STORM WATER and EROSION CONTROL CALCULATIONS
FOR:

ELM GROVE HEIGHTS

VILLAGE OF ELM GROVE, WI

Based on TR-55, Manning's Equation, and SLAMM.
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Overview

The proposed development is located on the north side of W. Bluemound Road and east of Elm Grove Road. The site has multi-tenant buildings located to the east and west and the Emerald Wood condominiums to the north. The site is currently vacant with pavement from a previous development and the driveway into the Emerald Woods site. The site currently drains from south to north to a drainage swale along the north side of the property. The drainage ditch drains to the east and discharges into the Underwood Creek. The existing site can be seen in Appendix A.

The proposed development will drain to proposed inlets located throughout the site. The inlets will drain the stormwater to a proposed underground detention system located under the main driveway. The stormwater management system will discharge stormwater to the existing drainage swale on the north side of the property. The proposed underground system will detain and treat stormwater to meet the village of Elm Grove, MMSD, and Wisconsin DNR standards. The project will disturb 1.42 acres. The proposed site can be seen in Appendix B.

Soils

A soil evaluation was performed onsite to determine the soil types. The borings completed onsite showed a variety of clay soils. The web soil survey map identified the soils within the project area as Loamy Land, Hydrologic soil group D.

Stormwater Management Requirements

Peak Discharge and Volumetric Design:

Village of Elm Grove and MMSD: Reduce or maintain the post-development runoff volumes to existing runoff volumes for the critical time period. Elm Grove is part of the Menomonee River Watershed. The Menomonee River watershed has a critical period of 9.5 hrs. The critical time for the watershed is 11:30-21:00.

Wisconsin DNR- Maintain or reduce the 1-yr and 2-yr, 24 hour post development peak runoff discharge rates to the 1-yr and 2-yr, 24 hour pre development peak runoff discharge rates respectively.

The proposed site currently drains from south to north to an existing drainage swale. The proposed site will match existing drainage patterns and will discharge the proposed underground system into the drainage swale to the west of the existing driveway.

The volumetric design will compare the total volume of stormwater released by the existing site during the critical time to the total volume of stormwater released by the proposed site during the critical time. The post development volume release volume will be reduced by the underground detention system.

Pre and Post Development Volumetric Design Summary Table

Storm	Pre Dev. Runoff Volume (cf)	Post Dev. Runoff Volume with BMPs (cf)
2-yr	5,993 cf	5750 cf
100-yr	18,418 cf	18,232 cf

Pre and Post Development Peak Flow Summary Table

Storm	Pre Dev. Runoff	Post Dev Runoff with BMPs
1-yr	1.59 CFS	0.23 CFS
2-yr	1.93 CFS	0.31 CFS

Pond A Release Rates
1-Year Storm = 0.11 CFS (4,302 C.F. stored to elevation 740.17')
2-Year Storm = 0.12 CFS (5,018 C.F. stored to elevation 740.45')
100-Year Storm = 0.68 CFS (11,659 C.F. stored to elevation 743.03')

Pond B Release Rates
1-Year Storm = 0.13 CFS (1,002 C.F. stored to elevation 735.27')
2-Year Storm = 0.20 CFS (1,133 C.F. stored to elevation 735.46')
100-Year Storm = 1.06 CFS (2,309 C.F. stored to elevation 737.23')

Since the post development release rates are all less than the predevelopment release rates for each basin; peak discharge requirements have been met.

Water Quality to provide TSS Removal:

Village of Elm Grove: Remove 80% total suspended solids (TSS) from the proposed development

Wisconsin DNR: The project site is considered a redevelopment post construction project NR 151 requires that 40% TSS be removed from driveways and parking areas.

The proposed underground stormwater system will include two storm trap systems with a 3' permanent pool to treat stormwater. SLAMM analysis was used to determine the total suspended solids that will be removed from the stormwater.

The proposed underground detention system will reduce TSS by 80.30%. Since the proposed stormwater system reduces TSS by 80.30%, which is greater than the 80% required by the village of Elm Grove and 40% required by the Wisconsin DNR, stormwater quality requirements have been met.

Storm Sewer Sizing:

All storm sewer draining to the stormwater management pond has been sized for the 100-yr storm event.

Infiltration:
Village of Elm Grove and Wisconsin DNR- The proposed project is exempt from infiltration requirements due to clay soils on site.

Erosion Control:
The erosion control specifications, construction sequence, site stabilization notes, seeding notes, dewatering notes, and post construction and maintenance plan are all listed on sheet C1.0 of the construction plan set.

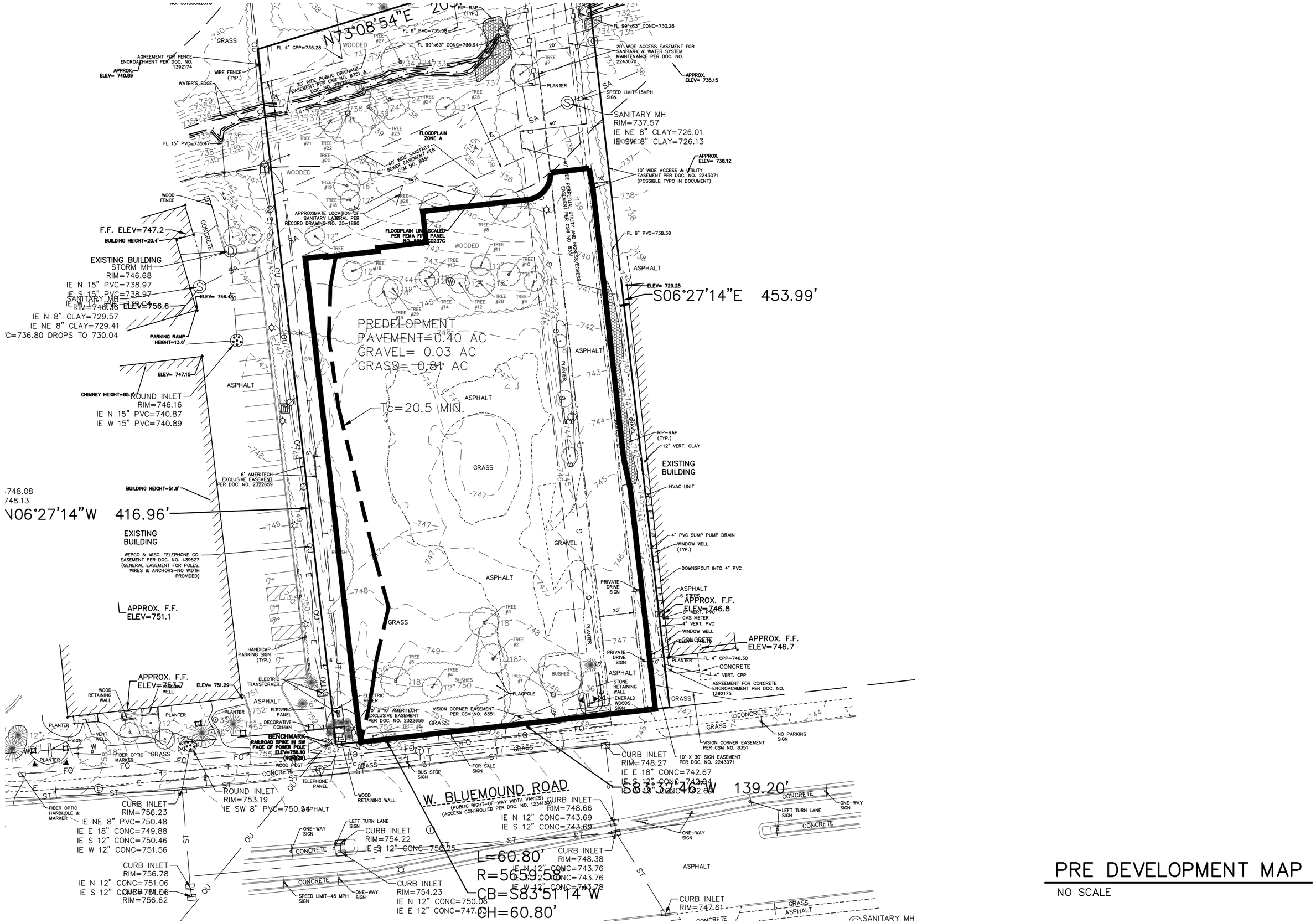
POST CONSTRUCTION OPERATION AND MAINTENANCE PLAN

The owner of the property affected shall inspect and maintain the following stormwater management systems frequently, especially after heavy rainfalls, but at least on an annual basis unless otherwise specified.

STORMWATER FACILITY	TYPE OF ACTION
1. Lawn and Landscaped Areas	All lawn areas shall be kept clear of any materials that block the flow of stormwater. Rills and small gullies shall immediately be filled and seeded or have sod placed in them. The lawn shall be kept mowed, tree seedlings shall be removed, and litter shall be removed from landscaped areas.
2. Swales	All grassed swales showing signs of erosion, scour, or channelization shall be repaired, reinforced, and revegetated immediately. All swales shall be repaired to the original plan requirements. Mowing shall take place no less than twice per year at a height of no less than three inches. Grasses shall not be allowed to grow to a height that permits branching or bending. Mowing shall only take place when the ground is dry and able to support machinery.
3. Catch Basin/Curb Inlet Grates	The grate openings to these structures must be cleared of any clogging or the blocking of stormwater flow from getting into the stormwater conveyance system of any kind.
5. Underground Stormwater Quality System	Standpipes, outlet structures, inlet and outlet pipes, and chambers shall be kept clear of debris. Non-structurally sound devices shall be replaced. These appurtenances shall be inspected semi-annually, in the spring and fall seasons. Follow underground detention system manufacturer's specifications for installation and maintenance procedures for proper installation. Contractor to remove all sediment and debris from the system prior to completing the storm system. Contractor to clean inlet and outlet structures and underground pipes prior to project completion. Every 2 years, beginning in the summer of 2018, the elevations of the silt accumulation on the bottom of the underground pipe network shall be surveyed to determine the permanent pool depth and sediment depth in the structure. When silt has accumulated 1 foot from the bottom of the structure, the pipe network shall be cleaned out with all sediment and water removed below the outlet structure elevation. Cleaning, removal, and deposit of silt from the underground stormwater quality system shall be done by means and methods acceptable to the Wisconsin Department of Natural Resources.

5. Rip Rap	All rip rap showing signs of erosion or scour shall be repaired, reinforced, and revegetated immediately. Rip rap should be kept clean of vegetation and sediment. All rip rap shall be repaired to the construction plan requirements.
6. Record of Maintenance	The operation and maintenance plan shall remain onsite and be available for inspection when requested by WDNR. When requested, the owner shall make available for inspection all maintenance records to the department or agent for the life of the system.

Appendix A:
Pre Development Map



PRE DEVELOPMENT MAP

NO SCALE

Appendix B:
Post Development Map

POST DEVELOPMENT
BASIN B
BUILDING– 0.04 AC
PAVEMENT– 0.22 AC
GRASS– 0.05 AC

S06°27'14"E 453.99'

PROPOSED 4
STORY BUILDING
75 UNITS
24,284 S.F.
CIVIL F.F.= 750.50
ARCH F.F.= 100.00

POST DEVELOPMENT
BASIN A
PAVEMENT– 0.24 AC
BUILDING– 0.53 AC
GRASS– 0.16 AC

N06°27'14"W 416.96'

S83°32'46"W 139.20'

L=60.80'
R=5659.58'
CB=S83°51'14"W

W. BLUEMOUND ROAD
(PUBLIC RIGHT-OF-WAY WIDTH VARIES)
(ACCESS CONTROLLED PER DOC. NO. 12341359)

EXISTING BUILDING
(CONDOMINIUM)

EXISTING BUILDING
(OFFICE SUITES)

EXISTING BUILDING
(PARKING STRUCTURE)

EXISTING BUILDING
(OFFICE SUITES)

F.F. ELEV=747.2
BUILDING HEIGHT=20.4'

STORM MH
RIM=746.68
IE N 15" PVC=738.97
IE S 15" PVC=738.97

SANITARY MH
RIM=746.36 ELEV=736.6
IE N 8" CLAY=729.57
IE NE 8" CLAY=729.41
IE SW 6" PVC=736.80 DROPS TO 730.04

SANITARY MH
RIM=737.57
IE NE 8" CLAY=726.01
IE W 8" CLAY=726.13

ROUND INLET
RIM=746.16
IE N 15" PVC=740.87
IE W 15" PVC=740.89

ROUND INLET
RIM=753.58
IE NE 10" PVC=748.08
IE SW 8" PVC=748.13

ROUND INLET
RIM=753.19
IE SW 8" PVC=750.54

CURB INLET
RIM=756.23
IE NE 8" PVC=750.48
IE E 18" CONC=749.88
IE S 12" CONC=750.46
IE W 12" CONC=751.56

CURB INLET
RIM=756.78
IE N 12" CONC=751.06
IE S 12" CONC=751.06

CURB INLET
RIM=756.62

CURB INLET
RIM=754.22
IE S 12" CONC=756.25

CURB INLET
RIM=754.23
IE N 12" CONC=750.06

CURB INLET
RIM=748.66
IE N 12" CONC=743.69
IE S 12" CONC=743.69

CURB INLET
RIM=748.38
IE N 12" CONC=743.76
IE S 12" CONC=743.76
IE W 12" CONC=743.78

CURB INLET
RIM=748.27
IE E 18" CONC=742.67
IE S 12" CONC=742.94
IE W 12" CONC=742.66

CURB INLET
RIM=747.61

APPROX. F.F.
ELEV=751.1

APPROX. F.F.
ELEV=753.7

APPROX. F.F.
ELEV=746.8

APPROX. F.F.
ELEV=746.7

APPROX.
ELEV= 735.15

APPROX.
ELEV= 738.12

ELEV= 740.89

ELEV= 746.44

ELEV= 747.15

ELEV= 751.29

ELEV= 729.28

FL 15" PVC=735.47

FL 6" PVC=738.38

FL 4" CPP=746.30

BENCHMARK
RAILROAD SPIKE IN SW FACE OF POWER POLE
ELEV=754.10
(NAVD88)

FLOODPLAIN ZONE A

FLOODPLAIN LINE SCALED PER FEMA FIRM PANEL NO. 55079C0139G

20' WIDE PUBLIC STORM SEWER EASEMENT PER CSM NO. 8351 DOC. NO. 2211792

40' WIDE SANITARY SEWER EASEMENT PER CSM NO. 8351

10' WIDE ACCESS & UTILITY EASEMENT PER DOC. NO. 2243071 (POSSIBLE TYPO IN DOCUMENT)

10' WIDE PEDESTRIAN EASEMENT PER DOC. NO. 2243071 AND INGRESS/EGRESS EASEMENT

6' AMERITECH EXCLUSIVE EASEMENT PER DOC. NO. 2322659

10' X 10' AMERITECH EXCLUSIVE EASEMENT PER DOC. NO. 2322659

10' X 30' SIGN EASEMENT PER DOC. NO. 2243071

VISION CORNER EASEMENT PER CSM NO. 8351

WISCONSIN ELECTRIC POWER CO. EASEMENT PER DOC. NO. 439527 (GENERAL EASEMENT FOR POLES, WIRES & ANCHORS–NO WIDTH PROVIDED)

AGREEMENT FOR CONCRETE ENCROACHMENT PER DOC. NO. 1392175

BUILDING HEIGHT=51.9'

CHIMNEY HEIGHT=65.4'

PARKING RAMP HEIGHT=13.6'

SPEED LIMIT-15MPH SIGN

SPEED LIMIT-45 MPH SIGN

HANDICAP PARKING SIGN (TYP.)

NO PARKING SIGN

ONE-WAY SIGN

LEFT TURN LANE SIGN

BUS STOP SIGN

FUTURE PARKING

WOODED

WATER'S EDGE (TYP.)

WOOD FENCE

CONCRETE

ASPHALT

GRASS

PLANTER

HVAC UNIT

WINDOW WELL (TYP.)

4" PVC SUMP PUMP DRAIN

DOWNSPOUT INTO 4" PVC

12" VERT. CLAY

4" VERT. PVC

GAS METER

WINDOW WELL

ELECTRIC METER

ELECTRIC TRANSFORMER

ELECTRIC PANEL

TELEPHONE PANEL

DECORATIVE COLUMN

WOOD POST

WOOD RETAINING WALL

VENT WELL

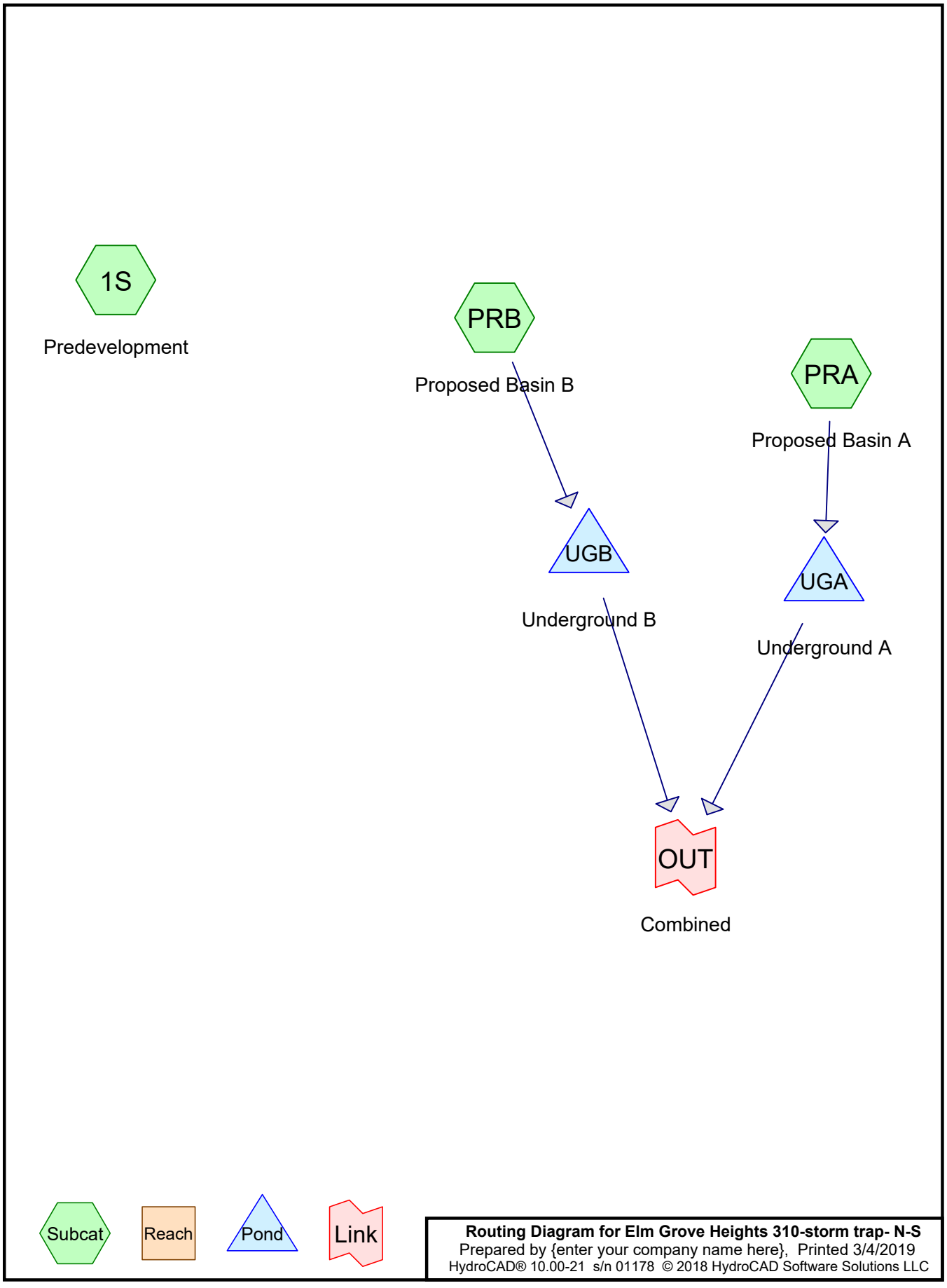
FIBER OPTIC MARKER

FIBER OPTIC HANDHOLE & MARKER

POST DEVELOPMENT MAP

NO SCALE

Appendix C:
Peak Discharge Hydrographs



Routing Diagram for Elm Grove Heights 310-storm trap- N-S
Prepared by {enter your company name here}, Printed 3/4/2019

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.020	80	>75% Grass cover, Good, HSG D (1S, PRA, PRB)
0.030	91	Gravel roads, HSG D (1S)
0.460	98	Paved parking, HSG D (PRA, PRB)
0.400	98	Pavement (1S)
0.570	98	Roofs, HSG D (PRA, PRB)
2.480	**91**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
2.080	HSG D	1S, PRA, PRB
0.400	Other	1S
2.480		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	1.020	0.000	1.020	>75% Grass cover, Good	1S, PRA, PRB
0.000	0.000	0.000	0.030	0.000	0.030	Gravel roads	1S
0.000	0.000	0.000	0.460	0.000	0.460	Paved parking	PRA, PRB
0.000	0.000	0.000	0.000	0.400	0.400	Pavement	1S
0.000	0.000	0.000	0.570	0.000	0.570	Roofs	PRA, PRB
0.000	**0.000**	**0.000**	**2.080**	**0.400**	**2.480**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	UGA	736.43	735.97	92.0	0.0050	0.012	12.0	0.0	0.0
2	UGB	733.75	733.72	6.0	0.0050	0.012	12.0	0.0	0.0

Time span=0.00-72.00 hrs, dt=0.02 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment1S: Predevelopment Runoff Area=1.240 ac 32.26% Impervious Runoff Depth=1.16"
Flow Length=296' Slope=0.0340 '/' Tc=20.5 min CN=86 Runoff=1.59 cfs 0.120 af

SubcatchmentPRA: Proposed Basin A Runoff Area=0.930 ac 82.80% Impervious Runoff Depth=1.87"
Tc=6.0 min CN=95 Runoff=3.00 cfs 0.145 af

SubcatchmentPRB: Proposed Basin B Runoff Area=0.310 ac 83.87% Impervious Runoff Depth=1.87"
Tc=6.0 min CN=95 Runoff=1.00 cfs 0.048 af

Pond UGA: Underground A Peak Elev=740.17' Storage=4,302 cf Inflow=3.00 cfs 0.145 af
Outflow=0.11 cfs 0.145 af

Pond UGB: Underground B Peak Elev=735.27' Storage=0.023 af Inflow=1.00 cfs 0.048 af
Outflow=0.13 cfs 0.048 af

Link OUT: Combined Inflow=0.23 cfs 0.193 af
Primary=0.23 cfs 0.193 af

Total Runoff Area = 2.480 ac Runoff Volume = 0.313 af Average Runoff Depth = 1.51"
42.34% Pervious = 1.050 ac 57.66% Impervious = 1.430 ac

Summary for Subcatchment 1S: Predevelopment

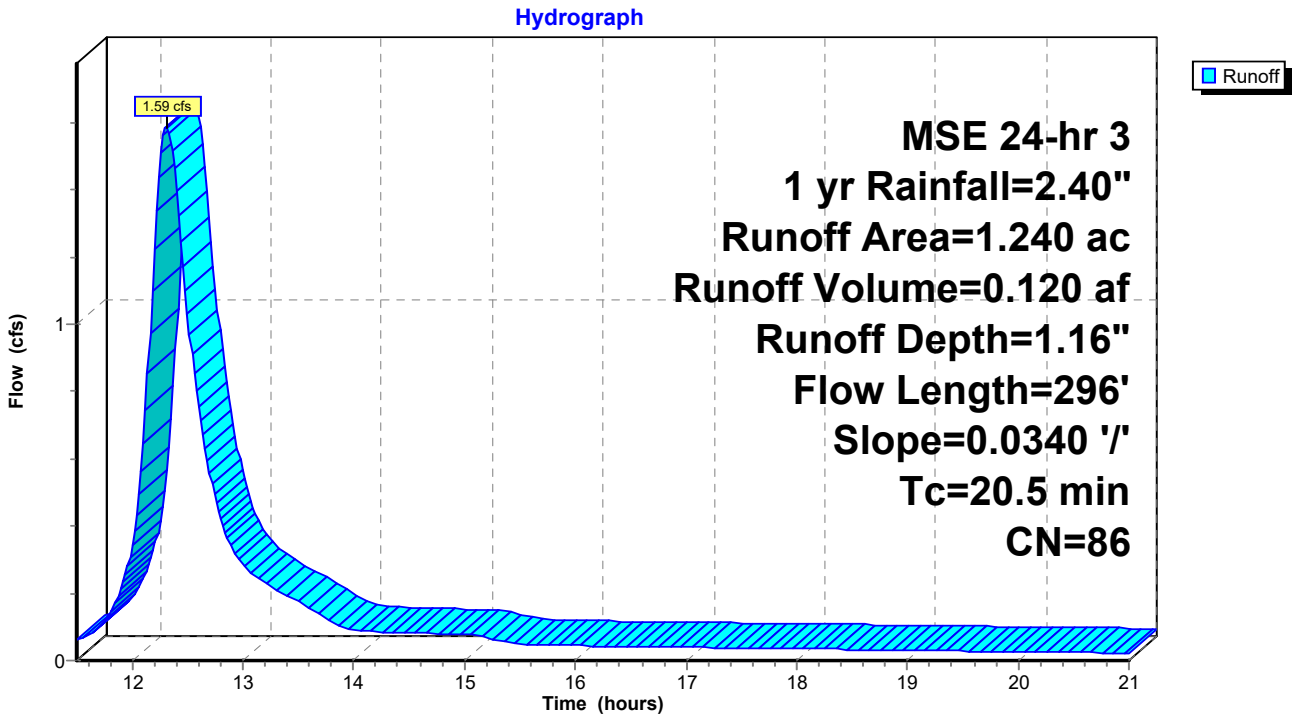
Runoff = 1.59 cfs @ 12.31 hrs, Volume= 0.120 af, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
MSE 24-hr 3 1 yr Rainfall=2.40"

	Area (ac)	CN	Description
*	0.400	98	Pavement
	0.030	91	Gravel roads, HSG D
	0.810	80	>75% Grass cover, Good, HSG D
	1.240	86	Weighted Average
	0.840		67.74% Pervious Area
	0.400		32.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.5	296	0.0340	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.71"

Subcatchment 1S: Predevelopment



Summary for Subcatchment PRA: Proposed Basin A

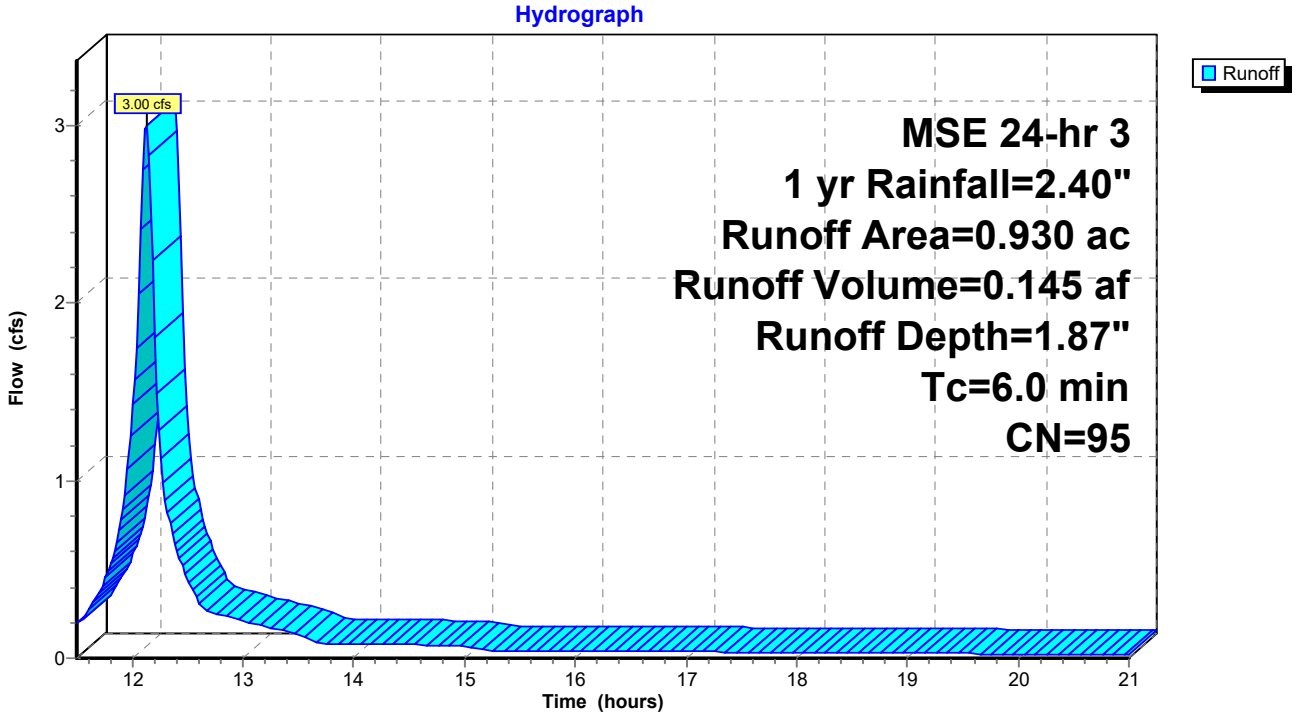
Runoff = 3.00 cfs @ 12.13 hrs, Volume= 0.145 af, Depth= 1.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
MSE 24-hr 3 1 yr Rainfall=2.40"

Area (ac)	CN	Description
0.240	98	Paved parking, HSG D
0.530	98	Roofs, HSG D
0.160	80	>75% Grass cover, Good, HSG D
0.930	95	Weighted Average
0.160		17.20% Pervious Area
0.770		82.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment PRA: Proposed Basin A



Summary for Subcatchment PRB: Proposed Basin B

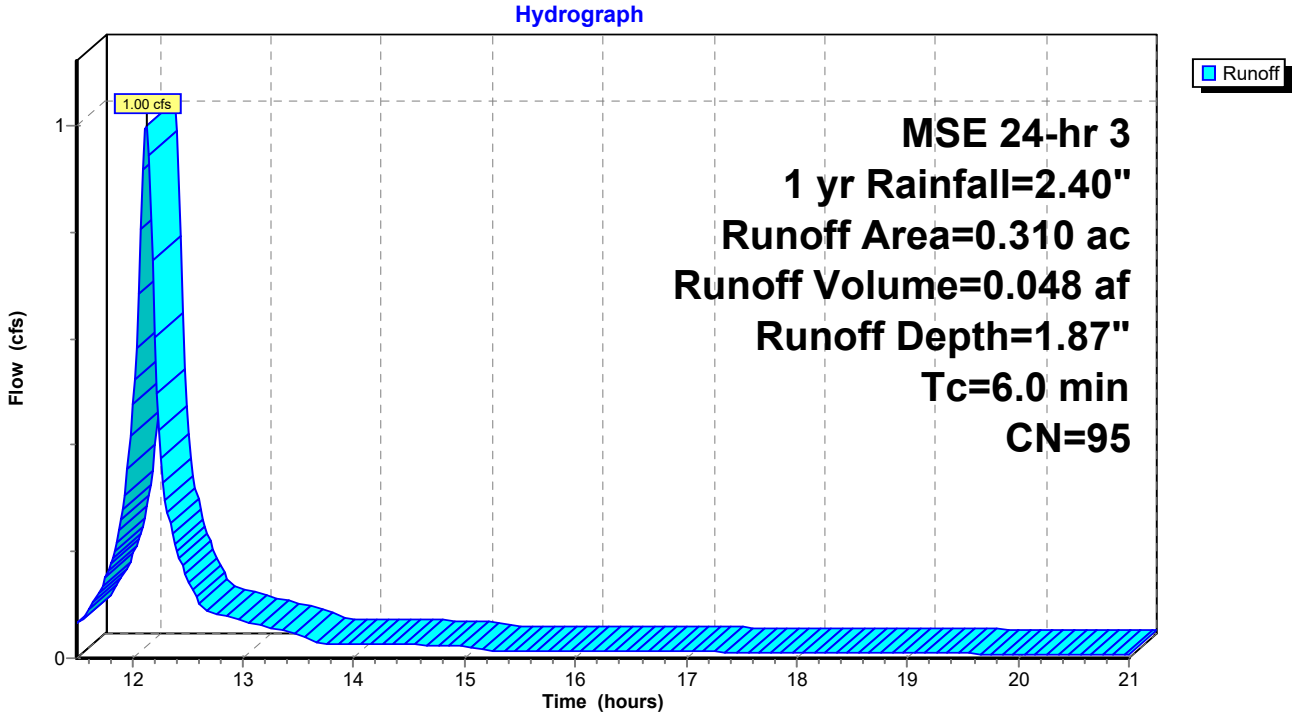
Runoff = 1.00 cfs @ 12.13 hrs, Volume= 0.048 af, Depth= 1.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
MSE 24-hr 3 1 yr Rainfall=2.40"

Area (ac)	CN	Description
0.040	98	Roofs, HSG D
0.220	98	Paved parking, HSG D
0.050	80	>75% Grass cover, Good, HSG D
0.310	95	Weighted Average
0.050		16.13% Pervious Area
0.260		83.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment PRB: Proposed Basin B



Summary for Pond UGA: Underground A

Inflow Area = 0.930 ac, 82.80% Impervious, Inflow Depth = 1.87" for 1 yr event
Inflow = 3.00 cfs @ 12.13 hrs, Volume= 0.145 af
Outflow = 0.11 cfs @ 13.58 hrs, Volume= 0.145 af, Atten= 96%, Lag= 86.9 min
Primary = 0.11 cfs @ 13.58 hrs, Volume= 0.145 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 740.17' @ 13.58 hrs Surf.Area= 2,902 sf Storage= 4,302 cf

Plug-Flow detention time= 515.8 min calculated for 0.145 af (100% of inflow)
Center-of-Mass det. time= 515.5 min (1,292.7 - 777.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	738.50'	0 cf	**38.75'W x 74.90'L x 5.50'H Field A** 15,962 cf Overall - 15,962 cf Embedded = 0 cf x 0.0% Voids
#2A	738.50'	12,873 cf	**StormTrap ST2 SingleTrap 5-0** x 12 Inside #1 Inside= 101.7"W x 60.0"H => 38.33 sf x 15.40'L = 590.2 cf Outside= 101.7"W x 66.0"H => 46.64 sf x 15.40'L = 718.0 cf 3 Rows of 4 Chambers 25.44' x 61.58' Core + 6.66' Border = 38.75' x 74.90' System
		12,873 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	736.43'	**12.0" Round Culvert** L= 92.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 736.43' / 735.97' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	738.50'	**1.8" Vert. Orifice/Grate** C= 0.600
#3	Device 1	740.50'	**3.5" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.11 cfs @ 13.58 hrs HW=740.17' (Free Discharge)
└**1=Culvert** (Passes 0.11 cfs of 5.98 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.11 cfs @ 6.08 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

Pond UGA: Underground A - Chamber Wizard Field A

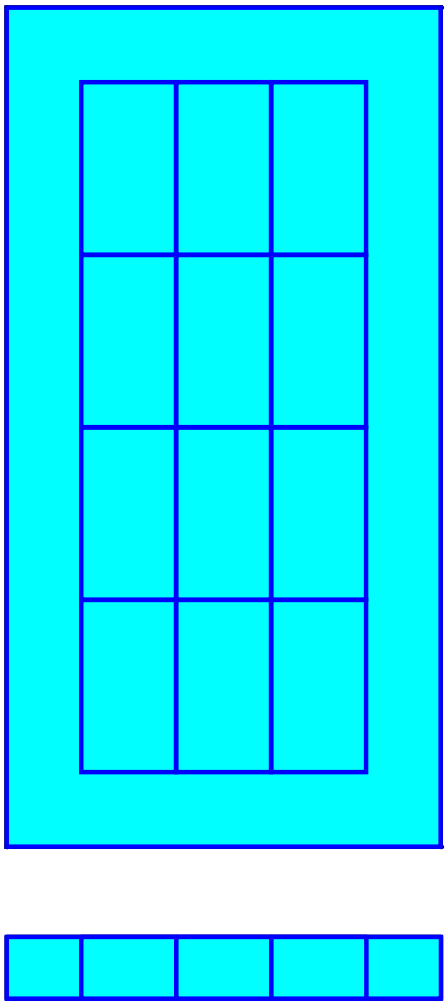
Chamber Model = StormTrap ST2 SingleTrap 5-0 (StormTrap ST2 SingleTrap® Type II+IV)
Inside= 101.7"W x 60.0"H => 38.33 sf x 15.40'L = 590.2 cf
Outside= 101.7"W x 66.0"H => 46.64 sf x 15.40'L = 718.0 cf

4 Chambers/Row x 15.40' Long = 61.58' Row Length +79.9" Border x 2 = 74.90' Base Length
3 Rows x 101.7" Wide + 79.9" Side Border x 2 = 38.75' Base Width
66.0" Chamber Height = 5.50' Field Height

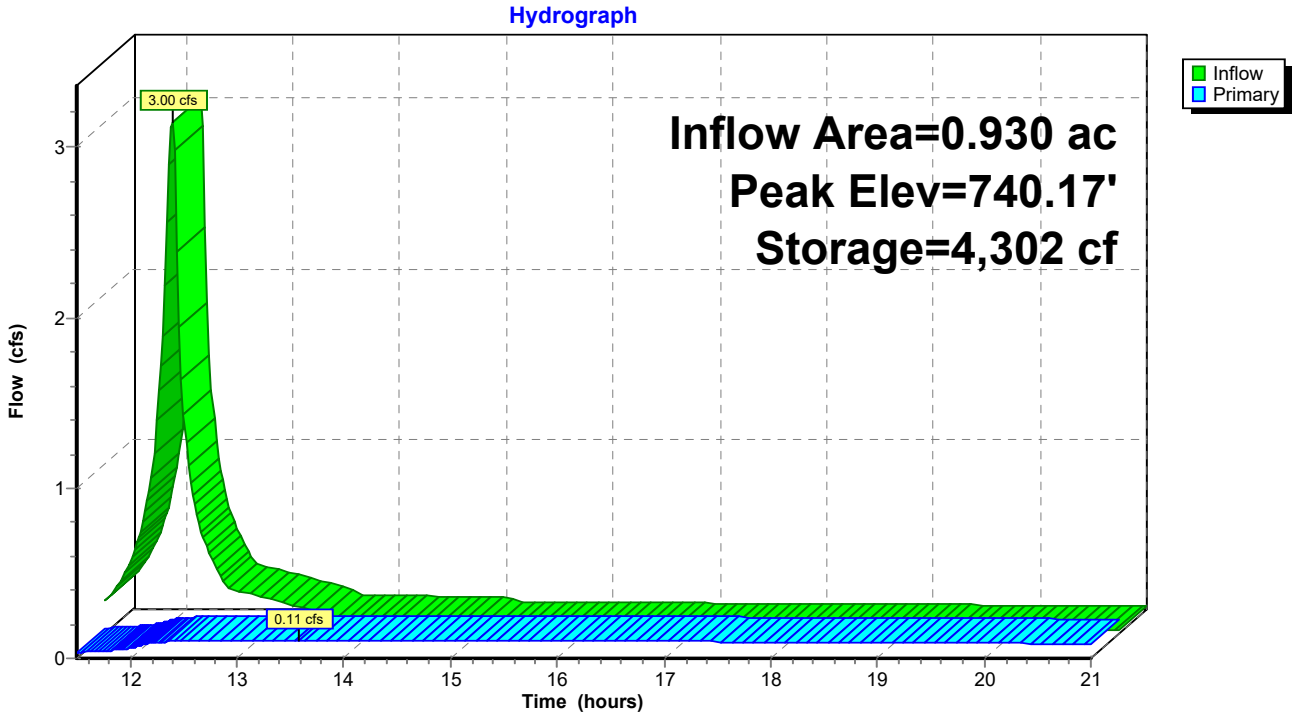
12 Chambers x 590.2 cf + 5,791.0 cf Border = 12,873.2 cf Chamber Storage
12 Chambers x 718.0 cf + 7,346.3 cf Border = 15,962.2 cf Displacement

Chamber Storage = 12,873.2 cf = 0.296 af
Overall Storage Efficiency = 80.6%
Overall System Size = 74.90' x 38.75' x 5.50'

12 Chambers (plus border)
591.2 cy Field



Pond UGA: Underground A



Summary for Pond UGB: Underground B

Inflow Area = 0.310 ac, 83.87% Impervious, Inflow Depth = 1.87" for 1 yr event
Inflow = 1.00 cfs @ 12.13 hrs, Volume= 0.048 af
Outflow = 0.13 cfs @ 12.56 hrs, Volume= 0.048 af, Atten= 87%, Lag= 25.5 min
Primary = 0.13 cfs @ 12.56 hrs, Volume= 0.048 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 735.27' @ 12.56 hrs Surf.Area= 0.018 ac Storage= 0.023 af

Plug-Flow detention time= 102.5 min calculated for 0.048 af (100% of inflow)
Center-of-Mass det. time= 102.7 min (879.9 - 777.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	733.75'	0.000 af	**13.79'W x 57.25'L x 4.17'H Field A** 0.076 af Overall - 0.076 af Embedded = 0.000 af x 0.0% Voids
#2A	733.75'	0.054 af	**StormTrap ST1 SingleTrap 3-6** x 8 Inside #1 Inside= 82.7"W x 42.0"H => 20.80 sf x 14.06'L = 292.5 cf Outside= 82.7"W x 50.0"H => 28.73 sf x 14.06'L = 404.1 cf 2 Rows of 4 Chambers 13.79' x 56.25' Core + 0.00' x 0.50' Border = 13.79' x 57.25' System
		0.054 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	733.75'	**12.0" Round Culvert** L= 6.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 733.75' / 733.72' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	733.75'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	735.30'	**5.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.13 cfs @ 12.56 hrs HW=735.27' (Free Discharge)
└**1=Culvert** (Passes 0.13 cfs of 3.62 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.13 cfs @ 5.77 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

Pond UGB: Underground B - Chamber Wizard Field A

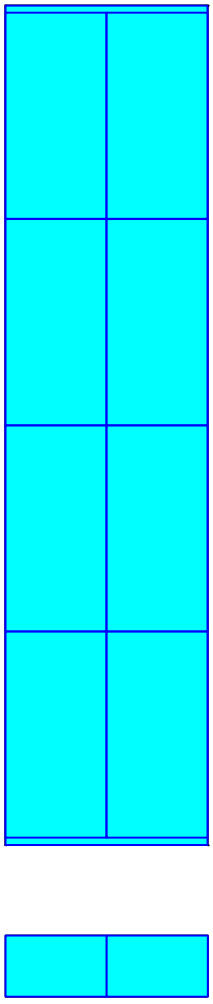
Chamber Model = StormTrap ST1 SingleTrap 3-6 (StormTrap ST1 SingleTrap® Type VI)
Inside= 82.7"W x 42.0"H => 20.80 sf x 14.06'L = 292.5 cf
Outside= 82.7"W x 50.0"H => 28.73 sf x 14.06'L = 404.1 cf

4 Chambers/Row x 14.06' Long = 56.25' Row Length +6.0" Border x 2 = 57.25' Base Length
2 Rows x 82.7" Wide = 13.79' Base Width
50.0" Chamber Height = 4.17' Field Height

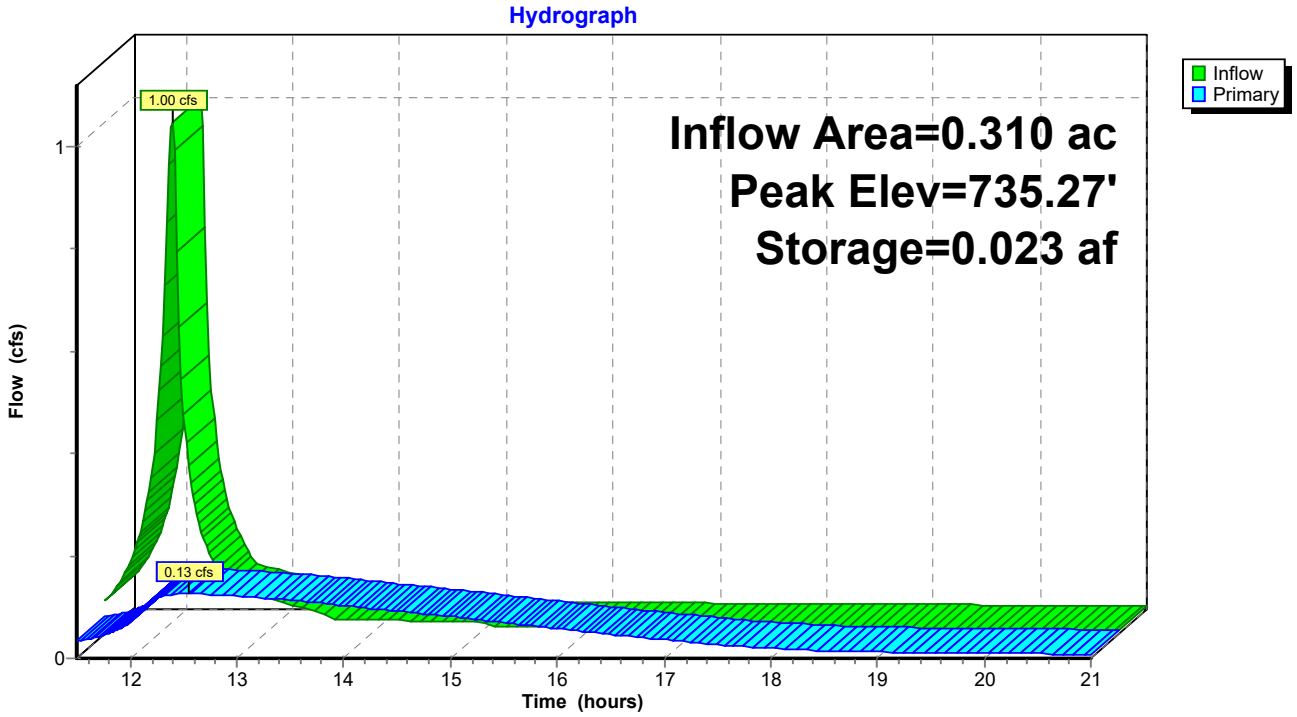
8 Chambers x 292.5 cf = 2,340.0 cf Chamber Storage
8 Chambers x 404.1 cf + 57.5 cf Border = 3,289.9 cf Displacement

Chamber Storage = 2,340.0 cf = 0.054 af
Overall Storage Efficiency = 71.1%
Overall System Size = 57.25' x 13.79' x 4.17'

8 Chambers (plus border)
121.8 cy Field



Pond UGB: Underground B

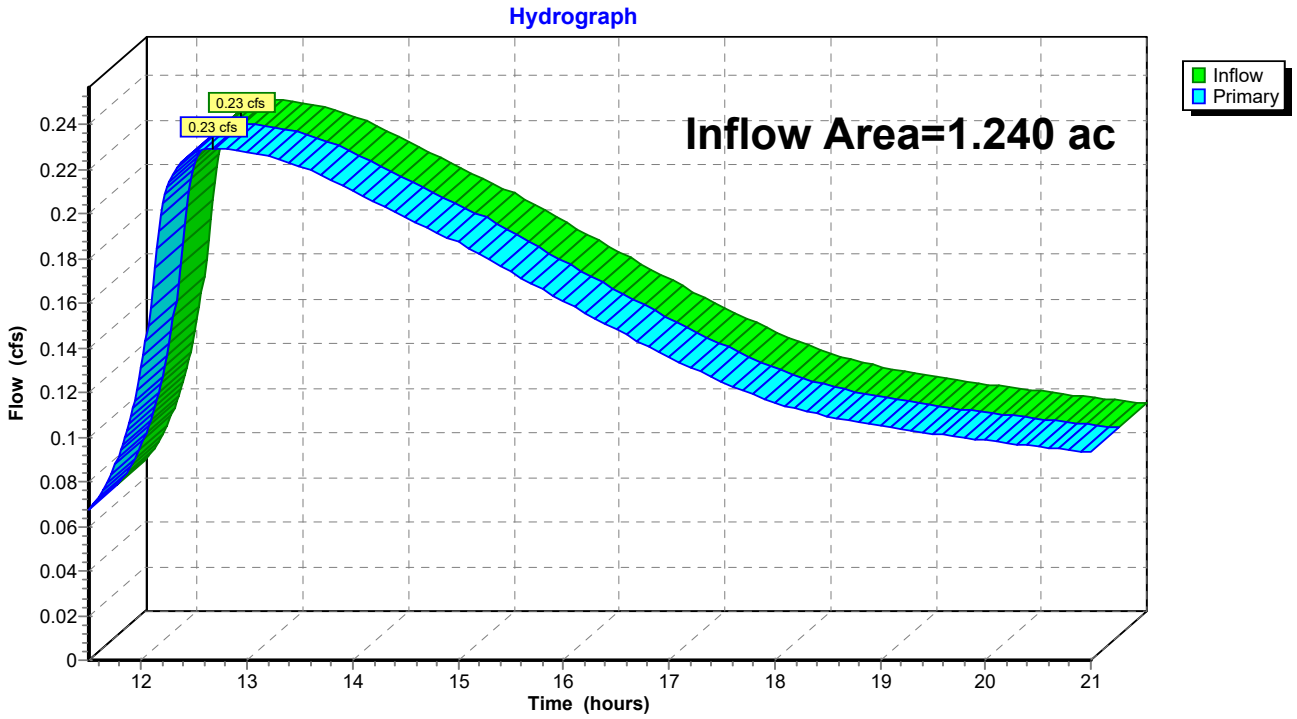


Summary for Link OUT: Combined

Inflow Area = 1.240 ac, 83.06% Impervious, Inflow Depth > 1.87" for 1 yr event
Inflow = 0.23 cfs @ 12.67 hrs, Volume= 0.193 af
Primary = 0.23 cfs @ 12.67 hrs, Volume= 0.193 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

Link OUT: Combined



Time span=0.00-72.00 hrs, dt=0.02 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment1S: Predevelopment Runoff Area=1.240 ac 32.26% Impervious Runoff Depth=1.41"
Flow Length=296' Slope=0.0340 '/' Tc=20.5 min CN=86 Runoff=1.93 cfs 0.146 af

SubcatchmentPRA: Proposed Basin A Runoff Area=0.930 ac 82.80% Impervious Runoff Depth=2.16"
Tc=6.0 min CN=95 Runoff=3.44 cfs 0.167 af

SubcatchmentPRB: Proposed Basin B Runoff Area=0.310 ac 83.87% Impervious Runoff Depth=2.16"
Tc=6.0 min CN=95 Runoff=1.15 cfs 0.056 af

Pond UGA: Underground A Peak Elev=740.45' Storage=5,018 cf Inflow=3.44 cfs 0.167 af
Outflow=0.12 cfs 0.167 af

Pond UGB: Underground B Peak Elev=735.46' Storage=0.026 af Inflow=1.15 cfs 0.056 af
Outflow=0.20 cfs 0.056 af

Link OUT: Combined Inflow=0.31 cfs 0.223 af
Primary=0.31 cfs 0.223 af

Total Runoff Area = 2.480 ac Runoff Volume = 0.368 af Average Runoff Depth = 1.78"
42.34% Pervious = 1.050 ac 57.66% Impervious = 1.430 ac

Summary for Subcatchment 1S: Predevelopment

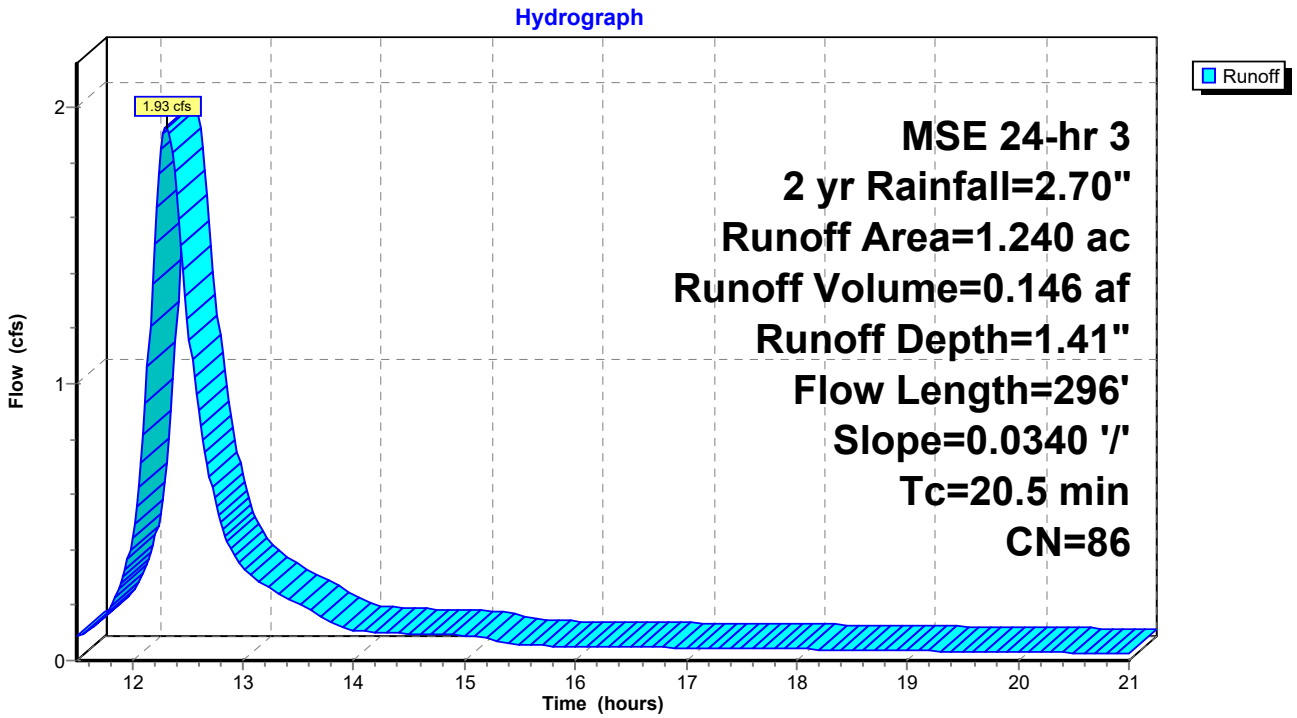
Runoff = 1.93 cfs @ 12.31 hrs, Volume= 0.146 af, Depth= 1.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
MSE 24-hr 3 2 yr Rainfall=2.70"

	Area (ac)	CN	Description
*	0.400	98	Pavement
	0.030	91	Gravel roads, HSG D
	0.810	80	>75% Grass cover, Good, HSG D
	1.240	86	Weighted Average
	0.840		67.74% Pervious Area
	0.400		32.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.5	296	0.0340	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.71"

Subcatchment 1S: Predevelopment



Summary for Subcatchment PRA: Proposed Basin A

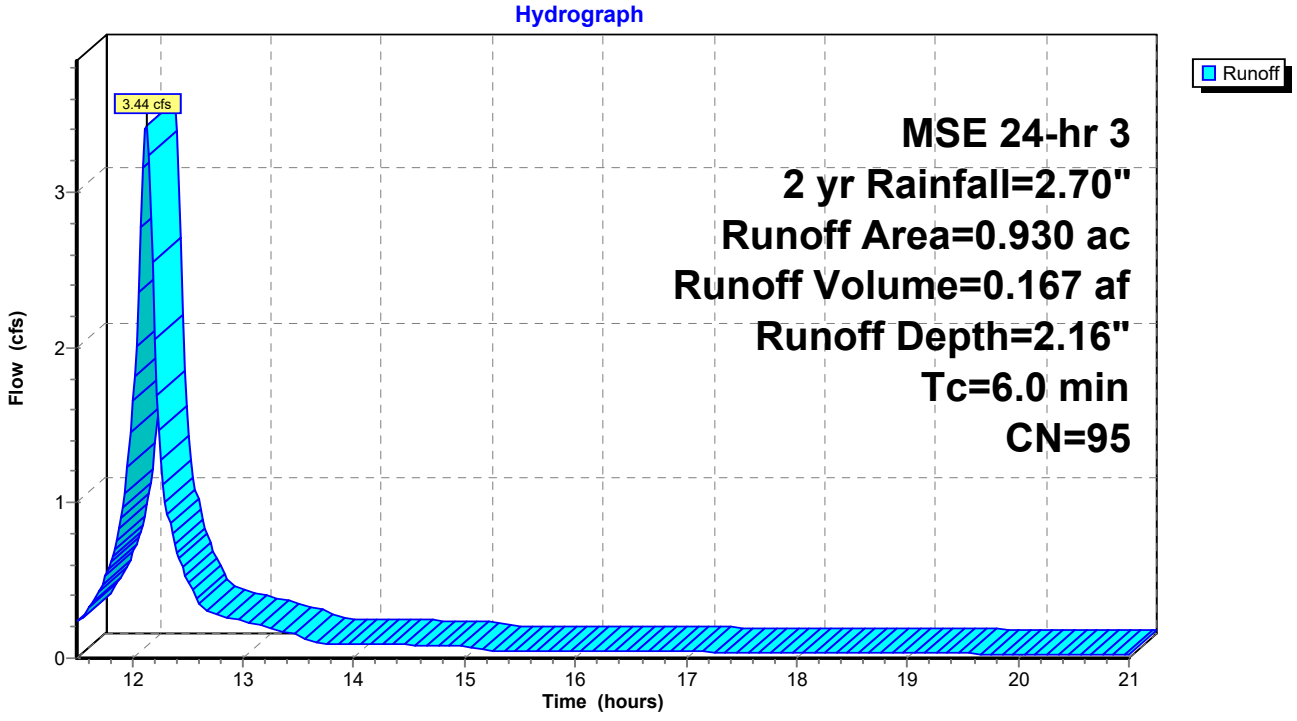
Runoff = 3.44 cfs @ 12.13 hrs, Volume= 0.167 af, Depth= 2.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
MSE 24-hr 3 2 yr Rainfall=2.70"

Area (ac)	CN	Description
0.240	98	Paved parking, HSG D
0.530	98	Roofs, HSG D
0.160	80	>75% Grass cover, Good, HSG D
0.930	95	Weighted Average
0.160		17.20% Pervious Area
0.770		82.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment PRA: Proposed Basin A



Summary for Subcatchment PRB: Proposed Basin B

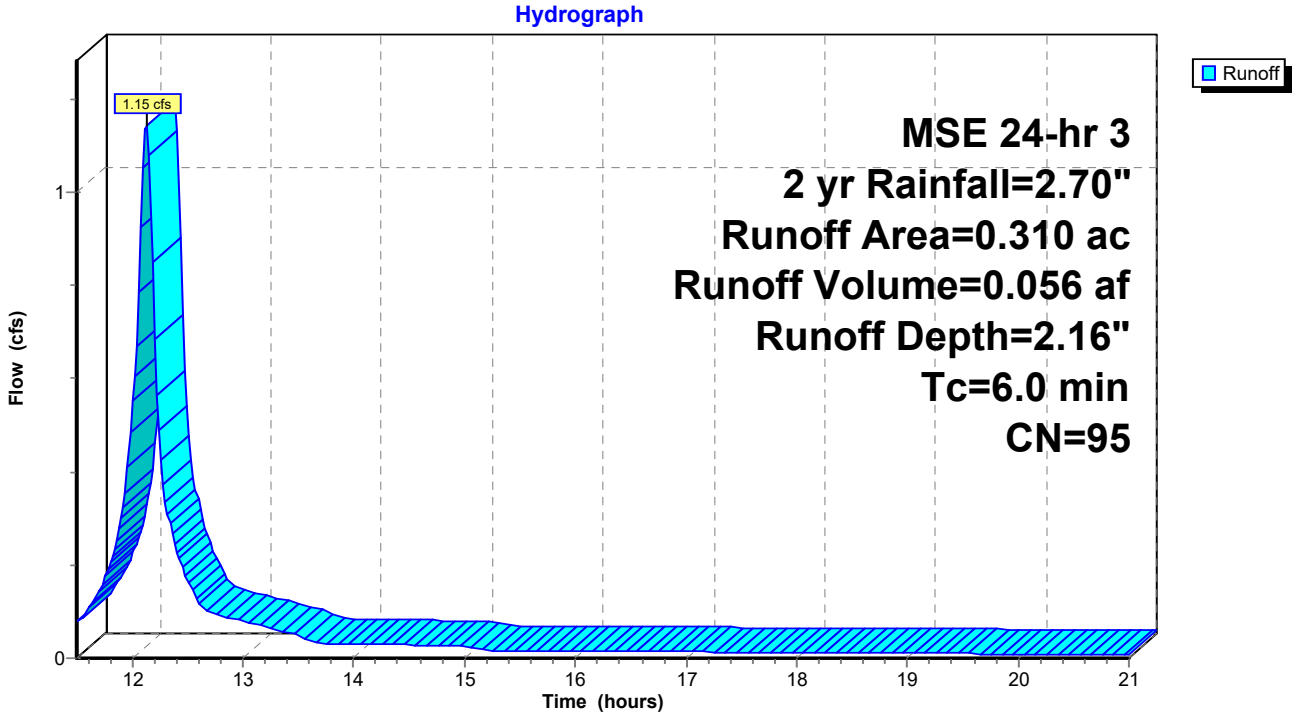
Runoff = 1.15 cfs @ 12.13 hrs, Volume= 0.056 af, Depth= 2.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
MSE 24-hr 3 2 yr Rainfall=2.70"

Area (ac)	CN	Description
0.040	98	Roofs, HSG D
0.220	98	Paved parking, HSG D
0.050	80	>75% Grass cover, Good, HSG D
0.310	95	Weighted Average
0.050		16.13% Pervious Area
0.260		83.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment PRB: Proposed Basin B



Summary for Pond UGA: Underground A

Inflow Area = 0.930 ac, 82.80% Impervious, Inflow Depth = 2.16" for 2 yr event
Inflow = 3.44 cfs @ 12.13 hrs, Volume= 0.167 af
Outflow = 0.12 cfs @ 13.59 hrs, Volume= 0.167 af, Atten= 97%, Lag= 87.6 min
Primary = 0.12 cfs @ 13.59 hrs, Volume= 0.167 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 740.45' @ 13.59 hrs Surf.Area= 2,902 sf Storage= 5,018 cf

Plug-Flow detention time= 548.8 min calculated for 0.167 af (100% of inflow)
Center-of-Mass det. time= 548.5 min (1,322.9 - 774.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	738.50'	0 cf	**38.75'W x 74.90'L x 5.50'H Field A** 15,962 cf Overall - 15,962 cf Embedded = 0 cf x 0.0% Voids
#2A	738.50'	12,873 cf	**StormTrap ST2 SingleTrap 5-0** x 12 Inside #1 Inside= 101.7"W x 60.0"H => 38.33 sf x 15.40'L = 590.2 cf Outside= 101.7"W x 66.0"H => 46.64 sf x 15.40'L = 718.0 cf 3 Rows of 4 Chambers 25.44' x 61.58' Core + 6.66' Border = 38.75' x 74.90' System
		12,873 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	736.43'	**12.0" Round Culvert** L= 92.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 736.43' / 735.97' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	738.50'	**1.8" Vert. Orifice/Grate** C= 0.600
#3	Device 1	740.50'	**3.5" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.12 cfs @ 13.59 hrs HW=740.45' (Free Discharge)
└**1=Culvert** (Passes 0.12 cfs of 6.23 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.12 cfs @ 6.59 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

Pond UGA: Underground A - Chamber Wizard Field A

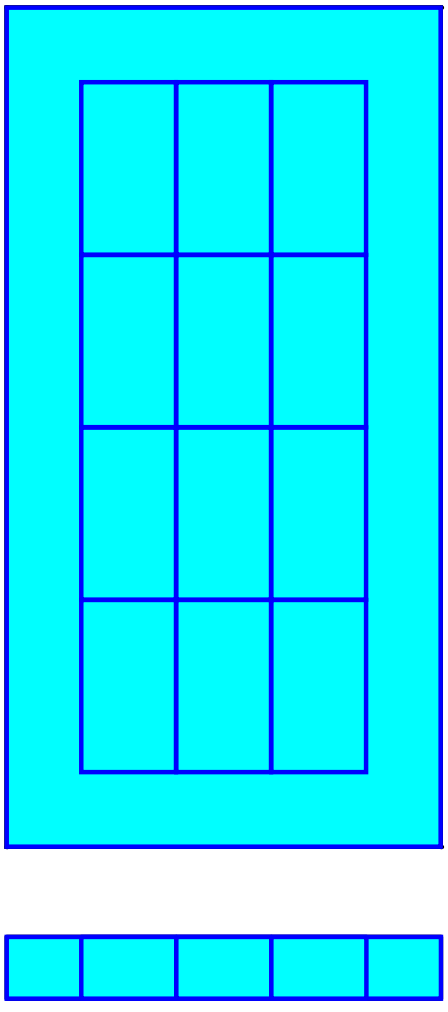
Chamber Model = StormTrap ST2 SingleTrap 5-0 (StormTrap ST2 SingleTrap® Type II+IV)
Inside= 101.7"W x 60.0"H => 38.33 sf x 15.40'L = 590.2 cf
Outside= 101.7"W x 66.0"H => 46.64 sf x 15.40'L = 718.0 cf

4 Chambers/Row x 15.40' Long = 61.58' Row Length +79.9" Border x 2 = 74.90' Base Length
3 Rows x 101.7" Wide + 79.9" Side Border x 2 = 38.75' Base Width
66.0" Chamber Height = 5.50' Field Height

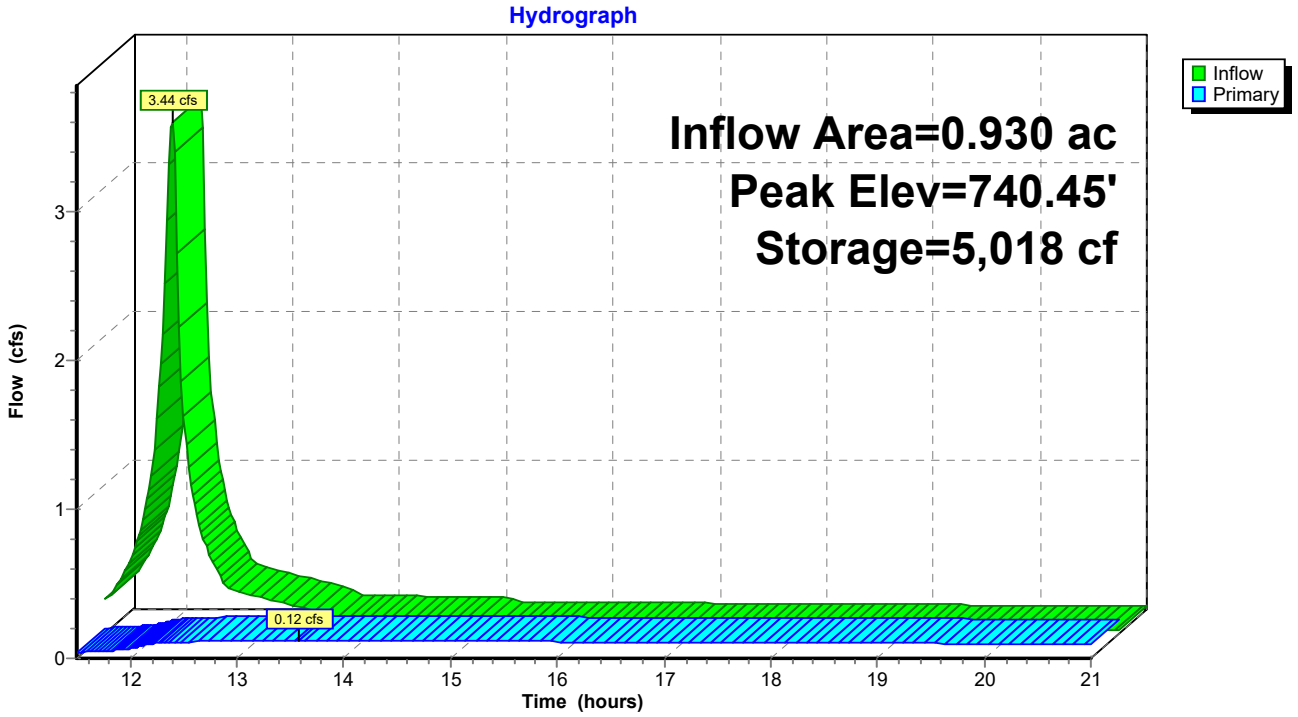
12 Chambers x 590.2 cf + 5,791.0 cf Border = 12,873.2 cf Chamber Storage
12 Chambers x 718.0 cf + 7,346.3 cf Border = 15,962.2 cf Displacement

Chamber Storage = 12,873.2 cf = 0.296 af
Overall Storage Efficiency = 80.6%
Overall System Size = 74.90' x 38.75' x 5.50'

12 Chambers (plus border)
591.2 cy Field



Pond UGA: Underground A



Summary for Pond UGB: Underground B

Inflow Area = 0.310 ac, 83.87% Impervious, Inflow Depth = 2.16" for 2 yr event
Inflow = 1.15 cfs @ 12.13 hrs, Volume= 0.056 af
Outflow = 0.20 cfs @ 12.45 hrs, Volume= 0.056 af, Atten= 83%, Lag= 18.9 min
Primary = 0.20 cfs @ 12.45 hrs, Volume= 0.056 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 735.46' @ 12.45 hrs Surf.Area= 0.018 ac Storage= 0.026 af

Plug-Flow detention time= 101.5 min calculated for 0.056 af (100% of inflow)
Center-of-Mass det. time= 101.7 min (876.1 - 774.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	733.75'	0.000 af	**13.79'W x 57.25'L x 4.17'H Field A** 0.076 af Overall - 0.076 af Embedded = 0.000 af x 0.0% Voids
#2A	733.75'	0.054 af	**StormTrap ST1 SingleTrap 3-6** x 8 Inside #1 Inside= 82.7"W x 42.0"H => 20.80 sf x 14.06'L = 292.5 cf Outside= 82.7"W x 50.0"H => 28.73 sf x 14.06'L = 404.1 cf 2 Rows of 4 Chambers 13.79' x 56.25' Core + 0.00' x 0.50' Border = 13.79' x 57.25' System
		0.054 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	733.75'	**12.0" Round Culvert** L= 6.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 733.75' / 733.72' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	733.75'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	735.30'	**5.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.20 cfs @ 12.45 hrs HW=735.46' (Free Discharge)
└**1=Culvert** (Passes 0.20 cfs of 4.16 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.13 cfs @ 6.14 fps)
  └**3=Orifice/Grate** (Orifice Controls 0.07 cfs @ 1.36 fps)

Pond UGB: Underground B - Chamber Wizard Field A

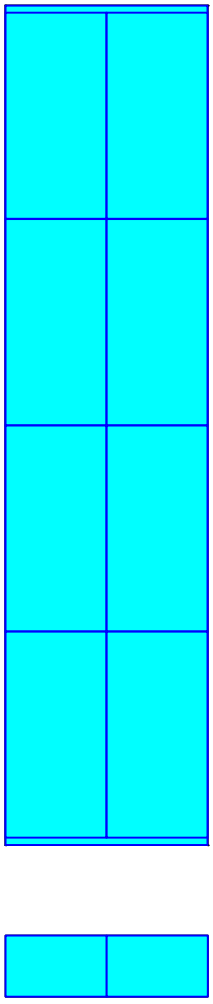
Chamber Model = StormTrap ST1 SingleTrap 3-6 (StormTrap ST1 SingleTrap® Type VI)
Inside= 82.7"W x 42.0"H => 20.80 sf x 14.06'L = 292.5 cf
Outside= 82.7"W x 50.0"H => 28.73 sf x 14.06'L = 404.1 cf

4 Chambers/Row x 14.06' Long = 56.25' Row Length +6.0" Border x 2 = 57.25' Base Length
2 Rows x 82.7" Wide = 13.79' Base Width
50.0" Chamber Height = 4.17' Field Height

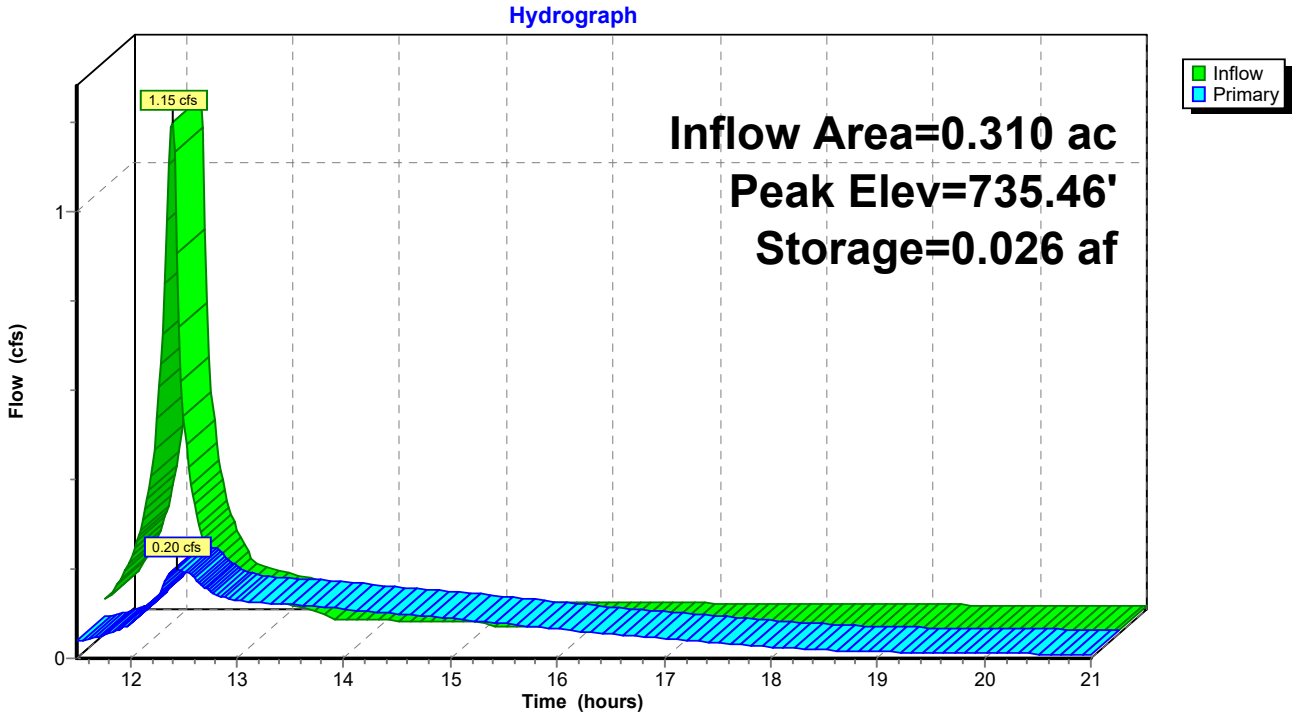
8 Chambers x 292.5 cf = 2,340.0 cf Chamber Storage
8 Chambers x 404.1 cf + 57.5 cf Border = 3,289.9 cf Displacement

Chamber Storage = 2,340.0 cf = 0.054 af
Overall Storage Efficiency = 71.1%
Overall System Size = 57.25' x 13.79' x 4.17'

8 Chambers (plus border)
121.8 cy Field



Pond UGB: Underground B

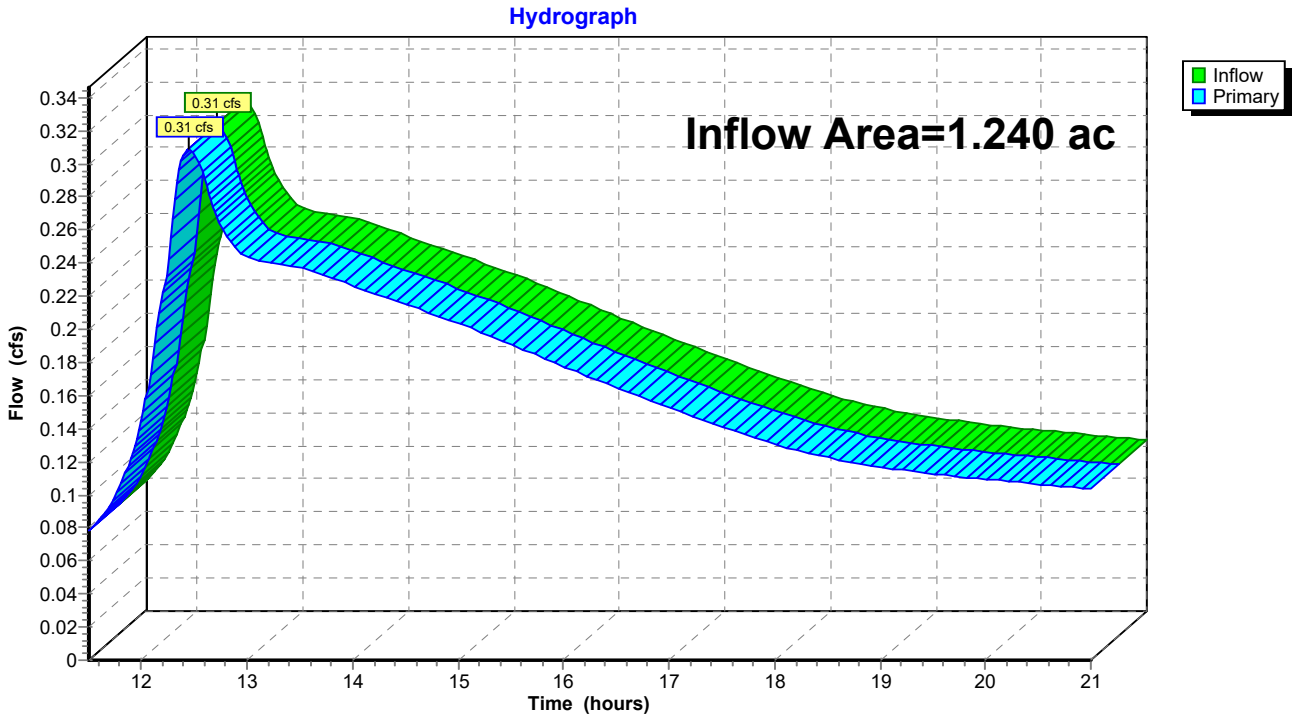


Summary for Link OUT: Combined

Inflow Area = 1.240 ac, 83.06% Impervious, Inflow Depth > 2.16" for 2 yr event
Inflow = 0.31 cfs @ 12.45 hrs, Volume= 0.223 af
Primary = 0.31 cfs @ 12.45 hrs, Volume= 0.223 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

Link OUT: Combined



Time span=0.00-72.00 hrs, dt=0.02 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment1S: Predevelopment Runoff Area=1.240 ac 32.26% Impervious Runoff Depth=4.58"
Flow Length=296' Slope=0.0340 '/' Tc=20.5 min CN=86 Runoff=6.12 cfs 0.473 af

SubcatchmentPRA: Proposed Basin A Runoff Area=0.930 ac 82.80% Impervious Runoff Depth=5.59"
Tc=6.0 min CN=95 Runoff=8.39 cfs 0.433 af

SubcatchmentPRB: Proposed Basin B Runoff Area=0.310 ac 83.87% Impervious Runoff Depth=5.59"
Tc=6.0 min CN=95 Runoff=2.80 cfs 0.144 af

Pond UGA: Underground A Peak Elev=743.03' Storage=11,659 cf Inflow=8.39 cfs 0.433 af
Outflow=0.68 cfs 0.433 af

Pond UGB: Underground B Peak Elev=737.23' Storage=0.053 af Inflow=2.80 cfs 0.144 af
Outflow=1.06 cfs 0.144 af

Link OUT: Combined Inflow=1.68 cfs 0.578 af
Primary=1.68 cfs 0.578 af

Total Runoff Area = 2.480 ac Runoff Volume = 1.051 af Average Runoff Depth = 5.09"
42.34% Pervious = 1.050 ac 57.66% Impervious = 1.430 ac

Summary for Subcatchment 1S: Predevelopment

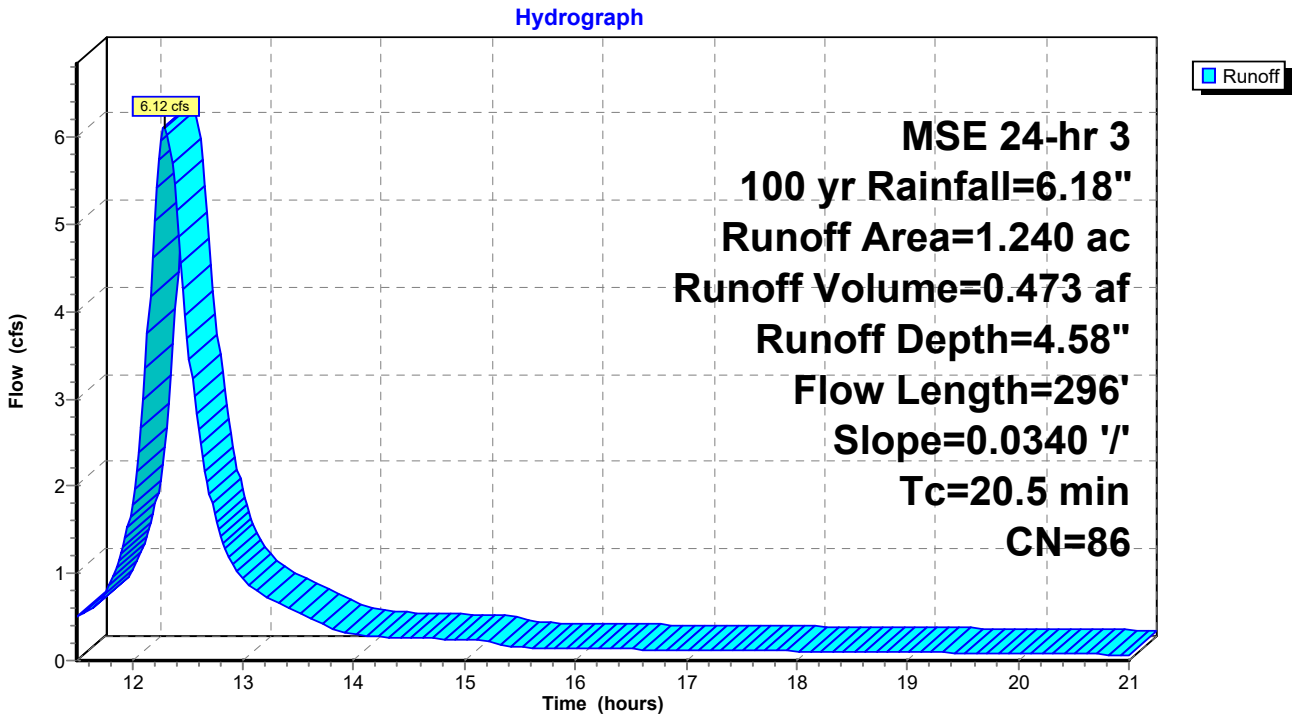
Runoff = 6.12 cfs @ 12.29 hrs, Volume= 0.473 af, Depth= 4.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
MSE 24-hr 3 100 yr Rainfall=6.18"

	Area (ac)	CN	Description
*	0.400	98	Pavement
	0.030	91	Gravel roads, HSG D
	0.810	80	>75% Grass cover, Good, HSG D
	1.240	86	Weighted Average
	0.840		67.74% Pervious Area
	0.400		32.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.5	296	0.0340	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.71"

Subcatchment 1S: Predevelopment



Summary for Subcatchment PRA: Proposed Basin A

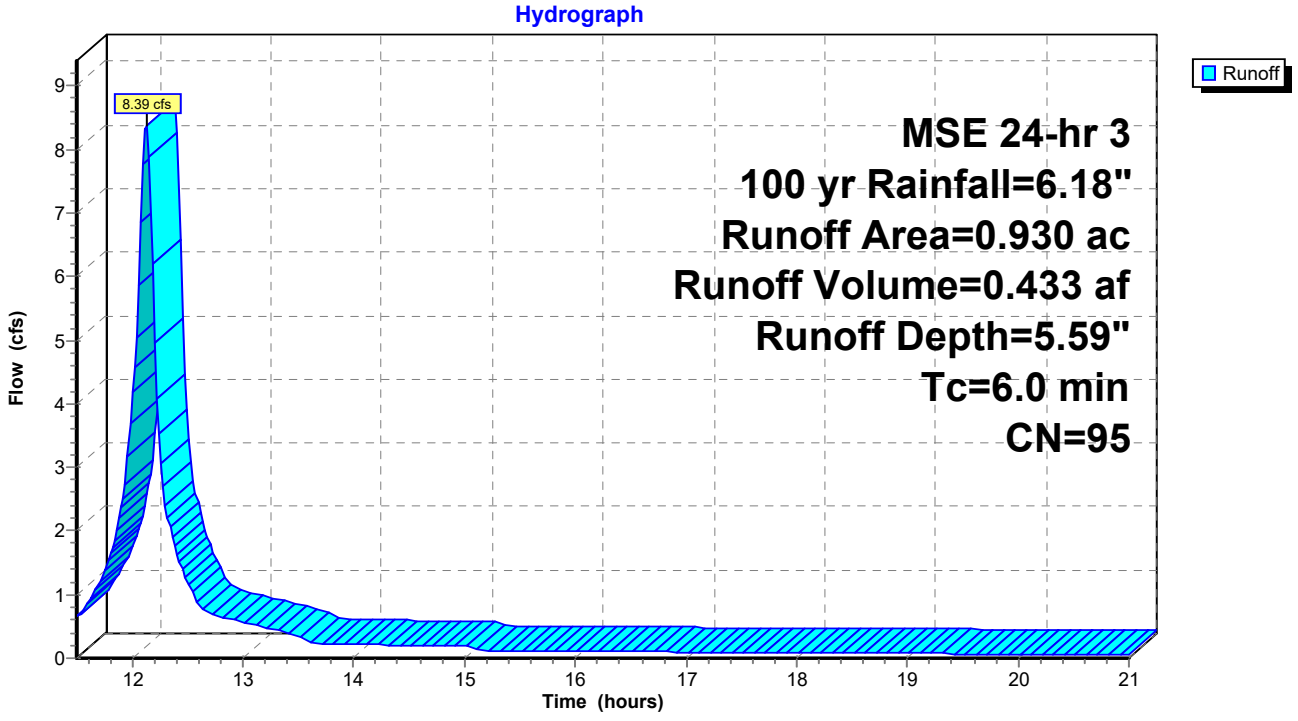
Runoff = 8.39 cfs @ 12.13 hrs, Volume= 0.433 af, Depth= 5.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
MSE 24-hr 3 100 yr Rainfall=6.18"

Area (ac)	CN	Description
0.240	98	Paved parking, HSG D
0.530	98	Roofs, HSG D
0.160	80	>75% Grass cover, Good, HSG D
0.930	95	Weighted Average
0.160		17.20% Pervious Area
0.770		82.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment PRA: Proposed Basin A



Summary for Subcatchment PRB: Proposed Basin B

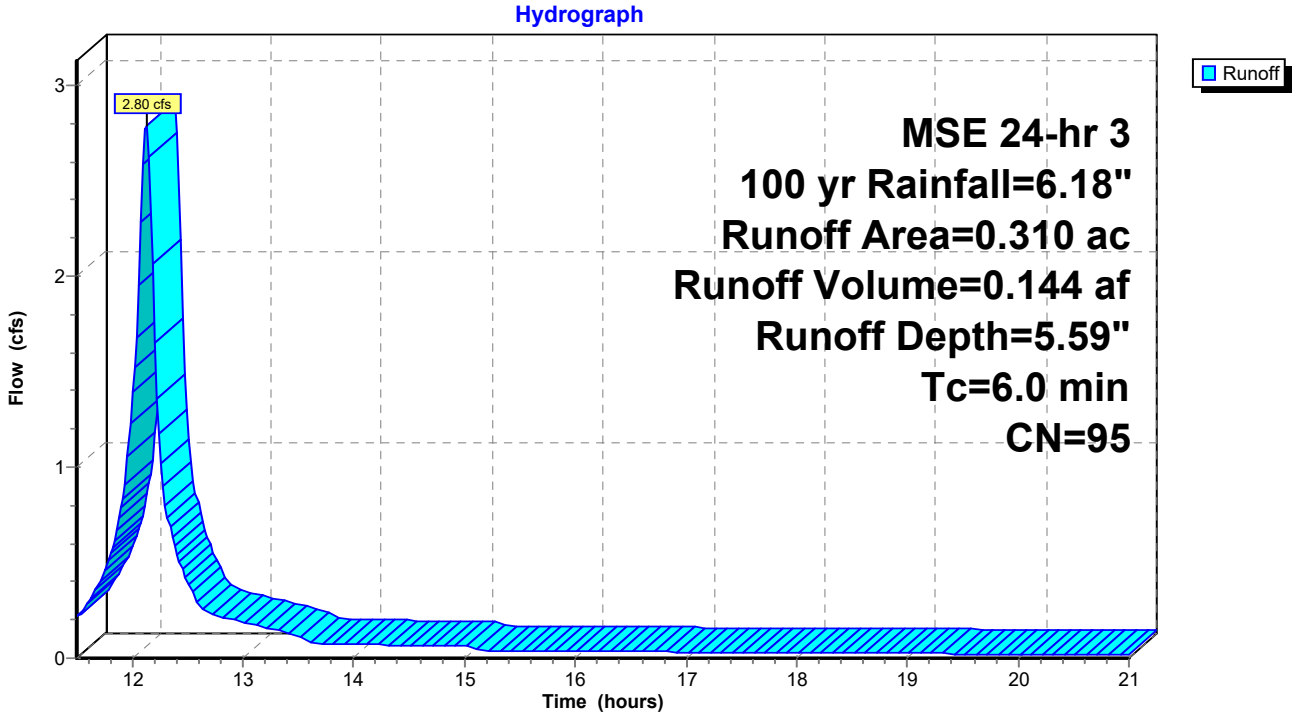
Runoff = 2.80 cfs @ 12.13 hrs, Volume= 0.144 af, Depth= 5.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
MSE 24-hr 3 100 yr Rainfall=6.18"

Area (ac)	CN	Description
0.040	98	Roofs, HSG D
0.220	98	Paved parking, HSG D
0.050	80	>75% Grass cover, Good, HSG D
0.310	95	Weighted Average
0.050		16.13% Pervious Area
0.260		83.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment PRB: Proposed Basin B



Summary for Pond UGA: Underground A

Inflow Area = 0.930 ac, 82.80% Impervious, Inflow Depth = 5.59" for 100 yr event
Inflow = 8.39 cfs @ 12.13 hrs, Volume= 0.433 af
Outflow = 0.68 cfs @ 12.75 hrs, Volume= 0.433 af, Atten= 92%, Lag= 37.5 min
Primary = 0.68 cfs @ 12.75 hrs, Volume= 0.433 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 743.03' @ 12.75 hrs Surf.Area= 2,902 sf Storage= 11,659 cf

Plug-Flow detention time= 388.9 min calculated for 0.433 af (100% of inflow)
Center-of-Mass det. time= 389.3 min (1,146.2 - 756.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	738.50'	0 cf	**38.75'W x 74.90'L x 5.50'H Field A** 15,962 cf Overall - 15,962 cf Embedded = 0 cf x 0.0% Voids
#2A	738.50'	12,873 cf	**StormTrap ST2 SingleTrap 5-0** x 12 Inside #1 Inside= 101.7"W x 60.0"H => 38.33 sf x 15.40'L = 590.2 cf Outside= 101.7"W x 66.0"H => 46.64 sf x 15.40'L = 718.0 cf 3 Rows of 4 Chambers 25.44' x 61.58' Core + 6.66' Border = 38.75' x 74.90' System
		12,873 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	736.43'	**12.0" Round Culvert** L= 92.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 736.43' / 735.97' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	738.50'	**1.8" Vert. Orifice/Grate** C= 0.600
#3	Device 1	740.50'	**3.5" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.68 cfs @ 12.75 hrs HW=743.03' (Free Discharge)
└**1=Culvert** (Passes 0.68 cfs of 8.22 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.18 cfs @ 10.16 fps)
  └**3=Orifice/Grate** (Orifice Controls 0.50 cfs @ 7.43 fps)

Pond UGA: Underground A - Chamber Wizard Field A

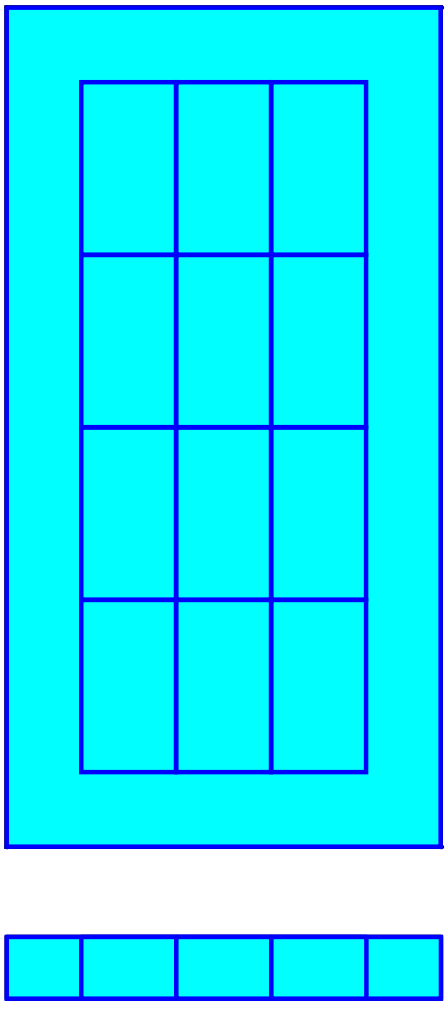
Chamber Model = StormTrap ST2 SingleTrap 5-0 (StormTrap ST2 SingleTrap® Type II+IV)
Inside= 101.7"W x 60.0"H => 38.33 sf x 15.40'L = 590.2 cf
Outside= 101.7"W x 66.0"H => 46.64 sf x 15.40'L = 718.0 cf

4 Chambers/Row x 15.40' Long = 61.58' Row Length +79.9" Border x 2 = 74.90' Base Length
3 Rows x 101.7" Wide + 79.9" Side Border x 2 = 38.75' Base Width
66.0" Chamber Height = 5.50' Field Height

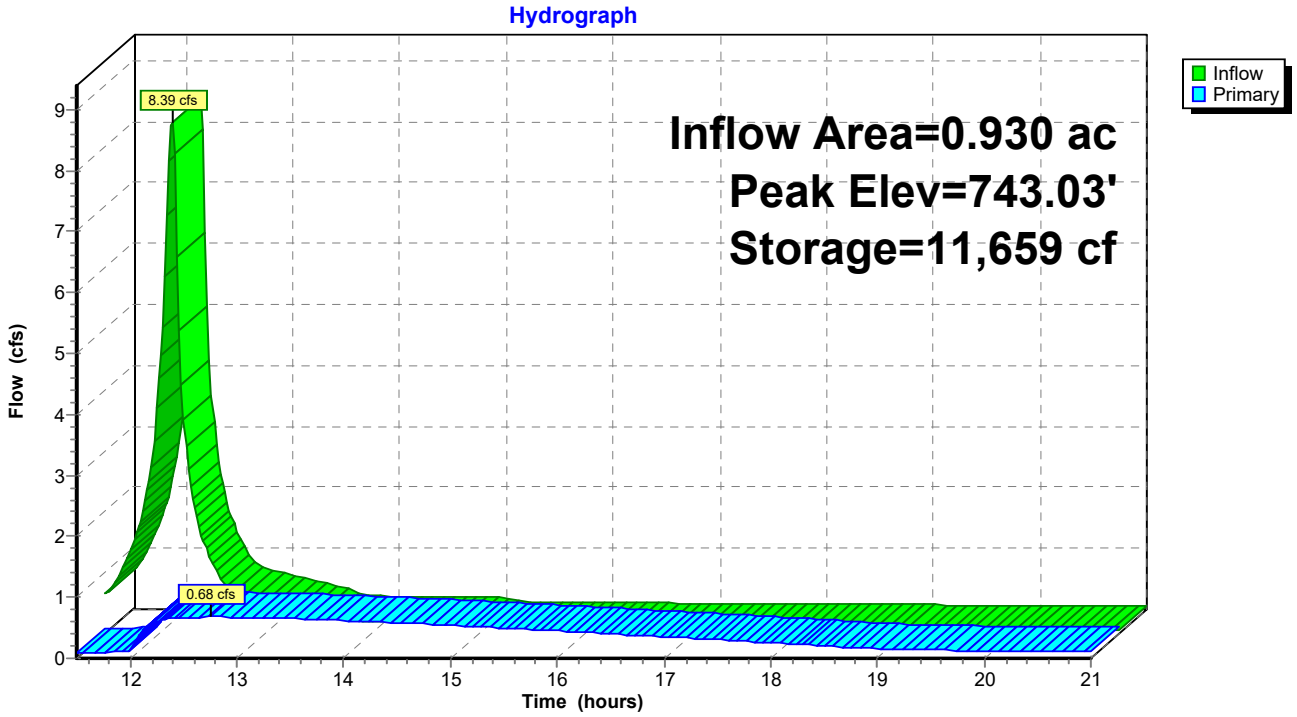
12 Chambers x 590.2 cf + 5,791.0 cf Border = 12,873.2 cf Chamber Storage
12 Chambers x 718.0 cf + 7,346.3 cf Border = 15,962.2 cf Displacement

Chamber Storage = 12,873.2 cf = 0.296 af
Overall Storage Efficiency = 80.6%
Overall System Size = 74.90' x 38.75' x 5.50'

12 Chambers (plus border)
591.2 cy Field



Pond UGA: Underground A



Summary for Pond UGB: Underground B

Inflow Area = 0.310 ac, 83.87% Impervious, Inflow Depth = 5.59" for 100 yr event
Inflow = 2.80 cfs @ 12.13 hrs, Volume= 0.144 af
Outflow = 1.06 cfs @ 12.26 hrs, Volume= 0.144 af, Atten= 62%, Lag= 7.7 min
Primary = 1.06 cfs @ 12.26 hrs, Volume= 0.144 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 737.23' @ 12.26 hrs Surf.Area= 0.018 ac Storage= 0.053 af

Plug-Flow detention time= 69.3 min calculated for 0.144 af (100% of inflow)
Center-of-Mass det. time= 69.5 min (826.4 - 756.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	733.75'	0.000 af	**13.79'W x 57.25'L x 4.17'H Field A** 0.076 af Overall - 0.076 af Embedded = 0.000 af x 0.0% Voids
#2A	733.75'	0.054 af	**StormTrap ST1 SingleTrap 3-6** x 8 Inside #1 Inside= 82.7"W x 42.0"H => 20.80 sf x 14.06'L = 292.5 cf Outside= 82.7"W x 50.0"H => 28.73 sf x 14.06'L = 404.1 cf 2 Rows of 4 Chambers 13.79' x 56.25' Core + 0.00' x 0.50' Border = 13.79' x 57.25' System
		0.054 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	733.75'	**12.0" Round Culvert** L= 6.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 733.75' / 733.72' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	733.75'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	735.30'	**5.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.06 cfs @ 12.26 hrs HW=737.23' (Free Discharge)
└**1=Culvert** (Passes 1.06 cfs of 6.53 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.19 cfs @ 8.88 fps)
  └**3=Orifice/Grate** (Orifice Controls 0.86 cfs @ 6.32 fps)

Pond UGB: Underground B - Chamber Wizard Field A

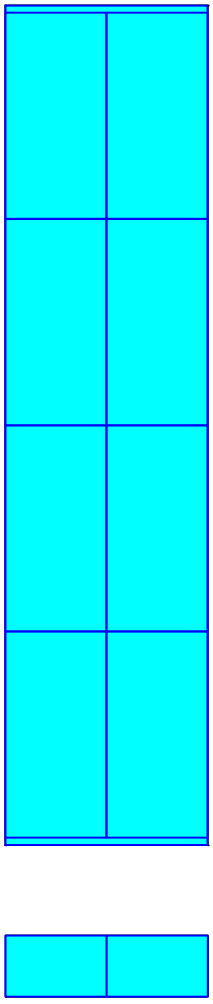
Chamber Model = StormTrap ST1 SingleTrap 3-6 (StormTrap ST1 SingleTrap® Type VI)
Inside= 82.7"W x 42.0"H => 20.80 sf x 14.06'L = 292.5 cf
Outside= 82.7"W x 50.0"H => 28.73 sf x 14.06'L = 404.1 cf

4 Chambers/Row x 14.06' Long = 56.25' Row Length +6.0" Border x 2 = 57.25' Base Length
2 Rows x 82.7" Wide = 13.79' Base Width
50.0" Chamber Height = 4.17' Field Height

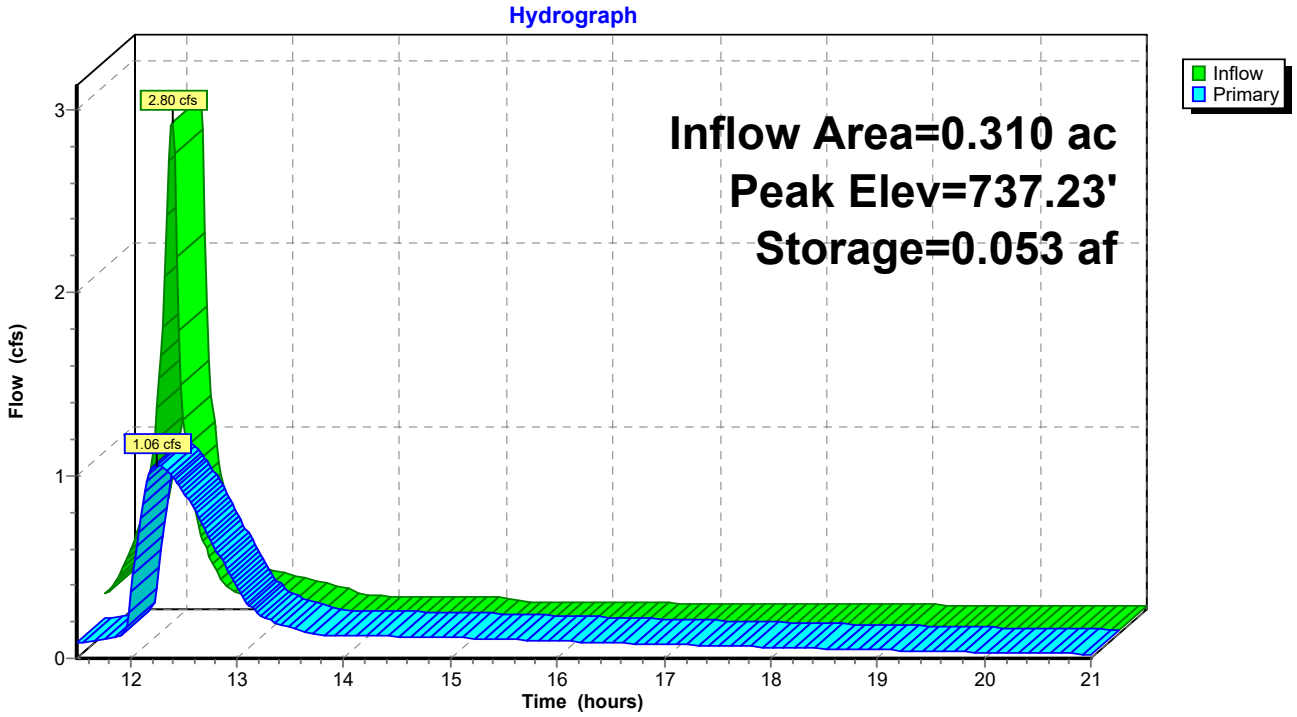
8 Chambers x 292.5 cf = 2,340.0 cf Chamber Storage
8 Chambers x 404.1 cf + 57.5 cf Border = 3,289.9 cf Displacement

Chamber Storage = 2,340.0 cf = 0.054 af
Overall Storage Efficiency = 71.1%
Overall System Size = 57.25' x 13.79' x 4.17'

8 Chambers (plus border)
121.8 cy Field



Pond UGB: Underground B

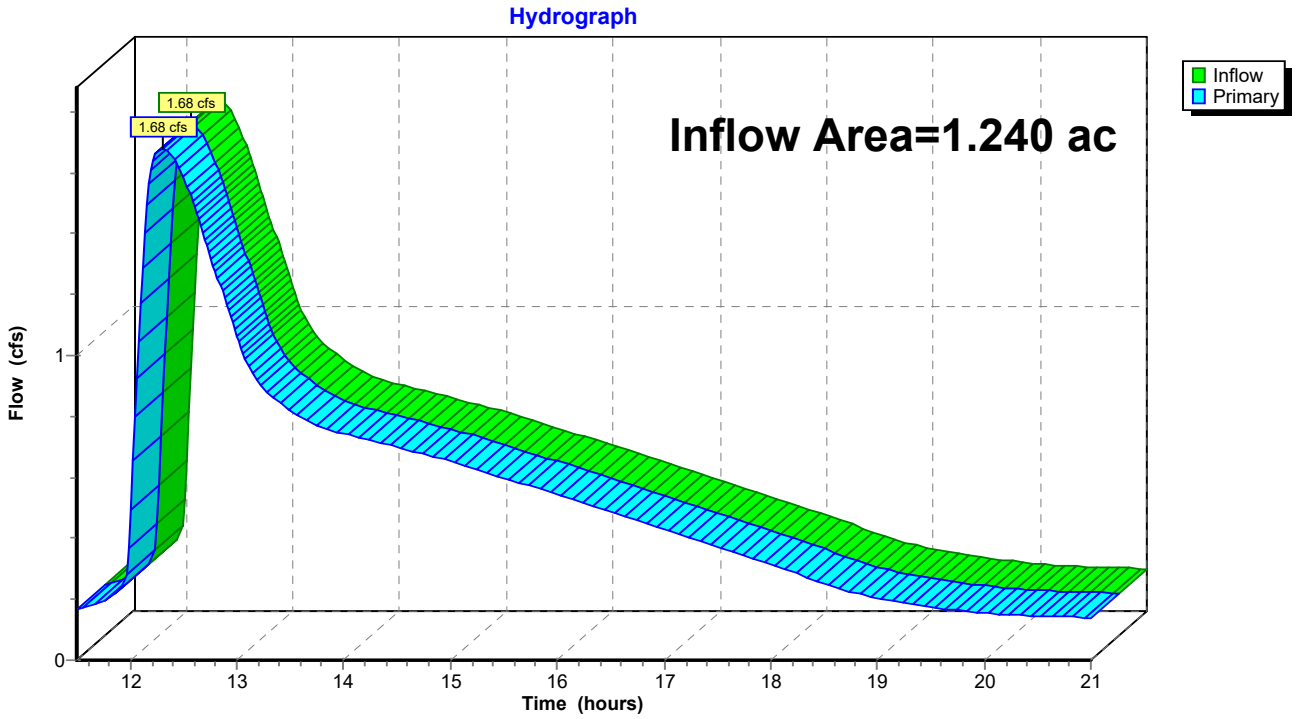


Summary for Link OUT: Combined

Inflow Area = 1.240 ac, 83.06% Impervious, Inflow Depth > 5.59" for 100 yr event
Inflow = 1.68 cfs @ 12.30 hrs, Volume= 0.578 af
Primary = 1.68 cfs @ 12.30 hrs, Volume= 0.578 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

Link OUT: Combined



Appendix D:
Volumetric Design Calculations

2yr- 24 hr Storm								
Pre development					Post development			
Time (sec)	Time (hours)	Runoff (cfs)	Volume (cf)		Time (sec)	Time (hours)	Primary (cfs)	Volume (cf)
41400	11.5	0.09			41400	11.5	0.08	
41472	11.52	0.09	6.48		41472	11.52	0.08	5.76
41544	11.54	0.09	6.48		41544	11.54	0.08	5.76
41616	11.56	0.1	7.2		41616	11.56	0.08	5.76
41688	11.58	0.1	7.2		41688	11.58	0.08	5.76
41760	11.6	0.1	7.2		41760	11.6	0.08	5.76
41832	11.62	0.11	7.92		41832	11.62	0.09	6.48
41904	11.64	0.11	7.92		41904	11.64	0.09	6.48
41976	11.66	0.12	8.64		41976	11.66	0.09	6.48
42048	11.68	0.13	9.36		42048	11.68	0.09	6.48
42120	11.7	0.13	9.36		42120	11.7	0.09	6.48
42192	11.72	0.14	10.08		42192	11.72	0.1	7.2
42264	11.74	0.15	10.8		42264	11.74	0.1	7.2
42336	11.76	0.16	11.52		42336	11.76	0.1	7.2
42408	11.78	0.18	12.96		42408	11.78	0.1	7.2
42480	11.8	0.19	13.68		42480	11.8	0.11	7.92
42552	11.82	0.2	14.4		42552	11.82	0.11	7.92
42624	11.84	0.22	15.84		42624	11.84	0.11	7.92
42696	11.86	0.24	17.28		42696	11.86	0.11	7.92
42768	11.88	0.26	18.72		42768	11.88	0.12	8.64
42840	11.9	0.28	20.16		42840	11.9	0.12	8.64
42912	11.92	0.3	21.6		42912	11.92	0.13	9.36
42984	11.94	0.33	23.76		42984	11.94	0.13	9.36
43056	11.96	0.36	25.92		43056	11.96	0.13	9.36
43128	11.98	0.4	28.8		43128	11.98	0.14	10.08
43200	12	0.44	31.68		43200	12	0.14	10.08
43272	12.02	0.49	35.28		43272	12.02	0.15	10.8
43344	12.04	0.55	39.6		43344	12.04	0.16	11.52
43416	12.06	0.63	45.36		43416	12.06	0.16	11.52
43488	12.08	0.71	51.12		43488	12.08	0.17	12.24
43560	12.1	0.81	58.32		43560	12.1	0.18	12.96
43632	12.12	0.93	66.96		43632	12.12	0.19	13.68
43704	12.14	1.06	76.32		43704	12.14	0.2	14.4
43776	12.16	1.21	87.12		43776	12.16	0.21	15.12
43848	12.18	1.36	97.92		43848	12.18	0.22	15.84
43920	12.2	1.5	108		43920	12.2	0.22	15.84
43992	12.22	1.64	118.08		43992	12.22	0.23	16.56
44064	12.24	1.76	126.72		44064	12.24	0.23	16.56
44136	12.26	1.85	133.2		44136	12.26	0.24	17.28
44208	12.28	1.91	137.52		44208	12.28	0.25	18
44280	12.3	1.92	138.24		44280	12.3	0.27	19.44
44352	12.32	1.92	138.24		44352	12.32	0.28	20.16

44424	12.34	1.89	136.08		44424	12.34	0.29	20.88
44496	12.36	1.84	132.48		44496	12.36	0.3	21.6
44568	12.38	1.77	127.44		44568	12.38	0.3	21.6
44640	12.4	1.68	120.96		44640	12.4	0.31	22.32
44712	12.42	1.6	115.2		44712	12.42	0.31	22.32
44784	12.44	1.5	108		44784	12.44	0.31	22.32
44856	12.46	1.41	101.52		44856	12.46	0.31	22.32
44928	12.48	1.32	95.04		44928	12.48	0.31	22.32
45000	12.5	1.24	89.28		45000	12.5	0.31	22.32
45072	12.52	1.16	83.52		45072	12.52	0.3	21.6
45144	12.54	1.09	78.48		45144	12.54	0.3	21.6
45216	12.56	1.02	73.44		45216	12.56	0.3	21.6
45288	12.58	0.96	69.12		45288	12.58	0.3	21.6
45360	12.6	0.9	64.8		45360	12.6	0.29	20.88
45432	12.62	0.85	61.2		45432	12.62	0.29	20.88
45504	12.64	0.8	57.6		45504	12.64	0.28	20.16
45576	12.66	0.75	54		45576	12.66	0.28	20.16
45648	12.68	0.71	51.12		45648	12.68	0.27	19.44
45720	12.7	0.66	47.52		45720	12.7	0.27	19.44
45792	12.72	0.63	45.36		45792	12.72	0.27	19.44
45864	12.74	0.59	42.48		45864	12.74	0.26	18.72
45936	12.76	0.56	40.32		45936	12.76	0.26	18.72
46008	12.78	0.53	38.16		46008	12.78	0.26	18.72
46080	12.8	0.5	36		46080	12.8	0.26	18.72
46152	12.82	0.47	33.84		46152	12.82	0.26	18.72
46224	12.84	0.45	32.4		46224	12.84	0.25	18
46296	12.86	0.43	30.96		46296	12.86	0.25	18
46368	12.88	0.41	29.52		46368	12.88	0.25	18
46440	12.9	0.4	28.8		46440	12.9	0.25	18
46512	12.92	0.38	27.36		46512	12.92	0.25	18
46584	12.94	0.37	26.64		46584	12.94	0.25	18
46656	12.96	0.36	25.92		46656	12.96	0.25	18
46728	12.98	0.35	25.2		46728	12.98	0.24	17.28
46800	13	0.34	24.48		46800	13	0.24	17.28
46872	13.02	0.33	23.76		46872	13.02	0.24	17.28
46944	13.04	0.32	23.04		46944	13.04	0.24	17.28
47016	13.06	0.31	22.32		47016	13.06	0.24	17.28
47088	13.08	0.31	22.32		47088	13.08	0.24	17.28
47160	13.1	0.3	21.6		47160	13.1	0.24	17.28
47232	13.12	0.29	20.88		47232	13.12	0.24	17.28
47304	13.14	0.29	20.88		47304	13.14	0.24	17.28
47376	13.16	0.28	20.16		47376	13.16	0.24	17.28
47448	13.18	0.28	20.16		47448	13.18	0.24	17.28
47520	13.2	0.27	19.44		47520	13.2	0.24	17.28
47592	13.22	0.27	19.44		47592	13.22	0.24	17.28
47664	13.24	0.26	18.72		47664	13.24	0.24	17.28
47736	13.26	0.26	18.72		47736	13.26	0.24	17.28

47808	13.28	0.25	18		47808	13.28	0.24	17.28
47880	13.3	0.25	18		47880	13.3	0.24	17.28
47952	13.32	0.24	17.28		47952	13.32	0.24	17.28
48024	13.34	0.24	17.28		48024	13.34	0.24	17.28
48096	13.36	0.23	16.56		48096	13.36	0.24	17.28
48168	13.38	0.23	16.56		48168	13.38	0.24	17.28
48240	13.4	0.23	16.56		48240	13.4	0.24	17.28
48312	13.42	0.22	15.84		48312	13.42	0.24	17.28
48384	13.44	0.22	15.84		48384	13.44	0.24	17.28
48456	13.46	0.21	15.12		48456	13.46	0.24	17.28
48528	13.48	0.21	15.12		48528	13.48	0.24	17.28
48600	13.5	0.21	15.12		48600	13.5	0.24	17.28
48672	13.52	0.2	14.4		48672	13.52	0.24	17.28
48744	13.54	0.2	14.4		48744	13.54	0.24	17.28
48816	13.56	0.19	13.68		48816	13.56	0.24	17.28
48888	13.58	0.19	13.68		48888	13.58	0.24	17.28
48960	13.6	0.19	13.68		48960	13.6	0.24	17.28
49032	13.62	0.18	12.96		49032	13.62	0.23	16.56
49104	13.64	0.18	12.96		49104	13.64	0.23	16.56
49176	13.66	0.17	12.24		49176	13.66	0.23	16.56
49248	13.68	0.17	12.24		49248	13.68	0.23	16.56
49320	13.7	0.16	11.52		49320	13.7	0.23	16.56
49392	13.72	0.16	11.52		49392	13.72	0.23	16.56
49464	13.74	0.15	10.8		49464	13.74	0.23	16.56
49536	13.76	0.15	10.8		49536	13.76	0.23	16.56
49608	13.78	0.14	10.08		49608	13.78	0.23	16.56
49680	13.8	0.14	10.08		49680	13.8	0.23	16.56
49752	13.82	0.13	9.36		49752	13.82	0.23	16.56
49824	13.84	0.13	9.36		49824	13.84	0.23	16.56
49896	13.86	0.12	8.64		49896	13.86	0.23	16.56
49968	13.88	0.12	8.64		49968	13.88	0.23	16.56
50040	13.9	0.12	8.64		50040	13.9	0.23	16.56
50112	13.92	0.12	8.64		50112	13.92	0.23	16.56
50184	13.94	0.11	7.92		50184	13.94	0.23	16.56
50256	13.96	0.11	7.92		50256	13.96	0.23	16.56
50328	13.98	0.11	7.92		50328	13.98	0.23	16.56
50400	14	0.11	7.92		50400	14	0.23	16.56
50472	14.02	0.11	7.92		50472	14.02	0.23	16.56
50544	14.04	0.11	7.92		50544	14.04	0.23	16.56
50616	14.06	0.11	7.92		50616	14.06	0.22	15.84
50688	14.08	0.11	7.92		50688	14.08	0.22	15.84
50760	14.1	0.1	7.2		50760	14.1	0.22	15.84
50832	14.12	0.1	7.2		50832	14.12	0.22	15.84
50904	14.14	0.1	7.2		50904	14.14	0.22	15.84
50976	14.16	0.1	7.2		50976	14.16	0.22	15.84
51048	14.18	0.1	7.2		51048	14.18	0.22	15.84
51120	14.2	0.1	7.2		51120	14.2	0.22	15.84

51192	14.22	0.1	7.2		51192	14.22	0.22	15.84
51264	14.24	0.1	7.2		51264	14.24	0.22	15.84
51336	14.26	0.1	7.2		51336	14.26	0.22	15.84
51408	14.28	0.1	7.2		51408	14.28	0.22	15.84
51480	14.3	0.1	7.2		51480	14.3	0.22	15.84
51552	14.32	0.1	7.2		51552	14.32	0.22	15.84
51624	14.34	0.1	7.2		51624	14.34	0.22	15.84
51696	14.36	0.1	7.2		51696	14.36	0.22	15.84
51768	14.38	0.1	7.2		51768	14.38	0.22	15.84
51840	14.4	0.1	7.2		51840	14.4	0.22	15.84
51912	14.42	0.1	7.2		51912	14.42	0.22	15.84
51984	14.44	0.1	7.2		51984	14.44	0.22	15.84
52056	14.46	0.1	7.2		52056	14.46	0.22	15.84
52128	14.48	0.1	7.2		52128	14.48	0.22	15.84
52200	14.5	0.1	7.2		52200	14.5	0.21	15.12
52272	14.52	0.1	7.2		52272	14.52	0.21	15.12
52344	14.54	0.1	7.2		52344	14.54	0.21	15.12
52416	14.56	0.1	7.2		52416	14.56	0.21	15.12
52488	14.58	0.1	7.2		52488	14.58	0.21	15.12
52560	14.6	0.1	7.2		52560	14.6	0.21	15.12
52632	14.62	0.1	7.2		52632	14.62	0.21	15.12
52704	14.64	0.1	7.2		52704	14.64	0.21	15.12
52776	14.66	0.1	7.2		52776	14.66	0.21	15.12
52848	14.68	0.09	6.48		52848	14.68	0.21	15.12
52920	14.7	0.09	6.48		52920	14.7	0.21	15.12
52992	14.72	0.09	6.48		52992	14.72	0.21	15.12
53064	14.74	0.09	6.48		53064	14.74	0.21	15.12
53136	14.76	0.09	6.48		53136	14.76	0.21	15.12
53208	14.78	0.09	6.48		53208	14.78	0.21	15.12
53280	14.8	0.09	6.48		53280	14.8	0.21	15.12
53352	14.82	0.09	6.48		53352	14.82	0.21	15.12
53424	14.84	0.09	6.48		53424	14.84	0.21	15.12
53496	14.86	0.09	6.48		53496	14.86	0.21	15.12
53568	14.88	0.09	6.48		53568	14.88	0.21	15.12
53640	14.9	0.09	6.48		53640	14.9	0.21	15.12
53712	14.92	0.09	6.48		53712	14.92	0.21	15.12
53784	14.94	0.09	6.48		53784	14.94	0.21	15.12
53856	14.96	0.09	6.48		53856	14.96	0.2	14.4
53928	14.98	0.09	6.48		53928	14.98	0.2	14.4
54000	15	0.09	6.48		54000	15	0.2	14.4
54072	15.02	0.09	6.48		54072	15.02	0.2	14.4
54144	15.04	0.09	6.48		54144	15.04	0.2	14.4
54216	15.06	0.09	6.48		54216	15.06	0.2	14.4
54288	15.08	0.09	6.48		54288	15.08	0.2	14.4
54360	15.1	0.09	6.48		54360	15.1	0.2	14.4
54432	15.12	0.09	6.48		54432	15.12	0.2	14.4
54504	15.14	0.09	6.48		54504	15.14	0.2	14.4

54576	15.16	0.09	6.48		54576	15.16	0.2	14.4
54648	15.18	0.08	5.76		54648	15.18	0.2	14.4
54720	15.2	0.08	5.76		54720	15.2	0.2	14.4
54792	15.22	0.08	5.76		54792	15.22	0.2	14.4
54864	15.24	0.08	5.76		54864	15.24	0.2	14.4
54936	15.26	0.08	5.76		54936	15.26	0.2	14.4
55008	15.28	0.07	5.04		55008	15.28	0.2	14.4
55080	15.3	0.07	5.04		55080	15.3	0.2	14.4
55152	15.32	0.07	5.04		55152	15.32	0.2	14.4
55224	15.34	0.07	5.04		55224	15.34	0.2	14.4
55296	15.36	0.07	5.04		55296	15.36	0.19	13.68
55368	15.38	0.06	4.32		55368	15.38	0.19	13.68
55440	15.4	0.06	4.32		55440	15.4	0.19	13.68
55512	15.42	0.06	4.32		55512	15.42	0.19	13.68
55584	15.44	0.06	4.32		55584	15.44	0.19	13.68
55656	15.46	0.06	4.32		55656	15.46	0.19	13.68
55728	15.48	0.06	4.32		55728	15.48	0.19	13.68
55800	15.5	0.06	4.32		55800	15.5	0.19	13.68
55872	15.52	0.06	4.32		55872	15.52	0.19	13.68
55944	15.54	0.06	4.32		55944	15.54	0.19	13.68
56016	15.56	0.06	4.32		56016	15.56	0.19	13.68
56088	15.58	0.06	4.32		56088	15.58	0.19	13.68
56160	15.6	0.06	4.32		56160	15.6	0.19	13.68
56232	15.62	0.06	4.32		56232	15.62	0.19	13.68
56304	15.64	0.06	4.32		56304	15.64	0.19	13.68
56376	15.66	0.05	3.6		56376	15.66	0.19	13.68
56448	15.68	0.05	3.6		56448	15.68	0.19	13.68
56520	15.7	0.05	3.6		56520	15.7	0.19	13.68
56592	15.72	0.05	3.6		56592	15.72	0.18	12.96
56664	15.74	0.05	3.6		56664	15.74	0.18	12.96
56736	15.76	0.05	3.6		56736	15.76	0.18	12.96
56808	15.78	0.05	3.6		56808	15.78	0.18	12.96
56880	15.8	0.05	3.6		56880	15.8	0.18	12.96
56952	15.82	0.05	3.6		56952	15.82	0.18	12.96
57024	15.84	0.05	3.6		57024	15.84	0.18	12.96
57096	15.86	0.05	3.6		57096	15.86	0.18	12.96
57168	15.88	0.05	3.6		57168	15.88	0.18	12.96
57240	15.9	0.05	3.6		57240	15.9	0.18	12.96
57312	15.92	0.05	3.6		57312	15.92	0.18	12.96
57384	15.94	0.05	3.6		57384	15.94	0.18	12.96
57456	15.96	0.05	3.6		57456	15.96	0.18	12.96
57528	15.98	0.05	3.6		57528	15.98	0.18	12.96
57600	16	0.05	3.6		57600	16	0.18	12.96
57672	16.02	0.05	3.6		57672	16.02	0.18	12.96
57744	16.04	0.05	3.6		57744	16.04	0.18	12.96
57816	16.06	0.05	3.6		57816	16.06	0.18	12.96
57888	16.08	0.05	3.6		57888	16.08	0.18	12.96

57960	16.1	0.05	3.6		57960	16.1	0.18	12.96
58032	16.12	0.05	3.6		58032	16.12	0.17	12.24
58104	16.14	0.05	3.6		58104	16.14	0.17	12.24
58176	16.16	0.05	3.6		58176	16.16	0.17	12.24
58248	16.18	0.05	3.6		58248	16.18	0.17	12.24
58320	16.2	0.05	3.6		58320	16.2	0.17	12.24
58392	16.22	0.05	3.6		58392	16.22	0.17	12.24
58464	16.24	0.05	3.6		58464	16.24	0.17	12.24
58536	16.26	0.05	3.6		58536	16.26	0.17	12.24
58608	16.28	0.05	3.6		58608	16.28	0.17	12.24
58680	16.3	0.05	3.6		58680	16.3	0.17	12.24
58752	16.32	0.05	3.6		58752	16.32	0.17	12.24
58824	16.34	0.05	3.6		58824	16.34	0.17	12.24
58896	16.36	0.05	3.6		58896	16.36	0.17	12.24
58968	16.38	0.05	3.6		58968	16.38	0.17	12.24
59040	16.4	0.05	3.6		59040	16.4	0.17	12.24
59112	16.42	0.05	3.6		59112	16.42	0.17	12.24
59184	16.44	0.05	3.6		59184	16.44	0.17	12.24
59256	16.46	0.05	3.6		59256	16.46	0.17	12.24
59328	16.48	0.05	3.6		59328	16.48	0.17	12.24
59400	16.5	0.05	3.6		59400	16.5	0.16	11.52
59472	16.52	0.05	3.6		59472	16.52	0.16	11.52
59544	16.54	0.05	3.6		59544	16.54	0.16	11.52
59616	16.56	0.05	3.6		59616	16.56	0.16	11.52
59688	16.58	0.05	3.6		59688	16.58	0.16	11.52
59760	16.6	0.05	3.6		59760	16.6	0.16	11.52
59832	16.62	0.05	3.6		59832	16.62	0.16	11.52
59904	16.64	0.05	3.6		59904	16.64	0.16	11.52
59976	16.66	0.05	3.6		59976	16.66	0.16	11.52
60048	16.68	0.05	3.6		60048	16.68	0.16	11.52
60120	16.7	0.05	3.6		60120	16.7	0.16	11.52
60192	16.72	0.05	3.6		60192	16.72	0.16	11.52
60264	16.74	0.05	3.6		60264	16.74	0.16	11.52
60336	16.76	0.05	3.6		60336	16.76	0.16	11.52
60408	16.78	0.05	3.6		60408	16.78	0.16	11.52
60480	16.8	0.05	3.6		60480	16.8	0.16	11.52
60552	16.82	0.05	3.6		60552	16.82	0.16	11.52
60624	16.84	0.05	3.6		60624	16.84	0.16	11.52
60696	16.86	0.05	3.6		60696	16.86	0.16	11.52
60768	16.88	0.05	3.6		60768	16.88	0.16	11.52
60840	16.9	0.05	3.6		60840	16.9	0.16	11.52
60912	16.92	0.05	3.6		60912	16.92	0.15	10.8
60984	16.94	0.05	3.6		60984	16.94	0.15	10.8
61056	16.96	0.05	3.6		61056	16.96	0.15	10.8
61128	16.98	0.05	3.6		61128	16.98	0.15	10.8
61200	17	0.05	3.6		61200	17	0.15	10.8
61272	17.02	0.05	3.6		61272	17.02	0.15	10.8

61344	17.04	0.05	3.6		61344	17.04	0.15	10.8
61416	17.06	0.05	3.6		61416	17.06	0.15	10.8
61488	17.08	0.05	3.6		61488	17.08	0.15	10.8
61560	17.1	0.05	3.6		61560	17.1	0.15	10.8
61632	17.12	0.05	3.6		61632	17.12	0.15	10.8
61704	17.14	0.05	3.6		61704	17.14	0.15	10.8
61776	17.16	0.05	3.6		61776	17.16	0.15	10.8
61848	17.18	0.05	3.6		61848	17.18	0.15	10.8
61920	17.2	0.05	3.6		61920	17.2	0.15	10.8
61992	17.22	0.05	3.6		61992	17.22	0.15	10.8
62064	17.24	0.05	3.6		62064	17.24	0.15	10.8
62136	17.26	0.05	3.6		62136	17.26	0.15	10.8
62208	17.28	0.05	3.6		62208	17.28	0.15	10.8
62280	17.3	0.05	3.6		62280	17.3	0.15	10.8
62352	17.32	0.05	3.6		62352	17.32	0.15	10.8
62424	17.34	0.05	3.6		62424	17.34	0.14	10.08
62496	17.36	0.05	3.6		62496	17.36	0.14	10.08
62568	17.38	0.04	2.88		62568	17.38	0.14	10.08
62640	17.4	0.04	2.88		62640	17.4	0.14	10.08
62712	17.42	0.04	2.88		62712	17.42	0.14	10.08
62784	17.44	0.04	2.88		62784	17.44	0.14	10.08
62856	17.46	0.04	2.88		62856	17.46	0.14	10.08
62928	17.48	0.04	2.88		62928	17.48	0.14	10.08
63000	17.5	0.04	2.88		63000	17.5	0.14	10.08
63072	17.52	0.04	2.88		63072	17.52	0.14	10.08
63144	17.54	0.04	2.88		63144	17.54	0.14	10.08
63216	17.56	0.04	2.88		63216	17.56	0.14	10.08
63288	17.58	0.04	2.88		63288	17.58	0.14	10.08
63360	17.6	0.04	2.88		63360	17.6	0.14	10.08
63432	17.62	0.04	2.88		63432	17.62	0.14	10.08
63504	17.64	0.04	2.88		63504	17.64	0.14	10.08
63576	17.66	0.04	2.88		63576	17.66	0.14	10.08
63648	17.68	0.04	2.88		63648	17.68	0.14	10.08
63720	17.7	0.04	2.88		63720	17.7	0.14	10.08
63792	17.72	0.04	2.88		63792	17.72	0.14	10.08
63864	17.74	0.04	2.88		63864	17.74	0.14	10.08
63936	17.76	0.04	2.88		63936	17.76	0.14	10.08
64008	17.78	0.04	2.88		64008	17.78	0.14	10.08
64080	17.8	0.04	2.88		64080	17.8	0.13	9.36
64152	17.82	0.04	2.88		64152	17.82	0.13	9.36
64224	17.84	0.04	2.88		64224	17.84	0.13	9.36
64296	17.86	0.04	2.88		64296	17.86	0.13	9.36
64368	17.88	0.04	2.88		64368	17.88	0.13	9.36
64440	17.9	0.04	2.88		64440	17.9	0.13	9.36
64512	17.92	0.04	2.88		64512	17.92	0.13	9.36
64584	17.94	0.04	2.88		64584	17.94	0.13	9.36
64656	17.96	0.04	2.88		64656	17.96	0.13	9.36

64728	17.98	0.04	2.88		64728	17.98	0.13	9.36
64800	18	0.04	2.88		64800	18	0.13	9.36
64872	18.02	0.04	2.88		64872	18.02	0.13	9.36
64944	18.04	0.04	2.88		64944	18.04	0.13	9.36
65016	18.06	0.04	2.88		65016	18.06	0.13	9.36
65088	18.08	0.04	2.88		65088	18.08	0.13	9.36
65160	18.1	0.04	2.88		65160	18.1	0.13	9.36
65232	18.12	0.04	2.88		65232	18.12	0.13	9.36
65304	18.14	0.04	2.88		65304	18.14	0.13	9.36
65376	18.16	0.04	2.88		65376	18.16	0.13	9.36
65448	18.18	0.04	2.88		65448	18.18	0.13	9.36
65520	18.2	0.04	2.88		65520	18.2	0.13	9.36
65592	18.22	0.04	2.88		65592	18.22	0.13	9.36
65664	18.24	0.04	2.88		65664	18.24	0.13	9.36
65736	18.26	0.04	2.88		65736	18.26	0.13	9.36
65808	18.28	0.04	2.88		65808	18.28	0.13	9.36
65880	18.3	0.04	2.88		65880	18.3	0.13	9.36
65952	18.32	0.04	2.88		65952	18.32	0.13	9.36
66024	18.34	0.04	2.88		66024	18.34	0.12	8.64
66096	18.36	0.04	2.88		66096	18.36	0.12	8.64
66168	18.38	0.04	2.88		66168	18.38	0.12	8.64
66240	18.4	0.04	2.88		66240	18.4	0.12	8.64
66312	18.42	0.04	2.88		66312	18.42	0.12	8.64
66384	18.44	0.04	2.88		66384	18.44	0.12	8.64
66456	18.46	0.04	2.88		66456	18.46	0.12	8.64
66528	18.48	0.04	2.88		66528	18.48	0.12	8.64
66600	18.5	0.04	2.88		66600	18.5	0.12	8.64
66672	18.52	0.04	2.88		66672	18.52	0.12	8.64
66744	18.54	0.04	2.88		66744	18.54	0.12	8.64
66816	18.56	0.04	2.88		66816	18.56	0.12	8.64
66888	18.58	0.04	2.88		66888	18.58	0.12	8.64
66960	18.6	0.04	2.88		66960	18.6	0.12	8.64
67032	18.62	0.04	2.88		67032	18.62	0.12	8.64
67104	18.64	0.04	2.88		67104	18.64	0.12	8.64
67176	18.66	0.04	2.88		67176	18.66	0.12	8.64
67248	18.68	0.04	2.88		67248	18.68	0.12	8.64
67320	18.7	0.04	2.88		67320	18.7	0.12	8.64
67392	18.72	0.04	2.88		67392	18.72	0.12	8.64
67464	18.74	0.04	2.88		67464	18.74	0.12	8.64
67536	18.76	0.04	2.88		67536	18.76	0.12	8.64
67608	18.78	0.04	2.88		67608	18.78	0.12	8.64
67680	18.8	0.04	2.88		67680	18.8	0.12	8.64
67752	18.82	0.04	2.88		67752	18.82	0.12	8.64
67824	18.84	0.04	2.88		67824	18.84	0.12	8.64
67896	18.86	0.04	2.88		67896	18.86	0.12	8.64
67968	18.88	0.04	2.88		67968	18.88	0.12	8.64
68040	18.9	0.04	2.88		68040	18.9	0.12	8.64

68112	18.92	0.04	2.88		68112	18.92	0.12	8.64
68184	18.94	0.04	2.88		68184	18.94	0.12	8.64
68256	18.96	0.04	2.88		68256	18.96	0.12	8.64
68328	18.98	0.04	2.88		68328	18.98	0.12	8.64
68400	19	0.04	2.88		68400	19	0.12	8.64
68472	19.02	0.04	2.88		68472	19.02	0.12	8.64
68544	19.04	0.04	2.88		68544	19.04	0.12	8.64
68616	19.06	0.04	2.88		68616	19.06	0.12	8.64
68688	19.08	0.04	2.88		68688	19.08	0.12	8.64
68760	19.1	0.04	2.88		68760	19.1	0.12	8.64
68832	19.12	0.04	2.88		68832	19.12	0.12	8.64
68904	19.14	0.04	2.88		68904	19.14	0.12	8.64
68976	19.16	0.04	2.88		68976	19.16	0.12	8.64
69048	19.18	0.04	2.88		69048	19.18	0.12	8.64
69120	19.2	0.04	2.88		69120	19.2	0.12	8.64
69192	19.22	0.04	2.88		69192	19.22	0.11	7.92
69264	19.24	0.04	2.88		69264	19.24	0.11	7.92
69336	19.26	0.03	2.16		69336	19.26	0.11	7.92
69408	19.28	0.03	2.16		69408	19.28	0.11	7.92
69480	19.3	0.03	2.16		69480	19.3	0.11	7.92
69552	19.32	0.03	2.16		69552	19.32	0.11	7.92
69624	19.34	0.03	2.16		69624	19.34	0.11	7.92
69696	19.36	0.03	2.16		69696	19.36	0.11	7.92
69768	19.38	0.03	2.16		69768	19.38	0.11	7.92
69840	19.4	0.03	2.16		69840	19.4	0.11	7.92
69912	19.42	0.03	2.16		69912	19.42	0.11	7.92
69984	19.44	0.03	2.16		69984	19.44	0.11	7.92
70056	19.46	0.03	2.16		70056	19.46	0.11	7.92
70128	19.48	0.03	2.16		70128	19.48	0.11	7.92
70200	19.5	0.03	2.16		70200	19.5	0.11	7.92
70272	19.52	0.03	2.16		70272	19.52	0.11	7.92
70344	19.54	0.03	2.16		70344	19.54	0.11	7.92
70416	19.56	0.03	2.16		70416	19.56	0.11	7.92
70488	19.58	0.03	2.16		70488	19.58	0.11	7.92
70560	19.6	0.03	2.16		70560	19.6	0.11	7.92
70632	19.62	0.03	2.16		70632	19.62	0.11	7.92
70704	19.64	0.03	2.16		70704	19.64	0.11	7.92
70776	19.66	0.03	2.16		70776	19.66	0.11	7.92
70848	19.68	0.03	2.16		70848	19.68	0.11	7.92
70920	19.7	0.03	2.16		70920	19.7	0.11	7.92
70992	19.72	0.03	2.16		70992	19.72	0.11	7.92
71064	19.74	0.03	2.16		71064	19.74	0.11	7.92
71136	19.76	0.03	2.16		71136	19.76	0.11	7.92
71208	19.78	0.03	2.16		71208	19.78	0.11	7.92
71280	19.8	0.03	2.16		71280	19.8	0.11	7.92
71352	19.82	0.03	2.16		71352	19.82	0.11	7.92
71424	19.84	0.03	2.16		71424	19.84	0.11	7.92

71496	19.86	0.03	2.16		71496	19.86	0.11	7.92
71568	19.88	0.03	2.16		71568	19.88	0.11	7.92
71640	19.9	0.03	2.16		71640	19.9	0.11	7.92
71712	19.92	0.03	2.16		71712	19.92	0.11	7.92
71784	19.94	0.03	2.16		71784	19.94	0.11	7.92
71856	19.96	0.03	2.16		71856	19.96	0.11	7.92
71928	19.98	0.03	2.16		71928	19.98	0.11	7.92
72000	20	0.03	2.16		72000	20	0.11	7.92
72072	20.02	0.03	2.16		72072	20.02	0.11	7.92
72144	20.04	0.03	2.16		72144	20.04	0.11	7.92
72216	20.06	0.03	2.16		72216	20.06	0.11	7.92
72288	20.08	0.03	2.16		72288	20.08	0.11	7.92
72360	20.1	0.03	2.16		72360	20.1	0.11	7.92
72432	20.12	0.03	2.16		72432	20.12	0.11	7.92
72504	20.14	0.03	2.16		72504	20.14	0.11	7.92
72576	20.16	0.03	2.16		72576	20.16	0.11	7.92
72648	20.18	0.03	2.16		72648	20.18	0.11	7.92
72720	20.2	0.03	2.16		72720	20.2	0.11	7.92
72792	20.22	0.03	2.16		72792	20.22	0.11	7.92
72864	20.24	0.03	2.16		72864	20.24	0.11	7.92
72936	20.26	0.03	2.16		72936	20.26	0.11	7.92
73008	20.28	0.03	2.16		73008	20.28	0.11	7.92
73080	20.3	0.03	2.16		73080	20.3	0.11	7.92
73152	20.32	0.03	2.16		73152	20.32	0.11	7.92
73224	20.34	0.03	2.16		73224	20.34	0.11	7.92
73296	20.36	0.03	2.16		73296	20.36	0.11	7.92
73368	20.38	0.03	2.16		73368	20.38	0.11	7.92
73440	20.4	0.03	2.16		73440	20.4	0.11	7.92
73512	20.42	0.03	2.16		73512	20.42	0.11	7.92
73584	20.44	0.03	2.16		73584	20.44	0.11	7.92
73656	20.46	0.03	2.16		73656	20.46	0.11	7.92
73728	20.48	0.03	2.16		73728	20.48	0.11	7.92
73800	20.5	0.03	2.16		73800	20.5	0.11	7.92
73872	20.52	0.03	2.16		73872	20.52	0.11	7.92
73944	20.54	0.03	2.16		73944	20.54	0.11	7.92
74016	20.56	0.03	2.16		74016	20.56	0.11	7.92
74088	20.58	0.03	2.16		74088	20.58	0.11	7.92
74160	20.6	0.03	2.16		74160	20.6	0.11	7.92
74232	20.62	0.03	2.16		74232	20.62	0.11	7.92
74304	20.64	0.03	2.16		74304	20.64	0.11	7.92
74376	20.66	0.03	2.16		74376	20.66	0.11	7.92
74448	20.68	0.03	2.16		74448	20.68	0.11	7.92
74520	20.7	0.03	2.16		74520	20.7	0.11	7.92
74592	20.72	0.03	2.16		74592	20.72	0.11	7.92
74664	20.74	0.03	2.16		74664	20.74	0.11	7.92
74736	20.76	0.03	2.16		74736	20.76	0.1	7.2
74808	20.78	0.03	2.16		74808	20.78	0.1	7.2

74880	20.8	0.03	2.16		74880	20.8	0.1	7.2
74952	20.82	0.03	2.16		74952	20.82	0.1	7.2
75024	20.84	0.03	2.16		75024	20.84	0.1	7.2
75096	20.86	0.03	2.16		75096	20.86	0.1	7.2
75168	20.88	0.03	2.16		75168	20.88	0.1	7.2
75240	20.9	0.03	2.16		75240	20.9	0.1	7.2
75312	20.92	0.03	2.16		75312	20.92	0.1	7.2
75384	20.94	0.03	2.16		75384	20.94	0.1	7.2
75456	20.96	0.03	2.16		75456	20.96	0.1	7.2
75528	20.98	0.03	2.16		75528	20.98	0.1	7.2
75600	21	0.03	2.16		75600	21	0.1	7.2

	Predevelopment (cf)	Post Development (cf)
Total Volume	5993.28	5749.92

100yr -24hr Storm								
Pre development					Post development			
Time (sec)	Time (hours)	Runoff (cfs)	Volume (cf)		Time (sec)	Time (hours)	Primary (cfs)	Volume (cf)
41400	11.5	0.5			41400	11.5	0.17	
41472	11.52	0.51	36.72		41472	11.52	0.17	12.24
41544	11.54	0.52	37.44		41544	11.54	0.17	12.24
41616	11.56	0.53	38.16		41616	11.56	0.17	12.24
41688	11.58	0.54	38.88		41688	11.58	0.17	12.24
41760	11.6	0.56	40.32		41760	11.6	0.17	12.24
41832	11.62	0.57	41.04		41832	11.62	0.18	12.96
41904	11.64	0.59	42.48		41904	11.64	0.18	12.96
41976	11.66	0.62	44.64		41976	11.66	0.18	12.96
42048	11.68	0.64	46.08		42048	11.68	0.19	13.68
42120	11.7	0.67	48.24		42120	11.7	0.19	13.68
42192	11.72	0.71	51.12		42192	11.72	0.19	13.68
42264	11.74	0.74	53.28		42264	11.74	0.19	13.68
42336	11.76	0.78	56.16		42336	11.76	0.2	14.4
42408	11.78	0.83	59.76		42408	11.78	0.2	14.4
42480	11.8	0.88	63.36		42480	11.8	0.21	15.12
42552	11.82	0.94	67.68		42552	11.82	0.21	15.12
42624	11.84	1	72		42624	11.84	0.21	15.12
42696	11.86	1.07	77.04		42696	11.86	0.22	15.84
42768	11.88	1.14	82.08		42768	11.88	0.22	15.84
42840	11.9	1.22	87.84		42840	11.9	0.23	16.56
42912	11.92	1.31	94.32		42912	11.92	0.23	16.56
42984	11.94	1.41	101.52		42984	11.94	0.24	17.28
43056	11.96	1.52	109.44		43056	11.96	0.28	20.16
43128	11.98	1.65	118.8		43128	11.98	0.37	26.64
43200	12	1.8	129.6		43200	12	0.5	36
43272	12.02	1.96	141.12		43272	12.02	0.65	46.8
43344	12.04	2.16	155.52		43344	12.04	0.8	57.6
43416	12.06	2.4	172.8		43416	12.06	0.92	66.24
43488	12.08	2.67	192.24		43488	12.08	1.05	75.6
43560	12.1	2.99	215.28		43560	12.1	1.17	84.24
43632	12.12	3.35	241.2		43632	12.12	1.29	92.88
43704	12.14	3.75	270		43704	12.14	1.4	100.8
43776	12.16	4.19	301.68		43776	12.16	1.49	107.28
43848	12.18	4.63	333.36		43848	12.18	1.56	112.32
43920	12.2	5.05	363.6		43920	12.2	1.61	115.92
43992	12.22	5.43	390.96		43992	12.22	1.64	118.08
44064	12.24	5.75	414		44064	12.24	1.66	119.52
44136	12.26	5.97	429.84		44136	12.26	1.67	120.24
44208	12.28	6.1	439.2		44208	12.28	1.68	120.96
44280	12.3	6.11	439.92		44280	12.3	1.68	120.96
44352	12.32	6.06	436.32		44352	12.32	1.68	120.96

44424	12.34	5.91	425.52		44424	12.34	1.67	120.24
44496	12.36	5.71	411.12		44496	12.36	1.66	119.52
44568	12.38	5.46	393.12		44568	12.38	1.66	119.52
44640	12.4	5.17	372.24		44640	12.4	1.65	118.8
44712	12.42	4.87	350.64		44712	12.42	1.63	117.36
44784	12.44	4.56	328.32		44784	12.44	1.62	116.64
44856	12.46	4.26	306.72		44856	12.46	1.61	115.92
44928	12.48	3.96	285.12		44928	12.48	1.59	114.48
45000	12.5	3.7	266.4		45000	12.5	1.58	113.76
45072	12.52	3.46	249.12		45072	12.52	1.56	112.32
45144	12.54	3.23	232.56		45144	12.54	1.54	110.88
45216	12.56	3.03	218.16		45216	12.56	1.53	110.16
45288	12.58	2.83	203.76		45288	12.58	1.51	108.72
45360	12.6	2.65	190.8		45360	12.6	1.49	107.28
45432	12.62	2.48	178.56		45432	12.62	1.47	105.84
45504	12.64	2.33	167.76		45504	12.64	1.45	104.4
45576	12.66	2.18	156.96		45576	12.66	1.42	102.24
45648	12.68	2.04	146.88		45648	12.68	1.4	100.8
45720	12.7	1.92	138.24		45720	12.7	1.38	99.36
45792	12.72	1.8	129.6		45792	12.72	1.36	97.92
45864	12.74	1.69	121.68		45864	12.74	1.34	96.48
45936	12.76	1.59	114.48		45936	12.76	1.32	95.04
46008	12.78	1.5	108		46008	12.78	1.29	92.88
46080	12.8	1.42	102.24		46080	12.8	1.27	91.44
46152	12.82	1.35	97.2		46152	12.82	1.25	90
46224	12.84	1.28	92.16		46224	12.84	1.23	88.56
46296	12.86	1.22	87.84		46296	12.86	1.21	87.12
46368	12.88	1.17	84.24		46368	12.88	1.19	85.68
46440	12.9	1.12	80.64		46440	12.9	1.17	84.24
46512	12.92	1.08	77.76		46512	12.92	1.15	82.8
46584	12.94	1.04	74.88		46584	12.94	1.13	81.36
46656	12.96	1.01	72.72		46656	12.96	1.11	79.92
46728	12.98	0.97	69.84		46728	12.98	1.09	78.48
46800	13	0.95	68.4		46800	13	1.06	76.32
46872	13.02	0.92	66.24		46872	13.02	1.04	74.88
46944	13.04	0.89	64.08		46944	13.04	1.02	73.44
47016	13.06	0.87	62.64		47016	13.06	1	72
47088	13.08	0.85	61.2		47088	13.08	0.99	71.28
47160	13.1	0.83	59.76		47160	13.1	0.97	69.84
47232	13.12	0.81	58.32		47232	13.12	0.96	69.12
47304	13.14	0.79	56.88		47304	13.14	0.94	67.68
47376	13.16	0.78	56.16		47376	13.16	0.93	66.96
47448	13.18	0.76	54.72		47448	13.18	0.92	66.24
47520	13.2	0.74	53.28		47520	13.2	0.91	65.52
47592	13.22	0.73	52.56		47592	13.22	0.9	64.8
47664	13.24	0.72	51.84		47664	13.24	0.9	64.8
47736	13.26	0.7	50.4		47736	13.26	0.89	64.08

47808	13.28	0.69	49.68		47808	13.28	0.88	63.36
47880	13.3	0.68	48.96		47880	13.3	0.87	62.64
47952	13.32	0.67	48.24		47952	13.32	0.87	62.64
48024	13.34	0.65	46.8		48024	13.34	0.86	61.92
48096	13.36	0.64	46.08		48096	13.36	0.86	61.92
48168	13.38	0.63	45.36		48168	13.38	0.85	61.2
48240	13.4	0.62	44.64		48240	13.4	0.85	61.2
48312	13.42	0.61	43.92		48312	13.42	0.84	60.48
48384	13.44	0.6	43.2		48384	13.44	0.84	60.48
48456	13.46	0.59	42.48		48456	13.46	0.83	59.76
48528	13.48	0.57	41.04		48528	13.48	0.83	59.76
48600	13.5	0.56	40.32		48600	13.5	0.82	59.04
48672	13.52	0.55	39.6		48672	13.52	0.82	59.04
48744	13.54	0.54	38.88		48744	13.54	0.81	58.32
48816	13.56	0.53	38.16		48816	13.56	0.81	58.32
48888	13.58	0.52	37.44		48888	13.58	0.8	57.6
48960	13.6	0.51	36.72		48960	13.6	0.8	57.6
49032	13.62	0.49	35.28		49032	13.62	0.79	56.88
49104	13.64	0.48	34.56		49104	13.64	0.79	56.88
49176	13.66	0.47	33.84		49176	13.66	0.79	56.88
49248	13.68	0.45	32.4		49248	13.68	0.78	56.16
49320	13.7	0.44	31.68		49320	13.7	0.78	56.16
49392	13.72	0.42	30.24		49392	13.72	0.77	55.44
49464	13.74	0.41	29.52		49464	13.74	0.77	55.44
49536	13.76	0.39	28.08		49536	13.76	0.77	55.44
49608	13.78	0.38	27.36		49608	13.78	0.77	55.44
49680	13.8	0.37	26.64		49680	13.8	0.76	54.72
49752	13.82	0.36	25.92		49752	13.82	0.76	54.72
49824	13.84	0.35	25.2		49824	13.84	0.76	54.72
49896	13.86	0.34	24.48		49896	13.86	0.76	54.72
49968	13.88	0.33	23.76		49968	13.88	0.75	54
50040	13.9	0.32	23.04		50040	13.9	0.75	54
50112	13.92	0.31	22.32		50112	13.92	0.75	54
50184	13.94	0.31	22.32		50184	13.94	0.75	54
50256	13.96	0.3	21.6		50256	13.96	0.75	54
50328	13.98	0.3	21.6		50328	13.98	0.75	54
50400	14	0.3	21.6		50400	14	0.74	53.28
50472	14.02	0.29	20.88		50472	14.02	0.74	53.28
50544	14.04	0.29	20.88		50544	14.04	0.74	53.28
50616	14.06	0.29	20.88		50616	14.06	0.74	53.28
50688	14.08	0.28	20.16		50688	14.08	0.74	53.28
50760	14.1	0.28	20.16		50760	14.1	0.73	52.56
50832	14.12	0.28	20.16		50832	14.12	0.73	52.56
50904	14.14	0.28	20.16		50904	14.14	0.73	52.56
50976	14.16	0.28	20.16		50976	14.16	0.73	52.56
51048	14.18	0.28	20.16		51048	14.18	0.73	52.56
51120	14.2	0.27	19.44		51120	14.2	0.73	52.56

51192	14.22	0.27	19.44		51192	14.22	0.72	51.84
51264	14.24	0.27	19.44		51264	14.24	0.72	51.84
51336	14.26	0.27	19.44		51336	14.26	0.72	51.84
51408	14.28	0.27	19.44		51408	14.28	0.72	51.84
51480	14.3	0.27	19.44		51480	14.3	0.72	51.84
51552	14.32	0.27	19.44		51552	14.32	0.71	51.12
51624	14.34	0.27	19.44		51624	14.34	0.71	51.12
51696	14.36	0.27	19.44		51696	14.36	0.71	51.12
51768	14.38	0.27	19.44		51768	14.38	0.71	51.12
51840	14.4	0.26	18.72		51840	14.4	0.71	51.12
51912	14.42	0.26	18.72		51912	14.42	0.71	51.12
51984	14.44	0.26	18.72		51984	14.44	0.7	50.4
52056	14.46	0.26	18.72		52056	14.46	0.7	50.4
52128	14.48	0.26	18.72		52128	14.48	0.7	50.4
52200	14.5	0.26	18.72		52200	14.5	0.7	50.4
52272	14.52	0.26	18.72		52272	14.52	0.7	50.4
52344	14.54	0.26	18.72		52344	14.54	0.69	49.68
52416	14.56	0.26	18.72		52416	14.56	0.69	49.68
52488	14.58	0.26	18.72		52488	14.58	0.69	49.68
52560	14.6	0.26	18.72		52560	14.6	0.69	49.68
52632	14.62	0.26	18.72		52632	14.62	0.69	49.68
52704	14.64	0.26	18.72		52704	14.64	0.69	49.68
52776	14.66	0.26	18.72		52776	14.66	0.68	48.96
52848	14.68	0.25	18		52848	14.68	0.68	48.96
52920	14.7	0.25	18		52920	14.7	0.68	48.96
52992	14.72	0.25	18		52992	14.72	0.68	48.96
53064	14.74	0.25	18		53064	14.74	0.68	48.96
53136	14.76	0.25	18		53136	14.76	0.67	48.24
53208	14.78	0.25	18		53208	14.78	0.67	48.24
53280	14.8	0.25	18		53280	14.8	0.67	48.24
53352	14.82	0.25	18		53352	14.82	0.67	48.24
53424	14.84	0.25	18		53424	14.84	0.67	48.24
53496	14.86	0.25	18		53496	14.86	0.67	48.24
53568	14.88	0.25	18		53568	14.88	0.66	47.52
53640	14.9	0.25	18		53640	14.9	0.66	47.52
53712	14.92	0.25	18		53712	14.92	0.66	47.52
53784	14.94	0.25	18		53784	14.94	0.66	47.52
53856	14.96	0.25	18		53856	14.96	0.66	47.52
53928	14.98	0.25	18		53928	14.98	0.65	46.8
54000	15	0.24	17.28		54000	15	0.65	46.8
54072	15.02	0.24	17.28		54072	15.02	0.65	46.8
54144	15.04	0.24	17.28		54144	15.04	0.65	46.8
54216	15.06	0.24	17.28		54216	15.06	0.65	46.8
54288	15.08	0.24	17.28		54288	15.08	0.65	46.8
54360	15.1	0.24	17.28		54360	15.1	0.64	46.08
54432	15.12	0.24	17.28		54432	15.12	0.64	46.08
54504	15.14	0.23	16.56		54504	15.14	0.64	46.08

54576	15.16	0.23	16.56		54576	15.16	0.64	46.08
54648	15.18	0.22	15.84		54648	15.18	0.63	45.36
54720	15.2	0.22	15.84		54720	15.2	0.63	45.36
54792	15.22	0.21	15.12		54792	15.22	0.63	45.36
54864	15.24	0.21	15.12		54864	15.24	0.63	45.36
54936	15.26	0.2	14.4		54936	15.26	0.63	45.36
55008	15.28	0.2	14.4		55008	15.28	0.62	44.64
55080	15.3	0.19	13.68		55080	15.3	0.62	44.64
55152	15.32	0.18	12.96		55152	15.32	0.62	44.64
55224	15.34	0.18	12.96		55224	15.34	0.62	44.64
55296	15.36	0.17	12.24		55296	15.36	0.61	43.92
55368	15.38	0.17	12.24		55368	15.38	0.61	43.92
55440	15.4	0.17	12.24		55440	15.4	0.61	43.92
55512	15.42	0.16	11.52		55512	15.42	0.61	43.92
55584	15.44	0.16	11.52		55584	15.44	0.61	43.92
55656	15.46	0.16	11.52		55656	15.46	0.6	43.2
55728	15.48	0.16	11.52		55728	15.48	0.6	43.2
55800	15.5	0.16	11.52		55800	15.5	0.6	43.2
55872	15.52	0.15	10.8		55872	15.52	0.6	43.2
55944	15.54	0.15	10.8		55944	15.54	0.59	42.48
56016	15.56	0.15	10.8		56016	15.56	0.59	42.48
56088	15.58	0.15	10.8		56088	15.58	0.59	42.48
56160	15.6	0.15	10.8		56160	15.6	0.59	42.48
56232	15.62	0.15	10.8		56232	15.62	0.59	42.48
56304	15.64	0.15	10.8		56304	15.64	0.58	41.76
56376	15.66	0.15	10.8		56376	15.66	0.58	41.76
56448	15.68	0.15	10.8		56448	15.68	0.58	41.76
56520	15.7	0.15	10.8		56520	15.7	0.58	41.76
56592	15.72	0.14	10.08		56592	15.72	0.57	41.04
56664	15.74	0.14	10.08		56664	15.74	0.57	41.04
56736	15.76	0.14	10.08		56736	15.76	0.57	41.04
56808	15.78	0.14	10.08		56808	15.78	0.57	41.04
56880	15.8	0.14	10.08		56880	15.8	0.56	40.32
56952	15.82	0.14	10.08		56952	15.82	0.56	40.32
57024	15.84	0.14	10.08		57024	15.84	0.56	40.32
57096	15.86	0.14	10.08		57096	15.86	0.56	40.32
57168	15.88	0.14	10.08		57168	15.88	0.56	40.32
57240	15.9	0.14	10.08		57240	15.9	0.55	39.6
57312	15.92	0.14	10.08		57312	15.92	0.55	39.6
57384	15.94	0.14	10.08		57384	15.94	0.55	39.6
57456	15.96	0.14	10.08		57456	15.96	0.55	39.6
57528	15.98	0.14	10.08		57528	15.98	0.54	38.88
57600	16	0.14	10.08		57600	16	0.54	38.88
57672	16.02	0.14	10.08		57672	16.02	0.54	38.88
57744	16.04	0.14	10.08		57744	16.04	0.54	38.88
57816	16.06	0.14	10.08		57816	16.06	0.54	38.88
57888	16.08	0.14	10.08		57888	16.08	0.53	38.16

57960	16.1	0.14	10.08		57960	16.1	0.53	38.16
58032	16.12	0.14	10.08		58032	16.12	0.53	38.16
58104	16.14	0.14	10.08		58104	16.14	0.53	38.16
58176	16.16	0.14	10.08		58176	16.16	0.52	37.44
58248	16.18	0.14	10.08		58248	16.18	0.52	37.44
58320	16.2	0.14	10.08		58320	16.2	0.52	37.44
58392	16.22	0.14	10.08		58392	16.22	0.52	37.44
58464	16.24	0.14	10.08		58464	16.24	0.52	37.44
58536	16.26	0.13	9.36		58536	16.26	0.51	36.72
58608	16.28	0.13	9.36		58608	16.28	0.51	36.72
58680	16.3	0.13	9.36		58680	16.3	0.51	36.72
58752	16.32	0.13	9.36		58752	16.32	0.51	36.72
58824	16.34	0.13	9.36		58824	16.34	0.5	36
58896	16.36	0.13	9.36		58896	16.36	0.5	36
58968	16.38	0.13	9.36		58968	16.38	0.5	36
59040	16.4	0.13	9.36		59040	16.4	0.5	36
59112	16.42	0.13	9.36		59112	16.42	0.5	36
59184	16.44	0.13	9.36		59184	16.44	0.49	35.28
59256	16.46	0.13	9.36		59256	16.46	0.49	35.28
59328	16.48	0.13	9.36		59328	16.48	0.49	35.28
59400	16.5	0.13	9.36		59400	16.5	0.49	35.28
59472	16.52	0.13	9.36		59472	16.52	0.48	34.56
59544	16.54	0.13	9.36		59544	16.54	0.48	34.56
59616	16.56	0.13	9.36		59616	16.56	0.48	34.56
59688	16.58	0.13	9.36		59688	16.58	0.48	34.56
59760	16.6	0.13	9.36		59760	16.6	0.48	34.56
59832	16.62	0.13	9.36		59832	16.62	0.47	33.84
59904	16.64	0.13	9.36		59904	16.64	0.47	33.84
59976	16.66	0.13	9.36		59976	16.66	0.47	33.84
60048	16.68	0.13	9.36		60048	16.68	0.47	33.84
60120	16.7	0.13	9.36		60120	16.7	0.46	33.12
60192	16.72	0.13	9.36		60192	16.72	0.46	33.12
60264	16.74	0.13	9.36		60264	16.74	0.46	33.12
60336	16.76	0.13	9.36		60336	16.76	0.46	33.12
60408	16.78	0.13	9.36		60408	16.78	0.46	33.12
60480	16.8	0.13	9.36		60480	16.8	0.45	32.4
60552	16.82	0.13	9.36		60552	16.82	0.45	32.4
60624	16.84	0.13	9.36		60624	16.84	0.45	32.4
60696	16.86	0.13	9.36		60696	16.86	0.45	32.4
60768	16.88	0.13	9.36		60768	16.88	0.44	31.68
60840	16.9	0.13	9.36		60840	16.9	0.44	31.68
60912	16.92	0.13	9.36		60912	16.92	0.44	31.68
60984	16.94	0.13	9.36		60984	16.94	0.44	31.68
61056	16.96	0.13	9.36		61056	16.96	0.43	30.96
61128	16.98	0.12	8.64		61128	16.98	0.43	30.96
61200	17	0.12	8.64		61200	17	0.43	30.96
61272	17.02	0.12	8.64		61272	17.02	0.43	30.96

61344	17.04	0.12	8.64		61344	17.04	0.43	30.96
61416	17.06	0.12	8.64		61416	17.06	0.42	30.24
61488	17.08	0.12	8.64		61488	17.08	0.42	30.24
61560	17.1	0.12	8.64		61560	17.1	0.42	30.24
61632	17.12	0.12	8.64		61632	17.12	0.42	30.24
61704	17.14	0.12	8.64		61704	17.14	0.41	29.52
61776	17.16	0.12	8.64		61776	17.16	0.41	29.52
61848	17.18	0.12	8.64		61848	17.18	0.41	29.52
61920	17.2	0.12	8.64		61920	17.2	0.41	29.52
61992	17.22	0.12	8.64		61992	17.22	0.41	29.52
62064	17.24	0.12	8.64		62064	17.24	0.4	28.8
62136	17.26	0.12	8.64		62136	17.26	0.4	28.8
62208	17.28	0.12	8.64		62208	17.28	0.4	28.8
62280	17.3	0.12	8.64		62280	17.3	0.4	28.8
62352	17.32	0.12	8.64		62352	17.32	0.39	28.08
62424	17.34	0.12	8.64		62424	17.34	0.39	28.08
62496	17.36	0.12	8.64		62496	17.36	0.39	28.08
62568	17.38	0.12	8.64		62568	17.38	0.39	28.08
62640	17.4	0.12	8.64		62640	17.4	0.39	28.08
62712	17.42	0.12	8.64		62712	17.42	0.38	27.36
62784	17.44	0.12	8.64		62784	17.44	0.38	27.36
62856	17.46	0.12	8.64		62856	17.46	0.38	27.36
62928	17.48	0.12	8.64		62928	17.48	0.38	27.36
63000	17.5	0.12	8.64		63000	17.5	0.37	26.64
63072	17.52	0.12	8.64		63072	17.52	0.37	26.64
63144	17.54	0.12	8.64		63144	17.54	0.37	26.64
63216	17.56	0.12	8.64		63216	17.56	0.37	26.64
63288	17.58	0.12	8.64		63288	17.58	0.36	25.92
63360	17.6	0.12	8.64		63360	17.6	0.36	25.92
63432	17.62	0.12	8.64		63432	17.62	0.36	25.92
63504	17.64	0.12	8.64		63504	17.64	0.36	25.92
63576	17.66	0.12	8.64		63576	17.66	0.36	25.92
63648	17.68	0.11	7.92		63648	17.68	0.35	25.2
63720	17.7	0.11	7.92		63720	17.7	0.35	25.2
63792	17.72	0.11	7.92		63792	17.72	0.35	25.2
63864	17.74	0.11	7.92		63864	17.74	0.35	25.2
63936	17.76	0.11	7.92		63936	17.76	0.34	24.48
64008	17.78	0.11	7.92		64008	17.78	0.34	24.48
64080	17.8	0.11	7.92		64080	17.8	0.34	24.48
64152	17.82	0.11	7.92		64152	17.82	0.34	24.48
64224	17.84	0.11	7.92		64224	17.84	0.33	23.76
64296	17.86	0.11	7.92		64296	17.86	0.33	23.76
64368	17.88	0.11	7.92		64368	17.88	0.33	23.76
64440	17.9	0.11	7.92		64440	17.9	0.33	23.76
64512	17.92	0.11	7.92		64512	17.92	0.32	23.04
64584	17.94	0.11	7.92		64584	17.94	0.32	23.04
64656	17.96	0.11	7.92		64656	17.96	0.32	23.04

64728	17.98	0.11	7.92		64728	17.98	0.32	23.04
64800	18	0.11	7.92		64800	18	0.32	23.04
64872	18.02	0.11	7.92		64872	18.02	0.31	22.32
64944	18.04	0.11	7.92		64944	18.04	0.31	22.32
65016	18.06	0.11	7.92		65016	18.06	0.31	22.32
65088	18.08	0.11	7.92		65088	18.08	0.31	22.32
65160	18.1	0.11	7.92		65160	18.1	0.3	21.6
65232	18.12	0.11	7.92		65232	18.12	0.3	21.6
65304	18.14	0.11	7.92		65304	18.14	0.3	21.6
65376	18.16	0.11	7.92		65376	18.16	0.3	21.6
65448	18.18	0.11	7.92		65448	18.18	0.29	20.88
65520	18.2	0.11	7.92		65520	18.2	0.29	20.88
65592	18.22	0.11	7.92		65592	18.22	0.29	20.88
65664	18.24	0.11	7.92		65664	18.24	0.29	20.88
65736	18.26	0.11	7.92		65736	18.26	0.28	20.16
65808	18.28	0.11	7.92		65808	18.28	0.28	20.16
65880	18.3	0.11	7.92		65880	18.3	0.28	20.16
65952	18.32	0.11	7.92		65952	18.32	0.28	20.16
66024	18.34	0.11	7.92		66024	18.34	0.27	19.44
66096	18.36	0.1	7.2		66096	18.36	0.27	19.44
66168	18.38	0.1	7.2		66168	18.38	0.27	19.44
66240	18.4	0.1	7.2		66240	18.4	0.26	18.72
66312	18.42	0.1	7.2		66312	18.42	0.26	18.72
66384	18.44	0.1	7.2		66384	18.44	0.26	18.72
66456	18.46	0.1	7.2		66456	18.46	0.26	18.72
66528	18.48	0.1	7.2		66528	18.48	0.25	18
66600	18.5	0.1	7.2		66600	18.5	0.25	18
66672	18.52	0.1	7.2		66672	18.52	0.25	18
66744	18.54	0.1	7.2		66744	18.54	0.25	18
66816	18.56	0.1	7.2		66816	18.56	0.25	18
66888	18.58	0.1	7.2		66888	18.58	0.24	17.28
66960	18.6	0.1	7.2		66960	18.6	0.24	17.28
67032	18.62	0.1	7.2		67032	18.62	0.24	17.28
67104	18.64	0.1	7.2		67104	18.64	0.24	17.28
67176	18.66	0.1	7.2		67176	18.66	0.23	16.56
67248	18.68	0.1	7.2		67248	18.68	0.23	16.56
67320	18.7	0.1	7.2		67320	18.7	0.23	16.56
67392	18.72	0.1	7.2		67392	18.72	0.23	16.56
67464	18.74	0.1	7.2		67464	18.74	0.23	16.56
67536	18.76	0.1	7.2		67536	18.76	0.22	15.84
67608	18.78	0.1	7.2		67608	18.78	0.22	15.84
67680	18.8	0.1	7.2		67680	18.8	0.22	15.84
67752	18.82	0.1	7.2		67752	18.82	0.22	15.84
67824	18.84	0.1	7.2		67824	18.84	0.22	15.84
67896	18.86	0.1	7.2		67896	18.86	0.21	15.12
67968	18.88	0.1	7.2		67968	18.88	0.21	15.12
68040	18.9	0.1	7.2		68040	18.9	0.21	15.12

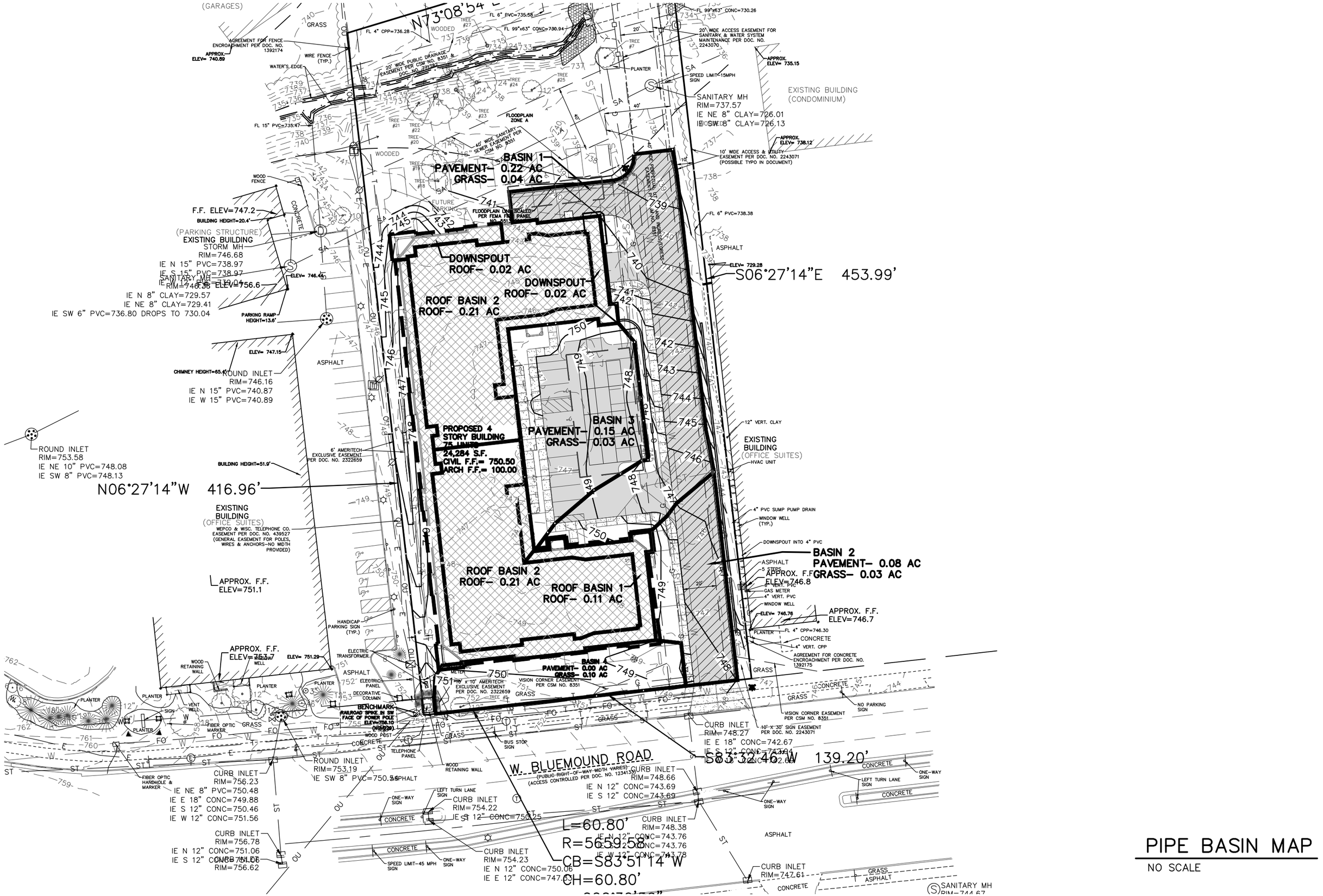
68112	18.92	0.1	7.2		68112	18.92	0.21	15.12
68184	18.94	0.1	7.2		68184	18.94	0.21	15.12
68256	18.96	0.1	7.2		68256	18.96	0.21	15.12
68328	18.98	0.1	7.2		68328	18.98	0.21	15.12
68400	19	0.1	7.2		68400	19	0.2	14.4
68472	19.02	0.1	7.2		68472	19.02	0.2	14.4
68544	19.04	0.1	7.2		68544	19.04	0.2	14.4
68616	19.06	0.1	7.2		68616	19.06	0.2	14.4
68688	19.08	0.09	6.48		68688	19.08	0.2	14.4
68760	19.1	0.09	6.48		68760	19.1	0.2	14.4
68832	19.12	0.09	6.48		68832	19.12	0.2	14.4
68904	19.14	0.09	6.48		68904	19.14	0.19	13.68
68976	19.16	0.09	6.48		68976	19.16	0.19	13.68
69048	19.18	0.09	6.48		69048	19.18	0.19	13.68
69120	19.2	0.09	6.48		69120	19.2	0.19	13.68
69192	19.22	0.09	6.48		69192	19.22	0.19	13.68
69264	19.24	0.09	6.48		69264	19.24	0.19	13.68
69336	19.26	0.09	6.48		69336	19.26	0.19	13.68
69408	19.28	0.09	6.48		69408	19.28	0.18	12.96
69480	19.3	0.09	6.48		69480	19.3	0.18	12.96
69552	19.32	0.09	6.48		69552	19.32	0.18	12.96
69624	19.34	0.09	6.48		69624	19.34	0.18	12.96
69696	19.36	0.09	6.48		69696	19.36	0.18	12.96
69768	19.38	0.09	6.48		69768	19.38	0.18	12.96
69840	19.4	0.09	6.48		69840	19.4	0.18	12.96
69912	19.42	0.09	6.48		69912	19.42	0.18	12.96
69984	19.44	0.09	6.48		69984	19.44	0.18	12.96
70056	19.46	0.09	6.48		70056	19.46	0.18	12.96
70128	19.48	0.09	6.48		70128	19.48	0.17	12.24
70200	19.5	0.09	6.48		70200	19.5	0.17	12.24
70272	19.52	0.09	6.48		70272	19.52	0.17	12.24
70344	19.54	0.09	6.48		70344	19.54	0.17	12.24
70416	19.56	0.09	6.48		70416	19.56	0.17	12.24
70488	19.58	0.09	6.48		70488	19.58	0.17	12.24
70560	19.6	0.09	6.48		70560	19.6	0.17	12.24
70632	19.62	0.09	6.48		70632	19.62	0.17	12.24
70704	19.64	0.09	6.48		70704	19.64	0.17	12.24
70776	19.66	0.09	6.48		70776	19.66	0.17	12.24
70848	19.68	0.09	6.48		70848	19.68	0.17	12.24
70920	19.7	0.09	6.48		70920	19.7	0.17	12.24
70992	19.72	0.09	6.48		70992	19.72	0.16	11.52
71064	19.74	0.09	6.48		71064	19.74	0.16	11.52
71136	19.76	0.08	5.76		71136	19.76	0.16	11.52
71208	19.78	0.08	5.76		71208	19.78	0.16	11.52
71280	19.8	0.08	5.76		71280	19.8	0.16	11.52
71352	19.82	0.08	5.76		71352	19.82	0.16	11.52
71424	19.84	0.08	5.76		71424	19.84	0.16	11.52

71496	19.86	0.08	5.76		71496	19.86	0.16	11.52
71568	19.88	0.08	5.76		71568	19.88	0.16	11.52
71640	19.9	0.08	5.76		71640	19.9	0.16	11.52
71712	19.92	0.08	5.76		71712	19.92	0.16	11.52
71784	19.94	0.08	5.76		71784	19.94	0.16	11.52
71856	19.96	0.08	5.76		71856	19.96	0.16	11.52
71928	19.98	0.08	5.76		71928	19.98	0.15	10.8
72000	20	0.08	5.76		72000	20	0.15	10.8
72072	20.02	0.08	5.76		72072	20.02	0.15	10.8
72144	20.04	0.08	5.76		72144	20.04	0.15	10.8
72216	20.06	0.08	5.76		72216	20.06	0.15	10.8
72288	20.08	0.08	5.76		72288	20.08	0.15	10.8
72360	20.1	0.08	5.76		72360	20.1	0.15	10.8
72432	20.12	0.08	5.76		72432	20.12	0.15	10.8
72504	20.14	0.08	5.76		72504	20.14	0.15	10.8
72576	20.16	0.08	5.76		72576	20.16	0.15	10.8
72648	20.18	0.08	5.76		72648	20.18	0.15	10.8
72720	20.2	0.08	5.76		72720	20.2	0.15	10.8
72792	20.22	0.08	5.76		72792	20.22	0.15	10.8
72864	20.24	0.08	5.76		72864	20.24	0.15	10.8
72936	20.26	0.08	5.76		72936	20.26	0.15	10.8
73008	20.28	0.08	5.76		73008	20.28	0.15	10.8
73080	20.3	0.08	5.76		73080	20.3	0.15	10.8
73152	20.32	0.08	5.76		73152	20.32	0.15	10.8
73224	20.34	0.08	5.76		73224	20.34	0.15	10.8
73296	20.36	0.08	5.76		73296	20.36	0.15	10.8
73368	20.38	0.08	5.76		73368	20.38	0.15	10.8
73440	20.4	0.08	5.76		73440	20.4	0.15	10.8
73512	20.42	0.08	5.76		73512	20.42	0.15	10.8
73584	20.44	0.08	5.76		73584	20.44	0.15	10.8
73656	20.46	0.07	5.04		73656	20.46	0.15	10.8
73728	20.48	0.07	5.04		73728	20.48	0.15	10.8
73800	20.5	0.07	5.04		73800	20.5	0.14	10.08
73872	20.52	0.07	5.04		73872	20.52	0.14	10.08
73944	20.54	0.07	5.04		73944	20.54	0.14	10.08
74016	20.56	0.07	5.04		74016	20.56	0.14	10.08
74088	20.58	0.07	5.04		74088	20.58	0.14	10.08
74160	20.6	0.07	5.04		74160	20.6	0.14	10.08
74232	20.62	0.07	5.04		74232	20.62	0.14	10.08
74304	20.64	0.07	5.04		74304	20.64	0.14	10.08
74376	20.66	0.07	5.04		74376	20.66	0.14	10.08
74448	20.68	0.07	5.04		74448	20.68	0.14	10.08
74520	20.7	0.07	5.04		74520	20.7	0.14	10.08
74592	20.72	0.07	5.04		74592	20.72	0.14	10.08
74664	20.74	0.07	5.04		74664	20.74	0.14	10.08
74736	20.76	0.07	5.04		74736	20.76	0.14	10.08
74808	20.78	0.07	5.04		74808	20.78	0.14	10.08

74880	20.8	0.07	5.04		74880	20.8	0.14	10.08
74952	20.82	0.07	5.04		74952	20.82	0.14	10.08
75024	20.84	0.07	5.04		75024	20.84	0.14	10.08
75096	20.86	0.07	5.04		75096	20.86	0.14	10.08
75168	20.88	0.07	5.04		75168	20.88	0.14	10.08
75240	20.9	0.07	5.04		75240	20.9	0.14	10.08
75312	20.92	0.07	5.04		75312	20.92	0.14	10.08
75384	20.94	0.07	5.04		75384	20.94	0.14	10.08
75456	20.96	0.07	5.04		75456	20.96	0.14	10.08
75528	20.98	0.07	5.04		75528	20.98	0.14	10.08
75600	21	0.07	5.04		75600	21	0.14	10.08

	Predevelopment (cf)	Post Development (cf)
Total Volume	18417.6	18231.84

Appendix E:
Storm Sewer Basin Map



PIPE BASIN MAP

NO SCALE

Appendix F:
Pipe Sizing TR-55 Calculations

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	-------	-------	-------	-------	-------	-------	2.003	Basin 1
2	SCS Runoff	------	-------	-------	-------	-------	-------	-------	-------	0.831	Basin 2
3	SCS Runoff	------	-------	-------	-------	-------	-------	-------	-------	1.387	Basin 3
4	SCS Runoff	------	-------	-------	-------	-------	-------	-------	-------	0.601	Basin 4
6	SCS Runoff	------	-------	-------	-------	-------	-------	-------	-------	0.157	Downspout
7	SCS Runoff	------	-------	-------	-------	-------	-------	-------	-------	0.864	Roof Basin 1
8	SCS Runoff	------	-------	-------	-------	-------	-------	-------	-------	1.649	Roof Basin 2

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	2.003	3	726	4,946	------	------	------	Basin 1
2	SCS Runoff	0.831	3	726	2,007	------	------	------	Basin 2
3	SCS Runoff	1.387	3	726	3,424	------	------	------	Basin 3
4	SCS Runoff	0.601	3	729	1,342	------	------	------	Basin 4
6	SCS Runoff	0.157	3	726	404	------	------	------	Downspout
7	SCS Runoff	0.864	3	726	2,224	------	------	------	Roof Basin 1
8	SCS Runoff	1.649	3	726	4,246	------	------	------	Roof Basin 2

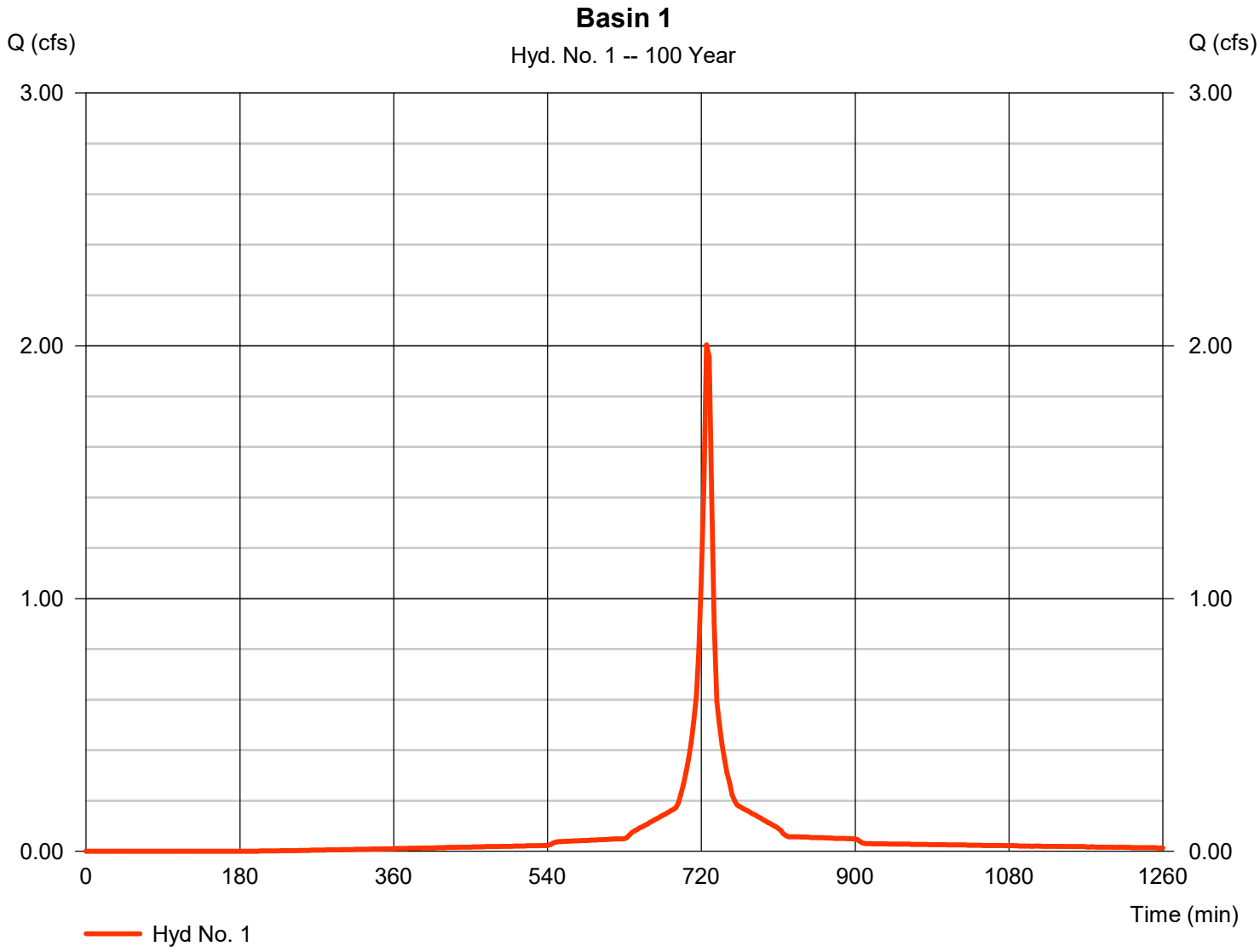
Hydrograph Report

Hyd. No. 1

Basin 1

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.003 cfs
Storm frequency	=	100 yrs	Time to peak	=	726 min
Time interval	=	3 min	Hyd. volume	=	4,946 cuft
Drainage area	=	0.260 ac	Curve number	=	95*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	6.18 in	Distribution	=	Custom
Storm duration	=	F:\Job Files\1608610 Faith Baptist Church Addition\1608614 Civil\storm water rep	Shape factor	=	484

* Composite (Area/CN) = [(0.220 x 98) + (0.040 x 80)] / 0.260



Hydrograph Report

Hyd. No. 2

Basin 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.831 cfs
Storm frequency	=	100 yrs	Time to peak	=	726 min
Time interval	=	3 min	Hyd. volume	=	2,007 cuft
Drainage area	=	0.110 ac	Curve number	=	93*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	6.18 in	Distribution	=	Custom
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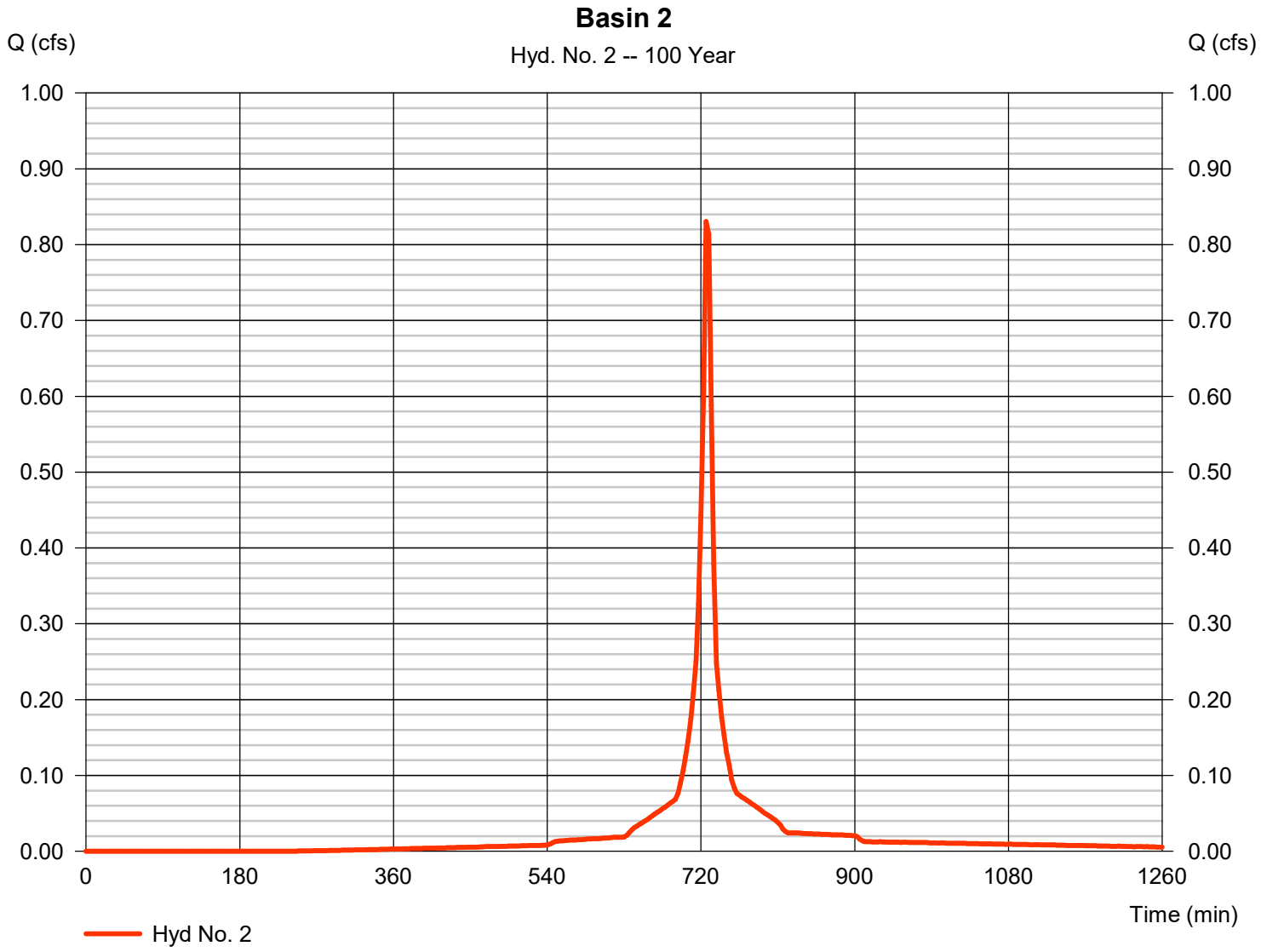
* Composite (Area/CN) = [(0.080 x 98) + (0.030 x 80)] / 0.110



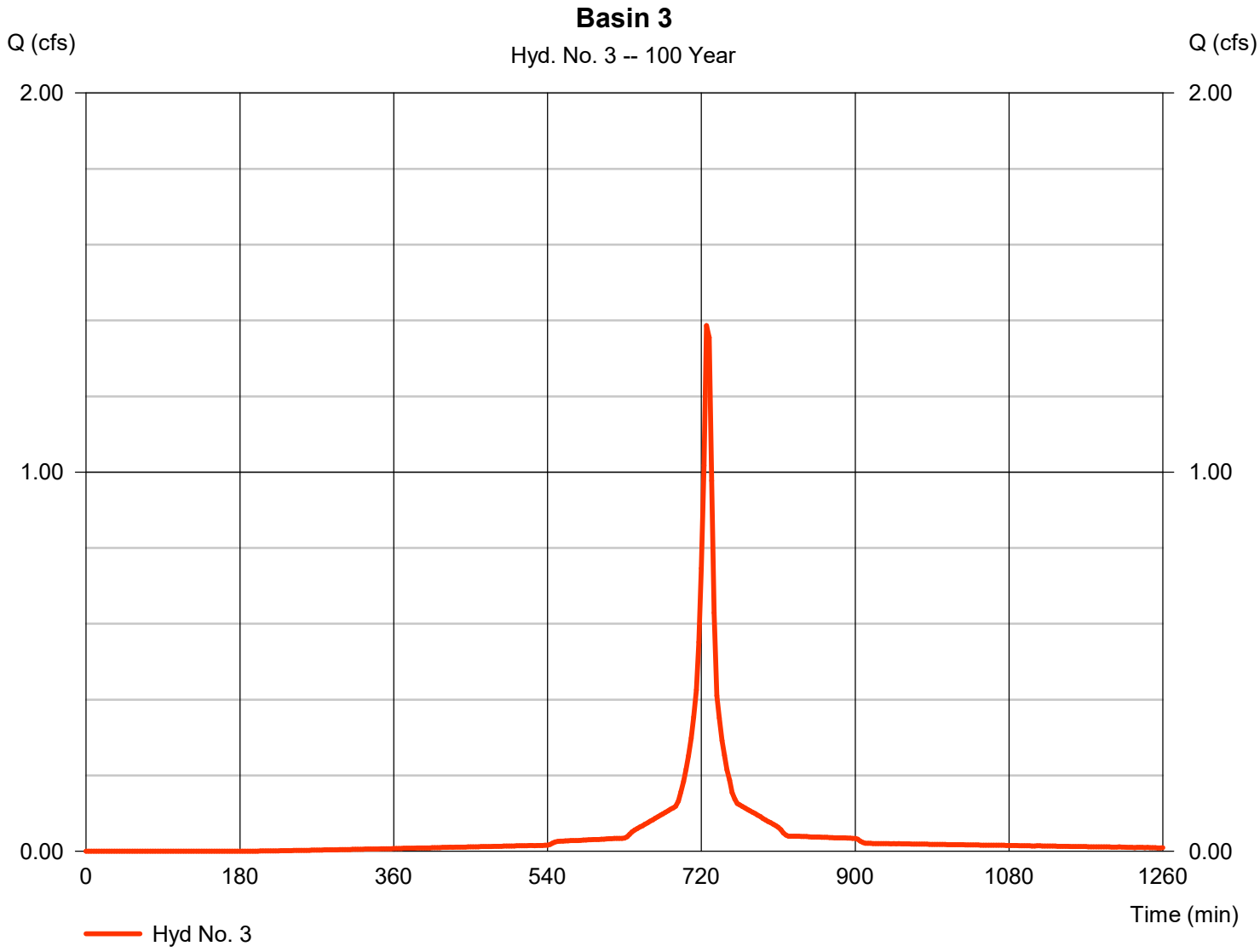
Hydrograph Report

Hyd. No. 3

Basin 3

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.387 cfs
Storm frequency	=	100 yrs	Time to peak	=	726 min
Time interval	=	3 min	Hyd. volume	=	3,424 cuft
Drainage area	=	0.180 ac	Curve number	=	95*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	6.18 in	Distribution	=	Custom
Storm duration	=	F:\Job Files\1608610 Faith Baptist Church Addition\1608634 Civil\storm water rep	Shape factor	=	484

* Composite (Area/CN) = [(0.150 x 98) + (0.030 x 80)] / 0.180



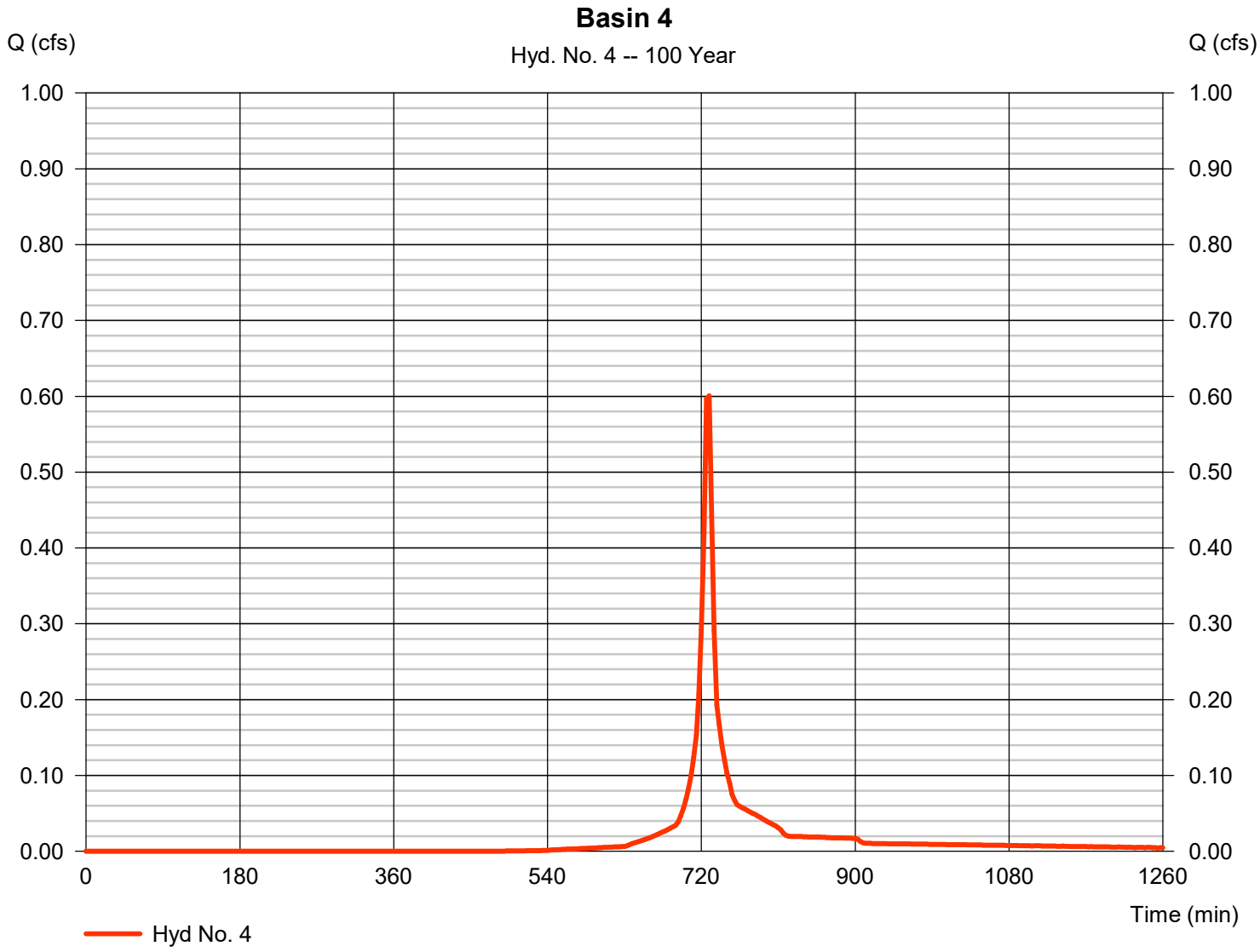
Hydrograph Report

Hyd. No. 4

Basin 4

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.601 cfs
Storm frequency	=	100 yrs	Time to peak	=	729 min
Time interval	=	3 min	Hyd. volume	=	1,342 cuft
Drainage area	=	0.100 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	6.18 in	Distribution	=	Custom
Storm duration	=	F:\Job Files\1608610 Faith Baptist Church Addition\1608614 Civil\storm water rep			

* Composite (Area/CN) = + (0.100 x 80)] / 0.100



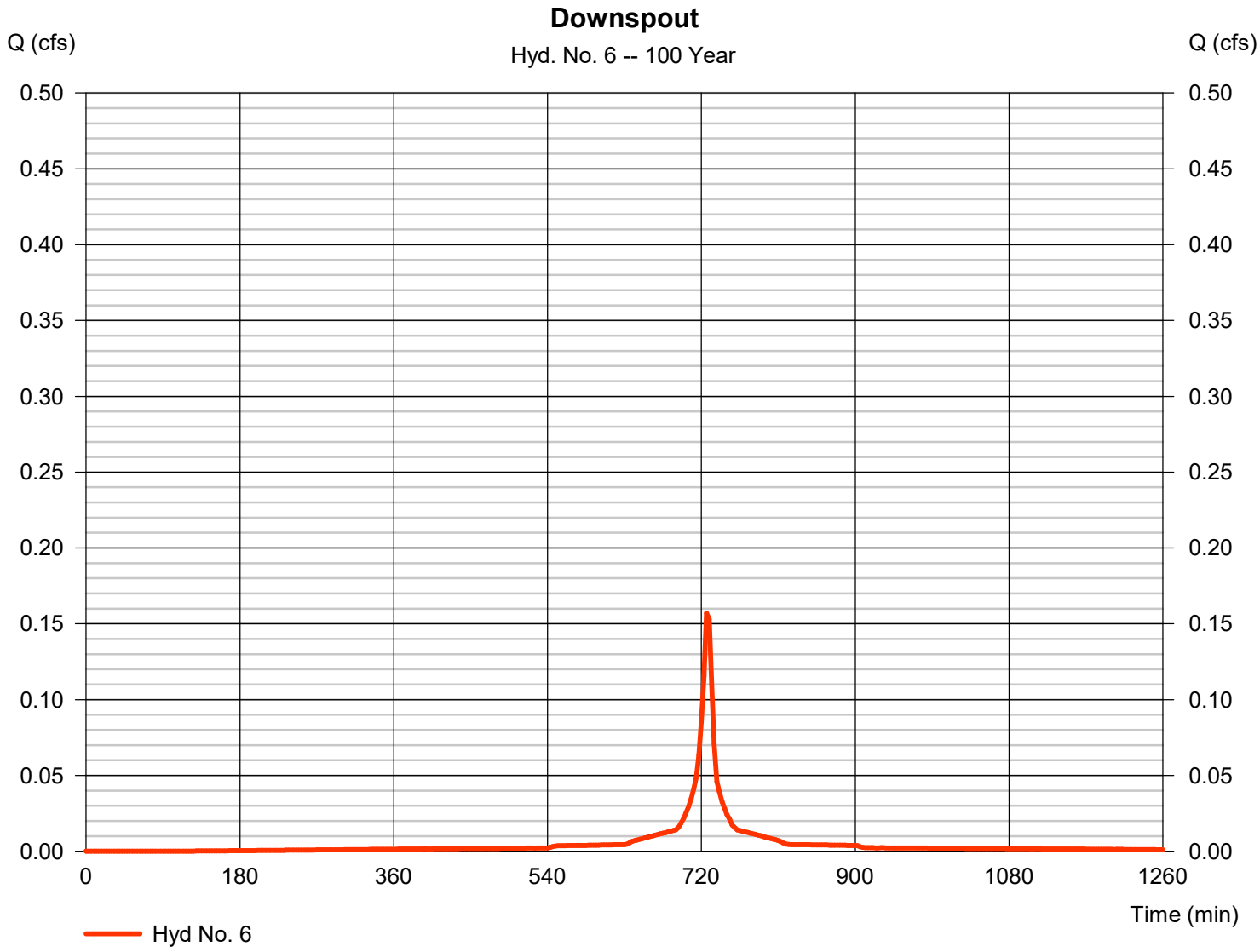
Hydrograph Report

Hyd. No. 6

Downspout

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.157 cfs
Storm frequency	=	100 yrs	Time to peak	=	726 min
Time interval	=	3 min	Hyd. volume	=	404 cuft
Drainage area	=	0.020 ac	Curve number	=	98*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	6.18 in	Distribution	=	Custom
Storm duration	=	F:\Job Files\1608610 Faith Baptist Church Addition\1608614 Civil\storm water rep			

* Composite (Area/CN) = [(0.160 x 98) + (0.140 x 80)] / 0.020



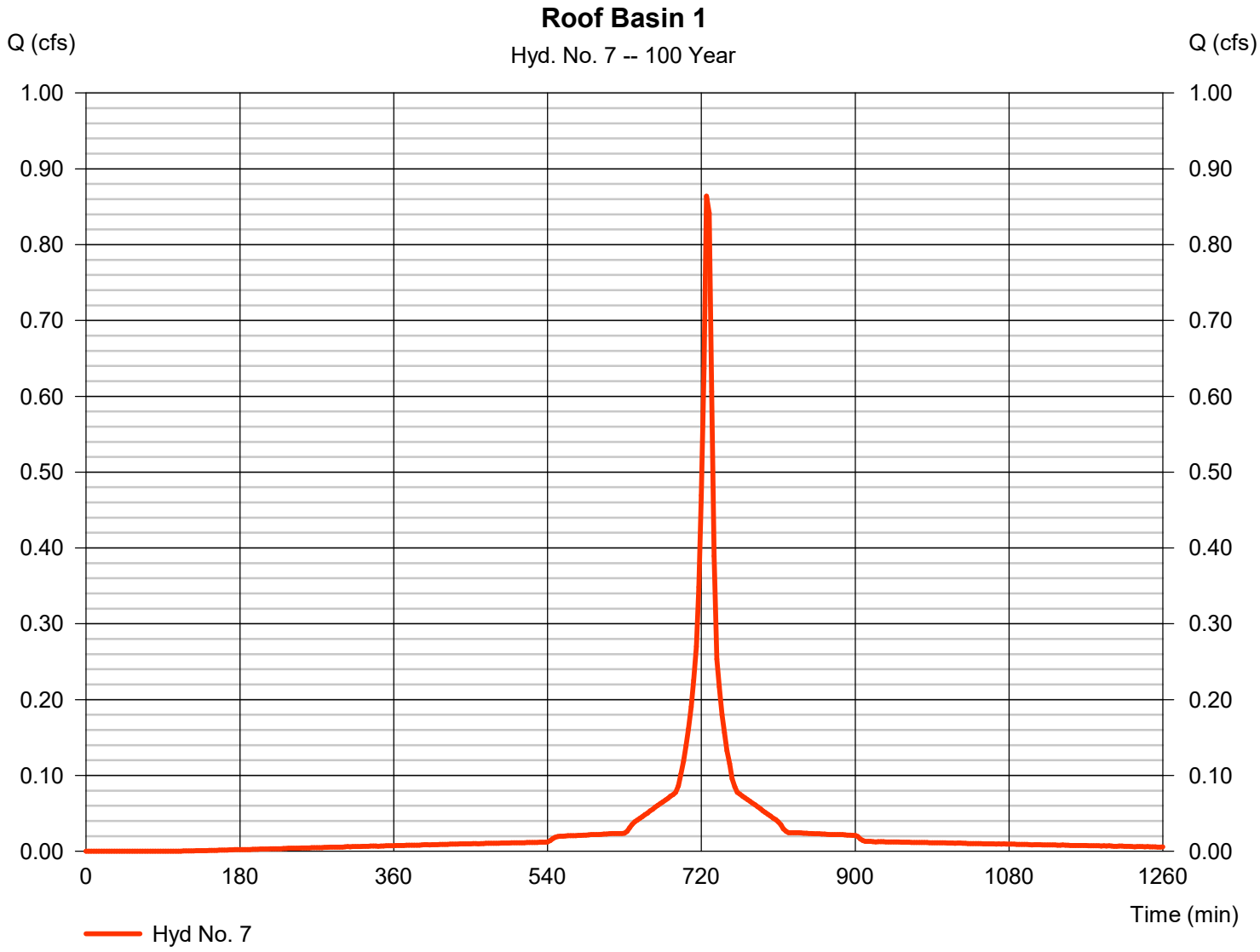
Hydrograph Report

Hyd. No. 7

Roof Basin 1

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.864 cfs
Storm frequency	=	100 yrs	Time to peak	=	726 min
Time interval	=	3 min	Hyd. volume	=	2,224 cuft
Drainage area	=	0.110 ac	Curve number	=	98*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	6.18 in	Distribution	=	Custom
Storm duration	=	F:\Job Files\1608610 Faith Baptist Church Addition\1608614 Civil\storm water rep			

* Composite (Area/CN) = [(0.160 x 98) + (0.140 x 80)] / 0.110

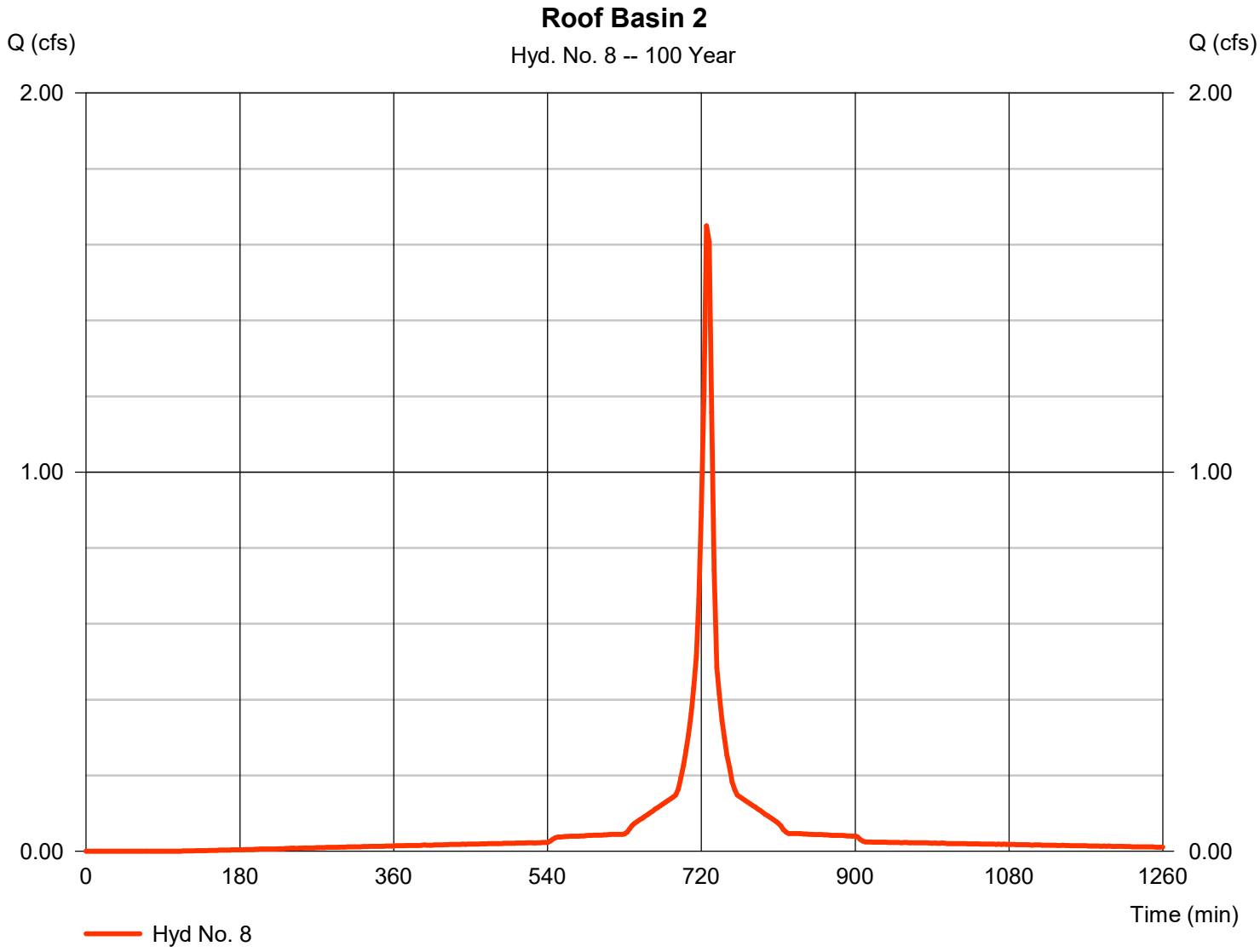


Hydrograph Report

Hyd. No. 8

Roof Basin 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.649 cfs
Storm frequency	=	100 yrs	Time to peak	=	726 min
Time interval	=	3 min	Hyd. volume	=	4,246 cuft
Drainage area	=	0.210 ac	Curve number	=	98
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	6.18 in	Distribution	=	Custom
Storm duration	=	F:\Job Files\1608610 Faith Baptist Church Addition\1608614 Civil\storm water rep	Shape factor	=	484



Appendix G:
Pipe Sizing Spreadsheet

Excel Engineering Project No. 1818280 Project Name Elm Grove Heights

Pipe Data				Pipe Capacity (100-yr)				
Pipe No.	Diameter (FT)	Slope (FT/FT)	Manning's n	Basin No.	Total Flow (cfs)	Total Flow (gpm)	Full Flow Capacity (cfs)	Full Flow Capacity (gpm)
1	1	0.0050	0.012	1	2.00	898	2.74	1228
2	0.83	0.0100	0.012	2	0.83	373	2.35	1057
3	0.83	0.0100	0.012	3	1.39	624	2.35	1057
4	0.66	0.0075	0.012	Roof 1	0.86	386	1.11	497
5	0.83	0.0100	0.012	Roof 1, 4	1.46	655	2.35	1057
6	1	0.0100	0.012	Roof 1, Roof 2, 4, DS	3.27	1468	3.87	1737
7	0.66	0.0075	0.012	Downspout	0.16	72	1.11	497
DS	0.33	0.0100	0.012	Downspout	0.16	72	0.20	90
Roof	0.83	0.0100	0.012	Roof 2	1.65	741	2.35	1057

* Pipes 8-12 are sized based on HydroCAD calculations

Full Flow Capacity based off Manning's Equation $Q = \frac{1.49}{n} R^{2/3} S^{1/2} a$

Where:
Q = Full Flow Capacity of Pipe (cfs)
n = manning's roughness coefficient
R = hydraulic radius (ft) (D/4)
s = hydraulic gradient, slope (ft/ft)
a = flow area (sq. ft.)

Typical Manning's n

HDPE	0.012
PVC	0.012
Concrete	0.013
CMP	0.024

*Total Flow calculated via TR-55 hydrologic calculations. Reference Storm Pipe Basin Map & TR-55 Calculations

Appendix H:
Geotechnical Report and NRCS Websoil Survey Map

Map Scale: 1:955 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 10 20 40 60

Feet
0 45 90 180 270

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Milwaukee and Waukesha Counties, Wisconsin
Survey Area Data: Version 13, Oct 6, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 7, 2014—Sep 22, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Lu	Loamy land	D	2.7	84.4%
Sm	Sebewa silt loam, 0 to 2 percent slopes	B/D	0.5	15.6%
Totals for Area of Interest			**3.2**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

AMERICAN ENGINEERING TESTING, INC.

CONSULTANTS
- ENVIRONMENTAL
- GEOTECHNICAL
- MATERIALS
- FORENSICS

REPORT OF GEOTECHNICAL EXPLORATION

Elm Grove Heights Senior Apartments
13040 W. Bluemound Road
Elm Grove, Wisconsin

AET Project No. 12-03211

Date:

May 25, 2018

Prepared for:

Horizon Development Group, Inc.
5201 East Terrace Drive, Suite 300
Madison, Wisconsin 53718

www.amengtest.com

AMERICAN ENGINEERING TESTING, INC.

May 25, 2018

Mr. Will Rutherford
Horizon Development Group, Inc.
5201 East Terrace Drive, Suite 300
Madison, Wisconsin 53718

RE: Report of Geotechnical Exploration
Elm Grove Heights Senior Apartments
13040 W. Bluemound Road
Elm Grove, Wisconsin
AET Project No. 12-03211

Dear Mr. Rutherford:

We are pleased to present the results of our subsurface exploration program for your Elm Grove Heights Senior Apartments project. These services were performed according to our proposal to you dated April 24, 2018.

We are submitting an electronic (PDF) version of this geotechnical report to you. Unless you request otherwise, we will not submit any hard copies of the report.

We appreciate the opportunity to work with you on this phase of the project. Please contact us if you have questions about this report or require further assistance.

Sincerely,

American Engineering Testing, Inc.

Benjamin B. Mattson, P.E.
Senior Geotechnical Engineer

Signature Page

Prepared for:

Mr. Will Rutherford
Horizon Development Group, Inc.
5201 East Terrace Drive, Suite 300
Madison, Wisconsin 53718

Prepared by:

American Engineering Testing, Inc.
4203 Schofield Avenue, Suite 1
Schofield, Wisconsin 54476
(715) 359-3534/www.amengtest.com

Report Authored By:

Benjamin Mattson, P.E.
Senior Geotechnical Engineer

Review Conducted By:

Andrew J. Walters, P.E.
Manager / Engineer II

TABLE OF CONTENTS

1.0 INTRODUCTION

Horizon Development Group, Inc. (Horizon) is providing planning and construction services for the proposed Elm Grove Heights Senior Apartments project in Elm Grove, Wisconsin. To assist planning and design, Horizon authorized American Engineering Testing, Inc. (AET) to conduct a subsurface exploration program at the site and perform a geotechnical engineering review for the project. This report presents the results of the above services and provides our engineering recommendations based on this data.

2.0 SCOPE OF SERVICE

AET's services were performed according to our proposal to Horizon dated April 24, 2018. The authorized scope consists of:

- Nine standard penetration test borings to depths of 6 to 25 feet each.
- Visual/manual classification and limited laboratory testing of the recovered soil samples.
- Geotechnical engineering review based on the gained data and preparation of this report.

These services are intended for geotechnical purposes. The scope is not intended to explore for the presence or extent of environmental contamination.

3.0 PROJECT INFORMATION

The project will include a 3- to 4-story apartment building covering a footprint of about 24,000 square feet. The building, which will include a single basement level for underground parking, will be wood-framed above-grade. The main floor elevation is preliminary planned at 750.5 feet and the parking level will probably be 10 feet lower. The project will include an exterior paved parking lot on the east side of the building and a stormwater management area on the north end of the site.

The above stated information represents our understanding of the proposed construction and is an integral part of our engineering review. It is important we be contacted if there are changes from that described so we can evaluate if modifications to our recommendations are appropriate.

4.0 SUBSURFACE EXPLORATION AND LABORATORY TESTING

Our subsurface exploration program for this project consisted of drilling nine borings with standard penetration testing (SPT) and sampling on May 14 and 15, 2018. Horizon and AET mutually agreed on the number, depths, and locations of the borings. The approximate boring locations are

shown on Figure 1 in Appendix A. We measured the surface elevations at the boring locations, using as our benchmark a manhole rim just northeast of the project site.

Prior to drilling, we contacted Wisconsin Diggers Hotline to locate public underground utilities at the site. We also subcontracted a private utility locator to mark private utilities near our boring locations. We drilled the borings using 3¼-inch inside-diameter hollow-stem augers. Refer to Appendix A for details on the drilling and sampling methods, the classification methods, and the water level measurement details.

The boring logs are found in Appendix A and contain information concerning soil layering, geologic description, moisture condition, and USCS classifications. Relative density or consistency is also noted for the natural soils, which are based on the standard penetration resistance (N-value).

We performed 40 moisture content tests and 37 unconfined compressive strength tests (qp, pocket penetrometer) on the recovered soil samples. The test results are shown on the boring logs, adjacent to the samples on which the tests were performed.

Wisconsin Department of Safety and Professional Services (DSPS) form SBD-10793 "Soil Evaluation – Storm" is included in Appendix A. This form includes USDA soil classifications, infiltration rates established by State of Wisconsin code (based on soil texture), and other characteristics of the soils we encountered in boring B-9.

5.0 SITE CONDITIONS

5.1 Surface Observations

The proposed project site is currently undeveloped, although we were told the site was previously occupied by a motel, which was razed prior to 2000. The northern one-third of the site is wooded, while the southern two-thirds has only scattered trees. The site generally slopes downward from south to north, with an elevation relief of about 7 feet across the building footprint. There is a sanitary sewer easement in the northern portion of the site; the sewer invert is about 11 to 17 feet deep, according to a topographic survey drawing prepared by others.

5.2 Subsurface Soils

Below the surficial topsoil (and pavement in boring B-2), we encountered fill overlying till. The fill was various mixtures of clay, silt, sand, and gravel, with organics at and near the ground surface. We found some pieces of wood from about 4.5 to 9.5 feet deep in boring B-2. We encountered auger refusal on an unknown obstruction at a depth of about 6.5 feet in B-4. We encountered some asphalt pieces at a depth of about 5 feet in boring B-6.

There were two distinct layers of till. The upper till was mostly lean clay, silt, and silty clay. The lower till layer was mostly gravel with varying sand, clay, and silt content; cobbles and boulders can also be present and common in this formation.

5.3 Groundwater

We measured groundwater levels at the depths and elevations shown in Table 1. It is likely that at least some of the water levels had reached static equilibrium prior to borehole abandonment. Groundwater levels will fluctuate due to varying seasonal and annual rainfall and snow melt amounts and other factors.

Table 1: Groundwater Measurements

Boring	Surface Elevation (feet)	Groundwater Depth (feet)	Groundwater Elevation (feet)	Comments
B-1	749.0	12.6	736.4	Water measured in piezometer at 736.2 feet on 5/25/2018
B-2	748.7	15.7	733.0	
B-3	747.7	11.7	736.0	
B-4	746.9	13.0	733.9	
B-5	746.5	9.8	736.7	Water measured in piezometer at 733.3 feet on 5/25/2018
B-6	745.1	12.6	732.5	
B-7	740.8	8.3	732.5	
B-8	746.8	N/A	N/A	Water not observed
B-9	741.0	N/A	N/A	Water not observed

6.0 BUILDING RECOMMENDATIONS

6.1 Approach Discussion

Based on the subsurface conditions found in our borings and on our understanding of the project, it is our opinion the building can be supported on a conventional footing foundation after proper

site preparation has taken place. We recommend that the below-grade drainage system consist of perimeter drains and underslab drains. Details of our recommendations are presented below.

6.2 Site Preparation

6.2.1 Excavation

To prepare the building area for foundation and floor slab support, we recommend removal of all remaining existing building components (including foundations and floor slabs, if any are found), pavement, organic soils, existing fill, and other unsuitable soils that are encountered. Table 2 lists our estimated subcut depths; we anticipate that most of this unsuitable material will be removed as excavation to the planned depths to accommodate the basement level. An experienced soils technician or geotechnical engineer should perform observations during construction to determine actual required subcut depths, which could be more or less than anticipated.

Table 2: Estimated Subcut Depths/Elevations

Boring	Surface Elevation (feet)	Estimated Subcut Depth (feet)	Estimated Subcut Elevation (feet)
B-1	749.0	9.5	739.5
B-2	748.7	9.5	739.2
B-3	747.7	7	740.5
B-4	746.9	7	739.9
B-5	746.5	4.5	742.0
B-6	745.1	7	738.1
B-7	740.8	2	738.8

If subcutting extends below the proposed foundation grade, the excavation bottom and resultant engineered fill system must be oversized laterally beyond the planned outside edges of the foundation to properly support the loads exerted by that foundation. This engineered fill lateral extension should at least be equal to the vertical depth of fill needed to attain foundation grade at that location (i.e., 1:1 lateral oversize).

The soils near the base of the excavation are highly susceptible to disturbance, especially when wet. We recommend that excavation of the final 2 feet of soil be performed using an excavator bucket with a smooth blade (i.e. with no teeth); the purpose of this is to reduce disturbance of the subgrade. Additionally, we strongly recommend the project team consider placing a working mat, such as a layer of breaker run, at the base of the excavation, to reduce disturbance of the subgrade.

Temporary construction dewatering will probably be necessary, depending on water levels (static and perched) during construction and excavation depths. The contractor is responsible for selecting an appropriate dewatering system.

6.2.2 Fill Placement and Compaction

For ease and placement of compaction, we recommend that fill supporting the building foundation and/or floor slab be granular soil having a maximum of 12% by weight passing the No. 200 sieve, and a maximum particle size of 2 inches. However, see our discussion in Section 6.4 regarding underslab drainage system recommendations. The existing soils at the site (within the expected excavation depths) would probably not be suitable for re-use except in green spaces.

Fill placed to attain grade for foundation and/or slab support should be compacted in thin lifts, such that the entire lift achieves a minimum compaction level of 95% of its maximum modified Proctor dry density (ASTM D1557). For granular soils, we anticipate a lift thickness on the order of 6 to 8 inches may be appropriate, although this should be reviewed in the field at the time of construction.

6.3 Foundation Design

The building can be supported on a conventional shallow foundation system founded on competent naturally-occurring soils, or on fill placed and compacted over a suitable subgrade, provided the site has been prepared in accordance with the above recommendations. We recommend that perimeter foundations for heated building spaces bear a minimum of 4 feet below exterior grade for protection from frost penetration. Interior footings in heated areas should bear at least 18 inches below the finished floor elevation to provide confinement to the bearing stratum. Footings in unheated areas should be extended to a minimum of 4.5 feet below surrounding grade. We recommend that column footings and continuous wall footings for this project have minimum widths of 3 feet and 18 inches, respectively.

Based on the subsurface conditions we encountered and provided our recommendations are followed, it is our opinion the foundation for the building can be designed based on a net maximum allowable soil bearing pressure of 3,000 psf. It is our judgment this design pressure will have a factor of safety of at least 3 against the ultimate bearing capacity.

With this design we estimate maximum total settlement of the building of up to 1 inch, and differential settlements of half this amount over a 30 foot distance, if the bearing soils are not soft, wet, disturbed, or frozen at the time of construction.

6.4 Floor Slab Design

As mentioned in Section 6.1, we recommend an underslab drainage system be included below the basement floor. This drainage layer should include at least 12 inches of free-draining sand meeting the gradation requirements of Table 3. As an alternative to the sand, it would be allowable to use crushed stone with a size in the range of ¾ inch to 1 inch, with less than 3% by weight passing the No. 200 sieve.

Table 3: Underslab Sand Layer Gradation Requirements

Sieve Size	Percent Passing (%)
3/8 inch	100
No. 4	90 to 100
No. 10	45 to 90
No. 40	5 to 35
No. 200	0 to 3

If sand is used, it should be compacted to at least 95% of its maximum Modified Proctor dry density. If crushed rock is used, it should be firmly compacted. A geosynthetic filter fabric should be placed between the drainage layer and the underlying subgrade; the fabric should meet the requirements of WisDOT 645, Type DF. Drain pipes, wrapped in filter fabric, should be placed at the bottom of the drainage layer to collect and remove water.

Interior backfill in under slab utility trenches and in footing trenches should be held to the same requirements of Section 6.2.2. Provided our site preparation recommendations are followed, the structural engineer can use a modulus of subgrade reaction of 175 pounds per cubic inch to design the floor slab thickness and reinforcement.

The project team should consider whether a vapor retarder is necessary. The purpose of a vapor retarder is to reduce the potential for the upward migration of water vapor from the soil into and through the concrete slab. Water vapor migrating upward through the slab can damage floor coverings such as the carpeting, wood, or paint/sealers and contribute to excess humidity and microbial growth in the building. Various methods of vapor retarder construction are described in Part 2, Section 302.2R of the American Concrete Institute *Manual of Concrete Practice*.

The slab-on-grade should be designed and constructed following the recommendations of the Portland Cement Association and the American Concrete Institute. The slab should have construction joints/control joints at spacings recommended by the Portland Cement Association and the American Concrete Institute to mitigate, but not eliminate, slab curling and cracking. The floor slab should be cast independent of the foundation walls of the building to allow relative movement of the slabs and footings to occur without causing excessive distress to the structure.

6.5 Basement Wall Backfilling, Earth pressures, and Drainage Requirements

Interior backfill against the basement walls (and other walls that are unevenly backfilled) should be granular, free-draining soil with less than 5% by weight passing the No. 200 sieve. Below-grade wall backfill should be compacted to at least 95% of its maximum modified Proctor dry density. Heavy towed or self-propelled compaction equipment should not be used for backfill compaction within 6 feet of the walls, in order to avoid imparting excessive permanent lateral stresses on the walls. Rather, manually-operated vibratory or impact compaction equipment should be used.

We anticipate that these walls would be sufficiently rigid that they would not yield or translate a sufficient amount to develop the full active earth condition. Thus, we recommend designing these walls for the partly mobilized active earth condition. Assuming that the moist unit weight of the compacted backfill would be approximately 125 pounds per cubic foot, we recommend using an equivalent fluid density of 55 pounds per cubic foot for the wall design. Loads next to the walls would impart lateral stresses in addition to the earth pressure. This surcharge load should be calculated as 0.5 times the adjacent vertical load(s).

Drain pipes should be placed at the base of the wall backfill zone to collect and remove water that infiltrates the wall backfill. The invert of the drain pipes should be at or only a few inches above bottom of footing. The drains should consist of continuous 4-inch diameter perforated PVC pipe, with at least 4 inches of free-draining gravel on all sides; this gravel should be in the size range of about 3/8-inch to 1 inch. The pipes and gravel should be completely enveloped by a geosynthetic filter fabric meeting the requirements of WisDOT 645, Type DF; fabrics that do not meet the requirements of Type DF are not suitable.

6.6 Exterior Slabs and Sidewalks

Where exterior slabs and sidewalks abut the building, they should be designed as structural slabs supported on footings bearing at least 5 feet deep; site preparation for these components should

follow the site preparation requirements of Section 6.2. An air gap of at least 4 inches should be left below the slab, and insulation panels should cover the vertical frost walls to act as a bondbreaker and to prevent adfreezing between the backfilled soils and the frost walls.

As an alternative, silty and clayey soils could be subcut to a depth of 4 feet below bottom of slab/sidewalk and replaced with non-frost susceptible (NFS) granular fill. This NFS fill subbase layer should consist of sand, sand and gravel mix, or clean crushed stone having less than 5% by weight passing the No. 200 sieve. This fill should be compacted to at least 95% of its maximum modified Proctor dry density. The purpose of constructing the NFS subgrade is to reduce the potential for the characteristic heave (including differential heave) that can occur when silty and clayey soils freeze each winter. This heaving can raise the slabs to jam doors or damage the structure. We recommend that 4-inch diameter perforated PVC pipes be placed at the base of the NFS zone to collect and remove precipitation and runoff that infiltrates the NFS backfill. These drain pipes should be wrapped in a geosynthetic filter fabric and lead to a suitable discharge location.

For either option, the design should include transition zones from the frost-protected slabs/sidewalks to unprotected (or less protected) areas. The purpose of this is to reduce the risk of abrupt transitions in frost heave of slabs and pavements.

6.7 Seismic Design Considerations

According to the International Building Code, the Site Class is determined by the average soil properties in the top 100 feet of soil. Based on our borings and geologic conditions at the site, it is our opinion the project site should be classified as Site Class D per Table 1613.5.2 of the IBC.

7.0 BITUMINOUS PAVEMENT RECOMMENDATIONS

7.1 Approach Discussion

The silty and clayey soils at this site are moderately to highly moisture sensitive and will become easily disturbed by construction activity. Even if the contractor uses appropriate methods, it is possible that wet weather during (or in the months leading up to) construction could make the on-site soils very difficult to use. The project team and contractor must understand this risk and take appropriate precautions.

Most of the soils we encountered in our borings are slow draining and highly frost susceptible. Depending on the desired pavement performance, it may be desirable to include a sand subbase to improve drainage and frost characteristics; a subbase thickness of 1 foot is usually acceptable in vehicle pavement areas. The sand subbase should meet the gradation requirements shown in Table 1 and be compacted to at least 95% of its maximum modified Proctor dry density; clean crushed stone would also be suitable as a subbase layer. A geosynthetic separation fabric (WisDOT 645, Type SAS) should be placed between the subbase and the underlying subgrade. As an alternative to a subbase in vehicle pavement areas, it may be acceptable to use a thickened base course layer, although performance will likely be reduced. If a subbase (or other drainage) layer is included, drain pipes must be included to collect and remove water.

Table 4: Sand Subbase Layer Gradation Requirements

Sieve Size	Percent Passing
1 inch	100
No. 4	60 to 100
No. 40	10 to 80
No. 100	0 to 20
No. 200	0 to 5

7.2 Pavement Subgrade Preparation

In areas of pavement reconstruction, we recommend complete removal of all existing pavement, organic soils, and other unsuitable soils that may be found. An experienced soils technician or geotechnical engineer should perform observations during construction to determine actual subcutting requirements.

After removal of these materials and excavation to the required depth, the top 12 inches of the exposed subgrade should be surface compacted to a minimum of 95% of its maximum modified Proctor dry density. Moisture conditioning will probably be necessary to meet this compaction requirement. In addition, each area should be proof rolled (with an appropriate construction vehicle) and observed for signs of poor performance by a geotechnical engineer or experienced soils technician, just prior to placing new fill. All soft areas should be dug out and corrected.

Where new fill is needed below the subbase and base course in pavement areas, we recommend it consist of non-organic soils similar to the existing soils at the site. Fill placed to attain subgrade elevation in pavement areas should be compacted in thin lifts, such that the entire lift achieves a

minimum compaction level of 95% of its maximum modified Proctor dry density. We anticipate a lift thickness on the order of 4 to 8 inches may be appropriate, although this should be reviewed in the field at the time of construction.

7.3 Pavement Design Parameters

Table 5 lists our recommended parameters the civil engineer can use to design the site pavements. These recommendations are based on the soil conditions found in our borings, subgrade preparation as described in Sections 7.1 and 7.2, and the anticipated new fill. If the subgrade conditions vary from those encountered in our borings, we should be contacted to review our recommendations.

Table 5: Pavement Design Parameters

Design Parameter	Recommended Value
Frost Index	F-4
Design Group Index	16
Soil Support Value	3.7
Resilient Modulus	2800 psi
Modulus of Subgrade Reaction	125 pci

7.4 Pavement Fatigue and Maintenance

Regardless of the subgrade preparation and design, the owner should expect that cracks will appear in the bituminous pavement within 1 to 3 years due to thermal expansion and contraction, and due to the loss of volatiles from the bituminous cement. These cracks cannot be avoided; they should be cleaned annually and filled with a hot bituminous sealant. Within three to five years after construction, cracks and depressions may appear in heavily traveled areas, such as drive aisles. Such areas should be cut out and repaired expeditiously to extend the pavement life. Periodically during the pavement life, the engineer responsible for maintenance of the facility should determine the need to apply a seal coat of hot bituminous and rock chips.

8.0 CONSTRUCTION CONSIDERATIONS

8.1 Groundwater

Based on the conditions found in our borings, it is our opinion the contractor might encounter groundwater (static and/or perched) at this site. It is likely that wet soils will be encountered in the excavations. If water is encountered in the excavations, it should be promptly pumped out before

compacted fill or concrete are placed. The contractor should not be allowed to place fill or concrete into standing water, or over softened soils in an attempt to displace these materials. This technique can result in trapping softened soils under footings, floor slabs, and/or pavements, resulting in excessive post-construction settlement, even if the softened zone is only a few inches thick.

8.2 Disturbance of Soils

The soils at this site are sensitive to disturbance and will become easily disturbed under construction traffic, especially when wet. If soils become disturbed, they should be subcut to the underlying undisturbed soils, followed by placement of new compacted fill.

8.3 Excavation Backsloping

If excavation faces are not retained, the excavations should maintain maximum allowable slopes in accordance with *OSHA Regulations (Standards 29 CFR), Part 1926, Subpart P, "Excavations"* (can be found on www.osha.gov). Even with the required OSHA sloping, water seepage or surface runoff can potentially induce sideslope erosion or running which could require slope maintenance.

8.4 Observation and Testing

The recommendations in this report are based on the subsurface conditions found at our test boring locations. Since the soil conditions can be expected to vary away from the soil boring locations, we recommend on-site observation by a geotechnical engineer/technician during construction to evaluate these potential changes. Soil density testing should also be performed on new fill placed in order to document that project specifications for compaction have been met.

9.0 LIMITATIONS

Within the limitations of scope, budget, and schedule, we have endeavored to provide our services according to generally accepted geotechnical engineering practices at this time and location. Other than this, no warranty, express or implied, is intended. Important information regarding risk management and proper use of this report is given in Appendix B entitled "Geotechnical Report Limitations and Guidelines for Use."

Appendix A

AET Project No. 12-03211

Geotechnical Field Exploration and Testing
Boring Log Notes
Unified Soil Classification System
Figure 1 – Boring Locations
Subsurface Boring Logs
SBD-10793 – Soil and Site Evaluation – Storm

Appendix A
Geotechnical Field Exploration and Testing
AET Project No. 12-03211

A.1 FIELD EXPLORATION

The subsurface conditions at the site were explored by drilling nine standard penetration test borings. The boring locations are shown on Figures 1 and 2.

A.2 SAMPLING METHODS

A.2.1 Split-Spoon Samples (SS)

Standard penetration (split-spoon) samples were collected in general accordance with ASTM: D1586. The ASTM test method consists of driving a 2-inch O.D. split-barrel sampler into the in-situ soil with a 140-pound hammer dropped from a height of 30 inches. After an initial set of 6 inches, the number of hammer blows to drive the sampler the next 12 inches is known as the standard penetration resistance or N-value.

In the past, standard penetration N-value tests were performed using a rope and cathead for the lift and drop system. The energy transferred to the split-spoon sampler was typically limited to about 60% of its potential energy due to the friction inherent in that system. That converted energy provided what is known as an N_{60} blow count.

Most drill rigs today incorporate an automatic hammer lift and drop system, which has higher energy efficiency and subsequently results in lower N-values than the traditional N_{60} values. We use a Pile Driving Analyzer (PDA) and an instrumented rod to measure the actual energy generated by the automatic hammer system. The drill rig (AET rig number 57) we used for this project has a measured energy transfer ratio of 89%. The N-values reported on the boring logs and the corresponding relative densities and consistencies are from the field blow counts and have not been adjusted to N_{60} values.

A.2.2 Disturbed Samples (DS)/Spin-up Samples (SU)

Sample types described as “DS” or “SU” on the boring logs are disturbed samples, which are taken from the flights of the auger. Because the auger disturbs the samples, possible soil layering and contact depths should be considered approximate.

A.2.3 Sampling Limitations

Unless actually observed in a sample, contacts between soil layers are estimated based on the spacing of samples and the action of drilling tools. Cobbles, boulders, and other large objects generally cannot be recovered from test borings, and they may be present in the ground even if they are not noted on the boring logs.

Determining the thickness of “topsoil” layers is usually limited, due to variations in topsoil definition, sample recovery, and other factors. Visual-manual description often relies on color for determination, and transitioning changes can account for significant variation in thickness judgment. Accordingly, the topsoil thickness presented on the logs should not be the sole basis for calculating topsoil stripping depths and volumes. If more accurate information is needed relating to thickness and topsoil quality definition, alternate methods of sample retrieval and testing should be employed.

A.3 CLASSIFICATION METHODS

Soil descriptions shown on the boring logs are based on the Unified Soil Classification System (USCS). The USCS is described in ASTM: D2487 and D2488. Where laboratory classification tests (sieve analysis or Atterberg Limits) have been performed, accurate classifications per ASTM: D2487 are possible. Otherwise, soil descriptions shown on the boring logs are visual-manual judgments. Charts are attached which provide information on the USCS, the descriptive terminology, and the symbols used on the boring logs.

The boring logs include descriptions of apparent geology. The geologic depositional origin of each soil layer is interpreted primarily by observation of the soil samples, which can be limited. Observations of the surrounding topography, vegetation, and development can sometimes aid this judgment.

A.4 WATER LEVEL MEASUREMENTS

The ground water level measurements are shown at the bottom of the boring logs. The following information appears under "Water Level Measurements" on the logs:

- Date and Time of measurement
- Sampled Depth: lowest depth of soil sampling at the time of measurement
- Casing Depth: depth to bottom of casing or hollow-stem auger at time of measurement
- Cave-in Depth: depth at which measuring tape stops in the borehole
- Water Level: depth in the borehole where free water is encountered
- Drilling Fluid Level: same as Water Level, except that the liquid in the borehole is drilling fluid

The true location of the water table at the boring locations may be different than the water levels measured in the boreholes. This is possible because there are several factors that can affect the water level measurements in the borehole. Some of these factors include: permeability of each soil layer in profile, presence of perched water, amount of time between water level readings, presence of drilling fluid, weather conditions, and use of borehole casing.

A.5 TEST STANDARD LIMITATIONS

Field and laboratory testing is done in general conformance with the described procedures. Compliance with any other standards referenced within the specified standard is neither inferred nor implied.

A.6 SAMPLE STORAGE

Unless notified to do otherwise, we routinely retain representative samples of the soils recovered from the borings for a period of 30 days.

BORING LOG NOTES

DRILLING AND SAMPLING SYMBOLS

Symbol	Definition
B, H, N:	Size of flush-joint casing
CA:	Crew Assistant (initials)
CAS:	Pipe casing, number indicates nominal diameter in inches
CC:	Crew Chief (initials)
COT:	Clean-out tube
DC:	Drive casing; number indicates diameter in inches
DM:	Drilling mud or bentonite slurry
DR:	Driller (initials)
DS:	Disturbed sample from auger flights
FA:	Flight auger; number indicates outside diameter in inches
HA:	Hand auger; number indicates outside diameter
HSA:	Hollow stem auger; number indicates inside diameter in inches
LG:	Field logger (initials)
MC:	Column used to describe moisture condition of samples and for the ground water level symbols
N (BPF):	Standard penetration resistance (N-value) in blows per foot (see notes)
NQ:	NQ wireline core barrel
PQ:	PQ wireline core barrel
RD:	Rotary drilling with fluid and roller or drag bit
REC:	In split-spoon (see notes) and thin-walled tube sampling, the recovered length (in inches) of sample. In rock coring, the length of core recovered (expressed as percent of the total core run). Zero indicates no sample recovered.
REV:	Revert drilling fluid
SS:	Standard split-spoon sampler (steel; 1d" is inside diameter; 2" outside diameter); unless indicated otherwise
SU	Spin-up sample from hollow stem auger
TW:	Thin-walled tube; number indicates inside diameter in inches
WASH:	Sample of material obtained by screening returning rotary drilling fluid or by which has collected inside the borehole after "falling" through drilling fluid
WH:	Sampler advanced by static weight of drill rod and 140-pound hammer
WR:	Sampler advanced by static weight of drill rod
94mm:	94 millimeter wireline core barrel
▼:	Water level directly measured in boring
▽:	Estimated water level based solely on sample appearance

TEST SYMBOLS

Symbol	Definition
CONS:	One-dimensional consolidation test
DEN:	Dry density, pcf
DST:	Direct shear test
E:	Pressuremeter Modulus, tsf
HYD:	Hydrometer analysis
LL:	Liquid Limit, %
LP:	Pressuremeter Limit Pressure, tsf
OC:	Organic Content, %
PERM:	Coefficient of permeability (K) test; F - Field; L - Laboratory
PL:	Plastic Limit, %
q_p:	Pocket Penetrometer strength, tsf (approximate)
q_c:	Static cone bearing pressure, tsf
q_u:	Unconfined compressive strength, psf
R:	Electrical Resistivity, ohm-cms
RQD:	Rock Quality Designation of Rock Core, in percent (aggregate length of core pieces 4" or more in length as a percent of total core run)
SA:	Sieve analysis
TRX:	Triaxial compression test
VSR:	Vane shear strength, remolded (field), psf
VSU:	Vane shear strength, undisturbed (field), psf
WC:	Water content, as percent of dry weight
%-200:	Percent of material finer than #200 sieve

STANDARD PENETRATION TEST NOTES

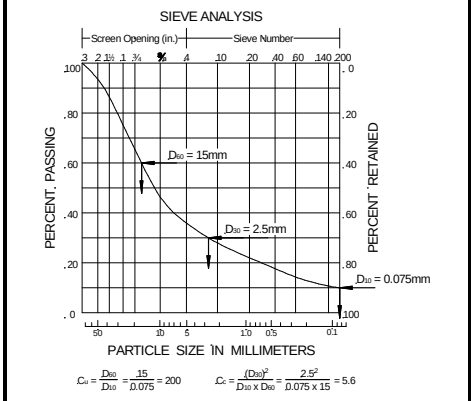
The standard penetration test consists of driving the sampler with a 140 pound hammer and counting the number of blows applied in each of three 6" increments of penetration. If the sampler is driven less than 18" (usually in highly resistant material), permitted in ASTM: D1586, the blows for each complete 6" increment and for each partial increment is on the boring log. For partial increments, the number of blows is shown to the nearest 0.1' below the slash.

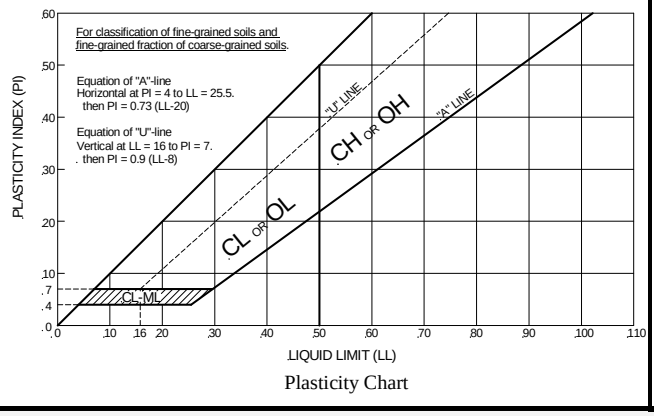
The length of sample recovered, as shown on the "REC" column, may be greater than the distance indicated in the N column. The disparity is because the N-value is recorded below the initial 6" set (unless partial penetration defined in ASTM: D1586 is encountered) whereas the length of sample recovered is for the entire sampler drive (which may even extend more than 18").

UNIFIED SOIL CLASSIFICATION SYSTEM
ASTM Designations: D 2487, D2488

AMERICAN ENGINEERING TESTING, INC.

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification	
				Group Symbol	Group Name[B]
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	Cu≥4 and 1≤Cc≤3[E]	GW	Well graded gravel[F]
			Cu<4 and/or 1>Cc>3[E]	GP	Poorly graded gravel[F]
		Gravels with Fines more than 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel[F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	Cu≥6 and 1≤Cc≤3[E]	SW	Well-graded sand[I]
			Cu<6 and 1>Cc>3[E]	SP	Poorly-graded sand[I]
		Sands with Fines more than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G,H,I]
			Fines classify as CL or CH	SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve (see Plasticity Chart below)	Silts and Clays Liquid limit less than 50	inorganic	PI>7 and plots on or above "A" line[J]	CL	Lean clay[K,L,M]
			PI<4 or plots below "A" line[J]	ML	Silt[K,L,M]
		organic	Liquid limit–oven dried / Liquid limit – not dried <0.75	OL	Organic clay[K,L,M,N] Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line	CH	Fat clay[K,L,M]
			PI plots below "A" line	MH	Elastic silt[K,L,M]
		organic	Liquid limit–oven dried / Liquid limit – not dried <0.75	OH	Organic clay[K,L,M,P] Organic silt[K,L,M,Q]
Highly organic soil			Primarily organic matter, dark in color, and organic in odor	PT	Peat[R]





Plasticity Chart

Notes

[A]Based on the material passing the 3-in (75-mm) sieve.

[B]If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C]Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay

[D]Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

[E]$Cu = D_{60} / D_{10}$, $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F]If soil contains ≥15% sand, add "with sand" to group name.

[G]If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H]If fines are organic, add "with organic fines" to group name.

[I]If soil contains ≥15% gravel, add "with gravel" to group name.

[J]If Atterberg limits plot is hatched area, soils is a CL-ML silty clay.

[K]If soil contains 15 to 29% plus No. 200 add "with sand" or "with gravel", whichever is predominant.

[L]If soil contains ≥30% plus No. 200, predominantly sand, add "sandy" to group name.

[M]If soil contains ≥30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N]PI≥4 and plots on or above "A" line.

[O]PI<4 or plots below "A" line.

[P]PI plots on or above "A" line.

[Q]PI plots below "A" line.

[R]Fiber Content description shown below.

ADDITIONAL TERMINOLOGY NOTES USED BY AET FOR SOIL IDENTIFICATION AND DESCRIPTION

Grain Size

Term	Particle Size
Boulders	Over 12"
Cobbles	3" to 12"
Gravel	#4 sieve to 3"
Sand	#200 to #4 sieve
Fines (silt & clay)	Pass #200 sieve

Gravel Percentages

Term	Percent
A Little Gravel	3% - 14%
With Gravel	15% - 29%
Gravelly	30% - 50%

Consistency of Plastic Soils

Term	N-Value, BPF
Very Soft	less than 2
Soft	2 - 4
Firm	5 - 8
Stiff	9 - 15
Very Stiff	16 - 30
Hard	Greater than 30

Relative Density of Non-Plastic Soils

Term	N-Value, BPF
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	Greater than 50

Moisture/Frost Condition
(MC Column)

D (Dry): Absense of moisture, dusty, dry to touch.

M (Moist): Damp, although free water not visible. Soil may still have a high water content (over "optimum").

W (Wet/ Waterbearing): Free water visible intended to describe non-plastic soils. Waterbearing usually relates to sands and sand with silt.

F (Frozen): Soil frozen

Layering Notes

Laminations: Layers less than ½" thick of differing material or color.

Lenses: Pockets or layers greater than ½" thick of differing material or color.

Peat Description

Term	Fiber Content (Visual Estimate)
Fibric Peat:	Greater than 67%
Hemic Peat:	33 – 67%
Sapric Peat:	Less than 33%

Organic Description (if no lab tests)

Soils are described as *organic*, if soil is not peat and is judged to have sufficient organic fines content to influence the Liquid Limit properties. *Slightly organic* used for borderline cases.

Root Inclusions

With roots: Judged to have sufficient quantity of roots to influence the soil properties.

Trace roots: Small roots present, but not judged to be in sufficient quantity to significantly affect soil properties.

Figure 1 - Boring Locations
AET Project No. 12-03211
May 25, 2018

HORIZON
DEVELOP • BUILD • MANAGE

JLA
ARCHITECTS

ELM GROVE HEIGHTS
CONCEPTUAL SITE PLAN

APRIL 17, 2018
1:30 @ 11 x 17

INSITE LANDSCAPE | DESIGN

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **12-03211** Log of Boring No. **B-1 (p. 1 of 1)**

Project: **Elm Grove Heights Senior Apartments; 13040 W. Bluemound Road; Elm Grove, Wisconsin**

DEPTH IN FEET	ELEV. FEET	Surface Elevation **749.0** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	qp	LL	PL	%-#200
1	748.7	FILL, lean clay with sand and organics, brown (OL)	FILL/ TOPSOIL	5	M	SS	15					
2	747.0	FILL, sandy silty clay, a little gravel, trace organics, dark brown and brown (CL-ML)	FILL									
3				4	M	SS	18	27				
4	744.5	FILL, lean clay with sand, a little gravel, brown (CL)										
5		FILL, clayey sand, fine to medium grained, a little gravel, brown, wet (SC)		2	W	SS	12	19				
6												
7	742.0											
8		FILL, lean clay with sand and gravel, brown (CL)		8	M	SS	11	16				
9	739.5											
10		Sandy LEAN CLAY, gray, wet, stiff (CL)	TILL	11	W	SS	16	22				
11												
12	737.0											
13	735.8	Sandy SILT, gray, wet, loose (ML)		10	W	SS	20	22				
14		LEAN CLAY with sand, a little gravel, brown, stiff to very stiff (CL)						18	>4.5			
15				19	W	SS	24	16	3.0			
16												
17												
18				18	W	SS	24	17	4.0			
19												
20												
21				27	W	SS	12	17	4.0			
22												
23	726.0											
24		GRAVEL with sand, gray, waterbearing, very dense (GP)										
25				83/.9	W	SS	17					
	723.1											
		End of boring at 25.9 feet *Temporary PVC well screen and riser inserted into borehole. Final water level measured on 5/25/2018.*										

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
0-24.5' 3.25" HSA	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
	5/14/18	**1415**	**25.9'**	**24.5'**	**23.5'**	**None**	**15.0'**	
	5/15/18	**1300**	**--**	**23.2'**	**--**	**--**	**12.6'**	
BORING COMPLETED: **5/14/18**	**5/25/18**	**0945**	**--**	**23.2'**	**--**	**--**	**12.9'**	
DR: **MD** LG: **LL** Rig: **57**								

AET_CORP W-ELEV 12-03211.GPJ AET+CPT+WELL.GDT 5/27/18

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **12-03211** Log of Boring No. **B-2 (p. 1 of 1)**

Project: **Elm Grove Heights Senior Apartments; 13040 W. Bluemound Road; Elm Grove, Wisconsin**

DEPTH IN FEET	ELEV. FEET	Surface Elevation **748.7** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	qp	LL	PL	%-#200
	748.4	About 3 inches of deteriorated asphalt	ASPHALT									
1	748.0	FILL, gravel with sand, gray, moist (GP)	FILL	16	M	SS	20					
2	746.7	FILL, lean clay with sand and gravel, dark brown and brown (CL)										
3		FILL, lean clay with sand, a little gravel, dark brown and black (CL)		12	M	SS	2					
4	744.2											
5		FILL, sandy silty clay, brown and gray, with a few pieces of wood (CL-ML)		6	M	SS	17	20				
6												
7												
8				20	W	SS	9					
9	739.2											
10		Sandy SILTY CLAY, gray, wet, very stiff (CL-ML)	TILL	18	W	SS	17	22				
11												
12	736.7											
13		LEAN CLAY with sand, a little gravel, brown, stiff to very stiff (CL)		9	M	SS	24	17	4.5			
14												
15				11	W	SS	24	18	3.5			
16												
17												
18				18	W	SS	24	17	3.0			
19												
20				18	W	SS	24	15	2.0			
21												
22												
23	725.7	GRAVEL WITH CLAY and sand, gray, waterbearing, dense (GP-GC)										
24												
25				34	W	SS	14					
26	722.5											
		End of boring at 26.2 feet										

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS						
	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-24.5' 3.25" HSA	**5/14/18**	**1621**	**26.2'**	**24.5'**	**23.8'**	**None**	**15.9'**
	5/14/18	**1628**	**26.2'**	**24.5'**	**23.8'**	**None**	**15.7'**
BORING COMPLETED: **5/14/18**							
DR: **MD** LG: **LL** Rig: **57**							

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP W-ELEV 12-03211.GPJ AET+CPT+WELL.GDT 5/27/18

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **12-03211** Log of Boring No. **B-3 (p. 1 of 1)**

Project: **Elm Grove Heights Senior Apartments; 13040 W. Bluemound Road; Elm Grove, Wisconsin**

DEPTH IN FEET	ELEV. FEET	Surface Elevation **747.5** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	qp	LL	PL	%-#200
1		FILL, lean clay with sand and organics, dark brown and black (OL)	FILL/ TOPSOIL	5	M	SS	17					
2	745.5											
3		FILL, clayey sand, fine to medium grained, a little gravel, brown and gray, wet (SC)	FILL	6	W	SS	19					
4	743.0											
5		FILL, lean clay with sand, a little gravel, brown (CL)		6	M	SS	20	17	0.5			
6												
7	740.5											
8		LEAN CLAY with sand, a little gravel, brown, stiff to very stiff (CL)	TILL	9	M	SS	21	16	3.5			
9												
10				12	M	SS	23	16	3.5			
11					▼							
12												
13				16	M/W	SS	24	16	4.5			
14												
15												
16				21	W	SS	24	17	3.5			
17	730.5											
18		LEAN CLAY with sand and gravel, brown, very stiff (CL)		24	W	SS	10		3.0			
19	728.0											
20		CLAYEY GRAVEL with sand, brown, waterbearing, dense (GC)		36	W	SS	12					
21												
22												
23	724.5											
24		GRAVEL WITH CLAY and sand, gray, waterbearing, medium dense (GP-GC)										
25				17	W	SS	24					
26	721.0											
		End of boring at 26.5 feet										

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS						
	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-24.5' 3.25" HSA	**5/14/18**	**1509**	**26.5'**	**24.5'**	**21.8'**	**None**	**11.7'**
BORING COMPLETED: **5/14/18**							
DR: **MD** LG: **LL** Rig: **57**							

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP W-ELEV 12-03211.GPJ AET+CPT+WELL.GDT 5/27/18

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **12-03211** Log of Boring No. **B-4 (p. 1 of 1)**

Project: **Elm Grove Heights Senior Apartments; 13040 W. Bluemound Road; Elm Grove, Wisconsin**

DEPTH IN FEET	ELEV. FEET	Surface Elevation **746.9** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	qp	LL	PL	%-#200
	746.6	FILL, sandy lean clay with organics, a little gravel, brown (OL)	FILL/ TOPSOIL									
1		FILL, sandy lean clay, a little gravel, brown, wet at about 6 feet (CL)	FILL	5	M	SS	17					
2												
3				7	M	SS	12	18				
4												
5												
6				23	M/W	SS	18		3.0			
7	739.9											
8	738.6	SILTY CLAY with sand, gray, slightly wet, stiff (CL-ML)	TILL	12	W	SS	18	20	2.0			
9		LEAN CLAY with sand, a little gravel, brown, stiff (CL)						16	3.0			
10												
11				12	M	SS	24	15	>4.5			
12												
13				15	M/W	SS	24	14	4.0			
14	732.4											
15		CLAYEY GRAVEL with sand, brown, waterbearing, dense (GC)		40	W	SS	16					
16												
17	729.9											
18	728.7	GRAVEL with sand, brown, waterbearing, very dense (GP)		18	W	SS						
		Initial attempt encountered auger refusal on unknown obstruction at 6.5 feet. Boring moved 10 feet east and drilled to auger refusal at a depth of 18.2 feet.										

DEPTH:	DRILLING METHOD
0-17.0'	**3.25" HSA**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
5/15/18	**0836**	**18.2'**	**17.0'**	**17.4'**	**None**	**13.9'**
5/15/18	**0845**	**18.2'**	**17.0'**	**17.4'**	**None**	**13.0'**

BORING COMPLETED: **5/15/18**

DR: **MD** LG: **LL** Rig: **57**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP W-ELEV 12-03211.GPJ AET+CPT+WELL.GDT 5/27/18

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **12-03211** Log of Boring No. **B-5 (p. 1 of 1)**

Project: **Elm Grove Heights Senior Apartments; 13040 W. Bluemound Road; Elm Grove, Wisconsin**

DEPTH IN FEET	ELEV. FEET	Surface Elevation **746.5** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	qp	LL	PL	%-#200
	746.2	FILL, lean clay with sand and organics, dark brown (OL)	FILL/ TOPSOIL									
1				12	M	SS	2					
	744.5	FILL, clayey sand with gravel, fine to medium grained, dark brown and brown, moist (SC)	FILL									
2			TILL									
3				9	M	SS	15		1.5			
4	742.0	Sandy LEAN CLAY, trace organics, dark brown, stiff (CL)										
5		SILTY SAND, fine grained, brown, wet, loose (SM)										
6				8	W	SS	22					
7	739.5											
8		Sandy SILT, brown, wet, medium dense (ML)		13	W	SS	18	21				
9	737.0											
10		CLAYEY SAND with gravel, fine to medium grained, brown, moist, dense (SC)										
11				40	M	SS	16	11	>4.5			
12	734.5				▼							
13		SILTY GRAVEL with sand, gray, moist to waterbearing, dense (GM)		40	M/W	SS	11					
14	732.0											
15		GRAVEL with sand, brown, waterbearing, dense (GP)										
16				62	W	SS	13					
17	729.5											
18		CLAYEY GRAVEL with sand, brown, waterbearing, dense to very dense (GC)		49	W	SS	13					
19												
20				64/.9	W	SS	9					
	725.6	*Auger refusal - end of boring at 20.9 feet Temporary PVC well screen and riser inserted into borehole. Final water level measured on 5/25/2018.*										

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS						
	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-20.6' 3.25" HSA	**5/14/18**	**1250**	**16.5'**	**14.5'**	**16.5'**	**None**	**14.5'**
	5/14/18	**1300**	**20.9'**	**19.5'**	**16.5'**	**None**	**9.8'**
BORING COMPLETED: **5/14/18**	**5/15/18**	**0800**	**--**	**15.0'**	**--**	**--**	**12.3'**
DR: **MD** LG: **LL** Rig: **57**	**5/25/18**	**0950**	**--**	**15.0'**	**--**	**--**	**13.2'**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP W-ELEV 12-03211.GPJ AET+CPT+WELL.GDT 5/27/18

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **12-03211** Log of Boring No. **B-6 (p. 1 of 1)**

Project: **Elm Grove Heights Senior Apartments; 13040 W. Bluemound Road; Elm Grove, Wisconsin**

DEPTH IN FEET	ELEV. FEET	Surface Elevation **745.1** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	qp	LL	PL	%-#200
	744.9	FILL, lean clay with sand and organics, dark brown (OL)	FILL/ TOPSOIL									
1		FILL, lean clay with sand, a little gravel, trace organics, dark brown and brown, with a few asphalt pieces around 5 feet deep (CL)	FILL	5	M	SS	20					
2												
3				52/.9	M	SS	9		1.5			
4												
5												
6				7	M	SS	17	21	2.0			
7	738.1											
8		LEAN CLAY with sand, brown, stiff (CL)	TILL	9	M	SS	24	16	>4.5			
9	735.6											
10		LEAN CLAY with sand, a little gravel, brown, very stiff (CL)		18	M	SS	24	15	>4.5			
11												
12					▼							
13				18	M/W	SS	14	14	3.0			
14	730.6											
15		GRAVEL with sand, brown, waterbearing, very dense (GP)		53	W	SS	14					
16												
17	728.1											
18	726.7	CLAYEY GRAVEL with sand, brown, waterbearing, very dense (GC)		63/.9	W	SS	11		>4.5			
		Auger refusal - end of boring at 18.4 feet										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS						
		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-17.0'	**3.25" HSA**	**5/15/18**	**1018**	**18.4'**	**17.0'**	**17.3'**	**None**	**14.8'**
		5/15/18	**1020**	**18.4'**	**17.0'**	**17.3'**	**None**	**12.6'**
BORING COMPLETED: **5/15/18**								
DR: **MD** LG: **LL** Rig: **57**								

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP W-ELEV 12-03211.GPJ AET+CPT+WELL.GDT 5/27/18

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **12-03211** Log of Boring No. **B-7 (p. 1 of 1)**

Project: **Elm Grove Heights Senior Apartments; 13040 W. Bluemound Road; Elm Grove, Wisconsin**

DEPTH IN FEET	ELEV. FEET	Surface Elevation **740.8** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	qp	LL	PL	%-#200
1	740.6	FILL, sandy silt with organics, dark brown, moist (OL)	FILL/ TOPSOIL	5	M	SS	16					
2	738.8	FILL, sandy silt, a little gravel, dark brown and brown (ML)	FILL									
3		Sandy SILT, mottled brown and gray, moist, loose (ML)	TILL	7	M	SS	12	21	0.5			
4	736.3											
5		Sandy SILT, mottled brown and gray, moist, medium dense, with lenses of lean clay (ML)		11	M	SS	20	20	1.0			
6												
7	733.8											
8		LEAN CLAY with sand, a little gravel, brown, stiff to very stiff (CL)		10	M/W	SS	20	17	4.0			
9												
10				16	W	SS	24	17	4.0			
11												
12												
13				15	W	SS	19	16	3.0			
14												
15				23	W	SS	24	16	>4.5			
16												
17	723.8											
18	722.3	GRAVEL with sand, gray, waterbearing, very dense (GP)		62/.9	W	SS	12					
		Auger refusal - end of boring at 18.5 feet										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS						
		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-18.5'	**3.25" HSA**	**5/15/18**	**1200**	**18.4'**	**17.0'**	**16.7'**	**None**	**8.5'**
		5/15/18	**1210**	**18.5'**	**17.0'**	**16.7'**	**None**	**8.3'**
BORING COMPLETED: **5/15/18**								
DR: **MD** LG: **LL** Rig: **57**								

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP W-ELEV 12-03211.GPJ AET+CPT+WELL.GDT 5/27/18

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **12-03211** Log of Boring No. **B-8 (p. 1 of 1)**

Project: **Elm Grove Heights Senior Apartments; 13040 W. Bluemound Road; Elm Grove, Wisconsin**

DEPTH IN FEET	ELEV. FEET	Surface Elevation **746.8** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	qp	LL	PL	%-#200
	746.4	FILL, lean clay with sand and organics, a little gravel, dark brown (OL)	FILL/ TOPSOIL									
1		FILL, lean clay with sand, a little gravel, dark brown and brown (CL)	FILL	6	M	SS	17	16	2.0			
2												
3				5	M	SS	24	18	1.5			
4												
5				6	M	SS	15	23				
6	740.8	*End of boring at 6.0 feet*										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS						
		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-4.0'	**3.25" HSA**	**5/15/18**	**0917**	**6.0'**	**4.0'**	**6.0'**	**None**	**None**
BORING COMPLETED:	**5/15/18**							
DR: **MD**	LG: **LL** Rig: **57**							

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP W-ELEV 12-03211.GPJ AET+CPT+WELL.GDT 5/27/18

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **12-03211** Log of Boring No. **B-9 (p. 1 of 1)**

Project: **Elm Grove Heights Senior Apartments; 13040 W. Bluemound Road; Elm Grove, Wisconsin**

DEPTH IN FEET	ELEV. FEET	Surface Elevation **741.0** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	qp	LL	PL	%-#200
1		SILT with organics, dark brown, moist, very loose (OL)	TOPSOIL	2	M	SS	12					
2												
3	738.0			9	M	SS	11					
4		CLAYEY SAND, fine to medium grained, a little gravel, mottled brown and gray, moist, loose (SC)	TILL									
5				12	M	SS	12					
6	735.0											
7		LEAN CLAY with sand, a little gravel, brown, stiff (CL)		10	M	SS	16		>4.5			
8												
9				13	M	SS	19		2.5			
10	731.0	*End of boring at 10.0 feet*										

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS						
	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-8.0' 3.25" HSA	**5/15/18**	**1400**	**10.0'**	**8.0'**	**10.0'**	**None**	**None**
BORING COMPLETED: **5/15/18**							
DR: **MD** LG: **LL** Rig: **57**							

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP W-ELEV 12-03211.GPJ AET+CPT+WELL.GDT 5/27/18

Wis. Dept. of Safety and Professional Services
Division of Safety and Buildings

SOIL EVALUATION - STORM

in accordance with SPS 382.365 and 385, Wis. Adm. Code

Attach complete site plan on paper not less than 8 1/2 x 11 inches in size. Plan must include, but not limited to: vertical and horizontal reference point (BM), direction and percent slope, scale or dimensions, north arrow, and BM referenced to nearest road.

Please print all information.

Personal information you provide may be used for secondary purposes (Privacy Law, s. 15.04 (1) (m)).

County: Waukesha

Parcel I.D.:

Reviewed by: Date:

Property Owner	Property Location
c/o Horizon Development Group, Inc.	Govt. Lot NW 1/4 SE 1/4 S 25 T 7 N R 20E E (or) W
Property Owner's Mailing Address: 5201 East Terrace Drive, Suite 300	Lot # / Block # / Subd. Name or CSM#
City: Madison; State: WI; Zip Code: 53718; Phone Number: (608) 354-0843	☐ City ☒ Village ☐ Town; Nearest Road: 13040 W. Bluemound Rd
	Village: Elm Grove

Drainage area _____ ☐ sq. ft. ☐ acres
Optional:

Test Site Suitable for (check all that apply)

☐ Irrigation ☐ Bioretention trench ☐ Trench(es)
☐ Rain garden ☐ Grassed swale ☐ Reuse
☐ Infiltration trench ☐ SDS (> 15' wide) ☐ Other _____

Hydraulic Application Test Method:

☒ Morphological Evaluation
☐ Double-Ring Infiltrometer
☐ Other (specify) _____

B-9 Obs. #

☒ Boring ☐ Pit

Ground surface elev. 741.0 ft. Depth to limiting factor 36 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr
1	0-36	10YR 2/2	---	sil	0,m	m,fr	a,w	<5	0.13
2	36-72	10YR 6/3	m, 1-2, D, 10YR 4/6	sc	0,m	m,fi	a,w	~5	0.04
3	72-120	7.5YR 4/3	---	c	0,m	m,vfi	---	~5-10	0.07

Obs. #

☐ Boring ☐ Pit

Ground surface elev. _____ ft. Depth to limiting factor _____ in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr

CST/PSS Name (Please Print): Benjamin B. Mattson

Signature:

CST/PSS Number: 1131386

Address: 4203 Schofield Avenue Suite 1, Schofield WI 54476

Date Evaluation Conducted: May 15, 2018

Telephone Number: (715) 359-3534

Property Owner c/o Horizon Dev Group Parcel ID # _____ Page 2 of 2

Obs. # ☐ Boring ☐ Pit Ground surface elev. _____ ft. Depth to limiting factor _____ in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr

Obs. # ☐ Boring ☐ Pit Ground surface elev. _____ ft. Depth to limiting factor _____ in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr

Test Results and/or Summary Comments

We did not encounter a water table in boring B-9. However, the soils we encountered are very slow draining and it is possible or likely it would take hours or days for the static water level to come to equilibrium in this boring. The water table elevation we observed in other borings at this site was generally from about 732 to 737 feet. The installation of a monitoring well for obtaining additional groundwater measurements was beyond our scope of services.

Appendix B

AET Project No. 12-03211

Geotechnical Report Limitations and Guidelines for Use

Appendix B
Geotechnical Report Limitations and Guidelines for Use
AET Project No. 12-03211

B.1 REFERENCE

This appendix provides information to help you manage your risks relating to subsurface problems which are caused by construction delays, cost overruns, claims, and disputes. This information was developed and provided by GBA[1], of which we are a member firm.

B.2 RISK MANAGEMENT INFORMATION

B.2.1 Geotechnical Services are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared solely for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. And no one, not even you, should apply the report for any purpose or project except the one originally contemplated.

B.2.2 Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

B.2.3 A Geotechnical Engineering Report is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typically, factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, always inform your geotechnical engineer of project changes, even minor ones, and request an assessment of their impact. Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.

B.2.4 Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. Do not rely on a geotechnical engineering report whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. Always contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

1 Geoprofessional Business Association, 1300 Piccard Drive, LL14, Rockville, MD 20850
Telephone: 301/565-2733: www.geoprofessional.org

B.2.5 Most Geotechnical Findings Are Professional Opinions
Site exploration identified subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

B.2.6 A Report's Recommendations Are Not Final
Do not over-rely on the construction recommendations included in your report. Those recommendations are not final, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.

B.2.7 A Geotechnical Engineering Report Is Subject to Misinterpretation
Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

B.2.8 Do Not Redraw the Engineer's Logs
Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, but recognizes that separating logs from the report can elevate risk.

B.2.9 Give Contractors a Complete Report and Guidance
Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, but preface it with a clearly written letter of transmittal. In the letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. Be sure contractors have sufficient time to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

B.2.10 Read Responsibility Provisions Closely
Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their report. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

B.2.11 Geoenvironmental Concerns Are Not Covered
The equipment, techniques, and personnel used to perform a geoenvironmental study differ significantly from those used to perform a geotechnical study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Unanticipated environmental problems have led to numerous project failures. If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. Do not rely on an environmental report prepared for someone else.

Appendix I:
WinSLAMM Reports

Data file name: F:\Job Files\1818280 Horizon - Elm Grove Heights - Elm Grove, WI\1818284 Civil\storm water report and calculations\SLAMM\Elm Grove Heights-storm trap.mdb
WinSLAMM Version 10.4.0
Rain file name: C:\WinSLAMM Files\Rain Files\WI Milwaukee 69.RAN
Particulate Solids Concentration file name: C:\WinSLAMM Files\v10.1 WI_AVG01.pscx
Runoff Coefficient file name: C:\WinSLAMM Files\WI_SL06 Dec06.rsvx
Residential Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Institutional Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Commercial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Industrial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Other Urban Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Freeway Street Delivery file name: C:\WinSLAMM Files\Freeway Dec06.std
Apply Street Delivery Files to Adjust the After Event Load Street Dirt Mass Balance: False
Pollutant Relative Concentration file name: C:\WinSLAMM Files\WI_GEO03.ppdx
Source Area PSD and Peak to Average Flow Ratio File: C:\WinSLAMM Files\NURP Source Area PSD Files.csv
Cost Data file name:
Seed for random number generator: -42
Study period starting date: 01/05/69 Study period ending date: 12/31/69
Start of Winter Season: 12/06 End of Winter Season: 03/28
Date: 03-04-2019 Time: 09:51:17
Site information:

LU# 1 - Commercial: Post Development Basin B Total area (ac): 0.310
  1 - Roofs 1: 0.040 ac. Flat Connected Source Area PSD File: C:\WinSLAMM Files\NURP.cpz
  13 - Paved Parking 1: 0.220 ac. Connected Source Area PSD File: C:\WinSLAMM Files\NURP.cpz
  51 - Small Landscaped Areas 1: 0.050 ac. Normal Clayey Low Density Source Area PSD File: C:\WinSLAMM Files\NURP.cpz

LU# 2 - Commercial: Post Development Basin A Total area (ac): 0.930
  1 - Roofs 1: 0.530 ac. Flat Connected Source Area PSD File: C:\WinSLAMM Files\NURP.cpz
  13 - Paved Parking 1: 0.240 ac. Connected Source Area PSD File: C:\WinSLAMM Files\NURP.cpz
  51 - Small Landscaped Areas 1: 0.160 ac. Normal Clayey Low Density Source Area PSD File: C:\WinSLAMM Files\NURP.cpz

Control Practice 1: Wet Detention Pond CP# 1 (DS) - DS Wet Pond # 1
   Particle Size Distribution file name: Not needed - calculated by program
   Initial stage elevation (ft):   3
   Peak to Average Flow Ratio: 3.8
   Maximum flow allowed into pond (cfs): No maximum value entered
   Outlet Characteristics:
        Outlet type: Orifice 1
               1. Orifice diameter (ft):   0.17
               2. Number of orifices: 1
               3. Invert elevation above datum (ft):   3
        Outlet type: Orifice 2
               1. Orifice diameter (ft):   0.42
               2. Number of orifices: 1
               3. Invert elevation above datum (ft):   4.55
        Outlet type: Broad Crested Weir
               1. Weir crest length (ft):   5
               2. Weir crest width (ft):   0.25
               3. Height from datum to bottom of weir opening: 6.5
   Pond stage and surface area

Entry Number	Stage (ft)	Pond Area (acres)	Natural Seepage (in/hr)	Other Outflow (cfs)
0	0.00	0.0000	0.00	0.00
1	1.00	0.0180	0.00	0.00
2	2.00	0.0180	0.00	0.00
3	3.00	0.0180	0.00	0.00
4	4.00	0.0180	0.00	0.00
5	5.00	0.0180	0.00	0.00
6	6.00	0.0180	0.00	0.00
7	6.50	0.0180	0.00	0.00

Control Practice 2: Wet Detention Pond CP# 2 (DS) - DS Wet Pond # 2
   Particle Size Distribution file name: Not needed - calculated by program
   Initial stage elevation (ft):   3
   Peak to Average Flow Ratio: 3.8
   Maximum flow allowed into pond (cfs): No maximum value entered

Outlet Characteristics:

Outlet type: Orifice 1

1. Orifice diameter (ft): 0.15
2. Number of orifices: 1
3. Invert elevation above datum (ft): 3

Outlet type: Orifice 2

1. Orifice diameter (ft): 0.29
2. Number of orifices: 1
3. Invert elevation above datum (ft): 5

Outlet type: Broad Crested Weir

1. Weir crest length (ft): 5
2. Weir crest width (ft): 0.25
3. Height from datum to bottom of weir opening: 8

Pond stage and surface area

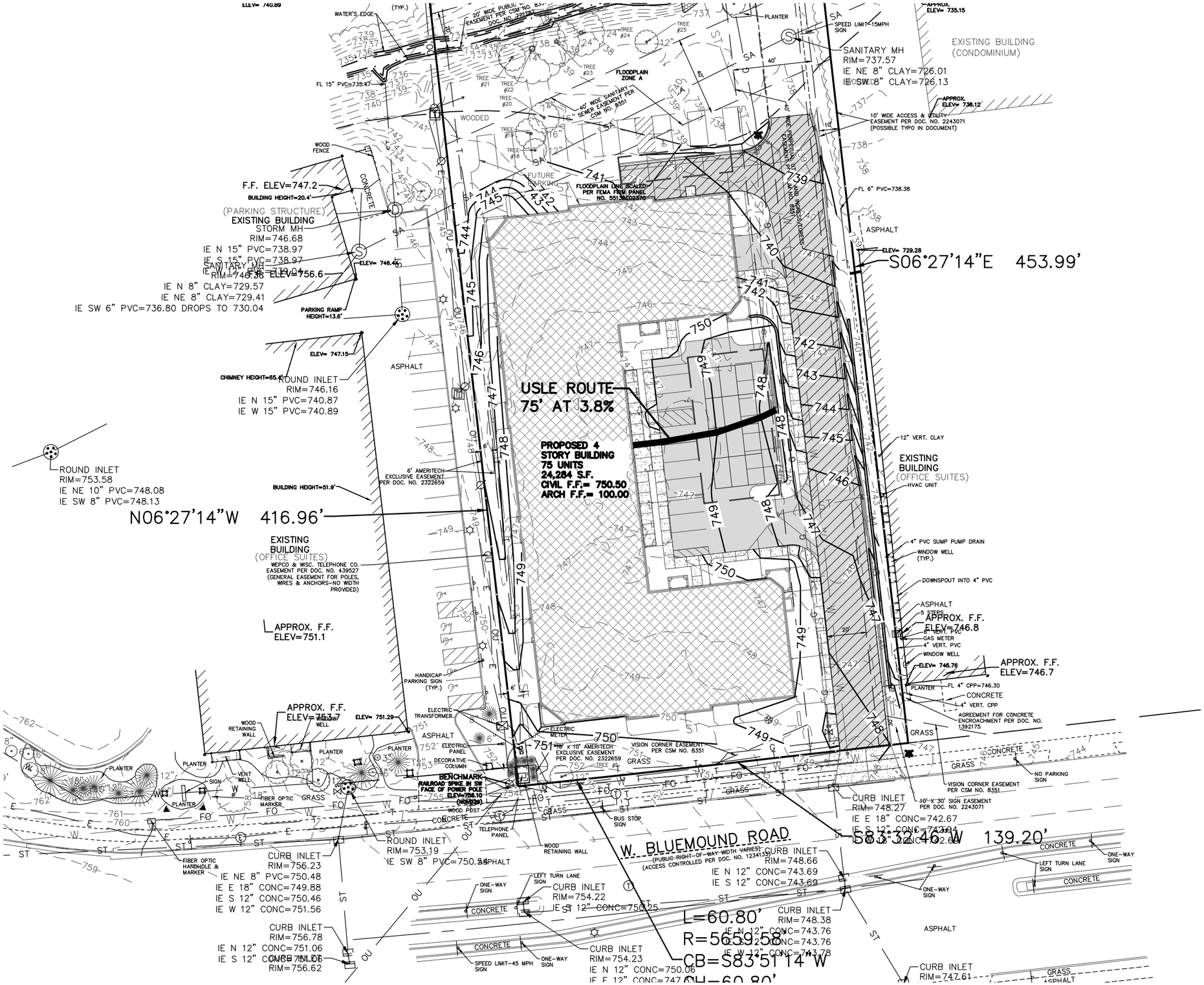
Entry Number	Stage (ft)	Pond Area (acres)	Natural Seepage (in/hr)	Other Outflow (cfs)
0	0.00	0.0000	0.00	0.00
1	1.00	0.0670	0.00	0.00
2	2.00	0.0670	0.00	0.00
3	3.00	0.0670	0.00	0.00
4	4.00	0.0670	0.00	0.00
5	5.00	0.0670	0.00	0.00
6	6.00	0.0670	0.00	0.00
7	7.00	0.0670	0.00	0.00
8	8.00	0.0670	0.00	0.00

SLAMM for Windows Version 10.4.0

Data file name: F:\Job Files\1818280 Horizon - Elm Grove Heights - Elm Grove, WI\1818284 Civil\storm water report and calculations\SLAMM\Elm Grove Heights-storm trap.mdb
Data file description:
Rain file name: C:\WinSLAMM Files\Rain Files\WI Milwaukee 69.RAN
Particulate Solids Concentration file name: C:\WinSLAMM Files\v10.1 WI_AVG01.pscx
Runoff Coefficient file name: C:\WinSLAMM Files\WI_SL06 Dec06.rsvx
Residential Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Institutional Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Commercial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Industrial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Other Urban Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Freeway Street Delivery file name: C:\WinSLAMM Files\Freeway Dec06.std
Pollutant Relative Concentration file name: C:\WinSLAMM Files\WI_GEO03.ppdx
Start of Winter Season: 12/06 End of Winter Season: 03/28
Model Run Start Date: 01/05/69 Model Run End Date: 12/31/69
Date of run: 03-04-2019 Time of run: 09:51:05
Total Area Modeled (acres): 1.240
Years in Model Run: 0.99

	Runoff Volume (cu ft)	Percent Runoff Volume Reduction	Particulate Solids Conc. (mg/L)	Particulate Solids Yield (lbs)	Percent Particulate Solids Reduction
Total of all Land Uses without Controls:	83345	-	77.81	404.8	-
Outfall Total with Controls:	83387	-0.05%	15.32	79.74	80.30%
Annualized Total After Outfall Controls:	84546			80.85	

Appendix J:
USLE Map and Calculations



USLE MAP

NO SCALE

Soil Loss & Sediment Discharge Calculation Tool

for use on Construction Sites in the State of Wisconsin

WDNR Version 2.0 (06-29-2017)

WISCONSIN DEPT. OF NATURAL RESOURCES

YEAR 1

Developer: Horizon

Project: Elm Grove Heights

Date: 03/04/19

County: Waukesha

Version 1.0

Activity (1)	Begin Date (2)	End Date (3)	Period % R (4)	Annual R Factor (5)	Sub Soil Texture (6)	Soil Erodibility K Factor (7)	Slope (%) (8)	Slope Length (ft) (9)	LS Factor (10)	Land Cover C Factor (11)	Soil loss A (tons/acre) (12)	SDF (13)	Sediment Control Practice (14)	Sediment Discharge (t/ac) (15)
Bare Ground	07/01/19	10/01/19	52.0%	130	Clay	0.32	3.8%	75	0.34	1.00	7.3	0.953	Inlet Protection	4.9
End	10/01/19	-----	-----	-----	-------	-----	3.8%	75	0.34	------	-----	0.000	Inlet Protection	0.0
		-----	-----	-----	-------	-----	3.8%	75	0.34	-----	-----	0.000		0.0
		-----	-----	-----	-------	-----	3.8%	75	0.34	-----	-----	0.000		0.0
		-----	-----	-----	-------	-----	3.8%	0	-----	-----	-----	0.000		0.0
		-----	-----	-----	-------	-----	0.0%	0	-----	-----	-----	0.000		0.0
										TOTAL	**7.3**		**TOTAL**	**4.9**
													% Reduction Required	**NONE**

Notes:

See Help Page for further descriptions of variables and items in drop-down boxes.
The last land disturbing activity on each sheet must be 'End'. This is either 12 months from the start of construction or final stabilization.
For periods of construction that exceed 12 months, please demonstrate that 5 tons/acre/year is not exceeded in any given 12 month period.

NOTE: THIS TOOL ONLY ADDRESSED SOIL EROSION DUE TO SHEET FLOW. MEASURES TO CONTROL CHANNEL EROSION MAY ALSO BE REQUIRED TO MEET SEDIMENT DISCHARGE REQUIREMENTS.

Recommended Permanent Seeding Dates:

4/1-5/15	and	8/7-8/29	Turf, introduced grasses and legumes
Thaw-6/30			Native Grasses, forbs, and legumes

Designed By:	
Date	