ALTUS
ENGINEERING, INC.

Civil
Site Planning
Environmental
Engineering

133 Court Street
Portsmouth, NH
03801-4413

August 8, 2017

Michael Behrendt, Town Planner
Town of Durham
8 Newmarket Road
Durham, NH 03824

Re: Site Plan Review Application
RiverWoods Durham
Assessor's Map 11, Lot 8-1 through 8-15 and Valbeth Lane ("Subject Parcel"), and
Portions of Map 22, Lot 12, and Lot 8-0
Stone Quarry Drvie
Durham, NH

Dear Mr. Behrendt,

The formal Site Plan Review Application was submitted for the subject project on July 19, 2017. In support of the application, enclosed are two (2) copies of the Preliminary Drainage Analysis for review and comment. As noted in the text, infiltration testing will be conducted at each of the proposed stormwater management galleries (SMGs) to refine the filtration and infiltration design parameters per NHDES Alteration of Terrain requirements. Upon receipt of the infiltration data, the Drainage Analysis and drawings will be updated as necessary.

If requested, we would welcome the opportunity to the meet with the Town Engineer to discuss the Drainage Analysis. If you have any questions or need any additional information, please call.

Sincerely,

Jeffrey K. Clifford, PE
Vice President

JKC/jkc/4836.008.ccrc.swm.ltr.doc

Enclosures

e-copies w/ enclosures:
Justine Vogel, The RiverWoods Group
Pat Gleason and Heather George, Greystone
Sharon Cutter Somers, Esquire and Stephanie Carty, DTC

Preliminary Drainage Analysis

FOR

RiverWoods Durham

Tax Map 11, Lots 8-1 through 8-15 & Valbeth Lane

Stone Quarry Drive
Durham, New Hampshire

August 2017

Prepared For:

The RiverWoods Group

7 RiverWoods Drive
Exeter, New Hampshire 03833

Prepared By:

ALTUS ENGINEERING, INC.
133 Court Street
Portsmouth, NH 03801-4413
Telephone: (603) 433-2335
Fax: (603) 433-4194

Stormwater Management Checklist

☒	**SITE PLAN REVIEW APPLICATION**	**Project Name**	RiverWoods Durham	
☒	**Date of Submittal** ___/____/_____	**Applicant's Name**	The RiverWoods Group c/o Justine Vogel, CEO	
☒	**Engineer**	Altus Engineering, Inc. Jeffrey K. Clifford, PE	**Architect**	AG Architecture Wauwatosa, WI 53213
☒	**New Development**		☐	**Re-Development**
☒	**Total Area of Disturbance** 330, 540 **Square Feet (SF)**			
	☐	< 10,000 SF and No Water Quality Threat *{No Stormwater Management Plan Required}*		
	☐	< 10,000 SF and Possible Water Quality Threat *{Stormwater Management Plan Required}*		
	☒	> 10,000 SF *{Stormwater Management Plan Required except as provided for in 9.03 (A) with an approved AOT permit}*		
STORMWATER MANAGEMENT PLAN – PART I				
☒	**EXISTING CONDITIONS PLAN**			
	☒	Title Block, Appropriate Scale, Legend, Datum, Locus Plan, Professional Stamp(s)		
	☒	Topographic Contours and benchmarks		
	☒	Buildings, Structures, Wells, Septic Systems, Utilities		
	☒	Water Bodies, Wetlands, Hydrologic Features, Soil Codes, Buffer Zone		
	☐	Area of Impervious Surface _____SF		
	☐	Total Area of Pavement _____SF	Area of Pervious Pavement_____SF	
☒	**PROPOSED CONDITIONS PLAN** (include above existing and below proposed features)			
	☒	Title Block, Appropriate Scale, Legend, Datums, Locus Plan, Professional Stamp(s)		
	☒	Topographic Contours and benchmarks		
	☒	Buildings, Structures, Wells, Septic Systems, Utilities		
	☒	Water Bodies, Wetlands, Hydrologic Features, Soil Codes, Buffer Zone		
	☒	Impervious Surface Area 223210 SF	Impervious Surface Increase 223,210 SF	
	☒	Total Area of Pavement 114,531 SF	Area of Pervious Pavement 14,170 SF	
	☒	Effective Impervious Area (EIA) 0 SF		
	☒	Stormwater Management & Treatment System (Describe System Elements Below)		
		☒	Name of Receiving Waterbody Oyster River	
		☒	Closed Drain & Catch Basin Network	☐ Connected to Town Closed System
		☒	Detention Structure Types Subsurface Stormwater Management Galleries	

		X	Structural BMP Types _____	
		☐	LID Strategies _____	
		X	Estimated Value of Parts to be Town Owned and/or Maintained (Municipal water and sewer extension)	$ T.D.B.

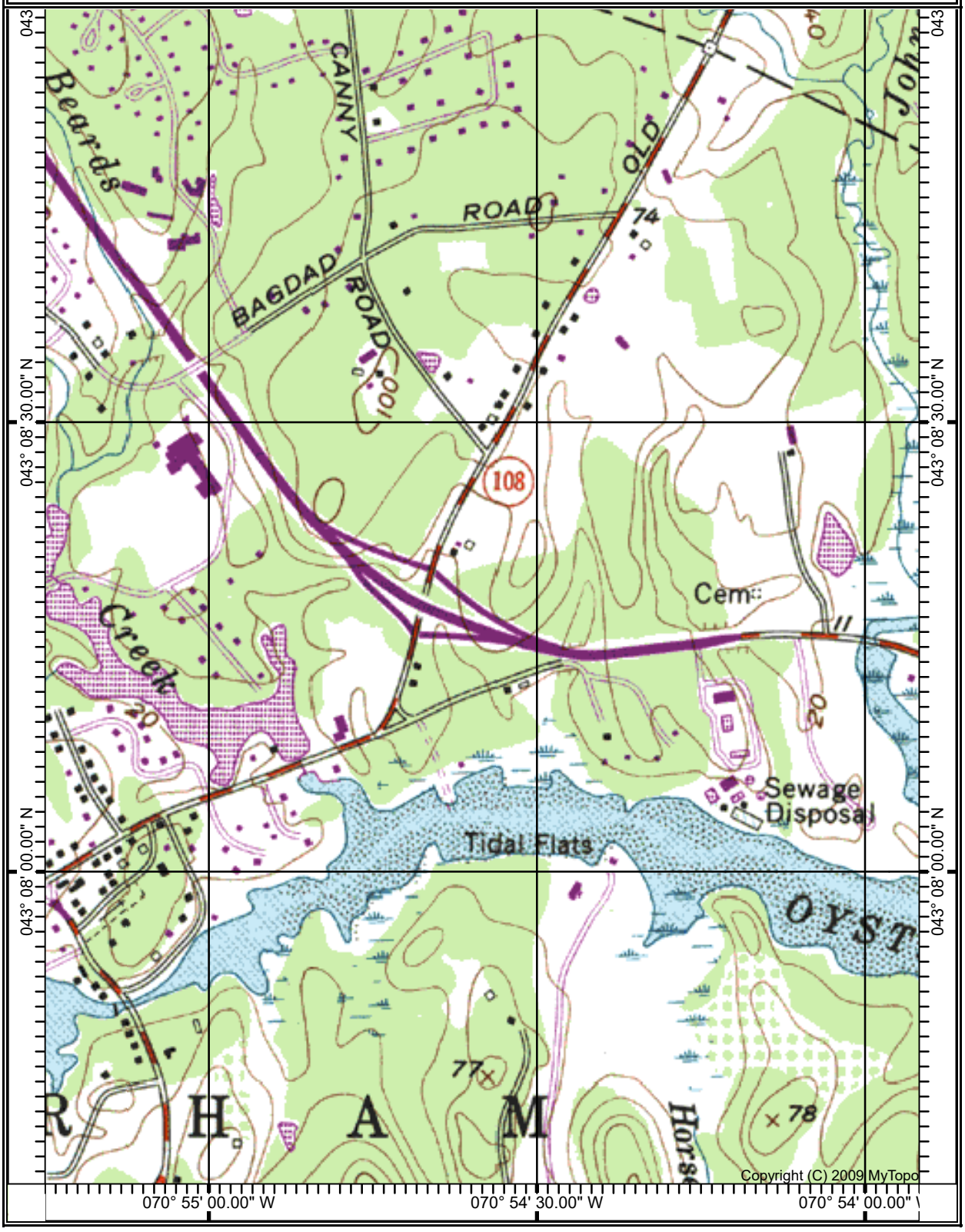
STORMWATER MANAGEMENT PLAN – PART II

X	**DRAINAGE ANALYSIS**				
	24-Hour Storm Event		Runoff	Pre-Development	Post-Development
	X	1-inch	Rate	0.01 Feet^3/Sec (CFS)	0.41 CFS
	X	1-inch	Volume	392 Feet^3 (CF)	10,454 CF
	X	2-Year	Rate	6.93 CFS	5.10 CFS
	X	2-Year	Volume	35,545 CF	72,,179 CF
	X	10-Year	Rate	17.14 CFS	12.18 CFS
	X	10-Year	Volume	80,673 CF	129,025 CF
	X	25-Year	Rate	26.38 CFS	18.56 CFS
	X	25-Year	Volume	121,750 CF	176,723 CF
	X	100-Year	Rate	46.56 CFS	33.14 CFS
X	**EROSION & SEDIMENT CONTROL PLAN**				
X	**OTHER PERMITS OR PLANS REQUIRED BY USEPA or NHDES** (Where applicable)				
	X	USEPA Pre- and Post-Construction Stormwater Pollution Prevention Plan			
	X	NHDES Alteration of Terrain Permit			
	☐	Other (Please list) _____			
X	**OPERATION & MAINTENANCE PLAN**				
☐	**Need for 3rd Party Review?** YES _____ NO _____				

TABLE OF CONTENTS

Map Name: DOVER WEST
Scale: 1 inch = 1,000 ft.

Map Center: 043° 08' 19.42" N 070° 54' 35.01" W
Horizontal Datum: NAD83



SCALE 1:12000

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FEET

PROJECT DESCRIPTION

RiverWoods Durham is a continuing care retirement community (CCRC), proposed by The RiverWoods Group (TRWG) on 11.30-acres of land located off Stone Quarry Drive in Durham, New Hampshire. The project site is an undeveloped commercial subdivision consisting of a paper street known as Valbeth Lane and 15 parcels identified on Durham Tax Map 11 Lots 8-1 through 8-15 (hereinafter the "Subject Parcel"). The subdivision lots and right-of way will be merged and together with the addition of 0.235 acres from a proposed lot line adjustment with Lot 8-0, totaling 11.30-acres. An exchange of 0.93 acres with the Town's abutting property to the east is also proposed.

The subject property abuts Route 4 to the south, Stone Quarry Road and vacant land to the north, Durham's Department of Public Works facility to the east, and commercial property abutting Route 108 to the west. The land cover is a mix of mature woodland, meadow and emerging woodland. Municipal water and sewer mains are located south along Route 108 and will need to be extended to Stone Quarry Drive and into the site.

RiverWoods Durham will be constructed as a single building comprised of independent living wings connected by the commons area to the multi-level supportive living area. A series of three courtyards will be located in the open space between wings of the structure. The site will be accessed via two (2) driveways off Stone Quarry Drive. The driveways circle the building providing excellent access for emergency vehicles. Parking for 107 cars is provided under portions of the independent living areas. An additional 172 spaces are provided at exterior parking lots, of which 18 spaces are located within a car port.

The project will disturb approximately 330,540 square feet or 7.6-acres with 5.19-acres being impervious surfaces, of which 15,302 square feet will be porous pavement. This project dictates that it be done in a single phase requiring the whole site is opened to construction at one time. Double sedimentation barriers are proposed along the perimeter minimizes the possibility of sedimentation leaving the site.

The project will incorporate best management practices to manage stormwater in accordance with local, state and federal regulatory requirements. An Alteration of Terrain (AoT) permit is being submitted to NHDES since construction activities will disturb over 100,000 sf. The project is also subject to USEPA's NPDES Phase II Construction General Permit requirements including filing of a Notice of Intent, preparation of a Stormwater Pollution Prevention Plan (SWPPP) and frequent SWPPP inspection reports.

The stormwater management system for the project will be extensive. Porous pavement will be used at perimeter parking spaces to collect and treat runoff from paved surfaces. Subsurface stormwater management galleries (SMGs) will be used to collect roof runoff and SMGs with water quality inlet structures (WQI) will be used to pretreat other impervious runoff. Each SMG is designed to pass a 100-year storm event. The porous pavement and SMGs have a filtration layer which provides stormwater treatment. For infiltration design, on-site tests will be conducted at each of the SMGs to provide the most accurate infiltration values (versus using published Ksat values for the mapped soils). Peak flows from the site will be attenuated by storing and slowly releasing runoff from the porous

pavement and SMGs. Plunge pools are proposed at each outfall; a level spreader is provided at the westerly outfall. The project team believes that the stormwater management design has been developed with significant sensitivity to the site and environment by keeping the larger stormwater practices within the developed footprint defined by the perimeter retaining walls.

Site topography, existing features, proposed site improvements, proposed grading, closed drainage system and erosion control measures are shown on the accompanying plans.

CALCULATION METHODS

The drainage analysis was completed using HydroCAD v.10. The program generates runoff hydrographs for specified storm distributions, and performs reservoir routing using the storage indication method. The criteria used for this drainage analysis are the 1-inch, 2-year, 10-year and 25-year 24-hour Type III frequency storm events based on Northeast Regional Climate Center "extreme precipitation tables" for the Durham, New Hampshire. The 100-year storm discharge rate was used for assessing BMPs and designing the emergency overflow structures.

Recommended erosion control measures are based upon the *"New Hampshire Stormwater Manual"*, developed in 2008.

The following modeling conservative data and assumptions were incorporated into the analysis:

- Model based on extreme precipitation values published by Cornell/UNH.
- Project area soils and hydrological group based on SSS mapping by GZA GeoEnvironemental, Inc. Additional mapping will be obtained.
- Assumed the soils are HSG C for the triangle parcel that part of the land swap with the Town; GZA shall complete soil survey after land swap is approved by Town council.
- Minimum Tc of 6 minutes SCS TR-55 Urban Hydrology for Small Watersheds indicates that the minimum Tc is 0.1 hour or 6 minutes. The Federal Highway Administration Hydraulic Engineering and NHDOT Drainage Design for Highways states that minimum time of concentration (Tc) for urbanized areas should not be less than 5-minutes. Extremely short Tc times can lead to improbable runoff values and is not appropriate for design.
- Prorated Tc value of 520 (based on UNH Stormwater Center studies where an extended Tc value of 790 minutes has produced good predictions of the final discharge from porous pavement with a 41" base, measured above the underdrains).
- Conservatively, the SMG are preliminary sized based on no infiltration. Upon field tests for Ksat values at each SMG, infiltration will be included in the drainage analysis.

Altus Engineering notes that stormwater modeling is limited in its capacity to precisely predict peak flow rates and flood elevations. Results should not be considered absolute due to the number of variables and assumptions involved in the modeling effort. Surface roughness coefficients (n), entrance loss coefficients (ke), velocity factors (kv), time of concentration (Tc), and tail water conditions are based on subjective field observations and engineering judgment. For design purposes, curve numbers (CN) describe the average conditions. However, curve numbers will vary from storm to storm depending on the antecedent runoff conditions (ARC). Modeling to simulate an actual storm event requires measurement of the pre-storm ARC to adjust the CN for the event. Also, higher flood elevations than predicted by modeling could occur if drainage channels and culverts are not maintained and become blocked by debris before or during the storm event. Siltation, blockage or damage to culverts or storm drains will impact flow capacity of the structures. Structures should be re-evaluated if future changes occur within drainage basins.

SUMMARY

Drainage Analysis

GZA GeoEnvironemental, Inc. completed a site-specific soil survey (SSS) for the site, except for the triangle parcel that part of the land swap with the Town. The soil survey will be completed upon the Town acceptance of the land swap. The survey results are shown on the Sheet G-2.0, Site Specific Soil Map and Sheet WS-1.0, Pre-Development Watershed Plan.

The pre-development watersheds are delineated on the accompanying Sheet WS-1.0, Pre-Development Watershed Plan. The site has a ridge in the middle of the site. Topography rises from the Route 108 side to the ridge then drops approximately 40 feet to a wetland and water course to the east. The ridge line, bisecting the site, creates two (2) watersheds that drain from Stone Quarry Lane southerly under Route 4 and to the Oyster River.

The post-development conditions were analyzed at the same discharge points as the pre-development conditions. The post-development watersheds are delineated on the accompanying Sheet WS-1.1, Post-Development Watershed Plan. Modifications to the delineated areas and associated ground cover were made to sub-catchments to account for the improvements to the property.

A complete summary of the flow conditions is included in Appendix A. The following compares pre- and post-development peak flow rates at each point of analysis.

	Storm Event	POA # 1		POA # 2	
		Runoff c.f.s.	Volume ft^3	Runoff c.f.s.	Volume ft^3
Pre	1"	0.01	261	0.01	174
Post		0.10	4,487	0.33	5,968
Diff.		0.09	4,225	0.32	5,793
Pre	2-yr	4.46	22,695	2.47	12,850
Post		3.25	37,244	2.11	34,935
Diff.		-1.21	14,549	-0.36	22,085
Pre	10-yr	11.21	51,793	5.97	28,880
Post		7.56	69,652	4.78	59,372
Diff.		-3.65	17,860	-1.19	30,492
Pre	25-yr	17.33	78,321	9.09	43,429
Post		11.74	97,400	6.84	79,366
Diff.		-5.59	19,079	-2.25	35,937

Conclusions

Comparison at the property line of the pre- and post-development stormwater runoff conditions indicate no net increase of peak flow due to the development of the property during the 2-, 10- & 25-year storm events. Therefore, peak flows from the development should not adversely impact down gradient abutters. The BMPs are design with emergency overflow structures that will pass the 100-year storm event. Appropriate stormwater practices are being used to treat and infiltrate runoff.

EROSION CONTROL MEASURES

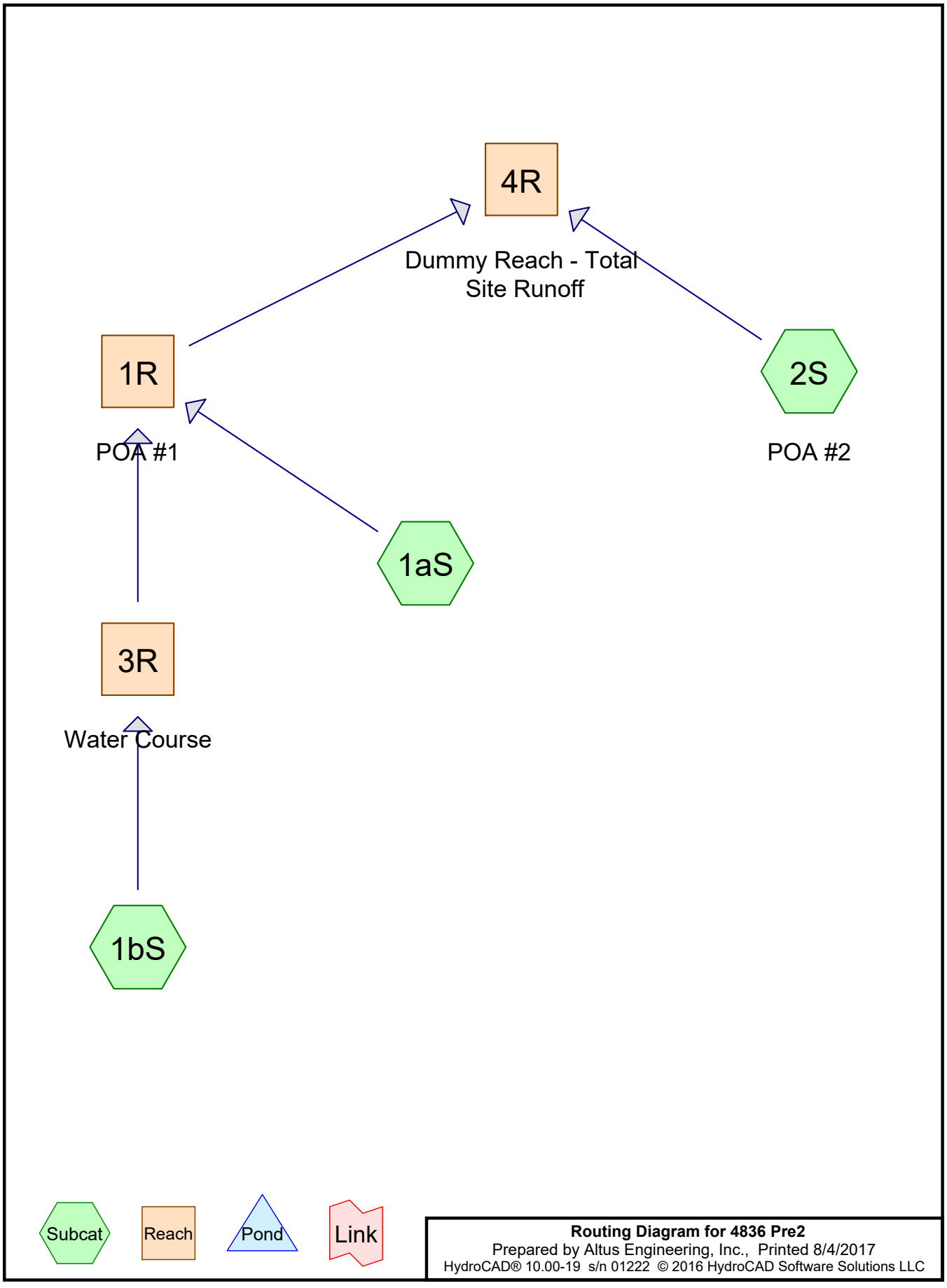
Permanent and temporary measures for erosion and sediment control are shown on the site plans. Temporary erosion control measures include the construction of silt fences, inlet sediment filter, stone check dams, temporary sediment traps and a stabilized construction entrances to minimize the transport of sediments and to prevent erosion during construction. Permanent erosion control measures will include construction of plunge pools, stone lip level spreader, loam and seeded side slopes, porous pavement, water quality inlet structures and subsurface stormwater management galleries.

A complete description of the permanent and temporary erosion control measures can be found on the accompanying plans and detail sheets.

APPENDIX A:

SUPPORTING CALCULATIONS

PRE-DEVELOPMENT CALCULATIONS



Routing Diagram for 4836 Pre2
Prepared by Altus Engineering, Inc., Printed 8/4/2017

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.067	30	Meadow, non-grazed, HSG A (2S)
8.401	70	Woods, Good, HSG C (1aS, 1bS, 2S)
2.833	77	Woods, Good, HSG D (1aS, 1bS, 2S)
11.300	**72**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.067	HSG A	2S
0.000	HSG B	
8.401	HSG C	1aS, 1bS, 2S
2.833	HSG D	1aS, 1bS, 2S
0.000	Other	
11.300		**TOTAL AREA**

Time span=5.00-36.00 hrs, dt=0.01 hrs, 3101 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1aS: Runoff Area=130,244 sf 0.00% Impervious Runoff Depth=0.51"
Flow Length=570' Tc=16.1 min CN=70 Runoff=1.03 cfs 0.127 af

Subcatchment 1bS: Runoff Area=189,381 sf 0.00% Impervious Runoff Depth=0.59"
Flow Length=710' Tc=18.4 min CN=72 Runoff=1.76 cfs 0.213 af

Subcatchment 2S: POA #2 Runoff Area=172,622 sf 0.00% Impervious Runoff Depth=0.59"
Flow Length=700' Tc=21.7 min CN=72 Runoff=1.50 cfs 0.194 af

Reach 1R: POA #1 Avg. Flow Depth=0.36' Max Vel=3.13 fps Inflow=2.66 cfs 0.339 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=24.24 cfs Outflow=2.66 cfs 0.339 af

Reach 3R: Water Course Avg. Flow Depth=0.33' Max Vel=2.26 fps Inflow=1.76 cfs 0.213 af
n=0.040 L=420.0' S=0.0286 '/' Capacity=18.33 cfs Outflow=1.72 cfs 0.213 af

Reach 4R: Dummy Reach - Total Site Avg. Flow Depth=0.32' Max Vel=2.93 fps Inflow=4.16 cfs 0.533 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=50.11 cfs Outflow=4.16 cfs 0.533 af

Total Runoff Area = 11.300 ac Runoff Volume = 0.533 af Average Runoff Depth = 0.57"
100.00% Pervious = 11.300 ac 0.00% Impervious = 0.000 ac

Time span=5.00-36.00 hrs, dt=0.01 hrs, 3101 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1aS: Runoff Area=130,244 sf 0.00% Impervious Runoff Depth=0.79"
Flow Length=570' Tc=16.1 min CN=70 Runoff=1.80 cfs 0.198 af

Subcatchment 1bS: Runoff Area=189,381 sf 0.00% Impervious Runoff Depth=0.89"
Flow Length=710' Tc=18.4 min CN=72 Runoff=2.89 cfs 0.323 af

Subcatchment 2S: POA #2 Runoff Area=172,622 sf 0.00% Impervious Runoff Depth=0.89"
Flow Length=700' Tc=21.7 min CN=72 Runoff=2.47 cfs 0.295 af

Reach 1R: POA #1 Avg. Flow Depth=0.45' Max Vel=3.66 fps Inflow=4.46 cfs 0.521 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=24.24 cfs Outflow=4.46 cfs 0.521 af

Reach 3R: Water Course Avg. Flow Depth=0.42' Max Vel=2.63 fps Inflow=2.89 cfs 0.323 af
n=0.040 L=420.0' S=0.0286 '/' Capacity=18.33 cfs Outflow=2.84 cfs 0.323 af

Reach 4R: Dummy Reach - Total Site Avg. Flow Depth=0.40' Max Vel=3.42 fps Inflow=6.93 cfs 0.816 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=50.11 cfs Outflow=6.93 cfs 0.816 af

Total Runoff Area = 11.300 ac Runoff Volume = 0.816 af Average Runoff Depth = 0.87"
100.00% Pervious = 11.300 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1aS:

Runoff = 1.80 cfs @ 12.25 hrs, Volume= 0.198 af, Depth= 0.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr storm Rainfall=3.14"

Area (sf)	CN	Description
127,425	70	Woods, Good, HSG C
2,819	77	Woods, Good, HSG D
130,244	70	Weighted Average
130,244		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.9	100	0.0900	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.14"
3.5	380	0.1342	1.83		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.7	90	0.0111	2.22	13.35	**Channel Flow,** Area= 6.0 sf Perim= 14.0' r= 0.43' n= 0.040 Winding stream, pools & shoals
16.1	570	Total			

Summary for Subcatchment 1bS:

Runoff = 2.89 cfs @ 12.28 hrs, Volume= 0.323 af, Depth= 0.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr storm Rainfall=3.14"

Area (sf)	CN	Description
140,770	70	Woods, Good, HSG C
48,611	77	Woods, Good, HSG D
189,381	72	Weighted Average
189,381		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0	100	0.0500	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.14"
2.3	225	0.1067	1.63		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.1	385	0.0727	5.69	34.16	**Channel Flow,** Area= 6.0 sf Perim= 14.0' r= 0.43' n= 0.040 Winding stream, pools & shoals
18.4	710	Total			

Summary for Subcatchment 2S: POA #2

Runoff = 2.47 cfs @ 12.33 hrs, Volume= 0.295 af, Depth= 0.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr storm Rainfall=3.14"

Area (sf)	CN	Description
97,739	70	Woods, Good, HSG C
71,960	77	Woods, Good, HSG D
2,923	30	Meadow, non-grazed, HSG A
172,622	72	Weighted Average
172,622		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.3	100	0.0350	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.14"
4.1	350	0.0829	1.44		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.3	250	0.0640	16.53	231.47	**Channel Flow,** Area= 14.0 sf Perim= 6.0' r= 2.33' n= 0.040 Winding stream, pools & shoals
21.7	700	Total			

Summary for Reach 1R: POA #1

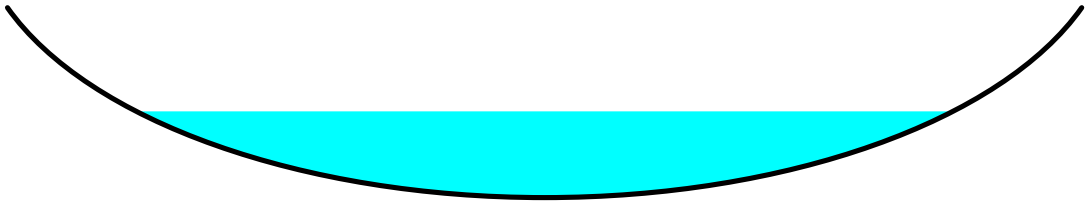
[62] Hint: Exceeded Reach 3R OUTLET depth by 0.04' @ 12.43 hrs

Inflow Area = 7.338 ac, 0.00% Impervious, Inflow Depth = 0.85" for 2-yr storm event
Inflow = 4.46 cfs @ 12.33 hrs, Volume= 0.521 af
Outflow = 4.46 cfs @ 12.33 hrs, Volume= 0.521 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.66 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.42 fps, Avg. Travel Time= 0.0 min

Peak Storage= 1 cf @ 12.33 hrs
Average Depth at Peak Storage= 0.45'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 24.24 cfs

6.00' x 1.00' deep Parabolic Channel, n= 0.040 Winding stream, pools & shoals
Length= 1.0' Slope= 0.0500 '/'
Inlet Invert= 20.00', Outlet Invert= 19.95'



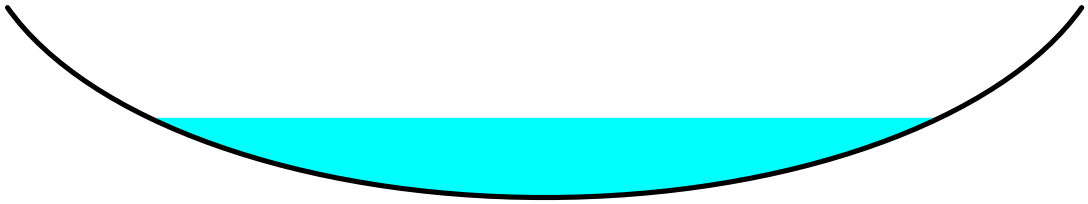
Summary for Reach 3R: Water Course

Inflow Area = 4.348 ac, 0.00% Impervious, Inflow Depth = 0.89" for 2-yr storm event
Inflow = 2.89 cfs @ 12.28 hrs, Volume= 0.323 af
Outflow = 2.84 cfs @ 12.36 hrs, Volume= 0.323 af, Atten= 2%, Lag= 4.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.63 fps, Min. Travel Time= 2.7 min
Avg. Velocity = 1.01 fps, Avg. Travel Time= 7.0 min

Peak Storage= 455 cf @ 12.31 hrs
Average Depth at Peak Storage= 0.42'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 18.33 cfs

6.00' x 1.00' deep Parabolic Channel, n= 0.040 Earth, cobble bottom, clean sides
Length= 420.0' Slope= 0.0286 '/'
Inlet Invert= 32.00', Outlet Invert= 20.00'



Summary for Reach 4R: Dummy Reach - Total Site Runoff

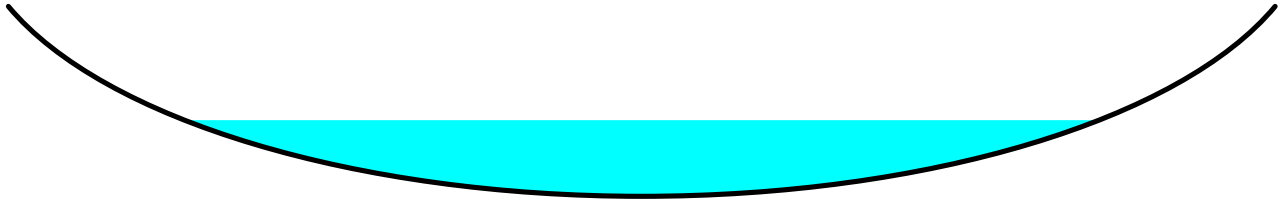
[62] Hint: Exceeded Reach 1R OUTLET depth by 0.01' @ 11.30 hrs

Inflow Area = 11.300 ac, 0.00% Impervious, Inflow Depth = 0.87" for 2-yr storm event
Inflow = 6.93 cfs @ 12.33 hrs, Volume= 0.816 af
Outflow = 6.93 cfs @ 12.33 hrs, Volume= 0.816 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.42 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.32 fps, Avg. Travel Time= 0.0 min

Peak Storage= 2 cf @ 12.33 hrs
Average Depth at Peak Storage= 0.40'
Bank-Full Depth= 1.00' Flow Area= 8.0 sf, Capacity= 50.11 cfs

12.00' x 1.00' deep Parabolic Channel, n= 0.040 Winding stream, pools & shoals
Length= 1.0' Slope= 0.0500 '/'
Inlet Invert= 19.95', Outlet Invert= 19.90'



‡

Time span=5.00-36.00 hrs, dt=0.01 hrs, 3101 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1aS: Runoff Area=130,244 sf 0.00% Impervious Runoff Depth=1.85"
Flow Length=570' Tc=16.1 min CN=70 Runoff=4.64 cfs 0.462 af

Subcatchment 1bS: Runoff Area=189,381 sf 0.00% Impervious Runoff Depth=2.01"
Flow Length=710' Tc=18.4 min CN=72 Runoff=7.00 cfs 0.727 af

Subcatchment 2S: POA #2 Runoff Area=172,622 sf 0.00% Impervious Runoff Depth=2.01"
Flow Length=700' Tc=21.7 min CN=72 Runoff=5.97 cfs 0.663 af

Reach 1R: POA #1 Avg. Flow Depth=0.70' Max Vel=4.82 fps Inflow=11.21 cfs 1.189 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=24.24 cfs Outflow=11.21 cfs 1.189 af

Reach 3R: Water Course Avg. Flow Depth=0.63' Max Vel=3.43 fps Inflow=7.00 cfs 0.727 af
n=0.040 L=420.0' S=0.0286 '/' Capacity=18.33 cfs Outflow=6.94 cfs 0.727 af

Reach 4R: Dummy Reach - Total Site Avg. Flow Depth=0.61' Max Vel=4.52 fps Inflow=17.14 cfs 1.852 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=50.11 cfs Outflow=17.14 cfs 1.852 af

Total Runoff Area = 11.300 ac Runoff Volume = 1.852 af Average Runoff Depth = 1.97"
100.00% Pervious = 11.300 ac 0.00% Impervious = 0.000 ac

Time span=5.00-36.00 hrs, dt=0.01 hrs, 3101 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1aS: Runoff Area=130,244 sf 0.00% Impervious Runoff Depth=2.83"
Flow Length=570' Tc=16.1 min CN=70 Runoff=7.25 cfs 0.705 af

Subcatchment 1bS: Runoff Area=189,381 sf 0.00% Impervious Runoff Depth=3.02"
Flow Length=710' Tc=18.4 min CN=72 Runoff=10.70 cfs 1.093 af

Subcatchment 2S: POA #2 Runoff Area=172,622 sf 0.00% Impervious Runoff Depth=3.02"
Flow Length=700' Tc=21.7 min CN=72 Runoff=9.09 cfs 0.997 af

Reach 1R: POA #1 Avg. Flow Depth=0.85' Max Vel=5.49 fps Inflow=17.33 cfs 1.798 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=24.24 cfs Outflow=17.33 cfs 1.798 af

Reach 3R: Water Course Avg. Flow Depth=0.77' Max Vel=3.90 fps Inflow=10.70 cfs 1.093 af
n=0.040 L=420.0' S=0.0286 '/' Capacity=18.33 cfs Outflow=10.61 cfs 1.093 af

Reach 4R: Dummy Reach - Total Site Avg. Flow Depth=0.74' Max Vel=5.15 fps Inflow=26.38 cfs 2.795 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=50.11 cfs Outflow=26.38 cfs 2.795 af

Total Runoff Area = 11.300 ac Runoff Volume = 2.795 af Average Runoff Depth = 2.97"
100.00% Pervious = 11.300 ac 0.00% Impervious = 0.000 ac

Time span=5.00-36.00 hrs, dt=0.01 hrs, 3101 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1aS: Runoff Area=130,244 sf 0.00% Impervious Runoff Depth=5.02"
Flow Length=570' Tc=16.1 min CN=70 Runoff=12.98 cfs 1.251 af

Subcatchment 1bS: Runoff Area=189,381 sf 0.00% Impervious Runoff Depth=5.26"
Flow Length=710' Tc=18.4 min CN=72 Runoff=18.72 cfs 1.906 af

Subcatchment 2S: POA #2 Runoff Area=172,622 sf 0.00% Impervious Runoff Depth=5.26"
Flow Length=700' Tc=21.7 min CN=72 Runoff=15.90 cfs 1.737 af

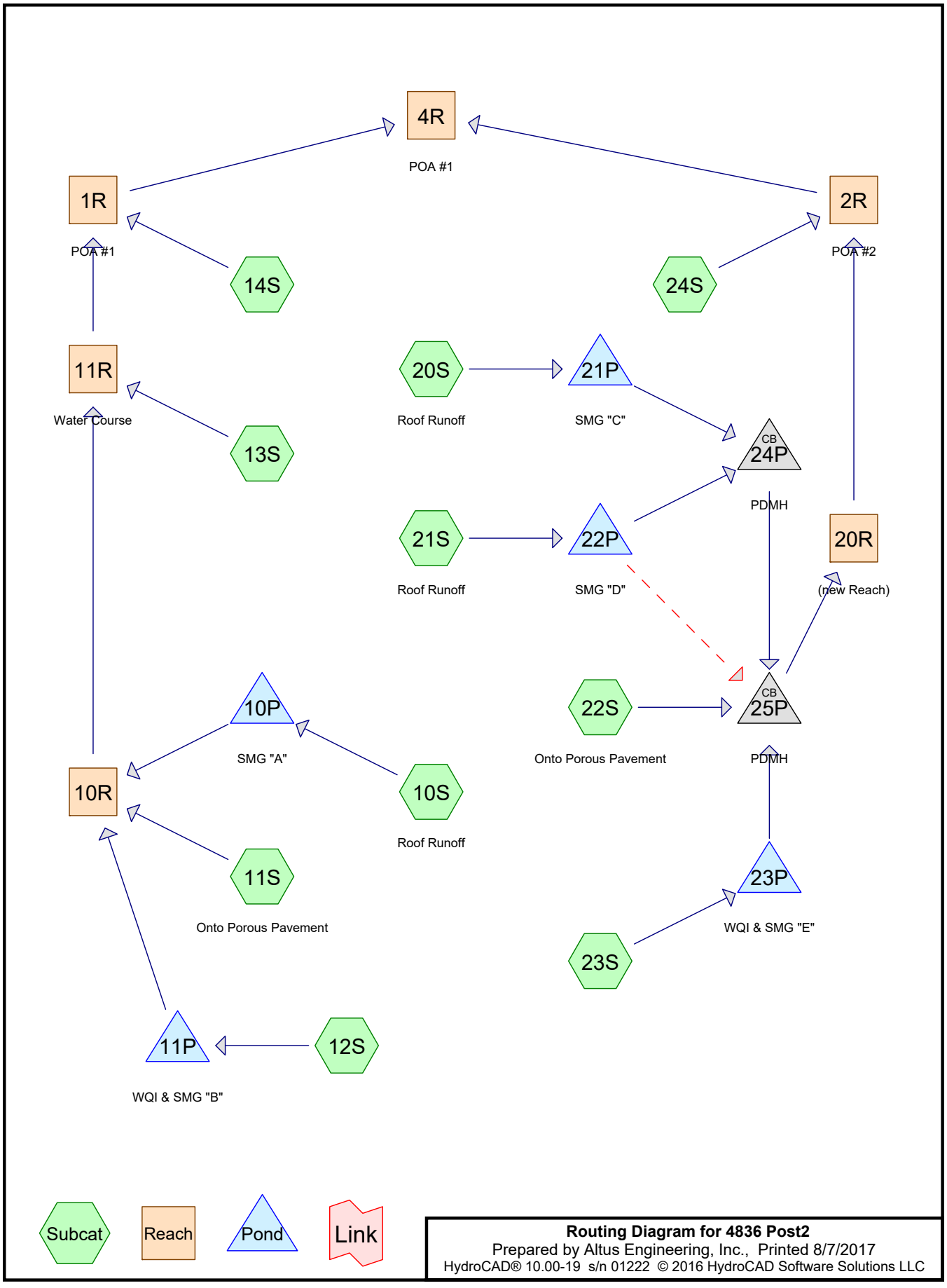
Reach 1R: POA #1 Avg. Flow Depth=1.13' Max Vel=6.46 fps Inflow=30.76 cfs 3.156 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=24.24 cfs Outflow=30.76 cfs 3.156 af

Reach 3R: Water Course Avg. Flow Depth=1.01' Max Vel=4.60 fps Inflow=18.72 cfs 1.906 af
n=0.040 L=420.0' S=0.0286 '/' Capacity=18.33 cfs Outflow=18.58 cfs 1.906 af

Reach 4R: Dummy Reach - Total Site Avg. Flow Depth=0.97' Max Vel=6.12 fps Inflow=46.56 cfs 4.894 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=50.11 cfs Outflow=46.56 cfs 4.894 af

Total Runoff Area = 11.300 ac Runoff Volume = 4.894 af Average Runoff Depth = 5.20"
100.00% Pervious = 11.300 ac 0.00% Impervious = 0.000 ac

POST-DEVELOPMENT CALCULATIONS



Routing Diagram for 4836 Post2
Prepared by Altus Engineering, Inc., Printed 8/7/2017
HydroCAD® 10.00-19 s/n 01222 © 2016 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.011	39	>75% Grass cover, Good, HSG A (24S)
1.817	74	>75% Grass cover, Good, HSG C (10S, 11S, 12S, 13S, 14S, 20S, 21S, 22S, 23S, 24S)
0.382	80	>75% Grass cover, Good, HSG D (20S, 22S, 23S, 24S)
0.017	98	Paved parking, HSG A (22S)
1.976	98	Paved parking, HSG C (10S, 11S, 12S, 21S, 22S, 23S)
0.636	98	Paved parking, HSG D (22S, 23S)
2.192	98	Roofs, HSG C (10S, 11S, 20S, 21S, 23S)
0.325	98	Roofs, HSG D (20S, 21S)
0.039	30	Woods, Good, HSG A (24S)
2.438	70	Woods, Good, HSG C (13S, 14S, 24S)
1.489	77	Woods, Good, HSG D (13S, 14S, 24S)
11.323	**84**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.067	HSG A	22S, 24S
0.000	HSG B	
8.424	HSG C	10S, 11S, 12S, 13S, 14S, 20S, 21S, 22S, 23S, 24S
2.833	HSG D	13S, 14S, 20S, 21S, 22S, 23S, 24S
0.000	Other	
11.323		**TOTAL AREA**

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S: Roof Runoff Runoff Area=28,989 sf 88.10% Impervious Runoff Depth=0.56"
Tc=6.0 min CN=95 Runoff=0.44 cfs 0.031 af

Subcatchment 11S: Onto Porous Pavement Runoff Area=83,395 sf 76.42% Impervious Runoff Depth>0.40"
Tc=480.0 min CN=92 Runoff=0.08 cfs 0.064 af

Subcatchment 12S: Runoff Area=21,083 sf 25.78% Impervious Runoff Depth=0.08"
Flow Length=225' Tc=6.0 min CN=80 Runoff=0.02 cfs 0.003 af

Subcatchment 13S: Runoff Area=96,990 sf 0.00% Impervious Runoff Depth=0.02"
Flow Length=430' Tc=12.8 min CN=74 Runoff=0.01 cfs 0.004 af

Subcatchment 14S: Runoff Area=67,403 sf 0.00% Impervious Runoff Depth=0.01"
Flow Length=330' Tc=11.9 min CN=71 Runoff=0.00 cfs 0.001 af

Subcatchment 20S: Roof Runoff Runoff Area=25,078 sf 73.73% Impervious Runoff Depth=0.45"
Tc=6.0 min CN=93 Runoff=0.30 cfs 0.022 af

Subcatchment 21S: Roof Runoff Runoff Area=53,360 sf 84.83% Impervious Runoff Depth=0.50"
Tc=6.0 min CN=94 Runoff=0.72 cfs 0.051 af

Subcatchment 22S: Onto Porous Pavement Runoff Area=29,551 sf 75.50% Impervious Runoff Depth>0.45"
Tc=480.0 min CN=93 Runoff=0.03 cfs 0.025 af

Subcatchment 23S: Runoff Area=64,178 sf 67.69% Impervious Runoff Depth=0.32"
Flow Length=225' Tc=6.0 min CN=90 Runoff=0.52 cfs 0.039 af

Subcatchment 24S: Runoff Area=23,220 sf 0.00% Impervious Runoff Depth=0.02"
Flow Length=350' Tc=12.8 min CN=73 Runoff=0.00 cfs 0.001 af

Reach 1R: POA #1 Avg. Flow Depth=0.08' Max Vel=1.17 fps Inflow=0.10 cfs 0.103 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=24.24 cfs Outflow=0.10 cfs 0.103 af

Reach 2R: POA #2 Avg. Flow Depth=0.13' Max Vel=1.66 fps Inflow=0.33 cfs 0.137 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=24.24 cfs Outflow=0.33 cfs 0.137 af

Reach 4R: POA #1 Avg. Flow Depth=0.11' Max Vel=1.43 fps Inflow=0.40 cfs 0.240 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=50.11 cfs Outflow=0.40 cfs 0.240 af

Reach 10R: Avg. Flow Depth=0.04' Max Vel=0.98 fps Inflow=0.10 cfs 0.098 af
n=0.030 L=400.0' S=0.0450 '/' Capacity=20.14 cfs Outflow=0.10 cfs 0.098 af

Reach 11R: Water Course Avg. Flow Depth=0.09' Max Vel=0.96 fps Inflow=0.10 cfs 0.102 af
n=0.040 L=420.0' S=0.0286 '/' Capacity=18.33 cfs Outflow=0.10 cfs 0.102 af

Reach 20R: (new Reach) Avg. Flow Depth=0.12' Max Vel=1.88 fps Inflow=0.33 cfs 0.136 af
n=0.040 L=350.0' S=0.0714 '/' Capacity=28.98 cfs Outflow=0.33 cfs 0.136 af

Pond 10P: SMG "A" Peak Elev=52.27' Storage=2,353 cf Inflow=0.44 cfs 0.031 af
Outflow=0.09 cfs 0.031 af

Pond 11P: WQI & SMG "B" Peak Elev=51.03' Storage=1,182 cf Inflow=0.02 cfs 0.003 af
Outflow=0.00 cfs 0.003 af

Pond 21P: SMG "C" Peak Elev=58.25' Storage=1,398 cf Inflow=0.30 cfs 0.022 af
Outflow=0.08 cfs 0.022 af

Pond 22P: SMG "D" Peak Elev=53.00' Storage=3,769 cf Inflow=0.72 cfs 0.051 af
Primary=0.08 cfs 0.026 af Secondary=0.08 cfs 0.026 af Outflow=0.16 cfs 0.051 af

Pond 23P: WQI & SMG "E" Peak Elev=50.20' Storage=3,483 cf Inflow=0.52 cfs 0.039 af
Outflow=0.08 cfs 0.038 af

Pond 24P: PDMH Peak Elev=51.46' Inflow=0.17 cfs 0.047 af
15.0" Round Culvert n=0.013 L=175.0' S=0.0057 '/' Outflow=0.17 cfs 0.047 af

Pond 25P: PDMH Peak Elev=50.28' Inflow=0.33 cfs 0.136 af
18.0" Round Culvert n=0.013 L=10.0' S=0.0100 '/' Outflow=0.33 cfs 0.136 af

Total Runoff Area = 11.323 ac Runoff Volume = 0.242 af Average Runoff Depth = 0.26"
54.54% Pervious = 6.176 ac 45.46% Impervious = 5.147 ac

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S: Roof Runoff Runoff Area=28,989 sf 88.10% Impervious Runoff Depth=2.59"
Tc=6.0 min CN=95 Runoff=1.91 cfs 0.143 af

Subcatchment 11S: Onto Porous Pavement Runoff Area=83,395 sf 76.42% Impervious Runoff Depth>2.28"
Tc=480.0 min CN=92 Runoff=0.47 cfs 0.364 af

Subcatchment 12S: Runoff Area=21,083 sf 25.78% Impervious Runoff Depth=1.36"
Flow Length=225' Tc=6.0 min CN=80 Runoff=0.76 cfs 0.055 af

Subcatchment 13S: Runoff Area=96,990 sf 0.00% Impervious Runoff Depth=1.00"
Flow Length=430' Tc=12.8 min CN=74 Runoff=1.96 cfs 0.185 af

Subcatchment 14S: Runoff Area=67,403 sf 0.00% Impervious Runoff Depth=0.84"
Flow Length=330' Tc=11.9 min CN=71 Runoff=1.13 cfs 0.109 af

Subcatchment 20S: Roof Runoff Runoff Area=25,078 sf 73.73% Impervious Runoff Depth=2.39"
Tc=6.0 min CN=93 Runoff=1.56 cfs 0.115 af

Subcatchment 21S: Roof Runoff Runoff Area=53,360 sf 84.83% Impervious Runoff Depth=2.49"
Tc=6.0 min CN=94 Runoff=3.42 cfs 0.254 af

Subcatchment 22S: Onto Porous Pavement Runoff Area=29,551 sf 75.50% Impervious Runoff Depth>2.37"
Tc=480.0 min CN=93 Runoff=0.17 cfs 0.134 af

Subcatchment 23S: Runoff Area=64,178 sf 67.69% Impervious Runoff Depth=2.11"
Flow Length=225' Tc=6.0 min CN=90 Runoff=3.61 cfs 0.259 af

Subcatchment 24S: Runoff Area=23,220 sf 0.00% Impervious Runoff Depth=0.94"
Flow Length=350' Tc=12.8 min CN=73 Runoff=0.44 cfs 0.042 af

Reach 1R: POA #1 Avg. Flow Depth=0.39' Max Vel=3.32 fps Inflow=3.22 cfs 0.855 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=24.24 cfs Outflow=3.22 cfs 0.855 af

Reach 2R: POA #2 Avg. Flow Depth=0.32' Max Vel=2.91 fps Inflow=2.09 cfs 0.802 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=24.24 cfs Outflow=2.09 cfs 0.802 af

Reach 4R: POA #1 Avg. Flow Depth=0.34' Max Vel=3.10 fps Inflow=4.98 cfs 1.657 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=50.11 cfs Outflow=4.98 cfs 1.657 af

Reach 10R: Avg. Flow Depth=0.10' Max Vel=1.72 fps Inflow=0.61 cfs 0.561 af
n=0.030 L=400.0' S=0.0450 '/' Capacity=20.14 cfs Outflow=0.61 cfs 0.561 af

Reach 11R: Water Course Avg. Flow Depth=0.38' Max Vel=2.45 fps Inflow=2.32 cfs 0.746 af
n=0.040 L=420.0' S=0.0286 '/' Capacity=18.33 cfs Outflow=2.26 cfs 0.746 af

Reach 20R: (new Reach) Avg. Flow Depth=0.28' Max Vel=3.18 fps Inflow=1.87 cfs 0.760 af
n=0.040 L=350.0' S=0.0714 '/' Capacity=28.98 cfs Outflow=1.86 cfs 0.760 af

Pond 10P: SMG "A" Peak Elev=53.23' Storage=4,573 cf Inflow=1.91 cfs 0.143 af
Outflow=0.25 cfs 0.143 af

Pond 11P: WQI & SMG "B" Peak Elev=51.51' Storage=1,846 cf Inflow=0.76 cfs 0.055 af
Outflow=0.24 cfs 0.055 af

Pond 21P: SMG "C" Peak Elev=59.29' Storage=2,840 cf Inflow=1.56 cfs 0.115 af
Outflow=0.47 cfs 0.115 af

Pond 22P: SMG "D" Peak Elev=54.01' Storage=7,589 cf Inflow=3.42 cfs 0.254 af
Primary=0.25 cfs 0.127 af Secondary=0.25 cfs 0.127 af Outflow=0.50 cfs 0.253 af

Pond 23P: WQI & SMG "E" Peak Elev=51.29' Storage=7,487 cf Inflow=3.61 cfs 0.259 af
Outflow=0.89 cfs 0.258 af

Pond 24P: PDMH Peak Elev=51.69' Inflow=0.72 cfs 0.241 af
15.0" Round Culvert n=0.013 L=175.0' S=0.0057 '/' Outflow=0.72 cfs 0.241 af

Pond 25P: PDMH Peak Elev=50.73' Inflow=1.87 cfs 0.760 af
18.0" Round Culvert n=0.013 L=10.0' S=0.0100 '/' Outflow=1.87 cfs 0.760 af

Total Runoff Area = 11.323 ac Runoff Volume = 1.660 af Average Runoff Depth = 1.76"
54.54% Pervious = 6.176 ac 45.46% Impervious = 5.147 ac

Summary for Subcatchment 10S: Roof Runoff

Runoff = 1.91 cfs @ 12.08 hrs, Volume= 0.143 af, Depth= 2.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr storm Rainfall=3.14"

Area (sf)	CN	Description
3,449	74	>75% Grass cover, Good, HSG C
24,496	98	Roofs, HSG C
1,044	98	Paved parking, HSG C
28,989	95	Weighted Average
3,449		11.90% Pervious Area
25,540		88.10% Impervious Area

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

Summary for Subcatchment 11S: Onto Porous Pavement

Runoff = 0.47 cfs @ 18.66 hrs, Volume= 0.364 af, Depth> 2.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr storm Rainfall=3.14"

Area (sf)	CN	Description
19,668	74	>75% Grass cover, Good, HSG C
5,102	98	Roofs, HSG C
58,625	98	Paved parking, HSG C
83,395	92	Weighted Average
19,668		23.58% Pervious Area
63,727		76.42% Impervious Area

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

Summary for Subcatchment 12S:

Runoff = 0.76 cfs @ 12.09 hrs, Volume= 0.055 af, Depth= 1.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr storm Rainfall=3.14"

Area (sf)	CN	Description
15,647	74	>75% Grass cover, Good, HSG C
5,436	98	Paved parking, HSG C
21,083	80	Weighted Average
15,647		74.22% Pervious Area
5,436		25.78% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	75	0.0800	0.28		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.14"
0.8	150	0.0400	3.00		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
5.3	225	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 13S:

Runoff = 1.96 cfs @ 12.19 hrs, Volume= 0.185 af, Depth= 1.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr storm Rainfall=3.14"

Area (sf)	CN	Description
833	74	>75% Grass cover, Good, HSG C
47,546	70	Woods, Good, HSG C
48,611	77	Woods, Good, HSG D
96,990	74	Weighted Average
96,990		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.3	100	0.1300	0.16		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.14"
1.1	100	0.1000	1.58		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.4	230	0.0174	2.79	16.71	**Channel Flow,** Area= 6.0 sf Perim= 14.0' r= 0.43' n= 0.040 Winding stream, pools & shoals
12.8	430	Total			

Summary for Subcatchment 14S:

Runoff = 1.13 cfs @ 12.18 hrs, Volume= 0.109 af, Depth= 0.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr storm Rainfall=3.14"

Area (sf)	CN	Description
7,571	74	>75% Grass cover, Good, HSG C
57,013	70	Woods, Good, HSG C
2,819	77	Woods, Good, HSG D
67,403	71	Weighted Average
67,403		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	100	0.1400	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.14"
1.2	140	0.1500	1.94		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.7	90	0.0111	2.22	13.35	**Channel Flow,** Area= 6.0 sf Perim= 14.0' r= 0.43' n= 0.040 Winding stream, pools & shoals
11.9	330	Total			

Summary for Subcatchment 20S: Roof Runoff

Runoff = 1.56 cfs @ 12.09 hrs, Volume= 0.115 af, Depth= 2.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr storm Rainfall=3.14"

Area (sf)	CN	Description
2,535	74	>75% Grass cover, Good, HSG C
4,053	80	>75% Grass cover, Good, HSG D
12,603	98	Roofs, HSG C
5,887	98	Roofs, HSG D
25,078	93	Weighted Average
6,588		26.27% Pervious Area
18,490		73.73% Impervious Area

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

Summary for Subcatchment 21S: Roof Runoff

Runoff = 3.42 cfs @ 12.08 hrs, Volume= 0.254 af, Depth= 2.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr storm Rainfall=3.14"

Area (sf)	CN	Description
8,093	74	>75% Grass cover, Good, HSG C
33,540	98	Roofs, HSG C
8,290	98	Roofs, HSG D
3,437	98	Paved parking, HSG C
53,360	94	Weighted Average
8,093		15.17% Pervious Area
45,267		84.83% Impervious Area

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

Summary for Subcatchment 22S: Onto Porous Pavement

Runoff = 0.17 cfs @ 18.66 hrs, Volume= 0.134 af, Depth> 2.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr storm Rainfall=3.14"

Area (sf)	CN	Description
1,347	74	>75% Grass cover, Good, HSG C
5,894	80	>75% Grass cover, Good, HSG D
730	98	Paved parking, HSG A
5,100	98	Paved parking, HSG C
16,480	98	Paved parking, HSG D
29,551	93	Weighted Average
7,241		24.50% Pervious Area
22,310		75.50% Impervious Area

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

Summary for Subcatchment 23S:

Runoff = 3.61 cfs @ 12.09 hrs, Volume= 0.259 af, Depth= 2.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr storm Rainfall=3.14"

Area (sf)	CN	Description
18,953	74	>75% Grass cover, Good, HSG C
1,785	80	>75% Grass cover, Good, HSG D
19,761	98	Roofs, HSG C
12,445	98	Paved parking, HSG C
11,234	98	Paved parking, HSG D
64,178	90	Weighted Average
20,738		32.31% Pervious Area
43,440		67.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	50	0.1200	0.30		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.14"
0.9	175	0.0500	3.35		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.7	225	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 24S:

Runoff = 0.44 cfs @ 12.19 hrs, Volume= 0.042 af, Depth= 0.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr storm Rainfall=3.14"

Area (sf)	CN	Description
1,697	30	Woods, Good, HSG A
1,628	70	Woods, Good, HSG C
13,428	77	Woods, Good, HSG D
496	39	>75% Grass cover, Good, HSG A
1,062	74	>75% Grass cover, Good, HSG C
4,909	80	>75% Grass cover, Good, HSG D
23,220	73	Weighted Average
23,220		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0800	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.14"
0.3	250	0.0640	16.53	231.47	**Channel Flow,** Area= 14.0 sf Perim= 6.0' r= 2.33' n= 0.040 Winding stream, pools & shoals
12.8	350	Total			

Summary for Reach 1R: POA #1

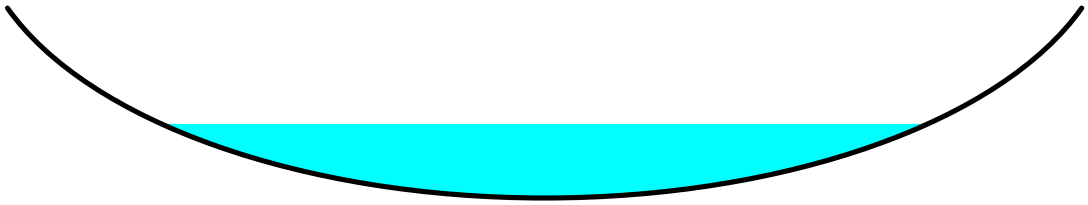
[62] Hint: Exceeded Reach 11R OUTLET depth by 0.02' @ 12.33 hrs

Inflow Area = 6.838 ac, 31.79% Impervious, Inflow Depth > 1.50" for 2-yr storm event
Inflow = 3.22 cfs @ 12.26 hrs, Volume= 0.855 af
Outflow = 3.22 cfs @ 12.26 hrs, Volume= 0.855 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.32 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.34 fps, Avg. Travel Time= 0.0 min

Peak Storage= 1 cf @ 12.26 hrs
Average Depth at Peak Storage= 0.39'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 24.24 cfs

6.00' x 1.00' deep Parabolic Channel, n= 0.040 Winding stream, pools & shoals
Length= 1.0' Slope= 0.0500 '/'
Inlet Invert= 20.00', Outlet Invert= 19.95'



Summary for Reach 2R: POA #2

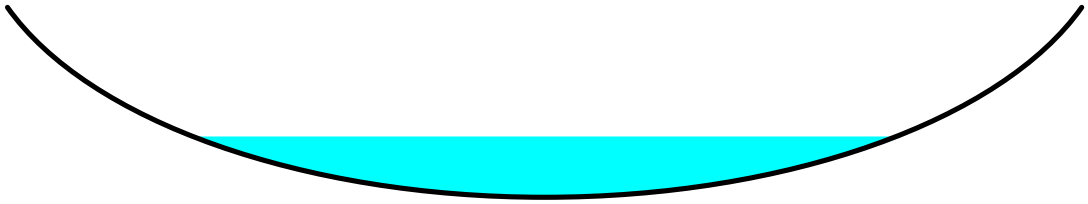
[62] Hint: Exceeded Reach 20R OUTLET depth by 0.05' @ 12.16 hrs

Inflow Area = 4.485 ac, 66.28% Impervious, Inflow Depth > 2.15" for 2-yr storm event
Inflow = 2.09 cfs @ 12.47 hrs, Volume= 0.802 af
Outflow = 2.09 cfs @ 12.47 hrs, Volume= 0.802 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.91 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.29 fps, Avg. Travel Time= 0.0 min

Peak Storage= 1 cf @ 12.47 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 24.24 cfs

6.00' x 1.00' deep Parabolic Channel, n= 0.040 Winding stream, pools & shoals
Length= 1.0' Slope= 0.0500 '/'
Inlet Invert= 24.00', Outlet Invert= 23.95'



Summary for Reach 4R: POA #1

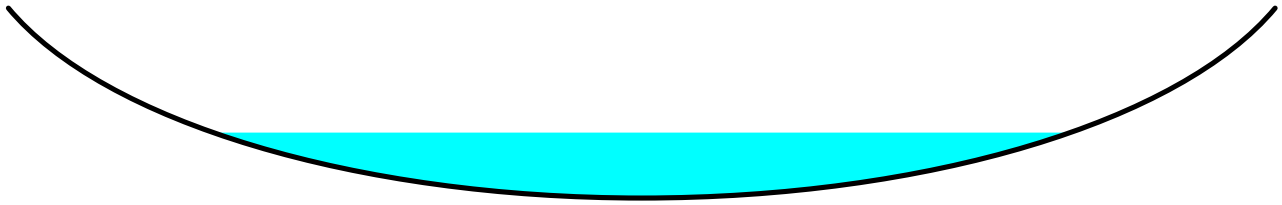
[62] Hint: Exceeded Reach 1R OUTLET depth by 0.03' @ 11.00 hrs

Inflow Area = 11.323 ac, 45.46% Impervious, Inflow Depth > 1.76" for 2-yr storm event
Inflow = 4.98 cfs @ 12.30 hrs, Volume= 1.657 af
Outflow = 4.98 cfs @ 12.30 hrs, Volume= 1.657 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.10 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.33 fps, Avg. Travel Time= 0.0 min

Peak Storage= 2 cf @ 12.30 hrs
Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 1.00' Flow Area= 8.0 sf, Capacity= 50.11 cfs

12.00' x 1.00' deep Parabolic Channel, n= 0.040 Winding stream, pools & shoals
Length= 1.0' Slope= 0.0500 '/'
Inlet Invert= 19.95', Outlet Invert= 19.90'



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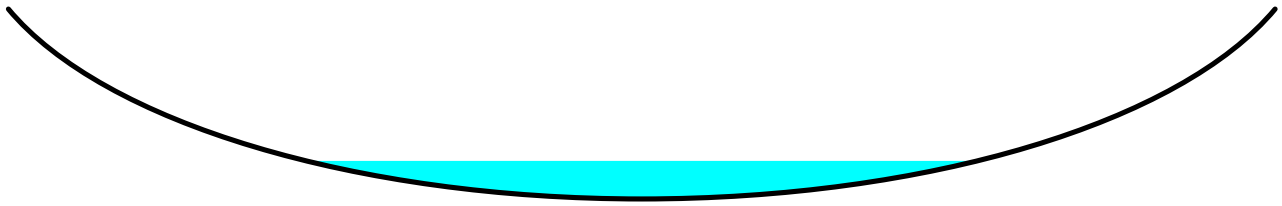
Summary for Reach 10R:

Inflow Area = 3.064 ac, 70.96% Impervious, Inflow Depth > 2.20" for 2-yr storm event
Inflow = 0.61 cfs @ 17.60 hrs, Volume= 0.561 af
Outflow = 0.61 cfs @ 17.71 hrs, Volume= 0.561 af, Atten= 0%, Lag= 6.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.72 fps, Min. Travel Time= 3.9 min
Avg. Velocity = 1.05 fps, Avg. Travel Time= 6.4 min

Peak Storage= 142 cf @ 17.64 hrs
Average Depth at Peak Storage= 0.10'
Bank-Full Depth= 0.50' Flow Area= 4.0 sf, Capacity= 20.14 cfs

12.00' x 0.50' deep Parabolic Channel, n= 0.030 Stream, clean & straight
Length= 400.0' Slope= 0.0450 '/'
Inlet Invert= 48.00', Outlet Invert= 30.00'



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Summary for Reach 11R: Water Course

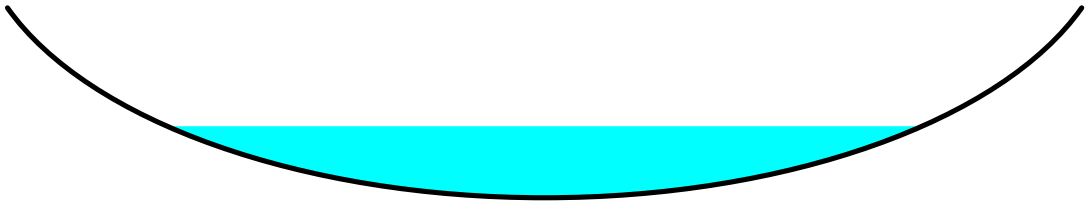
[62] Hint: Exceeded Reach 10R OUTLET depth by 2.29' @ 12.23 hrs

Inflow Area = 5.291 ac, 41.09% Impervious, Inflow Depth > 1.69" for 2-yr storm event
Inflow = 2.32 cfs @ 12.20 hrs, Volume= 0.746 af
Outflow = 2.26 cfs @ 12.29 hrs, Volume= 0.746 af, Atten= 3%, Lag= 5.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.45 fps, Min. Travel Time= 2.9 min
Avg. Velocity = 1.07 fps, Avg. Travel Time= 6.5 min

Peak Storage= 387 cf @ 12.24 hrs
Average Depth at Peak Storage= 0.38'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 18.33 cfs

6.00' x 1.00' deep Parabolic Channel, n= 0.040 Earth, cobble bottom, clean sides
Length= 420.0' Slope= 0.0286 '/'
Inlet Invert= 32.00', Outlet Invert= 20.00'



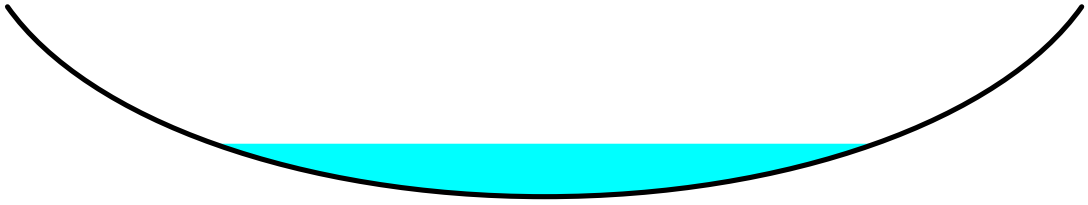
Summary for Reach 20R: (new Reach)

Inflow Area = 3.952 ac, 75.22% Impervious, Inflow Depth > 2.31" for 2-yr storm event
Inflow = 1.87 cfs @ 12.46 hrs, Volume= 0.760 af
Outflow = 1.86 cfs @ 12.51 hrs, Volume= 0.760 af, Atten= 0%, Lag= 3.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.18 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 1.45 fps, Avg. Travel Time= 4.0 min

Peak Storage= 205 cf @ 12.48 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 28.98 cfs

6.00' x 1.00' deep Parabolic Channel, n= 0.040 Earth, cobble bottom, clean sides
Length= 350.0' Slope= 0.0714 '/'
Inlet Invert= 49.00', Outlet Invert= 24.00'



Summary for Pond 10P: SMG "A"

Inflow Area = 0.665 ac, 88.10% Impervious, Inflow Depth = 2.59" for 2-yr storm event
Inflow = 1.91 cfs @ 12.08 hrs, Volume= 0.143 af
Outflow = 0.25 cfs @ 12.62 hrs, Volume= 0.143 af, Atten= 87%, Lag= 32.2 min
Primary = 0.25 cfs @ 12.62 hrs, Volume= 0.143 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Starting Elev= 52.00' Surf.Area= 2,550 sf Storage= 1,784 cf
Peak Elev= 53.23' @ 12.62 hrs Surf.Area= 2,550 sf Storage= 4,573 cf (2,789 cf above start)

Plug-Flow detention time= 329.9 min calculated for 0.102 af (71% of inflow)
Center-of-Mass det. time= 147.8 min (929.4 - 781.6)

Volume	Invert	Avail.Storage	Storage Description
#1	51.25'	7,434 cf	**17' x 150' gallery (Prismatic)**Listed below (Recalc) 11,475 cf Overall - 4,041 cf Embedded = 7,434 cf
#2	52.00'	2,969 cf	**36.0" Round Pipe Storage** x 3 Inside #1 L= 140.0' 4,041 cf Overall - 3.0" Wall Thickness = 2,969 cf
		10,403 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
51.25	2,550	0	0
55.75	2,550	11,475	11,475

Device	Routing	Invert	Outlet Devices
#1	Primary	52.00'	**3.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	53.30'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	54.90'	**4.0' long x 3.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.62 (C= 3.28)

Primary OutFlow Max=0.25 cfs @ 12.62 hrs HW=53.23' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 0.25 cfs @ 5.06 fps)
- **2=Orifice/Grate** (Controls 0.00 cfs)
- **3=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Summary for Pond 11P: WQI & SMG "B"

Inflow Area = 0.484 ac, 25.78% Impervious, Inflow Depth = 1.36" for 2-yr storm event
Inflow = 0.76 cfs @ 12.09 hrs, Volume= 0.055 af
Outflow = 0.24 cfs @ 12.44 hrs, Volume= 0.055 af, Atten= 68%, Lag= 20.9 min
Primary = 0.24 cfs @ 12.44 hrs, Volume= 0.055 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Starting Elev= 51.00' Surf.Area= 1,633 sf Storage= 1,140 cf
Peak Elev= 51.51' @ 12.44 hrs Surf.Area= 1,633 sf Storage= 1,846 cf (706 cf above start)

Plug-Flow detention time= 324.5 min calculated for 0.028 af (52% of inflow)
Center-of-Mass det. time= 65.1 min (908.8 - 843.7)

Volume	Invert	Avail.Storage	Storage Description
#1	50.25'	4,411 cf	**14.9' x 110' gallery (Prismatic)**Listed below (Recalc) 6,532 cf Overall - 2,121 cf Embedded = 4,411 cf
#2	51.00'	1,473 cf	**30.0" Round Pipe Storage** x 3 Inside #1 L= 100.0' 2,121 cf Overall - 3.0" Wall Thickness = 1,473 cf

5,884 cf Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
50.25	1,633	0	0
54.25	1,633	6,532	6,532

Device	Routing	Invert	Outlet Devices
#1	Primary	52.00'	**3.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	51.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	53.40'	**4.0' long x 3.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.62 (C= 3.28)

Primary OutFlow Max=0.25 cfs @ 12.44 hrs HW=51.51' (Free Discharge)
- **1=Orifice/Grate** (Controls 0.00 cfs)
- **2=Orifice/Grate** (Orifice Controls 0.25 cfs @ 2.81 fps)
- **3=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Summary for Pond 21P: SMG "C"

Inflow Area = 0.576 ac, 73.73% Impervious, Inflow Depth = 2.39" for 2-yr storm event
Inflow = 1.56 cfs @ 12.09 hrs, Volume= 0.115 af
Outflow = 0.47 cfs @ 12.41 hrs, Volume= 0.115 af, Atten= 70%, Lag= 19.4 min
Primary = 0.47 cfs @ 12.41 hrs, Volume= 0.115 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Starting Elev= 58.00' Surf.Area= 1,530 sf Storage= 1,074 cf
Peak Elev= 59.29' @ 12.41 hrs Surf.Area= 1,530 sf Storage= 2,840 cf (1,765 cf above start)

Plug-Flow detention time= 216.8 min calculated for 0.090 af (78% of inflow)
Center-of-Mass det. time= 83.2 min (876.6 - 793.3)

Volume	Invert	Avail.Storage	Storage Description
#1	57.25'	4,576 cf	**17' x 80' gallery (Prismatic)**Listed below (Recalc) 6,885 cf Overall - 2,309 cf Embedded = 4,576 cf
#2	58.00'	1,696 cf	**36.0" Round Pipe Storage** x 3 Inside #1 L= 80.0' 2,309 cf Overall - 3.0" Wall Thickness = 1,696 cf
		6,272 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
57.25	1,530	0	0
61.75	1,530	6,885	6,885

Device	Routing	Invert	Outlet Devices
#1	Primary	58.00'	**3.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	59.00'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	60.90'	**4.0' long x 3.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.62 (C= 3.28)

Primary OutFlow Max=0.47 cfs @ 12.41 hrs HW=59.29' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 0.26 cfs @ 5.20 fps)
- **2=Orifice/Grate** (Orifice Controls 0.22 cfs @ 1.83 fps)
- **3=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Summary for Pond 22P: SMG "D"

Inflow Area = 1.225 ac, 84.83% Impervious, Inflow Depth = 2.49" for 2-yr storm event
Inflow = 3.42 cfs @ 12.08 hrs, Volume= 0.254 af
Outflow = 0.50 cfs @ 12.58 hrs, Volume= 0.253 af, Atten= 85%, Lag= 29.8 min
Primary = 0.25 cfs @ 12.58 hrs, Volume= 0.127 af
Secondary = 0.25 cfs @ 12.58 hrs, Volume= 0.127 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Starting Elev= 52.75' Surf.Area= 4,114 sf Storage= 2,898 cf
Peak Elev= 54.01' @ 12.58 hrs Surf.Area= 4,114 sf Storage= 7,589 cf (4,691 cf above start)

Plug-Flow detention time= 286.5 min calculated for 0.187 af (74% of inflow)
Center-of-Mass det. time= 122.7 min (910.4 - 787.7)

Volume	Invert	Avail.Storage	Storage Description
#1	52.00'	8,976 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) 14,702 cf Overall - 5,726 cf Embedded = 8,976 cf
#2	52.75'	4,524 cf	**48.0" Round Pipe Storage** x 3 Inside #1 L= 120.0' 5,726 cf Overall - 3.0" Wall Thickness = 4,524 cf
#3	52.00'	5,063 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) 7,926 cf Overall - 2,863 cf Embedded = 5,063 cf
#4	52.75'	2,262 cf	**48.0" Round Pipe Storage** x 3 Inside #3 L= 60.0' 2,863 cf Overall - 3.0" Wall Thickness = 2,262 cf
		20,825 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
52.00	2,673	0	0
57.50	2,673	14,702	14,702

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
52.00	1,441	0	0
57.50	1,441	7,926	7,926

Device	Routing	Invert	Outlet Devices
#1	Primary	52.75'	**3.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	54.35'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	55.90'	**4.0' long x 4.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.62 (C= 3.28)
#4	Secondary	52.75'	**3.0" Vert. Orifice/Grate** C= 0.600
#5	Secondary	54.35'	**3.0" Vert. Orifice/Grate** C= 0.600

#6	Secondary	55.90'	**4.0' long x 4.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.62 (C= 3.28)

Primary OutFlow Max=0.25 cfs @ 12.58 hrs HW=54.01' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 0.25 cfs @ 5.14 fps)
- **2=Orifice/Grate** (Controls 0.00 cfs)
- **3=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.25 cfs @ 12.58 hrs HW=54.01' (Free Discharge)
- **4=Orifice/Grate** (Orifice Controls 0.25 cfs @ 5.14 fps)
- **5=Orifice/Grate** (Controls 0.00 cfs)
- **6=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Summary for Pond 23P: WQI & SMG "E"

Inflow Area = 1.473 ac, 67.69% Impervious, Inflow Depth = 2.11" for 2-yr storm event
Inflow = 3.61 cfs @ 12.09 hrs, Volume= 0.259 af
Outflow = 0.89 cfs @ 12.48 hrs, Volume= 0.258 af, Atten= 75%, Lag= 23.5 min
Primary = 0.89 cfs @ 12.48 hrs, Volume= 0.258 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Starting Elev= 50.00' Surf.Area= 4,030 sf Storage= 2,826 cf
Peak Elev= 51.29' @ 12.48 hrs Surf.Area= 4,030 sf Storage= 7,487 cf (4,661 cf above start)

Plug-Flow detention time= 285.0 min calculated for 0.193 af (75% of inflow)
Center-of-Mass det. time= 127.7 min (935.3 - 807.6)

Volume	Invert	Avail.Storage	Storage Description
#1	49.25'	12,610 cf	**32.75' x 130' gallery (Prismatic)**Listed below (Recalc) 20,150 cf Overall - 7,540 cf Embedded = 12,610 cf
#2	50.00'	5,773 cf	**42.0" Round Pipe Storage** x 5 Inside #1 L= 120.0' 7,540 cf Overall - 3.0" Wall Thickness = 5,773 cf
		18,383 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
49.25	4,030	0	0
54.25	4,030	20,150	20,150

Device	Routing	Invert	Outlet Devices
#1	Primary	50.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	51.00'	**6.0" Vert. Orifice/Grate X 2.00** C= 0.600
#3	Primary	53.40'	**4.0' long x 3.50' rise Sharp-Crested Vee/Trap Weir** Cv= 2.62 (C= 3.28)

Primary OutFlow Max=0.89 cfs @ 12.48 hrs HW=51.29' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 0.45 cfs @ 5.11 fps)
- **2=Orifice/Grate** (Orifice Controls 0.44 cfs @ 1.84 fps)
- **3=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Summary for Pond 24P: PDMH

Inflow Area = 1.801 ac, 81.28% Impervious, Inflow Depth > 1.61" for 2-yr storm event
Inflow = 0.72 cfs @ 12.42 hrs, Volume= 0.241 af
Outflow = 0.72 cfs @ 12.42 hrs, Volume= 0.241 af, Atten= 0%, Lag= 0.0 min
Primary = 0.72 cfs @ 12.42 hrs, Volume= 0.241 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 51.69' @ 12.42 hrs
Flood Elev= 61.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.25'	**15.0" Round Culvert** L= 175.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.25' / 50.25' S= 0.0057 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=0.71 cfs @ 12.42 hrs HW=51.69' (Free Discharge)
1=Culvert (Barrel Controls 0.71 cfs @ 2.77 fps)

Summary for Pond 25P: PDMH

[81] Warning: Exceeded Pond 23P by 0.08' @ 20.58 hrs
[79] Warning: Submerged Pond 24P Primary device # 1 OUTLET by 0.48'

Inflow Area = 3.952 ac, 75.22% Impervious, Inflow Depth > 2.31" for 2-yr storm event
Inflow = 1.87 cfs @ 12.46 hrs, Volume= 0.760 af
Outflow = 1.87 cfs @ 12.46 hrs, Volume= 0.760 af, Atten= 0%, Lag= 0.0 min
Primary = 1.87 cfs @ 12.46 hrs, Volume= 0.760 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 50.73' @ 12.46 hrs
Flood Elev= 59.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	50.00'	**18.0" Round Culvert** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.00' / 49.90' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=1.86 cfs @ 12.46 hrs HW=50.73' (Free Discharge)
1=Culvert (Barrel Controls 1.86 cfs @ 3.22 fps)

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S: Roof Runoff Runoff Area=28,989 sf 88.10% Impervious Runoff Depth=4.17"
Tc=6.0 min CN=95 Runoff=3.00 cfs 0.231 af

Subcatchment 11S: Onto Porous Pavement Runoff Area=83,395 sf 76.42% Impervious Runoff Depth>3.82"
Tc=480.0 min CN=92 Runoff=0.79 cfs 0.610 af

Subcatchment 12S: Runoff Area=21,083 sf 25.78% Impervious Runoff Depth=2.68"
Flow Length=225' Tc=6.0 min CN=80 Runoff=1.52 cfs 0.108 af

Subcatchment 13S: Runoff Area=96,990 sf 0.00% Impervious Runoff Depth=2.17"
Flow Length=430' Tc=12.8 min CN=74 Runoff=4.49 cfs 0.402 af

Subcatchment 14S: Runoff Area=67,403 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=330' Tc=11.9 min CN=71 Runoff=2.82 cfs 0.249 af

Subcatchment 20S: Roof Runoff Runoff Area=25,078 sf 73.73% Impervious Runoff Depth=3.95"
Tc=6.0 min CN=93 Runoff=2.52 cfs 0.190 af

Subcatchment 21S: Roof Runoff Runoff Area=53,360 sf 84.83% Impervious Runoff Depth=4.06"
Tc=6.0 min CN=94 Runoff=5.44 cfs 0.415 af

Subcatchment 22S: Onto Porous Pavement Runoff Area=29,551 sf 75.50% Impervious Runoff Depth>3.93"
Tc=480.0 min CN=93 Runoff=0.29 cfs 0.222 af

Subcatchment 23S: Runoff Area=64,178 sf 67.69% Impervious Runoff Depth=3.64"
Flow Length=225' Tc=6.0 min CN=90 Runoff=6.08 cfs 0.446 af

Subcatchment 24S: Runoff Area=23,220 sf 0.00% Impervious Runoff Depth=2.09"
Flow Length=350' Tc=12.8 min CN=73 Runoff=1.03 cfs 0.093 af

Reach 1R: POA #1 Avg. Flow Depth=0.58' Max Vel=4.28 fps Inflow=7.51 cfs 1.599 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=24.24 cfs Outflow=7.51 cfs 1.599 af

Reach 2R: POA #2 Avg. Flow Depth=0.47' Max Vel=3.73 fps Inflow=4.77 cfs 1.363 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=24.24 cfs Outflow=4.77 cfs 1.363 af

Reach 4R: POA #1 Avg. Flow Depth=0.52' Max Vel=4.06 fps Inflow=12.06 cfs 2.962 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=50.11 cfs Outflow=12.06 cfs 2.962 af

Reach 10R: Avg. Flow Depth=0.14' Max Vel=2.14 fps Inflow=1.25 cfs 0.949 af
n=0.030 L=400.0' S=0.0450 '/' Capacity=20.14 cfs Outflow=1.24 cfs 0.948 af

Reach 11R: Water Course Avg. Flow Depth=0.55' Max Vel=3.12 fps Inflow=5.13 cfs 1.350 af
n=0.040 L=420.0' S=0.0286 '/' Capacity=18.33 cfs Outflow=5.04 cfs 1.350 af

Reach 20R: (new Reach) Avg. Flow Depth=0.40' Max Vel=4.06 fps Inflow=4.17 cfs 1.271 af
n=0.040 L=350.0' S=0.0714 '/' Capacity=28.98 cfs Outflow=4.17 cfs 1.271 af

Pond 10P: SMG "A" Peak Elev=53.79' Storage=5,874 cf Inflow=3.00 cfs 0.231 af
Outflow=0.77 cfs 0.231 af

Pond 11P: WQI & SMG "B" Peak Elev=52.06' Storage=2,662 cf Inflow=1.52 cfs 0.108 af
Outflow=0.41 cfs 0.108 af

Pond 21P: SMG "C" Peak Elev=59.82' Storage=3,591 cf Inflow=2.52 cfs 0.190 af
Outflow=1.02 cfs 0.190 af

Pond 22P: SMG "D" Peak Elev=54.74' Storage=10,375 cf Inflow=5.44 cfs 0.415 af
Primary=0.67 cfs 0.213 af Secondary=0.44 cfs 0.201 af Outflow=1.12 cfs 0.414 af

Pond 23P: WQI & SMG "E" Peak Elev=51.90' Storage=9,764 cf Inflow=6.08 cfs 0.446 af
Outflow=2.08 cfs 0.445 af

Pond 24P: PDMH Peak Elev=51.94' Inflow=1.64 cfs 0.402 af
15.0" Round Culvert n=0.013 L=175.0' S=0.0057 '/' Outflow=1.64 cfs 0.402 af

Pond 25P: PDMH Peak Elev=51.17' Inflow=4.17 cfs 1.271 af
18.0" Round Culvert n=0.013 L=10.0' S=0.0100 '/' Outflow=4.17 cfs 1.271 af

Total Runoff Area = 11.323 ac Runoff Volume = 2.966 af Average Runoff Depth = 3.14"
54.54% Pervious = 6.176 ac 45.46% Impervious = 5.147 ac

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S: Roof Runoff Runoff Area=28,989 sf 88.10% Impervious Runoff Depth=5.44"
Tc=6.0 min CN=95 Runoff=3.85 cfs 0.302 af

Subcatchment 11S: Onto Porous Pavement Runoff Area=83,395 sf 76.42% Impervious Runoff Depth>5.07"
Tc=480.0 min CN=92 Runoff=1.04 cfs 0.809 af

Subcatchment 12S: Runoff Area=21,083 sf 25.78% Impervious Runoff Depth=3.81"
Flow Length=225' Tc=6.0 min CN=80 Runoff=2.15 cfs 0.154 af

Subcatchment 13S: Runoff Area=96,990 sf 0.00% Impervious Runoff Depth=3.21"
Flow Length=430' Tc=12.8 min CN=74 Runoff=6.72 cfs 0.596 af

Subcatchment 14S: Runoff Area=67,403 sf 0.00% Impervious Runoff Depth=2.92"
Flow Length=330' Tc=11.9 min CN=71 Runoff=4.35 cfs 0.377 af

Subcatchment 20S: Roof Runoff Runoff Area=25,078 sf 73.73% Impervious Runoff Depth=5.21"
Tc=6.0 min CN=93 Runoff=3.27 cfs 0.250 af

Subcatchment 21S: Roof Runoff Runoff Area=53,360 sf 84.83% Impervious Runoff Depth=5.33"
Tc=6.0 min CN=94 Runoff=7.03 cfs 0.544 af

Subcatchment 22S: Onto Porous Pavement Runoff Area=29,551 sf 75.50% Impervious Runoff Depth>5.18"
Tc=480.0 min CN=93 Runoff=0.37 cfs 0.293 af

Subcatchment 23S: Runoff Area=64,178 sf 67.69% Impervious Runoff Depth=4.88"
Flow Length=225' Tc=6.0 min CN=90 Runoff=8.02 cfs 0.599 af

Subcatchment 24S: Runoff Area=23,220 sf 0.00% Impervious Runoff Depth=3.11"
Flow Length=350' Tc=12.8 min CN=73 Runoff=1.56 cfs 0.138 af

Reach 1R: POA #1 Avg. Flow Depth=0.71' Max Vel=4.87 fps Inflow=11.61 cfs 2.236 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=24.24 cfs Outflow=11.61 cfs 2.236 af

Reach 2R: POA #2 Avg. Flow Depth=0.55' Max Vel=4.15 fps Inflow=6.79 cfs 1.822 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=24.24 cfs Outflow=6.79 cfs 1.822 af

Reach 4R: POA #1 Avg. Flow Depth=0.63' Max Vel=4.61 fps Inflow=18.35 cfs 4.057 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=50.11 cfs Outflow=18.35 cfs 4.057 af

Reach 10R: Avg. Flow Depth=0.17' Max Vel=2.41 fps Inflow=1.84 cfs 1.264 af
n=0.030 L=400.0' S=0.0450 '/' Capacity=20.14 cfs Outflow=1.83 cfs 1.263 af

Reach 11R: Water Course Avg. Flow Depth=0.67' Max Vel=3.56 fps Inflow=7.92 cfs 1.859 af
n=0.040 L=420.0' S=0.0286 '/' Capacity=18.33 cfs Outflow=7.80 cfs 1.859 af

Reach 20R: (new Reach) Avg. Flow Depth=0.47' Max Vel=4.47 fps Inflow=5.72 cfs 1.683 af
n=0.040 L=350.0' S=0.0714 '/' Capacity=28.98 cfs Outflow=5.72 cfs 1.683 af

Pond 10P: SMG "A" Peak Elev=54.20' Storage=6,844 cf Inflow=3.85 cfs 0.302 af
Outflow=1.11 cfs 0.301 af

Pond 11P: WQI & SMG "B" Peak Elev=52.48' Storage=3,278 cf Inflow=2.15 cfs 0.154 af
Outflow=0.62 cfs 0.154 af

Pond 21P: SMG "C" Peak Elev=60.31' Storage=4,272 cf Inflow=3.27 cfs 0.250 af
Outflow=1.32 cfs 0.250 af

Pond 22P: SMG "D" Peak Elev=55.23' Storage=12,240 cf Inflow=7.03 cfs 0.544 af
Primary=1.11 cfs 0.294 af Secondary=0.57 cfs 0.249 af Outflow=1.68 cfs 0.543 af

Pond 23P: WQI & SMG "E" Peak Elev=52.46' Storage=11,846 cf Inflow=8.02 cfs 0.599 af
Outflow=2.72 cfs 0.597 af

Pond 24P: PDMH Peak Elev=52.11' Inflow=2.40 cfs 0.544 af
15.0" Round Culvert n=0.013 L=175.0' S=0.0057 '/' Outflow=2.40 cfs 0.544 af

Pond 25P: PDMH Peak Elev=51.43' Inflow=5.72 cfs 1.683 af
18.0" Round Culvert n=0.013 L=10.0' S=0.0100 '/' Outflow=5.72 cfs 1.683 af

Total Runoff Area = 11.323 ac Runoff Volume = 4.061 af Average Runoff Depth = 4.30"
54.54% Pervious = 6.176 ac 45.46% Impervious = 5.147 ac

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S: Roof Runoff Runoff Area=28,989 sf 88.10% Impervious Runoff Depth=6.61"
Tc=6.0 min CN=95 Runoff=4.64 cfs 0.367 af

Subcatchment 11S: Onto Porous Pavement Runoff Area=83,395 sf 76.42% Impervious Runoff Depth>6.23"
Tc=480.0 min CN=92 Runoff=1.27 cfs 0.994 af

Subcatchment 12S: Runoff Area=21,083 sf 25.78% Impervious Runoff Depth=4.89"
Flow Length=225' Tc=6.0 min CN=80 Runoff=2.74 cfs 0.197 af

Subcatchment 13S: Runoff Area=96,990 sf 0.00% Impervious Runoff Depth=4.23"
Flow Length=430' Tc=12.8 min CN=74 Runoff=8.85 cfs 0.784 af

Subcatchment 14S: Runoff Area=67,403 sf 0.00% Impervious Runoff Depth=3.90"
Flow Length=330' Tc=11.9 min CN=71 Runoff=5.83 cfs 0.503 af

Subcatchment 20S: Roof Runoff Runoff Area=25,078 sf 73.73% Impervious Runoff Depth=6.38"
Tc=6.0 min CN=93 Runoff=3.95 cfs 0.306 af

Subcatchment 21S: Roof Runoff Runoff Area=53,360 sf 84.83% Impervious Runoff Depth=6.50"
Tc=6.0 min CN=94 Runoff=8.48 cfs 0.663 af

Subcatchment 22S: Onto Porous Pavement Runoff Area=29,551 sf 75.50% Impervious Runoff Depth>6.35"
Tc=480.0 min CN=93 Runoff=0.46 cfs 0.359 af

Subcatchment 23S: Runoff Area=64,178 sf 67.69% Impervious Runoff Depth=6.03"
Flow Length=225' Tc=6.0 min CN=90 Runoff=9.80 cfs 0.740 af

Subcatchment 24S: Runoff Area=23,220 sf 0.00% Impervious Runoff Depth=4.12"
Flow Length=350' Tc=12.8 min CN=73 Runoff=2.07 cfs 0.183 af

Reach 1R: POA #1 Avg. Flow Depth=0.81' Max Vel=5.33 fps Inflow=15.66 cfs 2.843 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=24.24 cfs Outflow=15.66 cfs 2.843 af

Reach 2R: POA #2 Avg. Flow Depth=0.61' Max Vel=4.42 fps Inflow=8.36 cfs 2.249 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=24.24 cfs Outflow=8.36 cfs 2.249 af

Reach 4R: POA #1 Avg. Flow Depth=0.71' Max Vel=5.01 fps Inflow=23.99 cfs 5.092 af
n=0.040 L=1.0' S=0.0500 '/' Capacity=50.11 cfs Outflow=23.99 cfs 5.092 af

Reach 10R: Avg. Flow Depth=0.18' Max Vel=2.57 fps Inflow=2.27 cfs 1.557 af
n=0.030 L=400.0' S=0.0450 '/' Capacity=20.14 cfs Outflow=2.26 cfs 1.557 af

Reach 11R: Water Course Avg. Flow Depth=0.77' Max Vel=3.88 fps Inflow=10.57 cfs 2.341 af
n=0.040 L=420.0' S=0.0286 '/' Capacity=18.33 cfs Outflow=10.42 cfs 2.340 af

Reach 20R: (new Reach) Avg. Flow Depth=0.51' Max Vel=4.72 fps Inflow=6.85 cfs 2.066 af
n=0.040 L=350.0' S=0.0714 '/' Capacity=28.98 cfs Outflow=6.85 cfs 2.066 af

Pond 10P: SMG "A" Peak Elev=54.63' Storage=7,814 cf Inflow=4.64 cfs 0.367 af
Outflow=1.35 cfs 0.366 af

Pond 11P: WQI & SMG "B" Peak Elev=52.90' Storage=3,907 cf Inflow=2.74 cfs 0.197 af
Outflow=0.76 cfs 0.197 af

Pond 21P: SMG "C" Peak Elev=60.77' Storage=4,910 cf Inflow=3.95 cfs 0.306 af
Outflow=1.55 cfs 0.306 af

Pond 22P: SMG "D" Peak Elev=55.72' Storage=14,148 cf Inflow=8.48 cfs 0.663 af
Primary=1.40 cfs 0.371 af Secondary=0.66 cfs 0.291 af Outflow=2.06 cfs 0.663 af

Pond 23P: WQI & SMG "E" Peak Elev=53.00' Storage=13,808 cf Inflow=9.80 cfs 0.740 af
Outflow=3.21 cfs 0.739 af

Pond 24P: PDMH Peak Elev=52.22' Inflow=2.93 cfs 0.677 af
15.0" Round Culvert n=0.013 L=175.0' S=0.0057 '/' Outflow=2.93 cfs 0.677 af

Pond 25P: PDMH Peak Elev=51.62' Inflow=6.85 cfs 2.066 af
18.0" Round Culvert n=0.013 L=10.0' S=0.0100 '/' Outflow=6.85 cfs 2.066 af

Total Runoff Area = 11.323 ac Runoff Volume = 5.096 af Average Runoff Depth = 5.40"
54.54% Pervious = 6.176 ac 45.46% Impervious = 5.147 ac

APPENDIX B:

HYDROLOGICAL DATA

Extreme Precipitation Tables

Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Smoothing	Yes
State	New Hampshire
Location	
Longitude	70.908 degrees West
Latitude	43.140 degrees North
Elevation	0 feet
Date/Time	Wed, 12 Jul 2017 16:57:08 -0400

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.26	0.40	0.50	0.65	0.81	1.03	**1yr**	0.70	0.98	1.20	1.55	2.00	2.61	2.85	**1yr**	2.31	2.74	3.14	3.86	4.44	**1yr**
2yr	0.32	0.49	0.61	0.81	1.01	1.29	**2yr**	0.88	1.17	1.50	1.91	2.44	3.14	3.48	**2yr**	2.78	3.35	3.84	4.58	5.21	**2yr**
5yr	0.37	0.57	0.72	0.96	1.23	1.58	**5yr**	1.06	1.44	1.85	2.38	3.07	3.98	4.46	**5yr**	3.52	4.29	4.90	5.79	6.55	**5yr**
10yr	0.40	0.63	0.80	1.09	1.42	1.85	**10yr**	1.22	1.69	2.18	2.82	3.66	4.75	5.39	**10yr**	4.21	5.18	5.90	6.92	7.80	**10yr**
25yr	0.46	0.74	0.94	1.29	1.72	2.27	**25yr**	1.48	2.09	2.69	3.53	4.62	6.03	6.92	**25yr**	5.33	6.65	7.54	8.77	9.82	**25yr**
50yr	0.51	0.83	1.06	1.48	1.99	2.66	**50yr**	1.72	2.46	3.18	4.19	5.50	7.21	8.36	**50yr**	6.38	8.04	9.07	10.50	11.70	**50yr**
100yr	0.58	0.93	1.20	1.70	2.31	3.12	**100yr**	2.00	2.89	3.74	4.96	6.55	8.64	10.11	**100yr**	7.64	9.72	10.92	12.57	13.95	**100yr**
200yr	0.64	1.04	1.35	1.94	2.69	3.66	**200yr**	2.32	3.40	4.42	5.90	7.83	10.34	12.22	**200yr**	9.15	11.75	13.16	15.05	16.63	**200yr**
500yr	0.75	1.24	1.61	2.34	3.28	4.52	**500yr**	2.83	4.21	5.49	7.39	9.87	13.14	15.72	**500yr**	11.63	15.12	16.83	19.11	21.01	**500yr**

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.24	0.37	0.45	0.60	0.74	0.90	**1yr**	0.64	0.88	0.91	1.26	1.57	2.04	2.51	**1yr**	1.80	2.41	2.91	3.28	4.01	**1yr**
2yr	0.31	0.49	0.60	0.81	1.00	1.18	**2yr**	0.86	1.16	1.36	1.83	2.36	3.04	3.39	**2yr**	2.69	3.26	3.74	4.46	5.05	**2yr**
5yr	0.35	0.54	0.67	0.92	1.16	1.40	**5yr**	1.01	1.37	1.62	2.15	2.78	3.72	4.13	**5yr**	3.29	3.97	4.59	5.43	6.14	**5yr**
10yr	0.38	0.59	0.73	1.02	1.32	1.60	**10yr**	1.14	1.56	1.82	2.45	3.13	4.29	4.81	**10yr**	3.80	4.63	5.33	6.29	7.07	**10yr**
25yr	0.44	0.67	0.83	1.18	1.56	1.91	**25yr**	1.34	1.87	2.11	2.85	3.66	5.01	5.85	**25yr**	4.43	5.63	6.53	7.66	8.53	**25yr**
50yr	0.48	0.73	0.91	1.31	1.77	2.19	**50yr**	1.53	2.14	2.36	3.20	4.11	5.74	6.78	**50yr**	5.08	6.52	7.61	8.88	9.83	**50yr**
100yr	0.54	0.81	1.02	1.47	2.02	2.50	**100yr**	1.74	2.45	2.64	3.59	4.60	6.56	7.85	**100yr**	5.81	7.55	8.87	10.29	11.30	**100yr**
200yr	0.60	0.90	1.14	1.65	2.30	2.86	**200yr**	1.99	2.80	2.94	4.01	5.14	7.50	9.09	**200yr**	6.64	8.74	10.35	11.94	13.02	**200yr**

TABLE 6-4.1 -- RUNOFF CURVE NUMBERS (Average Watershed Condition)

COVER DESCRIPTION Cover type and hydrologic condition	Average percent impervious area[2]	CURVE NUMBERS FOR HYDROLOGIC SOIL GROUP A	B	C	D
FULLY DEVELOPED URBAN AREAS[1] (Vegetation Established)					
Lawns, open spaces, parks, golf courses, cemeteries, etc.					
good condition; grass cover on 75% or more of the area		39	61	74	80
fair condition; grass cover on 50% to 75% of the area		49	69	79	84
poor condition; grass cover on 50% or less of the area		68	79	86	89
Paved parking lots, roofs, driveways, etc.		98	98	98	98
Streets and roads;					
paved with curbs and storm sewers		98	98	98	98
gravel		76	85	89	91
dirt		72	82	87	89
paved with open ditches		83	89	92	93
Commercial and business areas	85	89	92	94	95
Industrial districts	72	81	88	91	93
Row houses, town houses, and residential with lot sizes 1/8 acre or less	65	77	85	90	92
Residential					
Average lot size					
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acre	12	46	65	77	82
DEVELOPING URBAN AREAS[3] (No vegetation Established)					
Newly graded area		77	86	91	94

1. For land uses with impervious areas, curve numbers are computed assuming that 100% of runoff from impervious areas is directly connected to the drainage system. Pervious areas (lawn) are considered to be equivalent to lawns in good condition and the impervious areas have an RCN of 98.

2. Includes paved streets.

3. Use for the design of temporary measures during grading and construction. Impervious area percent for urban areas under development vary considerably. The user will determine the percent impervious. Then using the newly graded area RCN and Table 6-4, the composite RCN can be computed for any degree of development.

Source: USDA Soil Conservation Service

TABLE 6-4.3 -- RUNOFF CURVE NUMBERS (Average Watershed Condition)

COVER DESCRIPTION Cover type and hydrologic condition	Hydrologic condition[6]	CURVE NUMBERS FOR HYDROLOGIC SOIL GROUP A	B	C	D
NON-CULTIVATED AGRICULTURAL LAND					
Pasture, grassland, or range - continuous forage for grazing	poor	68	79	86	89
	fair	49	69	79	84
	good	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	---	30	58	71	78
Woods-grass combination (orchard or tree farm)	poor	57	73	82	86
	fair	43	65	76	82
	good	32	58	72	79
Brush - brush-weed-grass mixture with brush the major element	poor	48	67	77	83
	fair	35	56	70	77
	good	30	48	65	73
Woods	poor	45	66	77	83
	fair	36	60	73	79
	good	30	55	70	77
Farmsteads - buildings, lanes, driveways, and surrounding lots	---	59	74	82	86

6. Poor hydrologic condition has less than 50 percent ground cover density.
Fair hydrologic condition has between 50 and 75 percent ground cover density.
Good hydrologic condition has more than 75 percent ground cover density.

Source: USDA Soil Conservation Service

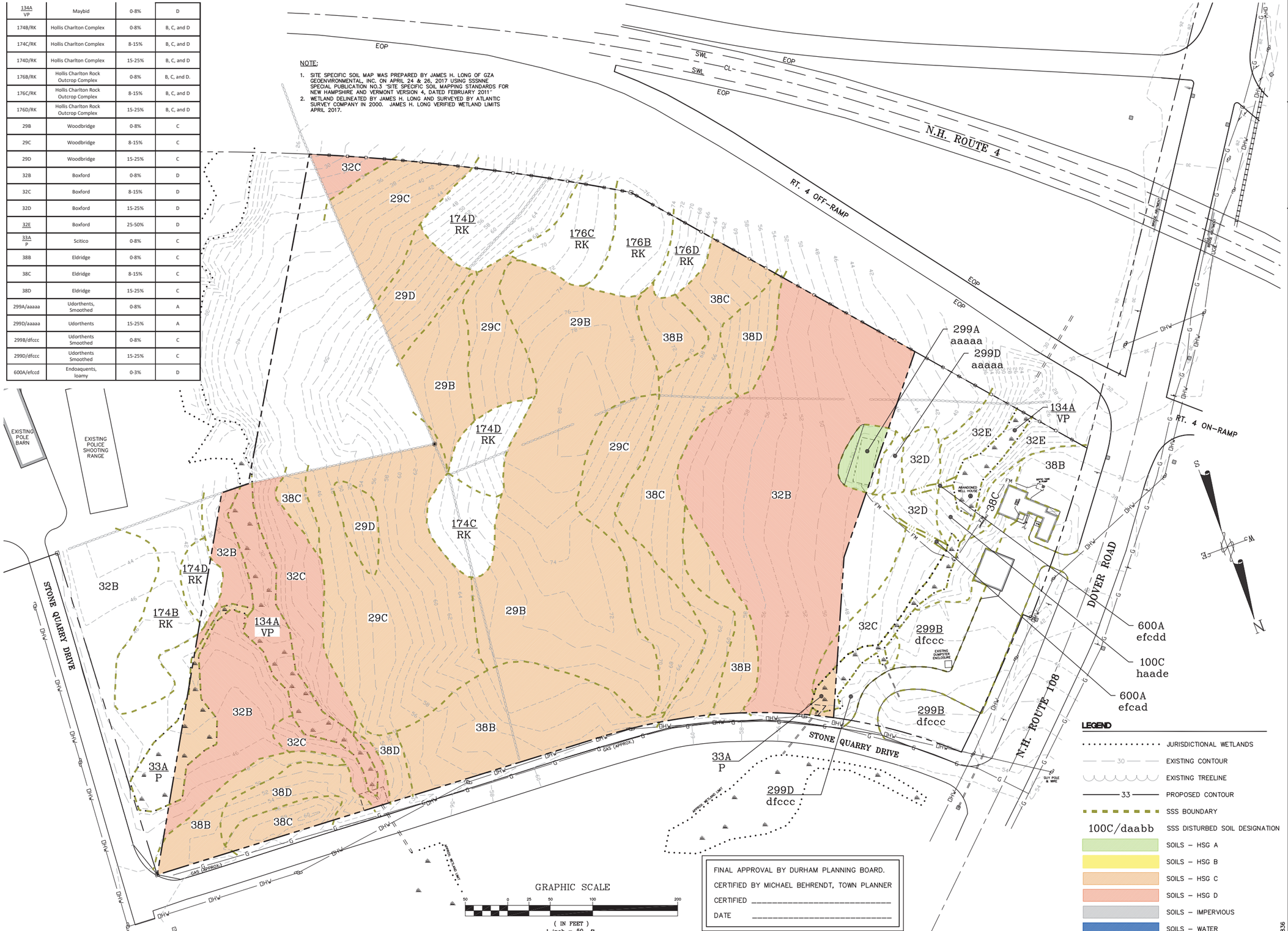
APPENDIX C:

WATERSHED PLANS

134A VP	Maybid	0-8%	D
174B/RK	Hollis Charlton Complex	0-8%	B, C, and D
174C/RK	Hollis Charlton Complex	8-15%	B, C, and D
174D/RK	Hollis Charlton Complex	15-25%	B, C, and D
176B/RK	Hollis Charlton Rock Outcrop Complex	0-8%	B, C, and D.
176C/RK	Hollis Charlton Rock Outcrop Complex	8-15%	B, C, and D
176D/RK	Hollis Charlton Rock Outcrop Complex	15-25%	B, C, and D
29B	Woodbridge	0-8%	C
29C	Woodbridge	8-15%	C
29D	Woodbridge	15-25%	C
32B	Boxford	0-8%	D
32C	Boxford	8-15%	D
32D	Boxford	15-25%	D
32E	Boxford	25-50%	D
33A P	Scitico	0-8%	C
38B	Eldridge	0-8%	C
38C	Eldridge	8-15%	C
38D	Eldridge	15-25%	C
299A/aaaaa	Udorthents, Smoothed	0-8%	A
299D/aaaaa	Udorthents	15-25%	A
299B/dfccc	Udorthents Smoothed	0-8%	C
299D/dfccc	Udorthents Smoothed	15-25%	C
600A/efccd	Endoaquents, loamy	0-3%	D

NOTE:

1. SITE SPECIFIC SOIL MAP WAS PREPARED BY JAMES H. LONG OF GZA GEOENVIRONMENTAL, INC. ON APRIL 24 & 26, 2017 USING SSSNNE SPECIAL PUBLICATION NO.3 "SITE SPECIFIC SOIL MAPPING STANDARDS FOR NEW HAMPSHIRE AND VERMONT VERSION 4, DATED FEBRUARY 2011"
2. WETLAND DELINEATED BY JAMES H. LONG AND SURVEYED BY ATLANTIC SURVEY COMPANY IN 2000. JAMES H. LONG VERIFIED WETLAND LIMITS APRIL 2017.



ALTUS ENGINEERING, INC.
133 COURT STREET PORTSMOUTH, NH 03801
VOICE: (603) 433-2335
FAX: (603) 433-4194

GZA GeoEnvironmental, Inc.
5 Commerce Park North
Bedford, New Hampshire 03110
Tel. (603) 232-8739

THIS DRAWING HAS NOT BEEN RELEASED FOR CONSTRUCTION

ISSUED FOR: APPROVAL

ISSUE DATE: JULY 19, 2017

REVISIONS

NO.	DESCRIPTION	BY	DATE
0	INITIAL SUBMISSION	JKC	7/19/17

DRAWN BY: RMB
APPROVED BY: JKC
DRAWING FILE: 4836SITE.DWG

SCALE: 1 " = 50'

LAND OWNER – SUBJECT PARCEL:

ROCKINGHAM PROPERTIES 1, LTD
P.O. BOX 423
BELMONT, MA 02178

APPLICANT:

THE RIVERWOODS GROUP
7 RIVERWOODS DRIVE
EXETER, NH 03833

PROJECT:

RIVERWOODS DURHAM
STONE QUARRY DRIVE
DURHAM, NH

TITLE:

SITE SPECIFIC SOILS MAP

SHEET NUMBER:

G - 2.0

POINT OF ANALYSIS #1

SUBCATCHMENT BOUNDARY (TYP.)

REACH (TYP.)

SUBCATCHMENT IDENTIFIER (TYP.)

LONGEST FLOW PATH (TYP.)

POINT OF ANALYSIS #2

EOP

SWL

CL

N.H. ROUTE 4

RT. 4 OFF-RAMP

RT. 4 ON-RAMP

SNOW DISPOSAL AREA

EXISTING POLE BARN

EXISTING POLICE SHOOTING RANGE

STONE QUARRY DRIVE

DOVER ROAD

N.H. ROUTE 108

ABANDONED WELL HEAD

EXISTING DUMPSTER ENCLOSURE

32C 29C 174D RK 176C RK 176B RK 176D RK 29D 1a 29C 29B 38C 38B 38D 174D RK 29C 2 38C 32B 32D 32E 32E 38B 38C 32D 174C RK 1b 29D 32B 174D RK 32C 29C 29B 32C 174B RK 134A VP 38B 32B 32C 38D 33A P 38D 38B 38C 38B 32C 299B dfccc 299B dfccc 299D dfccc 33A P 299A aaaaa 299D aaaaa 134A VP 600A efcdd 100C haade 600A efcad

GRAPHIC SCALE

50 0 25 50 100 200

(IN FEET)

1 inch = 50 ft.

P4836

ALTUS ENGINEERING, INC.

133 COURT STREET PORTSMOUTH, NH 03801

VOICE: (603) 433-2335

FAX: (603) 433-4194

STATE OF NEW HAMPSHIRE JEFFREY K CLIFFORD No. 8524 LICENSED PROFESSIONAL ENGINEER

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ISSUED FOR: APPROVAL

ISSUE DATE: AUGUST 2, 2017

REVISIONS

NO.	DESCRIPTION	BY	DATE
0	PB SUBMISSION	JKC	8/02/17

DRAWN BY: RMB

APPROVED BY: JKC

DRAWING FILE: 4836SITE.DWG

SCALE: 1 " = 50'

LAND OWNER – SUBJECT PARCEL:

ROCKINGHAM PROPERTIES 1, LTD

P.O. BOX 423

BELMONT, MA 02178

APPLICANT:

THE RIVERWOODS GROUP

7 RIVERWOODS DRIVE

EXETER, NH 03833

PROJECT:

RIVERWOODS DURHAM

STONE QUARRY DRIVE

DURHAM, NH

TITLE:

PRE-DEVELOPMENT WATERSHED PLAN

SHEET NUMBER:

WS - 1.0

POINT OF ANALYSIS #1

SUBCATCHMENT BOUNDARY (TYP.)

LONGEST FLOW PATH (TYP.)

POND IDENTIFIER (TYP.)

SUBCATCHMENT IDENTIFIER (TYP.)

REACH (TYP.)

PROPOSED POROUS PAVEMENT

PROPOSED STORMWATER GALLERY (SMG) 'A'

PROPOSED SMG 'B'

PROPOSED SMG 'C'

PROPOSED SMG 'D'

PROPOSED SMG 'E'

PROPOSED WATER QUALITY INLET STRUCTURE

POINT OF ANALYSIS #2

N.H. ROUTE 4

RT. 4 OFF-RAMP

RT. 4 ON-RAMP

EOP

SWL

CL

STONE QUARRY DRIVE

DOVER ROAD

N.H. ROUTE 108

SNOW DISPOSAL AREA

EXISTING POLE BARN

EXISTING POLICE SHOOTING RANGE

EXISTING DUMPSTER ENCLOSURE

ABANDONED WELL LOCATION

A

B

C

D

E

GRAPHIC SCALE

50 0 25 50 100 200

(IN FEET)
1 inch = 50 ft.

P4836

ALTUS ENGINEERING, INC.

133 COURT STREET PORTSMOUTH, NH 03801
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STATE OF NEW HAMPSHIRE
JEFFREY K. CLIFFORD No. 8524 LICENSED PROFESSIONAL ENGINEER

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ISSUED FOR: APPROVAL

ISSUE DATE: AUGUST 2, 2017

REVISIONS

NO.	DESCRIPTION	BY	DATE
0	PB SUBMISSION	JKC	8/02/17

DRAWN BY: RMB
APPROVED BY: JKC
DRAWING FILE: 4836SITE.DWG

SCALE: 1 " = 50'

LAND OWNER – SUBJECT PARCEL:

ROCKINGHAM PROPERTIES 1, LTD
P.O. BOX 423
BELMONT, MA 02178

APPLICANT:

THE RIVERWOODS GROUP
7 RIVERWOODS DRIVE
EXETER, NH 03833

PROJECT:

RIVERWOODS DURHAM
STONE QUARRY DRIVE
DURHAM, NH

TITLE:

POST-DEVELOPMENT WATERSHED PLAN

SHEET NUMBER:

WS - 1.1

APPENDIX D:

Stormwater Management Facility Operation and Maintenance (O&M) Manual

Stormwater Management Facility
Operation and Maintenance (O&M) Manual

For:

RiverWoods Durham
Stone Quarry Drive
Durham, NH

Prepared for:

The RiverWoods Group
7 Riverwoods Drive
Exeter, NH 03833

Prepared by:

Altus Engineering, Inc.
133 Court Street
Portsmouth, NH 03801-4413

Compliance with Stormwater Facility Maintenance Requirements

The property owner is the responsible party for ensuring that stormwater facilities installed on their property are properly maintained and that they function as designed. In some cases, this maintenance responsibility may be assigned to others through special agreements. The maintenance responsibility for a stormwater facility may be designated within a maintenance agreement for the property. Property owners shall be aware of their responsibilities regarding stormwater facility maintenance.

Long term inspection, maintenance, and repair are key elements in maintaining a successful stormwater management program on the developed property. Routine inspections will ensure permit compliance; will reduce the potential for deterioration of infrastructure and the high cost to repair/replace, and will reduced the degradation of water quality.

Inspection & Maintenance – Annual Reporting

Requirements for the long term inspection and maintenance of stormwater facilities, as well as reporting requirements are included in this Stormwater Management Facility Operation and Maintenance (O&M) Manual. The attached Long Term Inspection & Maintenance Schedule outlines specific requirements.

Preventative Measures to Reduce Maintenance Costs

The most effective way to maintain the water quality facility is to prevent the pollutants from entering the facility in the first place. Common pollutants include sediment, trash & debris, chemicals, dog wastes, runoff from stored materials, illicit discharges into the storm drainage system and many others. The maintenance program includes measures to address these potential contaminants, and will save money and time in the long run. Key of the maintenance program includes:

- Educate property owners, staff and patrons to be aware of how their actions affect water quality, and how they can help reduce maintenance costs.
- Keep the property, driveway, gutters and parking lots free of trash and debris
- Ensure the proper disposal of hazardous wastes and chemicals.
- Lawn care shall be planned to minimize the use of chemicals and pesticides.
- Be aware of automobiles leaking fluids. Use absorbents such as cat litter to soak up drippings – dispose of properly.
- Sweep paved surfaces of sediment and lawn clippings; dispose of offsite or in upland areas at least 25 feet from wetlands. Mulching mowers are encouraged.
- Re-vegetate disturbed and bare areas to maintain vegetative stabilization.
- Clean out the all components of the storm drainage system, including inlets, storm sewer and outfalls. Dispose of catch basin cleanings offsite.

- Do not store materials outdoors (including landscaping materials) unless properly protected from runoff and erosion.

Safety

Keep safety considerations at the forefront of inspection procedures at all times. Likely hazards should be anticipated and avoided. Never enter a confined space (outlet structure, manhole, etc) without proper training or equipment. A confined space should never be entered without at least one additional person present.

Inspecting Stormwater Management Facilities

The quality of stormwater entering the waters of the state relies heavily on the proper operation and maintenance of permanent best management practices. Stormwater management facilities must be periodically inspected to ensure that they function as designed. The inspection will determine the appropriate maintenance that is required for the facility.

A. Inspection Procedures

All stormwater management facilities are required to be inspected by a qualified individual at a minimum of once per year. Inspections should follow the inspection guidance found in O&M manual for the specific type of facility.

B. Inspection Report

The person(s) conducting the inspection activities shall complete the appropriate inspection report for the specific facility. An inspection and maintenance report, *Stormwater Management Facility Inspection Form*, is provided.

General Information

This section identifies the facility location, person conducting the inspection, the date and time the facility was inspected, and approximate days since the last rainfall. The reason for the inspection is also identified on the form depending on the nature of the inspection. All facilities should be inspected on an annual basis at a minimum. In addition, all facilities should be inspected after a significant precipitation event to ensure the facility is draining appropriately and to identify any damage that occurred as a result of the increased runoff. For the purpose of this Stormwater Management Program, a significant rainfall event is considered an event of three (3) inches in a 24-hour period or 0.5 inches in a one-hour period. It is anticipated that a short, intense event is likely to have a higher potential of erosion for this site than a longer, high volume event.

Inspection Scoring

For each inspection item, a score must be given to identify the urgency of required maintenance. The scoring is as follows:

0 = No deficiencies identified.

1 = Monitor – Although maintenance may not be required at this time, a potential problem exists that will most likely need to be addressed in the future. This can include items like minor erosion, concrete cracks/spalling, or minor sediment accumulation. This item should be revisited at the next inspection.

2 = Routine Maintenance Required – Some inspection items can be addressed through the routine maintenance program (See SOP in appendix A). This can include items like vegetation management or debris/trash removal.

3 = Immediate Repair Necessary – This item needs immediate attention because failure is imminent or has already occurred. This could include items such as structural failure of a feature (outlet works, forebay, etc), significant erosion, or significant sediment accumulation. This score should be given to an item that can significantly affect the function of the facility.

Inspection Summary/Additional Comments

Additional explanations to inspection items, and observations about the facility not covered by the form, are recorded in this section.

C. Verification of Inspection and Form Submittal

The *Stormwater Management Facility Inspection Form* provides a record of inspection of the facility. The verification and the inspection form(s) shall be reviewed and maintained by the property owner or property manager. Any transfer in ownership shall be documented in writing to NHDES.

Maintaining Stormwater Management Facilities

Stormwater management facilities must be properly maintained to ensure that they operate correctly and provide the water quality treatment for which they were designed. Routine maintenance performed on a frequently scheduled basis, can help avoid more costly rehabilitative maintenance that results when facilities are not adequately maintained. Maintenance personnel must be qualified to properly maintain stormwater management facilities. Inadequately trained personnel can cause additional problems resulting in additional maintenance costs.

The following provides a list of recommendations and guidelines for managing the stormwater facilities.

SILT FENCE/ SEDIMENT BARRIER

Straw/hay bale barriers, silt fence and filter barriers shall be inspected immediately after each rainfall and daily during prolonged rainfall events. These structures shall be inspected for signs of erosion or sedimentation regularly. Any required repairs shall be made immediately. If there are signs of undercutting at the center or the edges, or impounding of large volumes of water, sediment barriers shall be replaced with a temporary stone check dam.

Should the fabric of the silt fence or filter barrier decompose or become ineffective prior to the end of its expected usable life and the barrier is still necessary, the fabric shall be replaced promptly.

Sediment deposits must be removed when deposits reach approximately one third (1/3) the height of the barrier. Any sediment deposits remaining in place after the silt fence or filter barrier is no longer required shall be dressed to conform to the existing grade, then prepared, loamed and seeded.

POROUS PAVEMENT

Function – Porous pavement is designed to capture rainwater runoff containing suspended solids, nutrients and pollutants. Proper maintenance of porous pavement is crucial for ensuring its longevity and functionality to infiltrate runoff.

Maintenance

- Signs shall be installed indicating the location of porous pavement and the special maintenance required.
- New porous pavement shall be inspected several times in the first month after construction and at least annually thereafter. Inspections shall be conducted after major storms to check for surface ponding that might indicate possible clogging.
- Inspect annually for pavement deterioration or spalling.
- Vacuum sweeping shall be performed 2-4 times a year. Power washing may be required prior to vacuum sweeping to dislodge trapped particles.
- Sand and abrasives shall not be used for winter maintenance, as they will clog the pores; de-icing materials shall be used instead.
- Never reseal or repave with impermeable materials. If the porous pavement is damaged, it can be repaired using conventional, non-porous patching mixes as long as the cumulative area repaired does not exceed 10 percent of the paved area.

STREET/PARKING LOT SWEEPING (DENSE PAVEMENT)

Function – Parking lots accumulate sand and debris. Street sweeping removes the sand and debris, which lowers transport of sediment and pollutants the stormwater systems and into the environment.

Maintenance

- A regular periodic cleaning schedule is recommended. The more frequent, the greater the sediment and pollutant removal. Regular cleaning of paved areas reduces the frequency of cleaning catch basins and drainage systems. It is recommended that the parking lots and access ways shall be swept at least once a month during winter months.

DE-ICING CHEMICAL USE AND STORAGE

Function – Salt and sand is used for de-icing of walkways, parking lots and drives. Care shall be taken to prevent the over-application of salt for melting ice.

Maintenance

- Proper storage of salt is critical. Salt is highly water-soluble. Contamination of wetlands and other sensitive areas can occur when salt is stored in open areas. Salt shall stored in a building at all times
- When parking lots and walkways are free of snow and ice, they shall be swept clean. Disposal of sweepings shall be at a solid waste disposal facility.

DRAINAGE STRUCTURE CLEANING
(WATER QUALITY INLET, CATCH BASIN, DROP INLET AND AREA DRAIN)

Function – Catch basins and area drains collect stormwater, catch basins primarily from parking lots and area drains from lawn areas. Stormwater often contains sediment and contaminants. Catch basin sumps serve to trap sediment, trace metals, nutrients and debris. Hooded catch basins trap hydrocarbons and floating debris.

Maintenance

- Remove leaves and debris from drainage structure on an as-needed basis, especially in the fall when leaves all falling.
- Remove any free petroleum product from the water surface by pumping or adsorbent pads. Dispose of product and pads at an approved facility in accordance with applicable state and federal requirements
- Catch basin sumps and water quality inlet structures shall be cleaned on an annual basis to protect water quality. Debris shall be disposed of at a solid waste disposal facility.
- Remove cover of area drains and drop inlets and inspect pipes for debris.

UNDERDRAINS

Function – Underdrains keep the ground surface and swales from becoming saturated.

Maintenance
- Check cleanouts for function of underdrains
- Replace underdrains when clogged

STORMWATER MANAGEMENT GALLERIES

Function – Stormwater management galleries (SMG), as referred to for this project, are subsurface stormwater storage chambers with open graded stone. The SMGs provide several important stormwater functions including pre-treatment in "isolator rows" and detains stormwater to attenuate peak rates of runoff as well as provide water quality treatment by binding runoff pollutants to soil particles beneath the basin as water percolates into the subsurface.

Maintenance – Maintaining a clean and obstruction-free retention/detention system helps to ensure the system performs the intended function of the primary design. Buildup of debris may obstruct flow through the laterals in a retention system or block the entranceway of the outlet pipe in a detention system. This may result in ineffective operation or complete failure of the system. Additionally, surrounding areas may potentially run the risk of damage due to flooding or other similar issues. All retention/detention systems must be cleaned and maintained. Underground systems may be maintained more cost effectively if these simple guidelines are followed. Inspection should be performed at a minimum of once per year. Cleaning should be done at the discretion of individuals responsible to maintain proper storage and flow. While maintenance can generally be performed year round, it should be scheduled during a relatively dry season.

PLUNGE POOL OUTLET PROTECTION AND STONE LIP LEVEL SPREADERS

Function – Rip rap provides protection of soil from erosive velocities at pipe outlets

Maintenance
- Check for erosion at and adjacent to the rip rap
- Replace any displaced stones and add new stones as necessary
- Inspect for any signs of channelization down and immediately repaired.

CONTRACTOR'S GENERAL CLEAN UP

Upon completion of the site and permanent stabilization is attained, the contractor shall remove all temporary stormwater structures (i.e., temporary stone check dams, silt fence, temporary diversion swales, etc.). Any sediment deposits remaining in place after the silt fence or filter barrier is no longer required shall be dressed to conform to the existing grade, prepared and seeded. Remove any sediment in catch basins and clean drain pipes that may have accumulated during construction.

STORMWATER MANAGEMENT FACILITY INSPECTION FORM

(SEE ATTACHED SHEETS C-3.0 THRU C-3.4 FOR LOCATIONS)

RiverWoods Durham
Stone Quarry Drive, Durham, NH

Date: _____

Inspector _____ Qualifications _____

Current and recent hydrological conditions:

_____

_____

_____

BMP	Date Since Last Inspection	Inspection Scoring	Inspection summary / Additional comments of type and date of repairs made
Manicured Landscape Areas - Fertilizer Mgmt			
Manicured Landscape Areas - Litter Control			
Catch Basin Cleaning			
Water Quality Inlet Cleaning			
Porous Pavement			
Street/Parking Lot Sweeping			
De-ice Chemical Use – List Type and Quantity			
Plunge Pool			
Stone Lip Level Spreader			