameter	Area 1: Existing Residential	Area 2: Future Residential	Area 3: Existing Commercial
Area	48 ha	24 ha	19 ha
Total Impervious	30%	30%	80%
Directly Connected Impervious	15%	15%	50%
Curve Number, CN	50	50	50
Initial Abstraction	1.5mm	1.5mm	1.5mm
2-Year Peak Flow	1.31 m ³ /s	Uncontrolled = 0.70 m ³ /s Controlled rate = 0.05 m ³ /s	1.94 m ³ /s

Area 2 was modelled as a future residential development, therefore, to reduce flows to the Thompson Road storm sewer, it was assumed that this future residential area would feature an on-site detention pond, which would regulate the release rate to a maximum of 0.05 m³/s during the 2-year storm event.

The modelled summation of each of the aforementioned drainage areas resulted in a peak flow of 3.25 m³/s to the Thompson Road storm sewer during the 2-year storm event. Note that the total is not an algebraic sum due to the time lags and differences in the individual hydrograph peak times. Refer to the “*Waterford South Municipal Drain Design Brief*” dated August 14th 1996 in Appendix A for complete details of the original WSMD design.

Revised Drainage Areas

Since the construction of the Thompson Road storm sewer, various road reconstruction projects have occurred within the limits of the original drainage areas. As part of these reconstruction projects, the storm sewer system has been extended eastward along Thompson Road and several of the intersecting streets, connecting the existing residential and commercial areas to the WSMD storm system. In addition, Area 2 has been developed into several residential subdivisions and features two stormwater management facilities. Consequently, the drainage areas utilized in the original WSMD design can be revised to reflect the current development conditions and actual stormwater management controls.

In addition, it should be noted that the original WSMD design utilized a very conservative initial abstraction (IA) value to model each of the drainage areas. Initial Abstraction is a measure of rainfall that is lost to interception, infiltration and surface storage. For the original model, the IA was set at an assumed value of 1.5mm. Since the completion of the initial WSMD design brief, a more refined approach to estimating initial abstraction has been adopted. This refined approach considers the selected curve number, which is based on soil type. The calculation for Initial abstraction is as follows:

- Potential Maximum Soil Moisture Retention 20%, $S_{0.20} = 1000/CN - 10.0$ (in inches)
- Potential Maximum Soil Moisture Retention 5%, $S_{0.05} = 1.33 * S_{0.20}^{1.15}$ (in inches)
- Initial Abstraction $IA = (0.05 * S_{0.05}) * 25.4\text{mm/in}$

Therefore, low curve numbers associated with soil with good infiltration characteristics will have a higher initial abstraction than high curve numbers for soils with poor characteristics. The initial abstraction of 1.5mm used in the original WSMD design corresponds to a curve number of 91. A curve number of this magnitude is reflective of soils with poor to limited infiltration characteristics, which is not the case for the sandy soil with good infiltration characteristics that is native to Waterford. Therefore, the initial abstraction values used in the original WSMD should be revised to better reflect the actual soil conditions with the WSMD drainage areas.

Using a Visual OTTHYMO computer model, the original WSMD drainage model was re-created, and revised to reflect the aforementioned changes. Refer to the “Revised WSMD Drainage Area Parameters” found in Appendix B and FIG1 – Revised WSMD Drainage Areas in Appendix C for complete details. The revisions to the original drainage areas can be summarized as follows:

Area 1: Existing Residential

- Area 1 is predominately occupied by single-family residential lots, with interspaced areas of vacant land and some commercial and institutional uses.
- Several road reconstruction projects within the Area 1 catchment area have resulted in a portion of the original drainage area being diverted northwards rather than south as originally designed. These road reconstruction projects include:
 - Washington Street Reconstruction
 - St. James Street Reconstruction
 - Main Street Reconstruction
 - Wellington Street Reconstruction
 - Brown Street Reconstruction (scheduled for 2024 construction)
- Leamon Street from Church Street West to Green Street has not been reconstructed and will remain as part of Area 1 to allow for future storm sewers to be connected to the WSMD drainage system.
- Washington Street from Green Street to Thompson Road has not been reconstructed but will be connected to the Thompson Road storm sewer in the future.
- Charles Street will be reconstructed as part of the Charles Street Subdivision and therefore has been added to the drainage area.
- The original area of Area 1 was taken as 48 hectares and has been revised to 40 hectares as a result of the above modifications.
- The total and directly connected impervious percentages and curve number remain unchanged.
- The initial abstraction value has been updated to reflect actual soil characteristics.

Table 2 Area 1 Revisions		
	Original Design	Revised Design
Area	48.0 ha	40.0 ha
Total Impervious	30%	30%
Directly Connected Impervious	15%	15%
Curve Number, CN	50	50
Initial Abstraction	1.5 mm	23.9 mm

Area 2: Future Residential – Revised to Existing & Future Area 2A, 2B, 2C and 2D

- In the original WSMD design, Area 2 was designed as a future residential area with an assumed impervious and directly connected impervious percentage. It was also assumed that an on-site SWM facility would be constructed to reduce peak flows to the Thompson Road storm sewer.
- Under current conditions, Area 2 can be separated into four separate drainage areas:
 - Area 2A includes the Yin's Subdivision – Phase 2 and the Woodrow Estates Subdivision, and features and existing SWM facility.
 - Area 2B includes the Yin's Subdivision – Phase 5 and Yin's Subdivision – Phase 6, and features and existing SWM facility.
 - Six hectares of the Yin's Subdivision – Phase 5 and Yin's Subdivision – Phase 6 were included in the original Area 2 drainage area, and an additional 8.22 hectares were added.
 - Area 2C and 2D are not currently developed but were anticipated to be development, and therefore, were each allocated a peak flow allowance as part of the "Yin's Subdivision – Phase 5 Stormwater Management Report" dated December 10, 2010 (Appendix E).
- The total and directly connected impervious percentages, and curve numbers were updated to reflect the actual developed conditions.
- The initial abstraction value has also been updated to reflect actual soil characteristics.
- Refer to the "Yin's Subdivision – Phase 2 Stormwater Management Design Brief" dated April 2, 2002 and the "Yin's Subdivision – Phase 5 Stormwater Management Report" dated December 10, 2010 in Appendix D and E respectively, for complete details of each SWM design.

Table 3 Area 2 Revisions					
	Original Design	Revised Design Area 2A	Revised Design Area 2B	Revised Design Area 2C	Revised Design Area 2D
Area	24 ha	16.90 ha	11.82 ha	0.80 ha	1.40 ha
Total Impervious	30%	38%	47%	90%	90%
Directly Connected Impervious	15%	16%	22%	45%	45%
Curve Number, CN	50	50	58	58	58
Initial Abstraction	1.5 mm	23.9 mm	16.5 mm	16.5 mm	16.5 mm

Area 3: Existing Commercial

- Area 3 remains largely unchanged from the original WSMD design.
- Some sections of this area are commercially developed areas that are virtually 100% impervious, while other areas are vacant and naturally vegetated or agricultural land.
- Although much of Area 3 is undeveloped area, as a conservative approach, it is assumed that it may become fully commercially developed area in the future.
- The original area of Area 3 was taken as 19.0 hectares and has been revised to 19.2 hectares to account for the portion of Lam Boulevard that was left as an uncontrolled area.
- The total and directly connected impervious percentages, and curve number remain unchanged.
- The initial abstraction value has also been updated to reflect actual soil characteristics.

Table 4 Area 3 Revisions		
	Original Design	Revised Design
Area	19.0 ha	19.2 ha
Total Impervious	80%	80%
Directly Connected Impervious	50%	50%
Curve Number, CN	50	50
Initial Abstraction	1.5 mm	23.9 mm

Total Design Flow Under Current Conditions

Based on the aforementioned revisions to the WSMD drainage areas, the resulting peak flow to the Thompson Road storm sewer was determined using the revised Visual OTTHYMO computer model. The 100-year storm event was used to analyze the drainage systems, however, flows from the revised Area 1 and Area 3 are restricted to the 2-year event flow due to the capacity of the existing storm sewers connecting to the main Thompson Road trunk sewer. Flows during the 100-year event from Area 2A and Area 2B are controlled by each respective on-site stormwater management facility, prior to being released to the storm sewer system. Lastly, the 100-year peak flow from Area 2C and 2D have been limited to the allocated peak flow allowance, as per the “*Yin’s Subdivision – Phase 5 Stormwater Management Report*” dated December 10, 2010 (Appendix E).

In summary, under existing current conditions, the revised peak flow to the Thompson Road Storm sewer was determined to be 3.18 m³/s, compared to 3.25 m³/s as determined in the original WSMD design. Refer to Table 5. Note that the total is not an algebraic sum due to the time lags and differences in the individual hydrograph peak times. Refer to Appendix F for complete details of the revised Visual OTTHYMO model, and corresponding output file.

Table 5 Total Design Flow Under Current Conditions		
	Original Design	Revised Design (Current Conditions)
Area 1	1.31 m ³ /s	1.02 m ³ /s
Area 2 (Split into Area 2A, 2B, 2C and 2D)	0.05 m ³ /s	2A: 0.028 m ³ /s
		2B: 0.028 m ³ /s
		2C: 0.015 m ³ /s
		2D: 0.015 m ³ /s
Area 3	1.94 m ³ /s	1.83 m ³ /s
Total Peak Flow	3.25 m ³ /s	3.18 m ³ /s
Overall Time to Peak	1.53 hours	1.93 hours

Proposed Drainage Areas

G. Douglas Vallee has been retained to determine the technical feasibility of two proposed residential developments at the west edge of Waterford. As part of that process, it must be shown that each development can be functionally serviced in regard to stormwater management. It is proposed that each development will utilize the Thompson Road storm sewer as a legal stormwater outlet. Consequently, the proposed developments have been added to the revised WSMD Visual OTTHYMO model to confirm capacity within the Thompson Road storm sewer. The proposed developments include the Thompson Road Subdivision, located on the southwest corner of Thompson Road and Blueline Road, and the Charles Street Subdivision, located on the northwest corner of Charles Street and Washington Street.

Both the Thompson Road Subdivision and the Charles Street Subdivision are outside of the original WSMD drainage areas. Therefore, the 2-year pre-development peak flow rate from each site has been utilized as a stormwater quantity control target for the Thompson and Charles developments. Table 6 presents the proposed drainage area parameters and peak flow allowance associated with each proposed development. Refer to Appendix B and FIG1 – Revised WSMD Drainage in Appendix C for complete details of the proposed drainage areas and the parameters utilized to calculate the 2-year pre-development flow rates from the Thomson Road and Charles Street sites.

Table 6 Proposed Drainage Areas		
	Thompson Area 4	Charles Area 5
Area	7.85 ha	4.35 ha
Total Impervious	46%	46%
Directly Connected Impervious	22%	21%
Curve Number, CN	72	62
Initial Abstraction	8.1 mm	13.6 mm
Peak Flow Allowance	0.084 m ³ /s	0.023 m ³ /s

Refer to Appendix F for the revised Visual OTTHYMO model, and corresponding output file. To meet the proposed flow allowance for each prospective site, it is assumed that each development will feature an on-site stormwater management facility to control peak flows from up to and including the 100-year storm event to equal to or less than peak flow allowance.

Table 7 presents the total peak flow to the Thompson Road storm sewer prior to and after the addition of the proposed drainage areas to the WSMD system based on the revised drainage areas. In summary, the maximum peak flow to the Thomson Road storm sewer after construction of the two proposed developments is 3.28 m³/s.

Table 7 Total Peak Flow to the Thompson Road Storm Sewer		
	Current Conditions	Proposed Conditions
Total Peak Flow	3.18 m ³ /s	3.28 m ³ /s

Thompson Road Storm Sewer Capacity

The lower runs of the Thompson Road storm sewer have a diameter of 1500mm and the lowest sloped run has a slope of 0.22%, which results in a full flow capacity of 3.31 m³/s. As presented in the “*Yin’s Subdivision – Phase 2 Stormwater Management Design Brief*” dated April 2, 2002 (Appendix D), the actual maximum capacity of a circular pipe is when the pipe is flowing at 94% full. Considering this, the actual maximum capacity of the Thompson Road storm sewer is 3.56 m³/s, which is greater than the peak flow of 3.28 m³/s experienced under the proposed development conditions.

Therefore, it can be concluded that the existing Thompson Road storm sewer provides adequate capacity to accommodate the additional flow from all four proposed developments. The maximum capacity flow calculations are presented in Appendix B.

WSMD Stormwater Management Facility

The Thompson Road storm sewer ultimately discharges to the WSMD stormwater management facility, located on the south side of Thompson Road, west of the Waterford Heritage Trail, as shown in FIG1 – Revised WSMD Drainage in Appendix C. The WSMD stormwater management facility was designed to reduce the peak flows entering the Waterford Ponds during the 2-year and 5-year storm event and provide water quality treatment to prevent excess sediment and pollutants from entering the receiving watercourse and Waterford Ponds.

Quantity Control

To confirm that the WSMD stormwater management facility has adequate capacity to support the additional proposed developments, the revised drainage areas and proposed drainage areas were routed through the existing WSMD stormwater management facility using the revised Visual OTTHYMO model. The rating curve for the WSMD SWM facility was obtained from the original WSMD Design Brief as shown in Appendix A. Table 8 presents the peak outflow from the pond and the required active storage during the 2-year and 5-year storm event, for the original WSMD design and the proposed design, which includes the revised drainage areas and proposed drainage areas. Refer to complete details on the Visual OTTHYMO model in Appendix F.

Table 8 Peak Outflow & Required Storage				
Storm Event	Original Design		Proposed Design (Current + Proposed Conditions)	
	Peak Outflow	Required Active Storage	Peak Outflow	Required Active Storage
2-Year	0.24 m ³ /s	0.80 ha.m	0.24 m ³ /s	0.80 ha.m
5-Year	0.31 m ³ /s	1.08 ha.m	0.29 m ³ /s	1.00 ha.m

As presented in Table 8, the peak outflow from the WSMD SWM facility and the required active storage for the proposed design are less than or equal to the values achieved in the original WSMD design. Consequently, it can be concluded that the WSMD stormwater management facility provides adequate capacity to support the additional proposed developments, and will not increase the flows to the receiving watercourse during the 2-year and 5-year storm event.

Quality Control

The WSMD stormwater management facility was designed as a wet pond with an enhanced water quality protection level, corresponding to the long-term removal of 80% of total suspended solids (TSS). The required permanent pool volume was determined to be 0.84 ha.m for the original WSMD design. Note that Area 2 was not included as part of this calculation as it was assumed that the future subdivision would contain a detention pond to address water quality on-site. The original permanent pool calculations are presented in the original "Waterford South Municipal Drain Design Brief" dated August 14, 1996.

Due to the revisions to Area 1 and Area 3, it is necessary to confirm that the permanent pool provided satisfies the revised design condition. Note that Area 2A, Area 2B and the proposed development drainage areas do not require stormwater quality control as each area will feature its own on-site detention facility and quality control. The revised permanent pool calculations are presented below:

40.0 ha @ 30% impervious (Area 1)
19.2 ha @ 80% impervious (Area 3)
 59.2 ha @ 46% impervious total

From Table 3.2 (MOE, 2003)

35% Impervious Requires 140 m³/ha Storage

55% Impervious Requires 190 m³/ha Storage

By Interpolation:

46% Impervious Requires 168 m³/ha Storage

Total Storage

168 m³/ha

Less Detention Storage:

40 m³/ha

Permanent Pool Volume:

128 m³/ha

Permanent Pool Volume = 59.2 ha x 128 m³/ha = 7578 m³ = **0.76 ha.m**

Under the revised condition the required permanent pool volume is 0.76 ha.m, which is less than the permanent pool volume of 0.84 ha.m provided as part of the original WSMD design. Therefore, the existing WSMD SWM facility provides adequate water quality treatment to support the revised design condition.

Conclusions

Based on the review presented by this design brief, the revised WSMD design can be summarized as follows:

- The drainage areas utilized in the original WSMD design have been revised to reflect the current development conditions and stormwater management controls.
- The initial abstraction values used in the original WSMD have been revised to better reflect the actual soil conditions with the WSMD drainage areas.
- Based on the revisions to the currently developed drainage areas, the revised total peak flow to the Thompson Road storm sewer was determined to be $3.18 \text{ m}^3/\text{s}$.
- Development of the two proposed residential areas results in a total peak flow of $3.28 \text{ m}^3/\text{s}$ to the Thompson Road storm sewer.
- The maximum capacity of the lowest sloped run of the Thompson Road storm sewer was determined to be $3.56 \text{ m}^3/\text{s}$, confirming that the existing Thompson Road storm sewer provides adequate capacity to accommodate the additional flow from all four proposed developments.
- The existing WSMD stormwater management facility provides adequate stormwater quantity and quality control during the 2-year and 5-year storm events under the proposed design condition, ensuring no adverse impacts to the receiving watercourse downstream the WSMD SWM facility.

It is recommended that this report be provided to the Norfolk County and the Long Point Region Conservation Authority for review and approval of the updated WSMD design conditions and the proposed functional storm servicing for the prospective residential developments.

We trust that this information is complete and sufficient for submission. Should you have any questions or require further information please do not hesitate to contact us.

Respectfully submitted,



Natalie Biesinger, P.Eng
G. DOUGLAS VALLEE LIMITED
Consulting Engineers, Architects and Planners



John Iezzi, P.Eng
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Consulting Engineers, Architects and Planners

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Consulting Engineers, Architects & Planners

Appendix A

- *Waterford South Municipal Drain Design Brief (August 14, 1996)*

Appendix B

- Revised WSMD Drainage Area Parameters
- Thompson Road Storm Sewer Capacity Calculations

Appendix C

- FIG 1 – Revised WSMD Drainage Areas

Appendix D

- *Yin's Subdivision – Phase 2 Stormwater Management Design Brief (April 2, 2002)*

Appendix E

- *Yin's Subdivision – Phase 5 Stormwater Management Report (December 10, 2010)*

Appendix F – Otthymo Output Files

- Thompson Road and Charles Street Pre-Development Drainage Areas
- Revised WSMD Visual OTTHYMO Model
- Revised WSMD Visual OTTHYMO Model (With WSMD SWM Pond)



APPENDIX A

Waterford South Municipal Drain Design Brief (August 14, 1996)

DESIGN BRIEF

WATERFORD SOUTH MUNICIPAL DRAIN

**Waterford, City of Nanticoke
Regional Municipality of Haldimand-Norfolk**



G. DOUGLAS VALLEE LIMITED
CONSULTING ENGINEERS AND ARCHITECT
51 Park Road, R.R.1, Simcoe, Ontario N3Y 4J9
Telephone 519-426-6270 Fax 519-426-6277

Project 94-021
August 14, 1996

DESIGN BRIEF

WATERFORD SOUTH MUNICIPAL DRAIN

August 14, 1996
Project 94-021

A. Background

The Waterford South Municipal Drain is proceeding under the authority of the Drainage Act, R.S.O. 1990 according to a petition signed in January 1992 by the City of Nanticoke and the Regional Municipality of Haldimand-Norfolk. The petition has been declared valid according to Section 4 (1) (c) of the Drainage Act.

The south portion of Waterford, City of Nanticoke, current does not have a legal stormwater outlet. No adequate municipal storm sewer system exists, and no legal outlet is available.

This Municipal Drainage project has been undertaken to provide that legal stormwater outlet for the south area of Waterford.

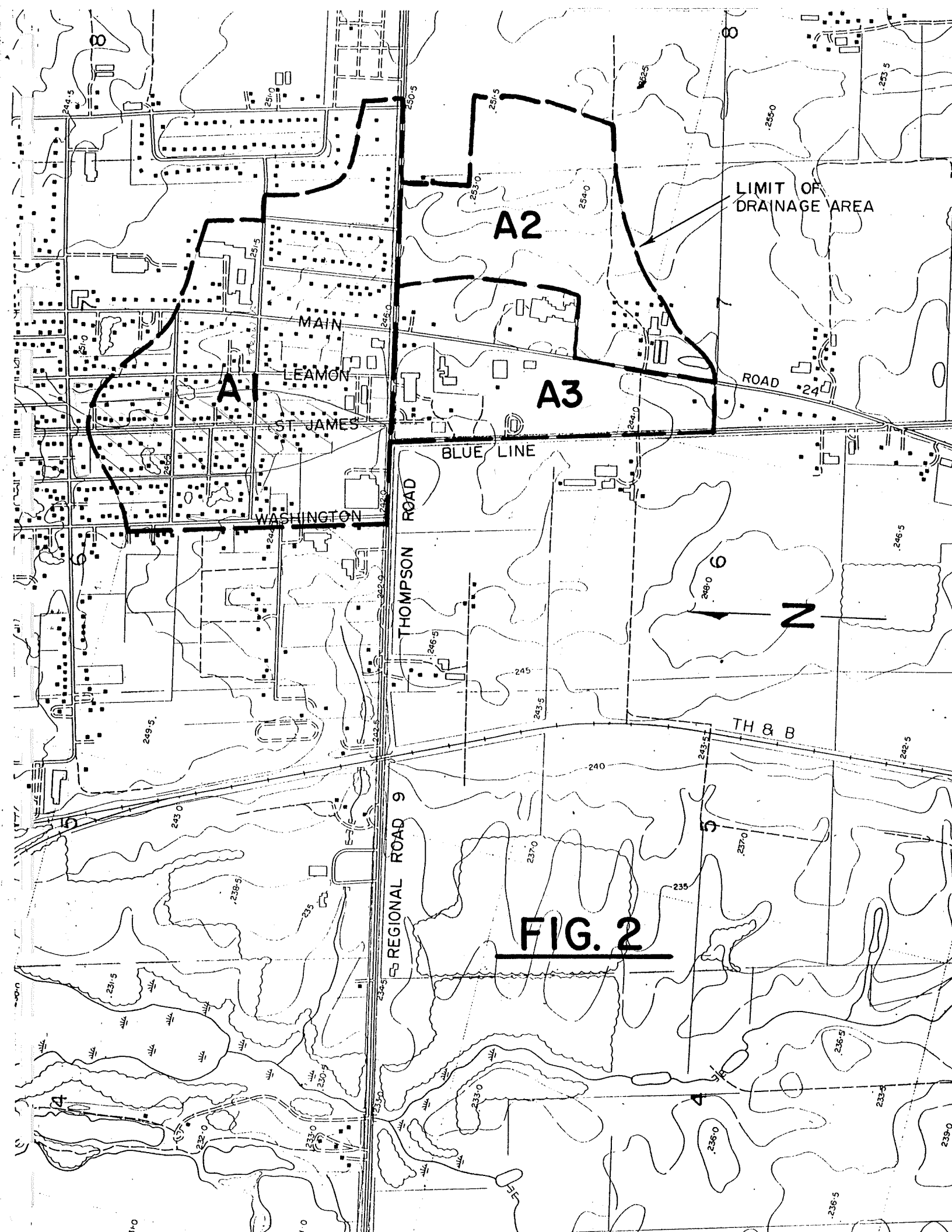
The Drain consists of three (3) components:

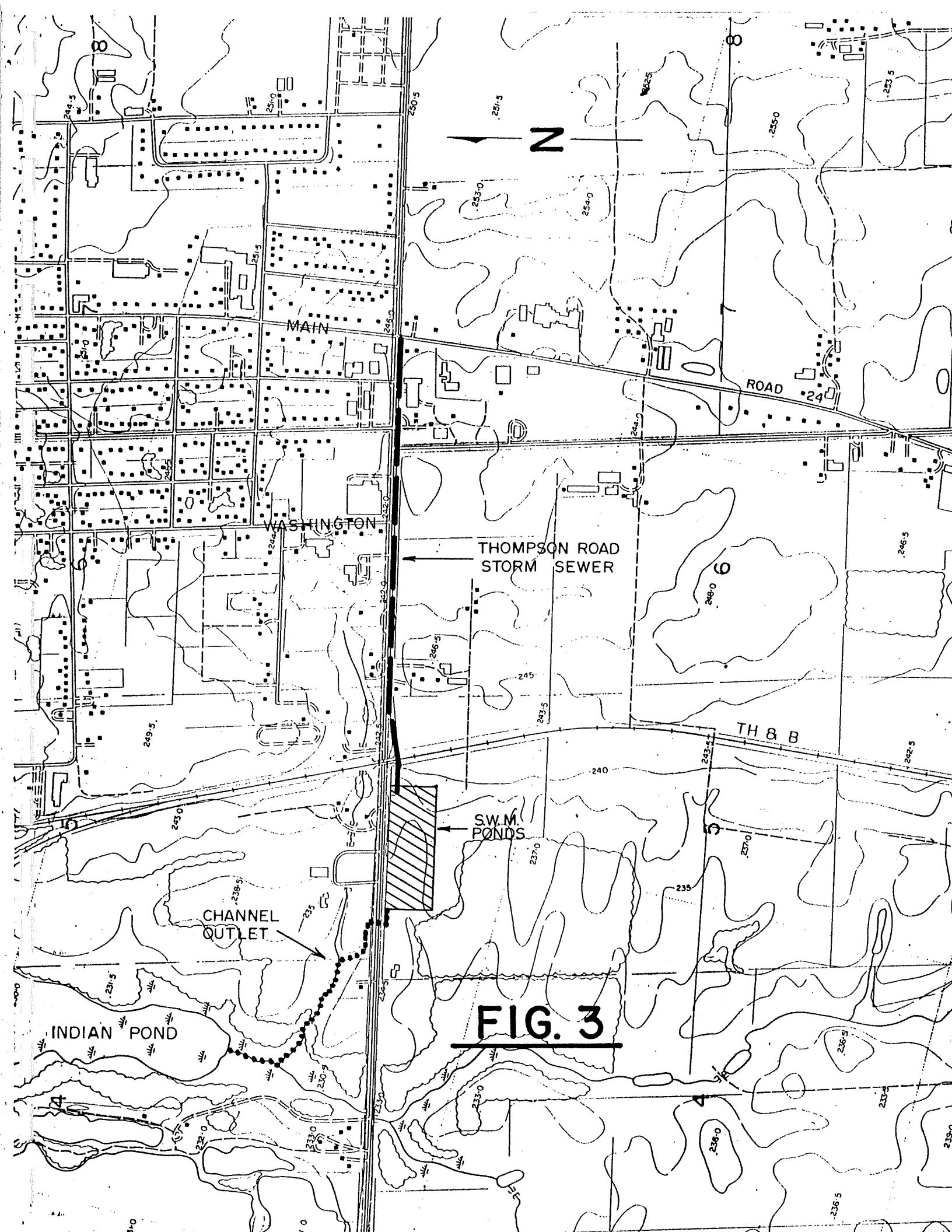
1. The Thompson Road Storm Sewer
2. The Stormwater Management Facility
3. The Outlet

B. Thompson Road Storm Sewer

The Thompson Road Storm Sewer has been designed as a trunk sewer to collect stormwater from various future storm sewer connections. The sewer itself has not been designed to collect stormwater from the south area of Waterford, but rather to provide an outlet for future storm sewer works in south Waterford.

The sewer has been designed to have hydraulic capacity to accept design flows from the two year storm (2:1 year event.) The upstream end of the sewer is located at the intersection of Main Street and Thompson Road (Regional Road 9) and the sewer flows to the west, past the rail road bridge for a total distance of approximately 1045 metres before discharging into the proposed stormwater management facility.





For the design of this sewer, three (3) drainage areas have been considered. These three areas have been modelled using the OTTHYMO'89 computer program to simulate stormwater runoff rates from these areas during the two (2) year storm event. The output printouts from this simulation are attached to this brief. The following summarizes the input values used to model the areas and this produced the associated calculated or output values:

Area 1: Existing Urban Residential:**Input**

Area:	48 ha
Total Impervious:	30%
Directly Connection Impervious:	15%
CN*:	50

Output

Modelled Peak Flow:	1.31 m ³ /s
Modelled Time to Peak:	1.53 hours
Modelled Runoff Coefficient:	0.27

Area 2: Rural Area with Potential for Future Residential Development**Input**

Area:	24 ha
Total Impervious:	30%
Directly Connection Impervious:	15%
CN*:	50

Output

Modelled Peak Flow:	0.70 m ³ /s
Modelled Time to Peak:	1.52 hours
Modelled Runoff Coefficient:	0.27

THIS AREA WAS ASSUMED TO BE DEVELOPED AS A RESIDENTIAL SUBDIVISION WITH AN ON-SITE DETENTION POND REGULATED TO A MAXIMUM RELEASE RATE OF 0.20 m³/s. IT WAS ALSO NOTED THAT THE TIME TO PEAK FLOW LEAVING THE POND WAS CALCULATED BY THE MODEL AS 4.15 HOURS.

Area 3: Existing Commercial: 19 ha**Input**

Area:	19 ha
Total Impervious:	80%
Directly Connection Impervious:	50%
CN*:	50

Output

Modelled Peak Flow:	1.94 m ³ /s
Modelled Time to Peak:	1.52 hours
Modelled Runoff Coefficient:	0.63

Total Design Flows

The modelled summation of these hydrographs produced the following design flows:

PEAK DESIGN FLOW: 3.25 m³/s
TIME TO PEAK: 1.53 hours

Sewer Hydraulic Capacity

Upper Runs: 1200mm diameter, min slope 0.85%
Capacity: 3.59 m³/s

Lower Runs: 1500mm diameter, min slope 0.22%
Capacity: 3.31 m³/s

C. Intersection Street Sewers

Storm sewer stubs are proposed for some intersecting streets on the project. These sewer stubs have been sized as follows:

Washington Street

Area: 11ha

R: 0.30

Q: 0.53 m³/sSewer: 675mm @ 0.5% Capacity=0.61m³/sSt. James Street

Area: 11.6 ha

R: 0.30

Q: 0.56 m³/sSewer: 675mm @ 1.0% Capacity=0.86m³/sLeamon Street

Area: 9 ha

R: 0.30

Q: 0.43 m³/s

City Requested oversizing for possible alternative servicing layout.

Sewer: 825mm @ 1.0% Capacity=0.86m³/sBlue Line Road

Area: 9 ha

R: 0.65

Q: 1.0 m³/sSewer: 825mm @ 0.5% Capacity=1.03m³/s

C. Stormwater Management Facility

The stormwater management facility has been designed using concepts from the "Stormwater Management Practices Planning and Design Manual" June 1994, by the Ontario Ministry of the Environment and Energy. The pond has been basically designed as a Wet Pond to improve water quality treatment.

The main pond has been sized according to Table 4.1 "Water Quality Storage Requirements based on Receiving Waters" using the following figures:

Level 1: Wet Pond

48 ha @ 30% impervious
19 ha @ 80% impervious
67 ha @ 44% impervious total

(Note that Area 2 has not been considered as the future subdivision will contain its own on-site detention pond which will address water quality.

From Table 4.1 35% Impervious Requires 140 m³/ha Storage
 55% Impervious Requires 190 m³/ha Storage
By Interpolation: 44% Impervious **Requires 165 m³/ha Storage**

Therefore from Table 4.1 bottom note:

Total Storage	165 m ³ /ha
Less Detention Storage:	<u>40 m³/ha</u>
Permanent Pool Volume:	125 m ³ /ha

Permanent Pool Volume

67 ha inputting "dirty water" @ 125 m³/ha = 8,375 m³ = 0.84 ha.m

Required Detention Volume

From OTTHYMO'89 model simulation: 8000 m³ = 0.80 ha.m
(84 m³/ha over whole 91 ha drainage area)

(5 Year storm requirement: 10,800 m³ = 1.08 ha.m)

Total Required Volume

0.84 ha.m + 0.80 ha.m = 1.64 ha.m

Pond Geometry

L = 143 m (bottom length)

W = 40 m (bottom width)

L/W = 3.575 > 3 recommended.

Permanent Pool Depth = 1.2 metres

Interior Side Slopes = 6:1

Pond Volume Equation:

Volume = $5720d + 1098d^2$

At elevation 232.9 (d=1.2) Pond Volume is 8,445 m³ = Perm. Pool Volume

At elevation 233.8 (d=2.1) Pond Volume is 16,854 m³ = 2 Year Storage

At elevation 234.0 (d=2.3) Pond Volume is 18,964 m³ = 5 Year Storage

Sediment Forebay

L = 50 m (bottom length)

W = 20 m (bottom width)

L/W = 2.5

Forebay Settling Length (Equ. 3.3 page 89)

r = L/W = 2.5

Qp = 0.24 (see OTTHYMO'89 output)

Vs = 0.0003 (as recommended on page 89)

Thus Dist = 45 m

Forebay Dispersion Length (Equ. 3.4 page 90)

Q = 3.25 m³/s

d = 1.2 m

Vf = 0.5 m/s (recommended on page 90)

Dist = 43 m

Minimum Forebay Bottom Width (Equ. 3.5 page 90)

Dist = 45

Width = 45 / 8 = 6 m

Actual Pond Dimensions

Length = 50 m > 45 m

Width = 20 m > 6 m

Permanent Pool Depth = 1.2 m

Forebay - Pond Culverts

Design Inflow to Sediment Forebay: $3.25 \text{ m}^3/\text{s}$

975 mm concrete pipe @ 0.6%: Capacity = $1.76 \text{ m}^3/\text{s}$

2 - 975 mm concrete pipes @ 0.6%: Capacity = $3.52 \text{ m}^3/\text{s}$

Outlet Design: Perforated Riser

First Flush Volume: $67 \text{ ha} \times 13 \text{ mm} \times 0.27 \text{ runoff}$
 $2,351 \text{ m}^3$

Volume above Perm. Pool = $8562a + 1266a^2$

At Elevation 233.16 ($a=0.26$) Volume above Perm Pool = $2,311 \text{ m}^3$

Therefore set open outlet at elevation 233.16 and allow riser to operate below that elevation.

Drawdown time

First Flush Volume: $2,300 \text{ m}^3 = 81,224 \text{ ft}^3$

Consider 6" Hickenbottom with 40 - 1" holes per foot

$Q = 0.74 \text{ ft}^3/\text{s}$ @ 2 feet of head

Time to Drain = $81,224 / 0.74 = 109,762 \text{ seconds} = 30 \text{ hours}$

Open Discharge Pipe

See attached "Detention Pond Rating Curve" dated July 24, 1996

Planting

The entire pond and sediment Forebay will be topsoiled and seeded where possible with a grass mixture. Certain areas of the pond, particularly the sediment Forebay may be permanently submerged with groundwater, and there areas obviously can not be planted.

Although it is preferred to utilize a planting strategy based on average water depth and soil moisture regime, the immediate performance of this pond is unknown. It is anticipated that this pond will be constructed in 1996, but that no external sewers will be connected to the Municipal Drain until 1997 at the earliest. For this reason, the entire pond could remain dry for a period of approximately one year.

As time progresses, more and more external sewers may be constructed and connected to the Municipal Drain. As these sewers are connected, permanent water levels in the pond will increase.

It is therefore considered to be wasteful to plant specific species based on assumed water levels that will drastically change over the following years.

It is therefore proposed to plant the ponds with a grass mixture, and allow native species to naturally plant themselves in the appropriate areas.

It should also be noted that the Public Works Department of the City of Nanticoke has requested that the entire facility be fenced, and that due to the berms between the roadway and the facility, the ponds themselves will not be visible to the public.

D. Outlet

This existing outlet makes use of the existing drainage features located downstream of the stormwater management facility. In an effort to protect and preserve the natural environment and the existing landscape in this area, it is proposed to perform a minimum of construction in this area other than cleaning of areas that are silted in, replacement of crushed culvert ends, and some clearing of over-vegetated areas to permit access.

An analysis of the hydraulic capacity of this existing system has not been undertaken, however it is expected that the existing system will be capable of accepting discharge flows from the stormwater management facility. In the early life of the stormwater management facility, it is expected that only a small percentage of the upstream lands will be connected to the Thompson Road Storm Sewer, and therefore

only and small discharge downstream of the ponds is expected. It is anticipated that the existing downstream drainage system has the hydraulic capacity to accept flows from the ponds during this stage of partial connection to upstream areas.

As more and more of the upstream lands are connected to the Waterford South Municipal Drain, the flow rates and flow durations leaving the pond will increase. Over time, this may begin to cause problems in the existing downstream system. Flooding of the system and minor erosion may occur. Landowners will report these problems to the City of Nanticoke, and these problems can be addressed as maintenance items.

If these problems develop into serious concerns, it may be necessary to complete a formal design for this outlet area. Until that time, in the interest of preserving the existing landscape, not disturbing the natural environment, and minimizing costs, it is proposed to use the existing drainage outlet with the minimal alterations indicated on the drawings.

It must be realized that in the future a formal design may be required for this outlet area.

Waterford South Municipal Drain

Detention Pond Rating Curve

Project: 94-021
Date: July 24, 1996

Elevation of Permanent Pool: 232.90
Depth of First Flush Storage: 0.26
Invert of 375mm Outlet pipe: 233.16
Centreline of 375mm Outlet pipe: 233.35

Storage Above Perm. Pool = $8562*d + 1266*d*d$

Water Elevation (m)	Water Above Perm. Pool (m)	Storage Volume Above Perm. Pool (m3)	Water Above Pipe C. Line (m)	Discharge Rate (m3/s)	Comment
232.90	0	0	n/a	0	Water @ Perm Pool
233.16	0.26	2,312	n/a	0	Water @ Pipe Invert
233.35	0.45	4,109	n/a	0.090	Water @ Pipe C.L.
233.54	0.64	5,998	n/a	0.180	Water @ Pipe Obvert
233.75	0.85	8,192	0.40	0.247	Pipe under Head
233.85	0.95	9,276	0.50	0.276	Pipe under Head
233.90	1	9,828	0.55	0.289	Pipe under Head
234.10	1.2	12,097	0.75	0.338	Pipe under Head
234.20	1.3	13,270	0.85	0.359	Pipe under Head

b:\ratecurv.wk1

Waterford South Municipal Drain: Otthymo Output: Final Design: 2 Year Storm p.1

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OOO TTTT TTTT H H Y Y M M OOO INTERHYMO
O O T T H H Y Y M M M O O *** 1989b ***
O O T T H H H H Y M M M O O
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OOO T T H H Y M M OOO cE/101051900024
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Input filename: 94021.dat
Output filename: 94021.out
Summary filename: 94021.sum

DATE: 08-14-1996

TIME: 15:53:27

COMMENTS: _____

*WATERFORD SOUTH MUNICIPAL DRAIN

*FINAL REPORT

*Project # 94-021

*Detention Pond Flow Simulation

*Chicago Storm

*4 Hour Distribution

*

*

*INPUT REVISED December 22, 1993

*****Area A2 reduced to 24 ha

*****Area A3 XIMP reduced to 0.40 TIMP reduced to 0.50

*****Area A4 reduced to 41 ha, Tp reduced to 0.51 hours

*****Area A5 reduced to 59 ha

*****Detention Pond Configurations and Rating Curves Revised

*

*INPUT REVISED JUNE 9, 1995

*****Area A3 TIMP increased to 0.80 and XIMP increased to 0.50

*

*INPUT REVISED JUNE 23, 1995

*****Revised main detention pond rating curve for pond with sediment forebay

*****Detention pond outlet reduced to 450 mm diameter at 0.5%

***** (See Rating Curve Calculation Sheet)

*

Waterford South Municipal Drain: Otthymo Output: Final Design: 2 Year Storm p.2

*INPUT REVISED MAY 14, 1996

*****Pond relocated to west of railway tracks

*****Overland flow from adjacent farmland no longer enters pond

*

*INPUT REVISED JULY 24, 1996

*****Detention pond rating curve revised for new pond configuration

*****Farmland areas removed from drainage area

*

*

*

** SIMULATION NUMBER: 1 **

*USE CHICAGO STORM

| READ STORM | Filename: CH2.STM
| Ptotal= 39.39 mm | Comments: 2 YEAR CHICAGO 4 HOUR DESIGN STORM DISTR

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	3.25	1.17	8.94	2.17	8.15	3.17	4.39
.33	3.56	1.33	16.92	2.33	7.01	3.33	4.11
.50	3.96	1.50	78.82	2.50	6.20	3.50	3.89
.67	4.52	1.67	21.89	2.67	5.59	3.67	3.68
.83	5.31	1.83	13.00	2.83	5.11	3.83	3.51
1.00	6.55	2.00	9.88	3.00	4.72	4.00	3.35

Waterford South Municipal Drain: Otthymo Output: Final Design: 2 Year Storm p.4

*AREA 2 - FUTURE RESIDENTIAL SUBDIVISION

DESIGN

STANDHYD (0102) | Area (ha)= 24.00

ID= 2 DT= 1.0 min | Total Imp(%)= 30.00 Dir. Conn.(%)= 15.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	7.20	16.80
Dep. Storage (mm)=	.80	1.50
Average Slope (%)=	2.00	2.00
Length (m)=	400.00	40.00
Mannings n =	.013	.250

Max. eff. Inten. (mm/hr)= 78.82 8.47

over (min) 5.00 25.00

Storage Coeff. (min)= 5.24 (ii) 24.19 (ii)

Unit Hyd. Tpeak (min)= 5.00 25.00

Unit Hyd. peak (cms)= .22 .05

TOTALS

PEAK FLOW (cms)= .65 .20 .70 (iii)

TIME TO PEAK (hrs)= 1.52 1.90 1.52

RUNOFF VOLUME (mm)= 38.59 5.88 10.78

TOTAL RAINFALL (mm)= 39.39 39.39 39.39

RUNOFF COEFFICIENT = .98 .15 .27

***** WARNING: FOR AREAS WITH IMPERVIOUS LESS THAN 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:

CN* = 50.0 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.

Waterford South Municipal Drain: Otthymo Output: Final Design: 2 Year Storm p.5

*PRINT HYDROGRAPH OF UNRESTRICTED FLOW FROM NEW DEVELOPMENT

| PRINT HYD (0102) | AREA (ha)= 24.00
| ID= 2 PCYC= 10 | QPEAK (cms)= .70 (i)
| DT= 1.0 min | TPEAK (hrs)= 1.52
|----- VOLUME (mm)= 10.78

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

TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW
hrs	cms	hrs	cms	hrs	cms	hrs	cms	hrs	cms
.00	.00	1.00	.06	2.00	.31	3.00	.14	4.00	.10
.17	.00	1.17	.09	2.17	.26	3.17	.13	4.17	.06
.33	.02	1.33	.16	2.33	.23	3.33	.12	4.33	.05
.50	.04	1.50	.68	2.50	.20	3.50	.11	4.50	.03
.67	.04	1.67	.45	2.67	.18	3.67	.11	4.67	.02
.83	.05	1.83	.36	2.83	.16	3.83	.10	4.83	.01

*ROUTE FUTURE SUBDIVISION THROUGH ON SITE DETENTION POND

*ALLOWING FOR 0.14 ha.m FOR FIRST FLUSH STORAGE

*RATING CURVE REVISED: January 3, 1994 for new drainage areas
* and revised pond depth.

| RESERVOIR (0200) |
| IN= 2---> OUT= 3 |
| DT= 1.0 min | OUTFLOW STORAGE | OUTFLOW STORAGE
|----- (cms) (ha.m.) | (cms) (ha.m.)
| .000 .000 | .141 .400
| .000 .140 | .200 .590
| .051 .230 | .245 .780
| .101 .310 | .000 .000

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 2 (0102)	24.00	.70	1.52	10.78
OUTFLOW: ID= 3 (0200)	24.00	.05	4.32	4.64

PEAK FLOW REDUCTION [Qout/Qin](%)= 6.94
TIME SHIFT OF PEAK FLOW (min)=168.00
MAXIMUM STORAGE USED (ha.m.)= .23

Waterford South Municipal Drain: Otthymo Output: Final Design: 2 Year Storm p.6

*ADD EXISTING URBAN AREA AND FUTURE DETAINED SUBDIVISION

```
-----
| ADD HYD (0300) |
| 1 + 3 = 4 | AREA QPEAK TPEAK R.V.
|-----| (ha) (cms) (hrs) (mm)
| ID1= 1 (0101): 48.00 1.31 1.53 10.79
| + ID2= 3 (0200): 24.00 .05 4.32 4.64
|=====
| ID = 4 (0300): 72.00 1.31 1.53 8.74
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

*AREA 3 - INDUSTRIAL/COMMERCIAL

```
-----
| DESIGN |
| STANDHYD (0103) | Area (ha)= 19.00
| ID= 5 DT= 1.0 min | Total Imp(%)= 80.00 Dir. Conn.(%)= 50.00
|-----
```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	15.20	3.80
Dep. Storage (mm)=	.80	1.50
Average Slope (%)=	2.00	2.00
Length (m)=	355.90	40.00
Mannings n =	.013	.250

Max.eff.Inten.(mm/hr)=	78.82	46.45
over (min)	5.00	11.00

Storage Coeff. (min)=	4.89 (ii)	10.27 (ii)
Unit Hyd. Tpeak (min)=	5.00	11.00
Unit Hyd. peak (cms)=	.23	.11

TOTALS

PEAK FLOW (cms)=	1.75	.30	1.94 (iii)
TIME TO PEAK (hrs)=	1.52	1.63	1.52
RUNOFF VOLUME (mm)=	38.58	10.72	24.65
TOTAL RAINFALL (mm)=	39.39	39.39	39.39
RUNOFF COEFFICIENT =	.98	.27	.63

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:

CN* = 50.0 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.

Waterford South Municipal Drain: Otthymo Output: Final Design: 2 Year Storm p.7

*ADD INDUSTRIAL/COMMERCIAL AREA TO TOTAL

```
-----
| ADD HYD (0301) |
| 4 + 5 = 6 |   AREA  QPEAK  TPEAK  R.V.
|-----|   (ha)  (cms)  (hrs)  (mm)
| ID1= 4 (0300): 72.00  1.31  1.53  8.74
| + ID2= 5 (0103): 19.00  1.94  1.52  24.65
|=====|
| ID = 6 (0301): 91.00  3.25  1.53  12.06
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

*ROUTE TOTAL FLOWS THROUGH NEW DETENTION POND TO WEST OF RAILWAY TRACKS

*Rating Curve Revised for New Pond Design July 1996

```
-----
| RESERVOIR (0200) |
| IN= 6---> OUT= 9 |
| DT= 1.0 min |   OUTFLOW  STORAGE  | OUTFLOW  STORAGE
|-----|   (cms)  (ha.m.) | (cms)  (ha.m.)
| .000  .000 | .276  .928
| .000  .231 | .289  .983
| .090  .411 | .338  1.210
| .180  .600 | .359  1.327
| .247  .819 | .000  .000
|
| AREA  QPEAK  TPEAK  R.V.
| (ha)  (cms)  (hrs)  (mm)
| INFLOW : ID= 6 (0301) 91.00  3.25  1.53  12.06
| OUTFLOW: ID= 9 (0200) 91.00  .24  4.15  8.53
```

PEAK FLOW REDUCTION [Qout/Qin](%)= 7.44
TIME SHIFT OF PEAK FLOW (min)=157.00
MAXIMUM STORAGE USED (ha.m.)= .80

Waterford South Municipal Drain: Otthymo Output: Final Design: 2 Year Storm p.8

*PRINT OUTFLOW HYD FROM POND

| PRINT HYD (0200) | AREA (ha)= 91.00
| ID= 9 PCYC= 10 | QPEAK (cms)= .24 (i)
| DT= 1.0 min | TPEAK (hrs)= 4.15
|----- VOLUME (mm)= 8.53

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

TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW
hrs	cms	hrs	cms	hrs	cms	hrs	cms	hrs	cms
.00	.00	3.50	.23	7.00	.19	10.50	.12	14.00	.07
.17	.00	3.67	.23	7.17	.19	10.67	.12	14.17	.07
.33	.00	3.83	.24	7.33	.19	10.83	.11	14.33	.07
.50	.00	4.00	.24	7.50	.18	11.00	.11	14.50	.06
.67	.00	4.17	.24	7.67	.18	11.17	.11	14.67	.06
.83	.00	4.33	.24	7.83	.18	11.33	.11	14.83	.06
1.00	.00	4.50	.24	8.00	.17	11.50	.10	15.00	.06
1.17	.00	4.67	.24	8.17	.17	11.67	.10	15.17	.06
1.33	.00	4.83	.23	8.33	.17	11.83	.10	15.33	.06
1.50	.00	5.00	.23	8.50	.16	12.00	.10	15.50	.05
1.67	.07	5.17	.23	8.67	.16	12.17	.09	15.67	.05
1.83	.12	5.33	.22	8.83	.15	12.33	.09	15.83	.05
2.00	.15	5.50	.22	9.00	.15	12.50	.09	16.00	.05
2.17	.17	5.67	.22	9.17	.15	12.67	.09	16.17	.05
2.33	.19	5.83	.21	9.33	.14	12.83	.08	16.33	.05
2.50	.20	6.00	.21	9.50	.14	13.00	.08	16.50	.05
2.67	.21	6.17	.21	9.67	.14	13.17	.08		
2.83	.21	6.33	.21	9.83	.13	13.33	.08		
3.00	.22	6.50	.20	10.00	.13	13.50	.08		
3.17	.22	6.67	.20	10.17	.13	13.67	.07		
3.33	.23	6.83	.20	10.33	.12	13.83	.07		

FINISH

=====

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O O T T H H Y Y M M M O O * * * 1989b * * *
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OOO T T H H Y M M OOO cE/101051900023
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Input filename: 94021.dat
*Output filename: 94021.out
Summary filename: 94021.sum

DATE: 08-14-1996 TIME: 15:46:53

COMMENTS: _____

*WATERFORD SOUTH MUNICIPAL DRAIN

*FINAL REPORT

*Project # 94-021

*Detention Pond Flow Simulation

*Chicago Storm

*4 Hour Distribution

*

*

*INPUT REVISED December 22, 1993

*****Area A2 reduced to 24 ha

*****Area A3 XIMP reduced to 0.40 TIMP reduced to 0.50

*****Area A4 reduced to 41 ha, Tp reduced to 0.51 hours

*****Area A5 reduced to 59 ha

*****Detention Pond Configurations and Rating Curves Revised

*

*INPUT REVISED JUNE 9, 1995

*****Area A3 TIMP increased to 0.80 and XIMP increased to 0.50

*

*INPUT REVISED JUNE 23, 1995

*****Revised main detention pond rating curve for pond with sediment forebay

*****Detention pond outlet reduced to 450 mm diameter at 0.5%

***** (See Rating Curve Calculation Sheet)

*

*INPUT REVISED MAY 14, 1996

*****Pond relocated to west of railway tracks

*****Overland flow from adjacent farmland no longer enters pond

*

*INPUT REVISED JULY 24, 1996

*****Detention pond rating curve revised for new pond configuration

*****Farmland areas removed from drainage area

*

*

*

** SIMULATION NUMBER: 1 **

*USE CHICAGO STORM

| READ STORM | Filename: CH5.STM
| Ptotal= 48.48 mm | Comments: 5 YEAR CHICAGO 4 HOUR DESIGN DISTRIBUTIO

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	3.53	1.17	10.19	2.17	9.15	3.17	4.55
.33	3.66	1.33	21.62	2.33	7.70	3.33	4.22
.50	4.04	1.50	112.37	2.50	6.68	3.50	3.96
.67	4.67	1.67	27.76	2.67	5.94	3.67	3.73
.83	5.61	1.83	15.75	2.83	5.39	3.83	3.53
1.00	7.11	2.00	11.43	3.00	4.93	4.00	3.35

*AREA 1 - EXISTING URBAN AREA DRAINING TO FUTURE POND

 DESIGN
 STANDHYD (0101) | Area (ha)= 48.00
 ID= 1 DT= 1.0 min | Total Imp(%)= 30.00 Dir. Conn.(%)= 15.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	14.40	33.60
Dep. Storage (mm)=	.80	1.50
Average Slope (%)=	2.00	2.00
Length (m)=	565.69	40.00
Mannings n =	.013	.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 MIN. TIME STEP.

	IMPERVIOUS	PERVIOUS (i)
Max. eff. Inten. (mm/hr)=	112.37	16.40
over (min)	6.00	21.00
Storage Coeff. (min)=	5.60 (ii)	20.15 (ii)
Unit Hyd. Tpeak (min)=	6.00	21.00
Unit Hyd. peak (cms)=	.20	.06
TOTALS		
PEAK FLOW (cms)=	1.77	.78
TIME TO PEAK (hrs)=	1.53	1.82
RUNOFF VOLUME (mm)=	47.68	8.70
TOTAL RAINFALL (mm)=	48.48	48.48
RUNOFF COEFFICIENT =	.98	.18

***** WARNING: FOR AREAS WITH IMPERVIOUS LESS THAN 20%
 YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:

CN* = 50.0 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.

Handwritten:
 LIEBMAN
 ST. JAMES
 WASHINGTON

***AREA 2 - FUTURE RESIDENTIAL SUBDIVISION**

DESIGN

STANDHYD (0102) | Area (ha)= 24.00
ID= 2 DT= 1.0 min | Total Imp(%)= 30.00 Dir. Conn.(%)= 15.00

	IMPERVIOUS	PERVIOUS (i)	
Surface Area (ha)=	7.20	16.80	
Dep. Storage (mm)=	.80	1.50	
Average Slope (%)=	2.00	2.00	
Length (m)=	400.00	40.00	
Mannings n =	.013	.250	
Max.eff.Inten.(mm/hr)=	112.37	16.40	
over (min)	5.00	20.00	
Storage Coeff. (min)=	4.55 (ii)	19.10 (ii)	
Unit Hyd. Tpeak (min)=	5.00	20.00	
Unit Hyd. peak (cms)=	.24	.06	
	TOTALS		
PEAK FLOW (cms)=	.96	.40	1.08 (iii)
TIME TO PEAK (hrs)=	1.52	1.80	1.52
RUNOFF VOLUME (mm)=	47.68	8.70	14.55
TOTAL RAINFALL (mm)=	48.48	48.48	48.48
RUNOFF COEFFICIENT =	.98	.18	.30

***** WARNING: FOR AREAS WITH IMPERVIOUS LESS THAN 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:

CN* = 50.0 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.

*PRINT HYDROGRAPH OF UNRESTRICTED FLOW FROM NEW DEVELOPMENT

 | PRINT HYD (0102) | AREA (ha)= 24.00
 | ID= 2 PCYC= 10 | QPEAK (cms)= 1.08 (i)
 | DT= 1.0 min | TPEAK (hrs)= 1.52
 |----- VOLUME (mm)= 14.55

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

TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW
hrs	cms	hrs	cms	hrs	cms	hrs	cms	hrs	cms
.00	.00	1.00	.07	2.00	.47	3.00	.17	4.00	.11
.17	.00	1.17	.10	2.17	.37	3.17	.15	4.17	.07
.33	.02	1.33	.21	2.33	.30	3.33	.14	4.33	.04
.50	.04	1.50	1.06	2.50	.25	3.50	.13	4.50	.03
.67	.05	1.67	.73	2.67	.22	3.67	.12	4.67	.02
.83	.06	1.83	.59	2.83	.19	3.83	.11		

*ROUTE FUTURE SUBDIVISION THROUGH ON SITE DETENTION POND

*ALLOWING FOR 0.14 ha.m FOR FIRST FLUSH STORAGE

*RATING CURVE REVISED: January 3, 1994 for new drainage areas
 * and revised pond depth.

 | RESERVOIR (0200) |
 | IN= 2---> OUT= 3 |
 | DT= 1.0 min | OUTFLOW STORAGE | OUTFLOW STORAGE
 |----- (cms) (ha.m.) | (cms) (ha.m.)

.000	.000	.141	.400
.000	.140	.200	.590
.051	.230	.245	.780
.101	.310	.000	.000

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 2 (0102)	24.00	1.08	1.52	14.55
OUTFLOW: ID= 3 (0200)	24.00	.09	4.10	8.22

PEAK FLOW REDUCTION [Qout/Qin](%)= 7.89
 TIME SHIFT OF PEAK FLOW (min)=155.00
 MAXIMUM STORAGE USED (ha.m.)= .29

*ADD EXISTING URBAN AREA AND FUTURE DETAINED SUBDIVISION

ADD HYD (0300) |

| 1 + 3 = 4 | AREA QPEAK TPEAK R.V.

(ha) (cms) (hrs) (mm)

ID1= 1 (0101): 48.00 2.04 1.53 14.55

+ ID2= 3 (0200): 24.00 .09 4.10 8.22

=====

ID = 4 (0300): 72.00 2.04 1.53 12.44

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

*AREA 3 - INDUSTRIAL/COMMERCIAL

DESIGN |

STANDHYD (0103) | Area (ha)= 19.00

| ID= 5 DT= 1.0 min | Total Imp(%)= 80.00 Dir. Conn.(%)= 50.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	15.20	3.80
Dep. Storage (mm)=	.80	1.50
Average Slope (%)=	2.00	2.00
Length (m)=	355.90	40.00
Mannings n =	.013	.250

Max. eff. Inten. (mm/hr)= 112.37 79.78
over (min) 5.00 9.00

Storage Coeff. (min)= 4.24 (ii) 8.91 (ii)

Unit Hyd. Tpeak (min)= 5.00 9.00

Unit Hyd. peak (cms)= .25 .13

TOTALS

PEAK FLOW (cms)= 2.57 .54 2.99 (iii)

TIME TO PEAK (hrs)= 1.52 1.60 1.52

RUNOFF VOLUME (mm)= 47.68 15.34 31.50

TOTAL RAINFALL (mm)= 48.48 48.48 48.48

RUNOFF COEFFICIENT = .98 .32 .65

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:

CN* = 50.0 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.

BLUE LINE / 24

*ADD INDUSTRIAL/COMMERCIAL AREA TO TOTAL

| ADD HYD (0301) |

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
4 + 5 = 6				

ID1= 4 (0300):	72.00	2.04	1.53	12.44
----------------	-------	------	------	-------

+ ID2= 5 (0103):	19.00	2.99	1.52	31.50
------------------	-------	------	------	-------

=====

ID = 6 (0301):	91.00	5.00	1.53	16.42
----------------	-------	------	------	-------

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

*ROUTE TOTAL FLOWS THROUGH NEW DETENTION POND TO WEST OF RAILWAY TRACKS

*Rating Curve Revised for New Pond Design July 1996

| RESERVOIR (0200) |

| IN= 6---> OUT= 9 |

DT= 1.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	.000	.000	.276	.928
	.000	.231	.289	.983
	.090	.411	.338	1.210
	.180	.600	.359	1.327
	.247	.819	.000	.000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
--	--------------	----------------	----------------	--------------

INFLOW : ID= 6 (0301)	91.00	5.00	1.53	16.42
-----------------------	-------	------	------	-------

OUTFLOW: ID= 9 (0200)	91.00	.31	4.13	12.22
-----------------------	-------	-----	------	-------

PEAK FLOW REDUCTION [Qout/Qin](%)= 6.19

TIME SHIFT OF PEAK FLOW (min)=156.00

MAXIMUM STORAGE USED (ha.m.)= 1.08

PRINT OUTFLOW HYD FROM POND

 PRINT HYD (0200) | AREA (ha)= 91.00
 ID= 9 PCYC= 10 | QPEAK (cms)= .31 (i)
 DT= 1.0 min | TPEAK (hrs)= 4.13
 ----- VOLUME (mm)= 12.22

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

TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW
hrs	cms	hrs	cms	hrs	cms	hrs	cms	hrs	cms
.00	.00	3.50	.30	7.00	.26	10.50	.19	14.00	.11
.17	.00	3.67	.30	7.17	.26	10.67	.19	14.17	.11
.33	.00	3.83	.31	7.33	.25	10.83	.18	14.33	.11
.50	.00	4.00	.31	7.50	.25	11.00	.18	14.50	.11
.67	.00	4.17	.31	7.67	.25	11.17	.18	14.67	.10
.83	.00	4.33	.31	7.83	.24	11.33	.17	14.83	.10
1.00	.00	4.50	.31	8.00	.24	11.50	.17	15.00	.10
1.17	.00	4.67	.30	8.17	.24	11.67	.16	15.17	.10
1.33	.00	4.83	.30	8.33	.23	11.83	.16	15.33	.09
1.50	.03	5.00	.30	8.50	.23	12.00	.16	15.50	.09
1.67	.15	5.17	.30	8.67	.23	12.17	.15	15.67	.09
1.83	.20	5.33	.29	8.83	.22	12.33	.15	15.83	.09
2.00	.23	5.50	.29	9.00	.22	12.50	.14	16.00	.08
2.17	.25	5.67	.29	9.17	.22	12.67	.14	16.17	.08
2.33	.26	5.83	.28	9.33	.21	12.83	.14	16.33	.08
2.50	.27	6.00	.28	9.50	.21	13.00	.13	16.50	.08
2.67	.28	6.17	.28	9.67	.21	13.17	.13		
2.83	.29	6.33	.28	9.83	.20	13.33	.13		
3.00	.29	6.50	.27	10.00	.20	13.50	.12		
3.17	.30	6.67	.27	10.17	.20	13.67	.12		
3.33	.30	6.83	.26	10.33	.19	13.83	.12		

FINISH

=====

APPENDIX B

Revised WSMD Drainage Area Parameters
Thompson Road Storm Sewer Capacity Calculations

EXISTING DEVELOPED AREAS

AREA 1 - EXISTING RESIDENTIAL

Original Area	48.00 ha
Updated Area	40.00 ha
Total Impervious	30 %
Directly Connected Impervious	15 %
CN	50
Original IA	1.5 mm
Updated IA	23.9 mm

AREA 2A - EXISTING RESIDENTIAL - YIN PHASE 2 & WOODROW

Area	16.90 ha
Total Impervious	38 %
Directly Connected Impervious	16 %
CN	50
Original IA	1.5 mm
Updated IA	23.9 mm

AREA 2B - EXISTING RESIDENTIAL - YIN PHASE 5 & PHASE 6

Area	11.82 ha	<i>*6.0 ha of Yin Phase 5 & 6 was included in original Area 2 drainage area, and an additional 8.22 ha was added per 10-034 Yin Phase 5 Design</i>
Total Impervious	47 %	
Directly Connected Impervious	22 %	
CN	58	
Original IA	1.5 mm	
Updated IA	16.5 mm	

AREA 2C - PROPOSED RESIDENTIAL - YIN PHASE 5 BLOCK 3 - LAM BOULEVARD

Area	0.80 ha	
Total Impervious	90 %	
Directly Connected Impervious	45 %	
CN	58	
Original IA	1.5 mm	
Updated IA	16.5 mm	
Peak Flow Allowance	0.015 m ³ /s	<i>*Per 10-034 Yin Phase 5 Design</i>

AREA 2D - PROPOSED RESIDENTIAL - YIN PHASE 5 BLOCK 4 - ORCHARD SQUARE

Area	1.40 ha	
Total Impervious	90 %	
Directly Connected Impervious	45 %	
CN	58	
Original IA	1.5 mm	
Updated IA	16.5 mm	
Peak Flow Allowance	0.015 m ³ /s	<i>*Per 10-034 Yin Phase 5 Design</i>

AREA 3 - EXISTING COMMERCIAL

Original Area	19.00 ha	
Updated Area	19.20 ha	<i>*Uncontrolled road added to Area 3 per 10-034 Yin Phase 5 Design</i>
Total Impervious	80 %	
Directly Connected Impervious	50 %	
CN	50	
Original IA	1.5 mm	
Updated IA	23.9 mm	

PROPOSED DEVELOPMENT AREAS

AREA 4 - PROPOSED RESIDENTIAL - THOMPSON

Area	7.85 ha	
Total Impervious	46 %	
Directly Connected Impervious	22 %	
CN	72	
IA	8.1 mm	
Peak Flow Allowance	0.084 m ³ /s	<i>*Peak flow allowance equal to the 2-YR pre-development flow from site</i>

AREA 5 - PROPOSED RESIDENTIAL - CHARLES

Area	4.35 ha	
Total Impervious	46 %	
Directly Connected Impervious	21 %	
CN	62	
IA	13.6 mm	
Peak Flow Allowance	0.023 m ³ /s	<i>*Peak flow allowance equal to the 2-YR pre-development flow from site</i>

PRE-DEVELOPMENT AREAS

AREA 4 - THOMPSON - PRE-DEVELOPMENT

Area	7.85 ha
Drainage Length	140.0 m
Upstream Elevation	240.4 m
Downstream Elevation	239.8 m
Slope	0.43 %
Runoff Coefficient	0.2
Time of Concentration	45.92 min
Time to Peak (0.6*tc)	0.46 hr
2-YR Peak Flow	0.084 m ³ /s

Airport Formula

$$T_c = 3.26 * (1.1 - C) * L^{0.5} / Sw^{0.33}$$

T_c = Time of Concentration (minutes)
 C = Runoff Coefficient (dimensionless)
 L = Watershed Length (metres)
 Sw = Watershed Slope % (m/m)

AREA 5 - CHARLES - PRE-DEVELOPMENT

Area	4.35 ha
Drainage Length	230.0 m
Upstream Elevation	245.5 m
Downstream Elevation	240.5 m
Slope	2.17 %
Runoff Coefficient	0.31
Time of Concentration	30.23 min
Time to Peak (0.6*tc)	0.30 hr
2-YR Peak Flow	0.023 m ³ /s

THOPMSON ROAD STORM SEWER CAPACITY

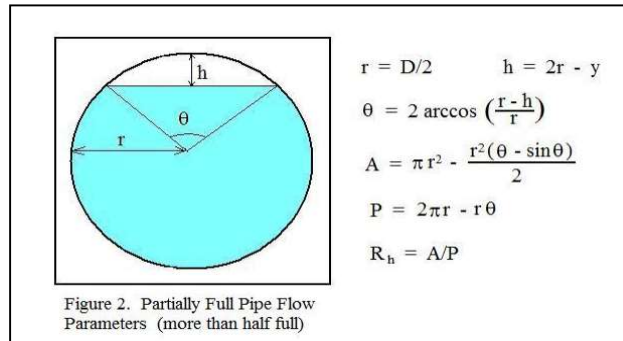
Pipe Flowing 100% Full

Diameter	1500 mm
Slope	0.22 %
Manning 'n' coeff.	0.013
Radius	0.75 m
Area	1.77 m
Rh	0.375 m
Capacity (100% Full)	3.316 m³/s

$$Q = \frac{1}{n} AR^{2/3} S^{1/2}$$

Pipe Flowing 94% Full

Diameter	1500
Slope	0.22
Manning 'n' coeff.	0.013
Radius	0.75 m
h	0.09 m
θ	0.99
Area (at 94% full)	1.72 m
P	3.97 m
Rh (A/P)	0.434 m
Capacity (94% Full)	3.567 m³/s



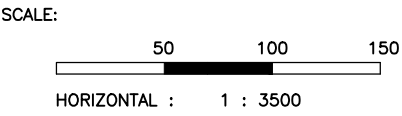
APPENDIX C

FIG 1 – Revised WSMD Drainage Areas

REV. No.	DATE	REVISION
0	MAY 11, 2022	REVISED DESIGN BRIEF
1	DEC 12, 2023	REVISED DESIGN BRIEF

LEGEND

-  DRAINAGE FLOW DIRECTION
-  ORIGINAL DRAINAGE WSMD BOUNDARY (1994)
-  WASHINGTON STREET AND ST. JAMES STREET DRAINAGE AREAS
-  REVISED & PROPOSED WSMD DRAINAGE AREAS
-  EXISTING SWM FACILITY



G. DOUGLAS VALLEE LIMITED
2 TALBOT STREET NORTH
SIMCOE, ONTARIO N3Y 3W4
(519) 426-6270

Stamp

Project Title

REVISED WSMD DESIGN
WATERFORD - NORFOLK COUNTY

Drawing Title

REVISED WSMD DRAINAGE AREAS

Designed by :

Drawn By :

JL NLB

Checked by :

Date Started :

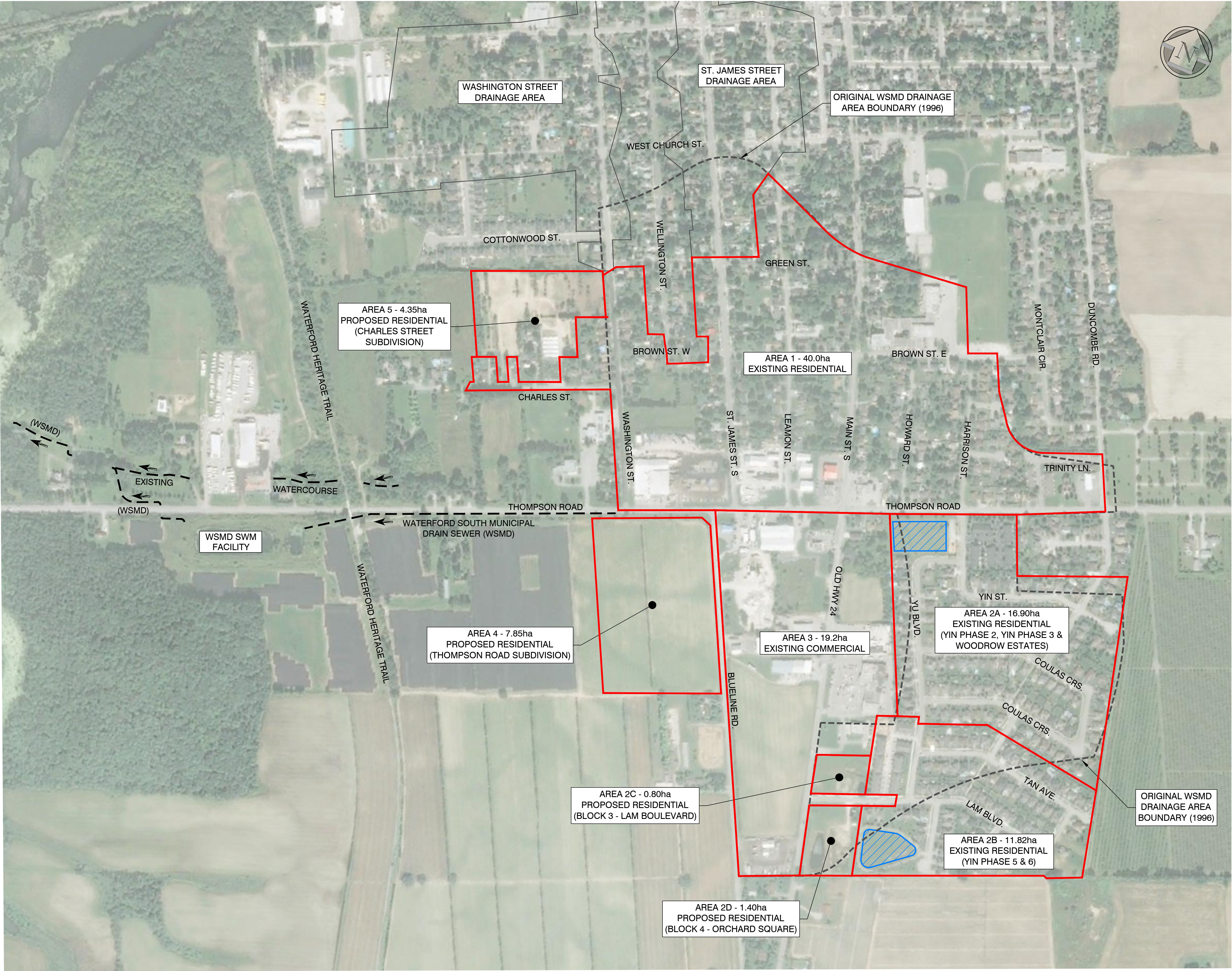
JL MAY 2022

Drawing Scale :

AS NOTED

Project No.

FIG1



APPENDIX D

Yin's Subdivision – Phase 2 Stormwater Management Design Brief (April 2, 2002)

Storm Water Management Design Brief

YIN SUBDIVISION - PHASE 2

NORFOLK COUNTY - WATERFORD



G. DOUGLAS VALLEE LIMITED
CONSULTING ENGINEERS AND ARCHITECT
51 Park Road, R.R.1, Simcoe, Ontario N3Y 4J9
Telephone 519-426-6270 Fax 519-426-6277

PROJECT NO. 00-026

REVISED APRIL 2, 2002

G. DOUGLAS VALLEE LIMITED

Consulting Engineers and Architect

G. Douglas Vallee, P.Eng., O.A.A.

John D. Vallee, P.Eng.

April 2, 2002

Mr. Tony Yin
R.R.#4
Waterford, Ontario
N0E 1Y0

Dear Sir:

**Reference: REVISED Storm Water Management Design Brief
Proposed Residential Subdivision
South of Thompson Road and East of Main Street
Waterford, Norfolk County, Ontario
Our Project Number 00-026**

This report presents our storm water management design for the proposed development of approximately 17 ha of land as a residential subdivision in Waterford, Norfolk County. The subdivision lands are bounded by the road allowance between Concessions 8 and 9, being County Road No. 9, to the north, and are located in the south east corner of Waterford. The site location and subdivision layout are indicated in attached maps.

This report forms our submission package to Norfolk County, Long Point Region Conservation Authority, and the Ministry of the Environment for their review and approval.

Background

The subject lands are located just east of the east (upstream) limit of the Waterford South Municipal Drain (WSM Drain). This drain consists of storm sewers constructed under MOE Certificate of Approval # 3-1100-96-006 and a storm water quality and quantity pond constructed under MOE Certificate of Approval # 3-1037-96-006. It is proposed that the subdivision will drain to existing municipal storm sewers and subsequently to the WSM Drain. This provides a legal and adequate outlet for the subdivision.

Given the quality control aspects of the WSM Drain pond, no water quality control aspects have been designed into the subdivision pond.

The Waterford South Municipal Drain storm sewer pipe was designed for a 2 year storm. Therefore this storm sewer will surcharge in during more severe rainfall events. This has been anticipated in the design of the subdivision storm water works.

Soil and Ground Conditions

Soil maps of the area were used to determine that the native soil is classified as Brady, Fox, and Granby. The soil is mainly lacustrine sand and loamy sand. This sand is classified into hydrologic soil group "AB." In the pre-development condition, being pasture and other improved land, this soil is given a soil/land use curve number of 62 for the AMCI condition. This converts to a CN value of 42 for the AMCII condition. Therefore a CN value of 50 has been used for modelling purposes. This is consistent with the design values used in the Waterford South Municipal Drain. The supporting documentation for these determinations are found in Appendix "A."

Water Quantity Limitations

The Waterford South Municipal Drain was sized to accommodate flows from the 2 year storm. The model that was used for the design of the drain provided a modest allowance for flows from the subdivision. During rainfall events in excess of the 2 year storm, the theoretical discharge from the subdivision pond will be in excess of the allowance for it in the WSM Drain design.

Therefore, the pond has been sized to accommodate all of the runoff from the subdivision without any outlet. This simulates a surcharged WSM Drain, or clogged outlet. It is expected that in actual fact, the discharge rate from the subdivision pond will be controlled by the available capacity of the WSM Drain.

Post-Development Flows and Retention

Post-development flows are routed to the proposed detention pond. In order to model the performance of this facility, a stage / storage / discharge table was prepared. This table calculates the storage volume, and discharge rate for various water elevations in the pond. Calculations were performed at 0.1 m intervals of water elevation. Volumes were calculated using the proposed contours and the end-area method.

The orifice equation was used to determine the discharge rates for the various water elevations above the pipe invert. The manning equation has been used to calculate discharge rates for water elevations with the pipe flowing partially full. The calculations are detailed in Appendix "B." It has been assumed that once the outlet pipe is submerged, it will operate under head in accordance with this equation.

$$Q = C * A * (2 * g * h)^{0.5}$$

The attached stage / storage / discharge table indicates the results of these calculations.

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The performance of the SWM pond was modelled using the OTTHYMO'89 computer program. The modelling was completed by modifying the original WSM Drain data file to represent the proposed design of the subdivision SWM pond. Output data for the post-development condition are attached in Appendix "C" and are summarized as follows:

Two rainfall events were considered.

- a) **The 2 year storm** was modelled to review the impact of the subdivision on the WSM Drain during the drain's design storm. This model output indicates the following key performance indicators:

Maximum Inflow Rate to the SWM Pond.....	0.55 m ³ /s
Maximum Outflow Rate from SWM Pond to WSM Drain	0.27 m ³ /s
Peak Downstream Flow in WSM Drain sewer.....	3.49 m ³ /s
Design Capacity of WSM Drain upper run sewers	3.59 m ³ /s
Design Capacity of WSM Drain lower run sewers.....	3.31 m ³ /s

This would indicate that the lower runs will be slightly surcharged during the 2 year storm, however, this design capacity of 3.31 m³/s is based on the pipe flowing full. The actual maximum capacity is with the pipe flowing 94% full. Considering this case, the capacity of the 1500mm lower runs is actually 3.56 m³/s, being slightly above the peak flow in the WSM Drain of 3.43 m³/s. The maximum capacity flow calculation is presented in Appendix "B."

- b) **The 100 year storm** was modelled to review the performance of the subdivision SWM pond in extreme event. Given the fact that the WSM Drain was only sized for the 2 year storm, it does not provide an adequate outlet for major storm events. **There is no clear overland flow route that is available to the subdivision.**

Therefore, the model for the 100 year storm has assumed that the WSM Drain is completely surcharged, and that there is absolutely no outlet capacity for the subdivision. The model has assumed no release from the pond during this extreme event.

In this very conservative and extreme condition, the model indicates that the maximum storage required is 0.58 ha.m. This volume is contained in the proposed SWM pond.

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It must be recalled that the 100 years storm was modelled considering no release from the SWM pond. This is considered a worst case scenario for the performance of the pond.

Water Quality Management

A water quality management pond currently exists at the downstream end of the WSM Drain. This pond contains a sediment forebay and permanent pools. This WSM Drain pond was designed to accommodate storm water runoff from the proposed subdivision, and **therefore no water quality aspects have been included in the design of the subdivision pond.**

Storm Sewer Design

Storm sewers have been designed using the rational method with a two year design storm. Details of this design are presented in a separate design brief. This separation is the result of the separate Ministry of the Environment approval processes for sewer and water works and stormwater management works

Summary

Storm water management designs for this project have been completed in accordance with standard design procedures.

Storm sewers have been sized for a two year storm in accordance with the rational method of design considering local design standards.

The detention pond discharges to existing municipal storm sewers and subsequently to the existing Waterford South Municipal Drain.

The Otthymo'89 model for the WSM Drain has been modified to include the stage / storage / discharge curve from the proposed detention pond in the Subdivision. This

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model has confirmed that in the 2 year storm, the release from the proposed facility will not surcharge the WSM Drain. It has also demonstrated that in the 100 year storm, the entire storm can be detained in the proposed pond, even without outlet to the presumably surcharged WSM Drain.

Storm water quality is addressed by the existing SWM facility near the downstream end of the WSM Drain. That quality control pond was designed to accept runoff from this site, and therefore no water quality control measures have been incorporated into the design of the subdivision facility.

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This report is respectfully submitted.

John D. Vallee, P.Eng.
G. DOUGLAS VALLEE LIMITED

Distribution:

Norfolk County Engineering Department
Long Point Region Conservation Authority
MOE Approval Branch - Toronto
MOE District Office - Hamilton

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Appendix C Post Development Flow Model

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=====

000	TTTT	TTTT	H	H	Y	Y	M	M	000	I	N	T	E	R	H	Y	M	O
0	0	T	T	H	H	Y	Y	MM	MM	0	0	*	*	*	1989b	*	*	*
0	0	T	T	HHHH	Y	M	M	M	0	0								
0	0	T	T	H	H	Y	M	M	0	0								
000	T	T	H	H	Y	M	M	000										

cE/101051900333

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Input filename: 00026pst.dat
Output filename: 000262.out
Summary filename: 000262.sum

DATE: 05-02-2001 TIME: 14:33:55

COMMENTS: _____

*POST DEVELOPMENT FLOW SIMULATION
*YIN SUBDIVISION - WATERFORD, NORFOLK COUNTY

** SIMULATION NUMBER: 1 **

READ STORM		Filename: CH2.STM															
Ptotal= 39.39 mm		Comments: 2 YEAR CHICAGO 4 HOUR DESIGN STORM DISTR															
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN										
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr										
.17	3.25	1.17	8.94	2.17	8.15	3.17	4.39										
.33	3.56	1.33	16.92	2.33	7.01	3.33	4.11										
.50	3.96	1.50	78.82	2.50	6.20	3.50	3.89										
.67	4.52	1.67	21.89	2.67	5.59	3.67	3.68										
.83	5.31	1.83	13.00	2.83	5.11	3.83	3.51										
1.00	6.55	2.00	9.88	3.00	4.72	4.00	3.35										

*CONSIDER ENTIRE AREA TO BE DEVELOPED

DESIGN		Area (ha)= 16.90															
STANDHYD (0101)		Total Imp(%)= 38.00 Dir. Conn.(%)= 16.00															
ID= 1 DT= 5.0 min																	
		IMPERVIOUS								PERVIOUS (i)							
Surface Area	(ha)=	6.42								10.48							
Dep. Storage	(mm)=	.80								1.50							
Average Slope	(%)=	2.00								2.00							
Length	(m)=	335.66								40.00							
Mannings n	=	.013								.250							

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

	IMPERVIOUS	PERVIOUS (i)	
Max.eff.Inten.(mm/hr)=	78.82	10.28	
over (min)	5.00	25.00	
Storage Coeff. (min)=	4.72 (ii)	22.26 (ii)	
Unit Hyd. Tpeak (min)=	5.00	25.00	
Unit Hyd. peak (cms)=	.22	.05	
			TOTALS
PEAK FLOW (cms)=	.54	.17	.58 (iii)
TIME TO PEAK (hrs)=	1.50	1.83	1.50
RUNOFF VOLUME (mm)=	38.58	6.49	11.62
TOTAL RAINFALL (mm)=	39.39	39.39	39.39
RUNOFF COEFFICIENT =	.98	.16	.29

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

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 50.0 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.

PRINT HYD (0101)		AREA (ha)= 16.90															
ID= 1 PCYC= 1		QPEAK (cms)= .58 (i)															
DT= 5.0 min		TPEAK (hrs)= 1.50															
		VOLUME (mm)= 11.62															

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

TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW
hrs	cms	hrs	cms	hrs	cms	hrs	cms	hrs	cms
.00	.00	1.00	.05	2.00	.23	3.00	.11	4.00	.07
.08	.00	1.08	.06	2.08	.21	3.08	.10	4.08	.05

.17	.00	1.17	.07	2.17	.20	3.17	.10	4.17	.04
.25	.00	1.25	.11	2.25	.18	3.25	.09	4.25	.04
.33	.02	1.33	.13	2.33	.17	3.33	.09	4.33	.03
.42	.03	1.42	.45	2.42	.16	3.42	.09	4.42	.03
.50	.03	1.50	.58	2.50	.15	3.50	.08	4.50	.02
.58	.03	1.58	.37	2.58	.14	3.58	.08	4.58	.02
.67	.03	1.67	.32	2.67	.13	3.67	.08	4.67	.01
.75	.04	1.75	.28	2.75	.12	3.75	.08	4.75	.01
.83	.04	1.83	.28	2.83	.12	3.83	.08		
.92	.05	1.92	.25	2.92	.11	3.92	.07		

*COMPUTE VOLUME ID=1 STRATE=-100 RELRATE=0.47

RESERVOIR (0102)					
IN= 1--> OUT= 2					
DT= 5.0 min					
		OUTFLOW	STORAGE	OUTFLOW	STORAGE
		(cms)	(ha.m.)	(cms)	(ha.m.)
		.000	.000	.390	.082
		.000	.000	.430	.109
		.020	.000	.530	.199
		.080	.002	.580	.267
		.210	.016	.636	.342
		.300	.033	.000	.000
		AREA	QPEAK	TPEAK	R.V.
		(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 1 (0101)		16.90	.58	1.50	11.62
OUTFLOW: ID= 2 (0102)		16.90	.28	1.83	11.62

PEAK FLOW REDUCTION [Qout/Qin](%)= 47.58
TIME SHIFT OF PEAK FLOW (min)= 20.00
MAXIMUM STORAGE USED (ha.m.)= .03

FINISH

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000	TTTT	TTTT	H	H	Y	Y	M	M	000	I	N	T	E	R	H	Y	M	O
0	0	T	T	H	H	Y	Y	MM	MM	0	0	*	*	*	1989b	*	*	*
0	0	T	T	HHHH	Y	M	M	M	0	0								
0	0	T	T	H	H	Y	M	M	0	0								
000	T	T	H	H	Y	M	M	000										

cE/101051900336

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Input filename: 00026pst.dat
Output filename: 00026100.out
Summary filename: 00026100.sum

DATE: 05-02-2001 TIME: 14:36:30

COMMENTS: _____

*POST DEVELOPMENT FLOW SIMULATION
*YIN SUBDIVISION - WATERFORD, NORFOLK COUNTY

** SIMULATION NUMBER: 1 **

READ STORM		Filename: CH100.STM							
Ptotal= 83.90 mm		Comments: 100 YEAR CHICAGO 4 HOUR DESIGN STORM DIS							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN		
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr		
.17	4.50	1.17	16.86	2.17	14.83	3.17	6.60		
.33	5.05	1.33	41.07	2.33	12.12	3.33	6.10		
.50	5.82	1.50	205.92	2.50	10.31	3.50	5.66		
.67	6.83	1.67	54.56	2.67	9.02	3.67	5.28		
.83	8.41	1.83	29.17	2.83	8.03	3.83	4.98		
1.00	11.07	2.00	19.28	3.00	7.24	4.00	4.70		

*CONSIDER ENTIRE AREA TO BE DEVELOPED

DESIGN				
STANDHYD (0101)		Area	(ha)=	16.90
ID= 1 DT= 5.0 min		Total Imp(%)=	38.00	Dir. Conn.(%)= 16.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	6.42	10.48
Dep. Storage	(mm)=	.80	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	335.66	40.00
Mannings n	=	.013	.250

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

		IMPERVIOUS	PERVIOUS (i)		
Max.eff.Inten.(mm/hr)=		205.92	75.39		
over (min)		5.00	15.00		
Storage Coeff. (min)=		3.21 (ii)	11.12 (ii)		
Unit Hyd. Tpeak (min)=		5.00	15.00		
Unit Hyd. peak (cms)=		.27	.09		
PEAK FLOW (cms)=		1.49	1.27	2.13 (iii)	
TIME TO PEAK (hrs)=		1.50	1.67	1.50	
RUNOFF VOLUME (mm)=		83.10	25.36	34.60	
TOTAL RAINFALL (mm)=		83.90	83.90	83.90	
RUNOFF COEFFICIENT =		.99	.30	.41	

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

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 50.0 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.

PRINT HYD (0101)		AREA	(ha)=	16.90
ID= 1 PCYC= 1		QPEAK	(cms)=	2.13 (i)
DT= 5.0 min		TPEAK	(hrs)=	1.50
		VOLUME	(mm)=	34.60

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

TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW
hrs	cms	hrs	cms	hrs	cms	hrs	cms	hrs	cms
.00	.00	1.00	.09	2.00	.78	3.00	.22	4.00	.14
.08	.00	1.08	.13	2.08	.64	3.08	.21	4.08	.10

.17	.00	1.17	.15	2.17	.55	3.17	.20	4.17	.07
.25	.03	1.25	.31	2.25	.47	3.25	.19	4.25	.05
.33	.04	1.33	.38	2.33	.42	3.33	.18	4.33	.03
.42	.04	1.42	1.54	2.42	.37	3.42	.17	4.42	.02
.50	.04	1.50	2.13	2.50	.34	3.50	.17	4.50	.01
.58	.05	1.58	1.70	2.58	.30	3.58	.16		
.67	.05	1.67	1.72	2.67	.28	3.67	.16		
.75	.06	1.75	1.35	2.75	.26	3.75	.15		
.83	.07	1.83	1.16	2.83	.25	3.83	.15		
.92	.09	1.92	.92	2.92	.23	3.92	.14		

*COMPUTE VOLUME ID=1 STRATE=-100 RELRATE=0.47

RESERVOIR (0102)					
IN= 1--> OUT= 2					
DT= 5.0 min					
		OUTFLOW	STORAGE	OUTFLOW	STORAGE
		(cms)	(ha.m.)	(cms)	(ha.m.)
		.000	.000	.390	.082
		.000	.000	.430	.109
		.020	.000	.530	.199
		.080	.002	.580	.267
		.210	.016	.636	.342
		.300	.033	.000	.000
		AREA	QPEAK	TPEAK	R.V.
		(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 1 (0101)		16.90	2.13	1.50	34.60
OUTFLOW: ID= 2 (0102)		16.90	.56	2.17	34.61

PEAK FLOW REDUCTION [Qout/Qin](%)= 26.43
TIME SHIFT OF PEAK FLOW (min)= 40.00
MAXIMUM STORAGE USED (ha.m.)= .24

FINISH

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000	TTTT	TTTT	H	H	Y	Y	M	M	000	I	N	T	E	R	H	Y	M	O
0	0	T	T	H	H	Y	Y	MM	MM	0	0	*	*	*	1989b	*	*	*
0	0	T	T	HHHH	Y	M	M	M	0	0								
0	0	T	T	H	H	Y	M	M	0	0								
000	T	T	H	H	Y	M	M	000		cE/101051900338								

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Input filename: 94021mod.dat
Output filename: 940212.out
Summary filename: 940212.sum

DATE: 05-02-2001 TIME: 15:25:02

COMMENTS: _____

*WATERFORD SOUTH MUNICIPAL DRAIN
*FINAL REPORT
*Project # 94-021
*Detention Pond Flow Simulation
*Chicago Storm
*4 Hour Distribution
*
*
*INPUT REVISED December 22, 1993
*****Area A2 reduced to 24 ha
*****Area A3 XIMP reduced to 0.40 TIMP reduced to 0.50
*****Area A4 reduced to 41 ha, Tp reduced to 0.51 hours
*****Area A5 reduced to 59 ha
*****Detention Pond Configurations and Rating Curves Revised
*
*INPUT REVISED JUNE 9, 1995
*****Area A3 TIMP increased to 0.80 and XIMP increased to 0.50
*
*INPUT REVISED JUNE 23, 1995
*****Revised main detention pond rating curve for pond with sediment forebay
*****Detention pond outlet reduced to 450 mm diameter at 0.5%
***** (See Rating Curve Caluculation Sheet)
*
*INPUT REVISED MAY 14, 1996
*****Pond relocated to west of railway tracks
*****Overland flow from adjacent farmland no longer enters pond

*
*INPUT REVISED JULY 24, 1996
*****Detention pond rating curve revised for new pond configuration
*****Farmland areas removed from drainage area
*
*INPUT REVISED APRIL 6, 2001
*****Yin Subdivision - Area 2 - on site stormwater pond routing curve
*****modified to actual design.
*

** SIMULATION NUMBER: 1 **

*USE CHICAGO STORM

READ STORM	Filename: CH2.STM
Ptotal= 39.39 mm	Comments: 2 YEAR CHICAGO 4 HOUR DESIGN STORM DISTR

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	3.25	1.17	8.94	2.17	8.15	3.17	4.39
.33	3.56	1.33	16.92	2.33	7.01	3.33	4.11
.50	3.96	1.50	78.82	2.50	6.20	3.50	3.89
.67	4.52	1.67	21.89	2.67	5.59	3.67	3.68
.83	5.31	1.83	13.00	2.83	5.11	3.83	3.51
1.00	6.55	2.00	9.88	3.00	4.72	4.00	3.35

*AREA 1 - EXISTING URBAN AREA DRAINING TO FUTURE POND

DESIGN	Area (ha)= 48.00
STANDHYD (0101)	Total Imp(%)= 30.00 Dir. Conn.(%)= 15.00
ID= 1 DT= 1.0 min	

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	14.40	33.60
Dep. Storage (mm)=	.80	1.50
Average Slope (%)=	2.00	2.00
Length (m)=	565.69	40.00
Mannings n =	.013	.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 MIN. TIME STEP.

	IMPERVIOUS	PERVIOUS (i)
Max.eff.Inten.(mm/hr)=	78.82	8.47
over (min)	6.00	26.00

Storage Coeff. (min)=	6.46 (ii)	25.41 (ii)	
Unit Hyd. Tpeak (min)=	6.00	26.00	
Unit Hyd. peak (cms)=	.18	.04	
PEAK FLOW (cms)=	1.20	.40	1.31 (iii)
TIME TO PEAK (hrs)=	1.53	1.92	1.53
RUNOFF VOLUME (mm)=	38.59	5.88	10.79
TOTAL RAINFALL (mm)=	39.39	39.39	39.39
RUNOFF COEFFICIENT =	.98	.15	.27

***** WARNING: FOR AREAS WITH IMPERVIOUS LESS THAN 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 50.0 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 2 - FUTURE RESIDENTIAL SUBDIVISION

DESIGN	Area (ha)= 16.90
STANDHYD (0102)	Total Imp(%)= 38.00 Dir. Conn.(%)= 16.00
ID= 2 DT= 1.0 min	

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	6.42	10.48
Dep. Storage (mm)=	.80	1.50
Average Slope (%)=	2.00	2.00
Length (m)=	335.66	40.00
Mannings n =	.013	.250
Max.eff.Inten.(mm/hr)=	78.82	10.71
over (min)	5.00	22.00
Storage Coeff. (min)=	4.72 (ii)	21.97 (ii)
Unit Hyd. Tpeak (min)=	5.00	22.00
Unit Hyd. peak (cms)=	.23	.05

PEAK FLOW (cms)=	.50	.17	.55 (iii)
TIME TO PEAK (hrs)=	1.52	1.85	1.52
RUNOFF VOLUME (mm)=	38.58	6.49	11.62
TOTAL RAINFALL (mm)=	39.39	39.39	39.39
RUNOFF COEFFICIENT =	.98	.16	.29

***** WARNING: FOR AREAS WITH IMPERVIOUS LESS THAN 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 50.0 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.

*PRINT HYDROGRAPH OF UNRESTRICTED FLOW FROM NEW DEVELOPMENT

PRINT HYD (0102)	AREA (ha)= 16.90
ID= 2 PCYC= 10	QPEAK (cms)= .55 (i)
DT= 1.0 min	TPEAK (hrs)= 1.52
	VOLUME (mm)= 11.62

- (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW
hrs	cms	hrs	cms	hrs	cms	hrs	cms	hrs	cms
.00	.00	1.00	.05	2.00	.24	3.00	.11	4.00	.07
.17	.00	1.17	.07	2.17	.20	3.17	.10	4.17	.05
.33	.01	1.33	.12	2.33	.17	3.33	.09	4.33	.03
.50	.03	1.50	.54	2.50	.15	3.50	.08	4.50	.02
.67	.03	1.67	.35	2.67	.13	3.67	.08	4.67	.01
.83	.04	1.83	.29	2.83	.12	3.83	.08		

*ROUTE SUBDIVISION THROUGH PROPOSED YIN SUBDIVISION SITE DETENTION POND

RESERVOIR (0200)	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
IN= 2--> OUT= 3	.000	.000	.460	.137
DT= 1.0 min	.020	.000	.530	.200
	.160	.007	.580	.267
	.300	.033	.640	.341
	.380	.082	.710	.481

AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0102)	16.90	.55	1.52
OUTFLOW: ID= 3 (0200)	16.90	.28	1.85

PEAK FLOW REDUCTION [Qout/Qin](%)= 51.27
TIME SHIFT OF PEAK FLOW (min)= 20.00
MAXIMUM STORAGE USED (ha.m.)= .03

*ADD EXISTING URBAN AREA AND FUTURE DETAINED SUBDIVISION

1.33	.00	3.83	.27	7.33	.21	10.83	.12	14.33	.07
1.50	.00	4.00	.28	7.50	.20	11.00	.12	14.50	.06
1.67	.00	4.17	.28	7.67	.20	11.17	.12	14.67	.06
1.83	.00	4.33	.28	7.83	.20	11.33	.11	14.83	.06
1.00	.00	4.50	.27	8.00	.19	11.50	.11	15.00	.06
1.17	.00	4.67	.27	8.17	.19	11.67	.11	15.17	.06
1.33	.00	4.83	.27	8.33	.19	11.83	.10	15.33	.06
1.50	.00	5.00	.26	8.50	.18	12.00	.10	15.50	.05
1.67	.09	5.17	.26	8.67	.18	12.17	.10	15.67	.05
1.83	.14	5.33	.26	8.83	.17	12.33	.09	15.83	.05
2.00	.18	5.50	.25	9.00	.17	12.50	.09	16.00	.05
2.17	.20	5.67	.25	9.17	.16	12.67	.09	16.17	.05
2.33	.22	5.83	.24	9.33	.16	12.83	.09	16.33	.05
2.50	.23	6.00	.24	9.50	.15	13.00	.08	16.50	.04
2.67	.24	6.17	.24	9.67	.15	13.17	.08		
2.83	.25	6.33	.23	9.83	.15	13.33	.08		
3.00	.26	6.50	.23	10.00	.14	13.50	.08		
3.17	.26	6.67	.22	10.17	.14	13.67	.07		
3.33	.27	6.83	.22	10.33	.13	13.83	.07		

*AREA 3 - INDUSTRIAL/COMMERCIAL

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	15.20	3.80
Dep. Storage	(mm)=	.80	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	355.90	40.00
Mannings n	=	.013	.250

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TOTALS

PEAK FLOW	(cms)=	1.75	.30	1.94 (iii)
TIME TO PEAK	(hrs)=	1.52	1.63	1.52
RUNOFF VOLUME	(mm)=	38.58	10.72	24.65
TOTAL RAINFALL	(mm)=	39.39	39.39	39.39
RUNOFF COEFFICIENT	=	.98	.27	.63

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

RESERVOIR (0200)				
IN= 6--> OUT= 9				
DT= 1.0 min				

	OUTFLOW	STORAGE	OUTFLOW	STORAGE
	(cms)	(ha.m.)	(cms)	(ha.m.)
	.000	.000	.276	.928
	.000	.231	.289	.983
	.090	.411	.338	1.210
	.180	.600	.359	1.327
	.247	.819	.000	.000
	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 6 (0301)	83.90	3.47	1.53	14.09
OUTFLOW: ID= 9 (0200)	83.90	.28	4.13	10.30

```
*****
*PRINT OUTFLOW HYD FROM POND
*****
```

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

TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW
hrs	cms	hrs	cms	hrs	cms	hrs	cms	hrs	cms
.00	.00	3.50	.27	7.00	.21	10.50	.13	14.00	.07
.17	.00	3.67	.27	7.17	.21	10.67	.13	14.17	.07

APPENDIX E

Yin's Subdivision – Phase 5 Stormwater Management Report (December 10, 2010)



vallee

*Consulting Engineers,
Architects & Planners*

December 10, 2010

Tony Yin
204 McMichael Rd
RR#4
Waterford, ON N0E 1Y0

Attention: Mr. Tony Yin

Dear Sir:

**Reference: Storm Water Management Report
Yin's Subdivision – Phase 5
Waterford – Norfolk County
Our File 10034**

1.0 Introduction

This storm water report has been completed to summarize the storm water management design for Phase 5 of the Yin's Subdivision in Waterford, Norfolk County, Ontario. It is the intention to submit this report to the Norfolk County and the Long Point Region Conservation Authority for review and approval.

Yin's Subdivision Phase 5 is a single family residential development located at the southern end of Waterford along Main Street (Old Highway 24). The site is bordered by agricultural lands to the south and west; single-family residences to the north and Main Street to the west. Figure 1 shows the overall development. This report will outline the SWM plan for the overall development.

The SWMHYMO computer model has been used to simulate the sub watershed under pre and post development conditions. The simulations were conducted using the 4-hour Chicago Distribution design storm of the 2-year, 5-year, 10-year, 25-year, 50-year and 100-year storm events.

The receiver for the discharge from the development is the Waterford South Municipal Drain. This municipal drain is a storm sewer system and also includes a dry pond facility at the down stream end of the system. Therefore, a basic level of protection is proposed with respect to water quality enhancement.

2.0 Pre-Development

Typically, it is requirement for development sites to reduce or control the post development runoff from the site to levels that do not exceed pre-development conditions. This is achieved by directing the majority of runoff to a retention area or areas. The release from these areas is controlled by means of orifice plates and/or weirs.

However, in this case the outlet for the proposed SWM facility will be the Waterford South Municipal Drain, which is a storm sewer system. Therefore, the Drain has a finite design capacity and the capacity attributable to the portion of the site within the drainage area of the municipal drain will be the limiting factor for the total discharge from the site, post development. Figure 2 shows the overall development site along with the portion of the site that is within the Waterford South Municipal Drain. Design information for the storm sewer along Main Street is unavailable from Norfolk County. However, this office completed the design of the Waterford South Municipal Drain and it is known the 2-year design storm was used.

The total site area is approximately 14.0 ha and the portion within the Waterford South Municipal drain is approximately 6.0 ha.

The SWMHYMO computer model was used to simulate pre-development conditions the portion of the site within the municipal drain's drainage area. The model uses a modified SCS procedure to estimate losses that occur naturally during a rainfall event such as evaporation and infiltration. For the areas with rural runoff characteristics, Table 1 summarizes the background information and input parameters for the computer model with complete notes included with this report as Appendix A.

Table 1	
SWMHYMO Model Input – Pre Development	
Parameters	Value
Area (ha)	6.0 ha
Soil Type	Fox – sand and loamy sand Granby – sand and loamy sand Wilsonville – sandy textures over gravelly sand
Hydrologic Soil Group	A
SCS Curve Number	58
Longest Flow Path (m)	429m
Average Slope (%)	1.63%
Runoff Coeff	0.2
Time to Peak (hrs)	0.52

The estimated peak pre-development storm water runoff generated from portion of the site within the Waterford South Municipal Drain is 0.064 cms.

3.0 Post-Development

Due the topography of the existing site, specifically the low elevation of Main Street relative to the elevation of the proposed SWM facility, Blocks 3 and 4 as well as small portion of Street B will not be able to drain to the SWM facility. These areas will connect directly to the proposed outlet sewer along Main Street. Therefore to achieve the required reduction in post development discharge to the identified criteria for the site, these two blocks will have a limiting post development discharge of 0.015 cms each. Both Blocks 3 and 4 will be subject to a site plan approval process with Norfolk County and as part of any submissions for these sites a SWM plan will need to be included demonstrating that the limiting discharge is achieved for these sites.

As was indicated previously the total development site is approximately 14 ha. Therefore the contributing area to the proposed SWM facility can be estimated by reducing the total area by the areas of Blocks 3 and 4 as well as the portion of Street A (approximately 2.18 ha). This results in a contributing area to the SWM facility of 11.82 ha.

Post development, impervious land areas will be introduced to each of these areas to differing degrees. For the areas within the development the following assumptions have been made with respect to impervious surfaces introduced post development.

- Assumed roof and driveway area per town single family unit 230m²
- Municipal Road (includes sidewalk one side) 11m²/m
(Road area considered directly connected to storm sewers)

The impervious land area introduced on the town house block and the apartment block has been assumed to be 75% of the total area of these blocks. Of this impervious area, 50% has been attributed to the parking/drive areas and therefore is considered directly connected.

For the commercial blocks, the impervious land area has assumed to 90% of total block areas with 50% of this impervious area corresponding to the parking/drive areas of the sites.

Table 2 summarizes the anticipated impervious land areas for the development.

Table 2 Post Development Impervious Areas			
Area	Total Area (ha)	Impervious Area (ha)	Directly Connected (ha)
SFD	9.3	3.47	1.52
Block 1 – TWNHSE	0.57	0.43	0.21
Block 2 – Apartments	0.69	0.52	0.26
Block 3 - Commercial	0.8	0.72	0.36
Block 4 – Commercial	1.4	1.26	0.63
Block 5 – SWM	1.26	1.13	0.57
TOTAL	14.02	3.55	7.53

Discharge to Storage Relationship

To determine the required level of storage for a storm water detention pond, the post-development conditions were modeled, again using the SWMHYMO computer model. In order for the computer model to determine the storage volume required the relationship between the storage volume of the pond and the discharge must be defined and is referred to as the pond-rating curve. This rating curve is determined by calculating volume of the proposed pond facility up to a proposed contour elevation and then calculating the expected discharge from the facility based on the water level at this contour elevation and the proposed outlet control configuration.

Generally orifices or weirs can control discharge from SWM facilities. Each of these control methods can be used by the singular control or they can be used in combination depending on the discharge characteristics desired. For this facility only an orifice and weir will be used to control with the following equations used to estimate discharge

1. Orifice

$$Q = C * A * \sqrt{2 * g * h}$$

where: Q = Discharge in cms

C = constant, 0.63

A = orifice area in m²

g = gravitational constant, 9.81 m/s²

h = height above orifice, m

For this facility a 125mm orifice will be used as the outlet control beginning at elevation 243.25. The complete rating curve is appended to this report as Appendix B.

Post Development Model

The post development model developed for this report as included as Appendix C. Table 3 summarizes the post development conditions for the storm events analyzed.

Table 3 Post Development Discharge		
Event	Post Development to WSMD (cms)	Allowable Discharge to WSMD (cms)
2-Year	0.047	0.064
5-Year	0.050	
10-Year	0.053	
25-Year	0.055	
50-Year	0.057	
100-Year	0.060	

For all storm events the peak post development discharge to the WSMD has been controlled to less than the estimated peak pre development runoff from the contributing area to the WSMD.

4.0 Proposed SWM Facility

The Ministry of the Environment's document titled **Stormwater Management Practices Planning and Design Manual** (March 2003) was used in conjunction with requirements of the Norfolk County to determine the design for the storm water ponds for Yin's Subdivision. The following summarizes the design guidelines presented by the manual along with the corresponding value for the proposed facility. The complete calculations are provided as Appendix D.

- a) Storage Sizing: Table 3.2 of the MOE design manual provides levels of storage volume required dependent on the percent impervious land area to provide basic protection. For a dry pond facility based on 54% impervious area of the contributing area to the facility, the required volume of storage is 147m³/ha of contributing area. For the contributing area of 11.82 ha this results in a required storage of 1,738 m³ and compares to the 1,768 m³ provided during the quality storm (2-year event).

- b) Detention Time: During the quality storm the design manual indicates a 24 hr detention time as a minimum requirement for dry pond facilities with 48 hr preferred. For the proposed facility the runoff stored during the quality storm (2-year event) is estimated to be between 26 and 35 hours.
- c) Minimum Orifice Size: A minimum orifice of 75mm is recommended for wet pond facilities and compares to the 125mm provided by this facility.
- d) Active Storage Depth: The MOE guideline recommends a maximum active storage depth of 2.0m. The active storage depth ranges between 0.3m and 0.9m depending on the storm event.
- e) Side Slopes: Average side slopes are recommended to be at 4(h):1(v) or flatter. The exposed side slopes of the proposed facility are proposed to be 5(h):1(v).
- f) Forebay Settling Length: The design manual outlines the calculation of the required length for the forebay to allow a certain size of particle to settle. The calculation is based on the peak flow rate from the pond during the quality storm, the length to width ratio of the forebay and settling velocity of the particle size (0.0003 m/s). The resulting length is 11m and compares to the 50m provided depending on the pond inlet.
- g) Forebay Dispersion Length: The design manual also outlines a calculation to determine the length of forebay required to slow a discharge. This calculation is based on the inlet flow rate during the quality storm (2-year), the depth of the permanent pool in the forebay and the desired velocity in the forebay (0.5 m/s). This results in a target forebay length of 8m and compares to the 38m provided.
- h) Sediment Accumulation: Based on the anticipated sediment loading rates outlined by Table 6.3 of the MOE guidelines, the estimated sediment accumulation can be determined based on the impervious land area within the catchment area along with the target removal efficiency of the proposed facility. For the estimated 54% impervious land of the contributing area, sediment accumulation is estimated to be approximately 130m³ over a 10-year period. This compares to the forebay volume of 444m³.

5.0 Outlet Capacity

The proposed outlet for the SWM facility outlined by this report is the Waterford South Municipal Drain. The main branch of this drain was constructed along Thompson Road in Waterford and was designed based on the 2-year storm event. Following construction of this drain, the former Regional Municipality of Haldimand Norfolk constructed a storm sewer south along Main Street. The purpose of this storm sewer was to provide an outlet to lands identified within the drainage area of the WSMD. It is unclear as to the genesis of this extension, however it appears that drainage report was not completed to bring this extension under the umbrella of the WSMD.

As was noted previously by this report, the design information for the storm sewer extension along Main Street is unavailable. Therefore to determine if the Main Street storm sewer provides sufficient capacity, design calculations were completed based on the contributing drainage area and at the 2-year storm event, the design event for the WSMD. These calculations, which are appended to this report, indicate that the existing system has insufficient capacity to service the existing drainage area.

Furthermore, a review of the existing system profile has indicated that the system would have insufficient depth to service the proposed development site.

Therefore, it is proposed to reconstruct this system beginning at the intersection of Thompson Road and proceeding southerly along Main Street with a new storm system of sufficient depth and capacity to service the existing drainage area and the development site. As the design of the WSMD is based on the 2-year event, the design of this new system is based on the 2-year event as well as the controlled discharges from the development site up to the 100-year event. The complete calculations for this system are appended to this report.

6.0 Emergency Overflow

As part of the outlet structure for the proposed SWM facility, a 1.8m square precast concrete catch basin structure has been placed with its top corresponding to the anticipated water level of the proposed SWM facility during the 100-year storm event (244.09 +/-). In the event that a storm event in excess of the 100-year storm occurs or the primary outlet is blocked, discharge from the facility will begin to occur over the top of this structure prior to overflowing the top of bank surrounding the SWM facility.

7.0 Proposed SWM Facility Summary

The following summarizes the proposed SWM Facility, shown drawings SWM1, for the Phase 5 of the Yin's Subdivision in Waterford.

- A dry pond facility with a permanent pool elevation in the sediment forebay of 243.25, pond bottom of elevation in the sediment forebay of 242.00 and top of slope 244.25.
- Permanent pool depth of 1.25m in the sediment forebay with a volume of 896m³
- Total storage volume provided for the 100-year storm event is 5,0690m³.
- Discharge from the proposed facility controlled by a 125mm diameter orifice at elevation 234.25.
- Outlet from the proposed facility to be provided by an extension of the WSMD along Main Street to the site. The design of this system to based on the 2-year event for the contributing area along Main Street and the controlled discharge from the development site as follows:
 - SWM Facility - 0.03 cms
 - Block 3 Commercial - 0.015 cms
 - Block 4 Commercial - 0.015 cms
- Emergency overflow flow provided by catch basin structure with top of casting elevation placed at the approximate 100-year storage level (244.09 +/-).

8.0 Erosion and Sediment Control

During construction, the contractor is required to protect the work site and all adjacent lands from sediment and erosion regardless of the source to the satisfaction of all applicable parties. The measures installed by the contractor are to remain in place until such time as there is no further threat of damage.

9.0 The Drainage Act

During the draft plan approval stage of this development, County staff recognized that the development site was within the drainage area of the WSMD. Therefore, the following draft plan condition was stipulated:

" 5. The applicant covenants and agrees to pay all costs related to the Corporation of Norfolk County hiring and engineer on behalf of the applicant as per Section 4(1) of the Drainage Act for the purpose of constructing an extension to the existing municipal drain or to construct an entirely new municipal drainage system to service the severed property(s)."

To begin this process a formal request needs to be provided by the applicant to Norfolk County.

11.0 Conclusions and Recommendations

It is concluded that:

1. Post development flows from the development site have been controlled to less than the current discharge of the portion of the site within the drainage area of the WSMD.
2. The proposed storm water pond has sufficient capacity and meets the design guidelines outlined by the MOE's document titled **Stormwater Management Practices Planning and Design Manual** (March 2003) for basic protection and requirements Norfolk County.
3. The existing storm sewer along Main Street has insufficient capacity during the 2-year event for the current contributing area to this system.

It is recommended that:

1. This report is provided to the Norfolk County and the Long Point Region Conservation Authority as part of the engineering approval package for the development.
2. Pending approval by the municipality and receipt of the required Ministry of the Environment approvals, the Facility and associated appurtenances be constructed as outlined by this report.
3. The applicant formally request of Norfolk County the appointment of an engineer under the Drainage Act to address the extension of the WSMD to the development site.

We trust that this is the information for submission. Should you have any questions or require further information please do not hesitate to call. Thank you.

Yours truly,



T. Gregory Smith, P.Eng.
G. DOUGLAS VALLEE LIMITED
Consulting Engineers, Architects and Planners



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Consulting Engineers, Architects & Planners



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List of Figures

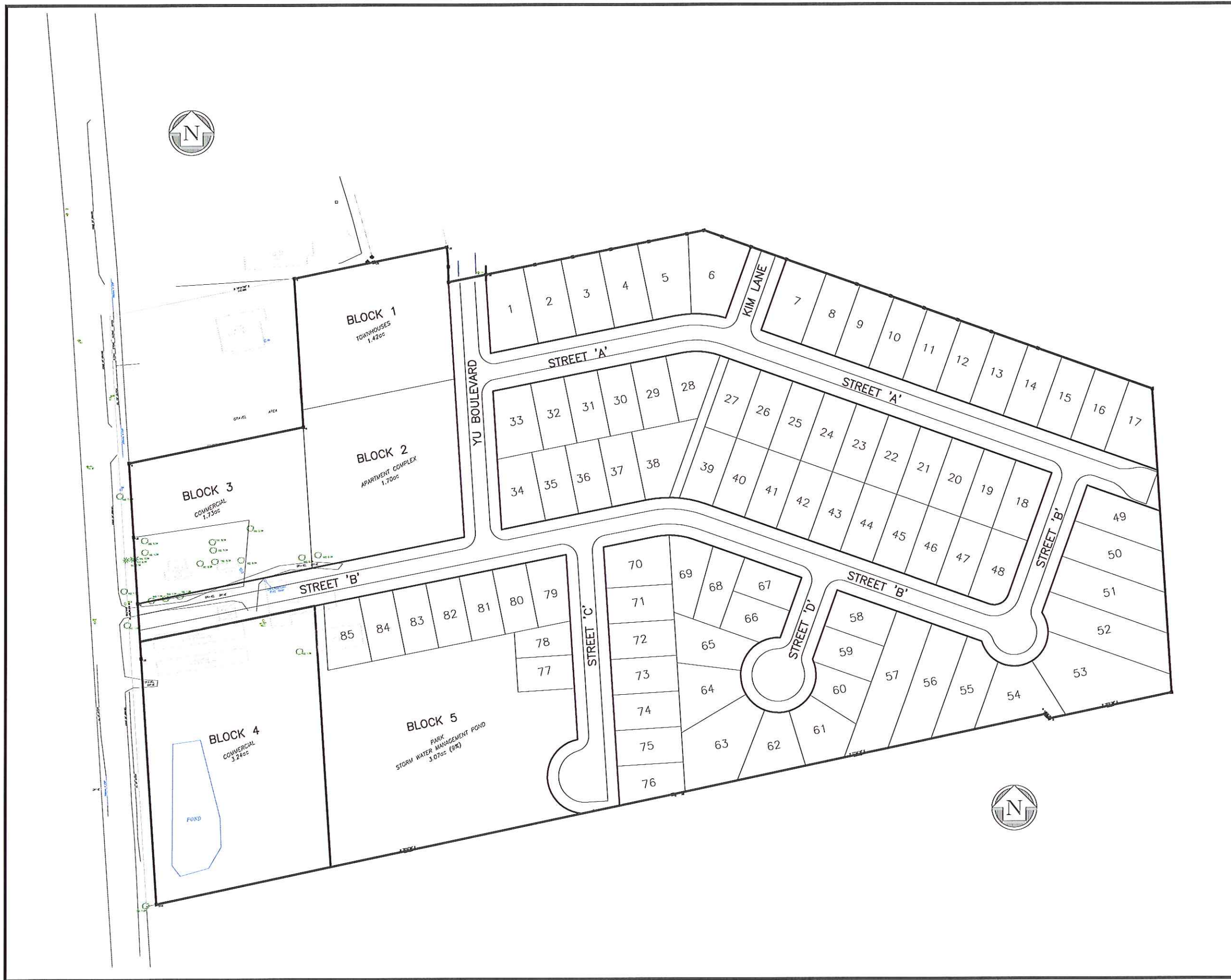
Figure 1: Development Layout
Figure 2: WSMD Drainage Area

List of Appendices

Appendix A: Pre-Development Model
Appendix B: Pond Rating Curves
Appendix C: Post Development Model
Appendix D: Miscellaneous Pond Design Calculations
Appendix E: Main Street Storm Sewer Design Calculations (Existing and Proposed)

List of Drawings

10034 SWM1 – Plan and Section Details



DATE	REVISION

Stamp	Stamp
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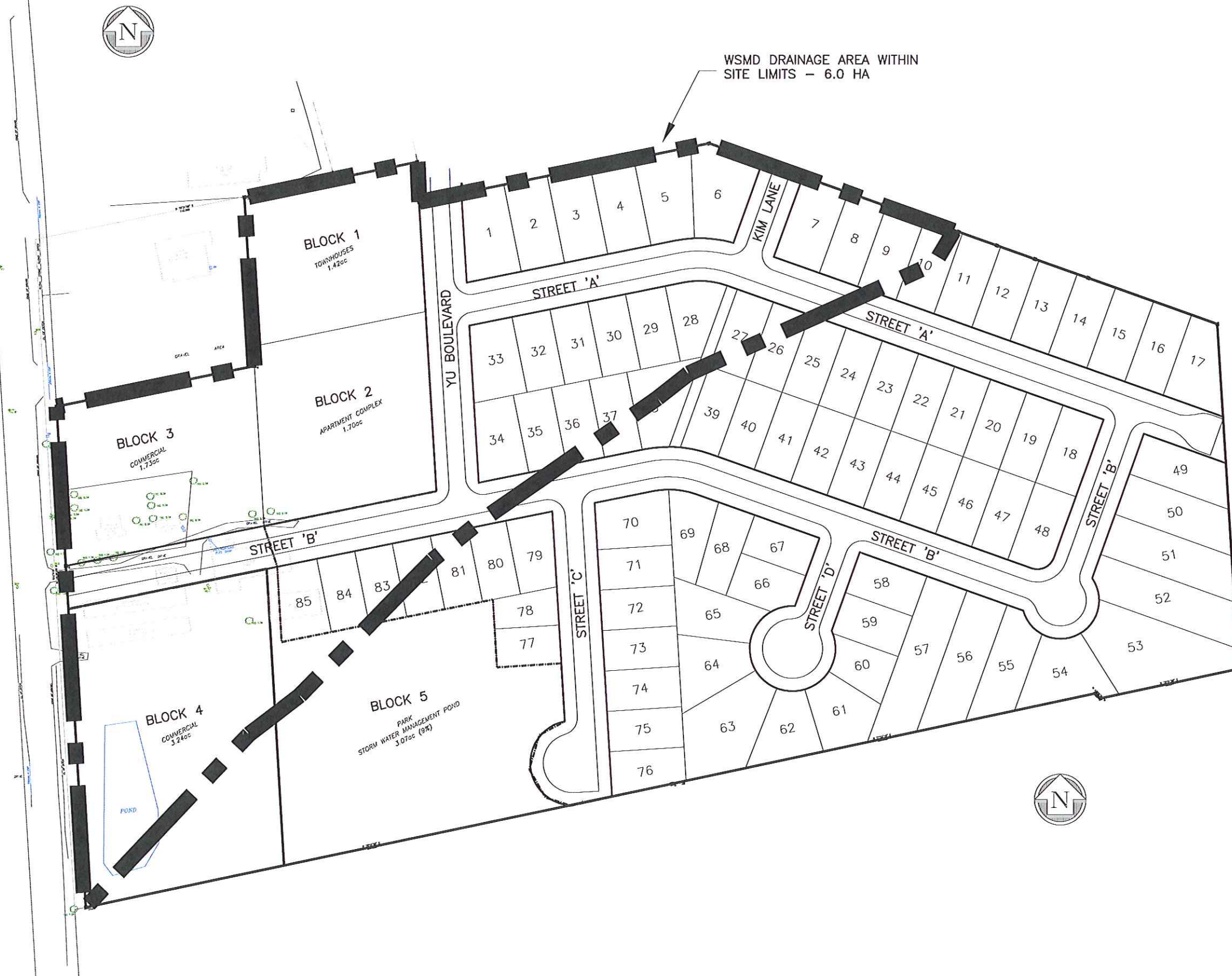
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Project Title
**YIN'S SUDIVISION
PHASE 5**

Drawing Title
**FIGURE 1
DEVELOPMENT LAYOUT**

Designed by : TGS	Drawn By : TGS	Checked By :
Scale : 1:2000	Date : DEC 2010	Drawing No. F1
Project No. 10034		

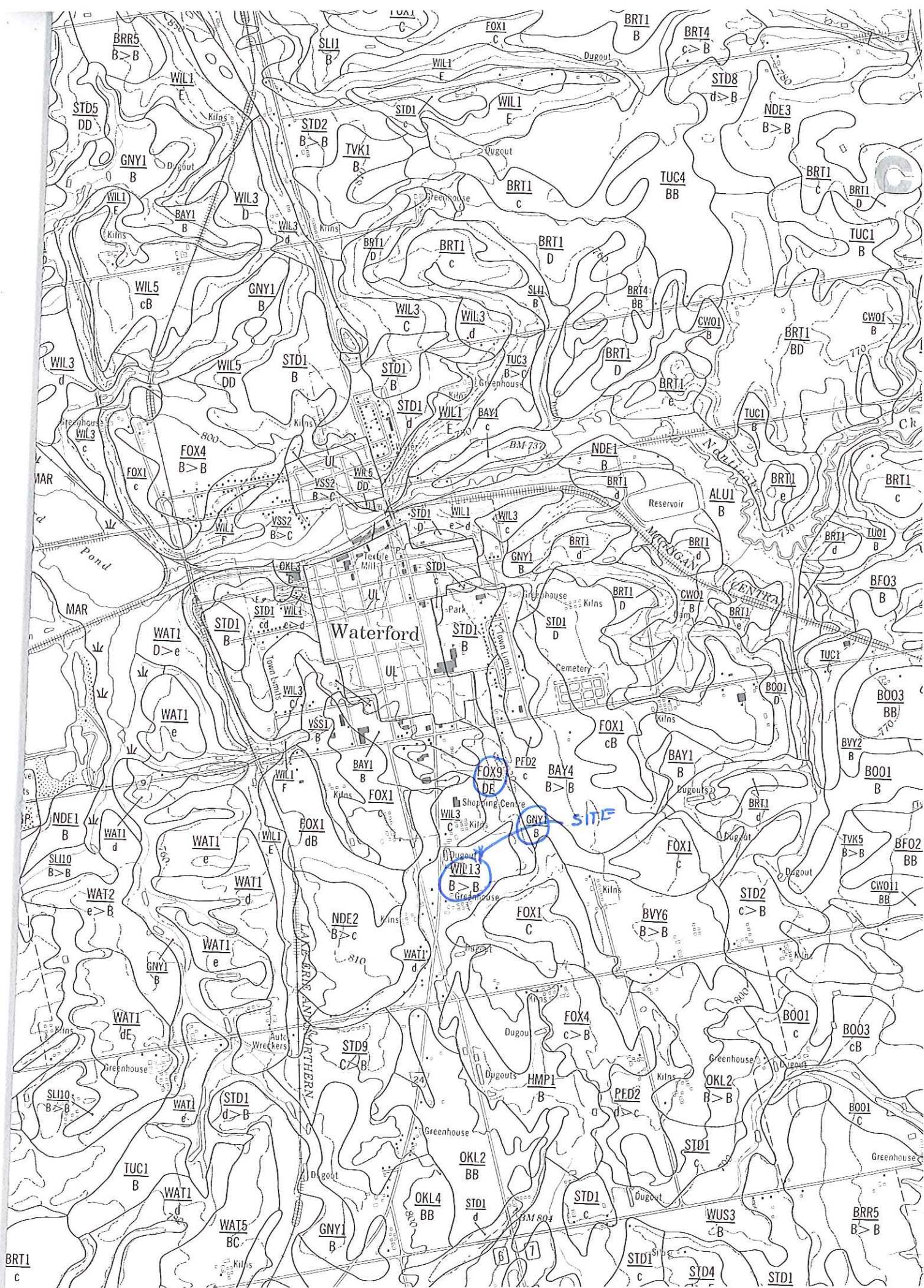
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Drawing Title
FIGURE 2
WSMD DRAINAGE AREA

10034

Appendix A: Pre-Development Model



CWO 20	CWO.C	BRR	15-40 cm sandy textures over lacustrine silt loam	see BRR 1	Poor	Imperfect
CWO 22	CWO.P	HMP	15-40 cm organic materials over lacustrine silt loam	see HMP 1	Poor	Very poor

FOX - Fox

FOX 1	FOX	None	Mainly lacustrine sand and loamy sand		Rapid to well	
FOX 3	FOX	GNY	see FOX 1	see GNY 1	Rapid to well	Poor
FOX 4	FOX	BAY	see FOX 1	see BAY 1	Rapid to well	Imperfect
FOX 8	FOX	BRR	see FOX 1	see BRR 1	Rapid to well	Imperfect
FOX 9	FOX	STD	see FOX 1	see STD 1	Rapid to well	Well
FOX 10	FOX	OKL	see FOX 1	see OKL 1	Rapid to well	Imperfect
FOX 13	FOX	CWO	see FOX 1	see CWO 1	Rapid to well	Poor

FRM - Farmington

FRM 1	FRM	None	Less than 20 cm variable textures over bedrock		Rapid	
-------	-----	------	--	--	-------	--

GNY - Granby

GNY 1	GNY	None	Mainly lacustrine sand and loamy sand		Poor	
GNY 3	GNY.P	None	15-40 cm organic materials over lacustrine sand and loamy sand		Very poor	
GNY 4	GNY	BAY	see GNY 1	see BAY 1	Poor	Imperfect
GNY 6	GNY	FOX	see GNY 1	see FOX 1	Poor	Rapid to well
GNY 7	GNY	CWO	see GNY 1	see CWO 1	Poor	Poor
GNY 11	GNY	GNY.P	see GNY 1	see GNY 3	Poor	Very poor
GNY 15	GNY	OKL	see GNY 1	see OKL 1	Poor	Imperfect
GNY 17	GNY	BRR	see GNY 1	see BRR 1	Poor	Imperfect
GNY 18	GNY.P	TLD.C	see GNY 3	see TLD 2	Very poor	Poor

STD 1	STD	None	40-100 cm sandy textures over	Rapid to well	
STD - Scotland					
SNA 13	SNA	FRM	Drumlinized loam till	see FRM 1	Well
SNA - Seneca					
					and gravels

DRAINAGE COMPONENTS
No. 2

Rapid
Variable
Rapid
Rapid to well
Rapid
Rapid to well

II

I drainages. This informa-

nate proportions, and the

ents in the map unit. The
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ent has been mapped in

the slope symbols appear
s, a "greater than" symbol
hat occupies at least 80%

Is B, c, C, d, D, e, E, f, F,

land that many soil bound-
veral hectares, of uniden-
cs to a depth of about 100

MAP UNIT SYMBOL	MAP UNIT COMPONENTS		PARENT MATERIAL COMPONENTS		DRAINAGE COMPONENTS	
	No. 1	No. 2	No. 1	No. 2	No. 1	No. 2
WIL - Wilsonville						
WIL 1	WIL	None	Mainly gravelly sandy till		Rapid to well	
WIL 3	WIL.C	None	15-40 cm sandy textures over gravelly sandy till		Rapid to well	
WIL 5	WIL	WIL.C	see WIL 1	see WIL 3	Rapid to well	Rapid to well
WIL 9	WIL.L	WIL	15-40 cm loamy textures over gravelly sandy till	see WIL 1	Rapid to well	Rapid to well
WIL 10	WIL.L	BRT	see WIL 9	see BRT 1	Rapid to well	Well
WIL 11	WIL.C	WIL	see WIL 3	see WIL 1	Rapid to well	Rapid to well
WIL 12	WIL.C	STD	see WIL 3	see STD 1	Rapid to well	Rapid to well
WIL 13	WIL.C	NDE	see WIL 3	see NDE 1	Rapid to well	Imperfect
WIL 14	WIL.C	OKL	see WIL 3	see OKL 1	Rapid to well	Imperfect
WSH - Walsher						
WSH 1	WSH	None	40-100 cm sandy textures over lacustrine silt loam		Well	
WUS - Wauseon						
WUS 1	WUS	None	40-100 cm sandy textures over lacustrine silty clay		Poor	
WUS 3	WUS.P	None	15-40 cm organic materials over lacustrine silty clay		Very poor	
WUS 4	WUS	BRR	see WUS 1	see BRR 1	Poor	Imperfect
WUS 6	WUS	TLD.C	see WUS 1	see TLD 2	Poor	Poor
WUS 9	WUS	SLI	see WUS 1	see SLI 1	Poor	Poor
WUS 10	WUS	TUC.C	see WUS 1	15-40 cm sandy textures over lacustrine silt loam	Poor	Imperfect

TVK - Ta

TVK 1

TVK 2

TVK 3

TVK 4

TVK 5

TVK 7

TVK 9

VSS - V

VSS 1

VSS 2

WAT - V

WAT 1

WAT 2

WAT 3

WAT 4

WAT 5

WAT 8

WAT 1

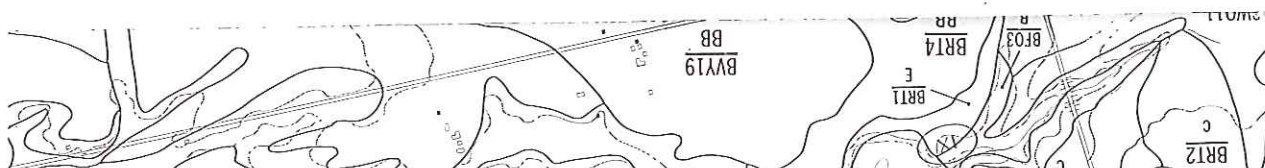


CHART C2-6 -continued

Soil Series	Soil Type	Hyd. Soil Grp.	Soil Series	Soil Type	Hyd. Soil Grp.	Soil Series	Soil Type	Hyd. Soil Grp.
Crombie	s 1	B	Englehart	s. 1	B	Harriston	l	BC
"	si 1	BC	Evanturel	si 1	BC	"	si 1	BC
Dack	c	D	"	si c 1	C	Harrow	s	A
Dalton	s	AB	Falardeau	si 1	BC	"	s 1	AB
Darlington	s	B	"	si c 1	C	"	l	B
"	l	C	Farmington	s 1	A	Havelock	s /g	A
Dawson	s 1	A	"	l	B	Hawkesvi.	l	B
"	l	B	"	c 1	C	Haysville	s 1	AB
Deloro	l	B	Femdale	si 1	BC	Heidelberg	f. s 1	B
Devlin	si c /	C	"	c 1	C	Hendrie	s /g	AB
"	c 1 }		Flamboro	s	B	Henwood	s /g.	A
Dinorwic	c	BC	Floradale	l	B	Hespeler	s. 1	B
Dobie	c /1	BC	Fonthill	g.	A	Hillier	c	C
Doe	s 1	B	Font	g. s 1	A	Hillsburgh	s 1	A
"	si 1	BC	Forbes	c	D	Himsworth	si 1	BC
Donald	l	B	Fox	s	A	Hinchinbr.	s 1	B
Donnybrook	s. g	A	"	s 1	AB	"	l	BC
"	s. 1	AB	Foxboro	s	A	"	si 1	BC
Dorion	c /1	C	Franktown	l	B	Honeywood	s. 1	AB
Dorking	si c 1	BC	Freeport	s 1	B	"	si 1	BC
Dumfries	s 1	A	Galesburg	s 1	A	Howland	s 1	B
"	l	AB	"	l	AB	"	l	BC
Dummer	s 1	A	Gameland	s /g.	AB	Huron	s 1	B
"	l	B	Gananoque	c	C	"	l	BC
Dundonald	s 1	AB	Gerow	c 1	C	"	si 1	BC
Dunedin	c	D	Gilford	s 1	B	"	c 1	CorD
Dymond	s 1	AB	"	l	B	Innisville	s. 1	B
"	l	B	Gordon	si c	C	Jeddo	l	BC
Eagle Lake	s /g	AB	Granby	s	B	"	c 1	C
Eamer	l	BC	"	s 1	B	Kagawong	si 1	BC
Earlton	si 1	B	Grand	l	B	Kars	s /g	A
"	c 1	C	Grenville	s 1	A	Kemble	si 1	BC
Eastport	s	A	"	l	BC	"	si c 1	C
Edenvale	s	AB	Grimsby	s. 1	A	"	c 1	D
Eganville	l	B	Guelph	s. 1	A	Kenabeek	s.	B
Elderslie	si 1	BC	"	l	BC	"	s 1	B
"	si c 1	C	"	si 1	BC	Killeen	l/s 1	AB
"	c 1	C	Guerin	s 1	AB	King	si 1	BC
Eldorado	s 1	A	"	l	B	"	c 1	C
"	l	B	Gwillimb.	g.	AB	Kirkland	s. 1	A
Elk Pit	s. g	A	Haileybury	si c 1	C	Kossuth	s 1	B
Ellwood	c 1	C	"	si c.	C	L'Achigan	s.	AB
Elmbrook	si 1	BC	"	c	CD	Lambton	l	BC
"	c 1	C	Haldimand	si 1	BC	"	si 1	BC
"	c	C	"	si c 1	C	Lanark	c	C
Elmira	l	B	"	c	CorD	Lansdowne	c /si 1	C
Elmsley	s 1	B	Hanbury	si c 1	C	Leech	si c 1	C
Embro	s. 1	BC	"	si c	C	"	c 1	D
"	s 1	C	"	c	D	Leitrim	g	B
Emily	l	B	Harkaway	l	B	Leith	si 1	BC
Emo	c & p	C	"	si 1	BC	Lily	l/s 1	B

DESIGN FLOOD ESTIMATION

DESIGN CHARTS

CHART C2-6

CHART C2-6 --continued

Soil Series	Soil Type	Hyd. Soil Grp.	Soil Series	Soil Type	Hyd. Soil Grp.	Soil Series	Soil Type	Hyd. Soil Grp.
						Late	Addit.	
Smithville	l	BC	Uplands	s	A	Percy	f s l	B
"	si c l	C	"	s l	A	Brisbane	l	B
"	si l	BC	Upsala	f s	AB	Donnybrook	l	B
Snedden	si c l	C	Vars	l	B			
Solmesville	c l	C	Vasey	s l	AB			
South Bay	c l	D	"	l	B			
"	c	D	Vergennes	si l	BC			
Spohn	s /g }		"	l	BC			
"	c	BC	"	c	C			
Springvale	s l	A	Vincent	si l	BC			
Stafford	l	B	"	si c l	C			
Stockdale	si l/f }		"	c l	D			
"	s	B	Vineland	s l	AB			
St. Clem.	s l	A	Wabi	s l	A			
"	si c l	C	"	l	B			
St. Jacobs	l	B	Wabigoon	c	C			
St. Peter	s /g	A	Waterloo	s	A			
St. Rosalie	c	C	"	s l	A			
St. Samuel	s	B	Watrin	s	B			
"	s l	B	Waupoos	c l	D			
St. Thomas	s	A	"	c	D			
Sullivan	s	A	Wauseon	s l	B			
"	s l	A	Wayside	s	AB			
Sutton Bay	s	B	Welland	c	C			
"	s l	B	Wellesley	s l	AB			
Tansley	c	D	"	si c l	C			
Tavistock	s l	AB	Wemyss	s l	AB			
"	si l	BC	Wendigo	s	A			
Tecumseth	s	AB	"	s l+r	AB			
Teeswater	si l	B	Wendover	c l	D			
Tennyson	s l	A	Westmeath	s	A			
Thames	c l	D	Whitby	l	BC			
Thorah	s	B	White Lake	s /g	A			
Thornloe	c	C	Whitfield	si l	B			
Thwaites	si l	BC	Wiarton	l	B			
Tioga	s	A	"	si l	BC			
"	s l	A	Wilmot	s l	B			
Toledo	si l	BC	"	si c l	C			
"	si c l	C	Winona	s l	AB			
"	c l	C	Woburn	s l	A			
"	c	C	"	l	B*			
Trafalgar	c	D	Wolford	c l	D			
Trent	s	AB	Wolsey	si c	C			
Tuscola	s l	AB	Wooler	si l/f }				
"	si l	BC	"	s	AB			
Tweed	s l	A	Woolwich	l	BC			
Undiffer'd	s l +r	AB or B (dep. on depth)	Worthing.	s /g /c	BC			
			Wyevale	s /g	A			

WILSONVILLE
NOT LISTED
-SANDY => GROUP A.

CHART C2-8 - SOIL/LAND USE CURVE NUMBERS

Land Use	Hydrologic Soil Group						
	A	AB	B	BC	C	CD	D
Fallow (special cases only)	77	82	86	89	91	93	94
Crop and other improved land	66*	70	74	78	82	84	86
Pasture & other unimproved land	58*	62*	65	71	76	79	81
Woodlots and forest	50*	54*	58	65	71	74	77
Impervious areas (paved)	98						
Bare rock draining <u>directly</u> to stream	98						
Bare rock draining <u>indirectly</u> to stream	70						
Water surfaces	100 (use in special cases only)						

Notes

- Figures are based on average antecedent moisture condition (AMC II) except those marked *, which are initially wet (AMC III) or an intermediate condition. For definition of AMC's see Chart C2-10.
- Table is not applicable to frozen soils or to periods in which snowmelt contributes to runoff.
- For detailed values in urban areas see Table 2.2 of ref. 14.
- Source: SCS Handbook of Hydrology, Chapter 9 (9), with modifications.

CHART C2-9 - PERCENT IMPERVIOUSNESS OF URBAN AREAS

Urban Land Use	% Imperviousness
Business - Commercial	40 - 90
Industrial - Light	45 - 65
Industrial - Heavy	50 - 70
Residential - Low density	20 - 30
Residential - Medium density	25 - 35
Residential - High density	30 - 40

Source: SCS Handbook of Hydrology, Chapter 15 (9)



vallee

*Consulting Engineers,
Architects & Planners*

Subject: Yin Phase 5

Date: Nov 2/10

By:

TGS

Project #: 10034

Page

High Density - predevelopment and current state

tc calc for upstream drainage area

$$t_c = 3.26 * (1.1 - C) * L^{(0.5)} / S^{0.333} \quad (\text{airport formula})$$

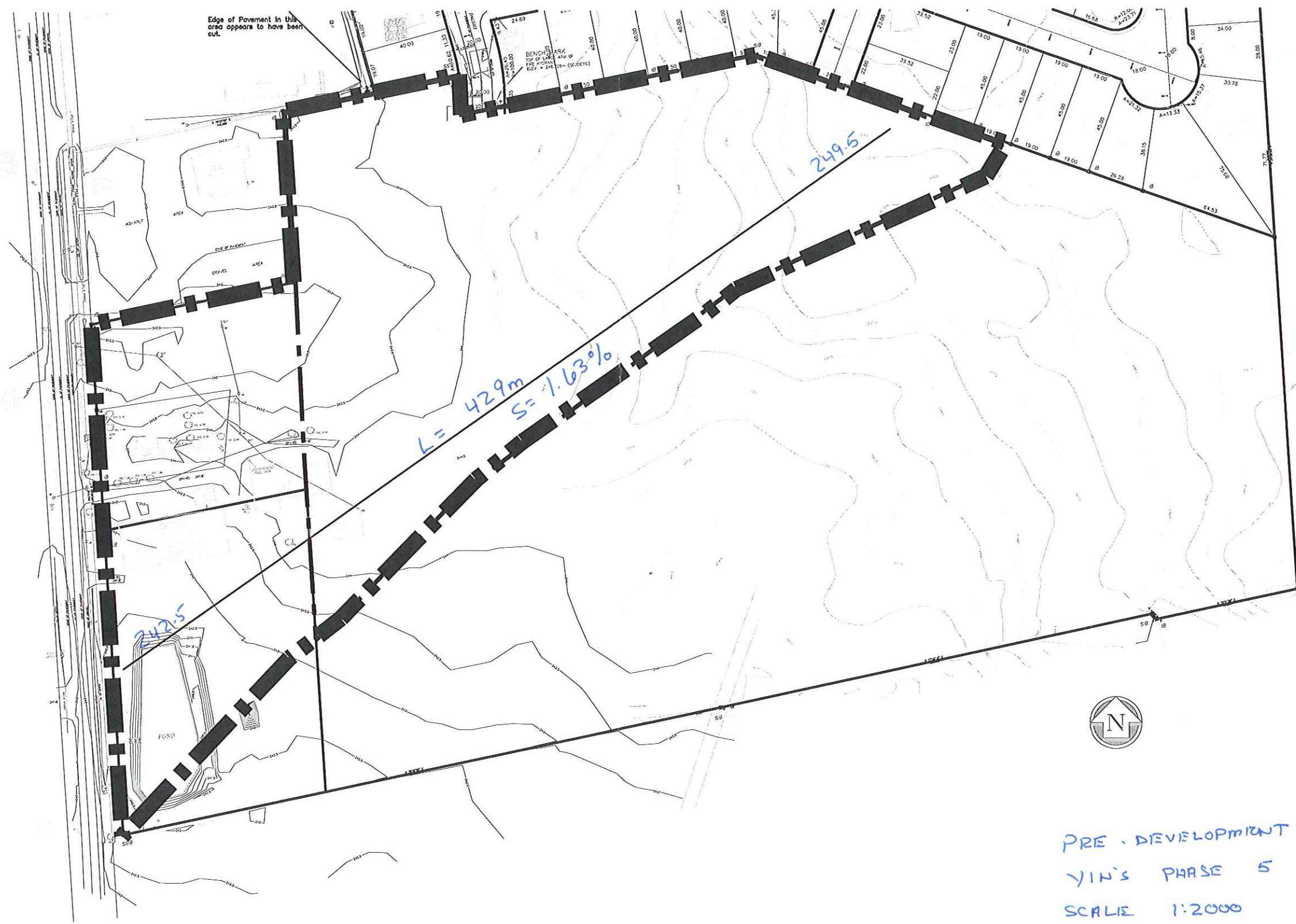
L as above 429 m

S as above but as percent 1.63 %

C, rational Runoff Coefficient (Pre dev) 0.2

$t_c =$ 52 min 0.86 hrs

$t_p = 0.6 * t_c$ $t_p =$ 0.52 hrs



PRE-DEVELOPMENT LONGEST FLOWPATH
VIN'S PHASE 5
SCALE 1:2000
PRE-DEV DRAINAGE AREA TO
WATERFORD SOUTH MUNICIPAL DRAIN.

```

SSSSS W W M M H H Y Y M M O O O 999 999 *****
S W W W M M M M H H Y Y M M M O O 9 9 9 9
SSSSS W W W M M M H H H H Y Y M M M O O ## 9 9 9 9 Ver. 4.02
S W W M M M H H Y Y M M M O O 9999 9999 July 1999
SSSSS W W M M H H Y Y M M O O O 9 9 9 9 # 3568969
StormWater Management Hydrologic Model 999 999 *****

```

```

***** SWSHMO-99 Ver/4.02 *****
***** A single event and continuous hydrologic simulation model *****
***** based on the principles of HYMO and its successors *****
***** OTIHYMO-83 and OTIHYMO-89. *****
***** Distributed by: J.F. Sabourin and Associates Inc. *****
***** Ottawa, Ontario: (613) 727-5199 *****
***** Gatineau, Quebec: (819) 243-6858 *****
***** E-Mail: swshmo@jfsa.com *****

```

```

***** Licensed user: G. Douglas Vallee Limited *****
***** Sircoo SERIAL#:3568969 *****
*****

```

```

***** PROGRAM ARRAY DIMENSIONS *****
***** Maximum value for ID numbers : 10 *****
***** Max. number of rainfall points: 15000 *****
***** Max. number of flow points : 15000 *****

```

```

***** DETAILED OUTPUT *****
* DATE: 2010-11-22 TIME: 14:14:54 RUN COUNTER: 001100 *
* Input filename: H:\SWSHYM-1\10034Y-1\PREDEV.DAT *
* Output filename: H:\SWSHYM-1\10034Y-1\PREDEV.out *
* Summary filename: H:\SWSHYM-1\10034Y-1\PREDEV.sum *
* User comments: *
* 1: *
* 2: *
* 3: *

```

```

001:0001-----
*# Project Name: [VIMS PHASE 5] Project Number: [101034]
*# Date : 02-11-2010
*# Modeller : [TGS]
*# Company : G. Douglas Vallee Limited
*# License # : 3568969
*#*****

```

```

I START | Project dir.: H:\SWSHYM-1\10034Y-1\
Rainfall dir.: H:\SWSHYM-1\10034Y-1\
TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 001
NSTOP= 1
# 1=CH2.SIM

```

```

001:0002-----
I READ STORM | Filename: H:\SWSHYM-1\10034Y-1\CH2.SIM
I Ptotal= 39.39 mm | Comments: 2 YEAR CHICAGO 4 HOUR DESIGN STORM DISTR
TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
.17 3.250 | 1.17 8.940 | 2.17 8.150 | 3.17 4.390
.33 3.560 | 1.33 16.920 | 2.33 7.010 | 3.33 4.110
.50 3.960 | 1.50 78.820 | 2.50 6.200 | 3.50 3.890
.67 4.520 | 1.67 21.890 | 2.67 5.590 | 3.67 3.680
.83 5.310 | 1.83 13.000 | 2.83 5.110 | 3.83 3.510
1.00 6.550 | 2.00 9.880 | 3.00 4.720 | 4.00 3.350

```

```

001:0003-----
*
* PRE DEVELOPMENT MODEL - ENTIRE SITE
*
*
I DESIGN HASHYD | Area (ha)= 14.00 Curve Number (CN)=58.00
I 01:PREDEV DT= 1.00 | Ia (mm)= 1.500 # of Linear Res. (N)= 3.00
U.H. Tp(hrs)= .670
Unit Hyd Cpeak (cms)= .798
PEAK FLOW (cms)= .111 (i)
TIME TO PEAK (hrs)= 2.400
RUNOFF VOLUME (mm)= 6.471
TOTAL RAINFALL (mm)= 39.385
RUNOFF COEFFICIENT = .164
(1) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

```

001:0004-----
*
* PORTION OF SITE THAT DRAINS TO WSMD AND WILL DRAIN TO POND
*
I DESIGN HASHYD | Area (ha)= 4.12 Curve Number (CN)=58.00
I 02:WSMD DT= 1.00 | Ia (mm)= 1.500 # of Linear Res. (N)= 3.00
U.H. Tp(hrs)= .520
Unit Hyd Cpeak (cms)= .303

```

```

PEAK FLOW (cms)= .038 (i)
TIME TO PEAK (hrs)= 2.167
RUNOFF VOLUME (mm)= 6.471
TOTAL RAINFALL (mm)= 39.385
RUNOFF COEFFICIENT = .164

```

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

```

001:0005-----
*
* PRE DEVELOPMENT TO WSMD
*
I DESIGN HASHYD | Area (ha)= 6.02 Curve Number (CN)=62.00
I 03:WSMD DT= 1.00 | Ia (mm)= 1.500 # of Linear Res. (N)= 3.00
U.H. Tp(hrs)= .520

```

```

Unit Hyd Cpeak (cms)= .442
PEAK FLOW (cms)= .064 (i)
TIME TO PEAK (hrs)= 2.167
RUNOFF VOLUME (mm)= 7.415
TOTAL RAINFALL (mm)= 39.385
RUNOFF COEFFICIENT = .188

```

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

```

001:0006-----
FINISH
*****
WARNINGS / ERRORS / NOTES
Simulation ended on 2010-11-22 at 14:14:54
*****

```

Appendix B: Pond Rating Curves



vallee

Consulting Engineers,
Architects & Planners

Subject:

Date:

Project #:

Yins Phase 5

Dec-10 By: TGS

10034 Page

Orifge Elevation 243.25 m
Orifice Dia 0.125 m
Orifice Area 0.012272 m²

Discharge Coeff 0.63

	Forebay	Main	Total	Incr Vol	Cum Vol	H above Orifice	Orifice Q	Storage	Incr Time to Drain	Cum. Time to Drain
	m ²	m ²	m ²	m ³	m ³	m	cms	ha*m	hr	hr
243.25	717	4485	5202	0	0	0	0	0	0	
243.35	778	4626	5404	530	530	0.0375	0.006632	0.05303		15.8
243.45	841	4769	5610	551	1081	0.1375	0.012698	0.1081	15.8	26.6
243.55	906	4913	5819	571	1652	0.2375	0.016689	0.165245	10.8	35.6
243.65		6042	6042	593	2245	0.3375	0.019895	0.22455	9.0	43.6
243.75		6196	6196	612	2857	0.4375	0.022651	0.28574	8.0	50.9
243.85		6351	6351	627	3485	0.5375	0.025107	0.348475	7.3	57.7
243.95		6508	6508	643	4128	0.6375	0.027343	0.41277	6.8	64.2
244.05		6667	6667	659	4786	0.7375	0.029409	0.478645	6.4	70.4
244.15		6827	6827	675	5461	0.8375	0.03134	0.546115	6.2	76.3
244.25		6989	6989	691	6152	0.9375	0.033158	0.615195	6.0	
					244.15	0.5461				
					244.05	0.4786				
					244.09	0.5069	Elevation at 100-year storage			

Appendix C: Post Development Model

IMPERVIOUS AREA ASSUMPTIONS:

AVERAGE DWELLING ROOF AREA:

185 m²

AVERAGE DWELLING DRIVEWAY AREA:

45 m²

TOTAL IMPERVIOUS AREA PER DWELLING:

230 m²

0.023 ha

ROADWAY AND ONE SIDE SIDEWALK AREA

PER METRE LENGTH OF ROAD:

11 m²

0.0011 ha

Area No.	Total Area (ha)	No. of Dwell	Dwelling Imp Area (ha)	Street Lenth (m)	Street Imp Area (ha)	Dir Conn Ratio	Total Imp Area (ha)	Imp Area Ratio
SFD	9.3	85	1.96	1380	1.52	0.16	3.47	0.37
BLOCK 1 TOWN HOUSES	0.57				0.21	0.38	0.43	0.75
BLOCK 2 APARTMENTS	0.69				0.26	0.38	0.52	0.75
BLOCK 3 COMMERCIAL	0.8				0.36	0.45	0.72	0.90
BLOCK 4 COMMERCIAL	1.4				0.63	0.45	1.26	0.90
BLOCK 5 SWM	1.26				0.57	0.45	1.13	0.90
	14.02				3.5475	0.25	7.532	0.54

- 1) IMPERVIOUS AREAS FOR BLOCKS 1 THROUGH 5 HAVE BEEN ASSUMED BASED ON RUNOFF COEFFICIENTS FOR APPLICABLE LAND USE PER NORFOLK COUNTY'S CURRENT DESIGN CRITERIA.
- 2) FOR DIRECTLY CONNECTED AREAS (IE DRIVES AND PARKING) OF BLOCKS 1 THROUGH 5, 50% OF THE TOTAL IMPERVIOUS AREA HAS BEEN ASSUMED.
- 3) TOTAL AREA DOES NOT EQUAL TOTAL SITE AREA AS APPROXIMATELY 0.2 HA OF STREET B WILL NOT FLOW TO SWM FACILITY.



TOTAL STREET LENGTH

580
150
80
370
50
150
1380m

1:2000

```

SSSSS W W M M H H Y Y M M OOO 999 999
S W W W M M M H H Y Y M M O O 9 9 9 9
SSSSS W W W M M M H H H H Y Y M M O O # 9 9 9 9 Ver. 4.02
S W W M M H H Y Y M M O O 9999 9999 July 1999
SSSSS W W M M H H Y Y M M OOO 9 9 9 9 # 3568969

```

Stormwater Management Hydrologic Model

```

***** SWGHYMO-99 Ver/4.02 *****
***** A single event and continuous hydrologic simulation model *****
***** based on the principles of HYMO and its successors *****
***** OTTHYMO-83 and OTTHYMO-89. *****
***** Distributed by: J.F. Sabourin and Associates Inc. *****
***** Ottawa, Ontario: (613) 727-5199 *****
***** Gatineau, Quebec: (819) 243-6858 *****
***** E-Mail: swghymo@jfsa.com *****

```

```

***** Licensed user: G. Douglas Vallee Limited *****
***** Simcoe SERIAL#:3568969 *****

```

```

***** PROGRAM ARRAY DIMENSIONS *****
***** Maximum value for ID numbers : 10 *****
***** Max. number of rainfall points: 15000 *****
***** Max. number of flow points : 15000 *****

```

DETAILED OUTPUT

```

*****
* DATE: 2010-11-22 TIME: 14:15:43 RUN COUNTER: 00101
*
* Input filename: H:\SWGHYMO-1\10034Y-1\PSTDEV.DAT
* Output filename: H:\SWGHYMO-1\10034Y-1\PSTDEV.out
* Summary filename: H:\SWGHYMO-1\10034Y-1\PSTDEV.sum
* User comments:
* 1:
* 2:
* 3:

```

001:0001

```

*****
*# Project Name: [VINS PHASE 5] Project Number: [10034]
*# Date : 02-11-2010
*# Modeller : [TGS]
*# Company : G. Douglas Vallee Limited
*# License # : 3568969

```

```

| START | Project dir.: H:\SWGHYMO-1\10034Y-1\
| TZERO = .00 hrs on Rainfall dir.: H:\SWGHYMO-1\10034Y-1\
| METOUT= 2 (output = METRIC)
| NRUN = 001
| NSTOPM= 1
| # 1=CH2.SIM

```

001:0002

```

| READ STORM | Filename: H:\SWGHYMO-1\10034Y-1\CH2.SIM
| Ptotal= 39.39 mm | Comments: 2 YEAR CHICAGO 4 HOUR DESIGN STORM DISTR

```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	3.250	1.17	8.940	2.17	8.150	3.17	4.390
.33	3.560	1.33	16.920	2.33	7.010	3.33	4.110
.50	3.960	1.50	78.820	2.50	6.200	3.50	3.890
.67	4.520	1.67	21.890	2.67	5.590	3.67	3.680
.83	5.310	1.83	13.000	2.83	5.110	3.83	3.510
1.00	6.550	2.00	9.880	3.00	4.720	4.00	3.350

001:0003

```

*****
* SFD

```

```

| DESIGN STANDHYD | Area (ha)= 9.30
| 01:SFD DT= 1.00 | Total Imp(t)= 37.00 Dir. Conn.(t)= 16.00

```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.44	5.86
Dep. Storage (mm)=	.80	1.50
Average Slope (t)=	1.00	1.00
Length (m)=	249.00	40.00
Mannings n	.013	.250
Max. eff. Inten. (mm/hr)=	78.82	11.25
over (min)	5.00	26.00
Storage Coeff. (min)=	4.86 (ii)	25.68 (ii)
Unit Hyd. Tpeak (min)=	5.00	26.00
Unit Hyd. peak (cms)=	.23	.04
PEAK FLOW (cms)=	.27	.11
TIME TO PEAK (hrs)=	1.52	1.92
RUNOFF VOLUME (mm)=	38.58	8.31
TOTAL RAINFALL (mm)=	39.38	39.38
RUNOFF COEFFICIENT	.98	.21

TOTALS

PEAK FLOW (cms)= .301 (iii)

TIME TO PEAK (hrs)= 1.517

RUNOFF VOLUME (mm)= 13.152

TOTAL RAINFALL (mm)= 39.385

RUNOFF COEFFICIENT = .334

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

001:0004

BLOCK 1 TOWNHOUSES

```

| DESIGN STANDHYD | Area (ha)= .57
| 02:BLK1 DT= 1.00 | Total Imp(t)= 75.00 Dir. Conn.(t)= 38.00

```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	.43	.14
Dep. Storage (mm)=	.80	1.50
Average Slope (t)=	1.00	1.00
Length (m)=	61.64	40.00
Mannings n	.013	.250
Max. eff. Inten. (mm/hr)=	78.82	48.36
over (min)	2.00	14.00
Storage Coeff. (min)=	2.10 (ii)	13.72 (ii)
Unit Hyd. Tpeak (min)=	2.00	14.00
Unit Hyd. peak (cms)=	.54	.08
PEAK FLOW (cms)=	.05	.01
TIME TO PEAK (hrs)=	1.50	1.70
RUNOFF VOLUME (mm)=	38.58	13.32
TOTAL RAINFALL (mm)=	39.38	39.38
RUNOFF COEFFICIENT	.98	.34

TOTALS

PEAK FLOW (cms)= .052 (iii)

TIME TO PEAK (hrs)= 1.500

RUNOFF VOLUME (mm)= 22.918

TOTAL RAINFALL (mm)= 39.385

RUNOFF COEFFICIENT = .582

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

001:0005

BLOCK 2 APARTMENTS

```

| DESIGN STANDHYD | Area (ha)= .69
| 03:BLK2 DT= 1.00 | Total Imp(t)= 75.00 Dir. Conn.(t)= 38.00

```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	.52	.17
Dep. Storage (mm)=	.80	1.50
Average Slope (t)=	1.00	1.00
Length (m)=	67.82	40.00
Mannings n	.013	.250
Max. eff. Inten. (mm/hr)=	78.82	48.36
over (min)	2.00	14.00
Storage Coeff. (min)=	2.23 (ii)	13.85 (ii)
Unit Hyd. Tpeak (min)=	2.00	14.00
Unit Hyd. peak (cms)=	.52	.08
PEAK FLOW (cms)=	.06	.01
TIME TO PEAK (hrs)=	1.50	1.70
RUNOFF VOLUME (mm)=	38.58	13.32
TOTAL RAINFALL (mm)=	39.38	39.38
RUNOFF COEFFICIENT	.98	.34

TOTALS

PEAK FLOW (cms)= .063 (iii)

TIME TO PEAK (hrs)= 1.500

RUNOFF VOLUME (mm)= 22.918

TOTAL RAINFALL (mm)= 39.385

RUNOFF COEFFICIENT = .582

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

001:0006

BLOCK 5 SSM

```

| DESIGN STANDHYD | Area (ha)= 1.26
| 06:BLK5 DT= 1.00 | Total Imp(t)= 90.00 Dir. Conn.(t)= 90.00

```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	1.13	.13
Dep. Storage (mm)=	.80	1.50
Average Slope (t)=	1.00	1.00
Length (m)=	91.65	40.00
Mannings n	.013	.250
Max. eff. Inten. (mm/hr)=	78.82	6.11
over (min)	3.00	29.00
Storage Coeff. (min)=	2.67 (ii)	29.24 (iii)
Unit Hyd. Tpeak (min)=	3.00	29.00
Unit Hyd. peak (cms)=	.40	.04
PEAK FLOW (cms)=	.24	.00
TIME TO PEAK (hrs)=	1.50	1.97
RUNOFF VOLUME (mm)=	38.58	6.47
TOTAL RAINFALL (mm)=	39.38	39.38
RUNOFF COEFFICIENT	.98	.16

TOTALS

PEAK FLOW (cms)= .241 (iii)

TIME TO PEAK (hrs)= 1.500

RUNOFF VOLUME (mm)= 35.374

TOTAL RAINFALL (mm)= 39.385

RUNOFF COEFFICIENT = .898

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

001:0007

DETERMINE INFLOW TO FOND

ADD HYD (PSTDEV)	ID: HHYD	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	INF (cms)
ID1 01:SED		9.30	.301	1.52	13.15	.000
+ID2 02:BLK1		.57	.052	1.50	22.92	.000
+ID3 03:BLK2		.69	.063	1.50	22.92	.000
+ID4 06:BLK5		1.26	.241	1.50	35.37	.000
SUM 07:PSTDEV		11.82	.651	1.50	16.56	.000

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

001:0008-
 *
 *
 * ROUTE THROUGH POND
 *
 *

ROUTE RESERVOIR	Requested routing time step = 1.0 min.
IN>07: (PSTDEV)	===== OUTFLOW STORAGE TABLE =====
OUT<08: (PNDOUT)	OUTFLOW STORAGE OUTFLOW STORAGE
	(cms) (ha.m.) (cms) (ha.m.)
	.000 .0000E+00 .025 .3535E+00
	.007 .5520E-01 .027 .4178E+00
	.013 .1118E+00 .029 .4937E+00
	.017 .1700E+00 .031 .5512E+00
	.020 .2295E+00 .033 .6203E+00
	.023 .2298E+00 .000 .0000E+00

ROUTING RESULTS	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW >07: (PSTDEV)	11.82	.651	1.500	16.562
OUTFLOW<08: (PNDOUT)	11.82	.017	4.533	16.561
OVERFLOW<09: (PNDOVR)	.00	.000	.000	.000

TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
 CUMULATIVE TIME OF OVERFLOWS (hours) = .00
 PERCENTAGE OF TIME OVERFLOWING (%) = .00

PEAK FLOW REDUCTION [Qout/Qin] (%) = 2.623
 TIME SHIFT OF PEAK FLOW (min) = 182.00
 MAXIMUM STORAGE USED (ha.m.) = .1768E+00

001:0009-
 *
 *
 * BLOCK 3 COMMERCIAL
 *
 *

DESIGN STANDHYD	Area (ha)=	Dir. Conn. (%) =
04:BLK3 DT= 1.00	.80	45.00

IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	.72 .08
Dep. Storage (mm)=	.80 1.50
Average Slope (%)=	1.00 1.00
Length (m)=	73.03 40.00
Mannings n =	.013 .250

Max. eff. Inten. (mm/hr)=	78.82	230.54
over (min)=	2.00	9.00
Storage Coeff. (min)=	2.33 (ii)	8.55 (ii)
Unit Hyd. Tpeak (min)=	2.00	9.00
Unit Hyd. peak (cms)=	.51	.13

PEAK FLOW (cms)=	.08	.03	.102 (iii)
TIME TO PEAK (hrs)=	1.50	1.60	1.500
RUNOFF VOLUME (mm)=	38.58	21.08	28.960
TOTAL RAINFALL (mm)=	39.38	39.38	39.385
RUNOFF COEFFICIENT =	.98	.54	.735

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 58.0 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.

001:0010-
 *
 *
 * SIMULATE STORAGE ON BLOCK 3 TO RELEASE AT CONTROLLED RATE
 *
 *

ROUTE RESERVOIR	Requested routing time step = 1.0 min.
IN>04: (BLK3)	===== OUTFLOW STORAGE TABLE =====
OUT<01: (B3CTRL)	OUTFLOW STORAGE OUTFLOW STORAGE
	(cms) (ha.m.) (cms) (ha.m.)
	.000 .0000E+00 .015 .1000E+01
	.015 .1000E-03 .000 .0000E+00

ROUTING RESULTS	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW >04: (BLK3)	.80	.102	1.500	28.960
OUTFLOW<01: (B3CTRL)	.80	.015	1.233	28.960
OVERFLOW<02: (3OVR)	.00	.000	.000	.000

TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
 CUMULATIVE TIME OF OVERFLOWS (hours) = .00
 PERCENTAGE OF TIME OVERFLOWING (%) = .00

PEAK FLOW REDUCTION [Qout/Qin] (%) = 14.763
 TIME SHIFT OF PEAK FLOW (min) = -16.00
 MAXIMUM STORAGE USED (ha.m.) = .9246E-02

001:0011-
 *
 *
 * BLOCK 4 COMMERCIAL
 *
 *

DESIGN STANDHYD	Area (ha)=	Dir. Conn. (%) =
05:BLK4 DT= 1.00	1.40	45.00

IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	1.26 .14
Dep. Storage (mm)=	.80 1.50
Average Slope (%)=	1.00 1.00
Length (m)=	96.61 40.00
Mannings n =	.013 .250

Max. eff. Inten. (mm/hr)=	78.82	230.54
over (min)=	3.00	9.00
Storage Coeff. (min)=	2.75 (ii)	8.97 (ii)
Unit Hyd. Tpeak (min)=	3.00	9.00
Unit Hyd. peak (cms)=	.40	.13

PEAK FLOW (cms)=	.13	.06	.174 (iii)
TIME TO PEAK (hrs)=	1.50	1.60	1.500
RUNOFF VOLUME (mm)=	38.58	21.08	28.960
TOTAL RAINFALL (mm)=	39.38	39.38	39.385
RUNOFF COEFFICIENT =	.98	.54	.735

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 58.0 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.

001:0012-
 *
 *
 * SIMULATE STORAGE ON 4 TO RELEASE AT CONTROLLED RATE
 *
 *

ROUTE RESERVOIR	Requested routing time step = 1.0 min.
IN>05: (BLK4)	===== OUTFLOW STORAGE TABLE =====
OUT<03: (B4CTRL)	OUTFLOW STORAGE OUTFLOW STORAGE
	(cms) (ha.m.) (cms) (ha.m.)
	.000 .0000E+00 .015 .1000E+01
	.015 .1000E-03 .000 .0000E+00

ROUTING RESULTS	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW >05: (BLK4)	1.40	.174	1.500	28.960
OUTFLOW<03: (B4CTRL)	1.40	.015	1.067	28.960
OVERFLOW<04: (4OVR)	.00	.000	.000	.000

TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
 CUMULATIVE TIME OF OVERFLOWS (hours) = .00
 PERCENTAGE OF TIME OVERFLOWING (%) = .00

PEAK FLOW REDUCTION [Qout/Qin] (%) = 8.616
 TIME SHIFT OF PEAK FLOW (min) = -26.00
 MAXIMUM STORAGE USED (ha.m.) = .2211E-01

001:0013-
 *
 *
 * TOTAL POST DEVELOPMENT FROM SITE
 *
 *

ADD HYD (PSTDEV)	ID: HHYD	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	INF (cms)
ID1 08:ENDOUT		11.82	.017	4.53	16.56	.000
+ID2 09:ENDOVR		.00	.000	.00	.00	.000 **DRY**
+ID3 01:B3CTRL		.80	.015	1.23	28.96	.000
+ID4 02:3OVR		.00	.000	.00	.00	.000 **DRY**
+ID5 03:B4CTRL		1.40	.015	1.07	28.96	.000
+ID6 04:4OVR		.00	.000	.00	.00	.000 **DRY**
SUM 05:PSTDEV		14.02	.047	4.53	18.51	.000

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

001:0014-
 *
 *
 * END OF RUN : 1
 *
 *

START | Project dir.: H:\SWHYM-1\10034Y-1\
 Rainfall dir.: H:\SWHYM-1\10034Y-1\
 TZERO = .00 hrs on 0
 METOUT = 2 (output = METRIC)
 MESH = 002
 NSTORM = 1
 # 1=CH5.57M

002:0002-
 *
 * Project Name: [YINS PHASE 5] Project Number: [10034]
 * Date : 02-11-2010
 * Modeller : [TGS]
 * Company : G. Douglas Vallee Limited

License # : 3568969

002:0002-

READ STORM | Filename: H:\SWHYM-1\10034Y-1\CH5.SIM
| Ptotal= 48.46 mm | Comments: 5 YEAR CHICAGO 4 HOUR DESIGN DISTRIBUTION

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	3.529	1.17	10.190	2.17	9.150	3.17	4.550
.33	3.658	1.33	21.620	2.33	7.700	3.33	4.220
.50	4.040	1.50	112.370	2.50	6.680	3.50	3.960
.67	4.670	1.67	27.760	2.67	5.940	3.67	3.730
.83	5.610	1.83	15.750	2.83	5.390	3.83	3.530
1.00	7.110	2.00	11.430	3.00	4.930	4.00	3.350

002:0003-

* SFD

DESIGN STANDHYD | Area (ha)= 9.30
| 01:SED DT= 1.00 | Total Imp(t)= 37.00 Dir. Conn.(t)= 16.00

IMPERVIOUS		PERVIOUS (i)	
Surface Area (ha)=	3.44	5.86	
Dep. Storage (mm)=	.80	1.50	
Average Slope (t)=	1.00	1.00	
Length (m)=	249.00	40.00	
Mannings n	.013	.250	
Max. eff. Inten. (mm/hr)=	112.37	22.33	
over (min)=	4.00	20.00	
Storage Coeff. (min)=	4.22 (ii)	20.04 (ii)	
Unit Hyd. Tpeak (min)=	4.00	20.00	
Unit Hyd. peak (cms)=	.27	.06	
TOTALS			
PEAK FLOW (cms)=	.41	.21	.475 (iii)
TIME TO PEAK (hrs)=	1.50	1.80	1.517
RUNOFF VOLUME (mm)=	47.68	12.10	17.793
TOTAL RAINFALL (mm)=	48.48	48.48	48.478
RUNOFF COEFFICIENT	.98	.25	.367

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

002:0004-

* BLOCK 1 TOWNHOUSES

DESIGN STANDHYD | Area (ha)= .57
| 02:BLK1 DT= 1.00 | Total Imp(t)= 75.00 Dir. Conn.(t)= 38.00

IMPERVIOUS		PERVIOUS (i)	
Surface Area (ha)=	.43	.14	
Dep. Storage (mm)=	.80	1.50	
Average Slope (t)=	1.00	1.00	
Length (m)=	61.64	40.00	
Mannings n	.013	.250	
Max. eff. Inten. (mm/hr)=	112.37	93.55	
over (min)=	2.00	11.00	
Storage Coeff. (min)=	1.82 (ii)	10.75 (ii)	
Unit Hyd. Tpeak (min)=	2.00	11.00	
Unit Hyd. peak (cms)=	.59	.10	
TOTALS			
PEAK FLOW (cms)=	.07	.02	.090 (iii)
TIME TO PEAK (hrs)=	1.50	1.63	1.500
RUNOFF VOLUME (mm)=	47.68	18.78	29.761
TOTAL RAINFALL (mm)=	48.48	48.48	48.478
RUNOFF COEFFICIENT	.98	.39	.614

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

002:0005-

* BLOCK 2 APARTMENTS

DESIGN STANDHYD | Area (ha)= .69
| 03:BLK2 DT= 1.00 | Total Imp(t)= 75.00 Dir. Conn.(t)= 38.00

IMPERVIOUS		PERVIOUS (i)	
Surface Area (ha)=	.52	.17	
Dep. Storage (mm)=	.80	1.50	
Average Slope (t)=	1.00	1.00	
Length (m)=	67.82	40.00	
Mannings n	.013	.250	
Max. eff. Inten. (mm/hr)=	112.37	93.55	
over (min)=	2.00	11.00	
Storage Coeff. (min)=	1.93 (ii)	10.86 (ii)	
Unit Hyd. Tpeak (min)=	2.00	11.00	
Unit Hyd. peak (cms)=	.57	.10	
TOTALS			
PEAK FLOW (cms)=	.08	.03	.097 (iii)

TIME TO PEAK (hrs)=	1.50	1.63	1.500
RUNOFF VOLUME (mm)=	47.68	18.78	29.761
TOTAL RAINFALL (mm)=	48.48	48.48	48.478
RUNOFF COEFFICIENT	.98	.39	.614

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

002:0006-

* BLOCK 5 SWM

DESIGN STANDHYD | Area (ha)= 1.26
| 06:BLK5 DT= 1.00 | Total Imp(t)= 90.00 Dir. Conn.(t)= 90.00

IMPERVIOUS		PERVIOUS (i)	
Surface Area (ha)=	1.13	.13	
Dep. Storage (mm)=	.80	1.50	
Average Slope (t)=	1.00	1.00	
Length (m)=	91.65	40.00	
Mannings n	.013	.250	
Max. eff. Inten. (mm/hr)=	112.37	11.89	
over (min)=	2.00	23.00	
Storage Coeff. (min)=	2.31 (ii)	22.68 (ii)	
Unit Hyd. Tpeak (min)=	2.00	23.00	
Unit Hyd. peak (cms)=	.51	.05	
TOTALS			
PEAK FLOW (cms)=	.35	.00	.350 (iii)
TIME TO PEAK (hrs)=	1.50	1.85	1.500
RUNOFF VOLUME (mm)=	47.68	9.56	43.866
TOTAL RAINFALL (mm)=	48.48	48.48	48.478
RUNOFF COEFFICIENT	.98	.20	.905

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

002:0007-

* DETERMINE INFLOW TO FOND

ADD HYD (PSTDEV) ID: NHYD	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	DNF (cms)
ID1 01:SED	9.30	.475	1.52	17.79	.000
ID2 02:BLK1	.57	.080	1.50	29.76	.000
ID3 03:BLK2	.69	.097	1.50	29.76	.000
ID4 06:BLK5	1.26	.350	1.50	43.87	.000
SUM 07:PSTDEV	11.82	.995	1.50	21.85	.000

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

002:0008-

* ROUTE THROUGH FOND

Requested routing time step = 1.0 min.			
ROUTE RESERVOIR	===== OUTFLOW STORAGE TABLE =====		
ID: 07: (PSTDEV)	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)
OUT: 08: (ENDOUT)			
	.000	.0000E+00	.025
	.007	.5520E-01	.027
	.013	.1118E+00	.029
	.017	.1700E+00	.031
	.020	.2296E+00	.033
	.023	.2908E+00	.000

ROUTING RESULTS	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW > 07: (PSTDEV)	11.82	.995	1.500	21.848
OUTFLOW < 08: (ENDOUT)	11.82	.020	4.400	21.847
OVERFLOW < 09: (ENDOVF)	.00	.000	.000	.000

TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
CUMULATIVE TIME OF OVERFLOWS (hours) = .00
PERCENTAGE OF TIME OVERFLOWING (t) = .00

PEAK FLOW REDUCTION (Qout/Qin)(t) = 2.034
TIME SHIFT OF PEAK FLOW (min) = 174.00
MAXIMUM STORAGE USED (ha.m.) = 2367E+00

002:0009-

* BLOCK 3 COMMERCIAL

DESIGN STANDHYD | Area (ha)= .80
| 04:BLK3 DT= 1.00 | Total Imp(t)= 90.00 Dir. Conn.(t)= 45.00

```

IMPERVIOUS      PERVIOUS (i)
Surface Area (ha)= .72      .08
Dep. Storage (mm)= .80      1.50
Average Slope (ft)= 1.00      1.00
Length (m)= 73.03      40.00
Mannings n = .013      .250

Max.eff.Inten.(mm/hr)= 112.37      389.75
over (min)= 2.00      7.00
Storage Coeff. (min)= 2.02 (ii)      7.06 (ii)
Unit Hyd. Tpeak (min)= 2.00      7.00
Unit Hyd. peak (cms)= .56      .16

PEAK FLOW (cms)= .11      .06
TIME TO PEAK (hrs)= 1.50      1.57
RUNOFF VOLUME (mm)= 47.68      28.46
TOTAL RAINFALL (mm)= 48.48      48.48
RUNOFF COEFFICIENT = .98      .59

```

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 58.0 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.

002:0010

* SIMULATE STORAGE ON BLOCK 3 TO RELEASE AT CONTROLLED RATE

ROUTE RESERVOIR Requested routing time step = 1.0 min.

```

===== OUTFLOW STORAGE TABLE =====
OUTFLOW STORAGE OUTFLOW STORAGE
(cms) (ha.m.) (cms) (ha.m.)
.000 .0000E+00 .015 .1000E+01
.015 .1000E-03 .000 .0000E+00

```

```

ROUTING RESULTS AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW >04: (BLK3 ) .80 .160 1.500 37.108
OUTFLOW<01: (B3CTRL) .80 .015 1.200 37.108
OVERFLOW<02: (3OVR ) .00 .000 .000 .000

```

TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
 CUMULATIVE TIME OF OVERFLOWS (hours)= .00
 PERCENTAGE OF TIME OVERFLOWING (t)= .00

PEAK FLOW REDUCTION [Qout/Qin] (t)= 9.363
 TIME SHIFT OF PEAK FLOW (min)= -18.00
 MAXIMUM STORAGE USED (ha.m.)=.1520E-01

002:0011

* BLOCK 4 COMMERCIAL

```

DESIGN STANDHYD Area (ha)= 1.40
05:BLK4 DT= 1.00 Total Imp(t)= 90.00 Dir. Conn. (t)= 45.00

```

```

IMPERVIOUS      PERVIOUS (i)
Surface Area (ha)= 1.26      .14
Dep. Storage (mm)= .80      1.50
Average Slope (ft)= 1.00      1.00
Length (m)= 96.61      40.00
Mannings n = .013      .250

Max.eff.Inten.(mm/hr)= 112.37      389.75
over (min)= 2.00      7.00
Storage Coeff. (min)= 2.39 (ii)      7.43 (ii)
Unit Hyd. Tpeak (min)= 2.00      7.00
Unit Hyd. peak (cms)= .50      .16

```

PEAK FLOW (cms)= .19 .10
 TIME TO PEAK (hrs)= 1.50 1.57
 RUNOFF VOLUME (mm)= 47.68 28.46
 TOTAL RAINFALL (mm)= 48.48 48.48
 RUNOFF COEFFICIENT = .98 .59

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 58.0 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.

002:0012

* SIMULATE STORAGE ON 4 TO RELEASE AT CONTROLLED RATE

ROUTE RESERVOIR Requested routing time step = 1.0 min.

```

===== OUTFLOW STORAGE TABLE =====
OUTFLOW STORAGE OUTFLOW STORAGE
(cms) (ha.m.) (cms) (ha.m.)
.000 .0000E+00 .015 .1000E+01
.015 .1000E-03 .000 .0000E+00

```

```

ROUTING RESULTS AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW >05: (BLK4 ) 1.40 .277 1.500 37.108
OUTFLOW<03: (B4CTRL) 1.40 .015 1.017 37.108
OVERFLOW<04: (4OVR ) .00 .000 .000 .000

```

TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
 CUMULATIVE TIME OF OVERFLOWS (hours)= .00
 PERCENTAGE OF TIME OVERFLOWING (t)= .00

PEAK FLOW REDUCTION [Qout/Qin] (t)= 5.425
 TIME SHIFT OF PEAK FLOW (min)= -29.00
 MAXIMUM STORAGE USED (ha.m.)=.3323E-01

002:0013

* TOTAL POST DEVELOPMENT FROM SITE

```

ADD HYD (PSTDEV) ID: NHYD AREA QPEAK TPEAK R.V. INF
(ha) (cms) (hrs) (mm) (cms)
ID1 08:ENHOUT 11.82 .020 4.40 21.85 .000
ID2 09:ENHOUT .00 .000 .00 .00 .000 **DRY**
ID3 01:B3CTRL .80 .015 1.20 37.11 .000
ID4 02:3OVR .00 .000 .00 .00 .000 **DRY**
ID5 03:B4CTRL 1.40 .015 1.02 37.11 .000
ID6 04:4OVR .00 .000 .00 .00 .000 **DRY**
SUM 05:PSTDEV 14.02 .050 4.40 24.24 .000

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

002:0014

002:0002
 ** END OF RUN : 2

```

START Project dir.: H:\SWMHYD-1\10034Y-1\
Rainfall dir.: H:\SWMHYD-1\10034Y-1\
TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 003
NSTORM= 1
# 1=CH10.STM

```

003:0002

* Project Name: [YINS PHASE 5] Project Number: [10034]
 * Date : 02-11-2010
 * Modeller : [TGS]
 * Company : G. Douglas Vallee Limited
 * License # : 3568969

003:0002

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READ STORM Filename: H:\SWMHYD-1\10034Y-1\CH10.STM
Ptotal= 56.08 mm Comments: 10 YEAR CHICAGO 4 HOURS DESIGN DISTRIBUT

```

```

TIME RAIN TIME RAIN TIME RAIN TIME RAIN
hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr
.17 3.580 1.17 11.510 2.17 10.310 3.17 5.050
.33 3.990 1.33 25.320 2.33 8.660 3.33 4.700
.50 4.500 1.50 139.600 2.50 7.520 3.50 4.394
.67 5.210 1.67 32.000 2.67 6.650 3.67 4.140
.83 6.270 1.83 19.730 2.83 5.380 3.83 3.910
1.00 8.000 2.00 12.954 3.00 5.490 4.00 3.632

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003:0003

* SFD

```

DESIGN STANDHYD Area (ha)= 9.30
01:SFD DT= 1.00 Total Imp(t)= 37.00 Dir. Conn. (t)= 16.00

```

```

IMPERVIOUS      PERVIOUS (i)
Surface Area (ha)= 3.44      5.86
Dep. Storage (mm)= .80      1.50
Average Slope (ft)= 1.00      1.00
Length (m)= 249.00      40.00
Mannings n = .013      .250

```

Max.eff.Inten.(mm/hr)= 133.60 31.29
 over (min)= 4.00 18.00
 Storage Coeff. (min)= 3.93 (ii) 17.76 (ii)
 Unit Hyd. Tpeak (min)= 4.00 18.00
 Unit Hyd. peak (cms)= .29 .06

PEAK FLOW (cms)= .50 .31
 TIME TO PEAK (hrs)= 1.50 1.77
 RUNOFF VOLUME (mm)= 55.28 15.66
 TOTAL RAINFALL (mm)= 56.08 56.08
 RUNOFF COEFFICIENT = .99 .28

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 58.0 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.

003:0004

* BLOCK 1 TOWNHOUSES

```

*
*
*****
| DESIGN STANDHYD | Area (ha)= .57
| 02:BLK1 DT= 1.00 | Total Imp(t)= 75.00 Dir. Conn.(t)= 38.00
*****

```

```

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= .43 .14
Dep. Storage (mm)= .80 1.50
Average Slope (t)= 1.00 1.00
Length (m)= 61.64 40.00
Mannings n = .013 .250

```

```

Max. eff. Inten. (mm/hr)= 133.60 136.37
over (min) 2.00 9.00
Storage Coeff. (min)= 1.70 (ii) 9.38 (ii)
Unit Hyd. Tpeak (min)= 2.00 9.00
Unit Hyd. peak (cms)= .62 .12

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```

*TOTALS*
PEAK FLOW (cms)= .08 .03 .102 (iii)
TIME TO PEAK (hrs)= 1.50 1.60 1.500
RUNOFF VOLUME (mm)= 55.28 23.74 35.727
TOTAL RAINFALL (mm)= 56.08 56.08 56.083
RUNOFF COEFFICIENT = .99 .42 .637

```

```

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

```

```

003:0005-----
*****
*
* BLOCK 2 APARTMENTS
*
*****

```

```

| DESIGN STANDHYD | Area (ha)= .69
| 03:BLK2 DT= 1.00 | Total Imp(t)= 75.00 Dir. Conn.(t)= 38.00
*****

```

```

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= .52 .17
Dep. Storage (mm)= .80 1.50
Average Slope (t)= 1.00 1.00
Length (m)= 67.82 40.00
Mannings n = .013 .250

```

```

Max. eff. Inten. (mm/hr)= 133.60 131.26
over (min) 2.00 10.00
Storage Coeff. (min)= 1.80 (ii) 9.60 (ii)
Unit Hyd. Tpeak (min)= 2.00 10.00
Unit Hyd. peak (cms)= .60 .12

```

```

*TOTALS*
PEAK FLOW (cms)= .10 .04 .121 (iii)
TIME TO PEAK (hrs)= 1.50 1.62 1.500
RUNOFF VOLUME (mm)= 55.28 23.74 35.727
TOTAL RAINFALL (mm)= 56.08 56.08 56.083
RUNOFF COEFFICIENT = .99 .42 .637

```

```

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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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003:0006-----
*****
*
* BLOCK 5 SHM
*
*****

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```

| DESIGN STANDHYD | Area (ha)= 1.26
| 06:BLK5 DT= 1.00 | Total Imp(t)= 90.00 Dir. Conn.(t)= 90.00
*****

```

```

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 1.13 .13
Dep. Storage (mm)= .80 1.50
Average Slope (t)= 1.00 1.00
Length (m)= 91.65 40.00
Mannings n = .013 .250

```

```

Max. eff. Inten. (mm/hr)= 133.60 17.53
over (min) 2.00 20.00
Storage Coeff. (min)= 2.16 (ii) 19.59 (ii)
Unit Hyd. Tpeak (min)= 2.00 20.00
Unit Hyd. peak (cms)= .53 .06

```

```

*TOTALS*
PEAK FLOW (cms)= .42 .00 .417 (iii)
TIME TO PEAK (hrs)= 1.50 1.80 1.500
RUNOFF VOLUME (mm)= 55.28 12.49 51.004
TOTAL RAINFALL (mm)= 56.08 56.08 56.083
RUNOFF COEFFICIENT = .99 .22 .909

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```

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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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003:0007-----
*****
*
* DETERMINE INFLOW TO FOND
*
*****

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| ADD HYD (PSTDEV) | ID: NHYD AREA QPEAK TPEAK R.V. DWF
| (ha) (cms) (hrs) (mm) (cms)

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ID1 01:SFB 9.39 .601 1.52 22.00 .000
+ID2 02:BLK1 .57 .102 1.50 35.73 .000
+ID3 03:BLK2 .69 .121 1.50 35.73 .000
+ID4 06:BLK5 1.26 .417 1.50 51.00 .000
SUM 07:PSTDEV 11.82 1.231 1.50 26.55 .000

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

003:0008-----
*****
*
* ROUTE THROUGH FOND
*
*****

```

```

| ROUTE RESERVOIR | Requested routing time step = 1.0 min.
| IN>07: (PSTDEV) |
| OUT<08: (ENDOUT) |

```

```

===== OUTFLOW STORAGE TABLE =====
OUTFLOW STORAGE OUTFLOW STORAGE
(cms) (ha.m.) (cms) (ha.m.)
.000 .0000E+00 .025 .3535E+00
.007 .5520E-01 .027 .4178E+00
.013 .1118E+00 .029 .4837E+00
.017 .1700E+00 .031 .5512E+00
.020 .2296E+00 .033 .6203E+00
.023 .2908E+00 .000 .0000E+00

```

```

ROUTING RESULTS AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW >07: (PSTDEV) 11.82 1.231 1.500 26.553
OUTFLOW<08: (ENDOUT) 11.82 .023 4.367 26.552
OVERFLOW<09: (ENDOVR) .00 .000 .000 .000

```

```

TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
CUMULATIVE TIME OF OVERFLOWS (hours) = .00
PERCENTAGE OF TIME OVERFLOWING (t)= .00

```

```

PEAK FLOW REDUCTION [Qout/Qin] (t)= 1.841
TIME SHIFT OF PEAK FLOW (min)= 172.00
MAXIMUM STORAGE USED (ha.m.)=.2900E+00

```

```

003:0009-----
*****
*
* BLOCK 3 COMMERCIAL
*
*****

```

```

| DESIGN STANDHYD | Area (ha)= .80
| 04:BLK3 DT= 1.00 | Total Imp(t)= 90.00 Dir. Conn.(t)= 45.00
*****

```

```

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= .72 .08
Dep. Storage (mm)= .80 1.50
Average Slope (t)= 1.00 1.00
Length (m)= 73.03 40.00
Mannings n = .013 .250

```

```

Max. eff. Inten. (mm/hr)= 133.60 504.85
over (min) 2.00 6.00
Storage Coeff. (min)= 1.88 (ii) 6.43 (ii)
Unit Hyd. Tpeak (min)= 2.00 6.00
Unit Hyd. peak (cms)= .58 .18

```

```

*TOTALS*
PEAK FLOW (cms)= .13 .08 .202 (iii)
TIME TO PEAK (hrs)= 1.50 1.55 1.500
RUNOFF VOLUME (mm)= 55.28 34.90 44.072
TOTAL RAINFALL (mm)= 56.08 56.08 56.083
RUNOFF COEFFICIENT = .99 .62 .786

```

```

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

```

```

003:0010-----
*****
*
* SIMULATE STORAGE ON BLOCK 3 TO RELEASE AT CONTROLLED RATE
*
*****

```

```

| ROUTE RESERVOIR | Requested routing time step = 1.0 min.
| IN>04: (BLK3 ) |
| OUT<01: (B3CTRL) |

```

```

===== OUTFLOW STORAGE TABLE =====
OUTFLOW STORAGE OUTFLOW STORAGE
(cms) (ha.m.) (cms) (ha.m.)
.000 .0000E+00 .015 .1000E+01
.015 .1000E-03 .000 .0000E+00

```

```

ROUTING RESULTS AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW >04: (BLK3 ) .80 .202 1.500 44.072
OUTFLOW<01: (B3CTRL) .80 .015 1.183 44.072
OVERFLOW<02: (3OVR) .00 .000 .000 .000

```

```

TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
CUMULATIVE TIME OF OVERFLOWS (hours) = .00
PERCENTAGE OF TIME OVERFLOWING (t)= .00

```

```

PEAK FLOW REDUCTION [Qout/Qin] (t)= 7.411
TIME SHIFT OF PEAK FLOW (min)= -19.00
MAXIMUM STORAGE USED (ha.m.)=.1986E-01

```

```

003:0011-----
*****

```



```

*
*
* BLOCK 4 COMMERCIAL
*
*****

```

```

| DESIGN STANDHYD | Area (ha)= 1.40
| 05:BLK4 DT= 1.00 | Total Imp(t)= 90.00 Dir. Conn.(t)= 45.00

```

```

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 1.26 .14
Dep. Storage (cm)= .80 1.50
Average Slope (t)= 1.00 1.00
Length (m)= 96.61 40.00
Mannings n = .013 .250

Max.eff.Inten.(cm/hr)= 133.60 494.86
over (min)= 2.00 7.00
Storage Coeff. (min)= 2.23 (ii) 6.81 (ii)
Unit Hyd. Tpeak (min)= 2.00 7.00
Unit Hyd. peak (cms)= .52 .16

*TOTALS*
PEAK FLOW (cms)= .23 .13 .342 (iii)
TIME TO PEAK (hrs)= 1.50 1.57 1.500
RUNOFF VOLUME (cm)= 55.28 34.90 44.072
TOTAL RAINFALL (cm)= 56.08 56.08 56.083
RUNOFF COEFFICIENT = .99 .62 .786

```

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

```

003:0012-----

```

```

* SIMULATE STORAGE ON 4 TO RELEASE AT CONTROLLED RATE

```

```

| ROUTE RESERVOIR | Requested routing time step = 1.0 min.
| IN>05:(BLK4 ) |
| OUT<03:(B4CTRL) |
===== OUTFLOW STORAGE TABLE =====
OUTFLOW STORAGE | OUTFLOW STORAGE
(cms) (ha.m.) | (cms) (ha.m.)
.000 .0000E+00 | .015 .1000E+01
.015 .1000E-03 | .000 .0000E+00

ROUTING RESULTS AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (cm)
INFLOW >05: (BLK4 ) 1.40 .342 1.500 44.072
OUTFLOW<03: (B4CTRL) 1.40 .015 .917 44.072
OVERFLOW<04: (4OVR ) .00 .000 .000 .000

```

```

TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
CUMULATIVE TIME OF OVERFLOWS (hours)= .00
PERCENTAGE OF TIME OVERFLOWING (t)= .00

```

```

PEAK FLOW REDUCTION [Qout/Qin] (t)= 4.387
TIME SHIFT OF PEAK FLOW (min)= -35.00
MAXIMUM STORAGE USED (ha.m.)= 4.236E-01

```

```

003:0013-----

```

```

* TOTAL POST DEVELOPMENT FROM SITE

```

```

| ADD HYD (PSTDEV) | ID: NHYD AREA QPEAK TPEAK R.V. DWF
(ha) (cms) (hrs) (cm) (cms)
ID1 08:ENDOUT 11.82 .023 4.37 26.55 .000
+ID2 09:ENDGOVR .00 .000 .00 .00 .000 **DRY**
+ID3 01:B4CTRL .80 .015 1.18 44.07 .000
+ID4 02:3OVR .00 .000 .00 .00 .000 **DRY**
+ID5 03:B4CTRL 1.40 .015 .92 44.07 .000
+ID6 04:4OVR .00 .000 .00 .00 .000 **DRY**
=====
SUM 05:PSTDEV 14.02 .053 4.37 29.30 .000

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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003:0014-----

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003:0002-----

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** END OF RUN : 3

```

```

| START | Project dir.: H:\SWHYM-1\10034Y-1\
| | Rainfall dir.: H:\SWHYM-1\10034Y-1\
TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 004
NSTORM= 1
# 1-CH25.STM

```

```

004:0002-----

```

```

*# Project Name: [VINS PHASE 5] Project Number: [10034]
*# Date : 02-11-2010
*# Modeller : [TGS]
*# Company : G. Douglas Vallee Limited

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*# License # : 3560969

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004:0002-----

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```

| READ STORM | Filename: H:\SWHYM-1\10034Y-1\CH25.STM
| Ptotal= 66.02 cm | Comments: 25 YEAR CHICAGO 4 HOUR DESIGN DISTRIBUTI

```

```

TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
hrs cm/hr | hrs cm/hr | hrs cm/hr | hrs cm/hr
.17 4.500 | 1.17 13.670 | 2.17 12.320 | 3.17 6.270
.33 4.980 | 1.33 27.690 | 2.33 10.440 | 3.33 5.000
.50 5.613 | 1.50 158.850 | 2.50 9.144 | 3.50 5.840
.67 6.450 | 1.67 35.080 | 2.67 8.150 | 3.67 5.180
.83 7.700 | 1.83 20.600 | 2.83 7.390 | 3.83 4.900
1.00 9.700 | 2.00 15.240 | 3.00 6.780 | 4.00 4.650

```

```

004:0003-----

```

```

* SFD

```

```

| DESIGN STANDHYD | Area (ha)= 9.30
| 01:SFD DT= 1.00 | Total Imp(t)= 37.00 Dir. Conn.(t)= 16.00

```

```

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 3.44 5.86
Dep. Storage (cm)= .80 1.50
Average Slope (t)= 1.00 1.00
Length (m)= 249.00 40.00
Mannings n = .013 .250

```

```

Max.eff.Inten.(cm/hr)= 158.85 44.51
over (min)= 4.00 16.00
Storage Coeff. (min)= 3.67 (ii) 15.68 (ii)
Unit Hyd. Tpeak (min)= 4.00 16.00
Unit Hyd. peak (cms)= .30 .07

*TOTALS*
PEAK FLOW (cms)= .60 .44 .775 (iii)
TIME TO PEAK (hrs)= 1.50 1.73 1.517
RUNOFF VOLUME (cm)= 65.22 20.76 27.877
TOTAL RAINFALL (cm)= 66.02 66.02 66.023
RUNOFF COEFFICIENT = .99 .31 .422

```

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

```

004:0004-----

```

```

* BLOCK 1 TOWNHOUSES

```

```

| DESIGN STANDHYD | Area (ha)= .57
| 02:BLK1 DT= 1.00 | Total Imp(t)= 75.00 Dir. Conn.(t)= 38.00

```

```

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= .43 .14
Dep. Storage (cm)= .80 1.50
Average Slope (t)= 1.00 1.00
Length (m)= 61.64 40.00
Mannings n = .013 .250

```

```

Max.eff.Inten.(cm/hr)= 158.85 186.82
over (min)= 2.00 8.00
Storage Coeff. (min)= 1.59 (ii) 8.36 (ii)
Unit Hyd. Tpeak (min)= 2.00 8.00
Unit Hyd. peak (cms)= .64 .14

*TOTALS*
PEAK FLOW (cms)= .10 .05 .130 (iii)
TIME TO PEAK (hrs)= 1.50 1.58 1.500
RUNOFF VOLUME (cm)= 65.22 30.66 43.793
TOTAL RAINFALL (cm)= 66.02 66.02 66.023
RUNOFF COEFFICIENT = .99 .46 .663

```

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

```

004:0005-----

```

```

* BLOCK 2 APARTMENTS

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```

| DESIGN STANDHYD | Area (ha)= .69
| 03:BLK2 DT= 1.00 | Total Imp(t)= 75.00 Dir. Conn.(t)= 38.00

```

```

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= .52 .17
Dep. Storage (cm)= .80 1.50
Average Slope (t)= 1.00 1.00
Length (m)= 67.92 40.00
Mannings n = .013 .250

```

```

Max.eff.Inten.(cm/hr)= 158.85 186.82
over (min)= 2.00 8.00
Storage Coeff. (min)= 1.68 (ii) 8.45 (ii)
Unit Hyd. Tpeak (min)= 2.00 8.00
Unit Hyd. peak (cms)= .62 .14

*TOTALS*
PEAK FLOW (cms)= .12 .05 .157 (iii)

```

TIME TO PEAK (hrs)= 1.50 1.58 1.500
 RUNOFF VOLUME (mm)= 65.22 30.66 43.793
 TOTAL RAINFALL (mm)= 66.02 66.02 66.023
 RUNOFF COEFFICIENT = .99 .46 .663

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 58.0 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.

004:0006-----

* BLOCK 5 SWM

DESIGN STANDHYD | Area (ha)= 1.26
 06:BLK5 DT= 1.00 | Total Imp(i)= 90.00 Dir. Conn.(i)= 90.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	1.13	.13
Dep. Storage (mm)=	.80	1.50
Average Slope (ft)=	1.00	1.00
Length (m)=	91.65	40.00
Mannings n	.013	.250
Max. eff. Inten. (mm/hr)=	158.85	25.55
over (min)=	2.00	17.00
Storage Coeff. (min)=	2.01 (ii)	17.01 (ii)
Unit Hyd. Tpeak (min)=	2.00	17.00
Unit Hyd. peak (cms)=	.56	.07
PEAK FLOW (cms)=	.50	.01
TIME TO PEAK (hrs)=	1.50	1.75
RUNOFF VOLUME (mm)=	65.22	16.76
TOTAL RAINFALL (mm)=	66.02	66.02
RUNOFF COEFFICIENT =	.99	.25

TOTALS
 .498 (iii)

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 58.0 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.

004:0007-----

* DETERMINE INFLOW TO POND

	AREA	QPEAK	TPEAK	R.V.	INF
ID1 01:SPD	9.30	.775	1.52	27.88	.000
+ID2 02:BLK1	.57	.130	1.50	43.79	.000
+ID3 03:BLK2	.69	.157	1.50	43.79	.000
+ID4 06:BLK5	1.26	.498	1.50	60.38	.000
SUM 07:PSTDEV	11.82	1.542	1.50	33.04	.000

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

004:0008-----

* ROUTE THROUGH POND

	AREA	QPEAK	TPEAK	R.V.	INF
ROUTE RESERVOIR					
IN>07: (PSTDEV)					
OUT<08: (PNDOUT)					
OUTFLOW STORAGE					
(cms) (ha.m.)					
.000 .0000E+00	.025	.3535E+00			
.007 .5520E-01	.027	.4178E+00			
.013 .1118E+00	.029	.4837E+00			
.017 .1700E+00	.031	.5512E+00			
.020 .2296E+00	.033	.6203E+00			
.023 .2908E+00	.000	.0000E+00			
ROUTING RESULTS					
INFLOW >07: (PSTDEV)	11.82	1.542	1.500	33.038	
OUTFLOW<08: (PNDOUT)	11.82	.025	4.383	33.036	
OVERFLOW<09: (PNEOVR)	.00	.000	.000	.000	

TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
 CUMULATIVE TIME OF OVERFLOWS (hours)= .00
 PERCENTAGE OF TIME OVERFLOWING (t)= .00

PEAK FLOW REDUCTION [Qout/Qin] (t)= 1.651
 TIME SHIFT OF PEAK FLOW (min)= 173.00
 MAXIMUM STORAGE USED (ha.m.)=.3637E+00

004:0009-----

* BLOCK 3 COMMERCIAL

DESIGN STANDHYD | Area (ha)= .80
 04:BLK3 DT= 1.00 | Total Imp(i)= 90.00 Dir. Conn.(i)= 45.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	.72	.08
Dep. Storage (mm)=	.80	1.50
Average Slope (ft)=	1.00	1.00
Length (m)=	73.03	40.00
Mannings n	.013	.250

Max. eff. Inten. (mm/hr)=	158.85	639.53
over (min)=	2.00	6.00
Storage Coeff. (min)=	1.76 (ii)	5.89 (ii)
Unit Hyd. Tpeak (min)=	2.00	6.00
Unit Hyd. peak (cms)=	.61	.19

PEAK FLOW (cms)=	.16	.10	*TOTALS*
TIME TO PEAK (hrs)=	1.50	1.53	.251 (iii)
RUNOFF VOLUME (mm)=	65.22	43.58	53.321
TOTAL RAINFALL (mm)=	66.02	66.02	66.023
RUNOFF COEFFICIENT =	.99	.66	.808

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 58.0 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.

004:0010-----

* SIMULATE STOPAGE ON BLOCK 3 TO RELEASE AT CONTROLLED RATE

	AREA	QPEAK	TPEAK	R.V.
ROUTE RESERVOIR				
IN>04: (BLK3)				
OUT<01: (B3CTRL)				
OUTFLOW STORAGE				
(cms) (ha.m.)				
.000 .0000E+00	.015	.1000E+01		
.015 .1000E-03	.000	.0000E+00		

ROUTING RESULTS				
INFLOW >04: (BLK3)	.80	.251	1.500	53.321
OUTFLOW<01: (B3CTRL)	.80	.015	1.067	53.321
OVERFLOW<02: (3OVR)	.00	.000	.000	.000

TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
 CUMULATIVE TIME OF OVERFLOWS (hours)= .00
 PERCENTAGE OF TIME OVERFLOWING (t)= .00

PEAK FLOW REDUCTION [Qout/Qin] (t)= 5.978
 TIME SHIFT OF PEAK FLOW (min)= -26.00
 MAXIMUM STORAGE USED (ha.m.)=.2536E-01

004:0011-----

* BLOCK 4 COMMERCIAL

DESIGN STANDHYD | Area (ha)= 1.40
 05:BLK4 DT= 1.00 | Total Imp(i)= 90.00 Dir. Conn.(i)= 45.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	1.26	.14
Dep. Storage (mm)=	.80	1.50
Average Slope (ft)=	1.00	1.00
Length (m)=	96.61	40.00
Mannings n	.013	.250

Max. eff. Inten. (mm/hr)=	158.85	639.53
over (min)=	2.00	6.00
Storage Coeff. (min)=	2.08 (ii)	6.22 (ii)
Unit Hyd. Tpeak (min)=	2.00	6.00
Unit Hyd. peak (cms)=	.54	.18

PEAK FLOW (cms)=	.28	.17	*TOTALS*
TIME TO PEAK (hrs)=	1.50	1.55	.434 (iii)
RUNOFF VOLUME (mm)=	65.22	43.58	53.321
TOTAL RAINFALL (mm)=	66.02	66.02	66.023
RUNOFF COEFFICIENT =	.99	.66	.808

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 58.0 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.

004:0012-----

* SIMULATE STOPAGE ON 4 TO RELEASE AT CONTROLLED RATE

	AREA	QPEAK	TPEAK	R.V.
ROUTE RESERVOIR				
IN>05: (BLK4)				
OUT<03: (B4CTRL)				
OUTFLOW STORAGE				
(cms) (ha.m.)				
.000 .0000E+00	.015	.1000E+01		
.015 .1000E-03	.000	.0000E+00		

ROUTING RESULTS				
INFLOW >05: (BLK4)	1.40	.434	1.500	53.321
OUTFLOW<03: (B4CTRL)	1.40	.015	.750	53.321
OVERFLOW<04: (4OVR)	.00	.000	.000	.000

TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
 CUMULATIVE TIME OF OVERFLOWS (hours) = .00
 PERCENTAGE OF TIME OVERFLOWING (%) = .00

PEAK FLOW REDUCTION [Qout/Qin] (%) = 3.459
 TIME SHIFT OF PEAK FLOW (min) = -45.00
 MAXIMUM STORAGE USED (ha.m.) = 5446E-01

004:0013

* TOTAL POST DEVELOPMENT FROM SITE

ID	HYD	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (cms)	INF (cms)
ID1	09:PHDOUT	11.82	.025	4.38	33.04	.000
ID2	09:PHDOVR	.00	.000	.00	.00	.000 **DRY**
ID3	01:B3CIRL	.80	.015	1.07	53.32	.000
ID4	02:30VR	.00	.000	.00	.00	.000 **DRY**
ID5	03:B4CIRL	1.40	.015	.75	53.32	.000
ID6	04:40VR	.00	.000	.00	.00	.000 **DRY**
SUM	05:PSTDEV	14.02	.055	4.38	36.22	.000

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

004:0014

004:0002

004:0002

004:0002

** END OF RUN : 4

START Project dir.: H:\SWSHYM-1\10034Y-1\
 Rainfall dir.: H:\SWSHYM-1\10034Y-1\
 TZERO = .00 hrs on 0
 METOUT = 2 (output = METRIC)
 NRUN = 005
 NSTORM = 1
 # 1=CH50.SIM

005:0002

Project Name: [YINS PHASE 5] Project Number: [10034]
 Date : 02-11-2010
 Modeller : [TGS]
 Company : G. Douglas Vallee Limited
 License # : 3568969

005:0002

READ STORM Filename: H:\SWSHYM-1\10034Y-1\CH50.SIM
 Ptotal = 72.96 mm Comments: 50 YEAR CHICAGO 4 HOUR DESIGN DISTRIBUTION

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	3.990	1.17	14.270	2.17	12.620	3.17	5.790
.33	4.450	1.33	33.900	2.33	10.390	3.33	5.330
.50	5.080	1.50	186.560	2.50	8.890	3.50	4.980
.67	5.970	1.67	44.810	2.67	7.800	3.67	4.650
.83	7.290	1.83	23.440	2.83	6.960	3.83	4.370
1.00	9.530	2.00	16.260	3.00	6.300	4.00	4.140

005:0003

* SFD

DESIGN STANDHYD Area (ha) = 9.30
 01:SFD DT = 1.00 Total Imp (t) = 37.00 Dir. Conn. (t) = 16.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)	3.44	5.86
Dep. Storage (mm)	.80	1.50
Average Slope (t)	1.00	1.00
Length (m)	249.00	40.00
Mannings n	.013	.250
Max.eff.Inten. (mm/hr)	186.56	61.99
over (min)	14.00	1.00
Storage Coeff. (min)	3.44 (ii)	13.96 (ii)
Unit Hyd. Tpeak (min)	3.00	14.00
Unit Hyd. peak (cms)	.34	.08
PEAK FLOW (cms)	.72	.62
TIME TO PEAK (hrs)	1.50	1.70
RUNOFF VOLUME (mm)	72.16	32.209
TOTAL RAINFALL (mm)	72.96	72.962
RUNOFF COEFFICIENT	.99	.34

TOTALS
 .987 (iii)

(i) CH PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CH* = 58.0 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.

005:0004

* BLOCK 1 TOWNHOUSES

DESIGN STANDHYD Area (ha) = .57
 02:BLK1 DT = 1.00 Total Imp (t) = 75.00 Dir. Conn. (t) = 38.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)	.43	.14
Dep. Storage (mm)	.80	1.50
Average Slope (t)	1.00	1.00
Length (m)	61.64	40.00
Mannings n	.013	.250
Max.eff.Inten. (mm/hr)	186.56	234.31
over (min)	1.00	8.00
Storage Coeff. (min)	1.49 (ii)	7.67 (ii)
Unit Hyd. Tpeak (min)	1.00	8.00
Unit Hyd. peak (cms)	.83	.15
PEAK FLOW (cms)	.11	.06
TIME TO PEAK (hrs)	1.50	1.58
RUNOFF VOLUME (mm)	72.16	35.73
TOTAL RAINFALL (mm)	72.96	72.962
RUNOFF COEFFICIENT	.99	.49

TOTALS
 .157 (iii)

(i) CH PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CH* = 58.0 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.

005:0005

* BLOCK 2 APARTMENTS

DESIGN STANDHYD Area (ha) = .69
 03:BLK2 DT = 1.00 Total Imp (t) = 75.00 Dir. Conn. (t) = 38.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)	.52	.17
Dep. Storage (mm)	.80	1.50
Average Slope (t)	1.00	1.00
Length (m)	67.82	40.00
Mannings n	.013	.250
Max.eff.Inten. (mm/hr)	186.56	234.31
over (min)	2.00	8.00
Storage Coeff. (min)	1.58 (ii)	7.76 (ii)
Unit Hyd. Tpeak (min)	2.00	8.00
Unit Hyd. peak (cms)	.65	.14
PEAK FLOW (cms)	.14	.07
TIME TO PEAK (hrs)	1.50	1.58
RUNOFF VOLUME (mm)	72.16	35.73
TOTAL RAINFALL (mm)	72.96	72.962
RUNOFF COEFFICIENT	.99	.49

TOTALS
 .190 (iii)

(i) CH PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CH* = 58.0 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.

005:0006

* BLOCK 5 SWM

DESIGN STANDHYD Area (ha) = 1.26
 06:BLK5 DT = 1.00 Total Imp (t) = 90.00 Dir. Conn. (t) = 90.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)	1.13	.13
Dep. Storage (mm)	.80	1.50
Average Slope (t)	1.00	1.00
Length (m)	91.65	40.00
Mannings n	.013	.250
Max.eff.Inten. (mm/hr)	186.56	35.64
over (min)	2.00	15.00
Storage Coeff. (min)	1.89 (ii)	15.02 (ii)
Unit Hyd. Tpeak (min)	2.00	15.00
Unit Hyd. peak (cms)	.58	.08
PEAK FLOW (cms)	.58	.01
TIME TO PEAK (hrs)	1.50	1.72
RUNOFF VOLUME (mm)	72.16	20.00
TOTAL RAINFALL (mm)	72.96	72.962
RUNOFF COEFFICIENT	.99	.27

TOTALS
 .587 (iii)

(i) CH PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CH* = 58.0 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.

005:0007

* DETERMINE INFLOW TO POND

```

*****
| ADD HYD (PSTDEV) | ID: NHYD   AREA   QPEAK   TPEAK   R.V.   LWF
|                   |           (ha)   (cms)   (hrs)   (mm)   (cms)
|                   |-----|-----|-----|-----|-----|
| ID1 01:SF0       |         9.30   .987   1.52   32.21   .000
| +ID2 02:BLK1     |         .57   .157   1.50   49.58   .000
| +ID3 03:BLK2     |         .69   .190   1.50   49.58   .000
| +ID4 06:BLK5     |        1.26   .587   1.50   66.95   .000
|                   |-----|-----|-----|-----|
| SUM 07:PSTDEV    |        11.82   1.905   1.50   37.76   .000
*****

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

*****
005:0008
*****
*
* ROUTE THROUGH FOND
*
*****

```

```

| ROUTE RESERVOIR | Requested routing time step = 1.0 min.
| IN>07: (PSTDEV) |
| OUT<08: (PNDOUT) |
*****
===== OUTFLOW STORAGE TABLE =====
OUTFLOW STORAGE | OUTFLOW STORAGE
(cms) (ha.m.) | (cms) (ha.m.)
.000 .0000E+00 | .025 .3535E+00
.007 .5520E-01 | .027 .4178E+00
.013 .1118E+00 | .029 .4837E+00
.017 .1700E+00 | .031 .5512E+00
.020 .2286E+00 | .033 .6203E+00
.023 .2908E+00 | .000 .0000E+00

ROUTING RESULTS      AREA   QPEAK   TPEAK   R.V.
                    (ha)   (cms)   (hrs)   (mm)
INFLOW >07: (PSTDEV) 11.82   1.905   1.500   37.763
OUTFLOW<08: (PNDOUT) 11.82   .027   4.300   37.761
OVERFLOW<09: (PNDOVR) .00    .000   .000    .000

```

TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
 CUMULATIVE TIME OF OVERFLOWS (hours) = .00
 PERCENTAGE OF TIME OVERFLOWING (t) = .00

PEAK FLOW REDUCTION [Qout/Qin] (t) = 1.434
 TIME SHIFT OF PEAK FLOW (min) = 160.00
 MAXIMUM STOPAGE USED (ha.m.) = .4182E+00

```

*****
005:0009
*****
*
* BLOCK 3 COMMERCIAL
*
*****

```

```

| DESIGN STANDHYD | Area (ha) = .80
| 04:BLK3 DT= 1.00 | Total Imp(t) = 90.00 Dir. Conn. (t) = 45.00

```

```

===== IMPERVIOUS PERVIOUS (i) =====
Surface Area (ha) = .72 .08
Dep. Storage (mm) = .80 1.50
Average Slope (t) = 1.00 1.00
Length (m) = 73.03 40.00
Mannings n = .013 .250

Max. eff. Inten. (mm/hr) = 186.56 792.82
over (min) = 2.00 5.00
Storage Coeff. (min) = 1.65 (ii) 5.44 (ii)
Unit Hyd. Tpeak (min) = 2.00 5.00
Unit Hyd. peak (cms) = .63 .21

```

```

===== *TOTALS* =====
PEAK FLOW (cms) = .19 .13 .310 (iii)
TIME TO PEAK (hrs) = 1.50 1.53 1.500
RUNOFF VOLUME (mm) = 72.16 49.78 59.854
TOTAL RAINFALL (mm) = 72.96 72.96 72.962
RUNOFF COEFFICIENT = .99 .68 .820

```

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 58.0 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.

```

*****
005:0010
*****
*
* SIMULATE STORAGE ON BLOCK 3 TO RELEASE AT CONTROLLED RATE
*
*****

```

```

| ROUTE RESERVOIR | Requested routing time step = 1.0 min.
| IN>04: (BLK3 ) |
| OUT<01: (B3CTRL) |
*****
===== OUTFLOW STORAGE TABLE =====
OUTFLOW STORAGE | OUTFLOW STORAGE
(cms) (ha.m.) | (cms) (ha.m.)
.000 .0000E+00 | .015 .1000E+01
.015 .1000E-03 | .000 .0000E+00

ROUTING RESULTS      AREA   QPEAK   TPEAK   R.V.
                    (ha)   (cms)   (hrs)   (mm)
INFLOW >04: (BLK3 ) .80 .310 1.500 59.854
OUTFLOW<01: (B3CTRL) .80 .015 1.067 59.854
OVERFLOW<02: (3OVR ) .00 .000 .000 .000

```

TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
 CUMULATIVE TIME OF OVERFLOWS (hours) = .00
 PERCENTAGE OF TIME OVERFLOWING (t) = .00

PEAK FLOW REDUCTION [Qout/Qin] (t) = 4.840
 TIME SHIFT OF PEAK FLOW (min) = -26.00
 MAXIMUM STOPAGE USED (ha.m.) = .3117E-01

```

*****
005:0011
*****
*
* BLOCK 4 COMMERCIAL
*
*****

```

```

| DESIGN STANDHYD | Area (ha) = 1.40
| 05:BLK4 DT= 1.00 | Total Imp(t) = 90.00 Dir. Conn. (t) = 45.00

```

```

===== IMPERVIOUS PERVIOUS (i) =====
Surface Area (ha) = 1.26 .14
Dep. Storage (mm) = .80 1.50
Average Slope (t) = 1.00 1.00
Length (m) = 96.61 40.00
Mannings n = .013 .250

```

```

Max. eff. Inten. (mm/hr) = 186.56 780.67
over (min) = 2.00 6.00
Storage Coeff. (min) = 1.95 (ii) 5.77 (ii)
Unit Hyd. Tpeak (min) = 2.00 6.00
Unit Hyd. peak (cms) = .57 .19

```

```

===== *TOTALS* =====
PEAK FLOW (cms) = .32 .22 .525 (iii)
TIME TO PEAK (hrs) = 1.50 1.53 1.500
RUNOFF VOLUME (mm) = 72.16 49.78 59.854
TOTAL RAINFALL (mm) = 72.96 72.96 72.962
RUNOFF COEFFICIENT = .99 .68 .820

```

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 58.0 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.

```

*****
005:0012
*****
*
* SIMULATE STORAGE ON 4 TO RELEASE AT CONTROLLED RATE
*
*****

```

```

| ROUTE RESERVOIR | Requested routing time step = 1.0 min.
| IN>05: (BLK4 ) |
| OUT<03: (B4CTRL) |
*****
===== OUTFLOW STORAGE TABLE =====
OUTFLOW STORAGE | OUTFLOW STORAGE
(cms) (ha.m.) | (cms) (ha.m.)
.000 .0000E+00 | .015 .1000E+01
.015 .1000E-03 | .000 .0000E+00

```

```

ROUTING RESULTS      AREA   QPEAK   TPEAK   R.V.
                    (ha)   (cms)   (hrs)   (mm)
INFLOW >05: (BLK4 ) 1.40 .525 1.500 59.854
OUTFLOW<03: (B4CTRL) 1.40 .015 .833 59.854
OVERFLOW<04: (4OVR ) .00 .000 .000 .000

```

TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
 CUMULATIVE TIME OF OVERFLOWS (hours) = .00
 PERCENTAGE OF TIME OVERFLOWING (t) = .00

PEAK FLOW REDUCTION [Qout/Qin] (t) = 2.859
 TIME SHIFT OF PEAK FLOW (min) = -40.00
 MAXIMUM STOPAGE USED (ha.m.) = .6394E-01

```

*****
005:0013
*****
*
* TOTAL POST DEVELOPMENT FROM SITE
*
*****

```

```

| ADD HYD (PSTDEV) | ID: NHYD   AREA   QPEAK   TPEAK   R.V.   LWF
|                   |           (ha)   (cms)   (hrs)   (mm)   (cms)
|                   |-----|-----|-----|-----|-----|
| ID1 08:PNDOUT     |        11.82   .027   4.30   37.76   .000
| +ID2 09:PNDOVR     |         .00   .000   .00   .00   .000 **DRY**
| +ID3 01:B3CTRL     |         .80   .015   1.07   59.85   .000
| +ID4 02:3OVR       |         .00   .000   .00   .00   .000 **DRY**
| +ID5 03:B4CTRL     |         1.40   .015   .83   59.85   .000
| +ID6 04:4OVR       |         .00   .000   .00   .00   .000 **DRY**
|                   |-----|-----|-----|-----|
| SUM 05:PSTDEV      |        14.02   .057   4.30   41.23   .000

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

*****
005:0014
*****
005:0002
*****
005:0002
*****
005:0002
*****
005:0002
*****
** END OF RUN : 5
*****

```

```

| START | Project dir.: H:\SWHYM-1\10034Y-1\
|       | Rainfall dir.: H:\SWHYM-1\10034Y-1\
|       | TZERO = .00 hrs on 0
|       | METOUT = 2 (output = METRIC)
|       | NURN = 006
|       | NSTORM = 1

```

```
# 1=CH100.SIM
006:0002-----
*****
*# Project Name: [YINS PHASE 5] Project Number: [10034]
*# Date : 02-11-2010
*# Modeller : [TGS]
*# Company : G. Douglas Vallee Limited
*# License # : 3568969
*****
006:0002-----
```

```
| READ STORM | File name: H:\SW\SHYD-1\10034V-1\CH100.SIM
| Ptotal= 83.90 mm | Comments: 100 YEAR CHICAGO 4 HOUR DESIGN STORM DIS
```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	4.500	1.17	16.860	2.17	14.830	3.17	6.600
.33	5.050	1.33	41.070	2.33	12.120	3.33	6.100
.50	5.620	1.50	205.920	2.50	10.310	3.50	5.660
.67	6.830	1.67	54.560	2.67	9.020	3.67	5.280
.83	8.410	1.83	29.170	2.83	8.030	3.83	4.980
1.00	11.070	2.00	19.280	3.00	7.240	4.00	4.700

```
006:0003-----
*****
*
*
* SFD
*****
```

```
| DESIGN STANDHYD | Area (ha)= 9.30
| 01:SFD DT= 1.00 | Total Imp(t)= 37.00 Dir. Conn.(t)= 16.00
```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.44	5.86
Dep. Storage (mm)=	.80	1.50
Average Slope (t)=	1.00	1.00
Length (m)=	249.00	40.00
Mannings n	.013	.250
Max. eff. Inten. (mm/hr)=	205.92	79.53
over (min)	3.00	13.00
Storage Coeff. (min)=	3.31 (iii)	12.83 (ii)
Unit Hyd. Tpeak (min)=	3.00	13.00
Unit Hyd. peak (cms)=	.35	.09
PEAK FLOW (cms)=	.80	1.92 (iii)
TIME TO PEAK (hrs)=	1.50	1.48
RUNOFF VOLUME (mm)=	83.10	31.04
TOTAL RAINFALL (mm)=	83.90	83.90
RUNOFF COEFFICIENT	.99	.37

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

```
006:0004-----
*****
*
*
* BLOCK 1 TOWNHOUSES
*****
```

```
| DESIGN STANDHYD | Area (ha)= .57
| 02:BLK1 DT= 1.00 | Total Imp(t)= 75.00 Dir. Conn.(t)= 38.00
```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	.43	.14
Dep. Storage (mm)=	.80	1.50
Average Slope (t)=	1.00	1.00
Length (m)=	61.84	40.00
Mannings n	.013	.250
Max. eff. Inten. (mm/hr)=	205.92	286.05
over (min)	1.00	7.00
Storage Coeff. (min)=	1.43 (iii)	7.14 (ii)
Unit Hyd. Tpeak (min)=	1.00	7.00
Unit Hyd. peak (cms)=	.85	.16
PEAK FLOW (cms)=	.12	.07
TIME TO PEAK (hrs)=	1.50	1.57
RUNOFF VOLUME (mm)=	83.10	44.06
TOTAL RAINFALL (mm)=	83.90	83.90
RUNOFF COEFFICIENT	.99	.53

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

```
006:0005-----
*****
*
*
* BLOCK 2 APARTMENTS
*****
```

```
| DESIGN STANDHYD | Area (ha)= .69
| 03:BLK2 DT= 1.00 | Total Imp(t)= 75.00 Dir. Conn.(t)= 38.00
```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	.52	.17
Dep. Storage (mm)=	.80	1.50
Average Slope (t)=	1.00	1.00
Length (m)=	67.82	40.00
Mannings n	.013	.250

	205.92	286.05
Max. eff. Inten. (mm/hr)=	205.92	286.05
over (min)	2.00	7.00
Storage Coeff. (min)=	1.52 (ii)	7.22 (iii)
Unit Hyd. Tpeak (min)=	2.00	7.00
Unit Hyd. peak (cms)=	.66	.16
PEAK FLOW (cms)=	.15	.09
TIME TO PEAK (hrs)=	1.50	1.57
RUNOFF VOLUME (mm)=	83.10	44.06
TOTAL RAINFALL (mm)=	83.90	83.90
RUNOFF COEFFICIENT	.99	.53

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

```
006:0006-----
*****
*
*
* BLOCK 5 SHM
*****
```

```
| DESIGN STANDHYD | Area (ha)= 1.26
| 06:BLK5 DT= 1.00 | Total Imp(t)= 90.00 Dir. Conn.(t)= 90.00
```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	1.13	.13
Dep. Storage (mm)=	.80	1.50
Average Slope (t)=	1.00	1.00
Length (m)=	91.65	40.00
Mannings n	.013	.250

	205.92	46.00
Max. eff. Inten. (mm/hr)=	205.92	46.00
over (min)	2.00	14.00
Storage Coeff. (min)=	1.82 (ii)	13.67 (ii)
Unit Hyd. Tpeak (min)=	2.00	14.00
Unit Hyd. peak (cms)=	.59	.08
PEAK FLOW (cms)=	.65	.01
TIME TO PEAK (hrs)=	1.50	1.70
RUNOFF VOLUME (mm)=	83.10	25.49
TOTAL RAINFALL (mm)=	83.90	83.90
RUNOFF COEFFICIENT	.99	.30

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

```
006:0007-----
*****
*
*
* DETERMINE INFLOW TO POND
*****
```

	AREA	QPEAK	TPEAK	R.V.	DMF
	(ha)	(cms)	(hrs)	(mm)	(cms)
ID1 01:SFD	9.30	1.192	1.52	39.37	.000
+ID2 02:BLK1	.57	.185	1.50	58.90	.000
+ID3 03:BLK2	.69	.224	1.50	58.90	.000
+ID4 06:BLK5	1.26	.650	1.50	77.34	.000
SUM 07:PSTDEV	11.82	2.221	1.50	45.50	.000

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
006:0008-----
*****
*
*
* ROUTE THROUGH POND
*****
```

```
| ROUTE RESERVOIR | Requested routing time step = 1.0 min.
```

	IN>07:(PSTDEV)	OUT<08:(PNDOUT)	OUTFLOW STORAGE	OUTFLOW STORAGE	STORAGE
	(cms)	(ha.m.)	(cms)	(ha.m.)	(mm)
.000	.0000E+00	.025	.3535E+00		
.007	.5520E-01	.027	.4178E+00		
.013	.1118E+00	.029	.4837E+00		
.017	.1700E+00	.031	.5512E+00		
.020	.2296E+00	.033	.6203E+00		
.023	.2908E+00	.030	.6000E+00		

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW >07: (PSTDEV)	11.82	2.221	1.500	45.501
OUTFLOW <08: (PNDOUT)	11.82	.030	4.300	45.500
OVERFLOW <09: (PNDOVR)	.00	.000	.000	.000

TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
CUMULATIVE TIME OF OVERFLOWS (hours)= .00
PERCENTAGE OF TIME OVERFLOWING (t)= .00

PEAK FLOW REDUCTION [Qout/Qin](t)= 1.353
TIME SHIFT OF PEAK FLOW (min)= 168.00
MAXIMUM STORAGE USED (ha.m.)=.5069E+00

```
006:0009-----
*****
*
*
*
*****
```

* BLOCK 3 COMMERCIAL

DESIGN STANDHYD | Area (ha)= .80
 04:BLK3 DT= 1.00 | Total Imp(t)= 90.00 Dir. Conn.(t)= 45.00

IMPERVIOUS PERVIOUS (i)
 Surface Area (ha)= .72 .08
 Dep. Storage (mm)= .80 1.50
 Average Slope (t)= 1.00 1.00
 Length (m)= 73.03 40.00
 Mannings n = .013 .250

Max.eff.Inten.(mm/hr)= 205.92 907.51
 over (min)= 2.00 5.00
 Storage Coeff. (min)= 1.58 (ii) 5.18 (ii)
 Unit Hyd. Tpeak (min)= 2.00 5.00
 Unit Hyd. peak (cms)= .64 .22

PEAK FLOW (cms)= .21 .15 .353 (iii)
 TIME TO PEAK (hrs)= 1.50 1.53 1.500
 RUNOFF VOLUME (mm)= 83.10 59.74 70.253
 TOTAL RAINFALL (mm)= 83.90 83.90 83.902
 RUNOFF COEFFICIENT = .99 .71 .837

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:

CN* = 58.0 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.

006:0010

* SIMULATE STORAGE ON BLOCK 3 TO RELEASE AT CONTROLLED RATE

ROUTE RESERVOIR | Requested routing time step = 1.0 min.
 IN>04: (BLK3) |
 OUT<01: (B3CTRL) |

===== OUTFLOW STORAGE TABLE =====
 OUTFLOW STORAGE | OUTFLOW STORAGE
 (cms) (ha.m.) | (cms) (ha.m.)
 .000 .0000E+00 | .015 .1000E+01
 .015 .1000E-03 | .000 .0000E+00

ROUTING RESULTS AREA QPEAK TPEAK R.V.
 (ha) (cms) (hrs) (mm)
 INFLOW >04: (BLK3) .80 .353 1.500 70.253
 OUTFLOW<01: (B3CTRL) .80 .015 1.033 70.253
 OVERFLOW<02: (30VR) .00 .000 .000 .000

TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
 CUMULATIVE TIME OF OVERFLOWS (hours)= .00
 PERCENTAGE OF TIME OVERFLOWING (t)= .00

PEAK FLOW REDUCTION [Qout/Qin](t)= 4.253
 TIME SHIFT OF PEAK FLOW (min)= -28.00
 MAXIMUM STORAGE USED (ha.m.)=.3841E-01

006:0011

* BLOCK 4 COMMERCIAL

DESIGN STANDHYD | Area (ha)= 1.40
 05:BLK4 DT= 1.00 | Total Imp(t)= 90.00 Dir. Conn.(t)= 45.00

IMPERVIOUS PERVIOUS (i)
 Surface Area (ha)= 1.26 .14
 Dep. Storage (mm)= .80 1.50
 Average Slope (t)= 1.00 1.00
 Length (m)= 96.61 40.00
 Mannings n = .013 .250

Max.eff.Inten.(mm/hr)= 205.92 907.51
 over (min)= 2.00 5.00
 Storage Coeff. (min)= 1.87 (ii) 5.47 (ii)
 Unit Hyd. Tpeak (min)= 2.00 5.00
 Unit Hyd. peak (cms)= .59 .21

PEAK FLOW (cms)= .36 .27 .610 (iii)
 TIME TO PEAK (hrs)= 1.50 1.53 1.500
 RUNOFF VOLUME (mm)= 83.10 59.74 70.253
 TOTAL RAINFALL (mm)= 83.90 83.90 83.902
 RUNOFF COEFFICIENT = .99 .71 .837

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:

CN* = 58.0 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.

006:0012

* SIMULATE STORAGE ON 4 TO RELEASE AT CONTROLLED RATE

ROUTE RESERVOIR | Requested routing time step = 1.0 min.
 IN>05: (BLK4) |
 OUT<03: (B4CTRL) |

===== OUTFLOW STORAGE TABLE =====
 OUTFLOW STORAGE | OUTFLOW STORAGE
 (cms) (ha.m.) | (cms) (ha.m.)
 .000 .0000E+00 | .015 .1000E+01

.015 .1000E-03 { .000 .0000E+00

ROUTING RESULTS AREA QPEAK TPEAK R.V.
 (ha) (cms) (hrs) (mm)
 INFLOW >05: (BLK4) 1.40 .610 1.500 70.253
 OUTFLOW<03: (B4CTRL) 1.40 .015 .717 70.253
 OVERFLOW<04: (40VR) .00 .000 .000 .000

TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
 CUMULATIVE TIME OF OVERFLOWS (hours)= .00
 PERCENTAGE OF TIME OVERFLOWING (t)= .00

PEAK FLOW REDUCTION [Qout/Qin](t)= 2.457
 TIME SHIFT OF PEAK FLOW (min)= -47.00
 MAXIMUM STORAGE USED (ha.m.)=.7812E-01

006:0013

* TOTAL POST DEVELOPMENT FROM SITE

ADD HYD (PSTDEV) | ID: NHYD AREA QPEAK TPEAK R.V. INF
 (ha) (cms) (hrs) (mm) (cms)
 ID1 08:ENDOUT 11.82 .030 4.30 45.50 .000
 +ID2 09:ENDOVR .00 .000 .00 .00 .000 **DRY**
 +ID3 01:B3CTRL .80 .015 1.03 70.25 .000
 +ID4 02:30VR .00 .000 .00 .00 .000 **DRY**
 +ID5 03:B4CTRL 1.40 .015 .72 70.25 .000
 +ID6 04:40VR .00 .000 .00 .00 .000 **DRY**
 SUM 05:PSTDEV 14.02 .060 4.30 49.38 .000

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

006:0014

006:0002

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Appendix D: Miscellaneous Pond Design Calculations



vallee

Consulting Engineers,
Architects & Planners

Subject: Yin's Phase 5

Date: Nov 4/10 By: TGS

Project #: 10034 Page

Water Quality Sizing

35% Impervious 90

55% Impervious 150

54% Impervious 147

Contributing Area 11.82

Volume Req. 1738

1) Forebay Design: Settling

Equation 4.5 $\text{Dist} = \sqrt{r \cdot Q_p / V_s}$

Dist = forebay length

r = length to width of forebay

Q_p = peak flow rate from pond during quality storm

V_s = target settling velocity, recommended at 0.0003 m/s

Given	r=	2	Target 2:1
	Q_p =	0.017	
	V_s =	0.0003	
	Dist=	11	

2) Forebay Design: Dispersion Length

Equation 4.6 $\text{Dist} = 8 \cdot Q / (d \cdot V_f)$

Dist = forebay length

Q = inlet flow rate for quality storm

d = depth of perm pool

V_f = desired velocity in forebay (<0.5m/s)

Given	Q=	0.651	SYMHYMO results to pond for 2-year event
	d=	1.25	
	V_f =	0.5	
	dist=	8	

3) Forebay Design: Bottom Width



vallee

*Consulting Engineers,
Architects & Planners*

Subject: Yin's Phase 5

Date: Nov 4/10 By: TGS

Project #: 10034 Page

Equation 4.7 Width=Dist/8

Given Dist= 11

width= 1.375

4) Forebay Design: Cleanout Frequency

Table 6.3 of SWM Planning and Design Manual

35% Impervious	0.6 m3/ha, annual sediment loading
55% Impervious	1.9 m3/ha, annual sediment loading

Reference Calculation of Impervious areas spreadsheet for this development==> 39% impervious

Therefore extrapolate

54% 1.835 m3/ha

Total site area, including external contributing area 11.82 ha

Sediment Accumulation 21.6897 m3/year

Target Removal eff. For basic protection 60%

Anticipate Accumulation 13.01382 m3/year

Clean Frequency 10 year

Total Anticipated Accumulation 130.1382 m3

Contour	Area	Incr V	Volume
242	73	0	
242.45	187	59	59
242.65	380	57	115
243.25	717	329	444

**Appendix E: Main Street Storm Sewer Design Calculations
(Existing and Proposed)**



vallee

*Consulting Engineers,
Architects & Planners*

Subject: Yins Phase 5 Main Street Ex Storm
Date: Dec-10 By: TGS
Project #: 10034 Page

Existing storm services drainage area from Thompson Road to Area 4-3.

	Area	Runoff C	C*A
1-ex	1.26	0.45	0.567
2-1	1.71	0.45	0.7695
3-2	1.81	0.9	1.629
4-3	2.09	0.9	1.881
			4.8465

WSMD Designed for 2-year storm

Norfolk County Design criteria for 2-year storm, $I = A/(t+B)^C$

A 529.711
B 4.501
C 0.745

Assume and inlet time of 10 min to account for initial estimate of 5.0min per design criteria
for commercial areas and some transit time in system

I 72.243 mm/hr

Q 973 L/s

Existing storm sewer along Main Street is all 525mm at 0.4%

Dia 0.525 m
n 0.013
Hyd R 0.13125 m
Slope 0.4%
C/S A 0.21647537 m²

Q 272 L/s

Therefore insufficient capacity to service drainage area for the 2-year event.

STORM SEWER DESIGN SHEET

Storm 2-year Simcoe

A= 529.71

Pipe Material PVC<=450, Concrete >450

n 0.013

B= 4.501

C= 0.745

Project 10034 Yin's Phase 5 - Main Street Storm

Town/County Waterford - Norfolk County

Date Nov 24/10

Designed by TGS

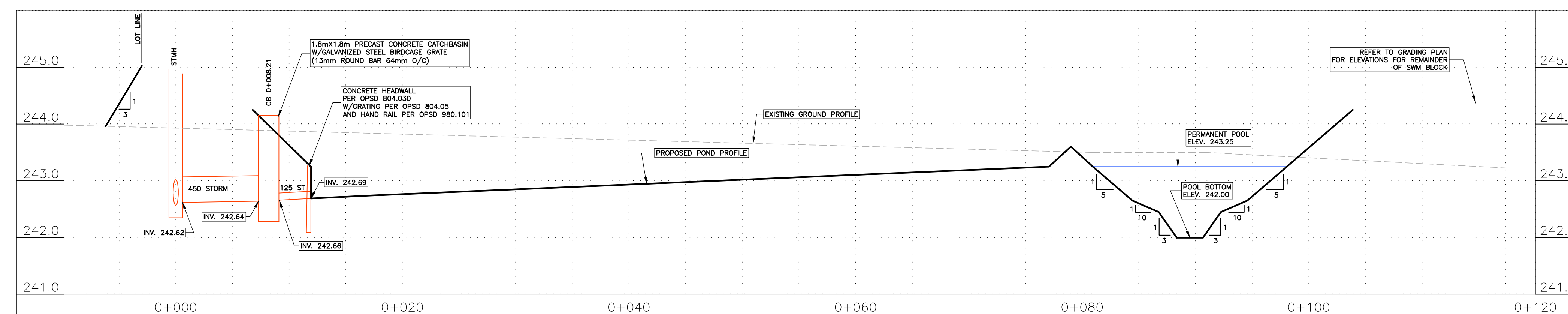
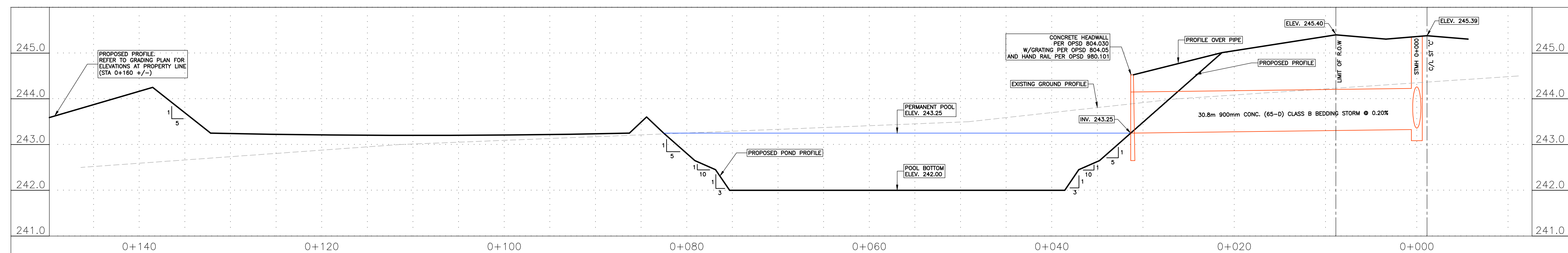
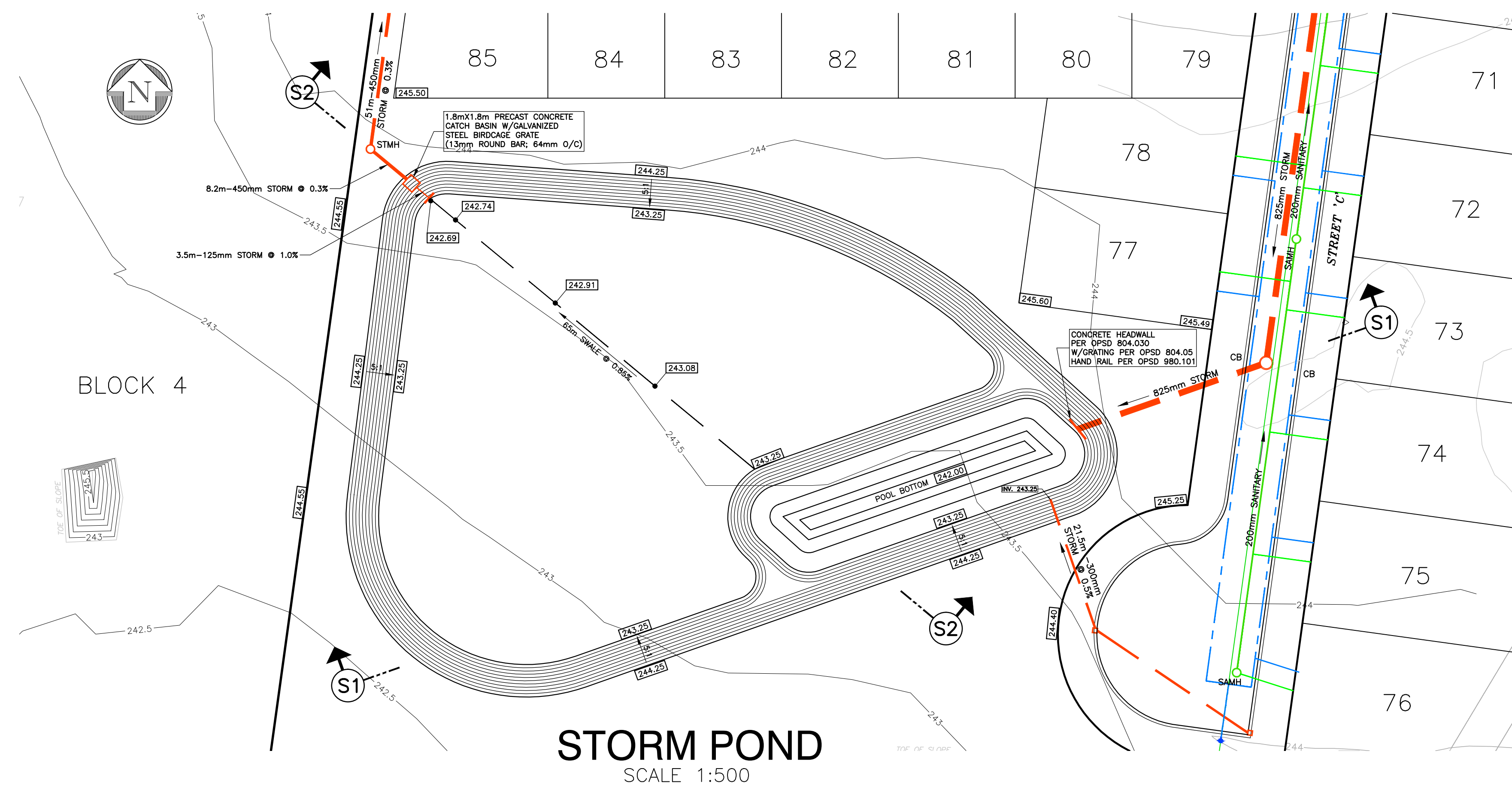
Checked by JDV

Sheet of : 1 of

Location			Area			Cumulative	Time	Rainfall	Flow	Sewer Design					
Area	From	To			TOTAL	R*A	of		2.78*I*A*R	Size	Slope	Cap	Vel	Length	Time
			Ha	Ha	Ha		Concentration	mm/hr							
			0.45	0.9			min		L/s	mm	%	L/s	m/s	m	min
Pond	Pond	7	0		0.00	0	0.00	N/A	30.0	450	0.30%	156.2	0.982	59.2	1
7-6	7	6	0.37		0.17	0.17	15.00	57.94	56.8	450	0.40%	180.3	1.134	104.5	1.54
6-5	6	5	0		0.00	0.17	16.54	54.75	85.3	600	0.20%	274.6	0.971	114	1.96
5-4	5	4		1.34	1.21	1.37	18.49	51.24	255.5	600	0.20%	274.6	0.971	119	2.04
4-3	4	3		2.09	1.88	3.25	20.53	48.10	495.0	750	0.25%	556.6	1.26	119.4	1.58
3-2	3	2		1.81	1.63	4.88	22.11	45.95	683.7	825	0.25%	717.7	1.343	84	1.04
2-1	2	1	1.71		0.77	5.65	23.16	44.66	761.7	825	0.30%	786.2	1.471	29.9	0.34
1-EX	1	EX	1.26		0.57	6.22	23.50	44.25	825.1	825	0.35%	849.2	1.589	107	1.12

Note:
Peak Discharge from Pond (100-yr storm)
Peak Discharge from Block 3
Peak Discharge from Block 4

0.03 Applied at Area POND
0.015 Applied at Area 6-5
0.015 Applied at Area 6-6

[illegible]

G. DOUGLAS VALLEE LIMITED
2 TALBOT STREET NORTH
SIMCOE, ONTARIO N3Y 3W4
(519) 426-6270

Stamp

PRELIMINARY
NOT TO BE USED
FOR CONSTRUCTION

Project Title	
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YIN PHASE 5

NORFOLK COUNTY - WATERFORD

Drawing Title	PLAN AND SECTION DETAILS
---------------	--------------------------

Designed by : GRB	Drawn By : TJC
Checked by : TGS	Date Started : NOVEMBER 2010
Drawing Scale : AS NOTED	Drawing No. SWM1
Project No. 10-034	

APPENDIX F

OTTHYMO OUTPUT FILES

Thompson Road and Charles Street Pre-Development Drainage Areas
Revised WSMD Visual OTTHYMO Model
Revised WSMD Visual OTTHYMO Model (With WSMD SWM Pond)

**Thompson Road and Charles Street
Pre-Development Drainage Areas
Visual OTTHYMO MODEL**



400

AREA 4 - THOMPSON - PRE-DEV



500

AREA 5 - CHARLES - PRE-DEV

2-Year Storm Event

```
=====
V  V  I  SSSSS  U  U  A  L  (v 6.2.2007)
V  V  I  SS  U  U  AA  L
V  V  I  SS  U  U  AAAAA  L
V  V  I  SS  U  U  A  A  L
VV  I  SSSSS  UUUUU  A  A  LLLLL

OOO  TTTT  TTTT  H  H  Y  Y  M  M  OOO  TM
O  O  T  T  H  H  Y  Y  MM  MM  O  O
O  O  T  T  H  H  Y  Y  M  M  O  O
OOO  T  T  H  H  Y  M  M  OOO

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```

***** D E T A I L E D O U T P U T *****

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Summary filename: C:\Users\Natalie\AppData\Local\Civica\XH5\2b61f5e3-29d9-4c68-
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DATE: 05/11/2022

TIME: 01:57:47

USER:

COMMENTS: _____

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** SIMULATION : Norfolk 2yr 4hr **
*****
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```

TIME	RAIN	TIME	RAIN	'	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	mm/hr
0.00	0.00	1.17	8.94	2.33	7.01	3.50	3.89	
0.17	3.25	1.33	16.92	2.50	6.20	3.67	3.68	
0.33	3.56	1.50	78.82	2.67	5.59	3.83	3.51	
0.50	3.96	1.67	21.89	2.83	5.11	4.00	3.35	
0.67	4.52	1.83	13.00	3.00	4.72			
0.83	5.31	2.00	9.88	3.17	4.39			
1.00	6.55	2.17	8.15	3.33	4.11			

PRE-DEVELOPMENT CHARLES AREA

```
-----
| CALIB |
| NASHYD ( 0500) | Area (ha)= 4.35 Curve Number (CN)= 62.0
| ID= 1 DT= 5.0 min | Ia (mm)= 13.60 # of Linear Res.(N)= 3.00
| U.H. Tp(hrs)= 0.30
-----
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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	mm/hr
0.083	0.00	1.167	6.55	2.250	8.15	3.33	4.39	
0.167	0.00	1.250	8.94	2.333	8.15	3.42	4.11	
0.250	3.25	1.333	8.94	2.417	7.01	3.50	4.11	
0.333	3.25	1.417	16.92	2.500	7.01	3.58	3.89	
0.417	3.56	1.500	16.92	2.583	6.20	3.67	3.89	
0.500	3.56	1.583	78.82	2.667	6.20	3.75	3.68	
0.583	3.96	1.667	78.82	2.750	5.59	3.83	3.68	
0.667	3.96	1.750	21.89	2.833	5.59	3.92	3.51	
0.750	4.52	1.833	21.89	2.917	5.11	4.00	3.51	
0.833	4.52	1.917	13.00	3.000	5.11	4.08	3.35	
0.917	5.31	2.000	13.00	3.083	4.72	4.17	3.35	
1.000	5.31	2.083	9.88	3.167	4.72			
1.083	6.55	2.167	9.88	3.250	4.39			

Unit Hyd Qpeak (cms)= 0.554

PEAK FLOW (cms)= 0.023 (i)
TIME TO PEAK (hrs)= 2.167
RUNOFF VOLUME (mm)= 3.662
TOTAL RAINFALL (mm)= 39.385
RUNOFF COEFFICIENT = 0.093

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

PRE-DEVELOPMENT THOMPSON AREA

```
-----
| CALIB |
| NASHYD ( 0400) | Area (ha)= 7.85 Curve Number (CN)= 72.0
| ID= 1 DT= 5.0 min | Ia (mm)= 8.10 # of Linear Res.(N)= 3.00
| U.H. Tp(hrs)= 0.46
-----
```

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

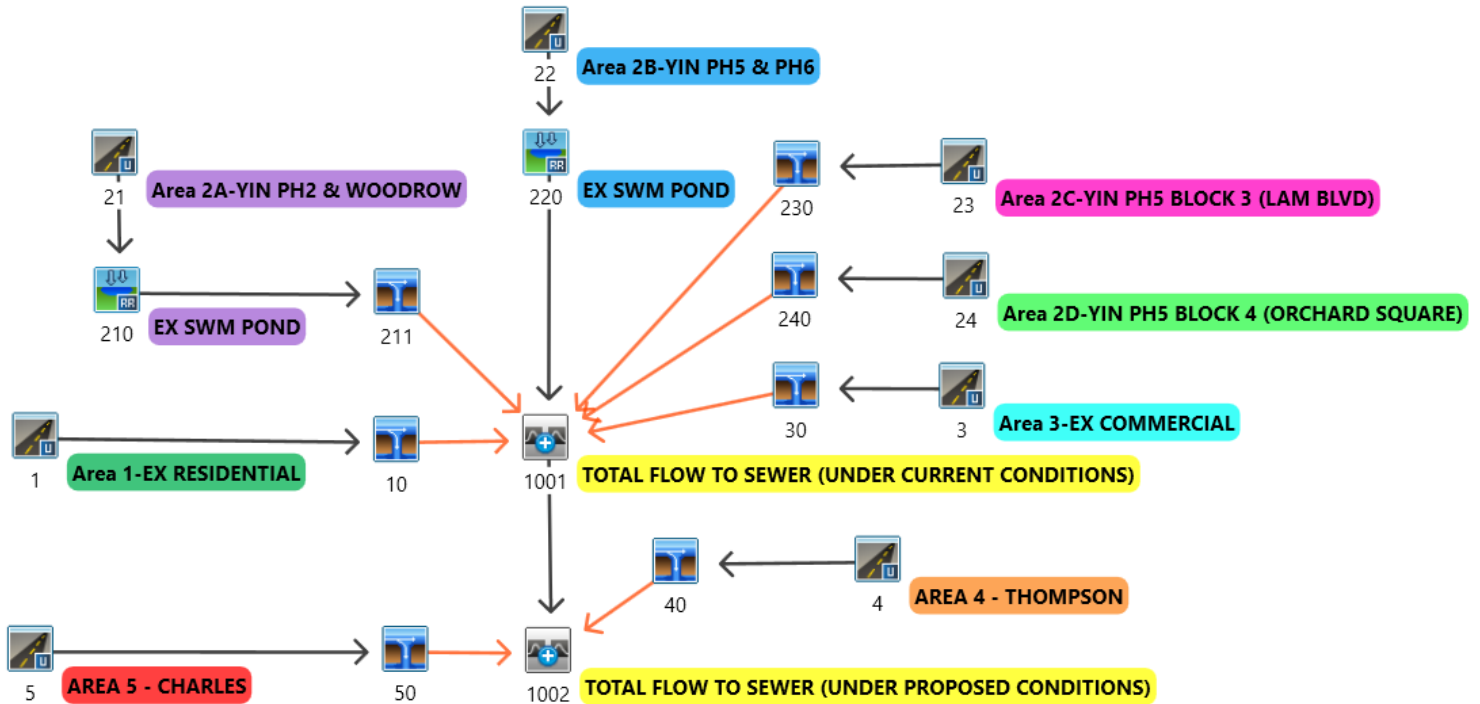
----- TRANSFORMED HYETOGRAPH -----								
TIME	RAIN	TIME	RAIN	'	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	mm/hr
0.083	0.00	1.167	6.55	2.250	8.15	3.33	4.39	
0.167	0.00	1.250	8.94	2.333	8.15	3.42	4.11	
0.250	3.25	1.333	8.94	2.417	7.01	3.50	4.11	
0.333	3.25	1.417	16.92	2.500	7.01	3.58	3.89	
0.417	3.56	1.500	16.92	2.583	6.20	3.67	3.89	
0.500	3.56	1.583	78.82	2.667	6.20	3.75	3.68	
0.583	3.96	1.667	78.82	2.750	5.59	3.83	3.68	
0.667	3.96	1.750	21.89	2.833	5.59	3.92	3.51	
0.750	4.52	1.833	21.89	2.917	5.11	4.00	3.51	
0.833	4.52	1.917	13.00	3.000	5.11	4.08	3.35	
0.917	5.31	2.000	13.00	3.083	4.72	4.17	3.35	
1.000	5.31	2.083	9.88	3.167	4.72			
1.083	6.55	2.167	9.88	3.250	4.39			

Unit Hyd Qpeak (cms)= 0.652

PEAK FLOW (cms)= 0.084 (i)
TIME TO PEAK (hrs)= 2.333
RUNOFF VOLUME (mm)= 7.525
TOTAL RAINFALL (mm)= 39.385
RUNOFF COEFFICIENT = 0.191

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

Revised Waterford Municipal Drain Design
Visual OTTHYMO MODEL



100-Year Storm Event

```
=====
V V I SSSS U U A L (v 6.2.2015)
V V I SS U U A A L
V V I SS U U A A A A L
V V I SS U U A A L
VV I SSSS UUUU A A LLLL

OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO

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```

***** DETAILED OUTPUT *****

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DATE: 12/13/2023 TIME: 09:45:01

USER:

COMMENTS:

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*****
** SIMULATION : Norfolk 100 yr 4hr **
*****
```

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| | 60d86d79-2507-4402-bf14-96afe0fd5daf\ei1495e0d
| Ptotal= 83.90 mm | Comments: Norfolk 100 yr 4hr
| |
```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	0.00	1.17	16.86	2.33	12.12	3.50	5.66
0.17	4.50	1.33	41.07	2.50	10.31	3.67	5.28
0.33	5.05	1.50	205.92	2.67	9.02	3.83	4.98
0.50	5.82	1.67	54.56	2.83	8.03	4.00	4.70
0.67	6.83	1.83	29.17	3.00	7.24		
0.83	8.41	2.00	19.28	3.17	6.60		
1.00	11.07	2.17	14.83	3.33	6.10		

AREA 1 - EXISTING RESIDENTIAL

```
-----
| CALIB |
| STANDHYD ( 0001) | Area (ha)= 40.00
| ID= 1 DT= 1.0 min | Total Imp(%)= 30.00 Dir. Conn.(%)= 15.00
| |
```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	12.00	28.00
Dep. Storage	(mm)=	0.80	23.90
Average Slope	(%)=	2.00	2.00
Length	(m)=	516.40	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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
0.017 0.00 | 1.067 11.07 | 2.117 19.28 | 3.17 7.24
0.033 0.00 | 1.083 11.07 | 2.133 19.28 | 3.18 6.60
0.050 0.00 | 1.100 11.07 | 2.150 19.28 | 3.20 6.60
0.067 0.00 | 1.117 11.07 | 2.167 19.28 | 3.22 6.60
0.083 0.00 | 1.133 11.07 | 2.183 14.83 | 3.23 6.60
0.100 0.00 | 1.150 11.07 | 2.200 14.83 | 3.25 6.60
0.117 0.00 | 1.167 11.07 | 2.217 14.83 | 3.27 6.60
0.133 0.00 | 1.183 16.86 | 2.233 14.83 | 3.28 6.60
0.150 0.00 | 1.200 16.86 | 2.250 14.83 | 3.30 6.60
0.167 0.00 | 1.217 16.86 | 2.267 14.83 | 3.32 6.60
0.183 4.50 | 1.233 16.86 | 2.283 14.83 | 3.33 6.60
0.200 4.50 | 1.250 16.86 | 2.300 14.83 | 3.35 6.10
0.217 4.50 | 1.267 16.86 | 2.317 14.83 | 3.37 6.10
0.233 4.50 | 1.283 16.86 | 2.333 14.83 | 3.38 6.10
0.250 4.50 | 1.300 16.86 | 2.350 12.12 | 3.40 6.10
0.267 4.50 | 1.317 16.86 | 2.367 12.12 | 3.42 6.10
0.283 4.50 | 1.333 16.86 | 2.383 12.12 | 3.43 6.10
0.300 4.50 | 1.350 41.07 | 2.400 12.12 | 3.45 6.10
0.317 4.50 | 1.367 41.07 | 2.417 12.12 | 3.47 6.10
0.333 4.50 | 1.383 41.07 | 2.433 12.12 | 3.48 6.10
0.350 5.05 | 1.400 41.07 | 2.450 12.12 | 3.50 6.10
0.367 5.05 | 1.417 41.07 | 2.467 12.12 | 3.52 5.66
0.383 5.05 | 1.433 41.07 | 2.483 12.12 | 3.53 5.66
0.400 5.05 | 1.450 41.07 | 2.500 12.12 | 3.55 5.66
0.417 5.05 | 1.467 41.07 | 2.517 10.31 | 3.57 5.66
0.433 5.05 | 1.483 41.07 | 2.533 10.31 | 3.58 5.66
0.450 5.05 | 1.500 41.07 | 2.550 10.31 | 3.60 5.66
0.467 5.05 | 1.517 205.92 | 2.567 10.31 | 3.62 5.66
0.483 5.05 | 1.533 205.92 | 2.583 10.31 | 3.63 5.66
0.500 5.05 | 1.550 205.92 | 2.600 10.31 | 3.65 5.66
0.517 5.82 | 1.567 205.92 | 2.617 10.31 | 3.67 5.66
0.533 5.82 | 1.583 205.92 | 2.633 10.31 | 3.68 5.28
0.550 5.82 | 1.600 205.92 | 2.650 10.31 | 3.70 5.28
0.567 5.82 | 1.617 205.92 | 2.667 10.31 | 3.72 5.28
0.583 5.82 | 1.633 205.92 | 2.683 9.02 | 3.73 5.28
0.600 5.82 | 1.650 205.92 | 2.700 9.02 | 3.75 5.28
0.617 5.82 | 1.667 205.92 | 2.717 9.02 | 3.77 5.28
0.633 5.82 | 1.683 54.57 | 2.733 9.02 | 3.78 5.28
0.650 5.82 | 1.700 54.56 | 2.750 9.02 | 3.80 5.28
0.667 5.82 | 1.717 54.56 | 2.767 9.02 | 3.82 5.28
0.683 6.83 | 1.733 54.56 | 2.783 9.02 | 3.83 5.28
0.700 6.83 | 1.750 54.56 | 2.800 9.02 | 3.85 4.98
0.717 6.83 | 1.767 54.56 | 2.817 9.02 | 3.87 4.98
```

Revised Waterford Municipal Drain Design
Visual OTTHYMO MODEL

100-Year Storm Event

0.733	6.83	1.783	54.56	2.833	9.02	3.88	4.98
0.750	6.83	1.800	54.56	2.850	8.03	3.90	4.98
0.767	6.83	1.817	54.56	2.867	8.03	3.92	4.98
0.783	6.83	1.833	54.56	2.883	8.03	3.93	4.98
0.800	6.83	1.850	29.17	2.900	8.03	3.95	4.98
0.817	6.83	1.867	29.17	2.917	8.03	3.97	4.98
0.833	6.83	1.883	29.17	2.933	8.03	3.98	4.98
0.850	8.41	1.900	29.17	2.950	8.03	4.00	4.98
0.867	8.41	1.917	29.17	2.967	8.03	4.02	4.70
0.883	8.41	1.933	29.17	2.983	8.03	4.03	4.70
0.900	8.41	1.950	29.17	3.000	8.03	4.05	4.70
0.917	8.41	1.967	29.17	3.017	7.24	4.07	4.70
0.933	8.41	1.983	29.17	3.033	7.24	4.08	4.70
0.950	8.41	2.000	29.17	3.050	7.24	4.10	4.70
0.967	8.41	2.017	19.28	3.067	7.24	4.12	4.70
0.983	8.41	2.033	19.28	3.083	7.24	4.13	4.70
1.000	8.41	2.050	19.28	3.100	7.24	4.15	4.70
1.017	11.07	2.067	19.28	3.117	7.24	4.17	4.70
1.033	11.07	2.083	19.28	3.133	7.24		
1.050	11.07	2.100	19.28	3.150	7.24		

Max.Eff.Inten.(mm/hr)= 205.92 30.28
over (min) 5.00 16.00
Storage Coeff. (min)= 4.16 (ii) 15.54 (ii)
Unit Hyd. Tpeak (min)= 5.00 16.00
Unit Hyd. peak (cms)= 0.25 0.07

TOTALS

PEAK FLOW (cms)= 2.99 1.25 3.281 (iii)
TIME TO PEAK (hrs)= 1.68 1.92 1.68
RUNOFF VOLUME (mm)= 83.10 15.08 25.29
TOTAL RAINFALL (mm)= 83.90 83.90 83.90
RUNOFF COEFFICIENT = 0.99 0.18 0.30

***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 50.0 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.

DUHYD (0010)				
Inlet Cap.= 1.020				
#of Inlets= 1				
Total(cms)= 1.0	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
TOTAL HYD.(ID= 1):	40.00	3.28	1.68	25.29
MAJOR SYS.(ID= 2):	10.79	2.26	1.68	25.29
MINOR SYS.(ID= 3):	29.21	1.02	1.55	25.29

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

AREA 2B - YIN PHASE 5 AND PHASE 6

CALIB			
STANDHYD (0022)	Area (ha)= 11.82		
ID= 1 DT= 1.0 min	Total Imp(%)= 47.00	Dir. Conn.(%)= 22.00	

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	5.56	6.26
Dep. Storage (mm)=	0.80	16.50
Average Slope (%)=	1.00	1.00
Length (m)=	280.71	40.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----									
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.017	0.00	1.067	11.07	2.117	19.28	3.17	7.24		
0.033	0.00	1.083	11.07	2.133	19.28	3.18	6.60		
0.050	0.00	1.100	11.07	2.150	19.28	3.20	6.60		
0.067	0.00	1.117	11.07	2.167	19.28	3.22	6.60		
0.083	0.00	1.133	11.07	2.183	14.83	3.23	6.60		
0.100	0.00	1.150	11.07	2.200	14.83	3.25	6.60		
0.117	0.00	1.167	11.07	2.217	14.83	3.27	6.60		
0.133	0.00	1.183	16.86	2.233	14.83	3.28	6.60		
0.150	0.00	1.200	16.86	2.250	14.83	3.30	6.60		
0.167	0.00	1.217	16.86	2.267	14.83	3.32	6.60		
0.183	4.50	1.233	16.86	2.283	14.83	3.33	6.60		
0.200	4.50	1.250	16.86	2.300	14.83	3.35	6.10		
0.217	4.50	1.267	16.86	2.317	14.83	3.37	6.10		
0.233	4.50	1.283	16.86	2.333	14.83	3.38	6.10		
0.250	4.50	1.300	16.86	2.350	12.12	3.40	6.10		
0.267	4.50	1.317	16.86	2.367	12.12	3.42	6.10		
0.283	4.50	1.333	16.86	2.383	12.12	3.43	6.10		
0.300	4.50	1.350	41.07	2.400	12.12	3.45	6.10		
0.317	4.50	1.367	41.07	2.417	12.12	3.47	6.10		
0.333	4.50	1.383	41.07	2.433	12.12	3.48	6.10		
0.350	5.05	1.400	41.07	2.450	12.12	3.50	6.10		
0.367	5.05	1.417	41.07	2.467	12.12	3.52	5.66		
0.383	5.05	1.433	41.07	2.483	12.12	3.53	5.66		
0.400	5.05	1.450	41.07	2.500	12.12	3.55	5.66		
0.417	5.05	1.467	41.07	2.517	10.31	3.57	5.66		
0.433	5.05	1.483	41.07	2.533	10.31	3.58	5.66		
0.450	5.05	1.500	41.07	2.550	10.31	3.60	5.66		
0.467	5.05	1.517	205.91	2.567	10.31	3.62	5.66		
0.483	5.05	1.533	205.92	2.583	10.31	3.63	5.66		
0.500	5.05	1.550	205.92	2.600	10.31	3.65	5.66		
0.517	5.82	1.567	205.92	2.617	10.31	3.67	5.66		
0.533	5.82	1.583	205.92	2.633	10.31	3.68	5.28		

0.550	5.82	1.600	205.92	2.650	10.31	3.70	5.28
0.567	5.82	1.617	205.92	2.667	10.31	3.72	5.28
0.583	5.82	1.633	205.92	2.683	9.02	3.73	5.28
0.600	5.82	1.650	205.92	2.700	9.02	3.75	5.28
0.617	5.82	1.667	205.92	2.717	9.02	3.77	5.28
0.633	5.82	1.683	54.57	2.733	9.02	3.78	5.28
0.650	5.82	1.700	54.56	2.750	9.02	3.80	5.28
0.667	5.82	1.717	54.56	2.767	9.02	3.82	5.28
0.683	6.83	1.733	54.56	2.783	9.02	3.83	5.28
0.700	6.83	1.750	54.56	2.800	9.02	3.85	4.98
0.717	6.83	1.767	54.56	2.817	9.02	3.87	4.98
0.733	6.83	1.783	54.56	2.833	9.02	3.88	4.98
0.750	6.83	1.800	54.56	2.850	8.03	3.90	4.98
0.767	6.83	1.817	54.56	2.867	8.03	3.92	4.98
0.783	6.83	1.833	54.56	2.883	8.03	3.93	4.98
0.800	6.83	1.850	29.17	2.900	8.03	3.95	4.98
0.817	6.83	1.867	29.17	2.917	8.03	3.97	4.98
0.833	6.83	1.883	29.17	2.933	8.03	3.98	4.98
0.850	8.41	1.900	29.17	2.950	8.03	4.00	4.98
0.867	8.41	1.917	29.17	2.967	8.03	4.02	4.70
0.883	8.41	1.933	29.17	2.983	8.03	4.03	4.70
0.900	8.41	1.950	29.17	3.000	8.03	4.05	4.70
0.917	8.41	1.967	29.17	3.017	7.24	4.07	4.70
0.933	8.41	1.983	29.17	3.033	7.24	4.08	4.70
0.950	8.41	2.000	29.17	3.050	7.24	4.10	4.70
0.967	8.41	2.017	19.28	3.067	7.24	4.12	4.70
0.983	8.41	2.033	19.28	3.083	7.24	4.13	4.70
1.000	8.41	2.050	19.28	3.100	7.24	4.15	4.70
1.017	11.07	2.067	19.28	3.117	7.24	4.17	4.70
1.033	11.07	2.083	19.28	3.133	7.24		
1.050	11.07	2.100	19.28	3.150	7.24		

Max.Eff.Inten.(mm/hr)= 205.92 82.84
over (min) 5.00 13.00
Storage Coeff. (min)= 3.55 (ii) 12.92 (ii)
Unit Hyd. Tpeak (min)= 5.00 13.00
Unit Hyd. peak (cms)= 0.28 0.09

TOTALS

PEAK FLOW (cms)= 1.34 0.78 1.685 (iii)
TIME TO PEAK (hrs)= 1.68 1.85 1.70
RUNOFF VOLUME (mm)= 83.10 26.73 39.13
TOTAL RAINFALL (mm)= 83.90 83.90 83.90
RUNOFF COEFFICIENT = 0.99 0.32 0.47

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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 2B - SWM POND

RESERVOIR(0220)	OVERFLOW IS OFF			
IN= 2--> OUT= 1				
DT= 1.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	0.0251	0.3540
	0.0066	0.0550	0.0273	0.4180
	0.0127	0.1120	0.0294	0.4840
	0.0167	0.1700	0.0313	0.5510
	0.0199	0.2300	0.0332	0.6200
	0.0226	0.2910	0.0000	0.0000
	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0022)	11.820	1.685	1.70	39.13
OUTFLOW: ID= 1 (0220)	11.820	0.028	4.50	22.49

PEAK FLOW REDUCTION [Qout/Qin](%)= 1.65
TIME SHIFT OF PEAK FLOW (min)=168.00
MAXIMUM STORAGE USED (ha.m.)= 0.4343

AREA 3 - EXISTING COMMERCIAL

CALIB			
STANDHYD (0003)	Area (ha)= 19.20		
ID= 1 DT= 1.0 min	Total Imp(%)= 80.00	Dir. Conn.(%)= 50.00	

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	15.36	3.84
Dep. Storage (mm)=	0.80	23.90
Average Slope (%)=	2.00	2.00
Length (m)=	357.77	40.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----									
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.017	0.00	1.067	11.07	2.117	19.28	3.17	7.24		
0.033	0.00	1.083	11.07	2.133	19.28	3.18	6.60		
0.050	0.00	1.100	11.07	2.150	19.28	3.20	6.60		
0.067	0.00	1.117	11.07	2.167	19.28	3.22	6.60		
0.083	0.00	1.133	11.07	2.183	14.83	3.23	6.60		
0.100	0.00	1.150	11.07	2.200	14.83	3.25	6.60		
0.117	0.00	1.167	11.07	2.217	14.83	3.27	6.60		
0.133	0.00	1.183	16.86	2.233	14.83	3.28	6.60		
0.150	0.00	1.200	16.86	2.250	14.83	3.30	6.60		
0.167	0.00	1.217	16.86	2.267	14.83	3.32	6.60		
0.183	4.50	1.233	16.86	2.283	14.83	3.33	6.60		
0.200	4.50	1.250	16.86	2.300	14.83	3.35	6.10		

Revised Waterford Municipal Drain Design
Visual OTTHYMO MODEL

100-Year Storm Event

0.217	4.50	1.267	16.86	2.317	14.83	3.37	6.10
0.233	4.50	1.283	16.86	2.333	14.83	3.38	6.10
0.250	4.50	1.300	16.86	2.350	12.12	3.40	6.10
0.267	4.50	1.317	16.86	2.367	12.12	3.42	6.10
0.283	4.50	1.333	16.86	2.383	12.12	3.43	6.10
0.300	4.50	1.350	41.07	2.400	12.12	3.45	6.10
0.317	4.50	1.367	41.07	2.417	12.12	3.47	6.10
0.333	4.50	1.383	41.07	2.433	12.12	3.48	6.10
0.350	5.05	1.400	41.07	2.450	12.12	3.50	6.10
0.367	5.05	1.417	41.07	2.467	12.12	3.52	5.66
0.383	5.05	1.433	41.07	2.483	12.12	3.53	5.66
0.400	5.05	1.450	41.07	2.500	12.12	3.55	5.66
0.417	5.05	1.467	41.07	2.517	10.31	3.57	5.66
0.433	5.05	1.483	41.07	2.533	10.31	3.58	5.66
0.450	5.05	1.500	41.07	2.550	10.31	3.60	5.66
0.467	5.05	1.517	205.92	2.567	10.31	3.62	5.66
0.483	5.05	1.533	205.92	2.583	10.31	3.63	5.66
0.500	5.05	1.550	205.92	2.600	10.31	3.65	5.66
0.517	5.82	1.567	205.92	2.617	10.31	3.67	5.66
0.533	5.82	1.583	205.92	2.633	10.31	3.68	5.28
0.550	5.82	1.600	205.92	2.650	10.31	3.70	5.28
0.567	5.82	1.617	205.92	2.667	10.31	3.72	5.28
0.583	5.82	1.633	205.92	2.683	9.02	3.73	5.28
0.600	5.82	1.650	205.92	2.700	9.02	3.75	5.28
0.617	5.82	1.667	205.92	2.717	9.02	3.77	5.28
0.633	5.82	1.683	54.57	2.733	9.02	3.78	5.28
0.650	5.82	1.700	54.56	2.750	9.02	3.80	5.28
0.667	5.82	1.717	54.56	2.767	9.02	3.82	5.28
0.683	6.83	1.733	54.56	2.783	9.02	3.83	5.28
0.700	6.83	1.750	54.56	2.800	9.02	3.85	4.98
0.717	6.83	1.767	54.56	2.817	9.02	3.87	4.98
0.733	6.83	1.783	54.56	2.833	9.02	3.88	4.98
0.750	6.83	1.800	54.56	2.850	8.03	3.90	4.98
0.767	6.83	1.817	54.56	2.867	8.03	3.92	4.98
0.783	6.83	1.833	54.56	2.883	8.03	3.93	4.98
0.800	6.83	1.850	29.17	2.900	8.03	3.95	4.98
0.817	6.83	1.867	29.17	2.917	8.03	3.97	4.98
0.833	6.83	1.883	29.17	2.933	8.03	3.98	4.98
0.850	8.41	1.900	29.17	2.950	8.03	4.00	4.98
0.867	8.41	1.917	29.17	2.967	8.03	4.02	4.70
0.883	8.41	1.933	29.17	2.983	8.03	4.03	4.70
0.900	8.41	1.950	29.17	3.000	8.03	4.05	4.70
0.917	8.41	1.967	29.17	3.017	7.24	4.07	4.70
0.933	8.41	1.983	29.17	3.033	7.24	4.08	4.70
0.950	8.41	2.000	29.17	3.050	7.24	4.10	4.70
0.967	8.41	2.017	19.28	3.067	7.24	4.12	4.70
0.983	8.41	2.033	19.28	3.083	7.24	4.13	4.70
1.000	8.41	2.050	19.28	3.100	7.24	4.15	4.70
1.017	11.07	2.067	19.28	3.117	7.24	4.17	4.70
1.033	11.07	2.083	19.28	3.133	7.24		
1.050	11.07	2.100	19.28	3.150	7.24		

Max.Eff.Inten.(mm/hr)= 205.92 172.65
over (min) 5.00 8.00
Storage Coeff. (min)= 3.34 (ii) 7.00 (ii)
Unit Hyd. Tpeak (min)= 5.00 8.00
Unit Hyd. peak (cms)= 0.29 0.15

TOTALS

PEAK FLOW (cms)= 5.01 1.36
TIME TO PEAK (hrs)= 1.67 1.75
RUNOFF VOLUME (mm)= 83.10 31.41
TOTAL RAINFALL (mm)= 83.90 83.90
RUNOFF COEFFICIENT = 0.99 0.37 0.68

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 50.0 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.

DUHYD (0030)				
Inlet Cap.= 1.827				
#of Inlets= 1				
Total(cms)= 1.8	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
TOTAL HYD.(ID= 1):	19.20	6.06	1.68	57.26
MAJOR SYS.(ID= 2):	5.24	4.24	1.68	57.26
MINOR SYS.(ID= 3):	13.96	1.83	1.55	57.26

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

AREA 2A - YIN PHASE 2 & WOODROW

CALIB				
STANDHYD (0021)	Area (ha)= 16.90			
ID= 1 DT= 5.0 min	Total Imp(%)= 38.00	Dir. Conn.(%)= 16.00		

		IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	6.42	10.48	
Dep. Storage (mm)=	0.80	23.90	
Average Slope (%)=	2.00	2.00	
Length (m)=	335.66	40.00	
Mannings n =	0.013	0.250	

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

		TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	1.167	11.07	2.250	14.83	3.33	6.60		
0.167	0.00	1.250	16.86	2.333	14.83	3.42	6.10		
0.250	4.50	1.333	16.86	2.417	12.12	3.50	6.10		

0.333	4.50	1.417	41.07	2.500	12.12	3.58	5.66
0.417	5.05	1.500	41.07	2.583	10.31	3.67	5.66
0.500	5.05	1.583	205.92	2.667	10.31	3.75	5.28
0.583	5.82	1.667	205.92	2.750	9.02	3.83	5.28
0.667	5.82	1.750	54.56	2.833	9.02	3.92	4.98
0.750	6.83	1.833	54.56	2.917	8.03	4.00	4.98
0.833	6.83	1.917	29.17	3.000	8.03	4.08	4.70
0.917	8.41	2.000	29.17	3.083	7.24	4.17	4.70
1.000	8.41	2.083	19.28	3.167	7.24		
1.083	11.07	2.167	19.28	3.250	6.60		

Max.Eff.Inten.(mm/hr)= 205.92 35.42
over (min) 5.00 15.00
Storage Coeff. (min)= 3.21 (ii) 13.90 (ii)
Unit Hyd. Tpeak (min)= 5.00 15.00
Unit Hyd. peak (cms)= 0.27 0.08

TOTALS

PEAK FLOW (cms)= 1.49 0.66 1.721 (iii)
TIME TO PEAK (hrs)= 1.67 1.83 1.67
RUNOFF VOLUME (mm)= 83.10 17.30 27.83
TOTAL RAINFALL (mm)= 83.90 83.90 83.90
RUNOFF COEFFICIENT = 0.99 0.21 0.33

***** 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* = 50.0 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 2A - SWM POND

RESERVOIR(0210)	OVERFLOW IS OFF			
IN= 2---> OUT= 1				
DT= 5.0 min				
-----	OUTFLOW	STORAGE	OUTFLOW	STORAGE
	(cms)	(ha.m.)	(cms)	(ha.m.)
	0.0000	0.0000	0.3900	0.0820
	0.0200	0.0000	0.4300	0.1090
	0.0800	0.0020	0.5800	0.2670
	0.2100	0.0160	0.6360	0.3420
	0.3000	0.0330	0.0000	0.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0021)	16.900	1.721	1.67	27.83
OUTFLOW: ID= 1 (0210)	16.900	0.482	2.33	27.83

PEAK FLOW REDUCTION [Qout/Qin](%)= 27.97
TIME SHIFT OF PEAK FLOW (min)= 40.00
MAXIMUM STORAGE USED (ha.m.)= 0.1634

DUHYD (0211)				
Inlet Cap.= 0.280				
#of Inlets= 1				
Total(cms)= 0.3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
TOTAL HYD.(ID= 1):	16.90	0.48	2.33	27.83
MAJOR SYS.(ID= 2):	4.71	0.20	2.33	27.83
MINOR SYS.(ID= 3):	12.19	0.28	1.67	27.83

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

AREA 2C - IAM BOULEVARD

CALIB				
STANDHYD (0023)	Area (ha)= 0.80			
ID= 1 DT= 1.0 min	Total Imp(%)= 90.00	Dir. Conn.(%)= 45.00		

		IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.72	0.08	
Dep. Storage (mm)=	0.80	16.50	
Average Slope (%)=	1.00	1.00	
Length (m)=	73.03	40.00	
Mannings n =	0.013	0.250	

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 MIN. TIME STEP.

		TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.017	0.00	1.067	11.07	2.117	19.28	3.17	7.24		
0.033	0.00	1.083	11.07	2.133	19.28	3.18	6.60		
0.050	0.00	1.100	11.07	2.150	19.28	3.20	6.60		
0.067	0.00	1.117	11.07	2.167	19.28	3.22	6.60		
0.083	0.00	1.133	11.07	2.183	14.83	3.23	6.60		
0.100	0.00	1.150	11.07	2.200	14.83	3.25	6.60		
0.117	0.00	1.167	11.07	2.217	14.83	3.27	6.60		
0.133	0.00	1.183	16.86	2.233	14.83	3.28	6.60		
0.150	0.00	1.200	16.86	2.250	14.83	3.30	6.60		
0.167	0.00	1.217	16.86	2.267	14.83	3.32	6.60		
0.183	4.50	1.233	16.86	2.283	14.83	3.33	6.60		
0.200	4.50	1.250	16.86	2.300	14.83	3.35	6.10		
0.217	4.50	1.267	16.86	2.317	14.83	3.37	6.10		
0.233	4.50	1.283	16.86	2.333	14.83	3.38	6.10		
0.250	4.50	1.300	16.86	2.350	12.12	3.40	6.10		
0.267	4.50	1.317	16.86	2.367	12.12	3.42	6.10		
0.283	4.50	1.333	16.86	2.383	12.12	3.43	6.10		

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0.300	4.50	1.350	41.07	2.400	12.12	3.45	6.10
0.317	4.50	1.367	41.07	2.417	12.12	3.47	6.10
0.333	4.50	1.383	41.07	2.433	12.12	3.48	6.10
0.350	5.05	1.400	41.07	2.450	12.12	3.50	6.10
0.367	5.05	1.417	41.07	2.467	12.12	3.52	5.66
0.383	5.05	1.433	41.07	2.483	12.12	3.53	5.66
0.400	5.05	1.450	41.07	2.500	12.12	3.55	5.66
0.417	5.05	1.467	41.07	2.517	10.31	3.57	5.66
0.433	5.05	1.483	41.07	2.533	10.31	3.58	5.66
0.450	5.05	1.500	41.07	2.550	10.31	3.60	5.66
0.467	5.05	1.517	205.91	2.567	10.31	3.62	5.66
0.483	5.05	1.533	205.92	2.583	10.31	3.63	5.66
0.500	5.05	1.550	205.92	2.600	10.31	3.65	5.66
0.517	5.82	1.567	205.92	2.617	10.31	3.67	5.66
0.533	5.82	1.583	205.92	2.633	10.31	3.68	5.28
0.550	5.82	1.600	205.92	2.650	10.31	3.70	5.28
0.567	5.82	1.617	205.92	2.667	10.31	3.72	5.28
0.583	5.82	1.633	205.92	2.683	9.02	3.73	5.28
0.600	5.82	1.650	205.92	2.700	9.02	3.75	5.28
0.617	5.82	1.667	205.92	2.717	9.02	3.77	5.28
0.633	5.82	1.683	54.57	2.733	9.02	3.78	5.28
0.650	5.82	1.700	54.56	2.750	9.02	3.80	5.28
0.667	5.82	1.717	54.56	2.767	9.02	3.82	5.28
0.683	6.83	1.733	54.56	2.783	9.02	3.83	5.28
0.700	6.83	1.750	54.56	2.800	9.02	3.85	4.98
0.717	6.83	1.767	54.56	2.817	9.02	3.87	4.98
0.733	6.83	1.783	54.56	2.833	9.02	3.88	4.98
0.750	6.83	1.800	54.56	2.850	8.03	3.90	4.98
0.767	6.83	1.817	54.56	2.867	8.03	3.92	4.98
0.783	6.83	1.833	54.56	2.883	8.03	3.93	4.98
0.800	6.83	1.850	29.17	2.900	8.03	3.95	4.98
0.817	6.83	1.867	29.17	2.917	8.03	3.97	4.98
0.833	6.83	1.883	29.17	2.933	8.03	3.98	4.98
0.850	8.41	1.900	29.17	2.950	8.03	4.00	4.98
0.867	8.41	1.917	29.17	2.967	8.03	4.02	4.70
0.883	8.41	1.933	29.17	2.983	8.03	4.03	4.70
0.900	8.41	1.950	29.17	3.000	8.03	4.05	4.70
0.917	8.41	1.967	29.17	3.017	7.24	4.07	4.70
0.933	8.41	1.983	29.17	3.033	7.24	4.08	4.70
0.950	8.41	2.000	29.17	3.050	7.24	4.10	4.70
0.967	8.41	2.017	19.28	3.067	7.24	4.12	4.70
0.983	8.41	2.033	19.28	3.083	7.24	4.13	4.70
1.000	8.41	2.050	19.28	3.100	7.24	4.15	4.70
1.017	11.07	2.067	19.28	3.117	7.24	4.17	4.70
1.033	11.07	2.083	19.28	3.133	7.24		
1.050	11.07	2.100	19.28	3.150	7.24		

Max.Eff.Inten.(mm/hr)= 205.92 801.64
over (min) 5.00 6.00
Storage Coeff. (min)= 1.58 (ii) 5.15 (ii)
Unit Hyd. Tpeak (min)= 5.00 6.00
Unit Hyd. peak (cms)= 0.41 0.21

TOTALS

PEAK FLOW (cms)= 0.20 0.15 0.340 (iii)
TIME TO PEAK (hrs)= 1.67 1.70 1.68
RUNOFF VOLUME (mm)= 83.10 57.24 68.87
TOTAL RAINFALL (mm)= 83.90 83.90 83.90
RUNOFF COEFFICIENT = 0.99 0.68 0.82

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

DUHYD (0230)				
Inlet Cap.= 0.015				
#of Inlets= 1				
Total(cms)= 0.0				

TOTAL HYD.(ID= 1):	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
	0.80	0.34	1.68	68.87
=====				
MAJOR SYS.(ID= 2):	0.54	0.33	1.68	68.87
MINOR SYS.(ID= 3):	0.26	0.01	1.22	68.87

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

AREA 2D - ORCHARD SQUARE

CALIB			
STANDHYD (0024)	Area (ha)=	1.40	
ID= 1 DT= 1.0 min	Total Imp(%)=	90.00	Dir. Conn.(%)= 45.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	1.26	0.14
Dep. Storage	(mm)=	0.80	16.50
Average Slope	(%)=	1.00	1.00
Length	(m)=	96.61	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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
0.017	0.00	1.067	11.07	2.117	19.28	3.17	7.24
0.033	0.00	1.083	11.07	2.133	19.28	3.18	6.60
0.050	0.00	1.100	11.07	2.150	19.28	3.20	6.60
0.067	0.00	1.117	11.07	2.167	19.28	3.22	6.60
0.083	0.00	1.133	11.07	2.183	14.83	3.23	6.60
0.100	0.00	1.150	11.07	2.200	14.83	3.25	6.60
0.117	0.00	1.167	11.07	2.217	14.83	3.27	6.60
0.133	0.00	1.183	16.86	2.233	14.83	3.28	6.60

0.150	0.00	1.200	16.86	2.250	14.83	3.30	6.60
0.167	0.00	1.217	16.86	2.267	14.83	3.32	6.60
0.183	4.50	1.233	16.86	2.283	14.83	3.33	6.60
0.200	4.50	1.250	16.86	2.300	14.83	3.35	6.10
0.217	4.50	1.267	16.86	2.317	14.83	3.37	6.10
0.233	4.50	1.283	16.86	2.333	14.83	3.38	6.10
0.250	4.50	1.300	16.86	2.350	12.12	3.40	6.10
0.267	4.50	1.317	16.86	2.367	12.12	3.42	6.10
0.283	4.50	1.333	16.86	2.383	12.12	3.43	6.10
0.300	4.50	1.350	41.07	2.400	12.12	3.45	6.10
0.317	4.50	1.367	41.07	2.417	12.12	3.47	6.10
0.333	4.50	1.383	41.07	2.433	12.12	3.48	6.10
0.350	5.05	1.400	41.07	2.450	12.12	3.50	6.10
0.367	5.05	1.417	41.07	2.467	12.12	3.52	5.66
0.383	5.05	1.433	41.07	2.483	12.12	3.53	5.66
0.400	5.05	1.450	41.07	2.500	12.12	3.55	5.66
0.417	5.05	1.467	41.07	2.517	10.31	3.57	5.66
0.433	5.05	1.483	41.07	2.533	10.31	3.58	5.66
0.450	5.05	1.500	41.07	2.550	10.31	3.60	5.66
0.467	5.05	1.517	205.91	2.567	10.31	3.62	5.66
0.483	5.05	1.533	205.92	2.583	10.31	3.63	5.66
0.500	5.05	1.550	205.92	2.600	10.31	3.65	5.66
0.517	5.82	1.567	205.92	2.617	10.31	3.67	5.66
0.533	5.82	1.583	205.92	2.633	10.31	3.68	5.28
0.550	5.82	1.600	205.92	2.650	10.31	3.70	5.28
0.567	5.82	1.617	205.92	2.667	10.31	3.72	5.28
0.583	5.82	1.633	205.92	2.683	9.02	3.73	5.28
0.600	5.82	1.650	205.92	2.700	9.02	3.75	5.28
0.617	5.82	1.667	205.92	2.717	9.02	3.77	5.28
0.633	5.82	1.683	54.57	2.733	9.02	3.78	5.28
0.650	5.82	1.700	54.56	2.750	9.02	3.80	5.28
0.667	5.82	1.717	54.56	2.767	9.02	3.82	5.28
0.683	6.83	1.733	54.56	2.783	9.02	3.83	5.28
0.700	6.83	1.750	54.56	2.800	9.02	3.85	4.98
0.717	6.83	1.767	54.56	2.817	9.02	3.87	4.98
0.733	6.83	1.783	54.56	2.833	9.02	3.88	4.98
0.750	6.83	1.800	54.56	2.850	8.03	3.90	4.98
0.767	6.83	1.817	54.56	2.867	8.03	3.92	4.98
0.783	6.83	1.833	54.56	2.883	8.03	3.93	4.98
0.800	6.83	1.850	29.17	2.900	8.03	3.95	4.98
0.817	6.83	1.867	29.17	2.917	8.03	3.97	4.98
0.833	6.83	1.883	29.17	2.933	8.03	3.98	4.98
0.850	8.41	1.900	29.17	2.950	8.03	4.00	4.98
0.867	8.41	1.917	29.17	2.967	8.03	4.02	4.70
0.883	8.41	1.933	29.17	2.983	8.03	4.03	4.70
0.900	8.41	1.950	29.17	3.000	8.03	4.05	4.70
0.917	8.41	1.967	29.17	3.017	7.24	4.07	4.70
0.933	8.41	1.983	29.17	3.033	7.24	4.08	4.70
0.950	8.41	2.000	29.17	3.050	7.24	4.10	4.70
0.967	8.41	2.017	19.28	3.067	7.24	4.12	4.70
0.983	8.41	2.033	19.28	3.083	7.24	4.13	4.70
1.000	8.41	2.050	19.28	3.100	7.24	4.15	4.70
1.017	11.07	2.067	19.28	3.117	7.24	4.17	4.70
1.033	11.07	2.083	19.28	3.133	7.24		
1.050	11.07	2.100	19.28	3.150	7.24		

Max.Eff.Inten.(mm/hr)= 205.92 801.64
over (min) 5.00 6.00
Storage Coeff. (min)= 1.87 (ii) 5.44 (ii)
Unit Hyd. Tpeak (min)= 5.00 6.00
Unit Hyd. peak (cms)= 0.38 0.20

TOTALS

PEAK FLOW (cms)= 0.35 0.25 0.589 (iii)
TIME TO PEAK (hrs)= 1.67 1.70 1.68
RUNOFF VOLUME (mm)= 83.10 57.24 68.88
TOTAL RAINFALL (mm)= 83.90 83.90 83.90
RUNOFF COEFFICIENT = 0.99 0.68 0.82

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

DUHYD (0240)				
Inlet Cap.= 0.015				
#of Inlets= 1				
Total(cms)= 0.0				

TOTAL HYD.(ID= 1):	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
	1.40	0.59	1.68	68.88
=====				
MAJOR SYS.(ID= 2):	1.11	0.57	1.68	68.88
MINOR SYS.(ID= 3):	0.29	0.01	0.95	68.88

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD CURRENT DEVELOPMENTS

ADD HYD (1001)				
1 + 2 = 3				

ID1= 1 (0010):	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
+ ID2= 2 (0211):	29.21	1.020	1.55	25.29
	12.19	0.280	1.67	27.83
=====				
ID = 3 (1001):	41.41	1.300	1.67	26.04

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)				
3 + 2 = 1	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)

ID1= 3 (1001):	41.41	1.300	1.67	26.04

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```
+ ID2= 2 ( 0220):  11.82  0.028  4.50  22.49
=====
ID = 1 ( 1001):  53.23  1.324  2.38  25.25
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 1001) |
| 1 + 2 = 3 |
|-----|
| AREA QPEAK TPEAK R.V. |
| (ha) (cms) (hrs) (mm) |
|-----|
| ID1= 1 ( 1001):  53.23  1.324  2.38  25.25 |
| + ID2= 2 ( 0230):  0.26  0.015  1.22  68.87 |
|-----|
| ID = 3 ( 1001):  53.48  1.339  2.38  25.46 |
|-----|
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 1001) |
| 3 + 2 = 1 |
|-----|
| AREA QPEAK TPEAK R.V. |
| (ha) (cms) (hrs) (mm) |
|-----|
| ID1= 3 ( 1001):  53.48  1.339  2.38  25.46 |
| + ID2= 2 ( 0240):  0.29  0.015  0.95  68.88 |
|-----|
| ID = 1 ( 1001):  53.77  1.354  2.38  25.69 |
|-----|
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 1001) |
| 1 + 2 = 3 |
|-----|
| AREA QPEAK TPEAK R.V. |
| (ha) (cms) (hrs) (mm) |
|-----|
| ID1= 1 ( 1001):  53.77  1.354  2.38  25.69 |
| + ID2= 2 ( 0030):  13.96  1.827  1.55  57.26 |
|-----|
| ID = 3 ( 1001):  67.73  3.176  1.93  32.20 |
|-----|
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

AREA 5 - CHARLES

```
-----
| CALIB |
| STANDHYD ( 0005) |
| ID= 1 DT= 5.0 min |
|-----|
| Area (ha)= 4.35 |
| Total Imp(%)= 46.00 |
| Dir. Conn.(%)= 21.00 |
|-----|
```

```
-----
| IMPERVIOUS PERVIOUS (i) |
| Surface Area (ha)= 2.00 2.35 |
| Dep. Storage (mm)= 1.00 13.60 |
| Average Slope (%)= 1.00 2.00 |
| Length (m)= 170.29 40.00 |
| Mannings n = 0.013 0.250 |
|-----|
```

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

```
-----
| TIME RAIN | TIME RAIN | ' TIME RAIN | TIME RAIN |
| hrs mm/hr | hrs mm/hr | ' hrs mm/hr | hrs mm/hr |
|-----|
| 0.083 0.00 | 1.167 11.07 | ' 2.250 14.83 | 3.33 6.60 |
| 0.167 0.00 | 1.250 16.86 | 2.333 14.83 | 3.42 6.10 |
| 0.250 4.50 | 1.333 16.86 | 2.417 12.12 | 3.50 6.10 |
| 0.333 4.50 | 1.417 41.07 | 2.500 12.12 | 3.58 5.66 |
| 0.417 5.05 | 1.500 41.07 | 2.583 10.31 | 3.67 5.66 |
| 0.500 5.05 | 1.583 205.92 | 2.667 10.31 | 3.75 5.28 |
| 0.583 5.82 | 1.667 205.92 | 2.750 9.02 | 3.83 5.28 |
| 0.667 5.82 | 1.750 54.56 | 2.833 9.02 | 3.92 4.98 |
| 0.750 6.83 | 1.833 54.56 | 2.917 8.03 | 4.00 4.98 |
| 0.833 6.83 | 1.917 29.17 | 3.000 8.03 | 4.08 4.70 |
| 0.917 8.41 | 2.000 29.17 | 3.083 7.24 | 4.17 4.70 |
| 1.000 8.41 | 2.083 19.28 | 3.167 7.24 | 4.17 4.70 |
| 1.083 11.07 | 2.167 19.28 | 3.250 6.60 | 4.17 4.70 |
|-----|
```

```
Max.Eff.Inten.(mm/hr)= 205.92 98.62
over (min)= 5.00 10.00
Storage Coeff. (min)= 2.63 (ii) 9.73 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.29 0.11
PEAK FLOW (cms)= 0.51 0.42
TIME TO PEAK (hrs)= 1.67 1.75
RUNOFF VOLUME (mm)= 82.90 30.75
TOTAL RAINFALL (mm)= 83.90 83.90
RUNOFF COEFFICIENT = 0.99 0.37
*TOTALS*
0.817 (iii)
```

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 62.0 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.

```
-----
| DUHYD ( 0050) |
| Inlet Cap.= 0.023 |
| #of Inlets= 1 |
| Total(cms)= 0.0 |
|-----|
| AREA QPEAK TPEAK R.V. |
| (ha) (cms) (hrs) (mm) |
|-----|
| TOTAL HYD.(ID= 1):  4.35  0.82  1.67  41.70 |
|-----|
| MAJOR SYS.(ID= 2):  3.59  0.79  1.67  41.70 |
| MINOR SYS.(ID= 3):  0.76  0.02  1.08  41.70 |
|-----|
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

AREA 4 - THOMPSON

```
-----
| CALIB |
| STANDHYD ( 0004) |
| ID= 1 DT= 5.0 min |
|-----|
| Area (ha)= 7.85 |
| Total Imp(%)= 46.00 |
| Dir. Conn.(%)= 22.00 |
|-----|
```

```
-----
| IMPERVIOUS PERVIOUS (i) |
| Surface Area (ha)= 3.61 4.24 |
| Dep. Storage (mm)= 1.00 8.10 |
| Average Slope (%)= 1.00 2.00 |
| Length (m)= 228.76 40.00 |
| Mannings n = 0.013 0.250 |
|-----|
```

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

```
-----
| TIME RAIN | TIME RAIN | ' TIME RAIN | TIME RAIN |
| hrs mm/hr | hrs mm/hr | ' hrs mm/hr | hrs mm/hr |
|-----|
| 0.083 0.00 | 1.167 11.07 | 2.250 14.83 | 3.33 6.60 |
| 0.167 0.00 | 1.250 16.86 | 2.333 14.83 | 3.42 6.10 |
| 0.250 4.50 | 1.333 16.86 | 2.417 12.12 | 3.50 6.10 |
| 0.333 4.50 | 1.417 41.07 | 2.500 12.12 | 3.58 5.66 |
| 0.417 5.05 | 1.500 41.07 | 2.583 10.31 | 3.67 5.66 |
| 0.500 5.05 | 1.583 205.92 | 2.667 10.31 | 3.75 5.28 |
| 0.583 5.82 | 1.667 205.92 | 2.750 9.02 | 3.83 5.28 |
| 0.667 5.82 | 1.750 54.56 | 2.833 9.02 | 3.92 4.98 |
| 0.750 6.83 | 1.833 54.56 | 2.917 8.03 | 4.00 4.98 |
| 0.833 6.83 | 1.917 29.17 | 3.000 8.03 | 4.08 4.70 |
| 0.917 8.41 | 2.000 29.17 | 3.083 7.24 | 4.17 4.70 |
| 1.000 8.41 | 2.083 19.28 | 3.167 7.24 | 4.17 4.70 |
| 1.083 11.07 | 2.167 19.28 | 3.250 6.60 | 4.17 4.70 |
|-----|
```

```
Max.Eff.Inten.(mm/hr)= 205.92 143.32
over (min)= 5.00 10.00
Storage Coeff. (min)= 3.14 (ii) 9.26 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.27 0.12
```

TOTALS

```
PEAK FLOW (cms)= 0.95 1.10 1.820 (iii)
TIME TO PEAK (hrs)= 1.67 1.75 1.67
RUNOFF VOLUME (mm)= 82.90 41.79 50.84
TOTAL RAINFALL (mm)= 83.90 83.90 83.90
RUNOFF COEFFICIENT = 0.99 0.50 0.61
```

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 72.0 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.

```
-----
| DUHYD ( 0040) |
| Inlet Cap.= 0.084 |
| #of Inlets= 1 |
| Total(cms)= 0.1 |
|-----|
| AREA QPEAK TPEAK R.V. |
| (ha) (cms) (hrs) (mm) |
|-----|
| TOTAL HYD.(ID= 1):  7.85  1.82  1.67  50.84 |
|-----|
| MAJOR SYS.(ID= 2):  5.79  1.74  1.67  50.84 |
| MINOR SYS.(ID= 3):  2.06  0.08  1.33  50.84 |
|-----|
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD CHARLES & THOMPSON DEVELOPMENTS

```
-----
| ADD HYD ( 1002) |
| 1 + 2 = 3 |
|-----|
| AREA QPEAK TPEAK R.V. |
| (ha) (cms) (hrs) (mm) |
|-----|
| ID1= 1 ( 1001):  67.73  3.176  1.93  32.20 |
| + ID2= 2 ( 0040):  2.06  0.084  1.33  50.84 |
|-----|
| ID = 3 ( 1002):  69.79  3.260  1.93  32.75 |
|-----|
```

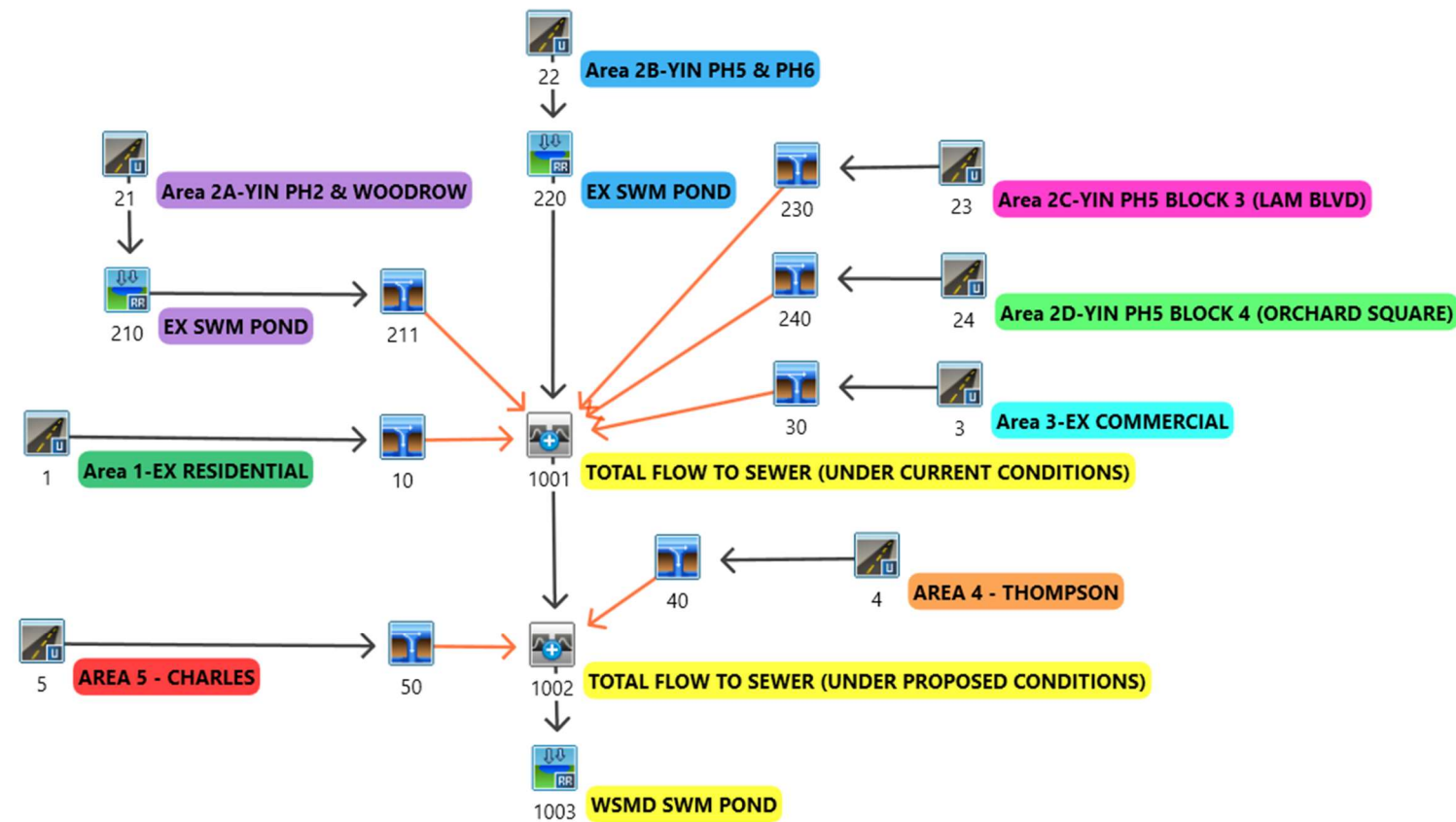
NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 1002) |
| 3 + 2 = 1 |
|-----|
| AREA QPEAK TPEAK R.V. |
| (ha) (cms) (hrs) (mm) |
|-----|
| ID1= 3 ( 1002):  69.79  3.260  1.93  32.75 |
| + ID2= 2 ( 0050):  0.76  0.023  1.08  41.70 |
|-----|
| ID = 1 ( 1002):  70.55  3.283  1.93  32.84 |
|-----|
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

FINISH

Revised Waterford Municipal Drain Design
With WSMD Stormwater Management Pond
Visual OTTHYMO MODEL



2-Year Storm Event

```
=====
V  V  I  SSSSS  U  U  A  L  (v 6.2.2015)
V  V  I  SS  U  U  A  A  L
V  V  I  SS  U  U  AAAAA  L
V  V  I  SS  U  U  A  A  L
VV  I  SSSSS  UUUUU  A  A  LLLLL

OOO  TTTT  TTTT  H  H  Y  Y  M  M  OOO  TM
O  O  T  T  H  H  Y  Y  M  M  O  O
O  O  T  T  H  H  Y  Y  M  M  O  O
OOO  T  T  H  H  Y  Y  M  M  OOO

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***** D E T A I L E D   O U T P U T *****

Input  filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voindat
Output filename: C:\Users\Natalie\AppData\Local\Civica\XH5\2b61f5e3-29d9-4c68-
a5ec-7ff64ecb31ab\caabad9e-8acc-4ac4-95f1-8956fa0d75e6\scen
Summary filename: C:\Users\Natalie\AppData\Local\Civica\XH5\2b61f5e3-29d9-4c68-
a5ec-7ff64ecb31ab\caabad9e-8acc-4ac4-95f1-8956fa0d75e6\scen

DATE: 12/12/2023                TIME: 04:13:06

USER:

COMMENTS:

*****
** SIMULATION : Norfolk 2yr 4hr **
*****

-----
| READ STORM | | Filename: C:\Users\Natalie\AppData
| | | | ata\Local\Temp\
| | | | af0cd1e9-1134-4877-b265-9cfe8f6625c1\53d15c3
| Ptotal= 39.38 mm | | Comments: Norfolk 2yr 4hr
| | | |
|-----|

TIME  RAIN | TIME  RAIN | TIME  RAIN | TIME  RAIN
hrs   mm/hr | hrs   mm/hr | '   hrs   mm/hr | hrs   mm/hr
```

0.00	0.00	1.17	8.94	2.33	7.01	3.50	3.89
0.17	3.25	1.33	16.92	2.50	6.20	3.67	3.68
0.33	3.56	1.50	78.82	2.67	5.59	3.83	3.51
0.50	3.96	1.67	21.89	2.83	5.11	4.00	3.35
0.67	4.52	1.83	13.00	3.00	4.72		
0.83	5.31	2.00	9.88	3.17	4.39		
1.00	6.55	2.17	8.15	3.33	4.11		

AREA 1 - EXISTING RESIDENTIAL

CALIB							
STANDHYD (0001)	Area	(ha)=	40.00				
ID= 1 DT= 1.0 min	Total Imp(%)=	30.00		Dir. Conn.(%)=	15.00		

Surface Area	(ha)=	12.00	IMPERVIOUS	PERVIOUS (i)
Dep. Storage	(mm)=	0.80	28.00	
Average Slope	(%)=	2.00	23.90	
Length	(m)=	516.40	2.00	
Mannings n	=	0.013	40.00	
			0.250	

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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
0.017	0.00	1.067	6.55	2.117	9.88	3.17	4.72	
0.033	0.00	1.083	6.55	2.133	9.88	3.18	4.39	
0.050	0.00	1.100	6.55	2.150	9.88	3.20	4.39	
0.067	0.00	1.117	6.55	2.167	9.88	3.22	4.39	
0.083	0.00	1.133	6.55	2.183	8.15	3.23	4.39	
0.100	0.00	1.150	6.55	2.200	8.15	3.25	4.39	
0.117	0.00	1.167	6.55	2.217	8.15	3.27	4.39	
0.133	0.00	1.183	8.94	2.233	8.15	3.28	4.39	
0.150	0.00	1.200	8.94	2.250	8.15	3.30	4.39	
0.167	0.00	1.217	8.94	2.267	8.15	3.32	4.39	
0.183	3.25	1.233	8.94	2.283	8.15	3.33	4.39	
0.200	3.25	1.250	8.94	2.300	8.15	3.35	4.11	
0.217	3.25	1.267	8.94	2.317	8.15	3.37	4.11	
0.233	3.25	1.283	8.94	2.333	8.15	3.38	4.11	
0.250	3.25	1.300	8.94	2.350	7.01	3.40	4.11	
0.267	3.25	1.317	8.94	2.367	7.01	3.42	4.11	
0.283	3.25	1.333	8.94	2.383	7.01	3.43	4.11	
0.300	3.25	1.350	16.92	2.400	7.01	3.45	4.11	
0.317	3.25	1.367	16.92	2.417	7.01	3.47	4.11	

Revised Waterford Municipal Drain Design
With WSMD Stormwater Management Pond
Visual OTTHYMO MODEL

2-Year Storm Event

0.333	3.25	1.383	16.92	2.433	7.01	3.48	4.11
0.350	3.56	1.400	16.92	2.450	7.01	3.50	4.11
0.367	3.56	1.417	16.92	2.467	7.01	3.52	3.89
0.383	3.56	1.433	16.92	2.483	7.01	3.53	3.89
0.400	3.56	1.450	16.92	2.500	7.01	3.55	3.89
0.417	3.56	1.467	16.92	2.517	6.20	3.57	3.89
0.433	3.56	1.483	16.92	2.533	6.20	3.58	3.89
0.450	3.56	1.500	16.92	2.550	6.20	3.60	3.89
0.467	3.56	1.517	78.82	2.567	6.20	3.62	3.89
0.483	3.56	1.533	78.82	2.583	6.20	3.63	3.89
0.500	3.56	1.550	78.82	2.600	6.20	3.65	3.89
0.517	3.96	1.567	78.82	2.617	6.20	3.67	3.89
0.533	3.96	1.583	78.82	2.633	6.20	3.68	3.68
0.550	3.96	1.600	78.82	2.650	6.20	3.70	3.68
0.567	3.96	1.617	78.82	2.667	6.20	3.72	3.68
0.583	3.96	1.633	78.82	2.683	5.59	3.73	3.68
0.600	3.96	1.650	78.82	2.700	5.59	3.75	3.68
0.617	3.96	1.667	78.82	2.717	5.59	3.77	3.68
0.633	3.96	1.683	21.89	2.733	5.59	3.78	3.68
0.650	3.96	1.700	21.89	2.750	5.59	3.80	3.68
0.667	3.96	1.717	21.89	2.767	5.59	3.82	3.68
0.683	4.52	1.733	21.89	2.783	5.59	3.83	3.68
0.700	4.52	1.750	21.89	2.800	5.59	3.85	3.51
0.717	4.52	1.767	21.89	2.817	5.59	3.87	3.51
0.733	4.52	1.783	21.89	2.833	5.59	3.88	3.51
0.750	4.52	1.800	21.89	2.850	5.11	3.90	3.51
0.767	4.52	1.817	21.89	2.867	5.11	3.92	3.51
0.783	4.52	1.833	21.89	2.883	5.11	3.93	3.51
0.800	4.52	1.850	13.00	2.900	5.11	3.95	3.51
0.817	4.52	1.867	13.00	2.917	5.11	3.97	3.51
0.833	4.52	1.883	13.00	2.933	5.11	3.98	3.51
0.850	5.31	1.900	13.00	2.950	5.11	4.00	3.51
0.867	5.31	1.917	13.00	2.967	5.11	4.02	3.35
0.883	5.31	1.933	13.00	2.983	5.11	4.03	3.35
0.900	5.31	1.950	13.00	3.000	5.11	4.05	3.35
0.917	5.31	1.967	13.00	3.017	4.72	4.07	3.35
0.933	5.31	1.983	13.00	3.033	4.72	4.08	3.35
0.950	5.31	2.000	13.00	3.050	4.72	4.10	3.35
0.967	5.31	2.017	9.88	3.067	4.72	4.12	3.35
0.983	5.31	2.033	9.88	3.083	4.72	4.13	3.35
1.000	5.31	2.050	9.88	3.100	4.72	4.15	3.35
1.017	6.55	2.067	9.88	3.117	4.72	4.17	3.35
1.033	6.55	2.083	9.88	3.133	4.72		
1.050	6.55	2.100	9.88	3.150	4.72		

Max.Eff.Inten.(mm/hr)= 78.82 0.98
over (min) 6.00 52.00
Storage Coeff. (min)= 6.11 (ii) 51.09 (ii)
Unit Hyd. Tpeak (min)= 6.00 52.00
Unit Hyd. peak (cms)= 0.19 0.02

TOTALS
PEAK FLOW (cms)= 1.02 0.06 1.017 (iii)
TIME TO PEAK (hrs)= 1.70 1.70
RUNOFF VOLUME (mm)= 38.58 1.70 7.23
TOTAL RAINFALL (mm)= 39.39 39.39
RUNOFF COEFFICIENT = 0.98 0.04 0.18

***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 50.0 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.

DUHYD (0010)				
Inlet Cap.= 1.020				
#of Inlets= 1				
Total(cms)= 1.0	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)

TOTAL HYD.(ID= 1):	40.00	1.02	1.70	7.23
=====				
MAJOR SYS.(ID= 2):	0.00	0.00	0.00	0.00
MINOR SYS.(ID= 3):	40.00	1.02	1.70	7.23

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.				

AREA 2B - YIN PHASE 5 AND PHASE 6

CALIB				
STANDHYD (0022)	Area (ha)=	11.82		
ID= 1 DT= 1.0 min	Total Imp(%)=	47.00	Dir. Conn.(%)=	22.00

	IMPERVIOUS	PERVIOUS (i)		
Surface Area (ha)=	5.56	6.26		
Dep. Storage (mm)=	0.80	16.50		
Average Slope (%)=	1.00	1.00		
Length (m)=	280.71	40.00		
Mannings n =	0.013	0.250		

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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
0.017	0.00	1.067	6.55	2.117	9.88	3.17	4.72
0.033	0.00	1.083	6.55	2.133	9.88	3.18	4.39

0.050	0.00	1.100	6.55	2.150	9.88	3.20	4.39
0.067	0.00	1.117	6.55	2.167	9.88	3.22	4.39
0.083	0.00	1.133	6.55	2.183	8.15	3.23	4.39
0.100	0.00	1.150	6.55	2.200	8.15	3.25	4.39
0.117	0.00	1.167	6.55	2.217	8.15	3.27	4.39
0.133	0.00	1.183	8.94	2.233	8.15	3.28	4.39
0.150	0.00	1.200	8.94	2.250	8.15	3.30	4.39
0.167	0.00	1.217	8.94	2.267	8.15	3.32	4.39
0.183	3.25	1.233	8.94	2.283	8.15	3.33	4.39
0.200	3.25	1.250	8.94	2.300	8.15	3.35	4.11
0.217	3.25	1.267	8.94	2.317	8.15	3.37	4.11
0.233	3.25	1.283	8.94	2.333	8.15	3.38	4.11
0.250	3.25	1.300	8.94	2.350	7.01	3.40	4.11
0.267	3.25	1.317	8.94	2.367	7.01	3.42	4.11
0.283	3.25	1.333	8.94	2.383	7.01	3.43	4.11
0.300	3.25	1.350	16.92	2.400	7.01	3.45	4.11
0.317	3.25	1.367	16.92	2.417	7.01	3.47	4.11
0.333	3.25	1.383	16.92	2.433	7.01	3.48	4.11
0.350	3.56	1.400	16.92	2.450	7.01	3.50	4.11
0.367	3.56	1.417	16.92	2.467	7.01	3.52	3.89
0.383	3.56	1.433	16.92	2.483	7.01	3.53	3.89
0.400	3.56	1.450	16.92	2.500	7.01	3.55	3.89
0.417	3.56	1.467	16.92	2.517	6.20	3.57	3.89
0.433	3.56	1.483	16.92	2.533	6.20	3.58	3.89
0.450	3.56	1.500	16.92	2.550	6.20	3.60	3.89
0.467	3.56	1.517	78.82	2.567	6.20	3.62	3.89
0.483	3.56	1.533	78.82	2.583	6.20	3.63	3.89
0.500	3.56	1.550	78.82	2.600	6.20	3.65	3.89
0.517	3.96	1.567	78.82	2.617	6.20	3.67	3.89
0.533	3.96	1.583	78.82	2.633	6.20	3.68	3.68
0.550	3.96	1.600	78.82	2.650	6.20	3.70	3.68
0.567	3.96	1.617	78.82	2.667	6.20	3.72	3.68
0.583	3.96	1.633	78.82	2.683	5.59	3.73	3.68
0.600	3.96	1.650	78.82	2.700	5.59	3.75	3.68
0.617	3.96	1.667	78.82	2.717	5.59	3.77	3.68
0.633	3.96	1.683	21.89	2.733	5.59	3.78	3.68
0.650	3.96	1.700	21.89	2.750	5.59	3.80	3.68
0.667	3.96	1.717	21.89	2.767	5.59	3.82	3.68
0.683	4.52	1.733	21.89	2.783	5.59	3.83	3.68
0.700	4.52	1.750	21.89	2.800	5.59	3.85	3.51
0.717	4.52	1.767	21.89	2.817	5.59	3.87	3.51
0.733	4.52	1.783	21.89	2.833	5.59	3.88	3.51
0.750	4.52	1.800	21.89	2.850	5.11	3.90	3.51
0.767	4.52	1.817	21.89	2.867	5.11	3.92	3.51
0.783	4.52	1.833	21.89	2.883	5.11	3.93	3.51
0.800	4.52	1.850	13.00	2.900	5.11	3.95	3.51
0.817	4.52	1.867	13.00	2.917	5.11	3.97	3.51
0.833	4.52	1.883	13.00	2.933	5.11	3.98	3.51
0.850	5.31	1.900	13.00	2.950	5.11	4.00	3.51
0.867	5.31	1.917	13.00	2.967	5.11	4.02	3.35
0.883	5.31	1.933	13.00	2.983	5.11	4.03	3.35
0.900	5.31	1.950	13.00	3.000	5.11	4.05	3.35
0.917	5.31	1.967	13.00	3.017	4.72	4.07	3.35
0.933	5.31	1.983	13.00	3.033	4.72	4.08	3.35
0.950	5.31	2.000	13.00	3.050	4.72	4.10	3.35
0.967	5.31	2.017	9.88	3.067	4.72	4.12	3.35
0.983	5.31	2.033	9.88	3.083	4.72	4.13	3.35
1.000	5.31	2.050	9.88	3.100	4.72	4.15	3.35
1.017	6.55	2.067	9.88	3.117	4.72	4.17	3.35
1.033	6.55	2.083	9.88	3.133	4.72		
1.050	6.55	2.100	9.88	3.150	4.72		

Max.Eff.Inten.(mm/hr)= 78.82 6.28
over (min) 5.00 32.00
Storage Coeff. (min)= 5.22 (ii) 31.50 (ii)
Unit Hyd. Tpeak (min)= 5.00 32.00
Unit Hyd. peak (cms)= 0.22 0.04

TOTALS
PEAK FLOW (cms)= 0.47 0.06 0.474 (iii)
TIME TO PEAK (hrs)= 1.68 2.43 1.68
RUNOFF VOLUME (mm)= 38.58 5.18 12.53
TOTAL RAINFALL (mm)= 39.39 39.39
RUNOFF COEFFICIENT = 0.98 0.13 0.32

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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 2B - SWM POND

RESERVOIR(0220)	OVERFLOW IS OFF			
IN= 2---> OUT= 1				
DT= 1.0 min	OUTFLOW	STORAGE	OUTFLOW	STORAGE
	(cms)	(ha.m.)	(cms)	(ha.m.)
	0.0000	0.0000	0.0251	0.3540
	0.0066	0.0550	0.0273	0.4180
	0.0127	0.1120	0.0294	0.4840
	0.0167	0.1700	0.0313	0.5510
	0.0199	0.2300	0.0332	0.6200
	0.0226	0.2910	0.0000	0.0000

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 2 (0022)	11.820	0.474	1.68	12.53
OUTFLOW: ID= 1 (0220)	11.820	0.014	4.90	9.08

PEAK FLOW REDUCTION [Qout/Qin](%)= 2.96
TIME SHIFT OF PEAK FLOW (min)=193.00

Revised Waterford Municipal Drain Design
With WSMD Stormwater Management Pond
Visual OTTHYMO MODEL

2-Year Storm Event

MAXIMUM STORAGE USED (ha.m.)= 0.1316

AREA 3 - EXISTING COMMERCIAL

| CALIB |
| STANDHYD (0003) | Area (ha)= 19.20
| ID= 1 DT= 1.0 min | Total Imp(%)= 80.00 Dir. Conn.(%)= 50.00

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 15.36 3.84
Dep. Storage (mm)= 0.80 23.90
Average Slope (%)= 2.00 2.00
Length (m)= 357.77 40.00
Mannings n = 0.013 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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
0.017 0.00 | 1.067 6.55 | 2.117 9.88 | 3.17 4.72
0.033 0.00 | 1.083 6.55 | 2.133 9.88 | 3.18 4.39
0.050 0.00 | 1.100 6.55 | 2.150 9.88 | 3.20 4.39
0.067 0.00 | 1.117 6.55 | 2.167 9.88 | 3.22 4.39
0.083 0.00 | 1.133 6.55 | 2.183 8.15 | 3.23 4.39
0.100 0.00 | 1.150 6.55 | 2.200 8.15 | 3.25 4.39
0.117 0.00 | 1.167 6.55 | 2.217 8.15 | 3.27 4.39
0.133 0.00 | 1.183 8.94 | 2.233 8.15 | 3.28 4.39
0.150 0.00 | 1.200 8.94 | 2.250 8.15 | 3.30 4.39
0.167 0.00 | 1.217 8.94 | 2.267 8.15 | 3.32 4.39
0.183 3.25 | 1.233 8.94 | 2.283 8.15 | 3.33 4.39
0.200 3.25 | 1.250 8.94 | 2.300 8.15 | 3.35 4.11
0.217 3.25 | 1.267 8.94 | 2.317 8.15 | 3.37 4.11
0.233 3.25 | 1.283 8.94 | 2.333 8.15 | 3.38 4.11
0.250 3.25 | 1.300 8.94 | 2.350 7.01 | 3.40 4.11
0.267 3.25 | 1.317 8.94 | 2.367 7.01 | 3.42 4.11
0.283 3.25 | 1.333 8.94 | 2.383 7.01 | 3.43 4.11
0.300 3.25 | 1.350 16.92 | 2.400 7.01 | 3.45 4.11
0.317 3.25 | 1.367 16.92 | 2.417 7.01 | 3.47 4.11
0.333 3.25 | 1.383 16.92 | 2.433 7.01 | 3.48 4.11
0.350 3.56 | 1.400 16.92 | 2.450 7.01 | 3.50 4.11
0.367 3.56 | 1.417 16.92 | 2.467 7.01 | 3.52 3.89
0.383 3.56 | 1.433 16.92 | 2.483 7.01 | 3.53 3.89
0.400 3.56 | 1.450 16.92 | 2.500 7.01 | 3.55 3.89
0.417 3.56 | 1.467 16.92 | 2.517 6.20 | 3.57 3.89
0.433 3.56 | 1.483 16.92 | 2.533 6.20 | 3.58 3.89
0.450 3.56 | 1.500 16.92 | 2.550 6.20 | 3.60 3.89
0.467 3.56 | 1.517 78.82 | 2.567 6.20 | 3.62 3.89
0.483 3.56 | 1.533 78.82 | 2.583 6.20 | 3.63 3.89
0.500 3.56 | 1.550 78.82 | 2.600 6.20 | 3.65 3.89
0.517 3.96 | 1.567 78.82 | 2.617 6.20 | 3.67 3.89
0.533 3.96 | 1.583 78.82 | 2.633 6.20 | 3.68 3.68
0.550 3.96 | 1.600 78.82 | 2.650 6.20 | 3.70 3.68
0.567 3.96 | 1.617 78.82 | 2.667 6.20 | 3.72 3.68
0.583 3.96 | 1.633 78.82 | 2.683 5.59 | 3.73 3.68
0.600 3.96 | 1.650 78.82 | 2.700 5.59 | 3.75 3.68
0.617 3.96 | 1.667 78.82 | 2.717 5.59 | 3.77 3.68
0.633 3.96 | 1.683 21.89 | 2.733 5.59 | 3.78 3.68
0.650 3.96 | 1.700 21.89 | 2.750 5.59 | 3.80 3.68
0.667 3.96 | 1.717 21.89 | 2.767 5.59 | 3.82 3.68
0.683 4.52 | 1.733 21.89 | 2.783 5.59 | 3.83 3.68
0.700 4.52 | 1.750 21.89 | 2.800 5.59 | 3.85 3.51
0.717 4.52 | 1.767 21.89 | 2.817 5.59 | 3.87 3.51
0.733 4.52 | 1.783 21.89 | 2.833 5.59 | 3.88 3.51
0.750 4.52 | 1.800 21.89 | 2.850 5.11 | 3.90 3.51
0.767 4.52 | 1.817 21.89 | 2.867 5.11 | 3.92 3.51
0.783 4.52 | 1.833 21.89 | 2.883 5.11 | 3.93 3.51
0.800 4.52 | 1.850 13.00 | 2.900 5.11 | 3.95 3.51
0.817 4.52 | 1.867 13.00 | 2.917 5.11 | 3.97 3.51
0.833 4.52 | 1.883 13.00 | 2.933 5.11 | 3.98 3.51
0.850 5.31 | 1.900 13.00 | 2.950 5.11 | 4.00 3.51
0.867 5.31 | 1.917 13.00 | 2.967 5.11 | 4.02 3.35
0.883 5.31 | 1.933 13.00 | 2.983 5.11 | 4.03 3.35
0.900 5.31 | 1.950 13.00 | 3.000 5.11 | 4.05 3.35
0.917 5.31 | 1.967 13.00 | 3.017 4.72 | 4.07 3.35
0.933 5.31 | 1.983 13.00 | 3.033 4.72 | 4.08 3.35
0.950 5.31 | 2.000 13.00 | 3.050 4.72 | 4.10 3.35
0.967 5.31 | 2.017 9.88 | 3.067 4.72 | 4.12 3.35
0.983 5.31 | 2.033 9.88 | 3.083 4.72 | 4.13 3.35
1.000 5.31 | 2.050 9.88 | 3.100 4.72 | 4.15 3.35
1.017 6.55 | 2.067 9.88 | 3.117 4.72 | 4.17 3.35
1.033 6.55 | 2.083 9.88 | 3.133 4.72 |
1.050 6.55 | 2.100 9.88 | 3.150 4.72 |

Max.Eff.Inten.(mm/hr)= 78.82 22.29
over (min) 5.00 11.00
Storage Coeff. (min)= 4.90 (ii) 10.28 (ii)
Unit Hyd. Tpeak (min)= 5.00 11.00
Unit Hyd. peak (cms)= 0.23 0.11

PEAK FLOW (cms)= 1.77 0.15
TIME TO PEAK (hrs)= 1.68 1.83
RUNOFF VOLUME (mm)= 38.58 6.77
TOTAL RAINFALL (mm)= 39.39 39.39
RUNOFF COEFFICIENT = 0.98 0.17

TOTALS
1.827 (iii)
1.68
22.68
39.39
0.58

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 50.0 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.

| DUHYD (0030) |
| Inlet Cap.= 1.827 |
| #of Inlets= 1 |
| Total(cms)= 1.8 | AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
TOTAL HYD.(ID= 1): 19.20 1.83 1.68 22.68
=====

MAJOR SYS.(ID= 2): 0.00 0.00 0.00 0.00
MINOR SYS.(ID= 3): 19.20 1.83 1.68 22.68

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

AREA 2A - YIN PHASE 2 & WOODROW

| CALIB |
| STANDHYD (0021) | Area (ha)= 16.90
| ID= 1 DT= 5.0 min | Total Imp(%)= 38.00 Dir. Conn.(%)= 16.00

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 6.42 10.48
Dep. Storage (mm)= 0.80 23.90
Average Slope (%)= 2.00 2.00
Length (m)= 335.66 40.00
Mannings n = 0.013 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083 0.00 | 1.167 6.55 | 2.250 8.15 | 3.33 4.39
0.167 0.00 | 1.250 8.94 | 2.333 8.15 | 3.42 4.11
0.250 3.25 | 1.333 8.94 | 2.417 7.01 | 3.50 4.11
0.333 3.25 | 1.417 16.92 | 2.500 7.01 | 3.58 3.89
0.417 3.56 | 1.500 16.92 | 2.583 6.20 | 3.67 3.89
0.500 3.56 | 1.583 78.82 | 2.667 6.20 | 3.75 3.68
0.583 3.96 | 1.667 78.82 | 2.750 5.59 | 3.83 3.68
0.667 3.96 | 1.750 21.89 | 2.833 5.59 | 3.92 3.51
0.750 4.52 | 1.833 21.89 | 2.917 5.11 | 4.00 3.51
0.833 4.52 | 1.917 13.00 | 3.000 5.11 | 4.08 3.35
0.917 5.31 | 2.000 13.00 | 3.083 4.72 | 4.17 3.35
1.000 5.31 | 2.083 9.88 | 3.167 4.72 |
1.083 6.55 | 2.167 9.88 | 3.250 4.39 |

Max.Eff.Inten.(mm/hr)= 78.82 1.58
over (min) 5.00 45.00
Storage Coeff. (min)= 4.72 (ii) 41.80 (ii)
Unit Hyd. Tpeak (min)= 5.00 45.00
Unit Hyd. peak (cms)= 0.22 0.03

PEAK FLOW (cms)= 0.54 0.03 0.536 (iii)
TIME TO PEAK (hrs)= 1.67 3.33 1.67
RUNOFF VOLUME (mm)= 38.58 2.26 8.07
TOTAL RAINFALL (mm)= 39.39 39.39 39.39
RUNOFF COEFFICIENT = 0.98 0.06 0.20

***** 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* = 50.0 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 2A - SWM POND

| RESERVOIR(0210) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
DT= 5.0 min
OUTFLOW STORAGE | OUTFLOW STORAGE
(cms) (ha.m.) | (cms) (ha.m.)
0.0000 0.0000 | 0.3900 0.0820
0.0200 0.0000 | 0.4300 0.1090
0.0800 0.0020 | 0.5800 0.2670
0.2100 0.0160 | 0.6360 0.3420
0.3000 0.0330 | 0.0000 0.0000

AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW : ID= 2 (0021) 16.900 0.536 1.67 8.07
OUTFLOW: ID= 1 (0210) 16.900 0.246 1.83 8.07

PEAK FLOW REDUCTION [Qout/Qin](%)= 45.85
TIME SHIFT OF PEAK FLOW (min)= 10.00
MAXIMUM STORAGE USED (ha.m.)= 0.0232

| DUHYD (0211) |
| Inlet Cap.= 0.280 |
| #of Inlets= 1 |

Revised Waterford Municipal Drain Design
With WSMD Stormwater Management Pond
Visual OTTHYMO MODEL

2-Year Storm Event

Total(cms)= 0.3| AREA (ha)= 0.80 QPEAK (cms)= 0.25 TPEAK (hrs)= 1.83 R.V. (mm)= 8.07

TOTAL HYD.(ID= 1): 16.90 0.25 1.83 8.07
=====

MAJOR SYS.(ID= 2): 0.00 0.00 0.00 0.00
MINOR SYS.(ID= 3): 16.90 0.25 1.83 8.07

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

AREA 2C - LAM BOULEVARD

| CALIB |
| STANDHYD (0023) | Area (ha)= 0.80
|ID= 1 DT= 1.0 min | Total Imp(%)= 90.00 Dir. Conn.(%)= 45.00

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 0.72 0.08
Dep. Storage (mm)= 0.80 16.50
Average Slope (%)= 1.00 1.00
Length (m)= 73.03 40.00
Mannings n = 0.013 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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
0.017 0.00 | 1.067 6.55 | 2.117 9.88 | 3.17 4.72
0.033 0.00 | 1.083 6.55 | 2.133 9.88 | 3.18 4.39
0.050 0.00 | 1.100 6.55 | 2.150 9.88 | 3.20 4.39
0.067 0.00 | 1.117 6.55 | 2.167 9.88 | 3.22 4.39
0.083 0.00 | 1.133 6.55 | 2.183 8.15 | 3.23 4.39
0.100 0.00 | 1.150 6.55 | 2.200 8.15 | 3.25 4.39
0.117 0.00 | 1.167 6.55 | 2.217 8.15 | 3.27 4.39
0.133 0.00 | 1.183 8.94 | 2.233 8.15 | 3.28 4.39
0.150 0.00 | 1.200 8.94 | 2.250 8.15 | 3.30 4.39
0.167 0.00 | 1.217 8.94 | 2.267 8.15 | 3.32 4.39
0.183 3.25 | 1.233 8.94 | 2.283 8.15 | 3.33 4.39
0.200 3.25 | 1.250 8.94 | 2.300 8.15 | 3.35 4.11
0.217 3.25 | 1.267 8.94 | 2.317 8.15 | 3.37 4.11
0.233 3.25 | 1.283 8.94 | 2.333 8.15 | 3.38 4.11
0.250 3.25 | 1.300 8.94 | 2.350 7.01 | 3.40 4.11
0.267 3.25 | 1.317 8.94 | 2.367 7.01 | 3.42 4.11
0.283 3.25 | 1.333 8.94 | 2.383 7.01 | 3.43 4.11
0.300 3.25 | 1.350 16.92 | 2.400 7.01 | 3.45 4.11
0.317 3.25 | 1.367 16.92 | 2.417 7.01 | 3.47 4.11
0.333 3.25 | 1.383 16.92 | 2.433 7.01 | 3.48 4.11
0.350 3.56 | 1.400 16.92 | 2.450 7.01 | 3.50 4.11
0.367 3.56 | 1.417 16.92 | 2.467 7.01 | 3.52 3.89
0.383 3.56 | 1.433 16.92 | 2.483 7.01 | 3.53 3.89
0.400 3.56 | 1.450 16.92 | 2.500 7.01 | 3.55 3.89
0.417 3.56 | 1.467 16.92 | 2.517 6.20 | 3.57 3.89
0.433 3.56 | 1.483 16.92 | 2.533 6.20 | 3.58 3.89
0.450 3.56 | 1.500 16.92 | 2.550 6.20 | 3.60 3.89
0.467 3.56 | 1.517 78.82 | 2.567 6.20 | 3.62 3.89
0.483 3.56 | 1.533 78.82 | 2.583 6.20 | 3.63 3.89
0.500 3.56 | 1.550 78.82 | 2.600 6.20 | 3.65 3.89
0.517 3.96 | 1.567 78.82 | 2.617 6.20 | 3.67 3.89
0.533 3.96 | 1.583 78.82 | 2.633 6.20 | 3.68 3.68
0.550 3.96 | 1.600 78.82 | 2.650 6.20 | 3.70 3.68
0.567 3.96 | 1.617 78.82 | 2.667 6.20 | 3.72 3.68
0.583 3.96 | 1.633 78.82 | 2.683 5.59 | 3.73 3.68
0.600 3.96 | 1.650 78.82 | 2.700 5.59 | 3.75 3.68
0.617 3.96 | 1.667 78.82 | 2.717 5.59 | 3.77 3.68
0.633 3.96 | 1.683 21.89 | 2.733 5.59 | 3.78 3.68
0.650 3.96 | 1.700 21.89 | 2.750 5.59 | 3.80 3.68
0.667 3.96 | 1.717 21.89 | 2.767 5.59 | 3.82 3.68
0.683 4.52 | 1.733 21.89 | 2.783 5.59 | 3.83 3.68
0.700 4.52 | 1.750 21.89 | 2.800 5.59 | 3.85 3.51
0.717 4.52 | 1.767 21.89 | 2.817 5.59 | 3.87 3.51
0.733 4.52 | 1.783 21.89 | 2.833 5.59 | 3.88 3.51
0.750 4.52 | 1.800 21.89 | 2.850 5.11 | 3.90 3.51
0.767 4.52 | 1.817 21.89 | 2.867 5.11 | 3.92 3.51
0.783 4.52 | 1.833 21.89 | 2.883 5.11 | 3.93 3.51
0.800 4.52 | 1.850 13.00 | 2.900 5.11 | 3.95 3.51
0.817 4.52 | 1.867 13.00 | 2.917 5.11 | 3.97 3.51
0.833 4.52 | 1.883 13.00 | 2.933 5.11 | 3.98 3.51
0.850 5.31 | 1.900 13.00 | 2.950 5.11 | 4.00 3.51
0.867 5.31 | 1.917 13.00 | 2.967 5.11 | 4.02 3.35
0.883 5.31 | 1.933 13.00 | 2.983 5.11 | 4.03 3.35
0.900 5.31 | 1.950 13.00 | 3.000 5.11 | 4.05 3.35
0.917 5.31 | 1.967 13.00 | 3.017 4.72 | 4.07 3.35
0.933 5.31 | 1.983 13.00 | 3.033 4.72 | 4.08 3.35
0.950 5.31 | 2.000 13.00 | 3.050 4.72 | 4.10 3.35
0.967 5.31 | 2.017 9.88 | 3.067 4.72 | 4.12 3.35
0.983 5.31 | 2.033 9.88 | 3.083 4.72 | 4.13 3.35
1.000 5.31 | 2.050 9.88 | 3.100 4.72 | 4.15 3.35
1.017 6.55 | 2.067 9.88 | 3.117 4.72 | 4.17 3.35
1.033 6.55 | 2.083 9.88 | 3.133 4.72 |
1.050 6.55 | 2.100 9.88 | 3.150 4.72 |

Max.Eff.Inten. (mm/hr)= 78.82 198.00
over (min)= 5.00 8.00
Storage Coeff. (min)= 2.33 (ii) 7.56 (ii)
Unit Hyd. Tpeak (min)= 5.00 8.00
Unit Hyd. peak (cms)= 0.35 0.15

PEAK FLOW (cms)= 0.08 0.03 0.101 (iii)
TIME TO PEAK (hrs)= 1.67 1.75 1.68
RUNOFF VOLUME (mm)= 38.58 18.96 27.79

TOTAL RAINFALL (mm)= 39.39 39.39 39.39
RUNOFF COEFFICIENT = 0.98 0.48 0.71

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

| DUHYD (0230) |
| Inlet Cap.= 0.015 |
| #of Inlets= 1 |
| Total(cms)= 0.0 | AREA (ha)= 0.80 QPEAK (cms)= 0.10 TPEAK (hrs)= 1.68 R.V. (mm)= 27.79

MAJOR SYS.(ID= 2): 0.31 0.09 1.68 27.79
MINOR SYS.(ID= 3): 0.49 0.01 1.42 27.79

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

AREA 2D - ORCHARD SQUARE

| CALIB |
| STANDHYD (0024) | Area (ha)= 1.40
|ID= 1 DT= 1.0 min | Total Imp(%)= 90.00 Dir. Conn.(%)= 45.00

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 1.26 0.14
Dep. Storage (mm)= 0.80 16.50
Average Slope (%)= 1.00 1.00
Length (m)= 96.61 40.00
Mannings n = 0.013 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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
0.017 0.00 | 1.067 6.55 | 2.117 9.88 | 3.17 4.72
0.033 0.00 | 1.083 6.55 | 2.133 9.88 | 3.18 4.39
0.050 0.00 | 1.100 6.55 | 2.150 9.88 | 3.20 4.39
0.067 0.00 | 1.117 6.55 | 2.167 9.88 | 3.22 4.39
0.083 0.00 | 1.133 6.55 | 2.183 8.15 | 3.23 4.39
0.100 0.00 | 1.150 6.55 | 2.200 8.15 | 3.25 4.39
0.117 0.00 | 1.167 6.55 | 2.217 8.15 | 3.27 4.39
0.133 0.00 | 1.183 8.94 | 2.233 8.15 | 3.28 4.39
0.150 0.00 | 1.200 8.94 | 2.250 8.15 | 3.30 4.39
0.167 0.00 | 1.217 8.94 | 2.267 8.15 | 3.32 4.39
0.183 3.25 | 1.233 8.94 | 2.283 8.15 | 3.33 4.39
0.200 3.25 | 1.250 8.94 | 2.300 8.15 | 3.35 4.11
0.217 3.25 | 1.267 8.94 | 2.317 8.15 | 3.37 4.11
0.233 3.25 | 1.283 8.94 | 2.333 8.15 | 3.38 4.11
0.250 3.25 | 1.300 8.94 | 2.350 7.01 | 3.40 4.11
0.267 3.25 | 1.317 8.94 | 2.367 7.01 | 3.42 4.11
0.283 3.25 | 1.333 8.94 | 2.383 7.01 | 3.43 4.11
0.300 3.25 | 1.350 16.92 | 2.400 7.01 | 3.45 4.11
0.317 3.25 | 1.367 16.92 | 2.417 7.01 | 3.47 4.11
0.333 3.25 | 1.383 16.92 | 2.433 7.01 | 3.48 4.11
0.350 3.56 | 1.400 16.92 | 2.450 7.01 | 3.50 4.11
0.367 3.56 | 1.417 16.92 | 2.467 7.01 | 3.52 3.89
0.383 3.56 | 1.433 16.92 | 2.483 7.01 | 3.53 3.89
0.400 3.56 | 1.450 16.92 | 2.500 7.01 | 3.55 3.89
0.417 3.56 | 1.467 16.92 | 2.517 6.20 | 3.57 3.89
0.433 3.56 | 1.483 16.92 | 2.533 6.20 | 3.58 3.89
0.450 3.56 | 1.500 16.92 | 2.550 6.20 | 3.60 3.89
0.467 3.56 | 1.517 78.82 | 2.567 6.20 | 3.62 3.89
0.483 3.56 | 1.533 78.82 | 2.583 6.20 | 3.63 3.89
0.500 3.56 | 1.550 78.82 | 2.600 6.20 | 3.65 3.89
0.517 3.96 | 1.567 78.82 | 2.617 6.20 | 3.67 3.89
0.533 3.96 | 1.583 78.82 | 2.633 6.20 | 3.68 3.68
0.550 3.96 | 1.600 78.82 | 2.650 6.20 | 3.70 3.68
0.567 3.96 | 1.617 78.82 | 2.667 6.20 | 3.72 3.68
0.583 3.96 | 1.633 78.82 | 2.683 5.59 | 3.73 3.68
0.600 3.96 | 1.650 78.82 | 2.700 5.59 | 3.75 3.68
0.617 3.96 | 1.667 78.82 | 2.717 5.59 | 3.77 3.68
0.633 3.96 | 1.683 21.89 | 2.733 5.59 | 3.78 3.68
0.650 3.96 | 1.700 21.89 | 2.750 5.59 | 3.80 3.68
0.667 3.96 | 1.717 21.89 | 2.767 5.59 | 3.82 3.68
0.683 4.52 | 1.733 21.89 | 2.783 5.59 | 3.83 3.68
0.700 4.52 | 1.750 21.89 | 2.800 5.59 | 3.85 3.51
0.717 4.52 | 1.767 21.89 | 2.817 5.59 | 3.87 3.51
0.733 4.52 | 1.783 21.89 | 2.833 5.59 | 3.88 3.51
0.750 4.52 | 1.800 21.89 | 2.850 5.11 | 3.90 3.51
0.767 4.52 | 1.817 21.89 | 2.867 5.11 | 3.92 3.51
0.783 4.52 | 1.833 21.89 | 2.883 5.11 | 3.93 3.51
0.800 4.52 | 1.850 13.00 | 2.900 5.11 | 3.95 3.51
0.817 4.52 | 1.867 13.00 | 2.917 5.11 | 3.97 3.51
0.833 4.52 | 1.883 13.00 | 2.933 5.11 | 3.98 3.51
0.850 5.31 | 1.900 13.00 | 2.950 5.11 | 4.00 3.51
0.867 5.31 | 1.917 13.00 | 2.967 5.11 | 4.02 3.35
0.883 5.31 | 1.933 13.00 | 2.983 5.11 | 4.03 3.35
0.900 5.31 | 1.950 13.00 | 3.000 5.11 | 4.05 3.35
0.917 5.31 | 1.967 13.00 | 3.017 4.72 | 4.07 3.35
0.933 5.31 | 1.983 13.00 | 3.033 4.72 | 4.08 3.35
0.950 5.31 | 2.000 13.00 | 3.050 4.72 | 4.10 3.35
0.967 5.31 | 2.017 9.88 | 3.067 4.72 | 4.12 3.35

Revised Waterford Municipal Drain Design
With WSMD Stormwater Management Pond
Visual OTTHYMO MODEL

2-Year Storm Event

0.983	5.31	2.033	9.88	3.083	4.72	4.13	3.35
1.000	5.31	2.050	9.88	3.100	4.72	4.15	3.35
1.017	6.55	2.067	9.88	3.117	4.72	4.17	3.35
1.033	6.55	2.083	9.88	3.133	4.72		
1.050	6.55	2.100	9.88	3.150	4.72		

Max.Eff.Inten.(mm/hr)=	78.82	198.00
over (min)	5.00	8.00
Storage Coeff. (min)=	2.75 (ii)	7.99 (ii)
Unit Hyd. Tpeak (min)=	5.00	8.00
Unit Hyd. peak (cms)=	0.32	0.14

PEAK FLOW (cms)=	0.13	0.05	*TOTALS*	0.173 (iii)
TIME TO PEAK (hrs)=	1.67	1.75		1.68
RUNOFF VOLUME (mm)=	39.58	18.96		27.79
TOTAL RAINFALL (mm)=	39.39	39.39		39.39
RUNOFF COEFFICIENT =	0.98	0.48		0.71

- (i) CN PROCEDURE SELECTED FOR PVIOUS LOSSES:
CN* = 58.0 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.

DUHYD (0240)				
Inlet Cap.= 0.015				
#of Inlets= 1				
Total(cms)= 0.0				
AREA	QPEAK	TPEAK	R.V.	
(ha)	(cms)	(hrs)	(mm)	
TOTAL HYD.(ID= 1):	1.40	0.17	1.68	27.79
MAJOR SYS.(ID= 2):	0.75	0.16	1.68	27.79
MINOR SYS.(ID= 3):	0.65	0.01	1.27	27.79

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)				
1 + 2 = 3				
AREA	QPEAK	TPEAK	R.V.	
(ha)	(cms)	(hrs)	(mm)	
ID1= 1 (0010):	40.00	1.017	1.70	7.23
+ ID2= 2 (0211):	16.90	0.246	1.83	8.07
ID = 3 (1001):	56.90	1.244	1.70	7.48

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD CURRENT DEVELOPMENTS

ADD HYD (1001)				
3 + 2 = 1				
AREA	QPEAK	TPEAK	R.V.	
(ha)	(cms)	(hrs)	(mm)	
ID1= 3 (1001):	56.90	1.244	1.70	7.48
+ ID2= 2 (0220):	11.82	0.014	4.90	9.08
ID = 1 (1001):	68.72	1.248	1.70	7.75

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)				
1 + 2 = 3				
AREA	QPEAK	TPEAK	R.V.	
(ha)	(cms)	(hrs)	(mm)	
ID1= 1 (1001):	68.72	1.248	1.70	7.75
+ ID2= 2 (0230):	0.49	0.015	1.42	27.79
ID = 3 (1001):	69.21	1.263	1.70	7.90

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)				
3 + 2 = 1				
AREA	QPEAK	TPEAK	R.V.	
(ha)	(cms)	(hrs)	(mm)	
ID1= 3 (1001):	69.21	1.263	1.70	7.90
+ ID2= 2 (0240):	0.65	0.015	1.27	27.79
ID = 1 (1001):	69.86	1.278	1.70	8.08

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (1001)				
1 + 2 = 3				
AREA	QPEAK	TPEAK	R.V.	
(ha)	(cms)	(hrs)	(mm)	
ID1= 1 (1001):	69.86	1.278	1.70	8.08
+ ID2= 2 (0030):	19.20	1.827	1.68	22.68
ID = 3 (1001):	89.06	3.091	1.70	11.23

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

AREA 5 - CHARLES

CALIB				
STANDHYD (0005)	Area (ha)=	4.35		
ID= 1 DT= 5.0 min	Total Imp(%)=	46.00	Dir. Conn.(%)=	21.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	2.00	2.35
Dep. Storage (mm)=	1.00	13.60
Average Slope (%)=	1.00	2.00
Length (m)=	170.29	40.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083	0.00	1.167	6.55	2.250	8.15	3.33	4.39
0.167	0.00	1.250	8.94	2.333	8.15	3.42	4.11
0.250	3.25	1.333	8.94	2.417	7.01	3.50	4.11
0.333	3.25	1.417	16.92	2.500	7.01	3.58	3.89
0.417	3.56	1.500	16.92	2.583	6.20	3.67	3.89
0.500	3.56	1.583	78.82	2.667	6.20	3.75	3.68
0.583	3.96	1.667	78.82	2.750	5.59	3.83	3.68
0.667	3.96	1.750	21.89	2.833	5.59	3.92	3.51
0.750	4.52	1.833	21.89	2.917	5.11	4.00	3.51
0.833	4.52	1.917	13.00	3.000	5.11	4.08	3.35
0.917	5.31	2.000	13.00	3.083	4.72	4.17	3.35
1.000	5.31	2.083	9.88	3.167	4.72		
1.083	6.55	2.167	9.88	3.250	4.39		

Max.Eff.Inten.(mm/hr)=	78.82	9.53
over (min)	5.00	25.00
Storage Coeff. (min)=	3.87 (ii)	21.94 (ii)
Unit Hyd. Tpeak (min)=	5.00	25.00
Unit Hyd. peak (cms)=	0.25	0.05

PEAK FLOW (cms)=	0.19	0.03	*TOTALS*	0.194 (iii)
TIME TO PEAK (hrs)=	1.67	2.17		1.67
RUNOFF VOLUME (mm)=	38.38	6.63		13.30
TOTAL RAINFALL (mm)=	39.39	39.39		39.39
RUNOFF COEFFICIENT =	0.97	0.17		0.34

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

- (i) CN PROCEDURE SELECTED FOR PVIOUS LOSSES:
CN* = 62.0 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.

DUHYD (0050)				
Inlet Cap.= 0.023				
#of Inlets= 1				
Total(cms)= 0.0				
AREA	QPEAK	TPEAK	R.V.	
(ha)	(cms)	(hrs)	(mm)	
TOTAL HYD.(ID= 1):	4.35	0.19	1.67	13.30
MAJOR SYS.(ID= 2):	2.07	0.17	1.67	13.30
MINOR SYS.(ID= 3):	2.28	0.02	1.42	13.30

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

AREA 4 - THOMPSON

CALIB				
STANDHYD (0004)	Area (ha)=	7.85		
ID= 1 DT= 5.0 min	Total Imp(%)=	46.00	Dir. Conn.(%)=	22.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.61	4.24
Dep. Storage (mm)=	1.00	8.10
Average Slope (%)=	1.00	2.00
Length (m)=	228.76	40.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083	0.00	1.167	6.55	2.250	8.15	3.33	4.39
0.167	0.00	1.250	8.94	2.333	8.15	3.42	4.11
0.250	3.25	1.333	8.94	2.417	7.01	3.50	4.11
0.333	3.25	1.417	16.92	2.500	7.01	3.58	3.89
0.417	3.56	1.500	16.92	2.583	6.20	3.67	3.89
0.500	3.56	1.583	78.82	2.667	6.20	3.75	3.68
0.583	3.96	1.667	78.82	2.750	5.59	3.83	3.68
0.667	3.96	1.750	21.89	2.833	5.59	3.92	3.51
0.750	4.52	1.833	21.89	2.917	5.11	4.00	3.51
0.833	4.52	1.917	13.00	3.000	5.11	4.08	3.35
0.917	5.31	2.000	13.00	3.083	4.72	4.17	3.35
1.000	5.31	2.083	9.88	3.167	4.72		
1.083	6.55	2.167	9.88	3.250	4.39		

Revised Waterford Municipal Drain Design
With WSMD Stormwater Management Pond
Visual OTTHYMO MODEL

2-Year Storm Event

Max.Eff.Inten.(mm/hr)=	78.82	21.24	
over (min)	5.00	20.00	
Storage Coeff. (min)=	4.62 (ii)	17.73 (ii)	
Unit Hyd. Tpeak (min)=	5.00	20.00	
Unit Hyd. peak (cms)=	0.22	0.06	
			TOTALS
PEAK FLOW (cms)=	0.34	0.14	0.385 (iii)
TIME TO PEAK (hrs)=	1.67	1.92	1.67
RUNOFF VOLUME (mm)=	38.38	11.17	17.15
TOTAL RAINFALL (mm)=	39.39	39.39	39.39
RUNOFF COEFFICIENT =	0.97	0.28	0.44

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

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 72.0 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.

DUHYD (0040)				
Inlet Cap.= 0.084				
#of Inlets= 1				
Total(cms)= 0.1				

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
TOTAL HYD.(ID= 1):	7.85	0.39	1.67	17.15
=====				
MAJOR SYS.(ID= 2):	2.70	0.30	1.67	17.15
MINOR SYS.(ID= 3):	5.15	0.08	1.58	17.15

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.				

ADD CHARLES & THOMPSON DEVELOPMENTS

ADD HYD (1002)				
1 + 2 = 3				

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (1001):	89.06	3.091	1.70	11.23
+ ID2= 2 (0040):	5.15	0.084	1.58	17.15
=====				
ID = 3 (1002):	94.21	3.175	1.70	11.55

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.				

ADD HYD (1002)				
3 + 2 = 1				

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 3 (1002):	94.21	3.175	1.70	11.55
+ ID2= 2 (0050):	2.28	0.023	1.42	13.30
=====				
ID = 1 (1002):	96.50	3.198	1.70	11.59

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.				

WSMD - SWM POND

RESERVOIR(1003)	OVERFLOW IS ON			
IN= 2---> OUT= 1				
DT= 5.0 min				

	OUTFLOW	STORAGE	OUTFLOW	STORAGE
	(cms)	(ha.m.)	(cms)	(ha.m.)
	0.0000	0.0000	0.2760	0.9280
	0.0000	0.2310	0.2890	0.9830
	0.0900	0.4410	0.3380	1.2100
	0.1800	0.6000	0.3590	1.3270
	0.2470	0.8190	0.0000	0.0000

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 2 (1002)	96.499	3.198	1.70	11.59
OUTFLOW: ID= 1 (1003)	96.499	0.241	4.32	8.98
OVERFLOW:ID= 3 (0003)	0.000	0.000	0.00	0.00

TOTAL NUMBER OF SIMULATION OVERFLOW = 0				
CUMULATIVE TIME OF OVERFLOW (HOURS)= 0.00				
PERCENTAGE OF TIME OVERFLOWING (%) = 0.00				

PEAK FLOW REDUCTION [Qout/Qin] (%) = 7.53				
TIME SHIFT OF PEAK FLOW (min)=157.00				
MAXIMUM STORAGE USED (ha.m.)= 0.7986				

**** WARNING : SELECTED ROUTING TIME STEP DENIED.				

FINISH
=====

5-Year Storm Event

----- TRANSFORMED HYTEOGRAPH -----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.017	0.00	1.067	7.11	2.117	11.43	3.17	4.93
0.033	0.00	1.083	7.11	2.133	11.43	3.18	4.55
0.050	0.00	1.100	7.11	2.150	11.43	3.20	4.55
0.067	0.00	1.117	7.11	2.167	11.43	3.22	4.55
0.083	0.00	1.133	7.11	2.183	9.15	3.23	4.55
0.100	0.00	1.150	7.11	2.200	9.15	3.25	4.55
0.117	0.00	1.167	7.11	2.217	9.15	3.27	4.55
0.133	0.00	1.183	10.19	2.233	9.15	3.28	4.55
0.150	0.00	1.200	10.19	2.250	9.15	3.30	4.55
0.167	0.00	1.217	10.19	2.267	9.15	3.32	4.55
0.183	3.53	1.233	10.19	2.283	9.15	3.33	4.55
0.200	3.53	1.250	10.19	2.300	9.15	3.35	4.22
0.217	3.53	1.267	10.19	2.317	9.15	3.37	4.22
0.233	3.53	1.283	10.19	2.333	9.15	3.38	4.22
0.250	3.53	1.300	10.19	2.350	7.70	3.40	4.22
0.267	3.53	1.317	10.19	2.367	7.70	3.42	4.22
0.283	3.53	1.333	10.19	2.383	7.70	3.43	4.22
0.300	3.53	1.350	21.62	2.400	7.70	3.45	4.22
0.317	3.53	1.367	21.62	2.417	7.70	3.47	4.22
0.333	3.53	1.383	21.62	2.433	7.70	3.48	4.22
0.350	3.66	1.400	21.62	2.450	7.70	3.50	4.22
0.367	3.66	1.417	21.62	2.467	7.70	3.52	3.96
0.383	3.66	1.433	21.62	2.483	7.70	3.53	3.96
0.400	3.66	1.450	21.62	2.500	7.70	3.55	3.96

---- TRANSFORMED HYETOGRAPH ----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.017	0.00	1.067	7.11	2.117	11.43	3.17	4.93
0.033	0.00	1.083	7.11	2.133	11.43	3.18	4.55
0.050	0.00	1.100	7.11	2.150	11.43	3.20	4.55
0.067	0.00	1.117	7.11	2.167	11.43	3.22	4.55
0.083	0.00	1.133	7.11	2.183	9.15	3.23	4.55
0.100	0.00	1.150	7.11	2.200	9.15	3.25	4.55
0.117	0.00	1.167	7.11	2.217	9.15	3.27	4.55

Revised Waterford Municipal Drain Design
With WSMD Stormwater Management Pond
Visual OTTHYMO MODEL

5-Year Storm Event

0.133	0.00	1.183	10.19	2.233	9.15	3.28	4.55
0.150	0.00	1.200	10.19	2.250	9.15	3.30	4.55
0.167	0.00	1.217	10.19	2.267	9.15	3.32	4.55
0.183	3.53	1.233	10.19	2.283	9.15	3.33	4.55
0.200	3.53	1.250	10.19	2.300	9.15	3.35	4.22
0.217	3.53	1.267	10.19	2.317	9.15	3.37	4.22
0.233	3.53	1.283	10.19	2.333	9.15	3.38	4.22
0.250	3.53	1.300	10.19	2.350	7.70	3.40	4.22
0.267	3.53	1.317	10.19	2.367	7.70	3.42	4.22
0.283	3.53	1.333	10.19	2.383	7.70	3.43	4.22
0.300	3.53	1.350	21.62	2.400	7.70	3.45	4.22
0.317	3.53	1.367	21.62	2.417	7.70	3.47	4.22
0.333	3.53	1.383	21.62	2.433	7.70	3.48	4.22
0.350	3.66	1.400	21.62	2.450	7.70	3.50	4.22
0.367	3.66	1.417	21.62	2.467	7.70	3.52	3.96
0.383	3.66	1.433	21.62	2.483	7.70	3.53	3.96
0.400	3.66	1.450	21.62	2.500	7.70	3.55	3.96
0.417	3.66	1.467	21.62	2.517	6.68	3.57	3.96
0.433	3.66	1.483	21.62	2.533	6.68	3.58	3.96
0.450	3.66	1.500	21.62	2.550	6.68	3.60	3.96
0.467	3.66	1.517	112.37	2.567	6.68	3.62	3.96
0.483	3.66	1.533	112.37	2.583	6.68	3.63	3.96
0.500	3.66	1.550	112.37	2.600	6.68	3.65	3.96
0.517	4.04	1.567	112.37	2.617	6.68	3.67	3.96
0.533	4.04	1.583	112.37	2.633	6.68	3.68	3.73
0.550	4.04	1.600	112.37	2.650	6.68	3.70	3.73
0.567	4.04	1.617	112.37	2.667	6.68	3.72	3.73
0.583	4.04	1.633	112.37	2.683	5.94	3.73	3.73
0.600	4.04	1.650	112.37	2.700	5.94	3.75	3.73
0.617	4.04	1.667	112.37	2.717	5.94	3.77	3.73
0.633	4.04	1.683	27.76	2.733	5.94	3.78	3.73
0.650	4.04	1.700	27.76	2.750	5.94	3.80	3.73
0.667	4.04	1.717	27.76	2.767	5.94	3.82	3.73
0.683	4.67	1.733	27.76	2.783	5.94	3.83	3.73
0.700	4.67	1.750	27.76	2.800	5.94	3.85	3.53
0.717	4.67	1.767	27.76	2.817	5.94	3.87	3.53
0.733	4.67	1.783	27.76	2.833	5.94	3.88	3.53
0.750	4.67	1.800	27.76	2.850	5.39	3.90	3.53
0.767	4.67	1.817	27.76	2.867	5.39	3.92	3.53
0.783	4.67	1.833	27.76	2.883	5.39	3.93	3.53
0.800	4.67	1.850	15.75	2.900	5.39	3.95	3.53
0.817	4.67	1.867	15.75	2.917	5.39	3.97	3.53
0.833	4.67	1.883	15.75	2.933	5.39	3.98	3.53
0.850	5.61	1.900	15.75	2.950	5.39	4.00	3.53
0.867	5.61	1.917	15.75	2.967	5.39	4.02	3.35
0.883	5.61	1.933	15.75	2.983	5.39	4.03	3.35
0.900	5.61	1.950	15.75	3.000	5.39	4.05	3.35
0.917	5.61	1.967	15.75	3.017	4.93	4.07	3.35
0.933	5.61	1.983	15.75	3.033	4.93	4.08	3.35
0.950	5.61	2.000	15.75	3.050	4.93	4.10	3.35
0.967	5.61	2.017	11.43	3.067	4.93	4.12	3.35
0.983	5.61	2.033	11.43	3.083	4.93	4.13	3.35
1.000	5.61	2.050	11.43	3.100	4.93	4.15	3.35
1.017	7.11	2.067	11.43	3.117	4.93	4.17	3.35
1.033	7.11	2.083	11.43	3.133	4.93		
1.050	7.11	2.100	11.43	3.150	4.93		

Max.Eff.Inten.(mm/hr)= 112.37 15.68
over (min)= 5.00 23.00
Storage Coeff. (min)= 4.53 (ii) 22.76 (ii)
Unit Hyd. Tpeak (min)= 5.00 23.00
Unit Hyd. peak (cms)= 0.24 0.05

PEAK FLOW (cms)= 0.69 0.14 0.713 (iii)
TIME TO PEAK (hrs)= 1.68 2.08 1.68
RUNOFF VOLUME (mm)= 47.68 8.56 17.16
TOTAL RAINFALL (mm)= 48.48 48.48 48.48
RUNOFF COEFFICIENT = 0.98 0.18 0.35

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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 2B - SWM POND

RESERVOIR(0220) | OVERFLOW IS OFF
| IN= 2--> OUT= 1 |
DT= 1.0 min
OUTFLOW STORAGE | OUTFLOW STORAGE
(cms) (ha.m.) | (cms) (ha.m.)
0.0000 0.0000 | 0.0251 0.3540
0.0066 0.0550 | 0.0273 0.4180
0.0127 0.1120 | 0.0294 0.4840
0.0167 0.1700 | 0.0313 0.5510
0.0199 0.2300 | 0.0332 0.6200
0.0226 0.2910 | 0.0000 0.0000

AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW : ID= 2 (0022) 11.820 0.713 1.68 17.16
OUTFLOW: ID= 1 (0220) 11.820 0.017 4.68 12.09

PEAK FLOW REDUCTION [Qout/Qin](%)= 2.44
TIME SHIFT OF PEAK FLOW (min)=180.00
MAXIMUM STORAGE USED (ha.m.)= 0.1839

AREA 3 - EXISTING COMMERCIAL

| CALIB |
| STANDHYD (0003) | Area (ha)= 19.20
| ID= 1 DT= 1.0 min | Total Imp(%)= 80.00 Dir. Conn.(%)= 50.00

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 15.36 3.84
Dep. Storage (mm)= 0.80 23.90
Average Slope (%)= 2.00 2.00
Length (m)= 357.77 40.00
Mannings n = 0.013 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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
0.017 0.00 | 1.067 7.11 | 2.117 11.43 | 3.17 4.93
0.033 0.00 | 1.083 7.11 | 2.133 11.43 | 3.18 4.55
0.050 0.00 | 1.100 7.11 | 2.150 11.43 | 3.20 4.55
0.067 0.00 | 1.117 7.11 | 2.167 11.43 | 3.22 4.55
0.083 0.00 | 1.133 7.11 | 2.183 9.15 | 3.23 4.55
0.100 0.00 | 1.150 7.11 | 2.200 9.15 | 3.25 4.55
0.117 0.00 | 1.167 7.11 | 2.217 9.15 | 3.27 4.55
0.133 0.00 | 1.183 10.19 | 2.233 9.15 | 3.28 4.55
0.150 0.00 | 1.200 10.19 | 2.250 9.15 | 3.30 4.55
0.167 0.00 | 1.217 10.19 | 2.267 9.15 | 3.32 4.55
0.183 3.53 | 1.233 10.19 | 2.283 9.15 | 3.33 4.55
0.200 3.53 | 1.250 10.19 | 2.300 9.15 | 3.35 4.22
0.217 3.53 | 1.267 10.19 | 2.317 9.15 | 3.37 4.22
0.233 3.53 | 1.283 10.19 | 2.333 9.15 | 3.38 4.22
0.250 3.53 | 1.300 10.19 | 2.350 7.70 | 3.40 4.22
0.267 3.53 | 1.317 10.19 | 2.367 7.70 | 3.42 4.22
0.283 3.53 | 1.333 10.19 | 2.383 7.70 | 3.43 4.22
0.300 3.53 | 1.350 21.62 | 2.400 7.70 | 3.45 4.22
0.317 3.53 | 1.367 21.62 | 2.417 7.70 | 3.47 4.22
0.333 3.53 | 1.383 21.62 | 2.433 7.70 | 3.48 4.22
0.350 3.66 | 1.400 21.62 | 2.450 7.70 | 3.50 4.22
0.367 3.66 | 1.417 21.62 | 2.467 7.70 | 3.52 3.96
0.383 3.66 | 1.433 21.62 | 2.483 7.70 | 3.53 3.96
0.400 3.66 | 1.450 21.62 | 2.500 7.70 | 3.55 3.96
0.417 3.66 | 1.467 21.62 | 2.517 6.68 | 3.57 3.96
0.433 3.66 | 1.483 21.62 | 2.533 6.68 | 3.58 3.96
0.450 3.66 | 1.500 21.62 | 2.550 6.68 | 3.60 3.96
0.467 3.66 | 1.517 112.37 | 2.567 6.68 | 3.62 3.96
0.483 3.66 | 1.533 112.37 | 2.583 6.68 | 3.63 3.96
0.500 3.66 | 1.550 112.37 | 2.600 6.68 | 3.65 3.96
0.517 4.04 | 1.567 112.37 | 2.617 6.68 | 3.67 3.96
0.533 4.04 | 1.583 112.37 | 2.633 6.68 | 3.68 3.73
0.550 4.04 | 1.600 112.37 | 2.650 6.68 | 3.70 3.73
0.567 4.04 | 1.617 112.37 | 2.667 6.68 | 3.72 3.73
0.583 4.04 | 1.633 112.37 | 2.683 5.94 | 3.73 3.73
0.600 4.04 | 1.650 112.37 | 2.700 5.94 | 3.75 3.73
0.617 4.04 | 1.667 112.37 | 2.717 5.94 | 3.77 3.73
0.633 4.04 | 1.683 27.76 | 2.733 5.94 | 3.78 3.73
0.650 4.04 | 1.700 27.76 | 2.750 5.94 | 3.80 3.73
0.667 4.04 | 1.717 27.76 | 2.767 5.94 | 3.82 3.73
0.683 4.67 | 1.733 27.76 | 2.783 5.94 | 3.83 3.73
0.700 4.67 | 1.750 27.76 | 2.800 5.94 | 3.85 3.53
0.717 4.67 | 1.767 27.76 | 2.817 5.94 | 3.87 3.53
0.733 4.67 | 1.783 27.76 | 2.833 5.94 | 3.88 3.53
0.750 4.67 | 1.800 27.76 | 2.850 5.39 | 3.90 3.53
0.767 4.67 | 1.817 27.76 | 2.867 5.39 | 3.92 3.53
0.783 4.67 | 1.833 27.76 | 2.883 5.39 | 3.93 3.53
0.800 4.67 | 1.850 15.75 | 2.900 5.39 | 3.95 3.53
0.817 4.67 | 1.867 15.75 | 2.917 5.39 | 3.97 3.53
0.833 4.67 | 1.883 15.75 | 2.933 5.39 | 3.98 3.53
0.850 5.61 | 1.900 15.75 | 2.950 5.39 | 4.00 3.53
0.867 5.61 | 1.917 15.75 | 2.967 5.39 | 4.02 3.35
0.883 5.61 | 1.933 15.75 | 2.983 5.39 | 4.03 3.35
0.900 5.61 | 1.950 15.75 | 3.000 5.39 | 4.05 3.35
0.917 5.61 | 1.967 15.75 | 3.017 4.93 | 4.07 3.35
0.933 5.61 | 1.983 15.75 | 3.033 4.93 | 4.08 3.35
0.950 5.61 | 2.000 15.75 | 3.050 4.93 | 4.10 3.35
0.967 5.61 | 2.017 11.43 | 3.067 4.93 | 4.12 3.35
0.983 5.61 | 2.033 11.43 | 3.083 4.93 | 4.13 3.35
1.000 5.61 | 2.050 11.43 | 3.100 4.93 | 4.15 3.35
1.017 7.11 | 2.067 11.43 | 3.117 4.93 | 4.17 3.35
1.033 7.11 | 2.083 11.43 | 3.133 4.93 |
1.050 7.11 | 2.100 11.43 | 3.150 4.93 |

Max.Eff.Inten.(mm/hr)= 112.37 47.52
over (min)= 5.00 9.00
Storage Coeff. (min)= 4.26 (ii) 8.92 (ii)
Unit Hyd. Tpeak (min)= 5.00 9.00
Unit Hyd. peak (cms)= 0.25 0.13

PEAK FLOW (cms)= 2.60 0.34 2.799 (iii)
TIME TO PEAK (hrs)= 1.68 1.78 1.68
RUNOFF VOLUME (mm)= 47.68 10.78 29.23
TOTAL RAINFALL (mm)= 48.48 48.48 48.48
RUNOFF COEFFICIENT = 0.98 0.22 0.60

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 50.0 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.

Revised Waterford Municipal Drain Design
With WSMD Stormwater Management Pond
Visual OTTHYMO MODEL

5-Year Storm Event

```
-----
| DUHYD ( 0030) |
| Inlet Cap.= 1.827 |
| #of Inlets= 1 |
| Total(cms)= 1.8 |
-----
TOTAL HYD.(ID= 1): 19.20 2.80 1.68 29.23
=====
MAJOR SYS.(ID= 2): 1.36 0.97 1.68 29.23
MINOR SYS.(ID= 3): 17.84 1.83 1.60 29.23
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

AREA 2A - YIN PHASE 2 & WOODROW

```
-----
| CALIB |
| STANDHYD ( 0021) |
| ID= 1 DT= 5.0 min |
-----
Area (ha)= 16.90
Total Imp(%)= 38.00 Dir. Conn.(%)= 16.00
```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	6.42	10.48
Dep. Storage (mm)=	0.80	23.90
Average Slope (%)=	2.00	2.00
Length (m)=	335.66	40.00
Mannings n	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083	0.00	1.167	7.11	2.250	9.15	3.33	4.55
0.167	0.00	1.250	10.19	2.333	9.15	3.42	4.22
0.250	3.53	1.333	10.19	2.417	7.70	3.50	4.22
0.333	3.53	1.417	21.62	2.500	7.70	3.58	3.96
0.417	3.66	1.500	21.62	2.583	6.68	3.67	3.96
0.500	3.66	1.583	112.37	2.667	6.68	3.75	3.73
0.583	4.04	1.667	112.37	2.750	5.94	3.83	3.73
0.667	4.04	1.750	27.76	2.833	5.94	3.92	3.53
0.750	4.67	1.833	27.76	2.917	5.39	4.00	3.53
0.833	4.67	1.917	15.75	3.000	5.39	4.08	3.35
0.917	5.61	2.000	15.75	3.083	4.93	4.17	3.35
1.000	5.61	2.083	11.43	3.167	4.93		
1.083	7.11	2.167	11.43	3.250	4.55		

Max.Eff.Inten.(mm/hr)=	112.37	5.30
over (min)	5.00	30.00
Storage Coeff. (min)=	4.10 (ii)	26.95 (ii)
Unit Hyd. Tpeak (min)=	5.00	30.00
Unit Hyd. peak (cms)=	0.24	0.04

PEAK FLOW (cms)=	0.78	0.08	*TOTALS*	0.790 (iii)
TIME TO PEAK (hrs)=	1.67	2.33		1.67
RUNOFF VOLUME (mm)=	47.68	4.36		11.29
TOTAL RAINFALL (mm)=	48.48	48.48		48.48
RUNOFF COEFFICIENT	=	0.98		0.23

***** 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* = 50.0 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 2A - SWM POND

```
-----
| RESERVOIR( 0210) |
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
-----
OVERFLOW IS OFF
OUTFLOW STORAGE | OUTFLOW STORAGE
(cms) (ha.m.) | (cms) (ha.m.)
0.0000 0.0000 | 0.3900 0.0820
0.0200 0.0000 | 0.4300 0.1090
0.0800 0.0020 | 0.5800 0.2670
0.2100 0.0160 | 0.6360 0.3420
0.3000 0.0330 | 0.0000 0.0000
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW : ID= 2 ( 0021) 16.900 0.790 1.67 11.29
OUTFLOW: ID= 1 ( 0210) 16.900 0.307 1.83 11.29
```

PEAK FLOW REDUCTION [Qout/Qin] (%)= 38.88
TIME SHIFT OF PEAK FLOW (min)= 10.00
MAXIMUM STORAGE USED (ha.m.)= 0.0373

```
-----
| DUHYD ( 0211) |
| Inlet Cap.= 0.280 |
| #of Inlets= 1 |
| Total(cms)= 0.3 |
-----
TOTAL HYD.(ID= 1): 16.90 0.31 1.83 11.29
```

```
=====
MAJOR SYS.(ID= 2): 0.24 0.03 1.83 11.29
MINOR SYS.(ID= 3): 16.66 0.28 1.75 11.29
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

AREA 2C - LAM BOULEVARD

```
-----
| CALIB |
| STANDHYD ( 0023) |
| ID= 1 DT= 1.0 min |
-----
Area (ha)= 0.80
Total Imp(%)= 90.00 Dir. Conn.(%)= 45.00
```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.72	0.08
Dep. Storage (mm)=	0.80	16.50
Average Slope (%)=	1.00	1.00
Length (m)=	73.03	40.00
Mannings n	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 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
0.017	0.00	1.067	7.11	2.117	11.43	3.17	4.93
0.033	0.00	1.083	7.11	2.133	11.43	3.18	4.55
0.050	0.00	1.100	7.11	2.150	11.43	3.20	4.55
0.067	0.00	1.117	7.11	2.167	11.43	3.22	4.55
0.083	0.00	1.133	7.11	2.183	9.15	3.23	4.55
0.100	0.00	1.150	7.11	2.200	9.15	3.25	4.55
0.117	0.00	1.167	7.11	2.217	9.15	3.27	4.55
0.133	0.00	1.183	10.19	2.233	9.15	3.28	4.55
0.150	0.00	1.200	10.19	2.250	9.15	3.30	4.55
0.167	0.00	1.217	10.19	2.267	9.15	3.32	4.55
0.183	3.53	1.233	10.19	2.283	9.15	3.33	4.55
0.200	3.53	1.250	10.19	2.300	9.15	3.35	4.22
0.217	3.53	1.267	10.19	2.317	9.15	3.37	4.22
0.233	3.53	1.283	10.19	2.333	9.15	3.38	4.22
0.250	3.53	1.300	10.19	2.350	7.70	3.40	4.22
0.267	3.53	1.317	10.19	2.367	7.70	3.42	4.22
0.283	3.53	1.333	10.19	2.383	7.70	3.43	4.22
0.300	3.53	1.350	21.62	2.400	7.70	3.45	4.22
0.317	3.53	1.367	21.62	2.417	7.70	3.47	4.22
0.333	3.53	1.383	21.62	2.433	7.70	3.48	4.22
0.350	3.66	1.400	21.62	2.450	7.70	3.50	4.22
0.367	3.66	1.417	21.62	2.467	7.70	3.52	3.96
0.383	3.66	1.433	21.62	2.483	7.70	3.53	3.96
0.400	3.66	1.450	21.62	2.500	7.70	3.55	3.96
0.417	3.66	1.467	21.62	2.517	6.68	3.57	3.96
0.433	3.66	1.483	21.62	2.533	6.68	3.58	3.96
0.450	3.66	1.500	21.62	2.550	6.68	3.60	3.96
0.467	3.66	1.517	112.37	2.567	6.68	3.62	3.96
0.483	3.66	1.533	112.37	2.583	6.68	3.63	3.96
0.500	3.66	1.550	112.37	2.600	6.68	3.65	3.96
0.517	4.04	1.567	112.37	2.617	6.68	3.67	3.96
0.533	4.04	1.583	112.37	2.633	6.68	3.68	3.73
0.550	4.04	1.600	112.37	2.650	6.68	3.70	3.73
0.567	4.04	1.617	112.37	2.667	6.68	3.72	3.73
0.583	4.04	1.633	112.37	2.683	5.94	3.73	3.73
0.600	4.04	1.650	112.37	2.700	5.94	3.75	3.73
0.617	4.04	1.667	112.37	2.717	5.94	3.77	3.73
0.633	4.04	1.683	27.76	2.733	5.94	3.78	3.73
0.650	4.04	1.700	27.76	2.750	5.94	3.80	3.73
0.667	4.04	1.717	27.76	2.767	5.94	3.82	3.73
0.683	4.67	1.733	27.76	2.783	5.94	3.83	3.73
0.700	4.67	1.750	27.76	2.800	5.94	3.85	3.53
0.717	4.67	1.767	27.76	2.817	5.94	3.87	3.53
0.733	4.67	1.783	27.76	2.833	5.94	3.88	3.53
0.750	4.67	1.800	27.76	2.850	5.39	3.90	3.53
0.767	4.67	1.817	27.76	2.867	5.39	3.92	3.53
0.783	4.67	1.833	27.76	2.883	5.39	3.93	3.53
0.800	4.67	1.850	15.75	2.900	5.39	3.95	3.53
0.817	4.67	1.867	15.75	2.917	5.39	3.97	3.53
0.833	4.67	1.883	15.75	2.933	5.39	3.98	3.53
0.850	5.61	1.900	15.75	2.950	5.39	4.00	3.53
0.867	5.61	1.917	15.75	2.967	5.39	4.02	3.35
0.883	5.61	1.933	15.75	2.983	5.39	4.03	3.35
0.900	5.61	1.950	15.75	3.000	5.39	4.05	3.35
0.917	5.61	1.967	15.75	3.017	4.93	4.07	3.35
0.933	5.61	1.983	15.75	3.033	4.93	4.08	3.35
0.950	5.61	2.000	15.75	3.050	4.93	4.10	3.35
0.967	5.61	2.017	11.43	3.067	4.93	4.12	3.35
0.983	5.61	2.033	11.43	3.083	4.93	4.13	3.35
1.000	5.61	2.050	11.43	3.100	4.93	4.15	3.35
1.017	7.11	2.067	11.43	3.117	4.93	4.17	3.35
1.033	7.11	2.083	11.43	3.133	4.93		
1.050	7.11	2.100	11.43	3.150	4.93		

Max.Eff.Inten.(mm/hr)=	112.37	330.04
over (min)	5.00	7.00
Storage Coeff. (min)=	2.02 (ii)	6.56 (ii)
Unit Hyd. Tpeak (min)=	5.00	7.00
Unit Hyd. peak (cms)=	0.37	0.17

PEAK FLOW (cms)=	0.11	0.05	*TOTALS*	0.157 (iii)
TIME TO PEAK (hrs)=	1.67	1.73		1.68
RUNOFF VOLUME (mm)=	47.68	26.21		35.86
TOTAL RAINFALL (mm)=	48.48	48.48		48.48
RUNOFF COEFFICIENT	=	0.98	0.54	0.74

Revised Waterford Municipal Drain Design
With WSMD Stormwater Management Pond
Visual OTTHYMO MODEL

5-Year Storm Event

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

```
-----
| DUHYD ( 0230) |
| Inlet Cap.= 0.015 |
| #of Inlets= 1 |
| Total(cms)= 0.0 |
|-----|
| AREA      QPEAK      TPEAK      R.V.
| (ha)      (cms)      (hrs)      (mm)
|-----|
TOTAL HYD.(ID= 1):  0.80      0.16      1.68      35.86
|-----|
MAJOR SYS.(ID= 2):  0.40      0.14      1.68      35.86
MINOR SYS.(ID= 3):  0.40      0.01      1.40      35.86
|-----|
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

AREA 2D - ORCHARD SQUARE

```
-----
| CALIB |
| STANDHYD ( 0024) |
| ID= 1 DT= 1.0 min |
|-----|
| AREA (ha)= 1.40
| Total Imp(%)= 90.00 Dir. Conn.(%)= 45.00
|-----|
```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	1.26	0.14
Dep. Storage (mm)=	0.80	16.50
Average Slope (%)=	1.00	1.00
Length (m)=	96.61	40.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----									
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.017	0.00	1.067	7.11	2.117	11.43	3.17	4.93		
0.033	0.00	1.083	7.11	2.133	11.43	3.18	4.55		
0.050	0.00	1.100	7.11	2.150	11.43	3.20	4.55		
0.067	0.00	1.117	7.11	2.167	11.43	3.22	4.55		
0.083	0.00	1.133	7.11	2.183	9.15	3.23	4.55		
0.100	0.00	1.150	7.11	2.200	9.15	3.25	4.55		
0.117	0.00	1.167	7.11	2.217	9.15	3.27	4.55		
0.133	0.00	1.183	10.19	2.233	9.15	3.28	4.55		
0.150	0.00	1.200	10.19	2.250	9.15	3.30	4.55		
0.167	0.00	1.217	10.19	2.267	9.15	3.32	4.55		
0.183	3.53	1.233	10.19	2.283	9.15	3.33	4.55		
0.200	3.53	1.250	10.19	2.300	9.15	3.35	4.22		
0.217	3.53	1.267	10.19	2.317	9.15	3.37	4.22		
0.233	3.53	1.283	10.19	2.333	9.15	3.38	4.22		
0.250	3.53	1.300	10.19	2.350	7.70	3.40	4.22		
0.267	3.53	1.317	10.19	2.367	7.70	3.42	4.22		
0.283	3.53	1.333	10.19	2.383	7.70	3.43	4.22		
0.300	3.53	1.350	21.62	2.400	7.70	3.45	4.22		
0.317	3.53	1.367	21.62	2.417	7.70	3.47	4.22		
0.333	3.53	1.383	21.62	2.433	7.70	3.48	4.22		
0.350	3.66	1.400	21.62	2.450	7.70	3.50	4.22		
0.367	3.66	1.417	21.62	2.467	7.70	3.52	3.96		
0.383	3.66	1.433	21.62	2.483	7.70	3.53	3.96		
0.400	3.66	1.450	21.62	2.500	7.70	3.55	3.96		
0.417	3.66	1.467	21.62	2.517	6.68	3.57	3.96		
0.433	3.66	1.483	21.62	2.533	6.68	3.58	3.96		
0.450	3.66	1.500	21.62	2.550	6.68	3.60	3.96		
0.467	3.66	1.517	112.37	2.567	6.68	3.62	3.96		
0.483	3.66	1.533	112.37	2.583	6.68	3.63	3.96		
0.500	3.66	1.550	112.37	2.600	6.68	3.65	3.96		
0.517	4.04	1.567	112.37	2.617	6.68	3.67	3.96		
0.533	4.04	1.583	112.37	2.633	6.68	3.68	3.73		
0.550	4.04	1.600	112.37	2.650	6.68	3.70	3.73		
0.567	4.04	1.617	112.37	2.667	6.68	3.72	3.73		
0.583	4.04	1.633	112.37	2.683	5.94	3.73	3.73		
0.600	4.04	1.650	112.37	2.700	5.94	3.75	3.73		
0.617	4.04	1.667	112.37	2.717	5.94	3.77	3.73		
0.633	4.04	1.683	27.76	2.733	5.94	3.78	3.73		
0.650	4.04	1.700	27.76	2.750	5.94	3.80	3.73		
0.667	4.04	1.717	27.76	2.767	5.94	3.82	3.73		
0.683	4.67	1.733	27.76	2.783	5.94	3.83	3.73		
0.700	4.67	1.750	27.76	2.800	5.94	3.85	3.53		
0.717	4.67	1.767	27.76	2.817	5.94	3.87	3.53		
0.733	4.67	1.783	27.76	2.833	5.94	3.88	3.53		
0.750	4.67	1.800	27.76	2.850	5.39	3.90	3.53		
0.767	4.67	1.817	27.76	2.867	5.39	3.92	3.53		
0.783	4.67	1.833	27.76	2.883	5.39	3.93	3.53		
0.800	4.67	1.850	15.75	2.900	5.39	3.95	3.53		
0.817	4.67	1.867	15.75	2.917	5.39	3.97	3.53		
0.833	4.67	1.883	15.75	2.933	5.39	3.98	3.53		
0.850	5.61	1.900	15.75	2.950	5.39	4.00	3.53		
0.867	5.61	1.917	15.75	2.967	5.39	4.02	3.35		
0.883	5.61	1.933	15.75	2.983	5.39	4.03	3.35		
0.900	5.61	1.950	15.75	3.000	5.39	4.05	3.35		
0.917	5.61	1.967	15.75	3.017	4.93	4.07	3.35		
0.933	5.61	1.983	15.75	3.033	4.93	4.08	3.35		
0.950	5.61	2.000	15.75	3.050	4.93	4.10	3.35		
0.967	5.61	2.017	11.43	3.067	4.93	4.12	3.35		
0.983	5.61	2.033	11.43	3.083	4.93	4.13	3.35		
1.000	5.61	2.050	11.43	3.100	4.93	4.15	3.35		
1.017	7.11	2.067	11.43	3.117	4.93	4.17	3.35		

1.033	7.11	2.083	11.43	3.133	4.93
1.050	7.11	2.100	11.43	3.150	4.93

Max.Eff.Inten.(mm/hr)=	112.37	330.04	
over (min)	5.00	7.00	
Storage Coeff. (min)=	2.39 (ii)	6.93 (ii)	
Unit Hyd. Tpeak (min)=	5.00	7.00	
Unit Hyd. peak (cms)=	0.35	0.16	
PEAK FLOW (cms)=	0.19	0.09	0.270 (iii)
TIME TO PEAK (hrs)=	1.67	1.73	1.68
RUNOFF VOLUME (mm)=	47.68	26.21	35.87
TOTAL RAINFALL (mm)=	48.48	48.48	48.48
RUNOFF COEFFICIENT =	0.98	0.54	0.74

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 58.0 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.

```
-----
| DUHYD ( 0240) |
| Inlet Cap.= 0.015 |
| #of Inlets= 1 |
| Total(cms)= 0.0 |
|-----|
| AREA      QPEAK      TPEAK      R.V.
| (ha)      (cms)      (hrs)      (mm)
|-----|
TOTAL HYD.(ID= 1):  1.40      0.27      1.68      35.87
|-----|
MAJOR SYS.(ID= 2):  0.89      0.26      1.68      35.87
MINOR SYS.(ID= 3):  0.51      0.01      1.23      35.87
|-----|
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD CURRENT DEVELOPMENTS

```
-----
| ADD HYD ( 1001) |
| 1 + 2 = 3 |
|-----|
| AREA      QPEAK      TPEAK      R.V.
| (ha)      (cms)      (hrs)      (mm)
|-----|
ID1= 1 ( 0010):  37.93      1.020      1.60      10.11
+ ID2= 2 ( 0211):  16.66      0.280      1.75      11.29
|-----|
ID = 3 ( 1001):  54.60      1.300      1.77      10.47
|-----|
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 1001) |
| 3 + 2 = 1 |
|-----|
| AREA      QPEAK      TPEAK      R.V.
| (ha)      (cms)      (hrs)      (mm)
|-----|
ID1= 3 ( 1001):  54.60      1.300      1.77      10.47
+ ID2= 2 ( 0220):  11.82      0.017      4.68      12.09
|-----|
ID = 1 ( 1001):  66.42      1.308      1.77      10.76
|-----|
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 1001) |
| 1 + 2 = 3 |
|-----|
| AREA      QPEAK      TPEAK      R.V.
| (ha)      (cms)      (hrs)      (mm)
|-----|
ID1= 1 ( 1001):  66.42      1.308      1.77      10.76
+ ID2= 2 ( 0230):  0.40      0.015      1.40      35.86
|-----|
ID = 3 ( 1001):  66.81      1.323      1.77      10.91
|-----|
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 1001) |
| 3 + 2 = 1 |
|-----|
| AREA      QPEAK      TPEAK      R.V.
| (ha)      (cms)      (hrs)      (mm)
|-----|
ID1= 3 ( 1001):  66.81      1.323      1.77      10.91
+ ID2= 2 ( 0240):  0.51      0.015      1.23      35.87
|-----|
ID = 1 ( 1001):  67.33      1.338      1.77      11.10
|-----|
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 1001) |
| 1 + 2 = 3 |
|-----|
| AREA      QPEAK      TPEAK      R.V.
| (ha)      (cms)      (hrs)      (mm)
|-----|
ID1= 1 ( 1001):  67.33      1.338      1.77      11.10
+ ID2= 2 ( 0030):  17.84      1.827      1.60      29.23
|-----|
ID = 3 ( 1001):  85.16      3.165      1.77      14.90
|-----|
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

Revised Waterford Municipal Drain Design
With WSMD Stormwater Management Pond
Visual OTTHYMO MODEL

5-Year Storm Event

AREA 5 - CHARLES

```
-----
| CALIB |
| STANDHYD ( 0005) |
| ID= 1 DT= 5.0 min |
|-----|
Area (ha)= 4.35
Total Imp(%)= 46.00 Dir. Conn.(%)= 21.00
```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	2.00	2.35
Dep. Storage (mm)=	1.00	13.60
Average Slope (%)=	1.00	2.00
Length (m)=	170.29	40.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083 0.00 | 1.167 7.11 | 2.250 9.15 | 3.33 4.55
0.167 0.00 | 1.250 10.19 | 2.333 9.15 | 3.42 4.22
0.250 3.53 | 1.333 10.19 | 2.417 7.70 | 3.50 4.22
0.333 3.53 | 1.417 21.62 | 2.500 7.70 | 3.58 3.96
0.417 3.66 | 1.500 21.62 | 2.583 6.68 | 3.67 3.96
0.500 3.66 | 1.583 112.37 | 2.667 6.68 | 3.75 3.73
0.583 4.04 | 1.667 112.37 | 2.750 5.94 | 3.83 3.73
0.667 4.04 | 1.750 27.76 | 2.833 5.94 | 3.92 3.53
0.750 4.67 | 1.833 27.76 | 2.917 5.39 | 4.00 3.53
0.833 4.67 | 1.917 15.75 | 3.000 5.39 | 4.08 3.35
0.917 5.61 | 2.000 15.75 | 3.083 4.93 | 4.17 3.35
1.000 5.61 | 2.083 11.43 | 3.167 4.93 |
1.083 7.11 | 2.167 11.43 | 3.250 4.55 |
```

Max.Eff.Inten.(mm/hr)=	112.37	21.69
over (min)=	5.00	20.00
Storage Coeff. (min)=	3.36 (ii)	16.36 (ii)
Unit Hyd. Tpeak (min)=	5.00	20.00
Unit Hyd. peak (cms)=	0.26	0.06

		TOTALS
PEAK FLOW (cms)=	0.27	0.08 0.294 (iii)
TIME TO PEAK (hrs)=	1.67	1.92 1.67
RUNOFF VOLUME (mm)=	47.48	10.54 18.30
TOTAL RAINFALL (mm)=	48.48	48.48 48.48
RUNOFF COEFFICIENT =	0.98	0.22 0.38

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

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 62.0 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.

```
-----
| DUHYD ( 0050) |
| Inlet Cap.= 0.023 |
| #of Inlets= 1 |
| Total(cms)= 0.0 |
|-----|
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
TOTAL HYD.(ID= 1): 4.35 0.29 1.67 18.30
MAJOR SYS.(ID= 2): 2.69 0.27 1.67 18.30
MINOR SYS.(ID= 3): 1.66 0.02 1.25 18.30
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

AREA 4 - THOMPSON

```
-----
| CALIB |
| STANDHYD ( 0004) |
| ID= 1 DT= 5.0 min |
|-----|
Area (ha)= 7.85
Total Imp(%)= 46.00 Dir. Conn.(%)= 22.00
```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.61	4.24
Dep. Storage (mm)=	1.00	8.10
Average Slope (%)=	1.00	2.00
Length (m)=	228.76	40.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 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
0.083 0.00 | 1.167 7.11 | 2.250 9.15 | 3.33 4.55
0.167 0.00 | 1.250 10.19 | 2.333 9.15 | 3.42 4.22
0.250 3.53 | 1.333 10.19 | 2.417 7.70 | 3.50 4.22
0.333 3.53 | 1.417 21.62 | 2.500 7.70 | 3.58 3.96
0.417 3.66 | 1.500 21.62 | 2.583 6.68 | 3.67 3.96
0.500 3.66 | 1.583 112.37 | 2.667 6.68 | 3.75 3.73
0.583 4.04 | 1.667 112.37 | 2.750 5.94 | 3.83 3.73
0.667 4.04 | 1.750 27.76 | 2.833 5.94 | 3.92 3.53
0.750 4.67 | 1.833 27.76 | 2.917 5.39 | 4.00 3.53
0.833 4.67 | 1.917 15.75 | 3.000 5.39 | 4.08 3.35
0.917 5.61 | 2.000 15.75 | 3.083 4.93 | 4.17 3.35
1.000 5.61 | 2.083 11.43 | 3.167 4.93 |
1.083 7.11 | 2.167 11.43 | 3.250 4.55 |
```

Max.Eff.Inten.(mm/hr)=	112.37	48.53
over (min)=	5.00	15.00
Storage Coeff. (min)=	4.01 (ii)	13.43 (ii)
Unit Hyd. Tpeak (min)=	5.00	15.00
Unit Hyd. peak (cms)=	0.24	0.08
PEAK FLOW (cms)=	0.50	0.30
TIME TO PEAK (hrs)=	1.67	1.83
RUNOFF VOLUME (mm)=	47.48	16.52
TOTAL RAINFALL (mm)=	48.48	48.48
RUNOFF COEFFICIENT =	0.98	0.34

TOTALS
0.638 (iii)

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

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 72.0 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.

```
-----
| DUHYD ( 0040) |
| Inlet Cap.= 0.084 |
| #of Inlets= 1 |
| Total(cms)= 0.1 |
|-----|
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
TOTAL HYD.(ID= 1): 7.85 0.64 1.67 23.33
MAJOR SYS.(ID= 2): 3.94 0.55 1.67 23.33
MINOR SYS.(ID= 3): 3.91 0.08 1.42 23.33
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD CHARLES & THOMPSON DEVELOPMENTS

```
-----
| ADD HYD ( 1002) |
| 1 + 2 = 3 |
|-----|
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
ID1= 1 ( 1001): 85.16 3.165 1.77 14.90
+ ID2= 2 ( 0040): 3.91 0.084 1.42 23.33
ID = 3 ( 1002): 89.08 3.249 1.77 15.27
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 1002) |
| 3 + 2 = 1 |
|-----|
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
ID1= 3 ( 1002): 89.08 3.249 1.77 15.27
+ ID2= 2 ( 0050): 1.66 0.023 1.25 18.30
ID = 1 ( 1002): 90.73 3.272 1.77 15.32
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

WSMD - SWM POND

```
-----
| RESERVOIR( 1003) |
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
|-----|
OVERFLOW IS ON
OUTFLOW STORAGE | OUTFLOW STORAGE
(cms) (ha.m.) | (cms) (ha.m.)
0.0000 0.0000 | 0.2760 0.9280
0.0000 0.2310 | 0.2890 0.9830
0.0900 0.4410 | 0.3380 1.2100
0.1800 0.6000 | 0.3590 1.3270
0.2470 0.8190 | 0.0000 0.0000
```

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 2 (1002)	90.735	3.272	1.77	15.32
OUTFLOW: ID= 1 (1003)	90.735	0.292	4.30	12.45
OVERFLOW: ID= 3 (0003)	0.000	0.000	0.00	0.00

TOTAL NUMBER OF SIMULATION OVERFLOW = 0
CUMULATIVE TIME OF OVERFLOW (HOURS) = 0.00
PERCENTAGE OF TIME OVERFLOWING (%) = 0.00

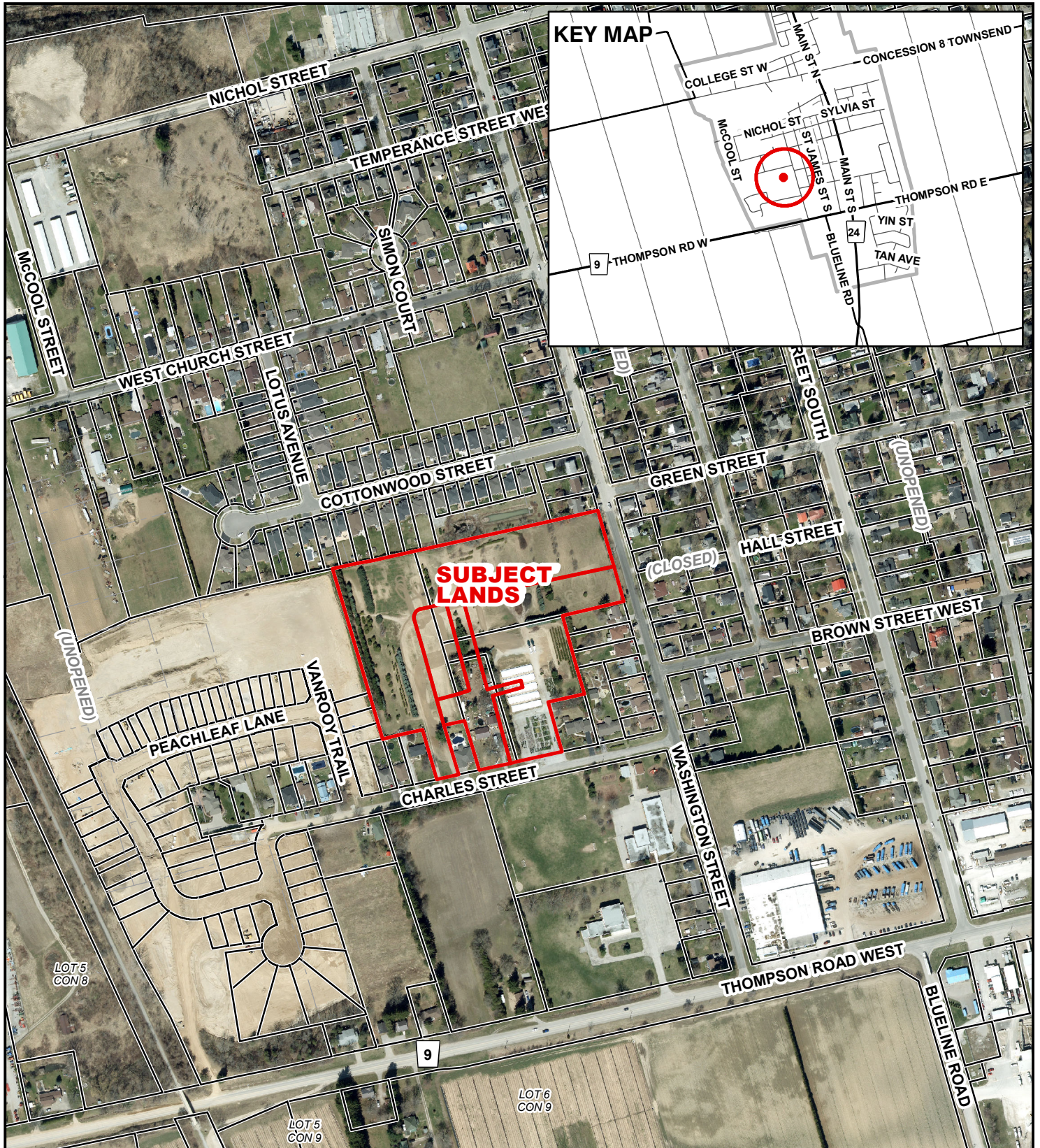
PEAK FLOW REDUCTION [Qout/Qin](%) = 8.93
TIME SHIFT OF PEAK FLOW (min)=152.00
MAXIMUM STORAGE USED (ha.m.) = 0.9975

**** WARNING : SELECTED ROUTING TIME STEP DENIED.

FINISH

MAP A
CONTEXT MAP
Urban Area of WATERFORD

28TPL2022267
ZNPL2022268

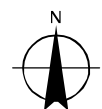


Legend

 Subject Lands

2020 Air Photo

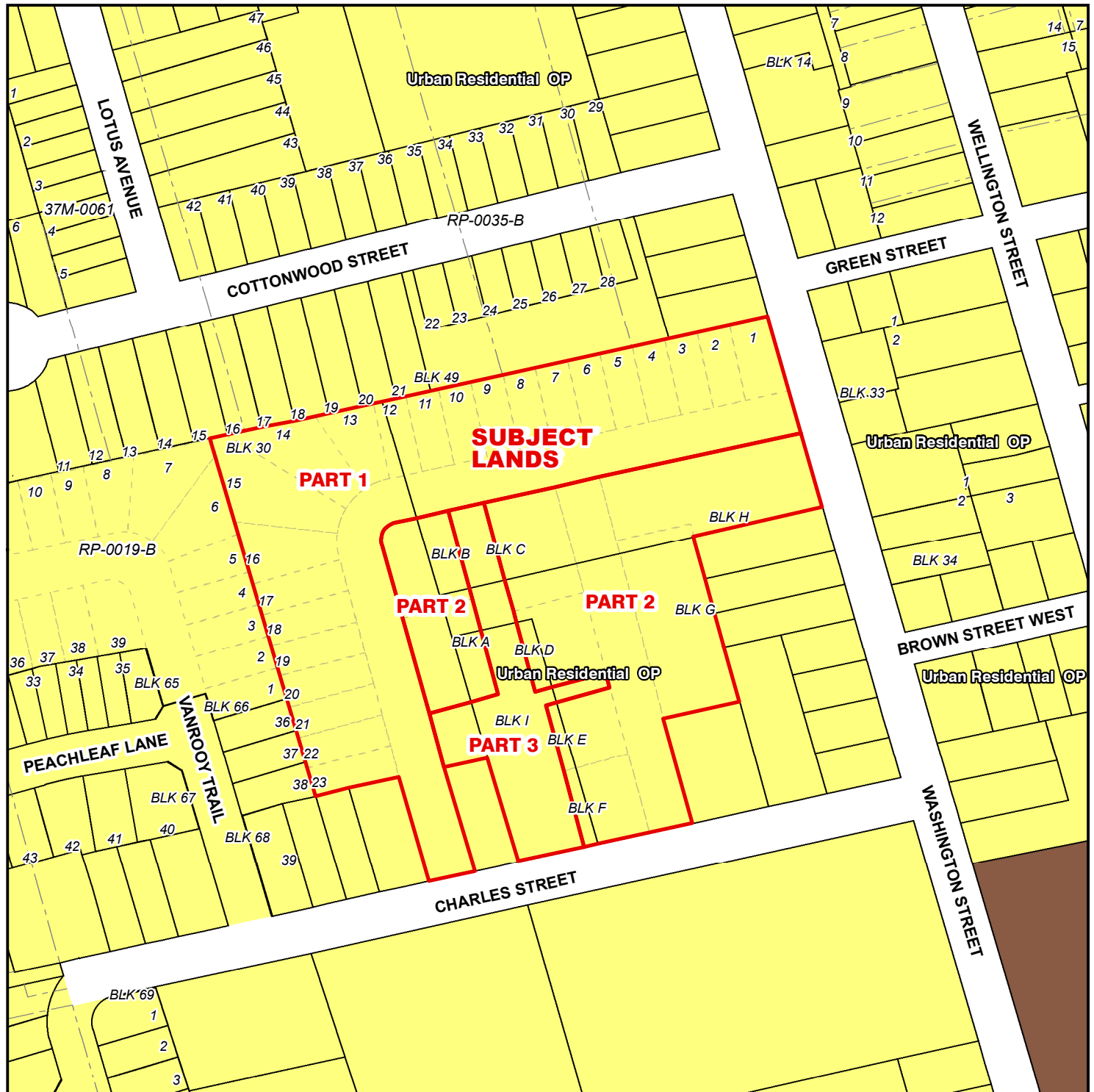
8/29/2022



40 20 0 40 80 120 160 Meters

Urban Area of WATERFORD

ZNPL2022268



Legend

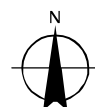
☐ Subject Lands

Official Plan Designations

Urban Residential
Protected Industrial

 Urban Area Boundary

8/29/2022



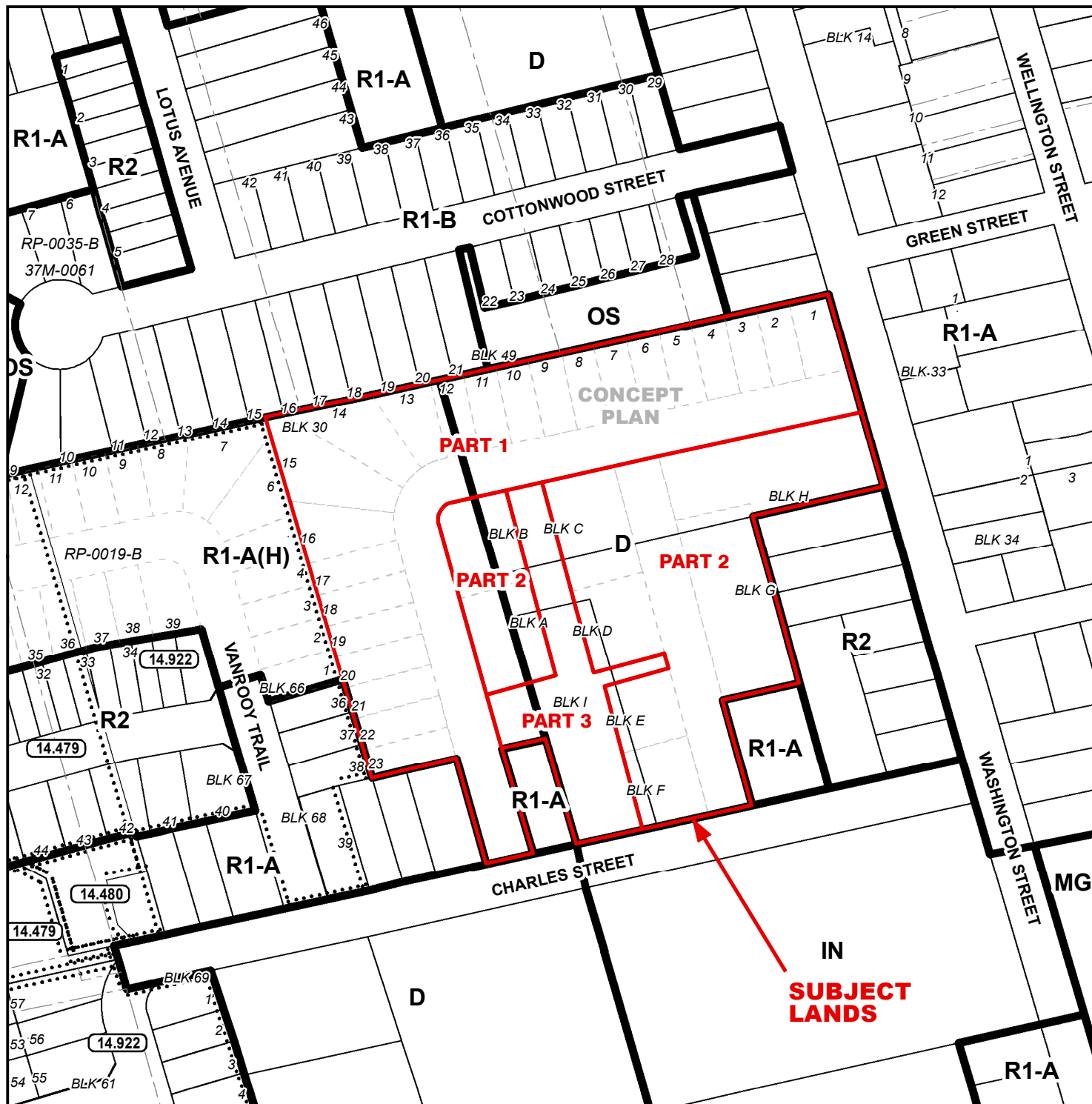
A scale bar labeled 'Meters' with markings at 20, 10, 0, 20, 40, 60, and 80.

MAP C

PROPOSED ZONING BY-LAW AMENDMENT MAP Urban Area of WATERFORD

28TPL2022267

ZNPL2022268



LEGEND

Subject Lands

ZONING BY-LAW 1-Z-2014

- (H) - Holding
- D - Development Zone
- MG - General Industrial Zone
- IN - Neighbourhood Institutional Zone
- OS - Open Space Zone
- R1-A - Residential R1-A Zone
- R1-B - Residential R1-B Zone
- R2 - Residential R2 Zone

PART 1

From: R1-A(H) & D
To: R1-B(H)

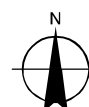
PART 2

From: R1-A(H) & D
To: R4(H)

PART 3

From: R1-A(H) & D
To: OS(H)

8/29/2022



20 10 0 20 40 60 80 Meters

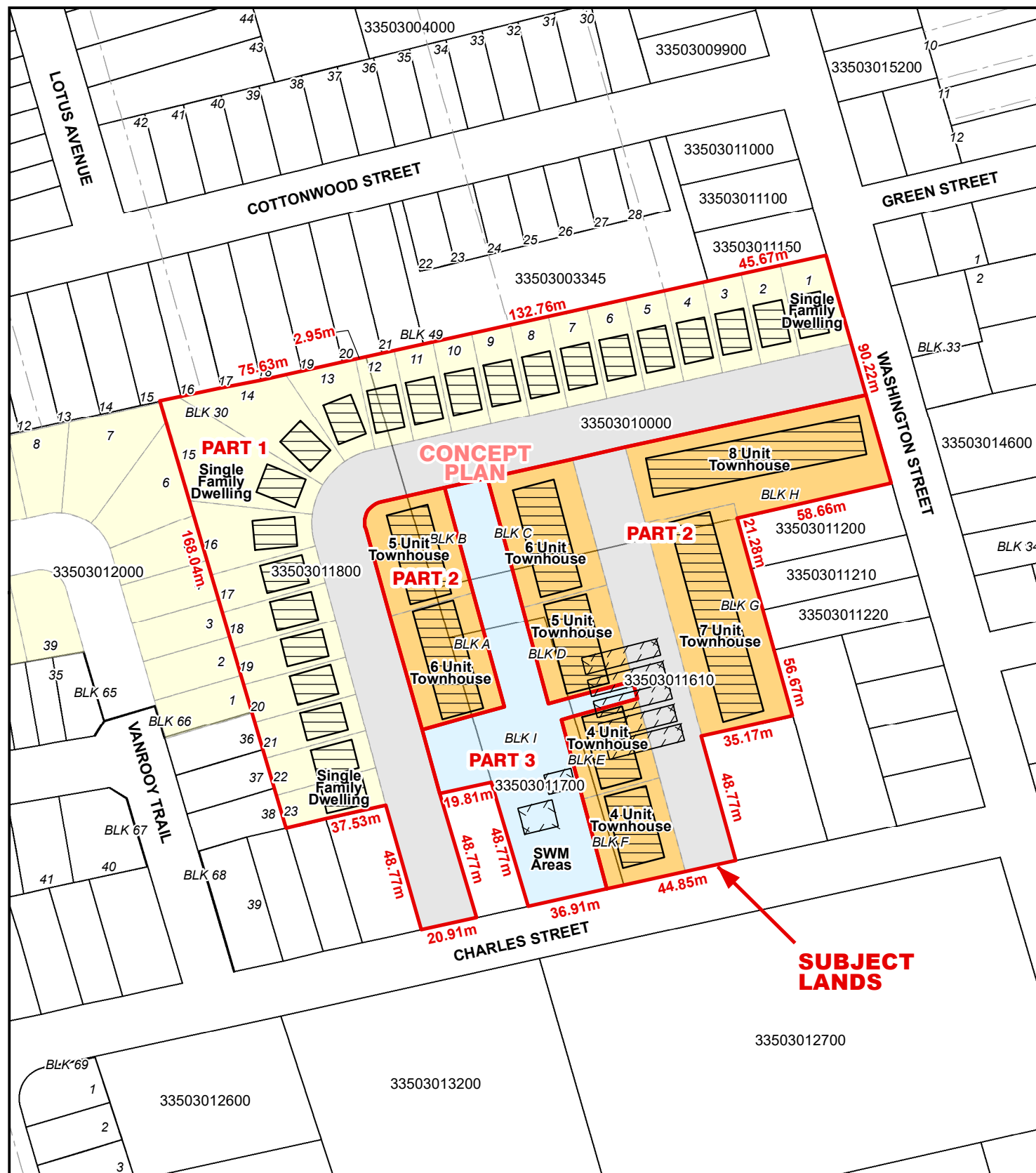
MAP D

CONCEPTUAL PLAN

Urban Area of WATERFORD

28TPL2022267

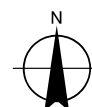
ZNPL2022268



Legend

Subject Lands

8/29/2022



20 10 0 20 40 60 80 Meters