



ENGINEERS

SURVEYORS

PLANNERS

December 4, 2015

Mr. Boyd Devane
512 N. Salisbury St.
Archdale Building - 9th floor
Raleigh, NC 27604

RE: Briar Chapel Phase 10

Mr. Devane,

Please find enclosed the plans, calculations, supplement forms and operation and maintenance agreements for the Phase 10 subdivision at Briar Chapel.

This letter is to formally request approval of the stormwater management plan for the enclosed plans in accordance with Water Quality Certification as issued by the Division of Water Resources on January 11, 2008.

Please let me know if you have any questions on this. Thank you for your assistance.

Sincerely,
McKIM & CREED, INC.

Venture IV Building

Suite 500

1730 Varsity Drive

Raleigh, NC 27606

Gareth Avant, PE
Project Engineer

919.233.8091

Fax 919.233.8031

www.mckimcreed.com

Red triangles at the upper right hand corner indicate design comments
Please complete the yellow shaded items.



STORMWATER MANAGEMENT PERMIT APPLICATION FORM
401 CERTIFICATION APPLICATION FORM

WET DETENTION BASIN SUPPLEMENT

This form must be filled out, printed and submitted.

The Required Items Checklist (Part III) must be printed, filled out and submitted along with all of the required information.

I. PROJECT INFORMATION

Project name	Briar Chapel - Phase 10
Contact person	Gareth Avant, PE
Phone number	919.233.8091
Date	4-Dec-2015
Drainage area number	1 - Wet Pond #25

II. DESIGN INFORMATION

Site Characteristics

Drainage area	639,050 ft ²
Impervious area, post-development	387,660 ft ²
% impervious	60.66 %
Design rainfall depth	1.0 in

Storage Volume: Non-SA Waters

Minimum volume required	31,737 ft ³	OK
Volume provided	38,100 ft ³	OK, volume provided is equal to or in excess of volume required.

Storage Volume: SA Waters

1.5" runoff volume	ft ³
Pre-development 1-yr, 24-hr runoff	ft ³
Post-development 1-yr, 24-hr runoff	ft ³
Minimum volume required	ft ³
Volume provided	ft ³

Peak Flow Calculations

Is the pre/post control of the 1yr 24hr storm peak flow required?	Y	(Y or N)
1-yr, 24-hr rainfall depth	3.0 in	
Rational C, pre-development	0.40 (unitless)	
Rational C, post-development	0.76 (unitless)	
Rainfall intensity: 1-yr, 24-hr storm	0.13 in/hr	OK
Pre-development 1-yr, 24-hr peak flow	12.87 ft ³ /sec	
Post-development 1-yr, 24-hr peak flow	47.65 ft ³ /sec	
Pre/Post 1-yr, 24-hr peak flow control	34.78 ft ³ /sec	

Elevations

Temporary pool elevation	415.10 fmsl	
Permanent pool elevation	413.50 fmsl	
SHWT elevation (approx. at the perm. pool elevation)	fmsl	
Top of 10ft vegetated shelf elevation	414.00 fmsl	
Bottom of 10ft vegetated shelf elevation	413.00 fmsl	Data not needed for calculation option #1, but OK if provided.
Sediment cleanout, top elevation (bottom of pond)	409.00 fmsl	
Sediment cleanout, bottom elevation	406.00 fmsl	Data not needed for calculation option #1, but OK if provided.
Sediment storage provided	3.00 ft	
Is there additional volume stored above the state-required temp. pool?	Y	(Y or N)
Elevation of the top of the additional volume	415.1 fmsl	OK

II. DESIGN INFORMATION
Surface Areas

Area, temporary pool	25,667	ft ²	
Area REQUIRED, permanent pool	19,811	ft ²	
SA/DA ratio	3.10	(unitless)	
Area PROVIDED, permanent pool, A_{perm_pool}	20,520	ft ²	OK
Area, bottom of 10ft vegetated shelf, A_{bot_shelf}	16,753	ft ²	
Area, sediment cleanout, top elevation (bottom of pond), A_{bot_pond}	23,568	ft ²	

Volumes

Volume, temporary pool	38,100	ft ³	OK
Volume, permanent pool, V_{perm_pool}	78,231	ft ³	
Volume, forebay (sum of forebays if more than one forebay)	16,820	ft ³	
Forebay % of permanent pool volume	21.5%	%	OK

SA/DA Table Data

Design TSS removal	90	%	
Coastal SA/DA Table Used?	N	(Y or N)	
Mountain/Piedmont SA/DA Table Used?	Y	(Y or N)	
SA/DA ratio	3.10	(unitless)	

Average depth (used in SA/DA table):

Calculation option 1 used? (See Figure 10-2b)	Y	(Y or N)	
Volume, permanent pool, V_{perm_pool}	78,231	ft ³	
Area provided, permanent pool, A_{perm_pool}	20,520	ft ²	
Average depth calculated	3.81	ft	OK
Average depth used in SA/DA, d_{av} , (Round to nearest 0.5ft)	3.6	ft	OK

Calculation option 2 used? (See Figure 10-2b)

Area provided, permanent pool, A_{perm_pool}	20,520	ft ²	
Area, bottom of 10ft vegetated shelf, A_{bot_shelf}	16,753	ft ²	

 Area, sediment cleanout, top elevation (bottom of pond), A_{bot_pond}

"Depth" (distance b/w bottom of 10ft shelf and top of sediment)

Average depth calculated

 Average depth used in SA/DA, d_{av} , (Round to nearest 0.5ft)

Drawdown Calculations

Drawdown through orifice?	Y	(Y or N)	
Diameter of orifice (if circular)	3.00	in	
Area of orifice (if non-circular)		in ²	
Coefficient of discharge (C_D)	0.60	(unitless)	
Driving head (H_o)	0.53	ft	
Drawdown through weir?	N	(Y or N)	
Weir type		(unitless)	
Coefficient of discharge (C_w)		(unitless)	
Length of weir (L)		ft	
Driving head (H)		ft	
Pre-development 1-yr, 24-hr peak flow	11.60	ft ³ /sec	
Post-development 1-yr, 24-hr peak flow	11.28	ft ³ /sec	
Storage volume discharge rate (through discharge orifice or weir)	0.01	ft ³ /sec	
Storage volume drawdown time	2.60	days	OK, draws down in 2-5 days.

Additional Information

Vegetated side slopes	3 :1	OK
Vegetated shelf slope	10 :1	OK
Vegetated shelf width	10.0	ft OK
Length of flowpath to width ratio	3 :1	OK
Length to width ratio	1.5 :1	OK
Trash rack for overflow & orifice?	Y	(Y or N) OK
Freeboard provided	1.0	ft OK
Vegetated filter provided?	N	(Y or N) OK
Recorded drainage easement provided?	Y	(Y or N) OK
Captures all runoff at ultimate build-out?	Y	(Y or N) OK
Drain mechanism for maintenance or emergencies is:	Pump provided by owner	

III. REQUIRED ITEMS CHECKLIST

Please indicate the page or plan sheet numbers where the supporting documentation can be found. **An incomplete submittal package will result in a request for additional information. This will delay final review and approval of the project.** Initial in the space provided to indicate the following design requirements have been met. If the applicant has designated an agent, the agent may initial below. **If a requirement has not been met, attach justification.**

Initials	Page/ Plan Sheet No.	
GCA	C3.1-C3.2	1. Plans (1" = 50' or larger) of the entire site showing: <ul style="list-style-type: none"> - Design at ultimate build-out, - Off-site drainage (if applicable), - Delineated drainage basins (include Rational C coefficient per basin), - Basin dimensions, - Pretreatment system, - High flow bypass system, - Maintenance access, - Proposed drainage easement and public right of way (ROW), - Overflow device, and - Boundaries of drainage easement.
GCA	D4.1-D4.3	2. Partial plan (1" = 30' or larger) and details for the wet detention basin showing: <ul style="list-style-type: none"> - Outlet structure with trash rack or similar, - Maintenance access, - Permanent pool dimensions, - Forebay and main pond with hardened emergency spillway, - Basin cross-section, - Vegetation specification for planting shelf, and - Filter strip.
GCA	D4.1-D4.3	3. Section view of the wet detention basin (1" = 20' or larger) showing: <ul style="list-style-type: none"> - Side slopes, 3:1 or lower, - Pretreatment and treatment areas, and - Inlet and outlet structures.
GCA	C3.1-C3.2	4. If the basin is used for sediment and erosion control during construction, clean out of the basin is specified on the plans prior to use as a wet detention basin.
GCA	Calc Booklet	5. A table of elevations, areas, incremental volumes & accumulated volumes for overall pond and for forebay, to verify volume provided.
GCA	C3.1-C3.2	6. A construction sequence that shows how the wet detention basin will be protected from sediment until the entire drainage area is stabilized.
GCA	Calc Booklet	7. The supporting calculations.
GCA	Included	8. A copy of the signed and notarized operation and maintenance (O&M) agreement.
GCA	N/A	9. A copy of the deed restrictions (if required).
_____	N/A	10. A soils report that is based upon an actual field investigation, soil borings, and infiltration tests. County soil maps are not an acceptable source of soils information.

Permit Number: _____
(to be provided by DWQ)

Drainage Area Number: _____

Wet Detention Basin Operation and Maintenance Agreement

I will keep a maintenance record on this BMP. This maintenance record will be kept in a log in a known set location. Any deficient BMP elements noted in the inspection will be corrected, repaired or replaced immediately. These deficiencies can affect the integrity of structures, safety of the public, and the removal efficiency of the BMP.

The wet detention basin system is defined as the wet detention basin, pretreatment including forebays and the vegetated filter if one is provided.

This system (check one):

☐ does ☒ does not incorporate a vegetated filter at the outlet.

This system (check one):

☐ does ☒ does not incorporate pretreatment other than a forebay.

Important maintenance procedures:

- Immediately after the wet detention basin is established, the plants on the vegetated shelf and perimeter of the basin should be watered twice weekly if needed, until the plants become established (commonly six weeks).
- No portion of the wet detention pond should be fertilized after the first initial fertilization that is required to establish the plants on the vegetated shelf.
- Stable groundcover should be maintained in the drainage area to reduce the sediment load to the wet detention basin.
- If the basin must be drained for an emergency or to perform maintenance, the flushing of sediment through the emergency drain should be minimized to the maximum extent practical.
- Once a year, a dam safety expert should inspect the embankment.

After the wet detention pond is established, it should be inspected **once a month and within 24 hours after every storm event greater than 1.0 inches (or 1.5 inches if in a Coastal County)**. Records of operation and maintenance should be kept in a known set location and must be available upon request.

Inspection activities shall be performed as follows. Any problems that are found shall be repaired immediately.

BMP element:	Potential problem:	How I will remediate the problem:
The entire BMP	Trash/debris is present.	Remove the trash/debris.
The perimeter of the wet detention basin	Areas of bare soil and/or erosive gullies have formed.	Regrade the soil if necessary to remove the gully, and then plant a ground cover and water until it is established. Provide lime and a one-time fertilizer application.
	Vegetation is too short or too long.	Maintain vegetation at a height of approximately six inches.

Permit Number: _____
(to be provided by DWQ)

Drainage Area Number: _____

BMP element:	Potential problem:	How I will remediate the problem:
The inlet device: pipe or swale	The pipe is clogged.	Unclog the pipe. Dispose of the sediment off-site.
	The pipe is cracked or otherwise damaged.	Replace the pipe.
	Erosion is occurring in the swale.	Regrade the swale if necessary to smooth it over and provide erosion control devices such as reinforced turf matting or riprap to avoid future problems with erosion.
The forebay	Sediment has accumulated to a depth greater than the original design depth for sediment storage.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the BMP.
	Erosion has occurred.	Provide additional erosion protection such as reinforced turf matting or riprap if needed to prevent future erosion problems.
	Weeds are present.	Remove the weeds, preferably by hand. If pesticide is used, wipe it on the plants rather than spraying.
The vegetated shelf	Best professional practices show that pruning is needed to maintain optimal plant health.	Prune according to best professional practices
	Plants are dead, diseased or dying.	Determine the source of the problem: soils, hydrology, disease, etc. Remedy the problem and replace plants. Provide a one-time fertilizer application to establish the ground cover if a soil test indicates it is necessary.
	Weeds are present.	Remove the weeds, preferably by hand. If pesticide is used, wipe it on the plants rather than spraying.
The main treatment area	Sediment has accumulated to a depth greater than the original design sediment storage depth.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the BMP.
	Algal growth covers over 50% of the area.	Consult a professional to remove and control the algal growth.
	Cattails, phragmites or other invasive plants cover 50% of the basin surface.	Remove the plants by wiping them with pesticide (do not spray).

Permit Number: _____
 (to be provided by DWQ)

Drainage Area Number: _____

BMP element:	Potential problem:	How I will remediate the problem:
The embankment	Shrubs have started to grow on the embankment.	Remove shrubs immediately.
	Evidence of muskrat or beaver activity is present.	Use traps to remove muskrats and consult a professional to remove beavers.
	A tree has started to grow on the embankment.	Consult a dam safety specialist to remove the tree.
	An annual inspection by an appropriate professional shows that the embankment needs repair. (if applicable)	Make all needed repairs.
The outlet device	Clogging has occurred.	Clean out the outlet device. Dispose of the sediment off-site.
	The outlet device is damaged	Repair or replace the outlet device.
The receiving water	Erosion or other signs of damage have occurred at the outlet.	Contact the local NC Division of Water Quality Regional Office, or the 401 Oversight Unit at 919-733-1786.

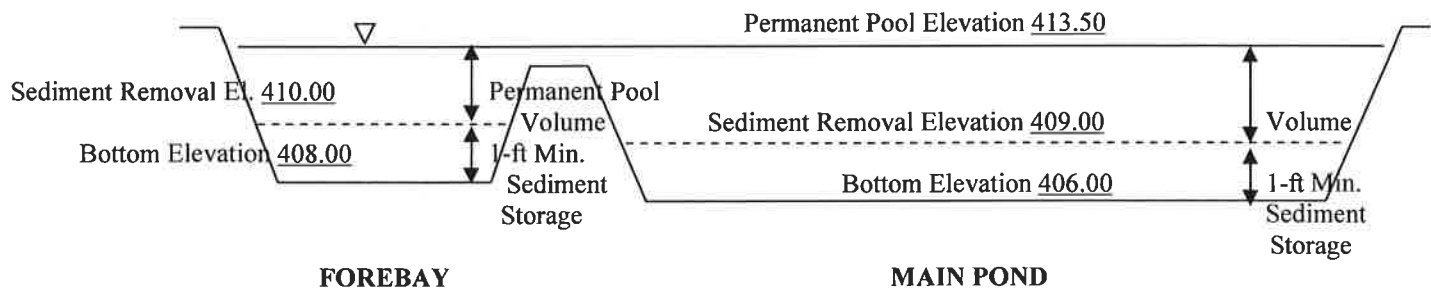
The measuring device used to determine the sediment elevation shall be such that it will give an accurate depth reading and not readily penetrate into accumulated sediments.

When the permanent pool depth reads 4.50 feet in the main pond, the sediment shall be removed.

When the permanent pool depth reads 3.50 feet in the forebay, the sediment shall be removed.

BASIN DIAGRAM

(fill in the blanks)



Permit Number: _____
(to be provided by DWQ)

I acknowledge and agree by my signature below that I am responsible for the performance of the maintenance procedures listed above. I agree to notify DWQ of any problems with the system or prior to any changes to the system or responsible party.

Project name: Briar Chapel - Phase 10

BMP drainage area number: 1 - Wet Detention Pond #25

Print name: Lee Bowman

Title: Senior Project Manager

Address: 16 Windy Knoll Circle, Chapel Hill, NC 27516

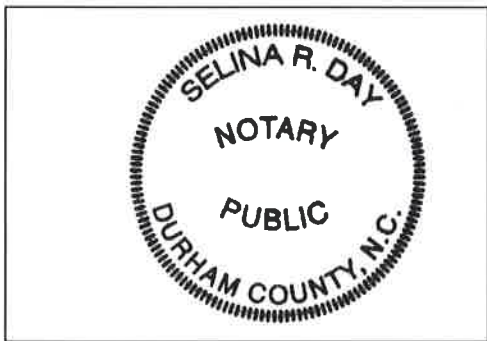
Phone: (919) 951-0712

Signature: [Handwritten Signature]

Date: 12/1/15

Note: The legally responsible party should not be a homeowners association unless more than 50% of the lots have been sold and a resident of the subdivision has been named the president.

I, Selina R. Day, a Notary Public for the State of North Carolina, County of Durham, do hereby certify that G. Lee Bowman personally appeared before me this 1 day of December, 2015, and acknowledge the due execution of the forgoing wet detention basin maintenance requirements. Witness my hand and official seal,



SEAL

My commission expires August 30, 2019



ENGINEERS

SURVEYORS

PLANNERS

December 4, 2015

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512 N. Salisbury St.
Archdale Building - 9th floor
Raleigh, NC 27604

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McKIM & CREED, INC.

Venture IV Building

Suite 500

1730 Varsity Drive

Raleigh, NC 27606

A handwritten signature in black ink that reads "Gareth Avant".

Gareth Avant, PE
Project Engineer

919.233.8091

Fax 919.233.8031

www.mckimcreed.com

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(to be provided by DWQ)

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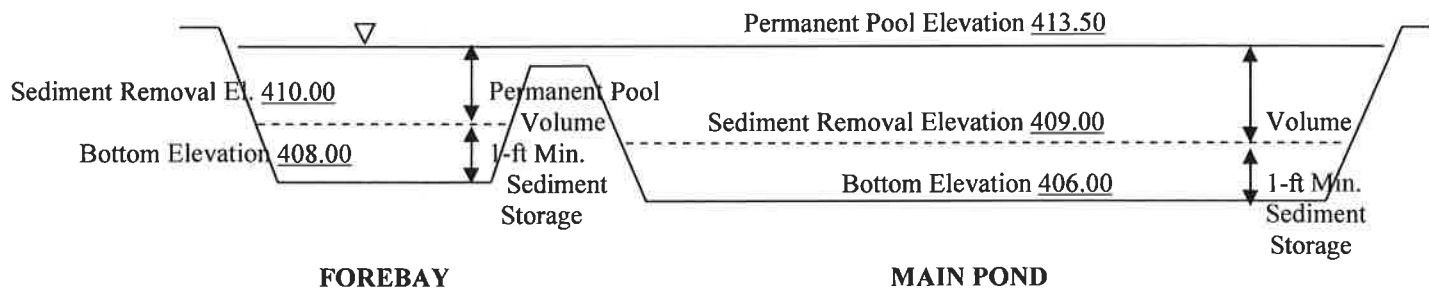
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(fill in the blanks)



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(to be provided by DWQ)

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BMP drainage area number: 1 - Wet Detention Pond #25

Print name: Lee Bowman

Title: Senior Project Manager

Address: 16 Windy Knoll Circle, Chapel Hill, NC 27516

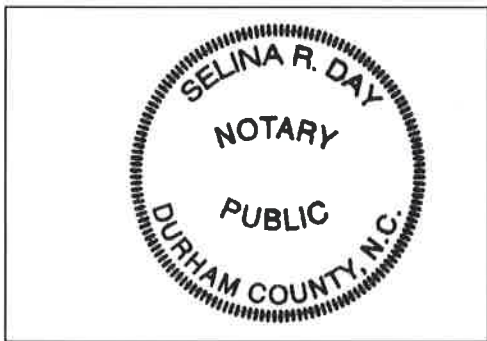
Phone: (919) 951-0712

Signature: [Handwritten Signature]

Date: 12/1/15

Note: The legally responsible party should not be a homeowners association unless more than 50% of the lots have been sold and a resident of the subdivision has been named the president.

I, Selina R. Day, a Notary Public for the State of North Carolina, County of Durham, do hereby certify that G. Lee Bowman personally appeared before me this 1 day of December, 2015, and acknowledge the due execution of the forgoing wet detention basin maintenance requirements. Witness my hand and official seal,



SEAL

My commission expires August 30, 2019

401 NARRATIVE & SUPPORTING CALCULATIONS

Briar Chapel Development Phase 10

Chatham County, North Carolina
December 4, 2015

Prepared for:



NNP Briar Chapel, LLC
16 Windy Knoll Circle
Chapel Hill, North Carolina 27516

Prepared By:



1730 Varsity Drive, Suite 500
Raleigh, North Carolina 27606
Phone: (919) 233.8091
Fax: (919) 233.8031

M&C Project No. 02735-0151



PROJECT DESCRIPTION

The purpose of the project is to construct water, sewer and roadway infrastructure to support 99 residential lots in the Phase 10 section of the overall Briar Chapel Development.

Based on the conditions of the approved 401 Water Quality Certification, NCDENR-DWR will require runoff from the roads to be captured and treated for 85% TSS removal before being discharged into existing stream buffers. To meet this requirement, the runoff from the general area of all Phase 10 construction will be directed to Wet Detention Pond #25. Calculations for this new facility is included in this package.

Upon completion of the project's construction, the proposed public roads will be turned over to and maintained by NCDOT.

SITE DESCRIPTION

The project area is approximately 19.20 acres located within the BC South development area, east of Granite Mill Boulevard, south east of Great Ridge Parkway, east of Briar Chapel Phase 11, and south of Briar Chapel Phase 7.

The site slopes away from a high point located in the west of the project area, and drains primarily to the east and northeast into adjacent buffered streams. Slopes on the site range from 5% to greater than 20% in localized areas.

SOILS

According to the Chatham County Generalized Soil Survey, the soils located on the site are classified as Helena sandy loam, 2% to 6% slopes (HeB), Wedowee sandy loam, 2% to 15% slopes (WeB, WeC).

The following soil descriptions are associated with the soils found on the site:

He(B) – Helena sandy loam are often found in piedmont uplands, along ridges, drainageways, and at the heads of drainageways. Permeability is slow and the soils are only moderately well drained. Soils have a high shrink/swell potential. The seasonal high water is perched and at a depth of 1.5-2.5 feet from January through April.

We(X) – Wedowee sandy loam soils are often found in piedmont uplands, along ridges and side slopes. Permeability is moderate and the soils are well drained. Soils have a low shrink/swell potential. The seasonal high water is generally more than 6.0 feet below the surface.

WET DETENTION DESIGN

The wet detention pond on this site has been designed to remove 90% of the total suspended solids entering from the surrounding impervious drainage areas before discharging into the adjacent stream buffer. The calculations provided with this package include all projected future drainage areas that might be captured by the pond. Treated runoff will be dissipated by a riprap outlet protection device before entering any stream buffers.

Design parameters were taken from the BMP manual and from DWQ's design supplement forms.

MAINTENANCE CONSIDERATIONS

The property owner shall be responsible for periodic inspection and maintenance of all permanent stormwater management devices and shall adhere to conditions agreed upon by the executed Operation and Maintenance agreements included with this submittal. Any measure that fails to function as intended shall be repaired immediately.



NOAA Atlas 14, Volume 2, Version 3
 Location name: Chapel Hill, North Carolina, US*
 Latitude: 35.8280°, Longitude: -79.1077°
 Elevation: 505ft*
 * source: Google Maps



POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerals](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	4.98 (4.55–5.45)	5.87 (5.38–6.43)	6.77 (6.20–7.40)	7.45 (6.82–8.15)	8.18 (7.44–8.93)	8.69 (7.87–9.48)	9.16 (8.24–9.98)	9.53 (8.54–10.4)	9.95 (8.83–10.9)	10.3 (9.04–11.2)
10-min	3.98 (3.64–4.35)	4.69 (4.30–5.14)	5.42 (4.96–5.93)	5.96 (5.45–6.52)	6.52 (5.93–7.12)	6.92 (6.27–7.55)	7.27 (6.55–7.93)	7.55 (6.77–8.26)	7.87 (6.98–8.60)	8.09 (7.12–8.85)
15-min	3.31 (3.03–3.62)	3.93 (3.60–4.31)	4.57 (4.18–5.00)	5.03 (4.60–5.49)	5.51 (5.01–6.02)	5.84 (5.29–6.37)	6.12 (5.52–6.68)	6.35 (5.69–6.94)	6.60 (5.86–7.22)	6.77 (5.96–7.40)
30-min	2.27 (2.08–2.48)	2.72 (2.49–2.97)	3.25 (2.97–3.55)	3.64 (3.33–3.98)	4.08 (3.71–4.45)	4.40 (3.99–4.80)	4.69 (4.23–5.12)	4.95 (4.43–5.40)	5.25 (4.66–5.74)	5.48 (4.82–6.00)
60-min	1.42 (1.30–1.55)	1.70 (1.56–1.87)	2.08 (1.91–2.28)	2.37 (2.17–2.59)	2.72 (2.47–2.97)	2.98 (2.70–3.25)	3.23 (2.91–3.53)	3.47 (3.11–3.79)	3.77 (3.35–4.12)	4.00 (3.52–4.38)
2-hr	0.840 (0.766–0.925)	1.02 (0.928–1.12)	1.25 (1.14–1.38)	1.44 (1.31–1.58)	1.67 (1.51–1.83)	1.85 (1.67–2.03)	2.03 (1.81–2.23)	2.20 (1.96–2.42)	2.43 (2.14–2.67)	2.61 (2.27–2.87)
3-hr	0.595 (0.544–0.655)	0.720 (0.660–0.792)	0.891 (0.814–0.979)	1.03 (0.938–1.13)	1.21 (1.09–1.32)	1.35 (1.21–1.48)	1.49 (1.33–1.63)	1.63 (1.45–1.78)	1.82 (1.60–2.00)	1.98 (1.71–2.17)
6-hr	0.358 (0.329–0.392)	0.433 (0.398–0.474)	0.536 (0.491–0.587)	0.620 (0.567–0.678)	0.731 (0.663–0.797)	0.822 (0.740–0.895)	0.913 (0.815–0.994)	1.01 (0.890–1.10)	1.13 (0.988–1.23)	1.24 (1.07–1.35)
12-hr	0.210 (0.194–0.230)	0.254 (0.234–0.278)	0.316 (0.290–0.345)	0.368 (0.336–0.402)	0.438 (0.397–0.476)	0.496 (0.446–0.537)	0.555 (0.495–0.601)	0.618 (0.544–0.668)	0.704 (0.609–0.762)	0.778 (0.662–0.841)
24-hr	0.123 (0.115–0.131)	0.148 (0.139–0.159)	0.186 (0.174–0.198)	0.215 (0.201–0.229)	0.254 (0.237–0.272)	0.285 (0.265–0.305)	0.317 (0.294–0.340)	0.350 (0.323–0.376)	0.395 (0.363–0.425)	0.431 (0.394–0.464)
2-day	0.072 (0.067–0.077)	0.086 (0.081–0.093)	0.107 (0.100–0.115)	0.123 (0.115–0.132)	0.145 (0.135–0.155)	0.162 (0.151–0.174)	0.180 (0.166–0.193)	0.198 (0.182–0.212)	0.222 (0.204–0.239)	0.241 (0.221–0.260)
3-day	0.051 (0.047–0.054)	0.061 (0.057–0.065)	0.075 (0.070–0.080)	0.086 (0.081–0.092)	0.102 (0.095–0.109)	0.114 (0.105–0.122)	0.126 (0.116–0.135)	0.138 (0.127–0.149)	0.155 (0.142–0.167)	0.169 (0.154–0.182)
4-day	0.040 (0.038–0.043)	0.048 (0.045–0.051)	0.059 (0.055–0.063)	0.068 (0.063–0.073)	0.080 (0.074–0.085)	0.089 (0.083–0.096)	0.099 (0.091–0.106)	0.109 (0.100–0.117)	0.122 (0.112–0.132)	0.133 (0.121–0.144)
7-day	0.026 (0.025–0.028)	0.031 (0.030–0.034)	0.038 (0.036–0.041)	0.044 (0.041–0.046)	0.051 (0.048–0.054)	0.057 (0.053–0.061)	0.063 (0.058–0.067)	0.069 (0.064–0.074)	0.077 (0.071–0.083)	0.084 (0.077–0.090)
10-day	0.021 (0.020–0.022)	0.025 (0.024–0.027)	0.030 (0.028–0.032)	0.034 (0.032–0.036)	0.039 (0.037–0.042)	0.043 (0.041–0.046)	0.048 (0.044–0.051)	0.052 (0.048–0.055)	0.058 (0.053–0.062)	0.062 (0.057–0.067)
20-day	0.014 (0.013–0.015)	0.017 (0.016–0.018)	0.020 (0.019–0.021)	0.022 (0.021–0.023)	0.025 (0.024–0.027)	0.028 (0.026–0.029)	0.030 (0.028–0.032)	0.033 (0.031–0.035)	0.036 (0.034–0.039)	0.039 (0.036–0.042)
30-day	0.012 (0.011–0.012)	0.014 (0.013–0.014)	0.016 (0.015–0.017)	0.018 (0.017–0.019)	0.020 (0.019–0.021)	0.022 (0.020–0.023)	0.023 (0.022–0.025)	0.025 (0.023–0.027)	0.027 (0.026–0.029)	0.029 (0.027–0.031)
45-day	0.010 (0.009–0.010)	0.012 (0.011–0.012)	0.013 (0.013–0.014)	0.015 (0.014–0.015)	0.016 (0.015–0.017)	0.018 (0.017–0.018)	0.019 (0.018–0.020)	0.020 (0.019–0.021)	0.022 (0.020–0.023)	0.023 (0.021–0.024)
60-day	0.009 (0.008–0.009)	0.010 (0.010–0.011)	0.012 (0.011–0.012)	0.013 (0.012–0.013)	0.014 (0.013–0.015)	0.015 (0.014–0.016)	0.016 (0.015–0.017)	0.017 (0.016–0.018)	0.018 (0.017–0.019)	0.019 (0.018–0.020)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).
 Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.
 Please refer to NOAA Atlas 14 document for more information.

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PF graphical



NOAA Atlas 14, Volume 2, Version 3
 Location name: Chapel Hill, North Carolina, US*
 Latitude: 35.8282°, Longitude: -79.1072°
 Elevation: 508ft*
 * source: Google Maps



POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aeriels](#)

PF tabular

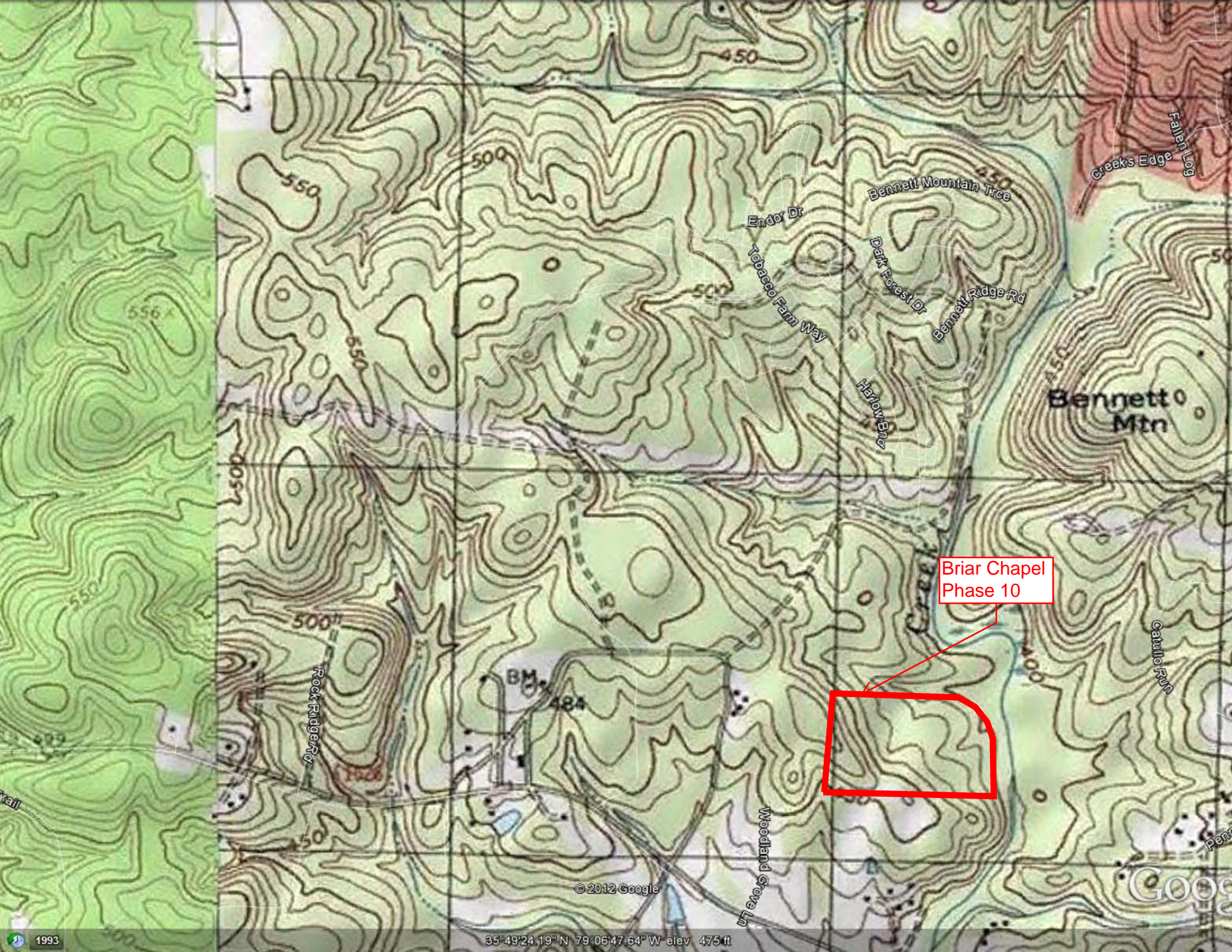
PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.415 (0.379–0.454)	0.489 (0.448–0.536)	0.564 (0.517–0.617)	0.621 (0.568–0.679)	0.682 (0.620–0.744)	0.724 (0.656–0.790)	0.763 (0.687–0.832)	0.794 (0.712–0.868)	0.829 (0.736–0.906)	0.856 (0.753–0.936)
10-min	0.663 (0.606–0.725)	0.782 (0.717–0.856)	0.904 (0.827–0.989)	0.994 (0.908–1.09)	1.09 (0.989–1.19)	1.15 (1.05–1.26)	1.21 (1.09–1.32)	1.26 (1.13–1.38)	1.31 (1.16–1.43)	1.35 (1.19–1.48)
15-min	0.828 (0.758–0.906)	0.983 (0.901–1.08)	1.14 (1.05–1.25)	1.26 (1.15–1.37)	1.38 (1.25–1.50)	1.46 (1.32–1.59)	1.53 (1.38–1.67)	1.59 (1.42–1.74)	1.65 (1.47–1.80)	1.69 (1.49–1.85)
30-min	1.14 (1.04–1.24)	1.36 (1.25–1.49)	1.62 (1.49–1.78)	1.82 (1.67–1.99)	2.04 (1.86–2.23)	2.20 (1.99–2.40)	2.35 (2.11–2.56)	2.47 (2.22–2.70)	2.63 (2.33–2.87)	2.74 (2.41–3.00)
60-min	1.42 (1.30–1.55)	1.70 (1.56–1.87)	2.08 (1.91–2.28)	2.37 (2.17–2.59)	2.72 (2.47–2.97)	2.98 (2.70–3.25)	3.23 (2.91–3.53)	3.47 (3.11–3.79)	3.77 (3.35–4.12)	4.00 (3.52–4.38)
2-hr	1.68 (1.53–1.85)	2.03 (1.86–2.23)	2.51 (2.29–2.76)	2.88 (2.61–3.16)	3.34 (3.02–3.67)	3.71 (3.33–4.07)	4.06 (3.62–4.45)	4.41 (3.91–4.84)	4.86 (4.27–5.34)	5.23 (4.55–5.75)
3-hr	1.79 (1.64–1.97)	2.16 (1.98–2.38)	2.68 (2.45–2.94)	3.09 (2.82–3.39)	3.62 (3.28–3.96)	4.05 (3.64–4.43)	4.47 (3.99–4.89)	4.90 (4.34–5.36)	5.47 (4.79–5.99)	5.94 (5.15–6.52)
6-hr	2.15 (1.97–2.35)	2.59 (2.38–2.84)	3.21 (2.94–3.51)	3.72 (3.40–4.06)	4.38 (3.97–4.77)	4.92 (4.43–5.36)	5.47 (4.88–5.95)	6.03 (5.33–6.56)	6.79 (5.92–7.39)	7.42 (6.39–8.10)
12-hr	2.54 (2.33–2.77)	3.06 (2.82–3.35)	3.81 (3.49–4.16)	4.44 (4.05–4.84)	5.28 (4.78–5.73)	5.97 (5.38–6.47)	6.69 (5.96–7.24)	7.44 (6.55–8.05)	8.49 (7.34–9.18)	9.37 (7.98–10.1)
24-hr	2.95 (2.76–3.15)	3.56 (3.34–3.81)	4.45 (4.17–4.76)	5.15 (4.82–5.50)	6.10 (5.68–6.52)	6.85 (6.37–7.33)	7.61 (7.06–8.16)	8.40 (7.76–9.02)	9.49 (8.72–10.2)	10.3 (9.46–11.1)
2-day	3.44 (3.23–3.69)	4.15 (3.89–4.44)	5.15 (4.82–5.51)	5.92 (5.53–6.34)	6.97 (6.49–7.46)	7.79 (7.23–8.34)	8.63 (7.98–9.26)	9.48 (8.74–10.2)	10.7 (9.78–11.5)	11.6 (10.6–12.5)
3-day	3.65 (3.42–3.90)	4.38 (4.11–4.69)	5.42 (5.07–5.79)	6.22 (5.81–6.66)	7.31 (6.81–7.83)	8.17 (7.58–8.76)	9.05 (8.37–9.71)	9.95 (9.17–10.7)	11.2 (10.3–12.1)	12.2 (11.1–13.1)
4-day	3.85 (3.61–4.12)	4.62 (4.33–4.94)	5.69 (5.32–6.08)	6.52 (6.09–6.98)	7.66 (7.13–8.20)	8.56 (7.93–9.17)	9.48 (8.76–10.2)	10.4 (9.60–11.2)	11.7 (10.7–12.6)	12.8 (11.6–13.8)
7-day	4.43 (4.18–4.72)	5.29 (4.98–5.63)	6.42 (6.05–6.84)	7.33 (6.89–7.81)	8.56 (8.02–9.12)	9.53 (8.90–10.2)	10.5 (9.80–11.2)	11.6 (10.7–12.4)	13.0 (11.9–13.9)	14.1 (12.9–15.1)
10-day	5.04 (4.76–5.36)	5.99 (5.65–6.37)	7.19 (6.78–7.65)	8.13 (7.65–8.65)	9.41 (8.82–10.0)	10.4 (9.73–11.1)	11.4 (10.6–12.2)	12.4 (11.6–13.3)	13.8 (12.8–14.8)	14.9 (13.8–16.0)
20-day	6.75 (6.38–7.14)	7.96 (7.53–8.42)	9.40 (8.88–9.94)	10.5 (9.95–11.2)	12.1 (11.4–12.8)	13.3 (12.5–14.1)	14.5 (13.6–15.4)	15.8 (14.7–16.8)	17.5 (16.2–18.7)	18.8 (17.4–20.1)
30-day	8.37 (7.94–8.85)	9.86 (9.33–10.4)	11.4 (10.8–12.1)	12.7 (12.0–13.4)	14.3 (13.5–15.1)	15.6 (14.7–16.5)	16.8 (15.8–17.8)	18.1 (16.9–19.2)	19.7 (18.4–21.0)	21.0 (19.5–22.4)
45-day	10.7 (10.2–11.2)	12.5 (11.9–13.1)	14.3 (13.6–15.0)	15.7 (14.9–16.5)	17.5 (16.6–18.4)	18.9 (17.9–19.9)	20.3 (19.1–21.3)	21.6 (20.3–22.8)	23.4 (21.9–24.7)	24.7 (23.1–26.2)
60-day	12.8 (12.2–13.4)	14.9 (14.2–15.6)	16.8 (16.1–17.6)	18.3 (17.5–19.2)	20.2 (19.3–21.2)	21.7 (20.6–22.7)	23.0 (21.9–24.2)	24.4 (23.1–25.7)	26.1 (24.7–27.6)	27.5 (25.9–29.0)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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PF graphical

Maps



Briar Chapel
Phase 10



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35°49'24.19" N 79°06'47.64" W elev 475 ft

39° 50' 00" N

39 67

39 66

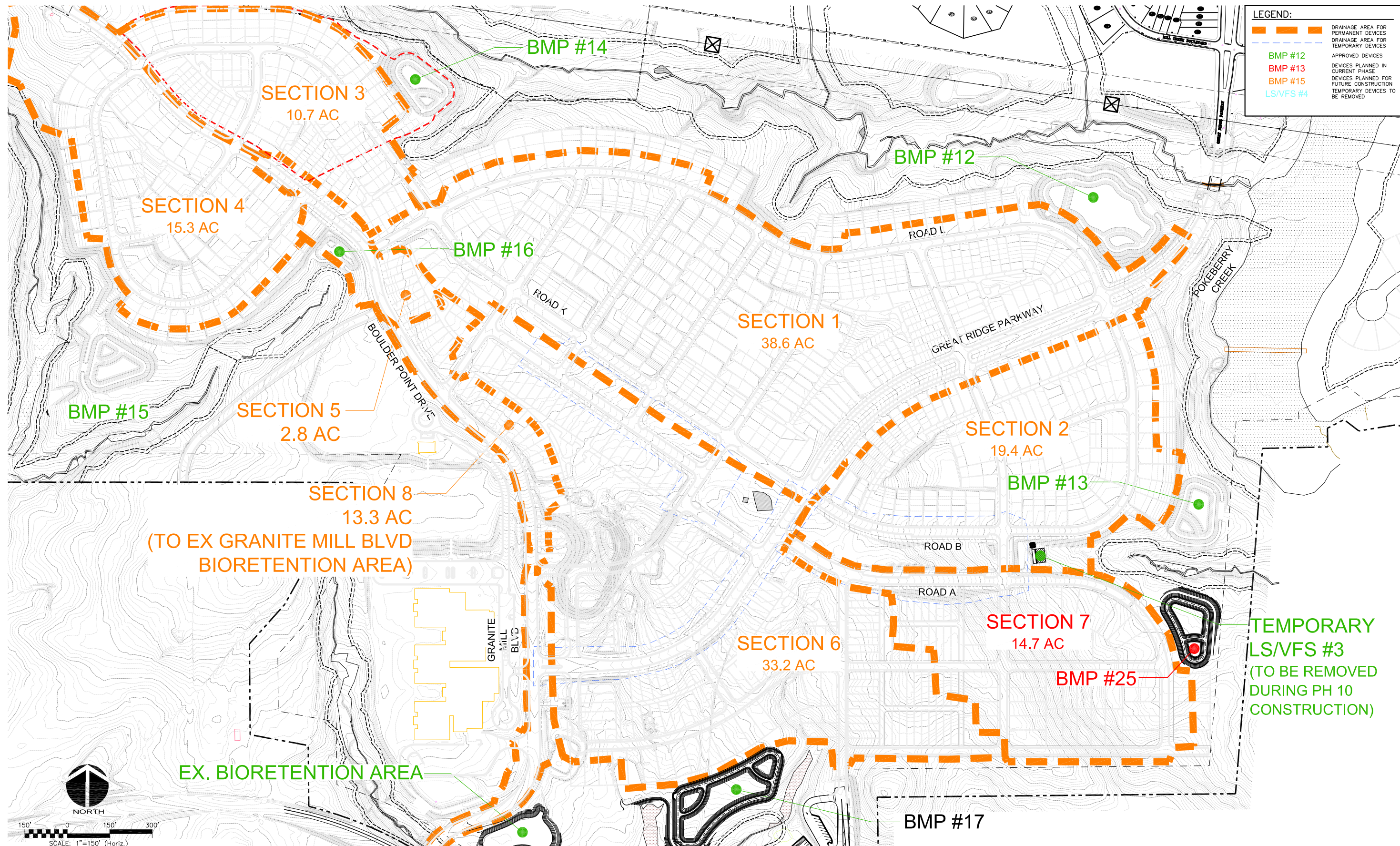
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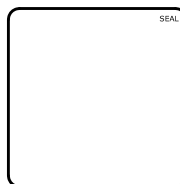
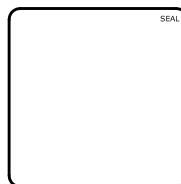
sheet 4 Bynum



Briar Chapel
Phase 10



REV.	DESCRIPTION	DATE
5	SUBMITTAL TO DWG 401 UNIT FOR PHASE 10 PROJECT	2015.12.04
4	SUBMITTAL TO DWG 401 UNIT FOR PHASE 11 PROJECT	2014.06.30
3	SUBMITTAL TO DWG 401 UNIT FOR PHASE 8 PROJECT	2013.05.21
2	SUBMITTAL TO DWG 401 UNIT FOR PHASE 7 PROJECT	2013.01.24
1	SUBMITTAL TO DWG 401 UNIT FOR GREAT RIDGE PARKWAY EXTENSION PROJECT	2012.12.19



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CHATHAM COUNTY, NORTH CAROLINA

BC SOUTH DRAINAGE AREA MAP

DATE: DECEMBER 19, 2012	SCALE: 1" = 150'	MISC FILE NUMBER: DA MAP
MCE PROJ. # 02735-0080	HORIZONTAL: 1" = 150'	DRAWING NUMBER: MAP 1
DRAWN: GCA	VERTICAL: N/A	
DESIGNED: GCA		
CHECKED: CHS		
PROJ. MGR.: CHS		
STATUS: FOR PERMIT ONLY	REVISION: 4	

Wet Detention Pond #25 Design

WATER QUALITY POND #25 CALCULATIONS

Project Name

Briar Chapel - Phase 10

Project Number

02735-0151

Date

November 23, 2015

3rd revision

2nd revision

1st revision

X

X

Water Quality Pond Drainage Area Data

Project Briar Chapel - Phase 10
 Project No. 02735-0151

Date November 23, 2015

Total site area 639,050 square feet = 14.67 acres

	Drainage area to pond			Other Drainage Area	
	Existing [sf]	Proposed [sf]	Change [sf]	Existing [sf]	Proposed [sf]
Impervious areas					
On-site buildings (BUA)	0	222,000	222,000	0	0
On-site streets	0	111,535	111,535	0	0
On-site alleys	0	3,230	3,230	0	0
On-site sidewalks	0	28,395	28,395	0	0
On-site future (open space)	0	0	0	0	0
Off-site future development	0	0	0	0	0
Contingency	0	22,500	22,500	0	0
Total Impervious	0	387,660	387,660	0	0

	Drainage area to pond			Other Drainage Area	
	Existing [sf]	Proposed [sf]	Change [sf]	Existing [sf]	Proposed [sf]
Non-impervious areas					
On-site grass/landscape	0	249,890	249,890	0	0
On-site woods	639,050	0	-639,050	0	0
Other undeveloped	0	0	0	0	0
Total off-site non-impervious	0	0	0	0	0
Total non-impervious	639,050	249,890	-389,160	0	0

Total Drainage Area	639,050	639,050	0	3,167,850	3,167,850
Percent Impervious	0.0	60.7	60.7	0.0	0.0

Water Quality Pond Surface Area Calculations

Project Briar Chapel - Phase 10
Project No. 02735-0151

Date November 23, 2015

Total on-site drainage area to pond 639,050 square feet
Total impervious area in drainage area 387,660 square feet

Average water depth of basin at normal pool 3.6 feet

Location of site Chatham County
Site region Piedmont

% Impervious cover 60.7 percent

If the site is in a coastal area, will a vegetative filter be used? n/a

Surface Area/Drainage Area Ratios:

For a site in the Piedmont (85%) 2.2 percent
For a site in the Piedmont (90%) 3.1 percent
For a site in a Coastal County w/ Vegetative Filter 4.3 percent
For a site in a Coastal County w/out Vegetative Filter 6.0 percent

Required surface area of pond:

For a site in the Piedmont (85%) 14,100.0 square feet
For a site in the Piedmont (90%) 19,900.0 square feet
For a site in a Coastal County w/ Vegetative Filter 27,700.0 square feet
For a site in a Coastal County w/out Vegetative Filter 38,580.0 square feet

Notes:

Water Quality Pond Stormwater Runoff Volume Calculations

Project Briar Chapel - Phase 10
Project No. 02735-0151

Date November 23, 2015

Drainage area 639,050 square feet
Impervious area 387,660 square feet
Rainfall depth 1.00 inches

Percent Impervious 60.7 percent

$R(v) = 0.05 + 0.009 * (\text{Percent impervious})$

Runoff coefficient - R(v) 0.60 in/in

Runoff volume = (Design rainfall) * (R(v)) * (Drainage area)

Runoff volume 31,737.2 cubic feet

Notes:

Project	Briar Chapel - Phase 10
Project No.	02735-0151
Date	November 23, 2015

2015.11.23.Phase 10 BMP #25.xls
Stage Storage (Temp Pool) Page 1 of 1 Printed 12/2/2015 11:31 AM

Water Quality Pond Volume Calculations
Stage-Storage Data for Pond - Permanent Pool

Project Briar Chapel - Phase 10

Project No. 02735-0151

Date November 23, 2015

Contour ID	Stage	Area [sq. ft.]	Area [acres]	Incremental Area [sq. ft.]	Incremental Area [acres]	Incremental volume [cu. ft]	Incremental volume [acre-ft]	Cumulative volume [cu. ft]	Cumulative volume [acre-ft]
406	0	4,404.0	0.101	4,404.0	0.1	0.0	0.0	0.0	0.0
407	1	5,243.0	0.120	839.0	0.0	4,823.5	0.1	4,823.5	0.1
408	2	7,120.0	0.163	1,877.0	0.0	6,181.5	0.1	11,005.0	0.3
409	3	8,674.0	0.199	1,554.0	0.0	7,897.0	0.2	18,902.0	0.3
410	4	10,429.0	0.239	1,755.0	0.0	9,551.5	0.2	28,453.5	0.4
411	5	12,385.0	0.284	1,956.0	0.0	11,407.0	0.3	39,860.5	0.5
412	6	14,483.0	0.332	2,098.0	0.0	13,434.0	0.3	53,294.5	0.6
413	7	16,753.0	0.385	2,270.0	0.1	15,618.0	0.4	68,912.5	0.7
413.5	7.5	20,520.0	0.471	3,767.0	0.1	9,318.3	0.2	78,230.8	0.6

Project	Briar Chapel - Phase 10
Project No.	02735-0151
Date	November 23, 2015

2015.11.23.Phase 10 BMP #25.xls
Stage Storage (Forebays) Page 1 of 1 Printed 12/2/2015 11:31 AM

Water Quality Basin Dewatering Time Calculations

Project Briar Chapel - Phase 10
Project No. 02735-0151

Date November 23, 2015

Water quality treatment volume	<u>31,737</u>	cubic feet
Total treatment volume	<u>38,100</u>	cubic feet
Maximum head of water above dewatering hole	<u>1.60</u>	feet
Driving head	<u>0.53</u>	feet
Orifice coefficient	<u>0.60</u>	
Diameter of each hole	<u>3.00</u>	inches
Number of holes	<u>1</u>	
Cross sectional area of each hole =	<u>0.049</u>	square feet
Cross sectional area of each hole =	<u>7.1</u>	square inches
Cross sectional area of dewatering hole(s) =	<u>0.049</u>	square feet
Cross sectional area of dewatering hole(s) =	<u>7.1</u>	square inches
Dewatering time for water quality volume =	<u>2.1</u>	days
	<u>51.3</u>	hours
Dewatering time for total volume =	<u>2.6</u>	days
	<u>61.6</u>	hours

Notes:

Dewatering time formula: $t \text{ (days)} = V / (Cd * A * \text{Sqrt}(2 * 32.2 * H) * 86,400)$

t = drawdown time
V = treatment volume
Cd = orifice coefficient
A = cross sectional area of orifice
H = driving head (1/3 max. head)

Water Quality Pond Summary Information

Project Briar Chapel - Phase 10
Project No. 02735-0151

Date November 23, 2015

Drainage area to pond 639,050 square feet = 14.67 acres
Impervious area in drainage area 387,660 square feet = 8.90 acres

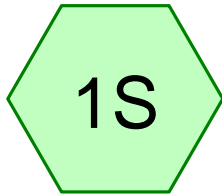
Bottom of pond elevation 406.00 feet
Normal pool elevation 413.50 feet
Pond volume at normal pool 78,231 cubic feet
Forebay volume at normal pool 16,820 cubic feet
Forbay % of total volume 21.5%

Required volume for design rainfall 31,737 cubic feet
Required surface area for pond 19,900 square feet

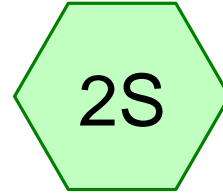
Volume provided for storage of design rainfall = 31,864 cubic feet at elevation 414.85

Surface area provided at normal pool 20,520 square feet

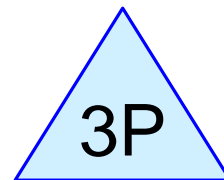
Average Depth 3.81 feet



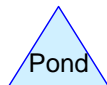
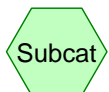
Pre-Development



Post-Development



BMP #25



2015.11.23.BMP #25.Revised*Type II 24-hr 1-Inch Rainfall=1.00"*

Prepared by McKim & Creed

Printed 12/4/2015

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Pre-Development

Runoff Area=14.670 ac 0.00% Impervious Runoff Depth>0.00"

Tc=15.0 min CN=70 Runoff=0.01 cfs 0.002 af

Subcatchment 2S: Post-Development

Runoff Area=14.670 ac 60.67% Impervious Runoff Depth>0.25"

Tc=10.0 min CN=89 Runoff=6.06 cfs 0.312 af

Pond 3P: BMP #25

Peak Elev=413.95' Storage=9,943 cf Inflow=6.06 cfs 0.312 af

Primary=0.14 cfs 0.084 af Secondary=0.00 cfs 0.000 af Outflow=0.14 cfs 0.084 af

Total Runoff Area = 29.340 ac Runoff Volume = 0.314 af Average Runoff Depth = 0.13"
69.67% Pervious = 20.440 ac 30.33% Impervious = 8.900 ac

Summary for Subcatchment 1S: Pre-Development

[73] Warning: Peak may fall outside time span

Runoff = 0.01 cfs @ 19.51 hrs, Volume= 0.002 af, Depth> 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

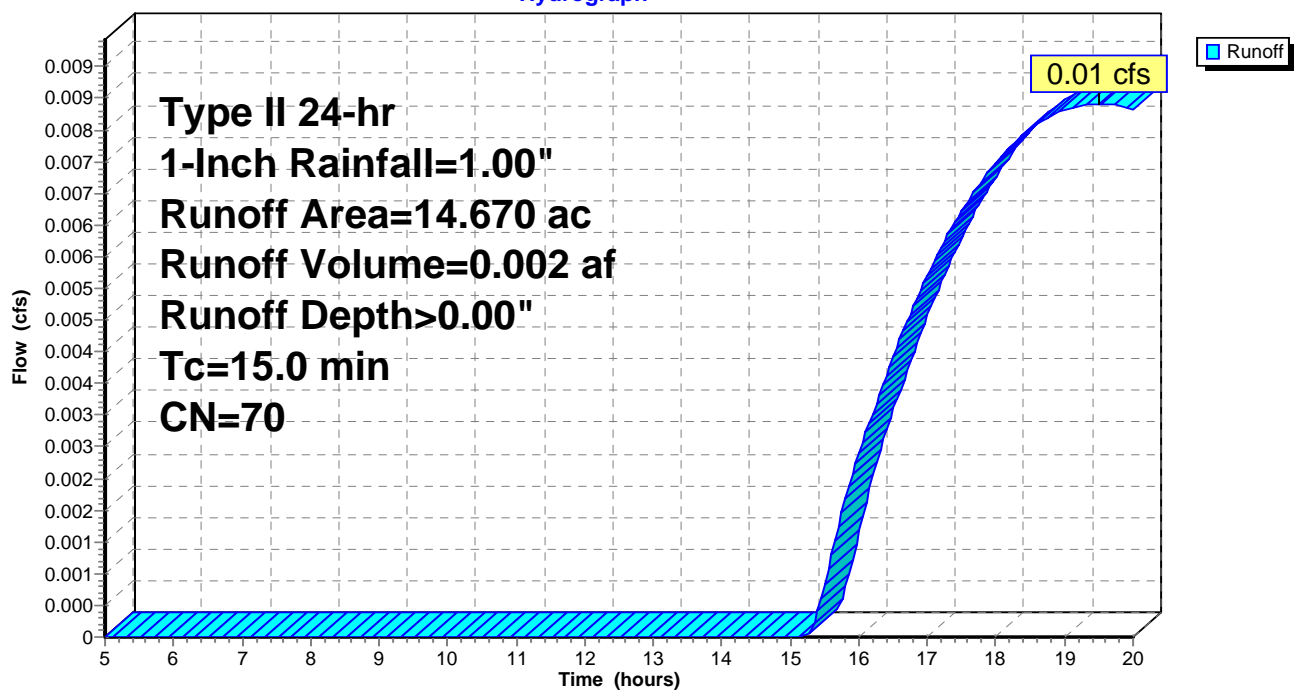
Type II 24-hr 1-Inch Rainfall=1.00"

Area (ac)	CN	Description
14.670	70	Woods, Good, HSG C
14.670		100.00% Pervious Area

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

Subcatchment 1S: Pre-Development

Hydrograph



Summary for Subcatchment 2S: Post-Development

Runoff = 6.06 cfs @ 12.03 hrs, Volume= 0.312 af, Depth> 0.25"

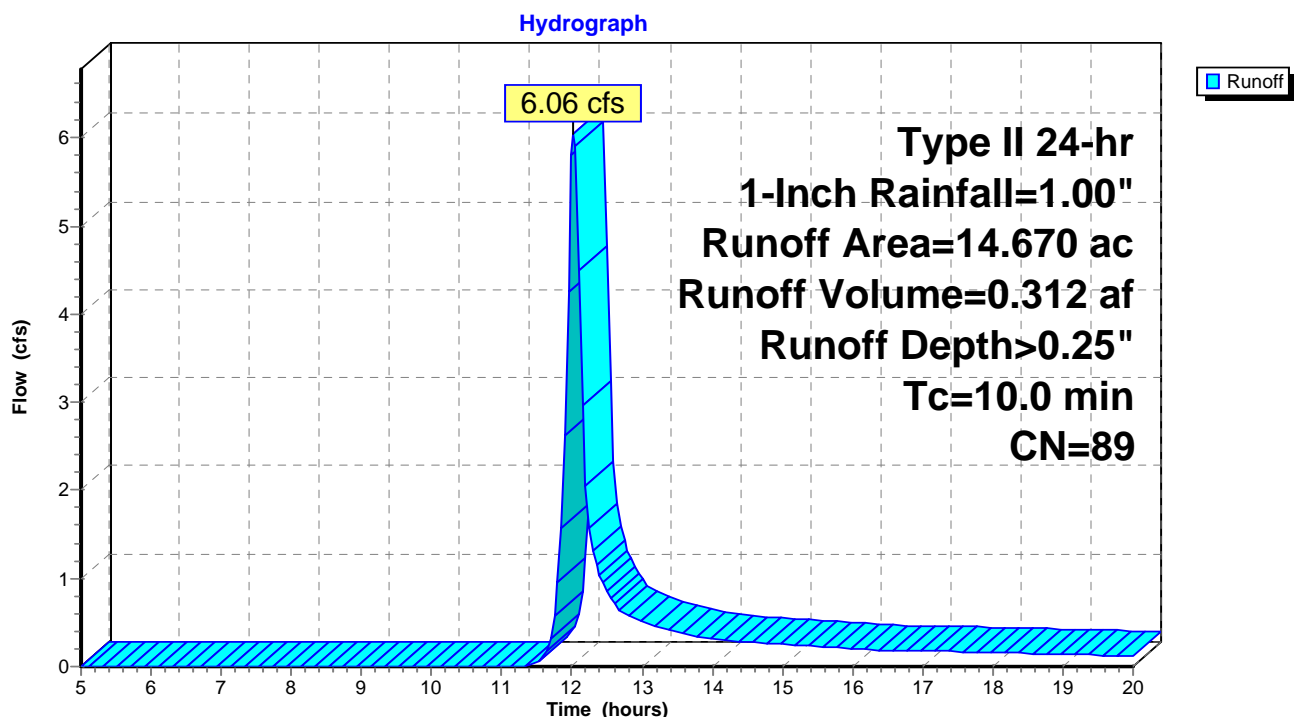
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type II 24-hr 1-Inch Rainfall=1.00"

Area (ac)	CN	Description
5.770	74	>75% Grass cover, Good, HSG C
8.900	98	Paved parking, HSG C
14.670	89	Weighted Average
5.770		39.33% Pervious Area
8.900		60.67% Impervious Area

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

Subcatchment 2S: Post-Development



Summary for Pond 3P: BMP #25

Inflow Area = 14.670 ac, 60.67% Impervious, Inflow Depth > 0.25" for 1-Inch event
 Inflow = 6.06 cfs @ 12.03 hrs, Volume= 0.312 af
 Outflow = 0.14 cfs @ 19.13 hrs, Volume= 0.084 af, Atten= 98%, Lag= 425.9 min
 Primary = 0.14 cfs @ 19.13 hrs, Volume= 0.084 af
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 413.95' @ 19.13 hrs Surf.Area= 23,287 sf Storage= 9,943 cf

Plug-Flow detention time= 254.7 min calculated for 0.084 af (27% of inflow)
 Center-of-Mass det. time= 154.9 min (972.0 - 817.1)

Volume	Invert	Avail.Storage	Storage Description
#1	413.50'	153,520 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
413.50	20,520	0	0
414.00	23,568	11,022	11,022
415.00	25,473	24,521	35,543
416.00	27,434	26,454	61,996
417.00	29,452	28,443	90,439
418.00	31,526	30,489	120,928
419.00	33,657	32,592	153,520

Device	Routing	Invert	Outlet Devices
#1	Primary	411.50'	24.0" Round Culvert L= 46.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 411.50' / 411.00' S= 0.0109 1' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Device 1	413.50'	3.0" Vert. Orifice/Grate C= 0.600
#3	Device 1	415.10'	42.0" x 42.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Secondary	417.00'	20.0' long x 22.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.14 cfs @ 19.13 hrs HW=413.95' (Free Discharge)

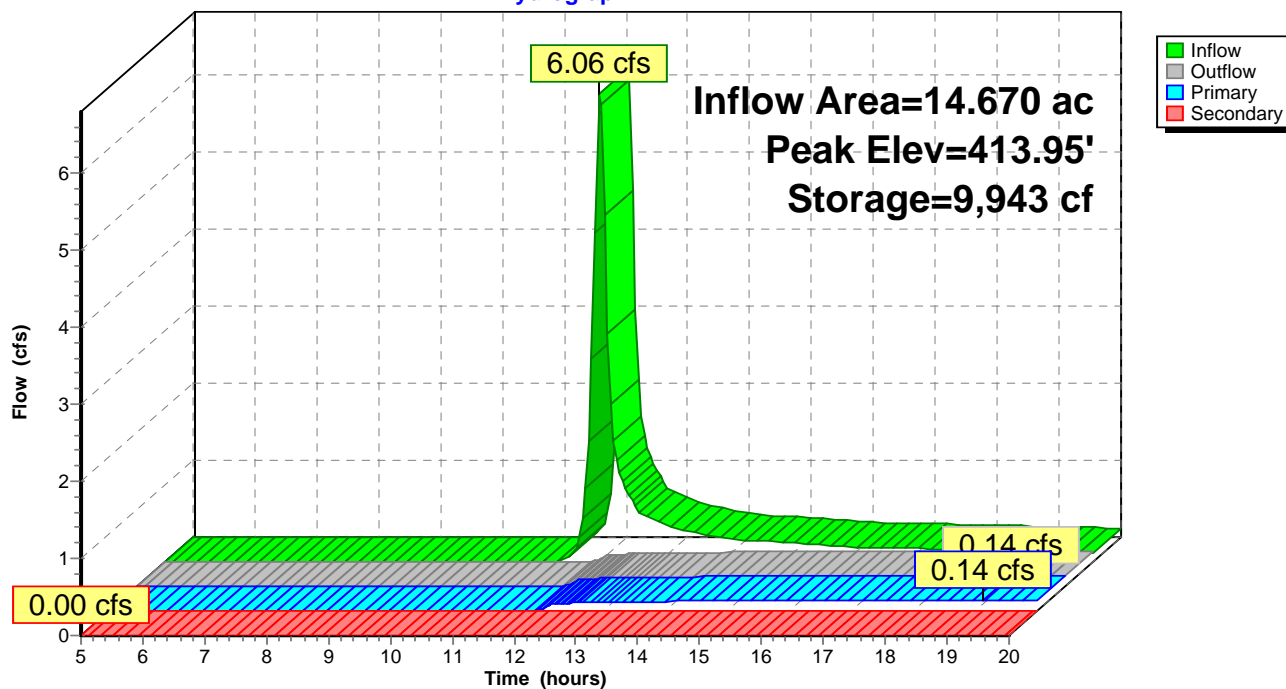
↑ **1=Culvert** (Passes 0.14 cfs of 18.24 cfs potential flow)
 ↑ **2=Orifice/Grate** (Orifice Controls 0.14 cfs @ 2.76 fps)
 ↑ **3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=413.50' (Free Discharge)

↑ **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: BMP #25

Hydrograph



2015.11.23.BMP #25.Revised*Type II 24-hr 10-Yr Rainfall=5.17"*

Prepared by McKim & Creed

Printed 12/4/2015

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Pre-Development

Runoff Area=14.670 ac 0.00% Impervious Runoff Depth>1.97"

Tc=15.0 min CN=70 Runoff=40.30 cfs 2.406 af

Subcatchment 2S: Post-Development

Runoff Area=14.670 ac 60.67% Impervious Runoff Depth>3.69"

Tc=10.0 min CN=89 Runoff=83.42 cfs 4.506 af

Pond 3P: BMP #25

Peak Elev=416.83' Storage=85,376 cf Inflow=83.42 cfs 4.506 af

Primary=31.47 cfs 3.594 af Secondary=0.00 cfs 0.000 af Outflow=31.47 cfs 3.594 af

Total Runoff Area = 29.340 ac Runoff Volume = 6.912 af Average Runoff Depth = 2.83"
69.67% Pervious = 20.440 ac 30.33% Impervious = 8.900 ac

Summary for Subcatchment 1S: Pre-Development

Runoff = 40.30 cfs @ 12.08 hrs, Volume= 2.406 af, Depth> 1.97"

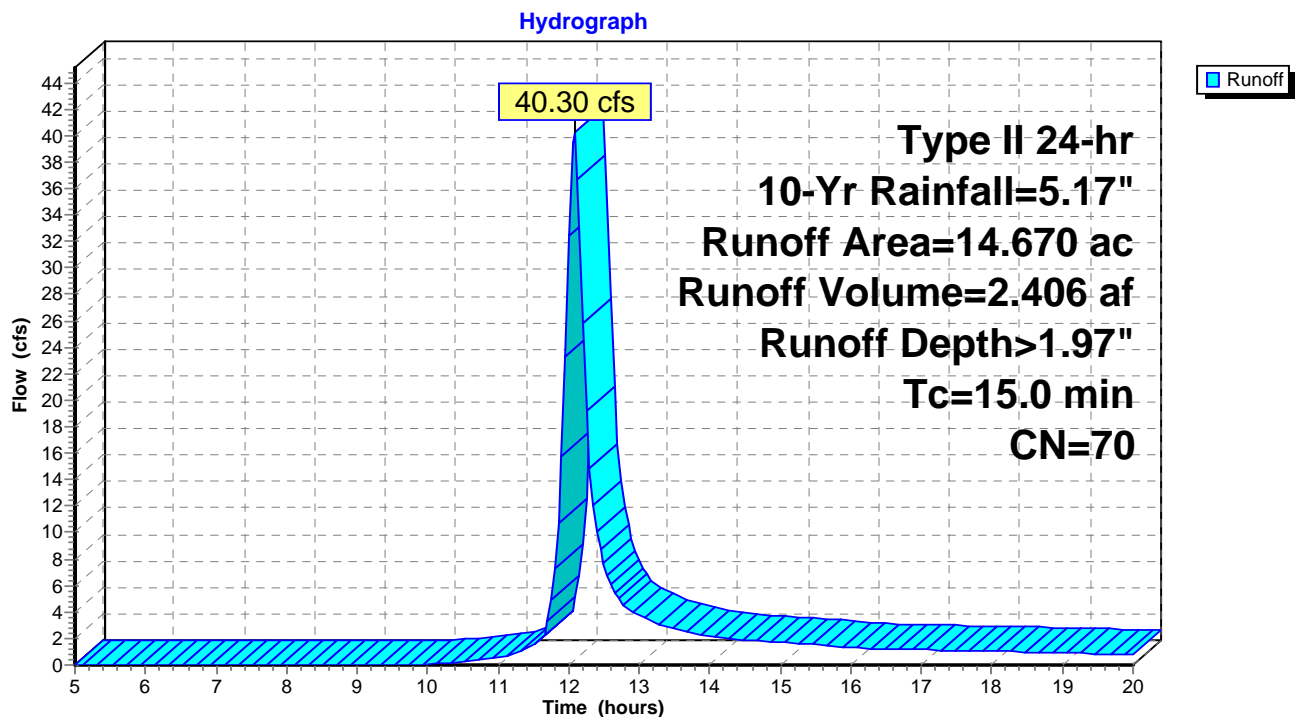
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type II 24-hr 10-Yr Rainfall=5.17"

Area (ac)	CN	Description
14.670	70	Woods, Good, HSG C
14.670		100.00% Pervious Area

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

Subcatchment 1S: Pre-Development



Summary for Subcatchment 2S: Post-Development

Runoff = 83.42 cfs @ 12.01 hrs, Volume= 4.506 af, Depth> 3.69"

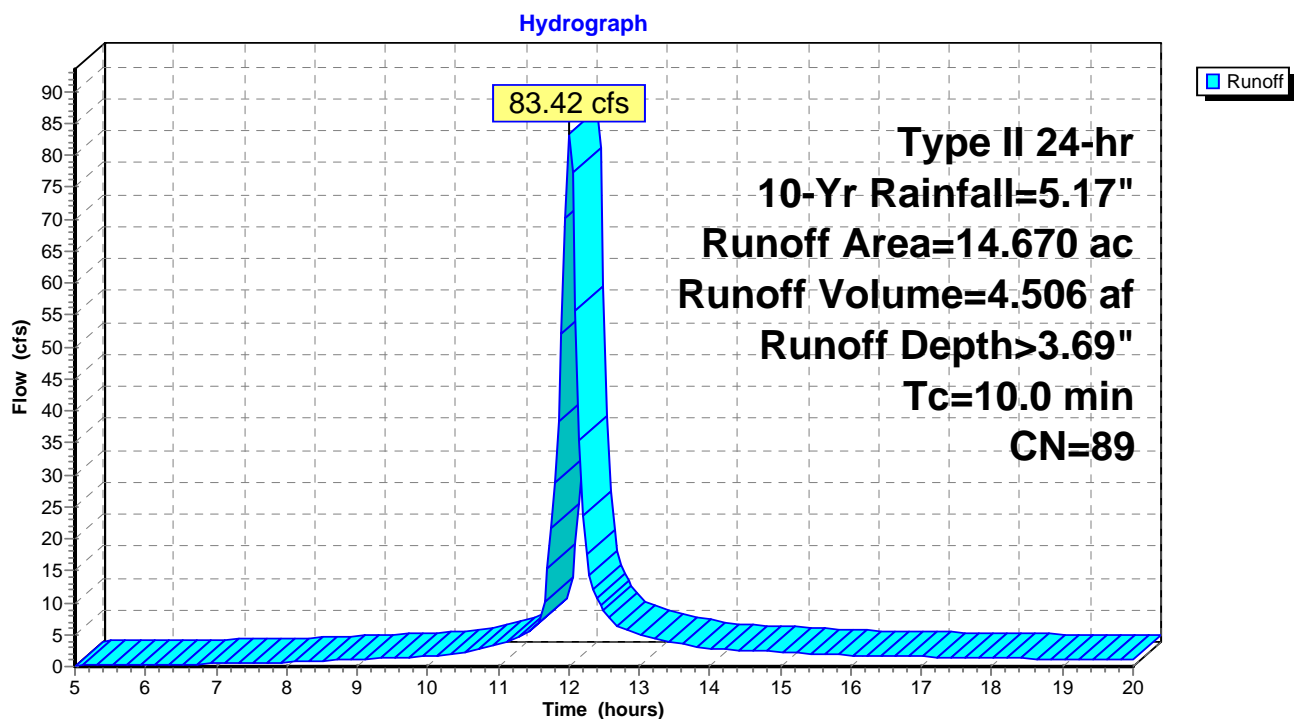
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type II 24-hr 10-Yr Rainfall=5.17"

Area (ac)	CN	Description
5.770	74	>75% Grass cover, Good, HSG C
8.900	98	Paved parking, HSG C
14.670	89	Weighted Average
5.770		39.33% Pervious Area
8.900		60.67% Impervious Area

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

Subcatchment 2S: Post-Development



Summary for Pond 3P: BMP #25

[82] Warning: Early inflow requires earlier time span

Inflow Area = 14.670 ac, 60.67% Impervious, Inflow Depth > 3.69" for 10-Yr event
 Inflow = 83.42 cfs @ 12.01 hrs, Volume= 4.506 af
 Outflow = 31.47 cfs @ 12.17 hrs, Volume= 3.594 af, Atten= 62%, Lag= 9.6 min
 Primary = 31.47 cfs @ 12.17 hrs, Volume= 3.594 af
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 416.83' @ 12.17 hrs Surf.Area= 29,103 sf Storage= 85,376 cf

Plug-Flow detention time= 102.3 min calculated for 3.594 af (80% of inflow)
 Center-of-Mass det. time= 47.8 min (806.7 - 758.9)

Volume	Invert	Avail.Storage	Storage Description
#1	413.50'	153,520 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
413.50	20,520	0	0
414.00	23,568	11,022	11,022
415.00	25,473	24,521	35,543
416.00	27,434	26,454	61,996
417.00	29,452	28,443	90,439
418.00	31,526	30,489	120,928
419.00	33,657	32,592	153,520

Device	Routing	Invert	Outlet Devices
#1	Primary	411.50'	24.0" Round Culvert L= 46.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 411.50' / 411.00' S= 0.0109 1' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Device 1	413.50'	3.0" Vert. Orifice/Grate C= 0.600
#3	Device 1	415.10'	42.0" x 42.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Secondary	417.00'	20.0' long x 22.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=31.42 cfs @ 12.17 hrs HW=416.82' (Free Discharge)

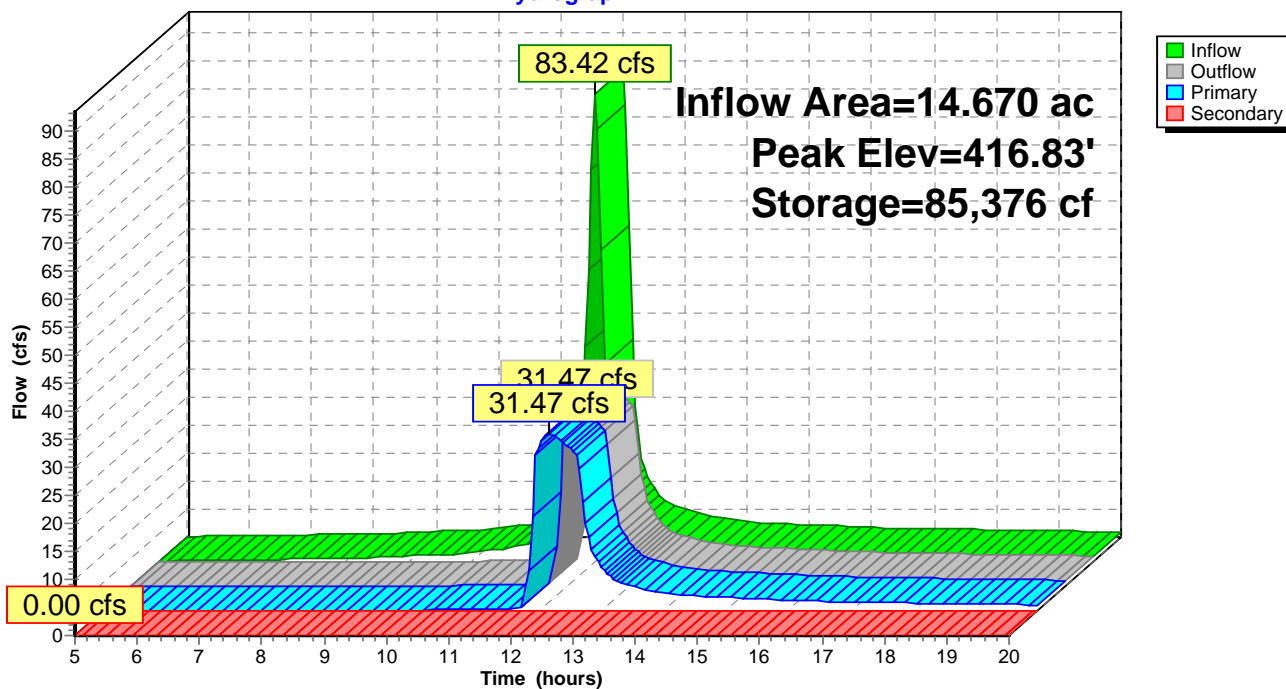
1=Culvert (Inlet Controls 31.42 cfs @ 10.00 fps)
 2=Orifice/Grate (Passes < 0.42 cfs potential flow)
 3=Orifice/Grate (Passes < 77.25 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=413.50' (Free Discharge)

4=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 3P: BMP #25

Hydrograph



Summary for Pond 3P: BMP #25

[82] Warning: Early inflow requires earlier time span

Inflow Area = 14.670 ac, 60.67% Impervious, Inflow Depth > 5.91" for 100-Yr event
 Inflow = 130.16 cfs @ 12.01 hrs, Volume= 7.228 af
 Outflow = 76.36 cfs @ 12.12 hrs, Volume= 6.300 af, Atten= 41%, Lag= 6.7 min
 Primary = 35.00 cfs @ 12.12 hrs, Volume= 5.556 af
 Secondary = 41.36 cfs @ 12.12 hrs, Volume= 0.744 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 417.85' @ 12.12 hrs Surf.Area= 31,219 sf Storage= 116,291 cf

Plug-Flow detention time= 84.8 min calculated for 6.279 af (87% of inflow)
 Center-of-Mass det. time= 44.1 min (793.8 - 749.7)

Volume	Invert	Avail.Storage	Storage Description
#1	413.50'	153,520 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
413.50	20,520	0	0
414.00	23,568	11,022	11,022
415.00	25,473	24,521	35,543
416.00	27,434	26,454	61,996
417.00	29,452	28,443	90,439
418.00	31,526	30,489	120,928
419.00	33,657	32,592	153,520

Device	Routing	Invert	Outlet Devices
#1	Primary	411.50'	24.0" Round Culvert L= 46.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 411.50' / 411.00' S= 0.0109 ' S= 0.0109 ' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Device 1	413.50'	3.0" Vert. Orifice/Grate C= 0.600
#3	Device 1	415.10'	42.0" x 42.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Secondary	417.00'	20.0' long x 22.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=34.91 cfs @ 12.12 hrs HW=417.83' (Free Discharge)

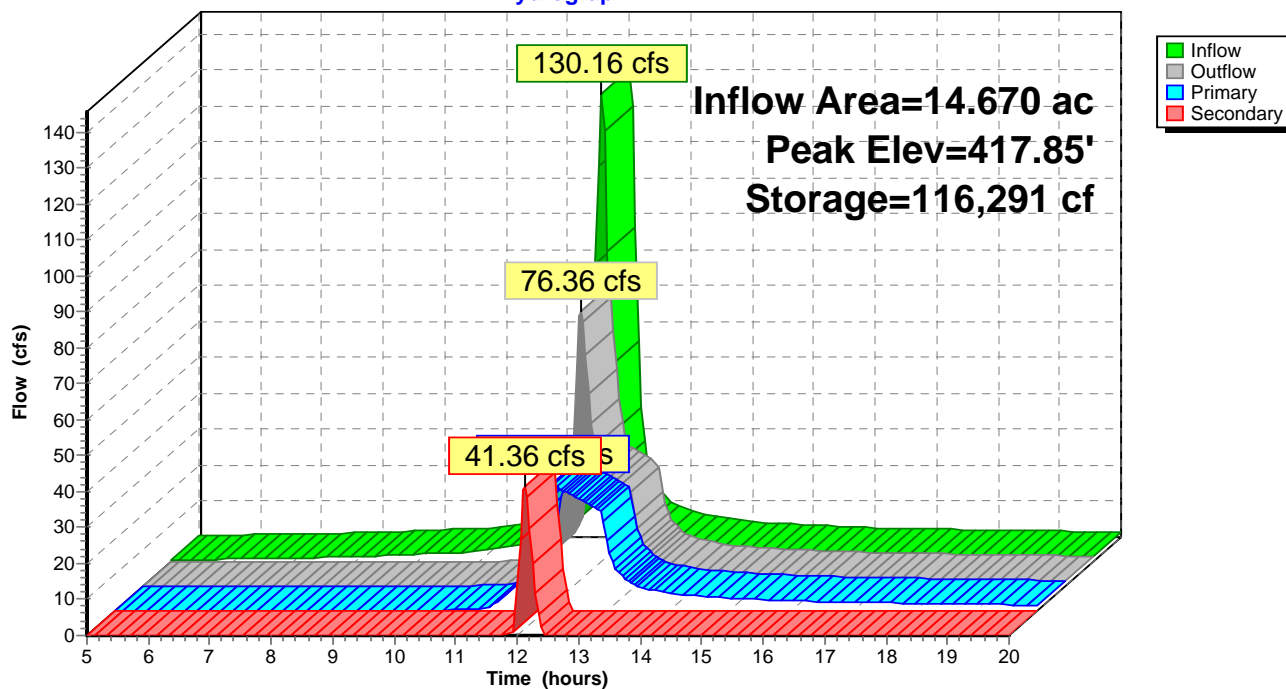
1=Culvert (Inlet Controls 34.91 cfs @ 11.11 fps)
 2=Orifice/Grate (Passes < 0.48 cfs potential flow)
 3=Orifice/Grate (Passes < 97.37 cfs potential flow)

Secondary OutFlow Max=39.57 cfs @ 12.12 hrs HW=417.83' (Free Discharge)

4=Broad-Crested Rectangular Weir (Weir Controls 39.57 cfs @ 2.40 fps)

Pond 3P: BMP #25

Hydrograph



ANTI-FLOATATION DESIGN		DATE: 11/24/2015	DESIGNED BY: GCA
PROJECT NAME: Briar Chapel - Phase 10 PROJECT LOCATION: Chatham County, NC		PROJECT NO: 02735-0151	CHECKED BY: GML
<div> <div> Pond Name= BMP #25 Riser Outer Width = 4.5 ft Riser Outer Length = 4.5 ft Riser Inner Width = 3.5 ft Riser Inner Length = 3.5 ft Riser Height = 4.1 ft Concrete Base Length = 6 ft Concrete Base Width = 6 ft Concrete Base Depth = 9 in </div> <div> Riser Resisting Force = 4,920 lb Base Resisting Force = 4,050 lb Total Resisting Force = 8,970 lb Riser Buoyant Force = 5,181 lb Base Buoyant Force = 1,685 lb Total Buoyant Force = 6,866 lb Factor of Safety 1.31 Design Acceptable </div> </div>			

OUTLET PROTECTION DESIGN

DATE: 12/4/2015

DESIGNED BY:
BSS

PROJECT NAME: Briar Chapel - Phase 10
PROJECT LOCATION: Chatham County, NC

PROJECT NO:
02735-0151

CHECKED BY
GCA

Storm Outlet Structure

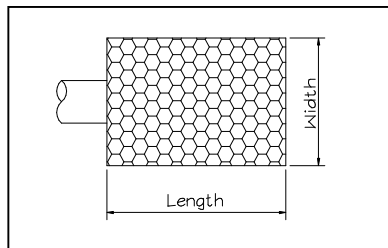
Structure= **BMP #25** Outlet
Size= 24 in
Q₁₀ = 31.47 cfs
Q_{full} = 23.58 cfs
V_{full} = 7.51 fps

Q₁₀/Q_{full} = 1.33
V/V_{full} = MAX
V = 10.0 fps

From Fig. 8.06.b.1:

Zone = **3**

From Fig. 8.06.b.2:



D₅₀ = 10 in
D_{MAX} = 15 in
Riprap Class = 1
Apron Thickness = 24 in
Apron Length = 16.0 ft
Apron Width = 3 x Dia = 6.0 ft