Stormwater Impact Analysis

The Point - North / AWH-20000 / October 2022

McAdams

THE POINT – NORTH

(PHASES 11-13)

ROLESVILLE, NORTH CAROLINA

STORMWATER IMPACT ANALYSIS

SITE PLAN

PLANNING #: TBD

PROJECT NUMBER:	AWH-20000
DESIGNED BY:	KELLI GARCIA, PE SAMANTHA DANIELL, PE ALEX THIERER, EI JOSHUA VINSON
DATE:	OCTOBER 2022

MCADAMS

621 HILLSBOROUGH STREET, SUITE 500

RALEIGH, NORTH CAROLINA 27603

NC LIC. # C-0293

THE POINT - NORTH

Stormwater Impact Analysis

GENERAL DESCRIPTION

The Point is a proposed residential development in Rolesville, North Carolina, located between Highway 401 and East Young Street/Rolesville Road. The development is approximately 300 acres, divided into a northern parcel and a southern parcel. This Stormwater Impact Analysis covers the development of the northern parcel only. Namely, the Northern Development will include 102 single-family lots, three stormwater control measures, sidewalks, roadways, greenway trail, and associated infrastructure.

The project site is located in the Neuse River Basin, and drains to Harris Creek (Peeples Creek / Wake Crossroads Lake) (BIMS # 27-26) and is classified as C;NSW. Per Town of Rolesville regulations, stormwater management on this site shall meet the stormwater management performance standards for development set forth in the Rolesville Unified Development Ordinance Article 7, Section 7.5.4 – Standards.

The regulations are as follows:

(A) Standards Based on Project Density

(4) **Development Standards for High-Density Projects** High-Density Projects shall implement stormwater control measures that comply with each of the following standards, in addition to the General Standards found in subsection B of this Section:

(a) The measures shall control and treat runoff from the first inch of rain. Runoff volume drawdown time shall be a minimum of 48 hours, but not more than 120 hours.

(b) All structural stormwater treatment systems used to meet these requirements shall be designed to have a minimum of 85 percent average annual removal for Total Suspended Solids (TSS).

(c) All Development and Redevelopment projects required to manage storm water shall provide permanent on-site BMPs to lower the nitrogen export amounts as part of the storm water management plan. BMPs are to be in accordance with and as specified in the Design Manual.

(d) Structural and Non-structural BMPs shall be used to ensure there is no net increase in peak flow leaving the site from the pre-Development conditions for the one-year, 24-hour storm. Runoff volume drawdown time shall be a minimum of 48 hours, but not more than 120 hours.

(e) General engineering design criteria for all projects shall be in accordance with 15A NCAC 2H .1008(c), as explained in the Design Manual;

(f) All Development and Redevelopment shall be located outside the Riparian Buffer Zone and the Flood Protection Zone. These Zones shall be in accordance with the following provisions:

i. Except where other applicable buffer standards are more restrictive, the Riparian Buffer Zone shall extend a minimum of 50 feet landward of all Perennial and Intermittent Surface Waters. The most restrictive standards shall apply.

ii. The Riparian Buffer Zone shall remain undisturbed unless otherwise permitted by this section.

iii. The Flood Protection Zone shall extend throughout the FEMA 100-year floodplain as identified on the current Flood Insurance Rate Map (FIRM) published by FEMA. The Flood Protection Zone shall remain undisturbed unless otherwise permitted by this section.

iv. No Development or Redevelopment is permitted within the Riparian Buffer Zone or the Flood Protection Zone except for stream bank or shoreline restoration or stabilization, water dependent structures, and public or private projects such as road crossings and installations, utility crossings and installations, and greenways, where no practical alternatives exist.

v. Permitted activities within the Riparian Buffer Zone and the Flood Protection Zone shall minimize impervious coverage, direct runoff away from surface waters to achieve diffuse flow, and maximize the utilization of Non-structural BMPs.

vi. Where the Riparian Buffer Zone and the Flood Protection Zone both are present adjacent to surface waters, the more restrictive shall apply.

(g) The approval of the stormwater permit shall require an enforceable restriction on property usage that runs with the land, such as recorded deed restrictions or protective covenants, to ensure that future Development and Redevelopment maintains the site consistent with the approved project plans. Buffer widths and locations shall be clearly delineated on all plans, final plat, and as-builts.

(B) General Standards

(1) Downstream Impact Analysis The downstream impact analysis must be performed in accordance with the "ten percent rule," and a copy of the analysis must be provided with the permit application. The purpose of the downstream impact analysis is to determine if the project will cause any impacts on flooding or channel degradation downstream of the project site. The analysis must include the assumptions, results and supporting calculations to show safe passage of post-Development design flows downstream. This analysis shall be performed at the outlet(s) of the site, and downstream at each tributary junction to the point(s) in the conveyance system where the area of the portion of the site draining into the system is less than or equal to ten percent of the total drainage area above that point.

(2) Standards for Stormwater Control Measures

(a) Evaluation According to Contents of Design Manual All stormwater control measures and stormwater treatment practices (or BMPs) required under this ordinance shall be evaluated by the Stormwater Administrator according to the policies, criteria, and information, including technical specifications and standards and the specific design criteria for each stormwater practice, in the Design Manual. The Stormwater Administrator shall determine whether proposed BMPs will be adequate to meet the requirements of this ordinance.

(b) Determination of Adequacy; Presumptions and Alternatives Stormwater treatment practices that are designed, constructed, and maintained in accordance with the criteria and specifications in the Design Manual will be presumed to meet the minimum water quality and quantity performance standards of this ordinance. Whenever an applicant proposes to utilize a practice or practices not designed and constructed in accordance with the criteria and specifications in the Design Manual, the applicant shall have the burden of demonstrating that the practice(s) will satisfy the minimum water quality and quantity performance standards of this ordinance. The Stormwater Administrator may require the applicant to provide the documentation, calculations, and examples necessary for the Stormwater Administrator to determine whether such an affirmative showing is made.

(c) Separation from Seasonal High Water Table For BMPs that require a separation from the seasonal high-water table, the separation shall be provided by at least 12 inches of naturally occurring soil above the seasonal high-water table.

CALCULATION METHODOLOGY

- Rainfall data for this area in the Rolesville, NC region is from NOAA Atlas 14. This data contains a depth-duration-frequency (DDF) table describing rainfall depth versus time for varying return periods in the area. These rainfall depths are input into the meteorological model within PondPack for peak flow rate calculations. Please reference the precipitation information within the Miscellaneous Site Information section of this report for additional information.

- On-site and off-site soils were determined using best available GIS data sources.

- Soil Conservation Service Curve Numbers (SCS CN) were selected from Table 2 of the USDA TR-55 for the land use that is most similar to the zoning type or cover condition.

- Land cover conditions for the pre-development condition were taken from survey provided by WithersRavenel and aerial imagery for the site. Land cover conditions for the post-development condition were taken from the proposed layout. Offsite cover conditions were based on GIS-based zoning mapping, provided by the Town of Rolesville.

- The time of concentration was calculated using SCS TR-55 (Segmental Approach, 1986). The Tc flow path can be divided into multiple segments, as necessary: overland flow, concentrated flow, and channel flow. The travel time was then computed for each segment, from which the overall time of concentration was determined by taking the sum of each segmental time.

- Existing topographic information used in this analysis is from survey provided by WithersRavenel and QL2 LiDAR from North Carolina's Spatial Data Download.

- PondPack Version V8i was used in determining the pre- & post-development peak flow rates for the 1- and 10-year storm events, as well as routing calculations for the proposed stormwater control measures.

- HY-8 Version 7.30 was used in designing and determining the hydraulic performance of the proposed Culvert Crossing on the XX road.

For 100-year storm routing calculations, approximately 1-foot of freeboard is provided between the peak elevation during the 100-year storm event and the top of the dam for the proposed facilities.

To meet the above Town of Rolesville standards, three stormwater control measures (SCMs) have been proposed for the northern parcel.

DISCUSSION OF RESULTS

PEAK RUNOFF CONTROL REQUIREMENTS

As shown in the Summary of Results section of this SIA, the proposed stormwater control measures provide the necessary peak runoff control for the proposed build-out condition of the development such that there are no calculated increases in the 1- and 10-year storm events at any point of analysis leaving the site.

POLLUTANT AND NUTRIENT CONTROL REQUIREMENTS

The proposed SCM is designed to the Minimum Design Criteria of the NCDEQ Stormwater Design Manual. Therefore, the proposed development is treated for 85% TSS removal and provides nitrogen and phosphorus treatment.

CONCLUSION

If the development on this tract is built as proposed within this report, then the requirements set forth in Town of Rolesville regulations will be met without additional stormwater management facilities. However, modifications to the proposed development may require that this analysis be revised. Some modifications that would require this analysis to be revised include:

1. The proposed site impervious surface exceeds the amount accounted for in this report.
2. The post-development watershed breaks change significantly from those used to prepare this report.

The above modifications may result in the assumptions within this report becoming invalid. The computations within this report will need to be revisited if any of the above conditions become apparent as development of the proposed site moves forward.

SUMMARY OF RESULTS

The Point - North
AWH-20000

RELEASE RATE MANAGEMENT RESULTS

POINT OF ANALYSIS #1			
Return Period	**Pre-Dev** [cfs]	**Post-Dev** [cfs]	**% Increase** [%]
1-Year	39.4	27.3	-31%
10-Year	100.8	77.6	-23%

POINT OF ANALYSIS #2			
Return Period	**Pre-Dev** [cfs]	**Post-Dev** [cfs]	**% Increase** [%]
1-Year	2.8	1.7	-39%
10-Year	6.1	3.9	-37%

STORMWATER CONTROL MEASURE 'M' SUMMARY

Design Drainage Area =	7.40	ac
Design Impervious Area =	3.28	ac
% Impervious =	44.4%	
Top of Dam =	346.00	ft
NWSE =	340.00	ft
Average Depth =	3.31	ft
WQv Ponding Elevation =	341.33	ft
Required Main Pool Surface Area at NWSE =	4,986	sf
Total Surface Area Provided at NWSE =	7,002	sf
Estimate of Provided Main Pool Surface Area at NWSE =	5,425	sf
WQv Orifice Diameter =	1.75	in
WQv Orifice Invert Elevation =	340.00	ft
Number of Orifices =	3	
Orifice Invert Elevation =	341.50	ft
Orifice Size =	0.5'Hx1'L	
Riser Size =	4' x 4'	
Riser Crest =	344.00	ft
Barrel Diameter =	24	in
# of Barrels =	1	
Upstream Invert =	339.00	ft
Downstream Invert =	338.00	ft
Length =	56	ft
Slope =	0.0179	ft/ft

STORMWATER CONTROL MEASURE 'M' ROUTING RESULTS

Return Period	Inflow [cfs]	Outflow [cfs]	Max. WSE [ft]	Freeboard [ft]
1-Year	20.6	4.1	342.06	3.94
10-Year	38.4	10.1	343.65	2.35
25-Year	44.6	14.2	344.15	1.85
100-Year	53.4	26.9	344.53	1.47

STORMWATER CONTROL MEASURE 'N' SUMMARY

Design Drainage Area =	8.58	ac
Design Impervious Area =	4.47	ac
% Impervious =	52.0%	
Top of Dam =	352.00	ft
NWSE =	346.00	ft
WQ Depth =	13.48	in
WQv Ponding Elevation =	347.12	ft
Required Surface Area at NWSE =	12,917	sf
Provided Surface Area at NWSE =	14,373	sf
WQv Orifice Diameter =	2.00	in
WQv Orifice Invert Elevation =	346.00	ft
Number of Orifices =	3	
Orifice Invert Elevation =	347.50	ft
Orifice Size =	0.5'Hx1'L	
Riser Size =	4' x 4'	
Riser Crest =	350.00	ft
Barrel Diameter =	24	in
# of Barrels =	1	
Upstream Invert =	343.00	ft
Downstream Invert =	342.00	ft
Length =	56	ft
Slope =	0.0179	ft/ft

STORMWATER CONTROL MEASURE 'N' ROUTING RESULTS

Return Period	Inflow [cfs]	Outflow [cfs]	Max. WSE [ft]	Freeboard [ft]
1-Year	26.4	4.2	348.07	3.93
10-Year	48.2	10.0	349.61	2.39
25-Year	55.6	13.7	350.13	1.87
100-Year	66.2	29.2	350.50	1.50

STORMWATER CONTROL MEASURE 'O' SUMMARY

Design Drainage Area =	8.32	ac
Design Impervious Area =	3.60	ac
% Impervious =	43.2%	
Top of Dam =	363.00	ft
NWSE =	357.00	ft
Average Depth =	3.44	ft
WQv Ponding Elevation =	358.09	ft
Required Main Pool Surface Area at NWSE =	5,365	sf
Total Surface Area Provided at NWSE =	9,229	sf
Estimate of Provided Main Pool Surface Area at NWSE =	7,150	sf
WQv Orifice Diameter =	1.75	in
WQv Orifice Invert Elevation =	357.00	ft
Number of Orifices =	3	
Orifice Invert Elevation =	358.50	ft
Orifice Size =	0.5'Hx1'L	
Riser Size =	4' x 4'	
Riser Crest =	361.00	ft
Barrel Diameter =	24	in
# of Barrels =	1	
Upstream Invert =	356.00	ft
Downstream Invert =	355.00	ft
Length =	60	ft
Slope =	0.0167	ft/ft

STORMWATER CONTROL MEASURE 'O' ROUTING RESULTS

Return Period	Inflow [cfs]	Outflow [cfs]	Max. WSE [ft]	Freeboard [ft]
1-Year	24.2	3.9	359.02	3.98
10-Year	45.2	9.8	360.53	2.47
25-Year	52.4	12.6	361.10	1.90
100-Year	62.8	25.4	361.49	1.51

MISCELLANEOUS SITE INFORMATION

N

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

THE POINT - NORTH

SITE AERIAL MAP

PROJECT #: AWH-20000

ROLESVILLE, NORTH CAROLINA

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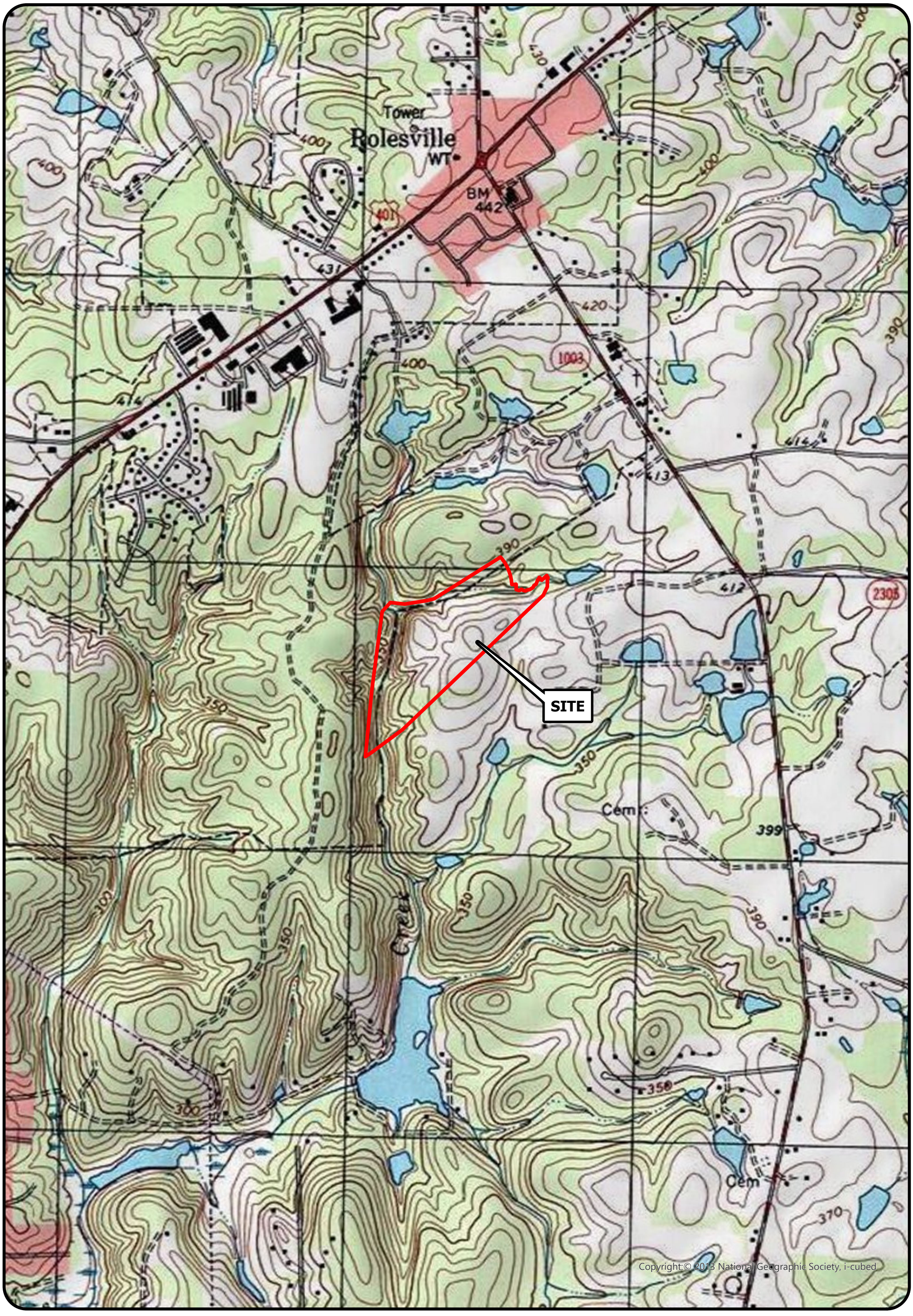

N

0 500 1,000 2,000 Feet

1" = 1,000'

THE POINT - NORTH

USGS TOPOGRAPHIC MAP

PROJECT #: AWH-20000

TOWN OF ROLESVILLE, WAKE COUNTY, NORTH CAROLINA

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. 0315 NEUSE RIVER BASIN

Name of Stream	Description	Class	Class Date	Index No.
NEUSE RIVER	From a point 0.5 mile upstream of Town of Wake Forest proposed water supply intake to Town of Wake Forest proposed water supply intake	WS-IV;NSW,CA	07/01/04	27-(22)
NEUSE RIVER	From Town of Wake Forest proposed water supply intake to mouth of Beddingfield Creek	C;NSW	08/03/92	27-(22.5)
Smith Creek	From source to a point 0.3 mile downstream of Franklin-Wake County Line	WS-II;HQW,NSW	08/03/92	27-23-(1)
Smith Creek (Wake Forest Reservoir)	From a point 0.3 mile downstream of Franklin-Wake County Line to dam at Wake Reservoir	WS-II;HQW,NSW, CA	08/03/92	27-23-(1.5)
Smith Creek	From dam at Wake Forest Reservoir to Neuse River	C;NSW	05/01/88	27-23-(2)
Austin Creek (Mitchell Pond)	From source to Smith Creek	C;NSW	07/01/96	27-23-3
Hatters Branch	From source to Smith Creek	C;NSW	05/01/88	27-23-4
Spring Branch	From source to Hatters Branch	C;NSW	05/01/88	27-23-4-1
Sanford Creek	From source to Smith Creek	C;NSW	05/01/88	27-23-5
Toms Creek (Mill Creek)	From source to Neuse River	C;NSW	05/01/88	27-24
Perry Creek (Greshams Lake)	From source to dam at Greshams Lake	B;NSW	05/01/88	27-25-(1)
Perry Creek	From dam at Greshams Lake to Neuse River	C;NSW	05/01/88	27-25-(2)
Unnamed Tributary near Neuse	From source to dam at Camp Durant	B;NSW	05/01/88	27-25-3-(1)
Unnamed Tributary near Neuse	From dam at Camp Durant to Perry Creek	C;NSW	05/01/88	27-25-3-(2)
Harris Creek (Peeples Creek) (Wake Crossroads Lake)	From source to Neuse River	C;NSW	05/01/88	27-26
Hodges Mill Creek (Lake Mirl)	From source to water intake at Lake Mirl	B;NSW	05/01/88	27-26-1-(1)
Hodges Mill Creek	From water intake at Lake Mirl to Harris Creek	C;NSW	05/01/88	27-26-1-(2)
Beaverdam Creek (west side of Neuse River)	From source to Neuse River	C;NSW	05/01/88	27-27
Rocky Creek	From source to Neuse River	C;NSW	05/01/88	27-28
Beaverdam Creek (east side of Neuse River) (Neuseco Lake, Beaverdam Lake)	From soruce to Neuse River	C;NSW	05/01/88	27-29
Bridges Creek (Bridges Lake)	From source to Neuse River	C;NSW	05/01/88	27-30
Milburnie Creek (Milburnie Lake)	From source to Neuse River	C;NSW	05/01/88	27-31
Mango Creek	From source to Neuse River	C;NSW	05/01/88	27-32
Crabtree Creek	From source to backwaters of Crabtree Lake	C;NSW	05/01/88	27-33-(1)
Turkey Creek	From source to Crabtree Creek	C;NSW	05/01/88	27-33-2
Coles Branch	From source to Crabtree Creek	C;NSW	05/01/88	27-33-3
South Fork Coles Branch	From source to Coles Branch	C;NSW	05/01/88	27-33-3-1
Crabtree Creek (Crabtree Lake)	From backwaters of Crabtree Lake to mouth of Richlands Creek	B;NSW	04/01/94	27-33-(3.5)

This digital Flood Insurance Rate Map (FIRM) was produced through a unique cooperative partnership between the State of North Carolina and the Federal Emergency Management Agency (FEMA). The State of North Carolina has implemented a long term approach to floodplain management to decrease the costs associated with flooding. This is demonstrated by the State's commitment to map flood hazard areas at the local level. As a part of this effort, the State of North Carolina has joined in a Cooperating Technical State agreement with FEMA to produce and maintain this digital FIRM.

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT HTTP://FRIS.NC.GOV/FRIS

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A,V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with Average Depth Less Than One Foot or With Drainage Areas of Less Than One Square Mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee See Notes *Zone X*

OTHER AREAS
- Areas Determined to be Outside the 0.2% Annual Chance Floodplain *Zone X*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Accredited or Provisionally Accredited Levee, Dike, or Floodwall
- Non-accredited Levee, Dike, or Floodwall
- BM5510 North Carolina Geodetic Survey bench mark
- BM5510 National Geodetic Survey bench mark
- BM5510 Contractor Est. NCFMP Survey bench mark
- 012 18.2 Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
- 8 Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

OTHER FEATURES
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. An accompanying Flood Insurance Study report, Letter of Map Revision (LOMR) or Letter of Map Amendment (LOMA) revising portions of this panel, and digital versions of this FIRM may be available. Visit the North Carolina Floodplain Mapping Program website at http://www.ncfloodmaps.com, or contact the FEMA Map Service Center.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in the community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on this FIRM was provided in digital format by the North Carolina Floodplain Mapping Program (NCFMP). The source of this information can be determined from the metadata available in the digital FLOOD database and in the Technical Support Data Notebook (TSDN).

ACCREDITED LEVEE NOTES TO USERS: If an accredited levee note appears on this panel check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/business/nfip/index.shtm.

PROVISIONALLY ACCREDITED LEVEE NOTES TO USERS: If a Provisionally Accredited Levee (PAL) note appears on this panel, check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection. To maintain accreditation, the levee owner or community is required to submit the data and documentation necessary to comply with Section 65.10 of the NFIP regulations. If the community or owner does not provide the necessary data and documentation or if the data and documentation provided indicates the levee system does not comply with Section 65.10 requirements, FEMA will revise the flood hazard and risk information for this area to reflect de-accreditation of the levee system. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/business/nfip/index.shtm.

LIMIT OF MODERATE WAVE ACTION NOTES TO USERS: For some coastal flooding zones the AE Zone category has been divided by a Limit of Moderate Wave Action (LiMWA). The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LiMWA (or between the shoreline and the LiMWA for areas where VE Zones are not identified) will be similar to, but less severe than those in the VE Zone.

Limit of Moderate Wave Action (LiMWA)

COASTAL BARRIER RESOURCES SYSTEM (CBRS) NOTE

This map may include approximate boundaries of the CBRS for informational purposes only. Flood insurance is not available within CBRS areas for structures that are newly built or substantially improved on or after the date(s) indicated on the map. For more information see http://www.fws.gov/habitatconservation/coastal_barrier.html, the FIS Report, or call the U.S. Fish and Wildlife Service Customer Service Center at 1-800-344-WILD.

CBRS Area Otherwise Protected Area

LOGO LOGO

SCALE

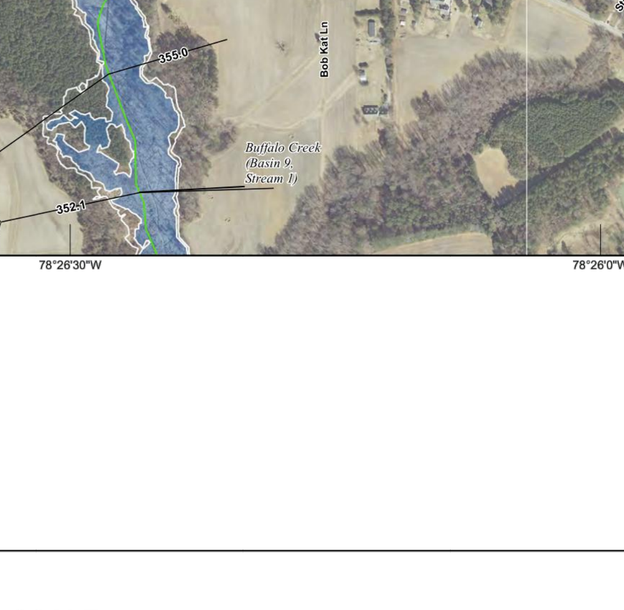
Map Projection:
North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet 1:6,000

0 250 500 1,000 Feet

0 75 150 300 Meters

PANEL LOCATOR



FEMA

National Flood Insurance Program

NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

NORTH CAROLINA

PANEL 1768

Panel Contains:

COMMUNITY	CID	PANEL	SUFFIX
ROLESVILLE, TOWN OF	370468	1768	J
WAKE COUNTY	370368	1768	J

MAP NUMBER
3720176800J

MAP REVISED
05/02/06

NORTH CAROLINA Cooperating Technical State
FEMA'S COOPERATING TECHNICAL PARTNER

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Base map information shown on this FIRM was provided in digital format by the North Carolina Floodplain Mapping Program (NCFMP). The source of this information can be determined from the metadata available in the digital FLOOD database and in the Technical Support Data Notebook (TSDN).

ACCREDITED LEVEE NOTES TO USERS: If an accredited levee note appears on this panel check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/business/nfip/index.shtm.

PROVISIONALLY ACCREDITED LEVEE NOTES TO USERS: If a Provisionally Accredited Levee (PAL) note appears on this panel, check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection. To maintain accreditation, the levee owner or community is required to submit the data and documentation necessary to comply with Section 65.10 of the NFIP regulations. If the community or owner does not provide the necessary data and documentation or if the data and documentation provided indicates the levee system does not comply with Section 65.10 requirements, FEMA will revise the flood hazard and risk information for this area to reflect de-accreditation of the levee system. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/business/nfip/index.shtm.

LIMIT OF MODERATE WAVE ACTION NOTES TO USERS: For some coastal flooding zones the AE Zone category has been divided by a Limit of Moderate Wave Action (LiMWA). The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LiMWA (or between the shoreline and the LiMWA for areas where VE Zones are not identified) will be similar to, but less severe than those in the VE Zone.

Limit of Moderate Wave Action (LiMWA)

COASTAL BARRIER RESOURCES SYSTEM (CBRS) NOTE

This map may include approximate boundaries of the CBRS for informational purposes only. Flood insurance is not available within CBRS areas for structures that are newly built or substantially improved on or after the date(s) indicated on the map. For more information see http://www.fws.gov/habitatconservation/coastal_barrier.html, the FIS Report, or call the U.S. Fish and Wildlife Service Customer Service Center at 1-800-344-WILD.

CBRS Area Otherwise Protected Area

LOGO LOGO

SCALE

Map Projection:
North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet 1:6,000

0 250 500 1,000 Feet
0 75 150 300 Meters

PANEL LOCATOR

FEMA
National Flood Insurance Program

NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

NORTH CAROLINA

PANEL 1758

Panel Contains:

COMMUNITY	CID	PANEL	SUFFIX
ROLESVILLE, TOWN OF	370468	1758	J
WAKE COUNTY	370368	1758	J

MAP NUMBER
3720175800J
MAP REVISED
05/02/06

N

0 500 1,000 2,000 Feet

1" = 1,000'

THE POINT - NORTH

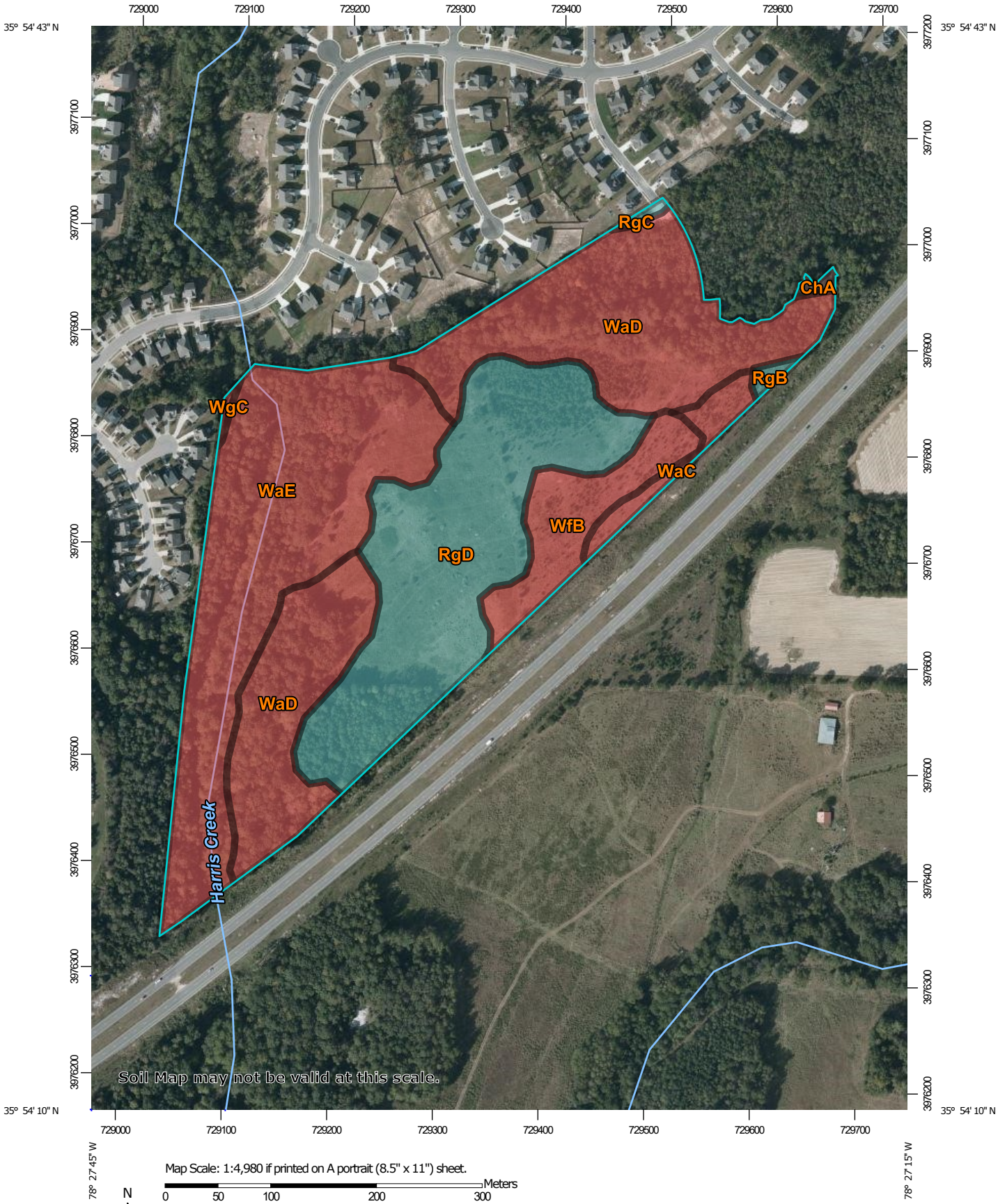
HISTORICAL SOIL SURVEY

PROJECT #: AWH-20000

TOWN OF ROLESVILLE, WAKE COUNTY, NORTH CAROLINA

McADAMS

Hydrologic Soil Group—Wake County, North Carolina
(PropertyLine)



Map Scale: 1:4,980 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

Streams and Canals

Transportation

Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

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

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

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

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

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

Soil Survey Area: Wake County, North Carolina
Survey Area Data: Version 20, Jun 3, 2020

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

Date(s) aerial images were photographed: Oct 11, 2019—Oct 19, 2019

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
ChA	Chewacla and Wehadkee soils, 0 to 2 percent slopes, frequently flooded	B/D	0.1	0.3%
RgB	Rawlings-Rion complex, 2 to 6 percent slopes	C	0.2	0.4%
RgC	Rawlings-Rion complex, 6 to 10 percent slopes	C	0.1	0.2%
RgD	Rawlings-Rion complex, 10 to 15 percent slopes	C	12.6	27.7%
WaC	Wake-Rolesville complex, 6 to 10 percent slopes, very rocky	D	1.1	2.4%
WaD	Wake-Rolesville complex, 10 to 15 percent slopes, very rocky	D	14.6	32.1%
WaE	Wake-Rolesville complex, 15 to 25 percent slopes, very rocky	D	13.4	29.5%
WfB	Wedowee-Saw complex, 2 to 6 percent slopes	D	3.2	7.1%
WgC	Wedowee-Urban land complex, 6 to 15 percent slopes	D	0.1	0.2%
Totals for Area of Interest			**45.4**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

NOAA Atlas 14, Volume 2, Version 3
Location name: Wake Forest, North Carolina, USA*
Latitude: 35.9053°, Longitude: -78.452°
Elevation: 354.67 ft**
* source: ESRI Maps
** source: USGS

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_&_aerials

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	**0.403** (0.369-0.442)	**0.468** (0.429-0.512)	**0.534** (0.489-0.582)	**0.600** (0.548-0.654)	**0.666** (0.606-0.726)	**0.718** (0.651-0.783)	**0.765** (0.690-0.834)	**0.807** (0.723-0.881)	**0.853** (0.758-0.932)	**0.895** (0.789-0.979)
10-min	**0.644** (0.590-0.705)	**0.749** (0.687-0.818)	**0.855** (0.783-0.933)	**0.959** (0.877-1.05)	**1.06** (0.966-1.16)	**1.14** (1.04-1.25)	**1.22** (1.10-1.33)	**1.28** (1.15-1.40)	**1.35** (1.20-1.47)	**1.41** (1.24-1.54)
15-min	**0.806** (0.738-0.882)	**0.942** (0.863-1.03)	**1.08** (0.991-1.18)	**1.21** (1.11-1.32)	**1.35** (1.22-1.47)	**1.45** (1.31-1.58)	**1.54** (1.39-1.68)	**1.61** (1.45-1.76)	**1.70** (1.51-1.86)	**1.77** (1.56-1.94)
30-min	**1.10** (1.01-1.21)	**1.30** (1.19-1.42)	**1.54** (1.41-1.68)	**1.76** (1.61-1.92)	**1.99** (1.81-2.17)	**2.18** (1.98-2.38)	**2.35** (2.12-2.57)	**2.51** (2.25-2.74)	**2.70** (2.40-2.95)	**2.87** (2.52-3.14)
60-min	**1.38** (1.26-1.51)	**1.63** (1.50-1.78)	**1.97** (1.81-2.15)	**2.29** (2.09-2.50)	**2.65** (2.42-2.89)	**2.96** (2.68-3.22)	**3.24** (2.92-3.53)	**3.52** (3.16-3.85)	**3.88** (3.45-4.24)	**4.18** (3.69-4.58)
2-hr	**1.61** (1.46-1.78)	**1.92** (1.75-2.10)	**2.34** (2.13-2.56)	**2.75** (2.49-3.01)	**3.23** (2.91-3.54)	**3.66** (3.28-4.00)	**4.07** (3.63-4.45)	**4.49** (3.98-4.91)	**5.04** (4.42-5.51)	**5.52** (4.80-6.05)
3-hr	**1.71** (1.55-1.89)	**2.03** (1.85-2.24)	**2.49** (2.26-2.74)	**2.94** (2.67-3.24)	**3.50** (3.15-3.84)	**3.99** (3.58-4.39)	**4.49** (3.98-4.92)	**5.00** (4.41-5.48)	**5.69** (4.96-6.24)	**6.32** (5.45-6.95)
6-hr	**2.05** (1.87-2.26)	**2.44** (2.23-2.68)	**2.99** (2.72-3.28)	**3.54** (3.22-3.88)	**4.22** (3.82-4.62)	**4.84** (4.35-5.29)	**5.46** (4.86-5.96)	**6.12** (5.39-6.67)	**7.00** (6.10-7.64)	**7.82** (6.72-8.55)
12-hr	**2.41** (2.21-2.66)	**2.87** (2.64-3.15)	**3.54** (3.24-3.88)	**4.21** (3.84-4.62)	**5.07** (4.59-5.53)	**5.85** (5.26-6.36)	**6.64** (5.91-7.22)	**7.49** (6.59-8.14)	**8.66** (7.50-9.41)	**9.76** (8.32-10.6)
24-hr	**2.86** (2.66-3.08)	**3.46** (3.22-3.73)	**4.35** (4.04-4.69)	**5.06** (4.69-5.44)	**6.02** (5.57-6.49)	**6.80** (6.27-7.32)	**7.60** (6.98-8.19)	**8.43** (7.71-9.09)	**9.58** (8.71-10.3)	**10.5** (9.50-11.3)
2-day	**3.32** (3.09-3.57)	**3.99** (3.72-4.30)	**4.98** (4.64-5.37)	**5.77** (5.35-6.21)	**6.83** (6.32-7.36)	**7.68** (7.09-8.27)	**8.56** (7.87-9.22)	**9.46** (8.66-10.2)	**10.7** (9.74-11.6)	**11.7** (10.6-12.7)
3-day	**3.52** (3.28-3.77)	**4.23** (3.94-4.54)	**5.25** (4.89-5.63)	**6.06** (5.64-6.50)	**7.17** (6.64-7.69)	**8.05** (7.44-8.64)	**8.96** (8.25-9.62)	**9.89** (9.07-10.6)	**11.2** (10.2-12.1)	**12.2** (11.1-13.2)
4-day	**3.72** (3.47-3.98)	**4.46** (4.17-4.77)	**5.52** (5.15-5.90)	**6.35** (5.92-6.79)	**7.50** (6.96-8.01)	**8.42** (7.79-9.00)	**9.36** (8.63-10.0)	**10.3** (9.49-11.1)	**11.7** (10.7-12.5)	**12.7** (11.6-13.7)
7-day	**4.31** (4.04-4.61)	**5.15** (4.82-5.50)	**6.29** (5.88-6.71)	**7.19** (6.72-7.68)	**8.43** (7.85-9.00)	**9.42** (8.75-10.1)	**10.4** (9.66-11.2)	**11.5** (10.6-12.3)	**12.9** (11.8-13.9)	**14.1** (12.8-15.1)
10-day	**4.91** (4.61-5.24)	**5.85** (5.48-6.23)	**7.04** (6.60-7.50)	**7.99** (7.47-8.50)	**9.26** (8.64-9.86)	**10.3** (9.55-10.9)	**11.3** (10.5-12.0)	**12.3** (11.4-13.2)	**13.7** (12.6-14.7)	**14.8** (13.6-15.9)
20-day	**6.59** (6.20-7.02)	**7.79** (7.32-8.29)	**9.23** (8.67-9.81)	**10.4** (9.72-11.0)	**11.9** (11.1-12.7)	**13.1** (12.2-14.0)	**14.3** (13.3-15.3)	**15.6** (14.5-16.6)	**17.3** (16.0-18.5)	**18.6** (17.1-19.9)
30-day	**8.18** (7.72-8.69)	**9.63** (9.08-10.2)	**11.2** (10.6-11.9)	**12.5** (11.7-13.2)	**14.1** (13.2-15.0)	**15.4** (14.4-16.3)	**16.6** (15.5-17.7)	**17.9** (16.7-19.0)	**19.5** (18.1-20.9)	**20.8** (19.3-22.3)
45-day	**10.4** (9.89-11.0)	**12.2** (11.6-12.9)	**14.0** (13.3-14.8)	**15.4** (14.6-16.2)	**17.2** (16.3-18.1)	**18.6** (17.5-19.6)	**19.9** (18.7-21.0)	**21.2** (19.9-22.5)	**23.0** (21.5-24.4)	**24.3** (22.7-25.8)
60-day	**12.5** (11.9-13.1)	**14.6** (13.9-15.4)	**16.6** (15.7-17.4)	**18.1** (17.1-19.0)	**20.0** (19.0-21.1)	**21.5** (20.3-22.6)	**22.9** (21.6-24.1)	**24.2** (22.9-25.6)	**26.0** (24.5-27.5)	**27.4** (25.7-29.0)

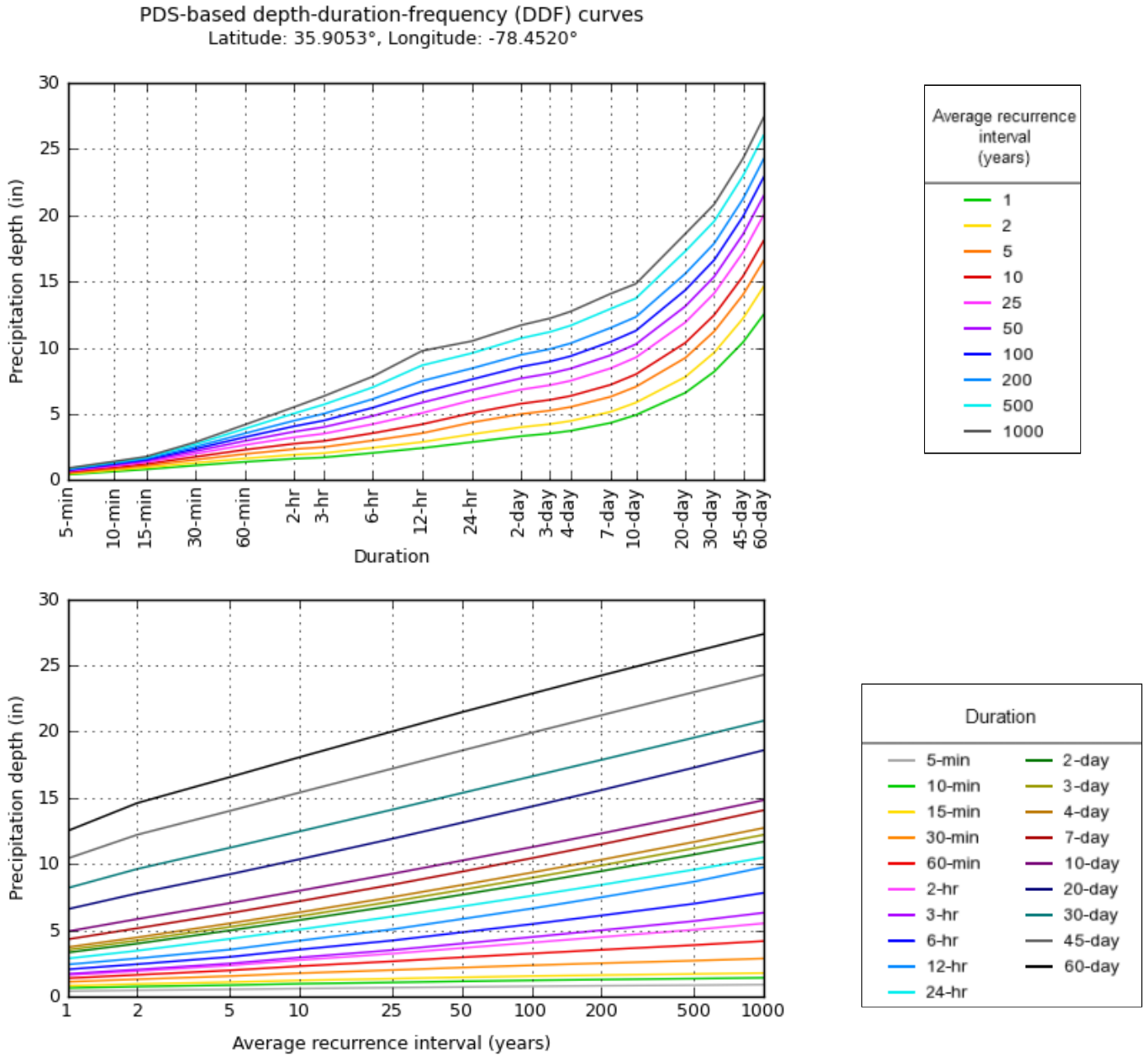
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

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.

Back to Top

PF graphical



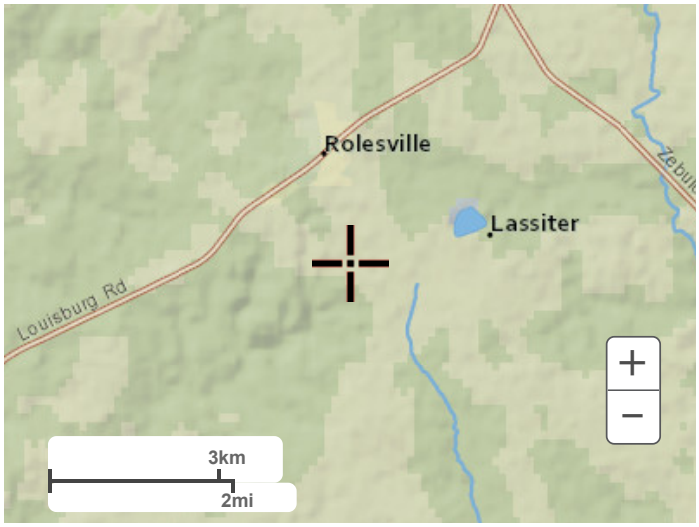
NOAA Atlas 14, Volume 2, Version 3

Created (GMT): Wed Jun 3 19:09:38 2020

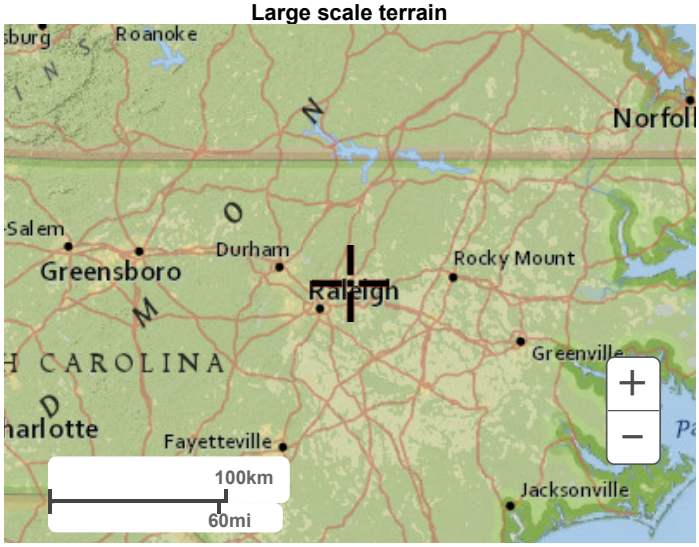
Back to Top

Maps & aerials

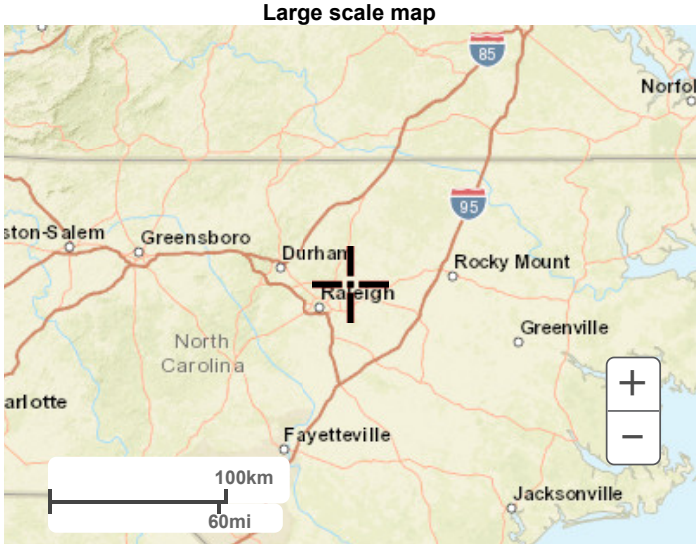
Small scale terrain



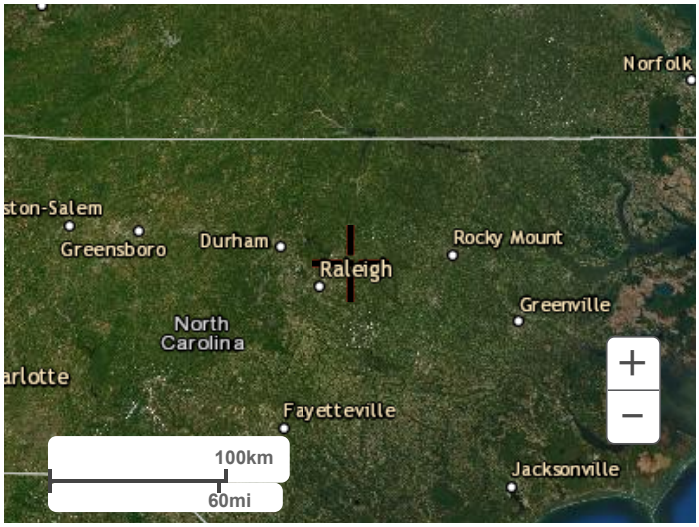
Large scale terrain



Large scale map



Large scale aerial



Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

PRE-DEVELOPMENT HYDROLOGIC CALCULATIONS

The Point - North
AWH-20000

THE POINT - NORTH
AWH-20000

PRE-DEVELOPMENT HYDROLOGY
Summary of Results

S. DANIELL, PE
10/26/2022

HYDROLOGY INPUT SUMMARY

Sub-basin ID	Onsite Area [acres]					Offsite Area [acres]					Total Area [acres]	SCS CN	Tc [min]
	Impervious	Open	Wooded	Pond	Total	Impervious	Open	Wooded	Pond	Total			
1	1.78	14.84	27.08	0.00	43.70	0.25	0.59	0.00	0.00	0.84	44.54	77	22.53
2	0.06	1.63	0.00	0.00	1.69	0.00	0.00	0.00	0.00	0.00	1.69	81	10.73
Totals =	1.83	16.48	27.08	0.00	**45.39**	0.25	0.59	0.00	0.00	**0.84**	**46.23**		

CURVE NUMBER CALCULATIONS

Land Use	HSG	CN	Onsite	Area (ac)	Percent Impervious (%)	Impervious Area (ac)
Open	C	74	Yes	8.66	0	0.00
Open	D	80	Yes	6.19	0	0.00
Sidewalk	C	98	Yes	0.43	100	0.43
Sidewalk	D	98	Yes	1.35	100	1.35
Wooded	C	70	Yes	3.76	0	0.00
Wooded	D	77	Yes	23.32	0	0.00
High Density Residential	C	82	No	0.49	30	0.15
High Density Residential	D	86	No	0.35	30	0.10

Onsite Area	**43.70**	**ac**
Onsite Impervious Area	**1.78**	**ac**
Offsite Area	**0.84**	**ac**
Offsite Impervious Area	**0.25**	**ac**
Total Area	**44.54**	**ac**
Total Impervious Area	**2.03**	**ac**
Percent Impervious	**5**	**%**
Composite Curve Number	**77**	

TIME OF CONCENTRATION

Time of concentration is calculated using the SCS Segmental Approach (TR-55).

Segment 1: Overland Flow

Length =	100	ft
Top Elev =	387.50	ft
Bot Elev =	384.00	ft
Height =	3.5	ft
Slope =	0.0350	ft/ft
Manning's n =	0.24	dense grasses
P (2-year/24-hour) =	3.46	inches (Rolesville, NC)
Segment Time =	***10.97***	***minutes***

Segment 2: Concentrated Flow

Length =	414	ft
Top Elev =	384.00	ft
Bot Elev =	350.00	ft
Height =	34	ft
Slope =	0.0821	ft/ft
Paved ? =	No	
Velocity =	4.62	ft/sec
Segment Time =	***1.49***	***minutes***

Segment 3: Channel Flow

Length =	3403	ft
Top Elev =	350.00	ft
Bot Elev =	302.00	ft
Height =	48	ft
Slope =	0.0141	ft/ft
Manning's n =	0.045	natural channel
Flow Area =	24.00	sf (assume 6' x 4' channel)
Wetted Perimeter =	14.00	lf (assume 6' x 4' channel)
Channel Velocity =	5.63	ft/sec
Segment Time =	***10.07***	***minutes***

Time of Concentration =	22.53	minutes
SCS Lag Time =	13.52	minutes (SCS Lag = 0.6* Tc)
Time Increment =	3.92	minutes (= 0.29*SCS Lag)

CURVE NUMBER CALCULATIONS

Land Use	HSG	CN	Onsite	Area (ac)	Percent Impervious (%)	Impervious Area (ac)
Open	D	80	Yes	1.63	0	0.00
Sidewalk	D	98	Yes	0.06	100	0.06

Onsite Area	**1.69**	**ac**
Onsite Impervious Area	**0.06**	**ac**
Offsite Area	**0.00**	**ac**
Offsite Impervious Area	**0.00**	**ac**
Total Area	**1.69**	**ac**
Total Impervious Area	**0.06**	**ac**
Percent Impervious	**3**	**%**
Composite Curve Number	**81**	

TIME OF CONCENTRATION

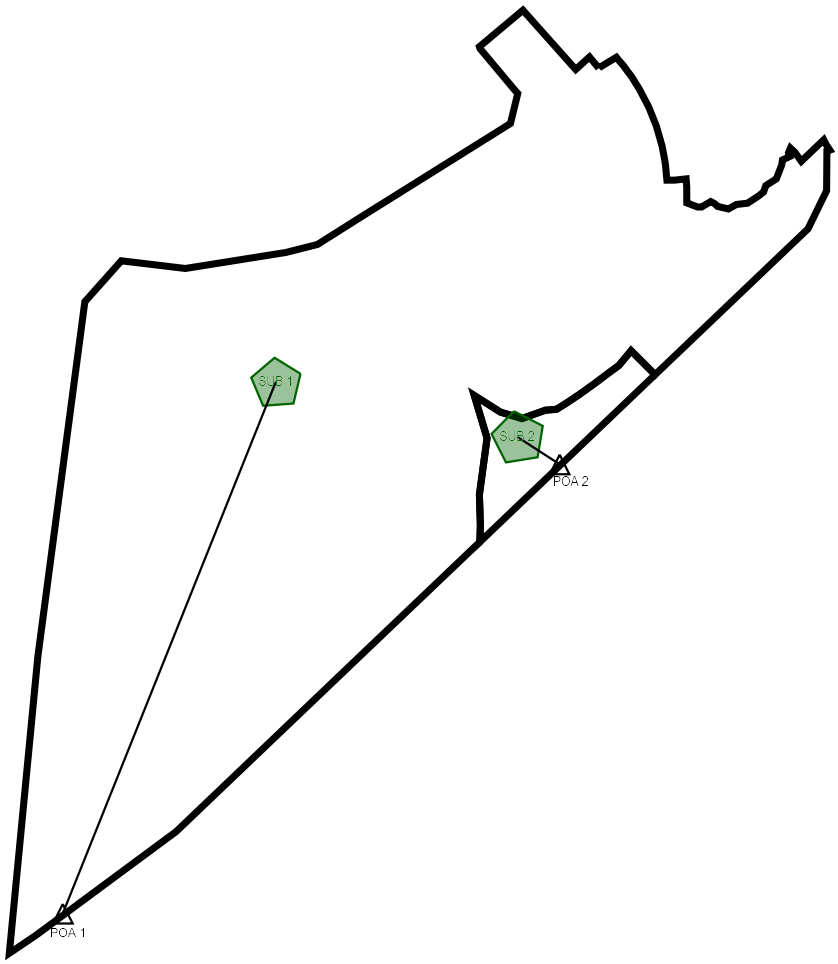
Time of concentration is calculated using the SCS Segmental Approach (TR-55).

Segment 1: Overland Flow			***Segment 2: Concentrated Flow***		
Length =	100	ft	Length =	195	ft
Top Elev =	394.00	ft	Top Elev =	389.50	ft
Bot Elev =	389.50	ft	Bot Elev =	377.50	ft
Height =	4.5	ft	Height =	12	ft
Slope =	0.0450	ft/ft	Slope =	0.0615	ft/ft
Manning's n =	0.24	dense grasses	Paved ? =	No	
P (2-year/24-hour) =	3.46	inches (Rolesville, NC)	Velocity =	4.00	ft/sec
Segment Time =	***9.92***	***minutes***	***Segment Time =***	***0.81***	***minutes***

Time of Concentration =	10.73	minutes
SCS Lag Time =	6.44	minutes (SCS Lag = 0.6* Tc)
Time Increment =	1.87	minutes (= 0.29*SCS Lag)

MCADAMS

Scenario: Pre-Development



MCADAMS

FlexTable: Catchment Table (AWH20000 - North.ppc)

Current Time: 0.00 min

Label	Outflow Node	Area (ft²)	SCS CN	Time of Concentration (min)	Notes
SUB 2	POA 2	73,657	81	10.73	PRE
SUB 1	POA 1	1,940,287	77	22.53	PRE

MCADAMS

Pre Master Summary

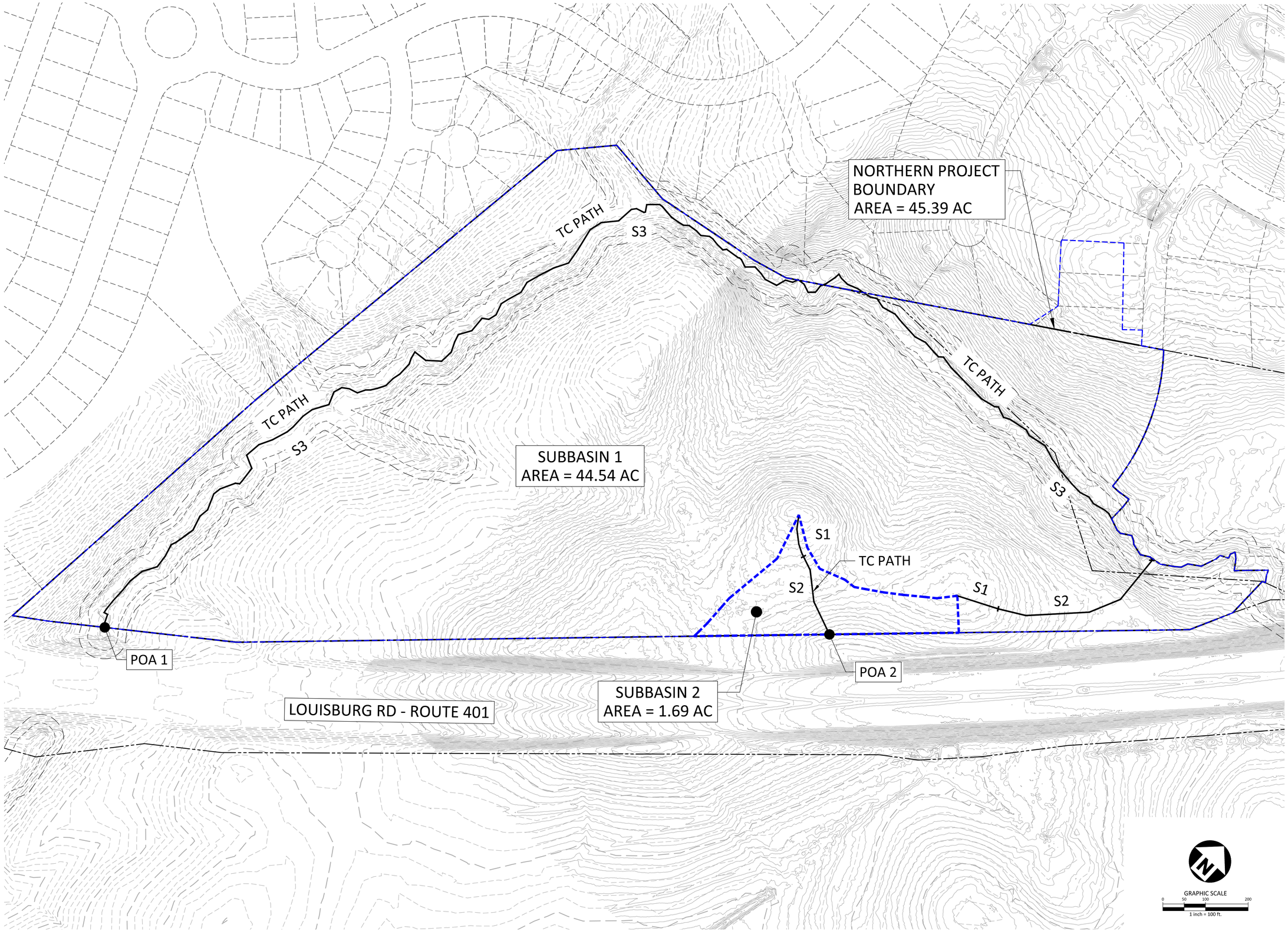
Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (min)	Peak Flow (ft^3/s)
SUB 2	Pre-Dev 1-yr	1	0.170	726.00	2.78
SUB 2	Pre-Dev 10-yr	10	0.428	725.00	6.12
SUB 1	Pre-Dev 1-yr	1	3.620	733.00	39.35
SUB 1	Pre-Dev 10-yr	10	9.923	733.00	100.80

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (min)	Peak Flow (ft^3/s)
POA 1	Pre-Dev 1-yr	1	3.620	733.00	39.35
POA 1	Pre-Dev 10-yr	10	9.923	733.00	100.80
POA 2	Pre-Dev 1-yr	1	0.170	726.00	2.78
POA 2	Pre-Dev 10-yr	10	0.428	725.00	6.12



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THE POINT
PHASES 1-10 AND 14
PRELIMINARY PLAT PLANS
EAST YOUNG STREET
TOWN OF ROLESVILLE, WAKE FOREST TOWNSHIP,
WAKE COUNTY, NORTH CAROLINA

REVISIONS

PLAN INFORMATION

PROJECT NO.	AWH-20000
FILENAME	AWH-20000 PRE
CHECKED BY	KEG
DRAWN BY	JDV
SCALE	1" = 100'
DATE	10.26.2022

SHEET

PRE DEVELOPMENT
HYDROLOGY MAP

PRE-DA

M:\Projects\AWH\AWH-20000\04-Production\Water Resources\North Site\Current Drawings\AWH20000x - PRE.dwg, 10/26/2022 4:38:28 PM, Joshua Vinson

POST-DEVELOPMENT HYDROLOGIC CALCULATIONS

The Point - North
AWH-20000

THE POINT - NORTH
AWH-20000

POST-DEVELOPMENT HYDROLOGY
Summary of Results

S. DANIELL, PE
10/26/2022

HYDROLOGY INPUT SUMMARY

Sub-basin ID	Onsite Area [acres]					Offsite Area [acres]					Total Area [acres]	SCS CN	Tc [min]
	Impervious	Open	Wooded	Pond	Total	Impervious	Open	Wooded	Pond	Total			
1 to SCM M	3.77	3.30	0.00	0.35	7.07	0.00	0.00	0.00	0.00	0.00	7.07	88	5.00
1 to SCM N	4.59	4.06	0.00	0.20	8.65	0.00	0.00	0.00	0.00	0.00	8.65	88	5.00
1 to SCM O	3.53	3.89	0.02	0.22	7.44	0.28	0.00	0.00	0.60	0.87	8.31	87	5.00
1 to Bypass	0.49	8.81	11.83	0.00	21.13	0.00	0.00	0.00	0.00	0.00	21.13	78	22.53
2 to Bypass	0.00	1.10	0.00	0.00	1.10	0.00	0.00	0.00	0.00	0.00	1.10	80	10.73
Totals =	12.37	21.16	11.85	0.78	**45.39**	0.28	0.00	0.00	0.60	**0.87**	**46.26**		

REACH DATA

REACH ID	Tc [min]
1 - SCM O to Junction 1	2.05
2 - Junction 1 to POA 1	6.16

CURVE NUMBER CALCULATIONS

Land Use	HSG	CN	Onsite	Area (ac)	Percent Impervious (%)	Impervious Area (ac)
Open	C	74	Yes	1.34	0	0.00
Open	D	80	Yes	0.46	0	0.00
Pond	C	100	Yes	0.13	100	0.13
Pond	D	100	Yes	0.22	100	0.22
Road	C	98	Yes	0.66	100	0.66
Road	D	98	Yes	0.40	100	0.40
Sidewalk	C	98	Yes	0.22	100	0.22
Sidewalk	D	98	Yes	0.15	100	0.15
Lot	C	88	Yes	2.60	57	1.48
Lot	D	90	Yes	0.89	57	0.51

Onsite Area	**7.07**	**ac**
Onsite Impervious Area	**3.77**	**ac**
Offsite Area	**0.00**	**ac**
Offsite Impervious Area	**0.00**	**ac**
Total Area	**7.07**	**ac**
Total Impervious Area	**3.77**	**ac**
Percent Impervious	**53**	**%**
Composite Curve Number	**88**	

TIME OF CONCENTRATION

Time of concentration is assumed to be 5 minutes.

Time of Concentration =	5.00	minutes
SCS Lag Time =	3.00	minutes (SCS Lag = 0.6* Tc)
Time Increment =	0.87	minutes (= 0.29*SCS Lag)

CURVE NUMBER CALCULATIONS

Land Use	HSG	CN	Onsite	Area (ac)	Percent Impervious (%)	Impervious Area (ac)
Open	C	74	Yes	0.61	0	0.00
Open	D	80	Yes	0.97	0	0.00
Pond	D	100	Yes	0.20	100	0.20
Road	C	98	Yes	0.50	100	0.50
Road	D	98	Yes	0.33	100	0.33
Sidewalk	C	98	Yes	0.18	100	0.18
Sidewalk	D	98	Yes	0.10	100	0.10
Lot	C	88	Yes	3.21	57	1.82
Lot	D	90	Yes	2.54	57	1.45

Onsite Area	**8.65**	**ac**
Onsite Impervious Area	**4.59**	**ac**
Offsite Area	**0.00**	**ac**
Offsite Impervious Area	**0.00**	**ac**
Total Area	**8.65**	**ac**
Total Impervious Area	**4.59**	**ac**
Percent Impervious	**53**	**%**
Composite Curve Number	**88**	

TIME OF CONCENTRATION

Time of concentration is assumed to be 5 minutes.

Time of Concentration =	5.00	minutes
SCS Lag Time =	3.00	minutes (SCS Lag = 0.6* Tc)
Time Increment =	0.87	minutes (= 0.29*SCS Lag)

CURVE NUMBER CALCULATIONS

Land Use	HSG	CN	Onsite	Area (ac)	Percent Impervious (%)	Impervious Area (ac)
Open	C	74	Yes	0.51	0	0.00
Open	D	80	Yes	2.02	0	0.00
Wooded	D	77	Yes	0.02	0	0.00
Pond	D	100	Yes	0.22	100	0.22
Road	C	98	No	0.02	100	0.02
Road	C	98	Yes	0.50	100	0.50
Road	D	98	Yes	0.63	100	0.63
Sidewalk	C	98	Yes	0.18	100	0.18
Sidewalk	D	98	Yes	0.20	100	0.20
Lot	C	88	Yes	0.99	57	0.56
Lot	D	90	Yes	2.17	57	1.23
Low Density Residential	D	84	No	0.01	20	0.00
High Density Residential	C	82	No	0.49	30	0.15
High Density Residential	D	86	No	0.35	30	0.10

Onsite Area	**7.44**	**ac**
Onsite Impervious Area	**3.53**	**ac**
Offsite Area	**0.87**	**ac**
Offsite Impervious Area	**0.28**	**ac**
Total Area	**8.31**	**ac**
Total Impervious Area	**3.81**	**ac**
Percent Impervious	**46**	**%**
Composite Curve Number	**87**	

TIME OF CONCENTRATION

Time of concentration is assumed to be 5 minutes.

Time of Concentration =	5.00	minutes
SCS Lag Time =	3.00	minutes (SCS Lag = 0.6* Tc)
Time Increment =	0.87	minutes (= 0.29*SCS Lag)

CURVE NUMBER CALCULATIONS

Land Use	HSG	CN	Onsite	Area (ac)	Percent Impervious (%)	Impervious Area (ac)
Open	C	74	Yes	1.19	0	0.00
Open	D	80	Yes	7.62	0	0.00
Wooded	D	77	Yes	11.83	0	0.00
Sidewalk	C	98	Yes	0.02	100	0.02
Sidewalk	D	98	Yes	0.46	100	0.46

Onsite Area	**21.13**	**ac**
Onsite Impervious Area	**0.49**	**ac**
Offsite Area	**0.00**	**ac**
Offsite Impervious Area	**0.00**	**ac**
Total Area	**21.13**	**ac**
Total Impervious Area	**0.49**	**ac**
Percent Impervious	**2**	**%**
Composite Curve Number	**78**	

TIME OF CONCENTRATION

Time of concentration is calculated using the SCS Segmental Approach (TR-55).

Segment 1: Overland Flow

Length =	100	ft
Top Elev =	387.50	ft
Bot Elev =	384.00	ft
Height =	3.5	ft
Slope =	0.0350	ft/ft
Manning's n =	0.24	dense grasses
P (2-year/24-hour) =	3.46	inches (Rolesville, NC)
Segment Time =	***10.97***	***minutes***

Segment 2: Concentrated Flow

Length =	414	ft
Top Elev =	384.00	ft
Bot Elev =	350.00	ft
Height =	34	ft
Slope =	0.0821	ft/ft
Paved ? =	No	
Velocity =	4.62	ft/sec
Segment Time =	***1.49***	***minutes***

Segment 3: Channel Flow

Length =	3403	ft
Top Elev =	350.00	ft
Bot Elev =	302.00	ft
Height =	48	ft
Slope =	0.0141	ft/ft
Manning's n =	0.045	natural channel
Flow Area =	24.00	sf (assume 6' x 4' channel)
Wetted Perimeter =	14.00	lf (assume 6' x 4' channel)
Channel Velocity =	5.63	ft/sec
Segment Time =	***10.07***	***minutes***

Time of Concentration =	22.53	minutes
SCS Lag Time =	13.52	minutes (SCS Lag = 0.6* Tc)
Time Increment =	3.92	minutes (= 0.29*SCS Lag)

CURVE NUMBER CALCULATIONS

Land Use	HSG	CN	Onsite	Area (ac)	Percent Impervious (%)	Impervious Area (ac)
Open	D	80	Yes	1.10	0	0.00

Onsite Area	**1.10**	**ac**
Onsite Impervious Area	**0.00**	**ac**
Offsite Area	**0.00**	**ac**
Offsite Impervious Area	**0.00**	**ac**
Total Area	**1.10**	**ac**
Total Impervious Area	**0.00**	**ac**
Percent Impervious	**0**	**%**
Composite Curve Number	**80**	

TIME OF CONCENTRATION

Time of concentration is calculated using the SCS Segmental Approach (TR-55).

Segment 1: Overland Flow			***Segment 2: Concentrated Flow***		
Length =	100	ft	Length =	195	ft
Top Elev =	394.00	ft	Top Elev =	389.50	ft
Bot Elev =	389.50	ft	Bot Elev =	377.50	ft
Height =	4.5	ft	Height =	12	ft
Slope =	0.0450	ft/ft	Slope =	0.0615	ft/ft
Manning's n =	0.24	dense grasses	Paved ? =	No	
P (2-year/24-hour) =	3.46	inches (Rolesville, NC)	Velocity =	4.00	ft/sec
Segment Time =	***9.92***	***minutes***	***Segment Time =***	***0.81***	***minutes***

Time of Concentration =	10.73	minutes
SCS Lag Time =	6.44	minutes (SCS Lag = 0.6* Tc)
Time Increment =	1.87	minutes (= 0.29*SCS Lag)

REACH DATA

Reach #1 - SCM O to Junction 1

Segment 1: Concentrated Flow		
Length =	74	ft
Top Elev =	356.00	ft
Bot Elev =	344.00	ft
Height =	12	ft
Slope =	0.1622	ft/ft
Paved ? =	No	
Velocity =	6.50	ft/sec
Segment Time =	***0.19***	***minutes***

Segment 2: Channel Flow		
Length =	608	ft
Top Elev =	344.00	ft
Bot Elev =	336.00	ft
Height =	8	ft
Slope =	0.0132	ft/ft
Manning's n =	0.045	natural channel
Flow Area =	24.00	sf (assume 6' x 4' channel)
Wetted Perimeter =	14.00	lf (assume 6' x 4' channel)
Channel Velocity =	5.44	ft/sec
Segment Time =	***1.86***	***minutes***

Total Travel Time = 2.05 minutes

Reach #2 - Junction 1 to POA 1

Segment 2: Channel Flow		
Length =	2187	ft
Top Elev =	336.00	ft
Bot Elev =	302.00	ft
Height =	34	ft
Slope =	0.0155	ft/ft
Manning's n =	0.045	natural channel
Flow Area =	24.00	sf (assume 6' x 4' channel)
Wetted Perimeter =	14.00	lf (assume 6' x 4' channel)
Channel Velocity =	5.91	ft/sec
Segment Time =	***6.16***	***minutes***

Total Travel Time = 6.16 minutes

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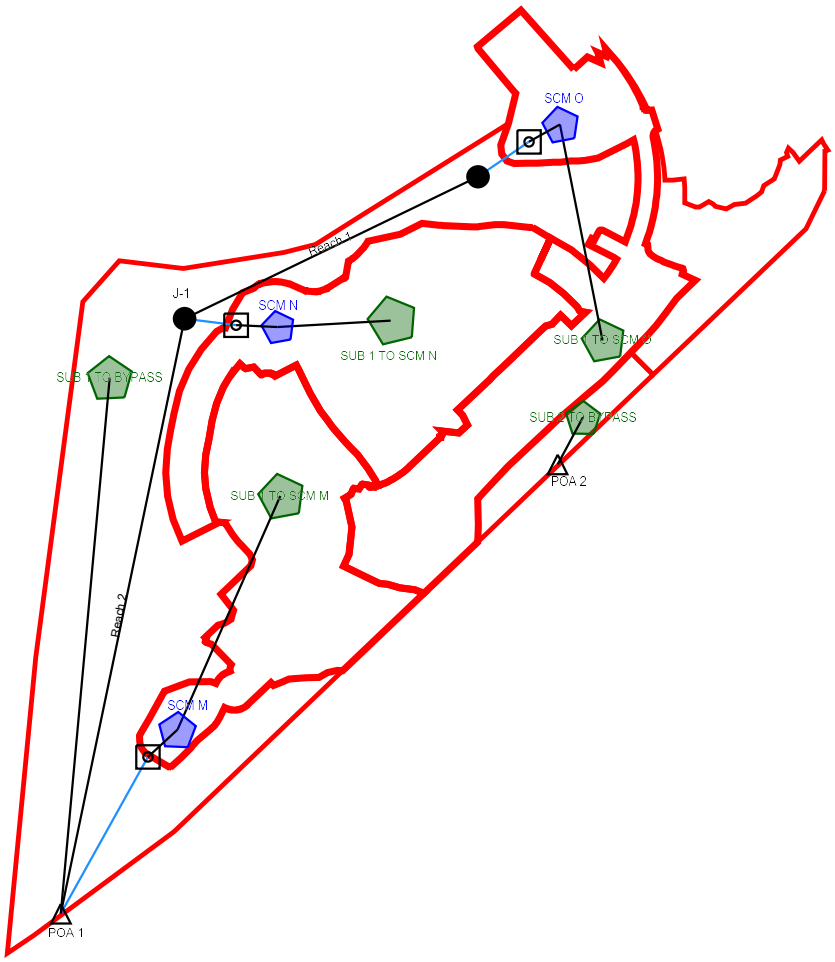
Scenario: Post-Development



MCADAMS

FlexTable: Catchment Table (AWH20000 - North.ppc)

Current Time: 0.00 min

Label	Outflow Node	Area (ft^2)	SCS CN	Time of Concentration (min)	Notes
SUB 1 TO SCM M	SCM M	307,796	87	5.00	POST
SUB 1 TO SCM N	SCM N	376,828	88	5.00	POST
SUB 1 TO SCM O	SCM O	362,233	87	5.00	POST
SUB 1 TO BYPASS	POA 1	920,589	78	22.53	POST
SUB 2 TO BYPASS	POA 2	47,900	80	10.73	POST

MCADAMS

Post Master Summary

Subsection: Master Network Summary

Catchments Summary

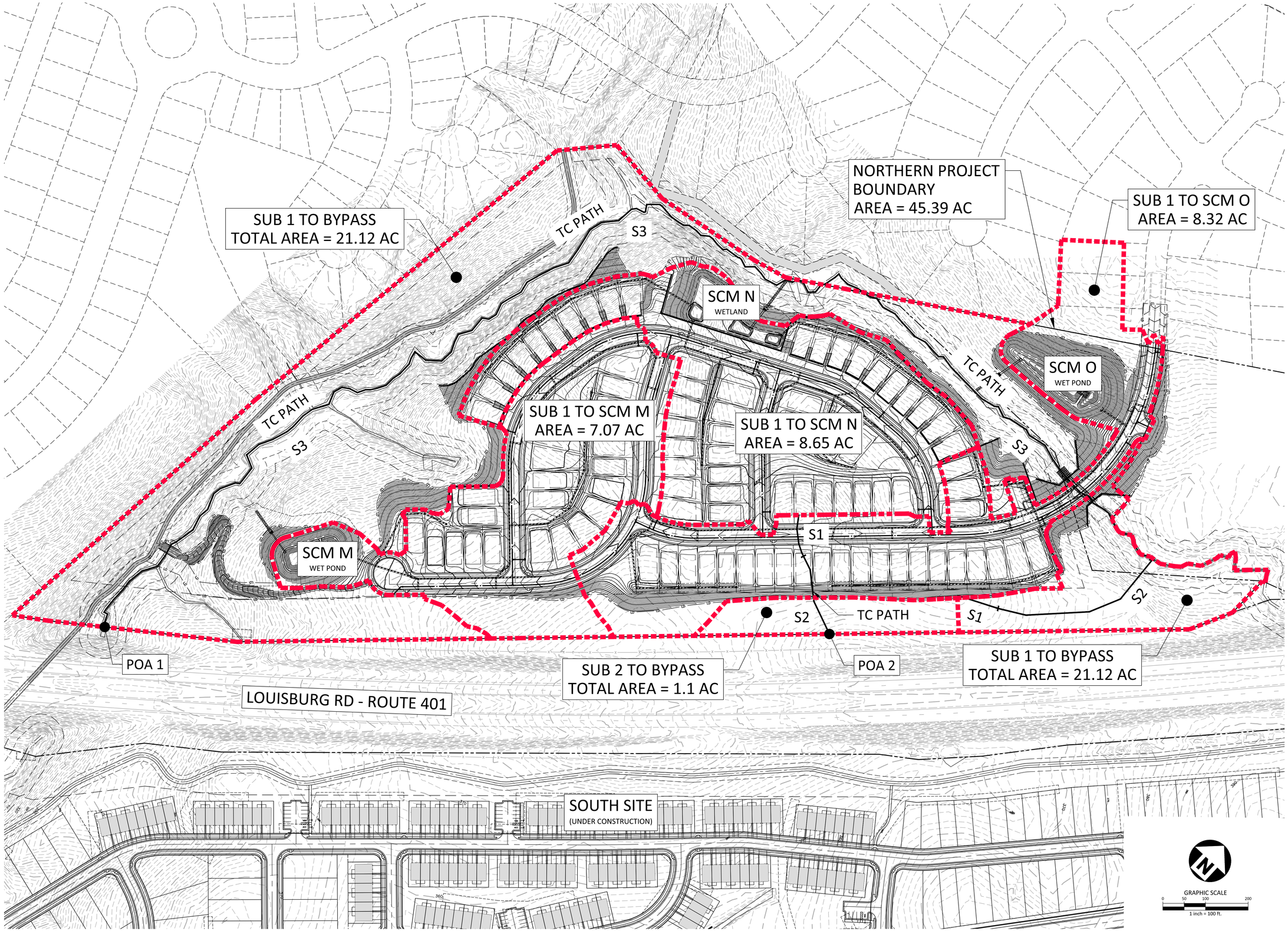
Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (min)	Peak Flow (ft³/s)
SUB 1 TO SCM M	Post-Dev 1-yr	1	0.952	721.00	20.56
SUB 1 TO SCM M	Post-Dev 10-yr	10	2.134	721.00	38.42
SUB 1 TO SCM N	Post-Dev 1-yr	1	1.221	721.00	26.38
SUB 1 TO SCM N	Post-Dev 10-yr	10	2.686	721.00	48.16
SUB 1 TO SCM O	Post-Dev 1-yr	1	1.121	721.00	24.20
SUB 1 TO SCM O	Post-Dev 10-yr	10	2.511	721.00	45.22
SUB 1 TO BYPASS	Post-Dev 1-yr	1	1.814	733.00	19.99
SUB 1 TO BYPASS	Post-Dev 10-yr	10	4.866	733.00	49.53
SUB 2 TO BYPASS	Post-Dev 1-yr	1	0.105	726.00	1.70
SUB 2 TO BYPASS	Post-Dev 10-yr	10	0.270	725.00	3.85

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (min)	Peak Flow (ft³/s)
POA 1	Post-Dev 1-yr	1	4.105	736.00	27.25
POA 1	Post-Dev 10-yr	10	11.174	733.00	77.57
POA 2	Post-Dev 1-yr	1	0.105	726.00	1.70
POA 2	Post-Dev 10-yr	10	0.270	725.00	3.85
J-1	Post-Dev 1-yr	1	1.603	754.00	8.10
J-1	Post-Dev 10-yr	10	4.444	753.00	19.80
	Post-Dev 1-yr	1	0.746	753.00	3.88
	Post-Dev 10-yr	10	2.131	752.00	9.77

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (min)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
SCM M (IN)	Post-Dev 1-yr	1	0.952	721.00	20.56	(N/A)	(N/A)
SCM M (OUT)	Post-Dev 1-yr	1	0.689	751.00	4.09	342.06	0.430
SCM M (IN)	Post-Dev 10-yr	10	2.134	721.00	38.42	(N/A)	(N/A)
SCM M (OUT)	Post-Dev 10-yr	10	1.866	733.00	10.09	343.65	0.845
SCM N (IN)	Post-Dev 1-yr	1	1.221	721.00	26.38	(N/A)	(N/A)
SCM N (OUT)	Post-Dev 1-yr	1	0.857	753.00	4.24	348.07	0.614
SCM N (IN)	Post-Dev 10-yr	10	2.686	721.00	48.16	(N/A)	(N/A)
SCM N (OUT)	Post-Dev 10-yr	10	2.314	752.00	10.04	349.61	1.206
SCM O (IN)	Post-Dev 1-yr	1	1.121	721.00	24.20	(N/A)	(N/A)
SCM O (OUT)	Post-Dev 1-yr	1	0.746	753.00	3.88	359.02	0.576
SCM O (IN)	Post-Dev 10-yr	10	2.511	721.00	45.22	(N/A)	(N/A)
SCM O (OUT)	Post-Dev 10-yr	10	2.131	752.00	9.77	360.53	1.113



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THE POINT
PHASES 1-10 AND 14
PRELIMINARY PLAT PLANS
EAST YOUNG STREET
TOWN OF ROLESVILLE, WAKE FOREST TOWNSHIP,
WAKE COUNTY, NORTH CAROLINA

REVISIONS

PLAN INFORMATION

PROJECT NO.	AWH-20000
FILENAME	AWH-20000 POST
CHECKED BY	KEG '
DRAWN BY	JDV
SCALE	1" = 100'
DATE	10.26.2022

SHEET

POST DEVELOPMENT
HYDROLOGY MAP

POST-DA

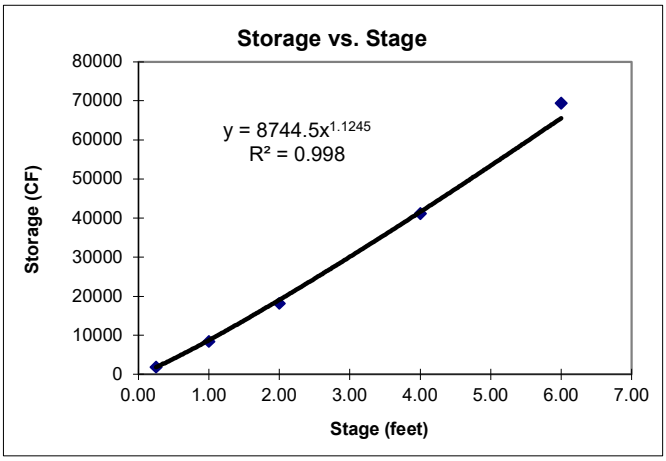
M:\Projects\AWH-20000\04 Production\Water Resources\North Site\Current Drawing\AWH-20000x - POST.dwg, 10/26/2022 4:23:31 PM, Joshua Vinson

STORMWATER CONTROL MEASURE 'M'
DESIGN CALCULATIONS

The Point - North
AWH-20000

STAGE-STORAGE FUNCTION - ABOVE NORMAL POOL

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
340.00	0.00	7,002				
340.25	0.25	8,291	7647	1912	1912	0.26
341.00	1.00	9,120	8706	6529	8441	0.97
342.00	2.00	10,275	9698	9698	18138	1.91
344.00	4.00	12,754	11515	23029	41167	3.97
346.00	6.00	15,460	14107	28214	69381	6.31



K_S =	8744
b =	1.1245

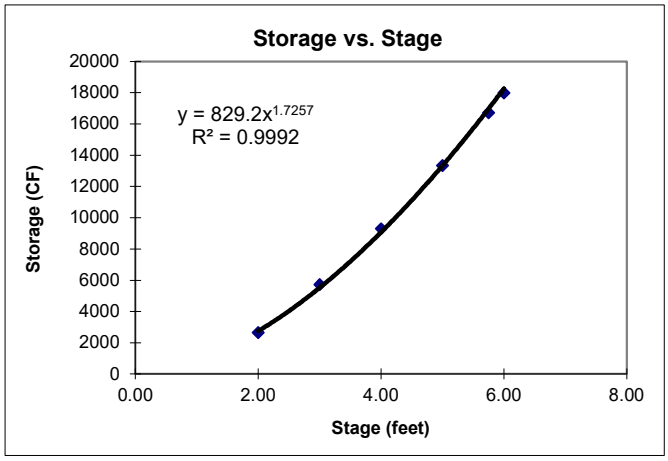
STORMWATER CONTROL MEASURE M

SSFxn Main Pool

STAGE-STORAGE FUNCTION - MAIN POOL

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
334.00	0.00	2,047	Sediment Storage			
335.00	1.00	2,442				
336.00	2.00	2,864	2653	2653	2653	1.87
337.00	3.00	3,314	3089	3089	5742	2.99
338.00	4.00	3,792	3553	3553	9295	4.01
339.00	5.00	4,298	4045	4045	13340	5.00
339.75	5.75	4,696	4497	3373	16713	5.74
340.00	6.00	5,425	5061	1265	17978	6.00

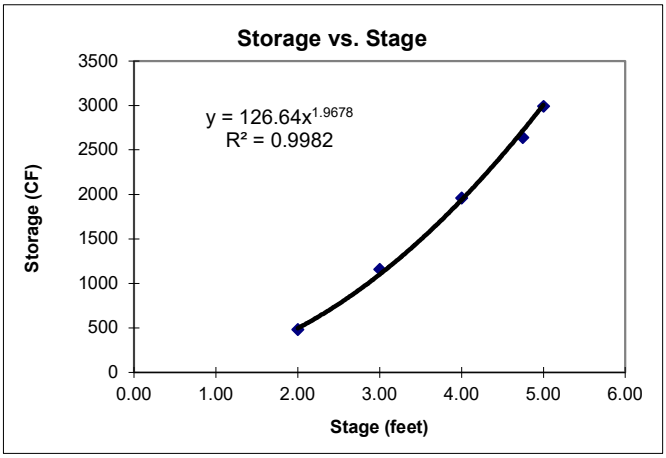
*surface area and volume used for avg. depth calculation



K_s =	949
b =	1.6417

STAGE-STORAGE FUNCTION - FOREBAY

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
335.00	0.00	243	Sediment Storage			
336.00	1.00	390				
337.00	2.00	571	481	481	481	1.97
338.00	3.00	787	679	679	1160	3.08
339.00	4.00	1,033	802	802	1962	4.02
339.75	4.75	1,238	905	678	2640	4.68
340.00	5.00	1,577	1408	352	2992	4.99



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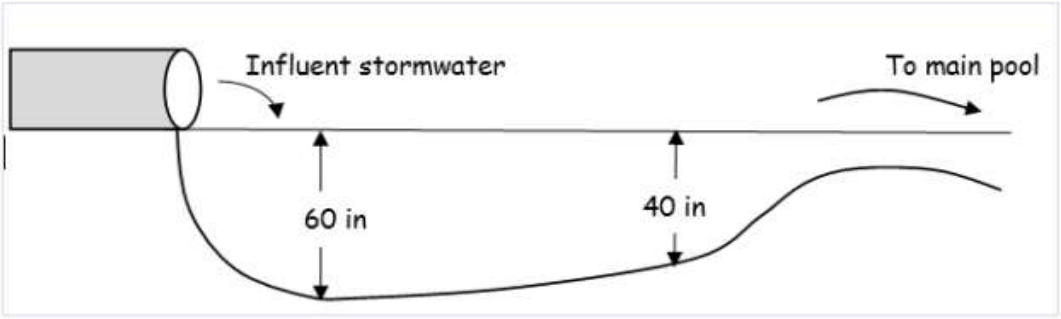
b =	1.9678



STORMWATER CONTROL MEASURE M

Volume Calculation

TOTAL VOLUME OF FACILITY

Volume of Main Pool below Normal Pool=	17,978	cf
Volume of Forebay below Normal Pool=	2,992	cf
Total Volume Below Normal Pool =	20,970	cf
Total Volume Above Normal Pool=	69,381	cf
Total Volume of Facility =	90,351	cf

FOREBAY PERCENTAGE OF PERMANENT POOL VOLUME

Per NCDEQ Minimum Design Criteria, the forebay volume should equal approximately 15-20% of the main pool volume.

Total Main Pool Volume =	17,978	cf
Provided Forebay Volume =	2,992	cf
Provided Forebay Volume % =	17%	

AVERAGE DEPTH OF MAIN POOL

Main Pool Volume at Normal Pool =	17,978	cf
Main Pool Area at Normal Pool =	5,425	sf
Average Depth =	3.31	ft

STORMWATER CONTROL MEASURE M

Surface Area Calculation

WET DETENTION BASIN SUMMARY

Enter the drainage area characteristics ==>

Total drainage area to pond =	7.40	acres
Total impervious area to pond =	3.28	acres

Note The basin must be sized to treat all impervious surface runoff draining into the pond, not just the impervious surface from on-site development.

Drainage area = **7.40** acres @ **44.4%** impervious

Estimate the surface area required at pond normal pool elevation ==>

Wet Detention Basins are based on an minimum average depth of = 3.31 feet ***(Calculated)***

		3.0	3.31	4.0
Lower Boundary =>	40.0	1.51		1.24
Site % impervious =>	44.4	1.63	***1.55***	1.36
Upper Boundary =>	50.0	1.79		1.51

Therefore, SA/DA required = ***1.55***

Surface area required for main pool at normal pool =	4,986	ft^2
=	0.11	acres
Surface area provided for main pool at normal pool =	5,425	ft^2

STORMWATER CONTROL MEASURE M

WQV Calculation

DETERMINATION OF WATER QUALITY VOLUME

$WQ_V = (P)(R_V)(A)/12$

where,

WQ_V = water quality volume (in acre-ft)

R_V = 0.05+0.009(I) where I is percent impervious cover

A = area in acres

P = rainfall (in inches)

Input data:

Total area, A =	7.40	acres
Impervious area =	3.28	acres
Percent impervious cover, I =	44.4	%
Rainfall, P =	1.00	inches

Calculated values:

R_V =	0.45	
WQ_V =	0.28	acre-ft
=	12074	cf.

ASSOCIATED DEPTH IN POND

WQ_V =	12074	cf.

Stage / Storage Data:

Ks =	8744	
b =	1.124	
Zo =	340.00	
Volume in 1" rainfall =	12074	cf.

Calculated values:

Depth of WQv in Basin =	1.33	ft
=	15.99	inches
Elevation =	341.33	ft

STORMWATER CONTROL MEASURE M

WQV Drawdown Calculation

DRAWDOWN ORIFICE DESIGN

D orifice =	1.75	inch
# orifices =	1	
Ks =	8744	
b =	1.1245	
C_d orifice =	0.60	
Normal Pool Elevation =	340.00	feet
Volume @ Normal Pool =	0	cf
Orifice Invert =	340.00	feet
WSEL @ 1" Runoff Volume =	341.33	feet

WSEL (feet)	Vol. Stored (cf)	Orifice Flow (cfs)	Avg. Flow (cfs)	Incr. Vol. (cf)	Incr. Time (sec)
341.33	12074	0.090			
341.22	10898	0.086	0.088	1176	13365
341.10	9736	0.081	0.084	1162	13896
340.98	8589	0.077	0.079	1147	14513
340.87	7459	0.072	0.074	1130	15245
340.75	6348	0.066	0.069	1111	16133
340.64	5258	0.060	0.063	1090	17245
340.52	4192	0.054	0.057	1066	18702
340.40	3156	0.046	0.050	1036	20745
340.29	2157	0.037	0.042	999	23953
340.17	1207	0.025	0.031	949	30372

Drawdown Time =	2.13	days

By comparison, if calculated by the average head over the orifice
(assuming average head is one-third the total depth), the result would be:

Average driving head on orifice =	0.420	feet
Orifice composite loss coefficient =	0.600	
Cross-sectional area of siphon =	0.017	sf
Q =	0.0521	cfs

Drawdown Time = Volume / Flowrate / 86400 (sec/day)

Drawdown Time =	2.68	days

STORMWATER CONTROL MEASURE M
Anti-Flotation Block Calculations

RISER ANTI-FLOTATION CALCULATION

Input Data ==>

Safety Factor:

Safety factor to use =	1.15	(recommend 1.15 or higher)

Concrete:

Concrete unit weight =	142.0	PCF	**Note:** NC Products lists unit wt. of manhole concrete at 142 PCF.

Riser:

Inside height of Riser =	5.00	feet
Inside length of riser =	4.00	feet
Inside width of riser =	4.00	feet
Wall thickness of riser =	6.00	inches
Base thickness of riser =	6.00	inches
Base length of riser =	5.00	feet
Base width of riser =	5.00	feet

Openings:

Total Orifice Area =	1.517	SF
OD of barrel exiting manhole =	30.00	inches
Size of drain pipe (if present) =	6.0	inches

Trash Rack:

Bottom Length =	7.00	feet
Bottom Width =	7.00	feet
Top Length =	1.00	feet
Top Width =	1.00	feet
Height =	2.00	feet
Trash Rack water displacement =	38.00	CF

Concrete Present in Riser Structure ==>

Total amount of concrete:

Base of Riser =	12.50	CF
Riser Walls =	45.00	CF

Adjust for openings:

Opening for Orifices =	0.76	CF
Opening for barrel =	2.45	CF
Opening for drain pipe =	0.10	CF

Total Concrete present, adjusted for openings =	***54.189***	***CF***
Weight of concrete present =	***7,695***	***lbs***

STORMWATER CONTROL MEASURE M

Anti-Flotation Block Calculations

Amount of water displaced by Riser Structure ==>

Displacement by concrete =	54.19	CF
Displacement by open air in riser =	80.00	CF
Displacement by trash rack =	38.00	CF
Total water displaced by riser/barrel structure =	***172.19***	***CF***
Weight of water displaced =	***10,745***	***lbs***

Calculate size of base for riser assembly ==>

Length =	8.00	feet
Width =	8.00	feet
Thickness =	12	inches
Concrete Present =	64.00	CF

Check validity of base as designed ==>

Total Water Displaced =	223.69	CF
Total Concrete Present =	118.19	CF
Total Water Displaced =	13,958	lbs
Total Concrete Present =	16,783	lbs
Actual safety factor =	*1.20*	OK

Results of design ==>

Base length =	**8.00**	**feet**
Base width =	**8.00**	**feet**
Base Thickness =	**12.00**	**inches**
CY of concrete total in base =	**2.37**	**CY**
Concrete unit weight in added base >=	**142.0**	**PCF**

STORMWATER CONTROL MEASURE M
Anti-Flotation Block Calculations

II. CALCULATION FOR RISER ANTI-FLOTATION STEEL

Input Data ==>

Anti-Floatation Block Length =	8.0	feet
Anti-Floatation Block Width =	8.0	feet
Anti-Floatation Block Thickness =	12	inches
A_{steel} to $A_{concrete}$ Ratio =	0.0020	(recommend 0.0018 or higher)

Cross-Section Calculations==>

Cross-Section Area* =	8.00	SF
Minimum Steel Area Required =	0.016	SF
	2.30	SI

**Note: Assumes a "square" x-sec (L and W same)*

Rebar Calculations ==>

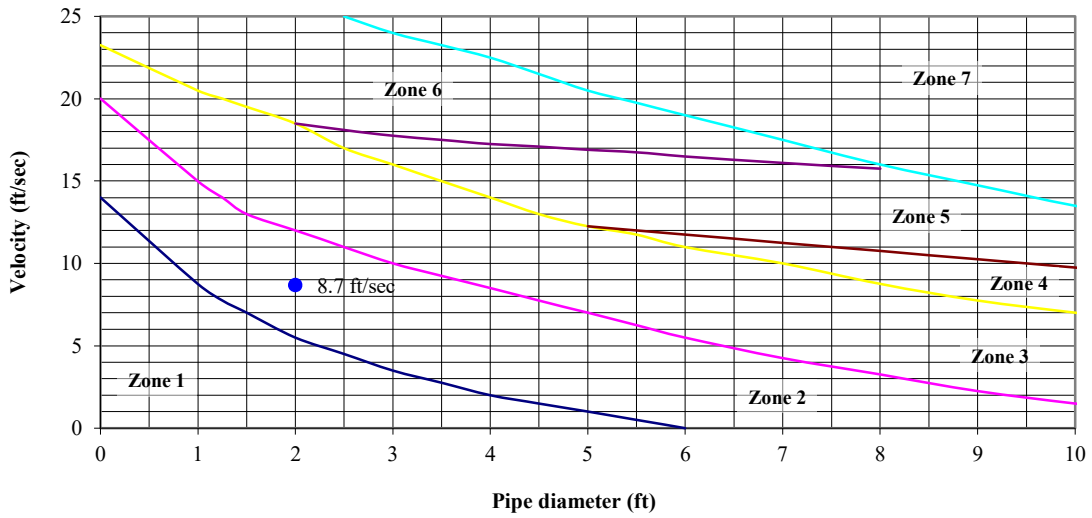
Bar Size	4	5	6	7	8
Diameter (inches)	0.500	0.625	0.750	0.875	1.000
X-Sec Area (SI)	0.196	0.307	0.442	0.601	0.785
Minimum Number of Bars	12	8	6	4	3

DESIGN OF RIPRAP OUTLET PROTECTION WORKSHEET

Project	The Point North	Date	10/27/2022
Project No.	AWH-20000	Designer	SDD
Outlet ID	SCM M		

Flow, $Q_{10\text{-}yr}$	10.1	cfs
Slope, S	1.79	%
Pipe Diameter, D_o	24	inches
Pipe Diameter, D_o	2.0	feet
Number of pipes	1	
Pipe separation	0	feet
Manning's n	0.013	

Figure 8.06.b.1



Zone from graph above = 2

Outlet pipe diameter	24 in.	Length =	12.0 ft.
Outlet flowrate	10.1 cfs	Width =	6.0 ft.
Outlet velocity	8.7 ft/sec	Stone diameter =	6 in.
Material =	Class B	Thickness =	22 in.

Zone	Material	Diameter	Thickness	Length	Width
1	Class A	3	9	4 x D(o)	3 x D(o)
2	Class B	6	22	6 x D(o)	3 x D(o)
3	Class I	13	22	8 x D(o)	3 x D(o)
4	Class I	13	22	8 x D(o)	3 x D(o)
5	Class II	23	27	10 x D(o)	3 x D(o)
6	Class II	23	27	10 x D(o)	3 x D(o)
7	Special study required				

1. Calculations based on NY DOT method - Pages 8.06.05 through 8.06.06 in NC Erosion Control Manual
2. Outlet velocity based on full-flow velocity

MCADAMS

SCM M Output

Subsection: Elevation-Area Volume Curve
Label: SCM M
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Elevation (ft)	Planimeter (ft²)	Area (ft²)	A1+A2+sqr (A1*A2) (ft²)	Volume (ac-ft)	Volume (Total) (ac-ft)
340.00	0.0	7,235	0	0.000	0.000
340.25	0.0	8,291	23,271	0.045	0.045
341.00	0.0	9,120	26,107	0.150	0.194
342.00	0.0	10,275	29,075	0.222	0.417
344.00	0.0	12,754	34,477	0.528	0.944
346.00	0.0	15,460	42,256	0.647	1.591

MCADAMS

SCM M Output

Subsection: Outlet Input Data
Label: SCM M
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Requested Pond Water Surface Elevations	
Minimum (Headwater)	340.00 ft
Increment (Headwater)	0.10 ft
Maximum (Headwater)	346.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Rectangular Weir	Weir	Forward	Culvert	341.50	342.00
Orifice-Area	Orifice	Forward	Culvert	342.00	346.00
Inlet Box	Riser	Forward	Culvert	344.00	346.00
Orifice-Circular	WQ Orifice	Forward	Culvert	340.00	346.00
Culvert-Circular	Culvert	Forward	TW	339.00	346.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

MCADAMS

SCM M Output

Subsection: Outlet Input Data
Label: SCM M
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Structure ID: Culvert Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	24.00 in
Length	56.00 ft
Length (Computed Barrel)	56.01 ft
Slope (Computed)	0.018 ft/ft

Outlet Control Data	
Manning's n	0.013
Ke	1
Kb	0
Kr	1
Convergence Tolerance	0.00 ft

Inlet Control Data	
Equation Form	Form 1
K	0.0098
M	2.0000
C	0.0398
Y	0.6700
T1 ratio (HW/D)	1
T2 ratio (HW/D)	1
Slope Correction Factor	-1

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	341.30 ft	T1 Flow	15.55 ft³/s
T2 Elevation	341.60 ft	T2 Flow	17.77 ft³/s

MCADAMS

SCM M Output

Subsection: Outlet Input Data
Label: SCM M
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Structure ID: Riser Structure Type: Inlet Box	
Number of Openings	1
Elevation	344.00 ft
Orifice Area	16.0 ft²
Orifice Coefficient	1
Weir Length	16.00 ft
Weir Coefficient	3.00 (ft^0.5)/s
K Reverse	1
Manning's n	0
Kev, Charged Riser	0
Weir Submergence	False
Orifice H to crest	False

Structure ID: WQ Orifice Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	340.00 ft
Orifice Diameter	1.75 in
Orifice Coefficient	1

Structure ID: Orifice Structure Type: Orifice-Area	
Number of Openings	3
Elevation	341.50 ft
Orifice Area	0.5 ft²
Top Elevation	342.00 ft
Datum Elevation	341.75 ft
Orifice Coefficient	1

Structure ID: Weir Structure Type: Rectangular Weir	
Number of Openings	1
Elevation	341.50 ft
Weir Length	3.00 ft
Weir Coefficient	3.00 (ft^0.5)/s

Structure ID: TW Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall

Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft

MCADAMS

SCM M Output

Subsection: Outlet Input Data
Label: SCM M
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Convergence Tolerances	
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

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SCM M Output

Subsection: Composite Rating Curve
Label: SCM M
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
340.00	0.00	(N/A)	0.00	(no Q: Weir,Orifice,Riser,WQ Orifice,Culvert)
340.10	0.01	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
340.20	0.03	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
340.30	0.04	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
340.40	0.05	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
340.50	0.05	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
340.60	0.06	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
340.70	0.06	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
340.80	0.07	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
340.90	0.07	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
341.00	0.08	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
341.10	0.08	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
341.20	0.09	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
341.30	0.09	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
341.40	0.09	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
341.50	0.10	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
341.60	0.38	(N/A)	0.00	Weir,WQ Orifice,Culvert (no Q: Orifice,Riser)
341.70	0.90	(N/A)	0.00	Weir,WQ Orifice,Culvert (no Q: Orifice,Riser)
341.80	1.55	(N/A)	0.00	Weir,WQ Orifice,Culvert (no Q: Orifice,Riser)
341.90	2.32	(N/A)	0.00	Weir,WQ Orifice,Culvert (no Q: Orifice,Riser)
342.00	3.72	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
342.10	4.39	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
342.20	4.95	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
342.30	5.47	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
342.40	5.94	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)

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SCM M Output

Subsection: Composite Rating Curve
Label: SCM M
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
342.50	6.36	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
342.60	6.77	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
342.70	7.16	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
342.80	7.52	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
342.90	7.86	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
343.00	8.20	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
343.10	8.51	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
343.20	8.82	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
343.30	9.12	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
343.40	9.40	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
343.50	9.68	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
343.60	9.96	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
343.70	10.21	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
343.80	10.47	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
343.90	10.72	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
344.00	10.96	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
344.10	12.72	(N/A)	0.00	Orifice,Riser,WQ Orifice,Culvert (no Q: Weir)
344.20	15.72	(N/A)	0.00	Orifice,Riser,WQ Orifice,Culvert (no Q: Weir)
344.30	19.34	(N/A)	0.00	Orifice,Riser,WQ Orifice,Culvert (no Q: Weir)
344.40	22.53	(N/A)	0.00	Orifice,Riser,WQ Orifice,Culvert (no Q: Weir)
344.50	25.87	(N/A)	0.00	Orifice,Riser,WQ Orifice,Culvert (no Q: Weir)
344.60	29.10	(N/A)	0.00	Orifice,Riser,WQ Orifice,Culvert (no Q: Weir)

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SCM M Output

Subsection: Composite Rating Curve
Label: SCM M
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
344.70	31.91	(N/A)	0.00	Orifice,Riser,WQ Orifice,Culvert (no Q: Weir)
344.80	33.32	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
344.90	33.69	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
345.00	34.06	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
345.10	34.42	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
345.20	34.78	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
345.30	35.13	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
345.40	35.49	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
345.50	35.83	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
345.60	36.18	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
345.70	36.52	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
345.80	36.86	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
345.90	37.19	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
346.00	37.52	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)

MCADAMS

SCM M Output

Subsection: Level Pool Pond Routing Summary
Label: SCM M (IN)
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	340.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	20.56 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	4.09 ft³/s	Time to Peak (Flow, Outlet)	751.00 min

Elevation (Water Surface, Peak)	342.06 ft
Volume (Peak)	0.430 ac-ft

Mass Balance (ac-ft)	
Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	0.952 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	0.689 ac-ft
Volume (Retained)	0.263 ac-ft
Volume (Unrouted)	0.000 ac-ft
Error (Mass Balance)	0.0 %

MCADAMS

SCM M Output

Subsection: Level Pool Pond Routing Summary
Label: SCM M (IN)
Scenario: Post-Dev 10-yr

Return Event: 10 years
Storm Event: 10 yr

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	340.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	38.42 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	10.09 ft³/s	Time to Peak (Flow, Outlet)	733.00 min

Elevation (Water Surface, Peak)	343.65 ft
Volume (Peak)	0.845 ac-ft

Mass Balance (ac-ft)	
Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	2.134 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	1.866 ac-ft
Volume (Retained)	0.267 ac-ft
Volume (Unrouted)	0.000 ac-ft
Error (Mass Balance)	0.0 %

MCADAMS

SCM M Output

Subsection: Level Pool Pond Routing Summary
Label: SCM M (IN)
Scenario: Post-Dev 25-yr

Return Event: 25 years
Storm Event: 25 yr

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	340.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	44.56 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	14.16 ft³/s	Time to Peak (Flow, Outlet)	731.00 min

Elevation (Water Surface, Peak)	344.15 ft
Volume (Peak)	0.988 ac-ft

Mass Balance (ac-ft)	
Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	2.671 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	2.403 ac-ft
Volume (Retained)	0.268 ac-ft
Volume (Unrouted)	0.000 ac-ft
Error (Mass Balance)	0.0 %

MCADAMS

SCM M Output

Subsection: Level Pool Pond Routing Summary
Label: SCM M (IN)
Scenario: Post-Dev 100-yr

Return Event: 100 years
Storm Event: 100 yr

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	340.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	53.39 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	26.87 ft³/s	Time to Peak (Flow, Outlet)	728.00 min

Elevation (Water Surface, Peak)	344.53 ft
Volume (Peak)	1.104 ac-ft

Mass Balance (ac-ft)	
Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	3.569 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	3.301 ac-ft
Volume (Retained)	0.268 ac-ft
Volume (Unrouted)	0.000 ac-ft
Error (Mass Balance)	0.0 %

STORMWATER CONTROL MEASURE 'N'
DESIGN CALCULATIONS

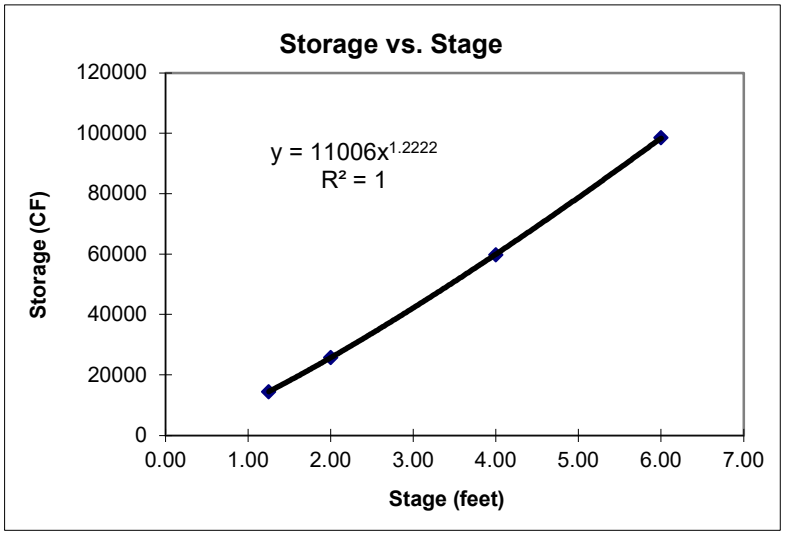
The Point - North
AWH-20000

STORMWATER CONTROL MEASURE N

SSFxn Above NP

STAGE-STORAGE FUNCTION - ABOVE NORMAL POOL

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
346.00	0.00	8,727				
347.25	1.25	14,373	11550	14438	14438	1.25
348.00	2.00	15,810	15092	11319	25756	2.00
350.00	4.00	18,166	16988	33976	59732	3.99
352.00	6.00	20,560	19363	38726	98458	6.01



K_S =	11006
b =	1.222

STORMWATER CONTROL MEASURE N

SSFxn Below NP

WETLAND ZONE TABULATION

Per NCDEQ "Stormwater Design Manual" Minimum Design Criteria

Zone	Depth at Normal Pool (inches)			Depth at Temp Pool (inches)			Portion of Wetland Surface Area
Deep Pool - Forebay	6	to	40	21	to	55	10 - 15%
Deep Pool - Non Forebay	6	to	40	21	to	55	5 - 15%
Shallow Water	0	to	6	15	to	21	35 - 45%
Shallow Land	-	to	-	0	to	15	30 - 45%

Permanent Pool Elevation =	346.00
Temporary Pool Elevation =	347.25
Wetland Surface Area at Temporary Pool =	14,373

Zone	Elevation		(ft)	Measured Area (sf)	Portion of Wetland Surface Area
Deep Pool - Forebay	345.50	to	343.00	2,101	14.6%
Deep Pool - Non Forebay	345.50	to	343.00	1,528	10.6%
Shallow Water	346.00	to	345.50	5,098	35.5%
Shallow Land	347.25	to	346.00	5,646	39.3%

STORMWATER CONTROL MEASURE N

WQV Calculation - MDC

DETERMINATION OF WATER QUALITY VOLUME

$WQ_V = (P)(R_V)(A)/12$

where,

WQ_V = water quality volume (in acre-ft)

R_V = 0.05+0.009(I) where I is percent impervious cover

A = area in acres

P = rainfall (in inches)

Input data:

Total area, A =	8.58	acres
Impervious area =	4.47	acres
Percent impervious cover, I =	52.0	%
Rainfall, P =	1.00	inches

Calculated values:

R_V =	0.52	
WQ_V =	0.37	acre-ft
=	16147	cf.

SURFACE AREA CALCULATION

Per NCDEQ "Stormwater Design Manual" Wetland MDC 3. Surface Area

WQ_V =	16,147	cf.
Max. ponding depth =	15	inches
Min. surface area (at temp. pool) =	12,917	sf.
Surface area provided at temp. pool =	14,373	sf.
Approximate ponding depth =	1.12	feet
=	13.48	inches

Calculated values:

Depth of WQv in Basin =	1.12	ft
=	13.48	inches
Elevation =	347.12	ft

STORMWATER CONTROL MEASURE N

WQV Drawdown Calculation

S. DANIELL, PE
10/27/2022

DRAWDOWN ORIFICE DESIGN

D orifice =	2	inch
# orifices =	1	
Ks =	11006	
b =	1.222	
C_d orifice =	0.60	
Normal Pool Elevation =	346.00	feet
Volume @ Normal Pool =	0	cf
Orifice Invert =	346.00	feet
WSEL @ 1" Runoff Volume =	347.37	feet

WSEL (feet)	Vol. Stored (cf)	Orifice Flow (cfs)	Avg. Flow (cfs)	Incr. Vol. (cf)	Incr. Time (sec)
347.37	16147	0.119			
347.25	14489	0.113	0.116	1657	14271
347.14	12866	0.108	0.111	1624	14692
347.02	11279	0.102	0.105	1587	15178
346.90	9731	0.095	0.098	1547	15747
346.79	8227	0.088	0.092	1504	16429
346.67	6772	0.080	0.084	1455	17270
346.56	5372	0.072	0.076	1400	18353
346.44	4036	0.063	0.067	1336	19835
346.32	2776	0.051	0.057	1260	22080
346.21	1615	0.037	0.044	1161	26252

Drawdown Time =	2.08	days

By comparison, if calculated by the average head over the orifice
(assuming average head is one-third the total depth), the result would be:

Average driving head on orifice =	0.428	feet
Orifice composite loss coefficient =	0.600	
Cross-sectional area of siphon =	0.022	sf
Q =	0.0687	cfs

Drawdown Time = Volume / Flowrate / 86400 (sec/day)

Drawdown Time =	2.72	days

STORMWATER CONTROL MEASURE N

Temp Pool Drawdown Calculation

DRAWDOWN ORIFICE DESIGN

D orifice =	2	inch
# orifices =	1	
Ks =	11006	
b =	1.222	
C_d orifice =	0.60	
Normal Pool Elevation =	346.00	feet
Volume @ Normal Pool =	0	cf
Orifice Invert =	346.00	feet
Temp Pool Elevation Volume =	347.25	feet

WSEL (feet)	Vol. Stored (cf)	Orifice Flow (cfs)	Avg. Flow (cfs)	Incr. Vol. (cf)	Incr. Time (sec)
347.25	14457	0.113			
347.15	12998	0.108	0.111	1459	13181
347.04	11568	0.103	0.105	1430	13567
346.94	10170	0.097	0.100	1398	14012
346.83	8806	0.091	0.094	1364	14532
346.73	7479	0.084	0.088	1327	15154
346.62	6194	0.077	0.081	1285	15920
346.52	4956	0.069	0.073	1238	16900
346.42	3772	0.061	0.065	1184	18232
346.31	2653	0.050	0.055	1119	20223
346.21	1615	0.037	0.044	1038	23808

Drawdown Time =	1.92	days

By comparison, if calculated by the average head over the orifice
(assuming average head is one-third the total depth), the result would be:

Average driving head on orifice =	0.389	feet
Orifice composite loss coefficient =	0.600	
Cross-sectional area of siphon =	0.022	sf
Q =	0.0655	cfs

Drawdown Time = Volume / Flowrate / 86400 (sec/day)

Drawdown Time =	2.55	days

STORMWATER CONTROL MEASURE N
Anti-Flotation Block Calculations

RISER ANTI-FLOTATION CALCULATION

Input Data ==>

Safety Factor:

Safety factor to use =	1.15	(recommend 1.15 or higher)

Concrete:

Concrete unit weight =	142.0	PCF	**Note:** NC Products lists unit wt. of manhole concrete at 142 PCF.

Riser:

Inside height of Riser =	7.00	feet
Inside length of riser =	4.00	feet
Inside width of riser =	4.00	feet
Wall thickness of riser =	6.00	inches
Base thickness of riser =	6.00	inches
Base length of riser =	5.00	feet
Base width of riser =	5.00	feet

Openings:

Total Orifice Area =	1.522	SF
OD of barrel exiting manhole =	30.00	inches
Size of drain pipe (if present) =	6.0	inches

Trash Rack:

Bottom Length =	7.00	feet
Bottom Width =	7.00	feet
Top Length =	1.00	feet
Top Width =	1.00	feet
Height =	2.00	feet
Trash Rack water displacement =	38.00	CF

Concrete Present in Riser Structure ==>

Total amount of concrete:

Base of Riser =	12.50	CF
Riser Walls =	63.00	CF

Adjust for openings:

Opening for Orifices =	0.76	CF
Opening for barrel =	2.45	CF
Opening for drain pipe =	0.10	CF

Total Concrete present, adjusted for openings =	***72.187***	***CF***
Weight of concrete present =	***10,250***	***lbs***

THE POINT - NORTH
AWH-20000

STORMWATER CONTROL MEASURE N
Anti-Flotation Block Calculations

S. DANIELL, PE
10/27/2022

Amount of water displaced by Riser Structure ==>

Displacement by concrete =	72.19	CF
Displacement by open air in riser =	112.00	CF
Displacement by trash rack =	38.00	CF
Total water displaced by riser/barrel structure =	***222.19***	***CF***
Weight of water displaced =	***13,864***	***lbs***

Calculate size of base for riser assembly ==>

Length =	8.00	feet
Width =	8.00	feet
Thickness =	18	inches
Concrete Present =	96.00	CF

Check validity of base as designed ==>

Total Water Displaced =	305.69	CF
Total Concrete Present =	168.19	CF
Total Water Displaced =	19,075	lbs
Total Concrete Present =	23,882	lbs
Actual safety factor =	*1.25*	OK

Results of design ==>

Base length =	**8.00**	**feet**
Base width =	**8.00**	**feet**
Base Thickness =	**18.00**	**inches**
CY of concrete total in base =	**3.56**	**CY**
Concrete unit weight in added base >=	**142.0**	**PCF**

STORMWATER CONTROL MEASURE N
Anti-Flotation Block Calculations

II. CALCULATION FOR RISER ANTI-FLOTATION STEEL

Input Data ==>

Anti-Floatation Block Length =	8.0	feet
Anti-Floatation Block Width =	8.0	feet
Anti-Floatation Block Thickness =	18	inches
A_{steel} to $A_{concrete}$ Ratio =	0.0020	(recommend 0.0018 or higher)

Cross-Section Calculations==>

Cross-Section Area* =	12.00	SF
Minimum Steel Area Required =	0.024	SF
	3.46	SI

**Note: Assumes a "square" x-sec (L and W same)*

Rebar Calculations ==>

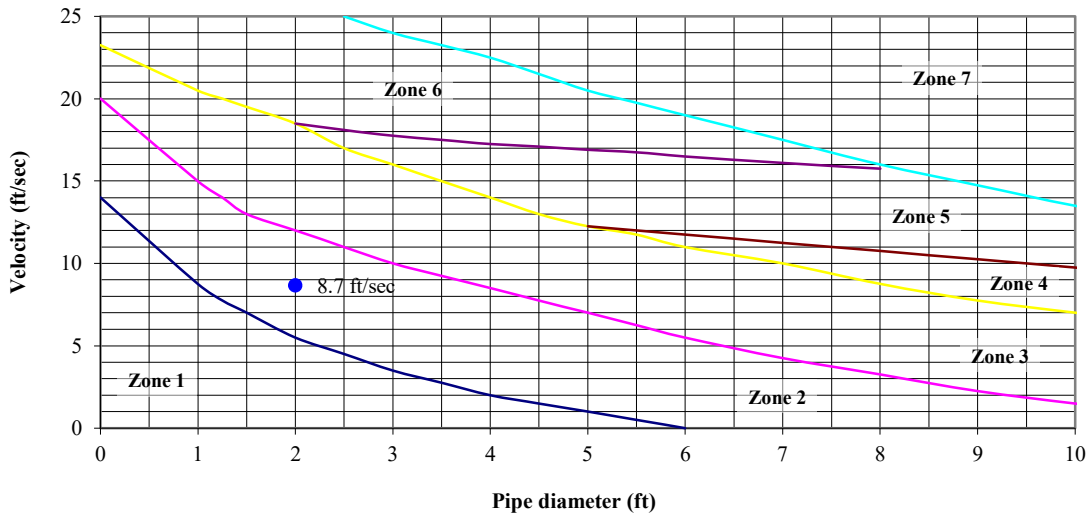
Bar Size	4	5	6	7	8
Diameter (inches)	0.500	0.625	0.750	0.875	1.000
X-Sec Area (SI)	0.196	0.307	0.442	0.601	0.785
Minimum Number of Bars	18	12	8	6	5

DESIGN OF RIPRAP OUTLET PROTECTION WORKSHEET

Project	The Point North	Date	10/27/2022
Project No.	AWH-20000	Designer	SDD
Outlet ID	SCM N		

Flow, $Q_{10\text{-}yr}$	10.0	cfs
Slope, S	1.79	%
Pipe Diameter, D_o	24	inches
Pipe Diameter, D_o	2.0	feet
Number of pipes	1	
Pipe separation	0	feet
Manning's n	0.013	

Figure 8.06.b.1



Zone from graph above = 2

Outlet pipe diameter	24 in.	Length =	12.0 ft.
Outlet flowrate	10.0 cfs	Width =	6.0 ft.
Outlet velocity	8.7 ft/sec	Stone diameter =	6 in.
Material =	Class B	Thickness =	22 in.

Zone	Material	Diameter	Thickness	Length	Width
1	Class A	3	9	4 x D(o)	3 x D(o)
2	Class B	6	22	6 x D(o)	3 x D(o)
3	Class I	13	22	8 x D(o)	3 x D(o)
4	Class I	13	22	8 x D(o)	3 x D(o)
5	Class II	23	27	10 x D(o)	3 x D(o)
6	Class II	23	27	10 x D(o)	3 x D(o)
7	Special study required				

1. Calculations based on NY DOT method - Pages 8.06.05 through 8.06.06 in NC Erosion Control Manual
2. Outlet velocity based on full-flow velocity

MCADAMS

SCM N Output

Subsection: Elevation-Area Volume Curve
Label: SCM N
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Elevation (ft)	Planimeter (ft²)	Area (ft²)	A1+A2+sqr (A1*A2) (ft²)	Volume (ac-ft)	Volume (Total) (ac-ft)
346.00	0.0	8,727	0	0.000	0.000
347.25	0.0	14,373	34,300	0.328	0.328
348.00	0.0	15,810	45,257	0.260	0.588
350.00	0.0	18,166	50,923	0.779	1.367
352.00	0.0	20,560	58,052	0.888	2.256

MCADAMS

SCM N Output

Subsection: Outlet Input Data
Label: SCM N
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Requested Pond Water Surface Elevations	
Minimum (Headwater)	346.00 ft
Increment (Headwater)	0.10 ft
Maximum (Headwater)	352.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Rectangular Weir	Weir	Forward	Culvert	347.50	348.00
Orifice-Area	Orifice	Forward	Culvert	348.00	352.00
Inlet Box	Riser	Forward	Culvert	350.00	352.00
Orifice-Circular	WQ Orifice	Forward	Culvert	346.00	352.00
Culvert-Circular	Culvert	Forward	TW	343.00	352.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

MCADAMS

SCM N Output

Subsection: Outlet Input Data
Label: SCM N
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Structure ID: Culvert Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	24.00 in
Length	56.00 ft
Length (Computed Barrel)	56.01 ft
Slope (Computed)	0.018 ft/ft

Outlet Control Data	
Manning's n	0.013
Ke	1
Kb	0
Kr	1
Convergence Tolerance	0.00 ft

Inlet Control Data	
Equation Form	Form 1
K	0.0098
M	2.0000
C	0.0398
Y	0.6700
T1 ratio (HW/D)	1
T2 ratio (HW/D)	1
Slope Correction Factor	-1

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	345.30 ft	T1 Flow	15.55 ft^3/s
T2 Elevation	345.60 ft	T2 Flow	17.77 ft^3/s

MCADAMS

SCM N Output

Subsection: Outlet Input Data
Label: SCM N
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Structure ID: Riser Structure Type: Inlet Box	
Number of Openings	1
Elevation	350.00 ft
Orifice Area	16.0 ft²
Orifice Coefficient	1
Weir Length	16.00 ft
Weir Coefficient	3.00 (ft^0.5)/s
K Reverse	1
Manning's n	0
Kev, Charged Riser	0
Weir Submergence	False
Orifice H to crest	False

Structure ID: WQ Orifice Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	346.00 ft
Orifice Diameter	2.00 in
Orifice Coefficient	1

Structure ID: Orifice Structure Type: Orifice-Area	
Number of Openings	3
Elevation	347.50 ft
Orifice Area	0.5 ft²
Top Elevation	348.00 ft
Datum Elevation	347.75 ft
Orifice Coefficient	1

Structure ID: Weir Structure Type: Rectangular Weir	
Number of Openings	1
Elevation	347.50 ft
Weir Length	3.00 ft
Weir Coefficient	3.00 (ft^0.5)/s

Structure ID: TW Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall

Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft

MCADAMS

SCM N Output

Subsection: Outlet Input Data
Label: SCM N
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Convergence Tolerances	
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

MCADAMS

SCM N Output

Subsection: Composite Rating Curve
Label: SCM N
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
346.00	0.00	(N/A)	0.00	(no Q: Weir,Orifice,Riser,WQ Orifice,Culvert)
346.10	0.01	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
346.20	0.04	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
346.30	0.05	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
346.40	0.06	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
346.50	0.07	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
346.60	0.08	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
346.70	0.08	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
346.80	0.09	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
346.90	0.09	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
347.00	0.10	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
347.10	0.11	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
347.20	0.11	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
347.30	0.12	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
347.40	0.12	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
347.50	0.13	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
347.60	0.41	(N/A)	0.00	Weir,WQ Orifice,Culvert (no Q: Orifice,Riser)
347.70	0.93	(N/A)	0.00	Weir,WQ Orifice,Culvert (no Q: Orifice,Riser)
347.80	1.59	(N/A)	0.00	Weir,WQ Orifice,Culvert (no Q: Orifice,Riser)
347.90	2.36	(N/A)	0.00	Weir,WQ Orifice,Culvert (no Q: Orifice,Riser)
348.00	3.76	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
348.10	4.42	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
348.20	5.00	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
348.30	5.51	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
348.40	5.98	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)

MCADAMS

SCM N Output

Subsection: Composite Rating Curve
Label: SCM N
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
348.50	6.42	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
348.60	6.82	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
348.70	7.21	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
348.80	7.57	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
348.90	7.91	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
349.00	8.25	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
349.10	8.57	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
349.20	8.87	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
349.30	9.18	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
349.40	9.46	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
349.50	9.74	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
349.60	10.02	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
349.70	10.27	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
349.80	10.53	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
349.90	10.79	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
350.00	11.03	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
350.10	12.78	(N/A)	0.00	Orifice,Riser,WQ Orifice,Culvert (no Q: Weir)
350.20	15.79	(N/A)	0.00	Orifice,Riser,WQ Orifice,Culvert (no Q: Weir)
350.30	19.62	(N/A)	0.00	Orifice,Riser,WQ Orifice,Culvert (no Q: Weir)
350.40	24.10	(N/A)	0.00	Orifice,Riser,WQ Orifice,Culvert (no Q: Weir)
350.50	29.10	(N/A)	0.00	Orifice,Riser,WQ Orifice,Culvert (no Q: Weir)
350.60	32.63	(N/A)	0.00	Orifice,Riser,WQ Orifice,Culvert (no Q: Weir)

MCADAMS

SCM N Output

Subsection: Composite Rating Curve
Label: SCM N
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
350.70	35.98	(N/A)	0.00	Orifice,Riser,WQ Orifice,Culvert (no Q: Weir)
350.80	38.89	(N/A)	0.00	Orifice,Riser,WQ Orifice,Culvert (no Q: Weir)
350.90	40.39	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
351.00	40.69	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
351.10	41.00	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
351.20	41.30	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
351.30	41.60	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
351.40	41.90	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
351.50	42.19	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
351.60	42.48	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
351.70	42.77	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
351.80	43.06	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
351.90	43.35	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
352.00	43.64	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)

MCADAMS

SCM N Output

Subsection: Level Pool Pond Routing Summary
Label: SCM N (IN)
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	346.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	26.38 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	4.24 ft³/s	Time to Peak (Flow, Outlet)	753.00 min

Elevation (Water Surface, Peak)	348.07 ft
Volume (Peak)	0.614 ac-ft

Mass Balance (ac-ft)	
Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	1.221 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	0.857 ac-ft
Volume (Retained)	0.364 ac-ft
Volume (Unrouted)	0.000 ac-ft
Error (Mass Balance)	0.0 %

MCADAMS

SCM N Output

Subsection: Level Pool Pond Routing Summary
Label: SCM N (IN)
Scenario: Post-Dev 10-yr

Return Event: 10 years
Storm Event: 10 yr

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	346.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	48.16 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	10.04 ft³/s	Time to Peak (Flow, Outlet)	752.00 min

Elevation (Water Surface, Peak)	349.61 ft
Volume (Peak)	1.206 ac-ft

Mass Balance (ac-ft)	
Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	2.686 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	2.314 ac-ft
Volume (Retained)	0.372 ac-ft
Volume (Unrouted)	0.000 ac-ft
Error (Mass Balance)	0.0 %

MCADAMS

SCM N Output

Subsection: Level Pool Pond Routing Summary
Label: SCM N (IN)
Scenario: Post-Dev 25-yr

Return Event: 25 years
Storm Event: 25 yr

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	346.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	55.57 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	13.69 ft³/s	Time to Peak (Flow, Outlet)	751.00 min

Elevation (Water Surface, Peak)	350.13 ft
Volume (Peak)	1.422 ac-ft

Mass Balance (ac-ft)	
Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	3.349 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	2.976 ac-ft
Volume (Retained)	0.373 ac-ft
Volume (Unrouted)	0.000 ac-ft
Error (Mass Balance)	0.0 %

MCADAMS

SCM N Output

Subsection: Level Pool Pond Routing Summary
Label: SCM N (IN)
Scenario: Post-Dev 100-yr

Return Event: 100 years
Storm Event: 100 yr

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	346.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	66.24 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	29.21 ft³/s	Time to Peak (Flow, Outlet)	729.00 min

Elevation (Water Surface, Peak)	350.50 ft
Volume (Peak)	1.580 ac-ft

Mass Balance (ac-ft)	
Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	4.453 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	4.080 ac-ft
Volume (Retained)	0.373 ac-ft
Volume (Unrouted)	0.000 ac-ft
Error (Mass Balance)	0.0 %

STORMWATER CONTROL MEASURE 'O'
DESIGN CALCULATIONS

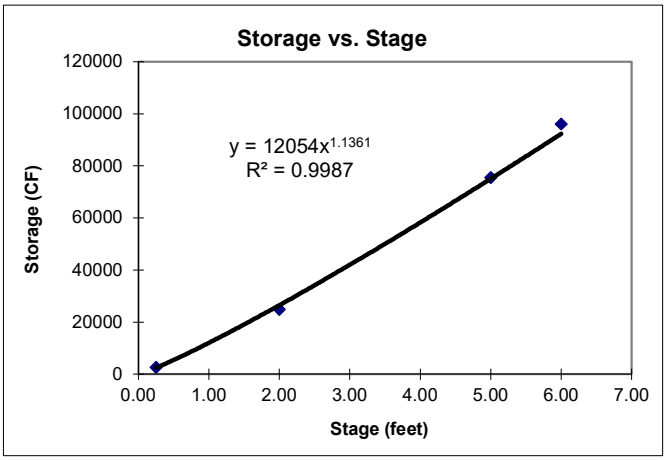
The Point - North
AWH-20000

STORMWATER CONTROL MEASURE O

SSFxn Above NP

STAGE-STORAGE FUNCTION - ABOVE NORMAL POOL

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
357.00	0.00	9,229				
357.25	0.25	11,204	10217	2554	2554	0.26
359.00	2.00	14,160	12682	22194	24748	1.88
362.00	5.00	19,631	16896	50687	75434	5.02
363.00	6.00	21,568	20600	20600	96034	6.21



K_S =	12054
b =	1.1361

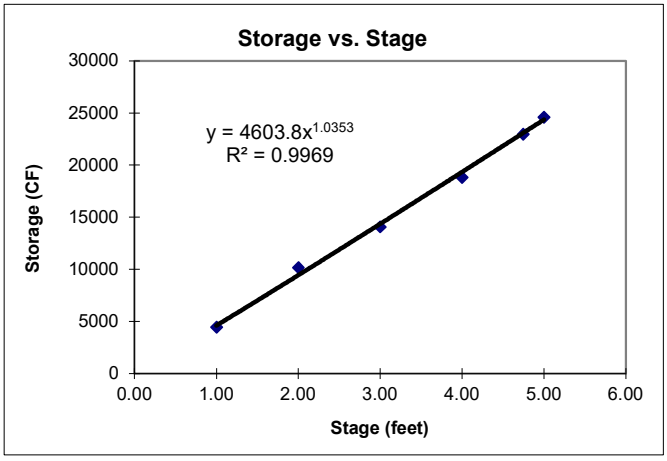
STORMWATER CONTROL MEASURE O

SSFxn Main Pool

STAGE-STORAGE FUNCTION - MAIN POOL

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
351.00	-1.00	1,650	Sediment Storage			
352.00	0.00	2,186				
353.00	1.00	2,808	2229	4458	4458	0.87
354.00	2.00	3,519	2853	5705	10163	2.06
355.00	3.00	4,314	3917	3917	14080	2.88
356.00	4.00	5,176	4745	4745	18825	3.90
356.75	4.75	5,892	5534	4151	22975	4.79
357.00	5.00	7,150	6521	1630	24605	5.15

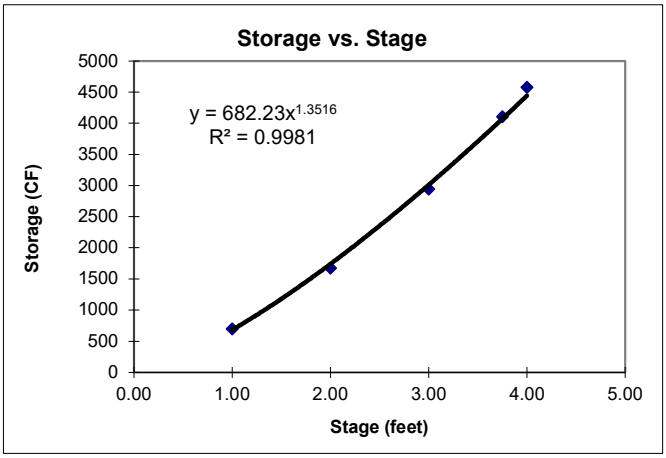
*surface area and volume used for avg. depth calculation



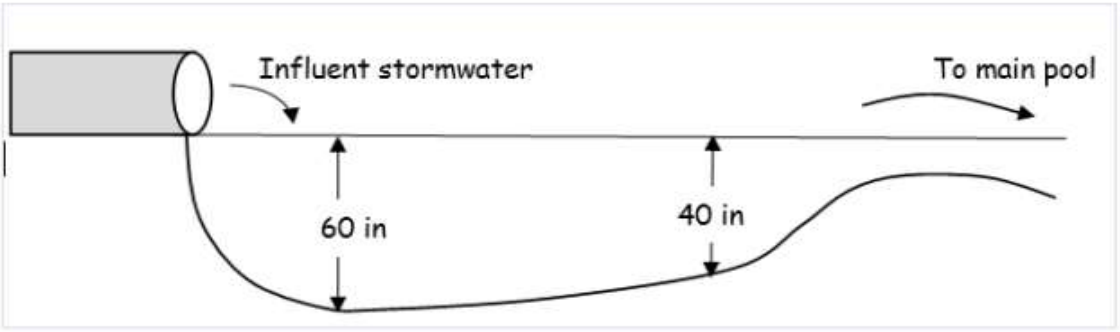
K_s =	5072
b =	0.9641

STAGE-STORAGE FUNCTION - FOREBAY

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
352.00	-1.00	145	Sediment Storage			
353.00	0.00	559				
354.00	1.00	838	699	699	699	1.10
355.00	2.00	1,116	977	977	1676	2.01
356.00	3.00	1,419	1268	1268	2943	2.97
356.75	3.75	1,682	1551	1163	4106	3.74
357.00	4.00	2,079	1881	470	4576	4.03



K_s =	612.8
b =	1.4417



STORMWATER CONTROL MEASURE O

Volume Calculation

TOTAL VOLUME OF FACILITY

Volume of Main Pool below Normal Pool=	24,605	cf
Volume of Forebay below Normal Pool=	4,576	cf
Total Volume Below Normal Pool =	29,181	cf
Total Volume Above Normal Pool=	96,034	cf
Total Volume of Facility =	125,215	cf

FOREBAY PERCENTAGE OF PERMANENT POOL VOLUME

Per NCDEQ Minimum Design Criteria, the forebay volume should equal approximately 15-20% of the main pool volume.

Total Main Pool Volume =	24,605	cf
Provided Forebay Volume =	4,576	cf
Provided Forebay Volume % =	19%	

AVERAGE DEPTH OF MAIN POOL

Main Pool Volume at Normal Pool =	24,605	cf
Main Pool Area at Normal Pool =	7,150	sf
Average Depth =	3.44	ft

STORMWATER CONTROL MEASURE O

Surface Area Calculation

WET DETENTION BASIN SUMMARY

Enter the drainage area characteristics ==>

Total drainage area to pond =	8.32	acres
Total impervious area to pond =	3.60	acres

Note The basin must be sized to treat all impervious surface runoff draining into the pond, not just the impervious surface from on-site development.

Drainage area = **8.32** acres @ **43.2%** impervious

Estimate the surface area required at pond normal pool elevation ==>

Wet Detention Basins are based on an minimum average depth of = 3.44 feet ***(Calculated)***

		3.0	3.44	4.0
Lower Boundary =>	40.0	1.51		1.24
Site % impervious =>	43.2	1.60	***1.48***	1.33
Upper Boundary =>	50.0	1.79		1.51

Therefore, SA/DA required = ***1.48***

Surface area required for main pool at normal pool =	5,365	ft^2
=	0.12	acres
Surface area provided for main pool at normal pool =	7,150	ft^2

STORMWATER CONTROL MEASURE O

WQV Calculation

DETERMINATION OF WATER QUALITY VOLUME

$WQ_V = (P)(R_V)(A)/12$

where,

WQ_V = water quality volume (in acre-ft)

R_V = 0.05+0.009(I) where I is percent impervious cover

A = area in acres

P = rainfall (in inches)

Input data:

Total area, A =	8.32	acres
Impervious area =	3.60	acres
Percent impervious cover, I =	43.2	%
Rainfall, P =	1.00	inches

Calculated values:

R_V =	0.44	
WQ_V =	0.30	acre-ft
=	13264	cf.

ASSOCIATED DEPTH IN POND

WQ_V =	13264	cf.

Stage / Storage Data:

Ks =	12054	
b =	1.136	
Zo =	357.00	
Volume in 1" rainfall =	13264	cf.

Calculated values:

Depth of WQv in Basin =	1.09	ft
=	13.05	inches
Elevation =	358.09	ft

STORMWATER CONTROL MEASURE O

WQV Drawdown Calculation

DRAWDOWN ORIFICE DESIGN

D orifice =	1.75	inch
# orifices =	1	
Ks =	12054	
b =	1.1361	
C_d orifice =	0.60	
Normal Pool Elevation =	357.00	feet
Volume @ Normal Pool =	0	cf
Orifice Invert =	357.00	feet
WSEL @ 1" Runoff Volume =	358.09	feet

WSEL (feet)	Vol. Stored (cf)	Orifice Flow (cfs)	Avg. Flow (cfs)	Incr. Vol. (cf)	Incr. Time (sec)
358.09	13264	0.081			
357.99	11964	0.077	0.079	1300	16469
357.90	10680	0.073	0.075	1284	17114
357.80	9415	0.069	0.071	1265	17866
357.71	8169	0.064	0.066	1245	18759
357.62	6946	0.059	0.062	1223	19846
357.52	5749	0.054	0.056	1198	21213
357.43	4581	0.048	0.051	1168	23015
357.33	3447	0.041	0.044	1133	25568
357.24	2357	0.033	0.037	1090	29655
357.14	1326	0.021	0.027	1031	38323

Drawdown Time =	2.64	days

By comparison, if calculated by the average head over the orifice
(assuming average head is one-third the total depth), the result would be:

Average driving head on orifice =	0.338	feet
Orifice composite loss coefficient =	0.600	
Cross-sectional area of siphon =	0.017	sf
Q =	0.0468	cfs

Drawdown Time = Volume / Flowrate / 86400 (sec/day)

Drawdown Time =	3.28	days

STORMWATER CONTROL MEASURE O
Anti-Flotation Block Calculations

RISER ANTI-FLOTATION CALCULATION

Input Data ==>

Safety Factor:

Safety factor to use =	1.15	(recommend 1.15 or higher)

Concrete:

Concrete unit weight =	142.0	PCF	**Note:** NC Products lists unit wt. of manhole concrete at 142 PCF.

Riser:

Inside height of Riser =	5.00	feet
Inside length of riser =	4.00	feet
Inside width of riser =	4.00	feet
Wall thickness of riser =	6.00	inches
Base thickness of riser =	6.00	inches
Base length of riser =	5.00	feet
Base width of riser =	5.00	feet

Openings:

Total Orifice Area =	1.517	SF
OD of barrel exiting manhole =	30.00	inches
Size of drain pipe (if present) =	6.0	inches

Trash Rack:

Bottom Length =	7.00	feet
Bottom Width =	7.00	feet
Top Length =	1.00	feet
Top Width =	1.00	feet
Height =	2.00	feet
Trash Rack water displacement =	38.00	CF

Concrete Present in Riser Structure ==>

Total amount of concrete:

Base of Riser =	12.50	CF
Riser Walls =	45.00	CF

Adjust for openings:

Opening for Orifices =	0.76	CF
Opening for barrel =	2.45	CF
Opening for drain pipe =	0.10	CF

Total Concrete present, adjusted for openings =	***54.189***	***CF***
Weight of concrete present =	***7,695***	***lbs***

STORMWATER CONTROL MEASURE O

Anti-Flotation Block Calculations

Amount of water displaced by Riser Structure ==>

Displacement by concrete =	54.19	CF
Displacement by open air in riser =	80.00	CF
Displacement by trash rack =	38.00	CF
Total water displaced by riser/barrel structure =	***172.19***	***CF***
Weight of water displaced =	***10,745***	***lbs***

Calculate size of base for riser assembly ==>

Length =	8.00	feet
Width =	8.00	feet
Thickness =	12	inches
Concrete Present =	64.00	CF

Check validity of base as designed ==>

Total Water Displaced =	223.69	CF
Total Concrete Present =	118.19	CF
Total Water Displaced =	13,958	lbs
Total Concrete Present =	16,783	lbs
Actual safety factor =	*1.20*	OK

Results of design ==>

Base length =	**8.00**	**feet**
Base width =	**8.00**	**feet**
Base Thickness =	**12.00**	**inches**
CY of concrete total in base =	**2.37**	**CY**
Concrete unit weight in added base >=	**142.0**	**PCF**

STORMWATER CONTROL MEASURE O
Anti-Flotation Block Calculations

II. CALCULATION FOR RISER ANTI-FLOTATION STEEL

Input Data ==>

Anti-Floatation Block Length =	8.0	feet
Anti-Floatation Block Width =	8.0	feet
Anti-Floatation Block Thickness =	12	inches
A_{steel} to $A_{concrete}$ Ratio =	0.0020	(recommend 0.0018 or higher)

Cross-Section Calculations==>

Cross-Section Area* =	8.00	SF
Minimum Steel Area Required =	0.016	SF
	2.30	SI

**Note: Assumes a "square" x-sec (L and W same)*

Rebar Calculations ==>

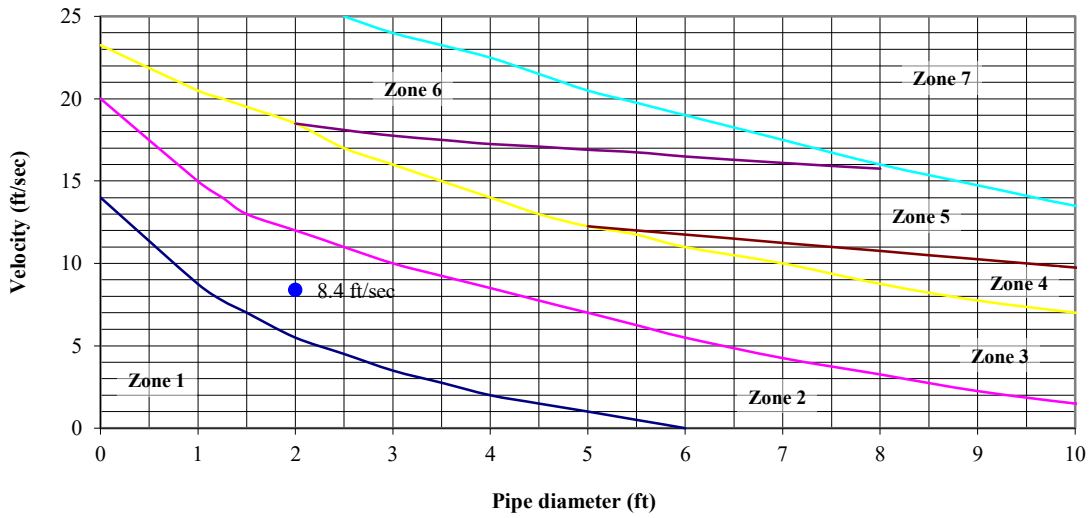
Bar Size	4	5	6	7	8
Diameter (inches)	0.500	0.625	0.750	0.875	1.000
X-Sec Area (SI)	0.196	0.307	0.442	0.601	0.785
Minimum Number of Bars	12	8	6	4	3

DESIGN OF RIPRAP OUTLET PROTECTION WORKSHEET

Project	The Point North	Date	10/27/2022
Project No.	AWH-20000	Designer	SDD
Outlet ID	SCM O		

Flow, $Q_{10\text{-}yr}$	9.8	cfs
Slope, S	1.67	%
Pipe Diameter, D_o	24	inches
Pipe Diameter, D_o	2.0	feet
Number of pipes	1	
Pipe separation	0	feet
Manning's n	0.013	

Figure 8.06.b.1



Zone from graph above = 2

Outlet pipe diameter	24 in.	Length =	12.0 ft.
Outlet flowrate	9.8 cfs	Width =	6.0 ft.
Outlet velocity	8.4 ft/sec	Stone diameter =	6 in.
Material =	Class B	Thickness =	22 in.

Zone	Material	Diameter	Thickness	Length	Width
1	Class A	3	9	4 x D(o)	3 x D(o)
2	Class B	6	22	6 x D(o)	3 x D(o)
3	Class I	13	22	8 x D(o)	3 x D(o)
4	Class I	13	22	8 x D(o)	3 x D(o)
5	Class II	23	27	10 x D(o)	3 x D(o)
6	Class II	23	27	10 x D(o)	3 x D(o)
7	Special study required				

1. Calculations based on NY DOT method - Pages 8.06.05 through 8.06.06 in NC Erosion Control Manual
2. Outlet velocity based on full-flow velocity

MCADAMS

SCM O Output

Subsection: Elevation-Area Volume Curve
Label: SCM O
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Elevation (ft)	Planimeter (ft²)	Area (ft²)	A1+A2+sqr (A1*A2) (ft²)	Volume (ac-ft)	Volume (Total) (ac-ft)
357.00	0.0	9,592	0	0.000	0.000
357.25	0.0	11,204	31,163	0.060	0.060
359.00	0.0	14,160	37,960	0.508	0.568
362.00	0.0	19,631	50,464	1.158	1.726
363.00	0.0	21,568	61,776	0.473	2.199

MCADAMS

SCM O Output

Subsection: Outlet Input Data
Label: SCM O
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Requested Pond Water Surface Elevations	
Minimum (Headwater)	357.00 ft
Increment (Headwater)	0.10 ft
Maximum (Headwater)	363.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Rectangular Weir	Weir	Forward	Culvert	358.50	359.00
Orifice-Area	Orifice	Forward	Culvert	359.00	363.00
Inlet Box	Riser	Forward	Culvert	361.00	363.00
Orifice-Circular	WQ Orifice	Forward	Culvert	357.00	363.00
Culvert-Circular	Culvert	Forward	TW	356.00	363.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

MCADAMS

SCM O Output

Subsection: Outlet Input Data
Label: SCM O
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Structure ID: Culvert Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	24.00 in
Length	60.00 ft
Length (Computed Barrel)	60.01 ft
Slope (Computed)	0.017 ft/ft

Outlet Control Data	
Manning's n	0.013
Ke	1
Kb	0
Kr	1
Convergence Tolerance	0.00 ft

Inlet Control Data	
Equation Form	Form 1
K	0.0098
M	2.0000
C	0.0398
Y	0.6700
T1 ratio (HW/D)	1
T2 ratio (HW/D)	1
Slope Correction Factor	-1

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	358.30 ft	T1 Flow	15.55 ft^3/s
T2 Elevation	358.60 ft	T2 Flow	17.77 ft^3/s

MCADAMS

SCM O Output

Subsection: Outlet Input Data
Label: SCM O
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Structure ID: Riser Structure Type: Inlet Box	
Number of Openings	1
Elevation	361.00 ft
Orifice Area	16.0 ft²
Orifice Coefficient	1
Weir Length	16.00 ft
Weir Coefficient	3.00 (ft^0.5)/s
K Reverse	1
Manning's n	0
Kev, Charged Riser	0
Weir Submergence	False
Orifice H to crest	False

Structure ID: WQ Orifice Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	357.00 ft
Orifice Diameter	1.75 in
Orifice Coefficient	1

Structure ID: Orifice Structure Type: Orifice-Area	
Number of Openings	3
Elevation	358.50 ft
Orifice Area	0.5 ft²
Top Elevation	359.00 ft
Datum Elevation	358.75 ft
Orifice Coefficient	1

Structure ID: Weir Structure Type: Rectangular Weir	
Number of Openings	1
Elevation	358.50 ft
Weir Length	3.00 ft
Weir Coefficient	3.00 (ft^0.5)/s

Structure ID: TW Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall

Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft

MCADAMS

SCM O Output

Subsection: Outlet Input Data
Label: SCM O
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Convergence Tolerances	
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft^3/s
Flow Tolerance (Maximum)	10.000 ft^3/s

MCADAMS

SCM O Output

Subsection: Composite Rating Curve
Label: SCM O
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
357.00	0.00	(N/A)	0.00	(no Q: Weir,Orifice,Riser,WQ Orifice,Culvert)
357.10	0.01	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
357.20	0.03	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
357.30	0.04	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
357.40	0.05	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
357.50	0.05	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
357.60	0.06	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
357.70	0.06	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
357.80	0.07	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
357.90	0.07	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
358.00	0.08	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
358.10	0.08	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
358.20	0.09	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
358.30	0.09	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
358.40	0.09	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
358.50	0.10	(N/A)	0.00	WQ Orifice,Culvert (no Q: Weir,Orifice,Riser)
358.60	0.38	(N/A)	0.00	Weir,WQ Orifice,Culvert (no Q: Orifice,Riser)
358.70	0.90	(N/A)	0.00	Weir,WQ Orifice,Culvert (no Q: Orifice,Riser)
358.80	1.55	(N/A)	0.00	Weir,WQ Orifice,Culvert (no Q: Orifice,Riser)
358.90	2.33	(N/A)	0.00	Weir,WQ Orifice,Culvert (no Q: Orifice,Riser)
359.00	3.72	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
359.10	4.39	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
359.20	4.95	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
359.30	5.46	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
359.40	5.94	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)

MCADAMS

SCM O Output

Subsection: Composite Rating Curve
Label: SCM O
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
359.50	6.37	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
359.60	6.77	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
359.70	7.15	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
359.80	7.51	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
359.90	7.86	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
360.00	8.19	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
360.10	8.52	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
360.20	8.82	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
360.30	9.12	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
360.40	9.40	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
360.50	9.68	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
360.60	9.96	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
360.70	10.21	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
360.80	10.47	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
360.90	10.73	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
361.00	10.96	(N/A)	0.00	Orifice,WQ Orifice,Culvert (no Q: Weir,Riser)
361.10	12.72	(N/A)	0.00	Orifice,Riser,WQ Orifice,Culvert (no Q: Weir)
361.20	15.72	(N/A)	0.00	Orifice,Riser,WQ Orifice,Culvert (no Q: Weir)
361.30	19.34	(N/A)	0.00	Orifice,Riser,WQ Orifice,Culvert (no Q: Weir)
361.40	22.53	(N/A)	0.00	Orifice,Riser,WQ Orifice,Culvert (no Q: Weir)
361.50	25.87	(N/A)	0.00	Orifice,Riser,WQ Orifice,Culvert (no Q: Weir)
361.60	29.10	(N/A)	0.00	Orifice,Riser,WQ Orifice,Culvert (no Q: Weir)

MCADAMS

SCM O Output

Subsection: Composite Rating Curve
Label: SCM O
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
361.70	31.90	(N/A)	0.00	Orifice,Riser,WQ Orifice,Culvert (no Q: Weir)
361.80	33.32	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
361.90	33.69	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
362.00	34.06	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
362.10	34.42	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
362.20	34.77	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
362.30	35.13	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
362.40	35.48	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
362.50	35.83	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
362.60	36.17	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
362.70	36.51	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
362.80	36.85	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
362.90	37.19	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)
363.00	37.52	(N/A)	0.00	Riser,Culvert (no Q: Weir,Orifice,WQ Orifice)

MCADAMS

SCM O Output

Subsection: Level Pool Pond Routing Summary
Label: SCM O (IN)
Scenario: Post-Dev 1-yr

Return Event: 1 years
Storm Event: 1 yr

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	357.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	24.20 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	3.88 ft³/s	Time to Peak (Flow, Outlet)	753.00 min

Elevation (Water Surface, Peak)	359.02 ft
Volume (Peak)	0.576 ac-ft

Mass Balance (ac-ft)	
Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	1.121 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	0.746 ac-ft
Volume (Retained)	0.375 ac-ft
Volume (Unrouted)	0.000 ac-ft
Error (Mass Balance)	0.0 %

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SCM O Output

Subsection: Level Pool Pond Routing Summary
Label: SCM O (IN)
Scenario: Post-Dev 10-yr

Return Event: 10 years
Storm Event: 10 yr

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	357.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	45.22 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	9.77 ft³/s	Time to Peak (Flow, Outlet)	752.00 min

Elevation (Water Surface, Peak)	360.53 ft
Volume (Peak)	1.113 ac-ft

Mass Balance (ac-ft)	
Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	2.511 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	2.131 ac-ft
Volume (Retained)	0.381 ac-ft
Volume (Unrouted)	0.000 ac-ft
Error (Mass Balance)	0.0 %

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SCM O Output

Subsection: Level Pool Pond Routing Summary
Label: SCM O (IN)
Scenario: Post-Dev 25-yr

Return Event: 25 years
Storm Event: 25 yr

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	357.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	52.44 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	12.64 ft³/s	Time to Peak (Flow, Outlet)	751.00 min

Elevation (Water Surface, Peak)	361.10 ft
Volume (Peak)	1.337 ac-ft

Mass Balance (ac-ft)	
Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	3.144 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	2.762 ac-ft
Volume (Retained)	0.381 ac-ft
Volume (Unrouted)	0.000 ac-ft
Error (Mass Balance)	0.0 %

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SCM O Output

Subsection: Level Pool Pond Routing Summary
Label: SCM O (IN)
Scenario: Post-Dev 100-yr

Return Event: 100 years
Storm Event: 100 yr

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	357.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	62.83 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	25.40 ft³/s	Time to Peak (Flow, Outlet)	729.00 min

Elevation (Water Surface, Peak)	361.49 ft
Volume (Peak)	1.501 ac-ft

Mass Balance (ac-ft)	
Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	4.200 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	3.818 ac-ft
Volume (Retained)	0.381 ac-ft
Volume (Unrouted)	0.000 ac-ft
Error (Mass Balance)	0.0 %

CULVERT DESIGN CALCULATIONS

THE POINT
AWH-20000

SUMMARY OF RESULTS
GENOVESA DRIVE

CULVERT DESIGN CALCULATIONS

Peak Flows Used for Culvert Sizing:

Q10, Peak =	200.55	cfs
Q25, Peak =	243.03	cfs
Q100, Peak =	307.60	cfs

Culvert 1 (Main Channel) Specifications:

Number of Barrels =	1	
Culvert Diameter =	72	in
US Pipe Invert =	347.00	ft
DS Pipe Invert =	344.92	ft
Pipe Length =	80.00	ft
Embedment =	1.00	ft
Slope =	0.0260	ft/ft

Culvert 2 (Left Floodplain) Specifications:

Number of Barrels =	1	
Culvert Diameter =	15	in
US Pipe Invert =	351.34	ft
DS Pipe Invert =	347.77	ft
Pipe Length =	80.00	ft
Embedment =	0.00	ft
Slope =	0.0446	ft/ft

Culvert 3 (Right Floodplain) Specifications:

Number of Barrels =	1	
Culvert Diameter =	15	in
US Pipe Invert =	349.50	ft
DS Pipe Invert =	349.00	ft
Pipe Length =	80.00	ft
Embedment =	0.00	ft
Slope =	0.0063	ft/ft

Combined Culvert System Routing:

25-Year Storm

Headwater Elevation =	354.64	ft
Hw/D =	1.3	
Road Crest Elevation =	375.00	ft
Freeboard =	20.36	ft

100-Year Storm

Headwater Elevation =	356.97	ft
Hw/D =	1.8	
Road Crest Elevation =	375.00	ft
Freeboard =	18.03	ft

Velocity Dissipator Specifications:

Length =	26.50	ft
Width =	23.00	ft
Thickness=	27.00	in
Classification=	I	

CURVE NUMBER CALCULATIONS

Land Use	HSG	CN	Area (ac)	Percent Impervious (%)	Impervious Area (ac)
Open	C	74	0.11	0	0.00
Open	D	80	1.23	0	0.00
Wooded	C	70	0.00	0	0.00
Wooded	D	77	0.94	0	0.00
Sidewalk	C	98	0.00	100	0.00
Sidewalk	D	98	0.00	100	0.00
Mixed Use Neighborhood	C	90	0.00	65	0.00
Mixed Use Neighborhood	D	92	0.00	65	0.00
High Density Residential	C	82	3.90	30	1.17
High Density Residential	D	86	2.80	30	0.84
Low Density Residential	C	79	6.40	20	1.28
Low Density Residential	D	84	20.98	20	4.20

Total Area	**36.37**	**ac**
Total Impervious Area	**7.49**	**ac**
Percent Impervious	**21**	**%**
Composite Curve Number	**83**	

TIME OF CONCENTRATION

Time of concentration is calculated using the SCS Segmental Approach (TR-55).

Segment 1: Overland Flow

Length =	100	ft
Top Elev =	428.00	ft
Bot Elev =	425.75	ft
Height =	2.25	ft
Slope =	0.0225	ft/ft
Manning's n =	0.24	dense grasses
P (2-year/24-hour) =	3.46	inches (Rolesville, NC)
Segment Time =	***13.09***	***minutes***

Segment 2: Concentrated Flow

Length =	2272	ft
Top Elev =	425.75	ft
Bot Elev =	388.50	ft
Height =	37	ft
Slope =	0.0164	ft/ft
Paved ? =	No	
Velocity =	2.07	ft/sec
Segment Time =	***18.33***	***minutes***

Segment 4: Channel Flow

Length =	1254	ft
Top Elev =	388.50	ft
Bot Elev =	350.00	ft
Height =	38.5	ft
Slope =	0.0307	ft/ft
Manning's n =	0.045	natural channel
Flow Area =	12.00	sf (assume 6'w x 2'h channel)
Wetted Perimeter =	10.00	lf (assume 6'w x 2'h channel)
Channel Velocity =	6.55	ft/sec
Segment Time =	***3.19***	***minutes***

Time of Concentration =	34.61	minutes
SCS Lag Time =	20.77	minutes (SCS Lag = 0.6* Tc)
Time Increment =	6.02	minutes (= 0.29*SCS Lag)

CURVE NUMBER CALCULATIONS

Land Use	HSG	CN	Area (ac)	Percent Impervious (%)	Impervious Area (ac)
Open	C	74	1.25	0	0.00
Open	D	80	0.61	0	0.00
Wooded	C	70	0.45	0	0.00
Wooded	D	77	1.75	0	0.00
Sidewalk	C	98	0.14	100	0.14
Sidewalk	D	98	0.07	100	0.07
Mixed Use Neighborhood	C	90	2.20	65	1.43
Mixed Use Neighborhood	D	92	7.86	65	5.11
High Density Residential	C	82	0.00	30	0.00
High Density Residential	D	86	0.00	30	0.00
Low Density Residential	C	79	5.41	20	1.08
Low Density Residential	D	84	34.51	20	6.90

Total Area	**54.26**	**ac**
Total Impervious Area	**14.73**	**ac**
Percent Impervious	**27**	**%**
Composite Curve Number	**84**	

TIME OF CONCENTRATION

Time of concentration is calculated using the SCS Segmental Approach (TR-55).

Segment 1: Overland Flow

Length =	100	ft
Top Elev =	427.00	ft
Bot Elev =	426.00	ft
Height =	1	ft
Slope =	0.0100	ft/ft
Manning's n =	0.17	cultivated soils, residue cover
P (2-year/24-hour) =	3.46	inches (Rolesville, NC)
Segment Time =	***13.74***	***minutes***

Segment 2: Concentrated Flow

Length =	2541	ft
Top Elev =	426.00	ft
Bot Elev =	368.00	ft
Height =	58	ft
Slope =	0.0228	ft/ft
Paved ? =	No	
Velocity =	2.44	ft/sec
Segment Time =	***17.37***	***minutes***

Time of Concentration =	31.12	minutes
SCS Lag Time =	18.67	minutes (SCS Lag = 0.6* Tc)
Time Increment =	5.41	minutes (= 0.29*SCS Lag)

REACH DATA

Reach #1

Time of concentration is calculated using the SCS Segmental Approach (TR-55).

Segment 1: Channel Flow (Culvert)

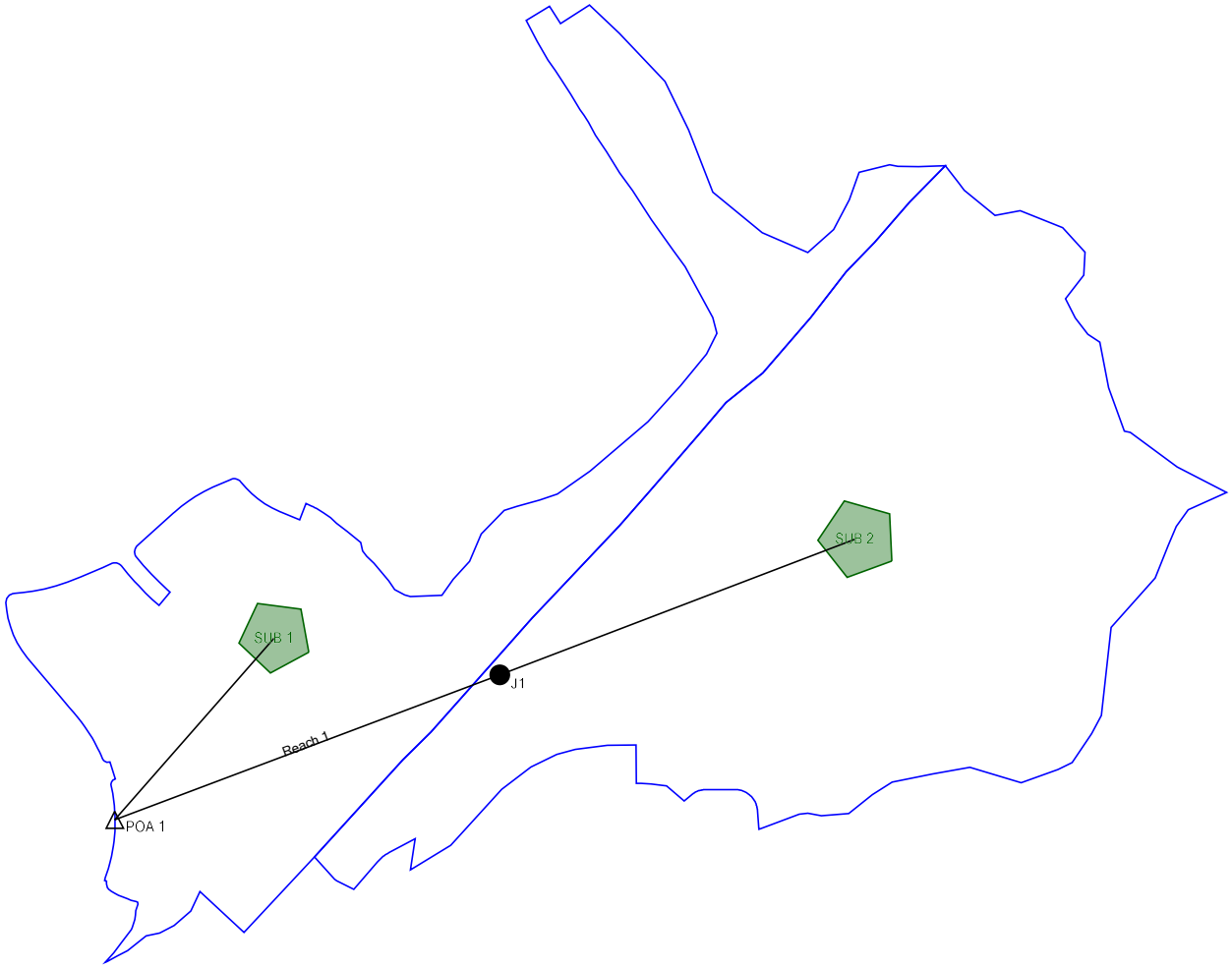
Length =	386	ft
Top Elev =	367.00	ft
Bot Elev =	357.00	ft
Height =	10	ft
Slope =	0.0259	ft/ft
Manning's n =	0.013	concrete culvert
Flow Area =	20.00	sf (assume 10'w x 10'h box culvert flowing 2 ft depth)
Wetted Perimeter =	14.00	lf (assume 10'w x 10'h box culvert flowing 2 ft depth)
Channel Velocity =	23.39	ft/sec
Segment Time =	***0.28***	***minutes***

Segment 4: Channel Flow

Length =	1254	ft
Top Elev =	357.00	ft
Bot Elev =	350.00	ft
Height =	7	ft
Slope =	0.0056	ft/ft
Manning's n =	0.045	natural channel
Flow Area =	12.00	sf (assume 6'w x 2'h channel)
Wetted Perimeter =	10.00	lf (assume 6'w x 2'h channel)
Channel Velocity =	2.79	ft/sec
Segment Time =	***7.48***	***minutes***

Time of Concentration =	7.76	minutes
SCS Lag Time =	4.66	minutes (SCS Lag = 0.6* Tc)
Time Increment =	1.35	minutes (= 0.29*SCS Lag)

Scenario: Culvert
Hydrology



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FlexTable: Catchment Table (AWH20000-CulvertHydro.ppc)

Current Time: 0.00 min

Label	Outflow Node	Area (ft²)	SCS CN	Time of Concentration (min)	Notes
SUB 2	J1	1,584,372	84	31.12	POST
SUB 1	POA 1	2,363,457	83	34.17	POST

MCADAMS

Post Culvert Master Summary

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (min)	Peak Flow (ft^3/s)
SUB 2	Post- 10yr	10	9.997	739.00	85.74
SUB 2	Post- 25yr	25	12.683	738.00	103.34
SUB 2	Post- 100yr	100	17.217	738.00	129.83
SUB 1	Post- 10yr	10	14.466	739.00	117.61
SUB 1	Post- 25yr	25	18.433	739.00	142.97
SUB 1	Post- 100yr	100	25.148	738.00	181.54

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (min)	Peak Flow (ft^3/s)
POA 1	Post- 10yr	10	24.437	743.00	200.55
POA 1	Post- 25yr	25	31.086	743.00	243.03
POA 1	Post- 100yr	100	42.334	743.00	307.60
J1	Post- 10yr	10	9.997	739.00	85.74
J1	Post- 25yr	25	12.683	738.00	103.34
J1	Post- 100yr	100	17.217	738.00	129.83

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 200.55 cfs

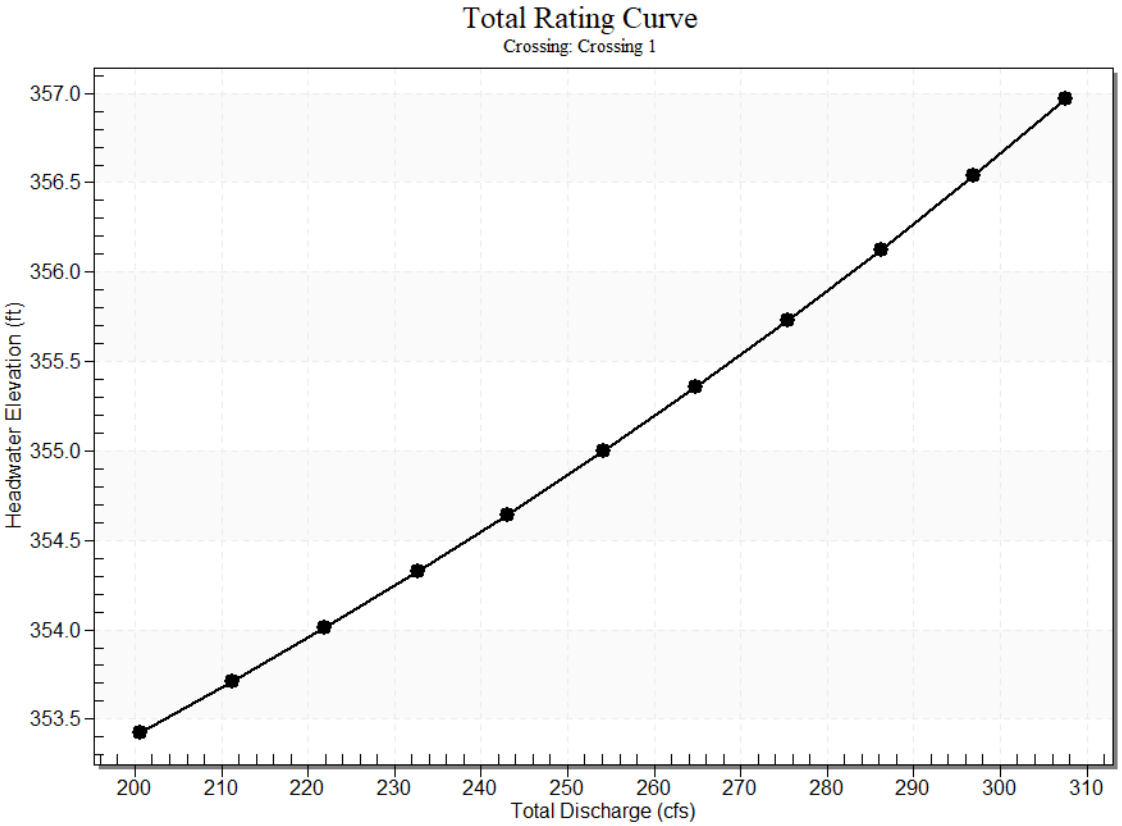
Design Flow: 243.03 cfs

Maximum Flow: 307.60 cfs

Table 1 - Summary of Culvert Flows at Crossing: Crossing 1

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Floodplain Left Discharge (cfs)	Floodplain Right Discharge (cfs)	Roadway Discharge (cfs)	Iterations
353.43	200.55	183.96	6.98	9.63	0.00	7
353.71	211.26	193.49	7.73	10.05	0.00	3
354.01	221.96	203.08	8.42	10.47	0.00	3
354.33	232.67	212.71	9.10	10.87	0.00	3
354.64	243.03	222.04	9.73	11.28	0.00	3
355.00	254.08	231.96	10.39	11.72	0.00	3
355.36	264.78	241.62	11.00	12.16	0.00	4
355.73	275.49	251.30	11.59	12.60	0.00	3
356.13	286.19	260.97	12.18	13.05	0.00	3
356.54	296.90	270.64	12.77	13.49	0.00	3
356.97	307.60	280.30	13.36	13.95	0.00	3
375.00	589.91	536.12	27.02	26.77	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing 1



Culvert Data: Culvert 1

Table 1 - Culvert Summary Table: Culvert 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
200.55 cfs	183.96 cfs	353.43	6.34	3.336	5-S2n	2.07	3.64	2.49	1.91	16.10	5.44
211.26 cfs	193.49 cfs	353.71	6.63	3.532	5-S2n	2.13	3.74	2.57	1.95	16.27	5.51
221.96 cfs	203.08 cfs	354.01	6.93	3.731	5-S2n	2.18	3.84	2.64	1.98	16.44	5.61
232.67 cfs	212.71 cfs	354.33	7.24	3.938	5-S2n	2.24	3.93	2.72	2.01	16.60	5.70

243.03 cfs	222.04 cfs	354.64	7.56	4.145	5-S2n	2.29	4.02	2.79	2.04	16.75	5.79
254.08 cfs	231.96 cfs	355.00	7.91	4.397	5-S2n	2.35	4.11	2.87	2.07	16.92	5.88
264.78 cfs	241.62 cfs	355.36	8.27	4.685	5-S2n	2.41	4.20	2.94	2.10	17.08	5.97
275.49 cfs	251.30 cfs	355.73	8.65	4.981	5-S2n	2.46	4.28	3.02	2.13	17.23	6.05
286.19 cfs	260.97 cfs	356.13	9.04	5.283	5-S2n	2.51	4.37	3.09	2.16	17.39	6.13
296.90 cfs	270.64 cfs	356.54	9.45	6.325	5-S2n	2.57	4.45	3.16	2.18	17.54	6.21
307.60 cfs	280.30 cfs	356.97	9.88	6.597	5-S2n	2.62	4.52	3.23	2.21	17.69	6.29

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

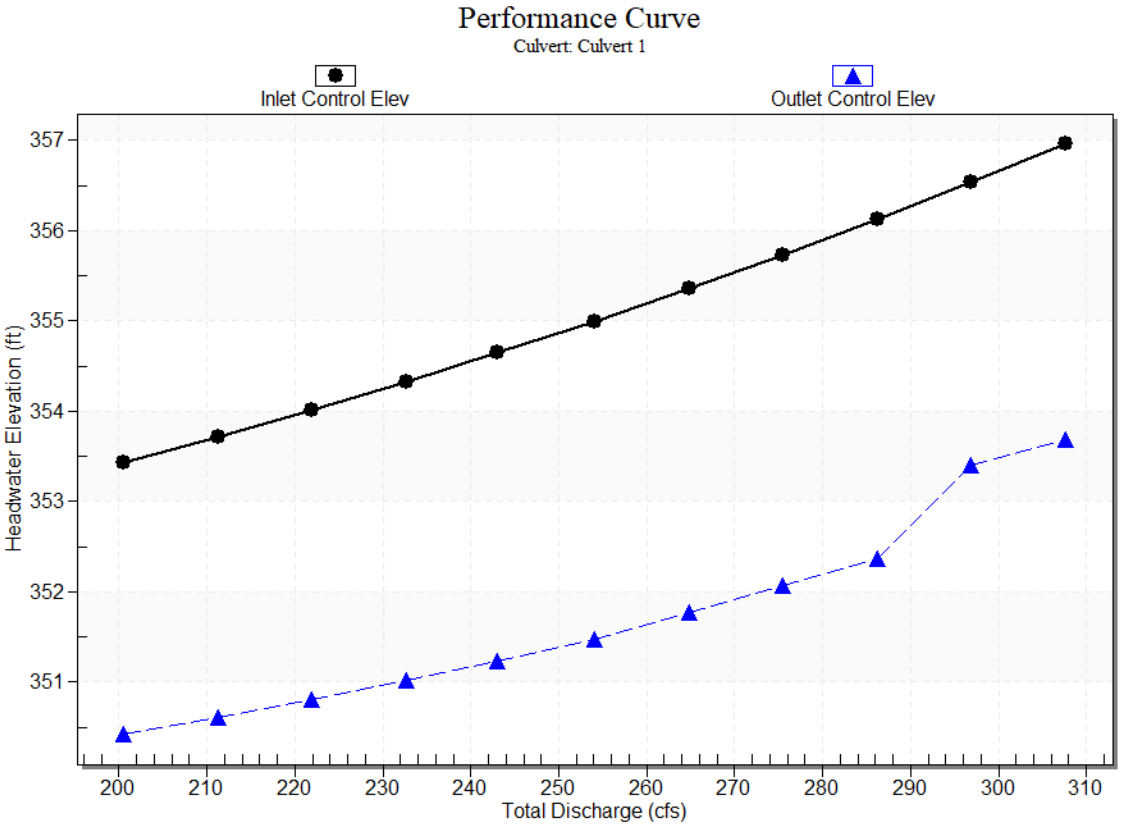
Inlet Elevation (invert): 347.08 ft,

Outlet Elevation (invert): 345.00 ft

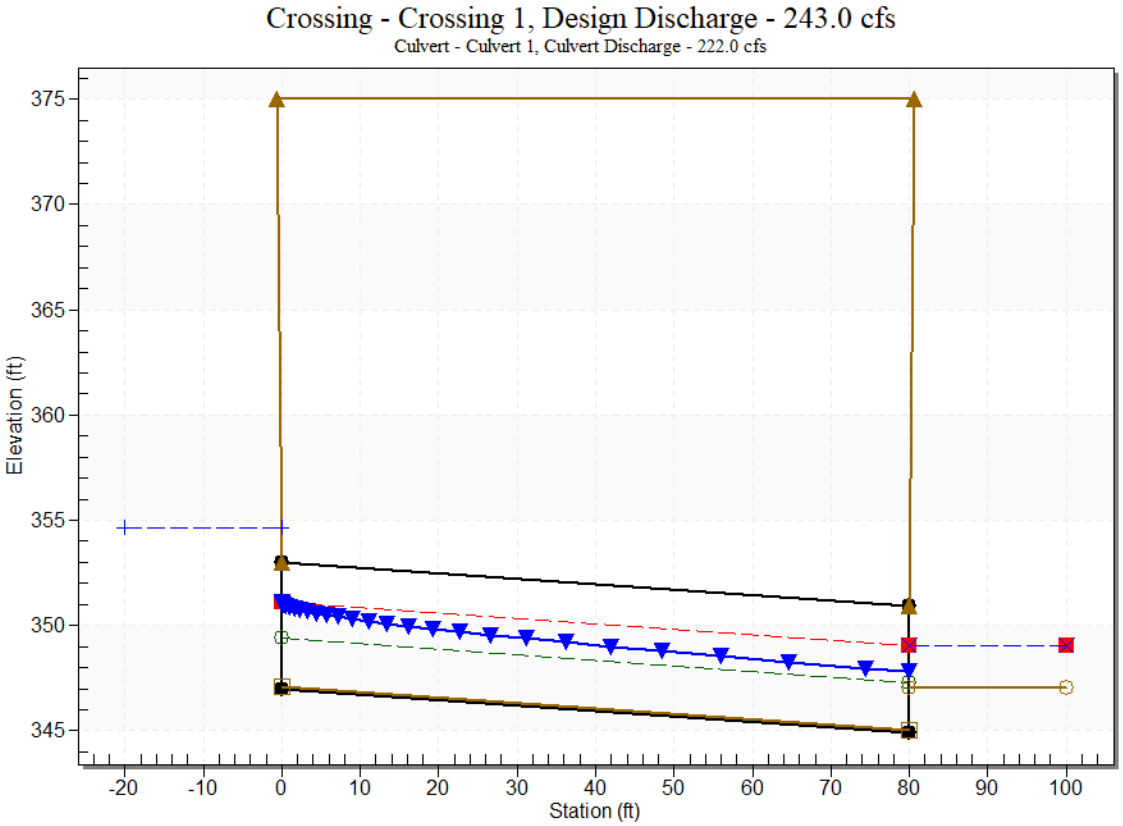
Culvert Length: 80.03 ft,

Culvert Slope: 0.0260

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 347.00 ft

Outlet Station: 80.00 ft

Outlet Elevation: 344.92 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 6.00 ft

Barrel Material: Concrete

Embedment: 1.00 in

Barrel Manning's n: 0.0130 (top and sides)

Manning's n: 0.0130 (bottom)

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Culvert Data: Floodplain Left

Table 2 - Culvert Summary Table: Floodplain Left

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
200.55 cfs	6.98 cfs	353.43	2.09	0.0*	5-S2n	0.63	1.06	0.63	1.91	11.20	5.44
211.26 cfs	7.73 cfs	353.71	2.37	0.0*	5-S2n	0.67	1.10	0.70	1.95	10.92	5.51
221.96 cfs	8.42 cfs	354.01	2.67	0.111	5-S2n	0.71	1.13	0.72	1.98	11.46	5.61
232.67 cfs	9.10 cfs	354.33	2.99	0.544	5-S2n	0.75	1.16	0.76	2.01	11.63	5.70
243.03 cfs	9.73 cfs	354.64	3.30	0.984	5-S2n	0.78	1.18	0.79	2.04	11.82	5.79
254.08 cfs	10.39 cfs	355.00	3.66	1.472	5-S2n	0.81	1.19	0.83	2.07	11.94	5.88
264.78 cfs	11.00 cfs	355.36	4.02	1.952	5-S2n	0.85	1.14	0.87	2.10	12.09	5.97
275.49 cfs	11.59 cfs	355.73	4.39	2.444	5-S2n	0.88	1.19	0.90	2.13	12.21	6.05
286.19 cfs	12.18 cfs	356.13	4.79	2.956	5-S2n	0.92	1.25	0.92	2.16	12.59	6.13
296.90 cfs	12.77 cfs	356.54	5.20	3.490	5-S2n	0.96	1.25	0.96	2.18	12.66	6.21

307.60 cfs	13.36 cfs	356.97	5.63	4.045	4-FFf	1.00	1.25	1.25	2.21	10.88	6.29

* Full Flow Headwater elevation is below inlet invert.

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

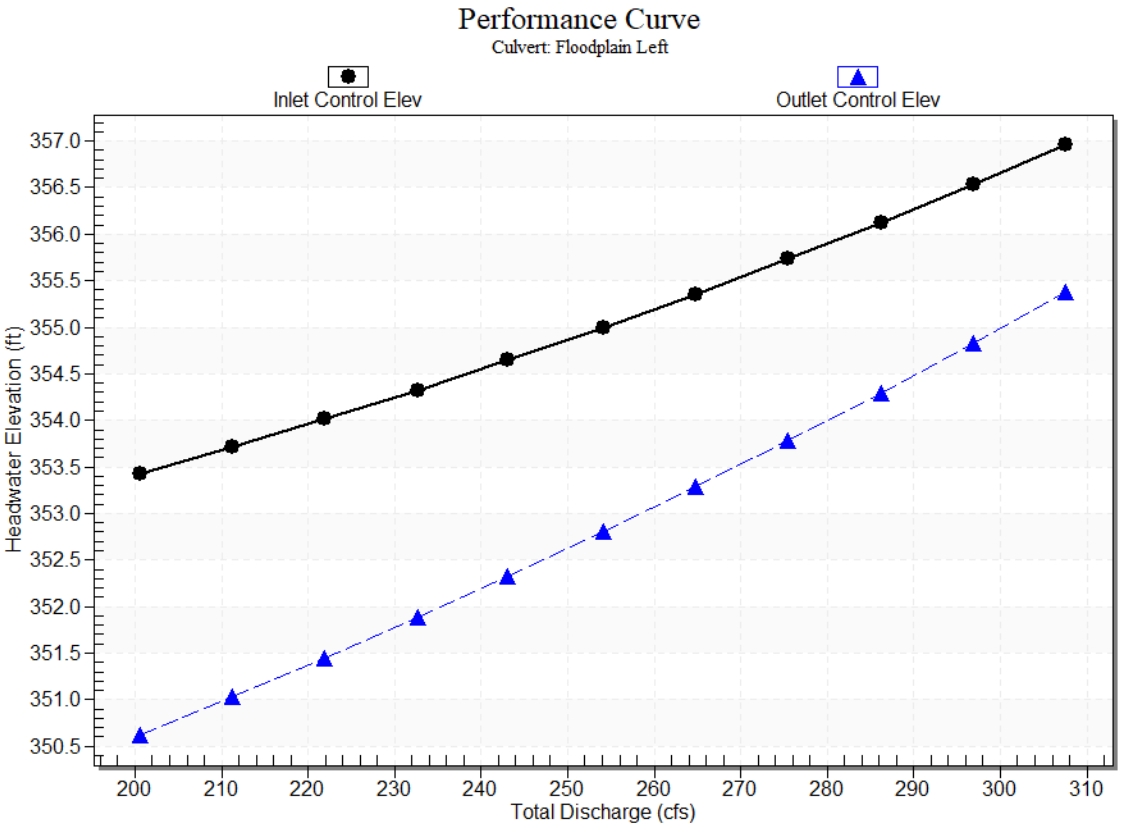
Inlet Elevation (invert): 351.34 ft,

Outlet Elevation (invert): 347.77 ft

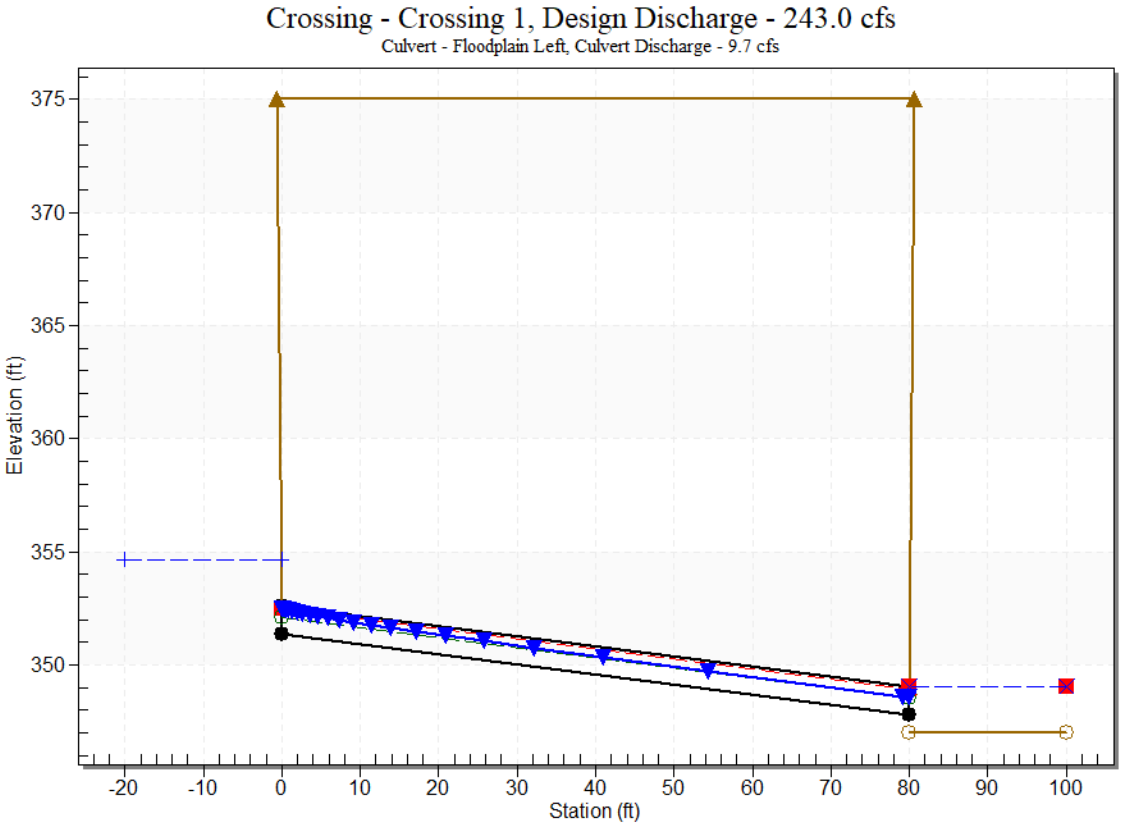
Culvert Length: 80.08 ft,

Culvert Slope: 0.0446

Culvert Performance Curve Plot: Floodplain Left



Water Surface Profile Plot for Culvert: Floodplain Left



Site Data - Floodplain Left

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 351.34 ft

Outlet Station: 80.00 ft

Outlet Elevation: 347.77 ft

Number of Barrels: 1

Culvert Data Summary - Floodplain Left

Barrel Shape: Circular

Barrel Diameter: 1.25 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Culvert Data: Floodplain Right

Table 3 - Culvert Summary Table: Floodplain Right

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
200.55 cfs	9.63 cfs	353.43	3.28	3.925	7-M2c	1.25	1.17	1.17	1.91	8.05	5.44
211.26 cfs	10.05 cfs	353.71	3.50	4.213	7-M2c	1.25	1.18	1.18	1.95	8.35	5.51
221.96 cfs	10.47 cfs	354.01	3.73	4.513	7-M2c	1.25	1.19	1.19	1.98	8.67	5.61
232.67 cfs	10.87 cfs	354.33	3.96	4.826	7-M2c	1.25	1.15	1.15	2.01	9.21	5.70
243.03 cfs	11.28 cfs	354.64	4.22	5.144	7-M2c	1.25	1.09	1.09	2.04	9.95	5.79
254.08 cfs	11.72 cfs	355.00	4.51	5.497	6-FFc	1.25	1.25	1.25	2.07	9.55	5.88
264.78 cfs	12.16 cfs	355.36	4.80	5.856	6-FFc	1.25	1.25	1.25	2.10	9.91	5.97
275.49 cfs	12.60 cfs	355.73	5.11	6.233	6-FFc	1.25	1.25	1.25	2.13	10.27	6.05
286.19 cfs	13.05 cfs	356.13	5.43	6.626	6-FFc	1.25	1.25	1.25	2.16	10.63	6.13
296.90 cfs	13.49 cfs	356.54	5.77	7.038	6-FFc	1.25	1.25	1.25	2.18	11.00	6.21
307.60 cfs	13.95 cfs	356.97	6.12	7.467	6-FF	1.25	1.25	1.25	2.21	11.37	6.29

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

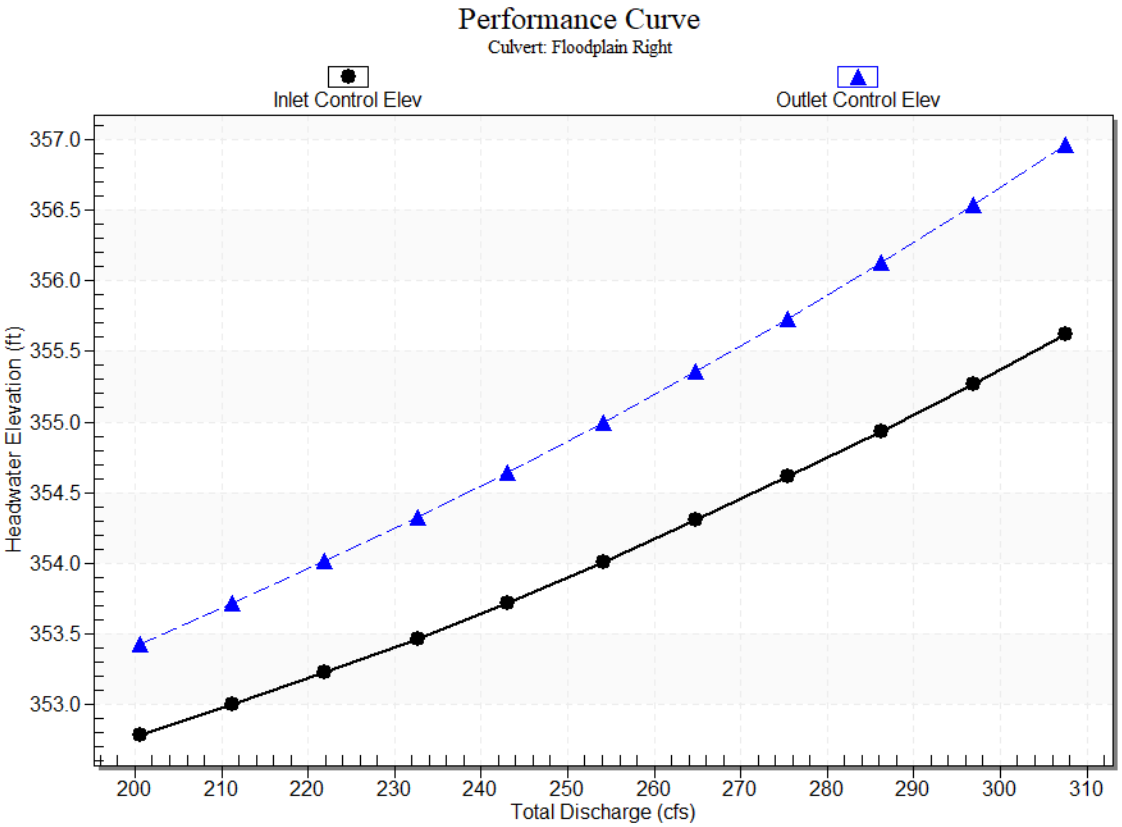
Inlet Elevation (invert): 349.50 ft,

Outlet Elevation (invert): 349.00 ft

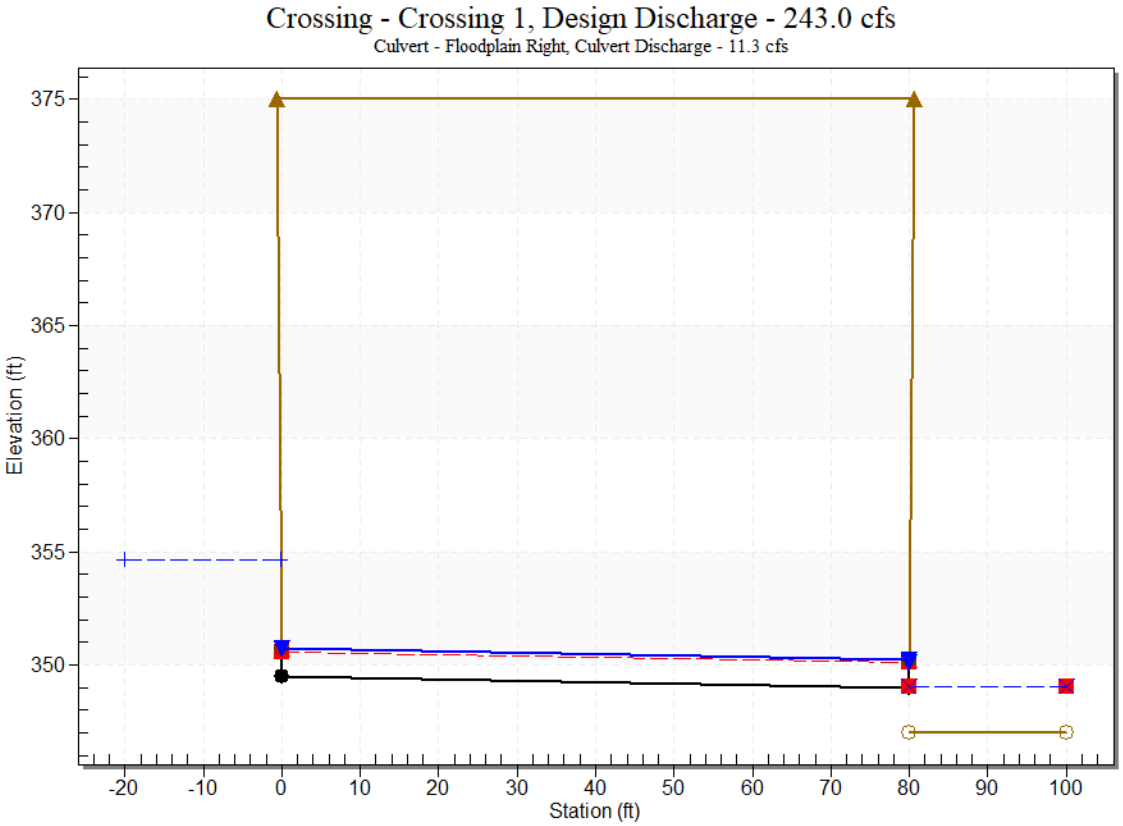
Culvert Length: 80.00 ft,

Culvert Slope: 0.0063

Culvert Performance Curve Plot: Floodplain Right



Water Surface Profile Plot for Culvert: Floodplain Right



Site Data - Floodplain Right

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 349.50 ft

Outlet Station: 80.00 ft

Outlet Elevation: 349.00 ft

Number of Barrels: 1

Culvert Data Summary - Floodplain Right

Barrel Shape: Circular

Barrel Diameter: 1.25 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: Crossing 1

Table 2 - Downstream Channel Rating Curve (Crossing: Crossing 1)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
200.55	348.93	1.91	5.44	3.47	0.98
211.26	348.97	1.95	5.51	3.53	0.98
221.96	349.00	1.98	5.61	3.59	0.99
232.67	349.03	2.01	5.70	3.65	1.00
243.03	349.06	2.04	5.79	3.70	1.00
254.08	349.09	2.07	5.88	3.75	1.01
264.78	349.12	2.10	5.97	3.80	1.02
275.49	349.14	2.13	6.05	3.86	1.02
286.19	349.17	2.16	6.13	3.90	1.03
296.90	349.20	2.18	6.21	3.95	1.04
307.60	349.22	2.21	6.29	4.00	1.04

Tailwater Channel Data - Crossing 1

Tailwater Channel Option: Irregular Channel

Channel Slope: Irregular Channel

User Defined Channel Cross-Section

Coord No.	Station (ft)	Elevation (ft)	Manning's n
1	0.00	355.38	0.0150
2	28.33	352.06	0.0450
3	56.66	347.01	0.0450
4	84.99	348.97	0.0150
5	113.31	351.94	0.0150
6	141.64	354.47	0.0000

Roadway Data for Crossing: Crossing 1

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 37.72 ft

Crest Elevation: 375.00 ft

Roadway Surface: Paved

Roadway Top Width: 81.15 ft

HY-8 Energy Dissipation Results

External Energy Dissipator

Parameter	Value	Units
Select Culvert and Flow		
Crossing	Crossing 1	
Culvert	Culvert 1	
Flow	200.55	cfs
Culvert Data		
Culvert Width (including multiple barrels)	6.0	ft
Culvert Height	6.0	ft
Outlet Depth	2.49	ft
Outlet Velocity	16.10	ft/s
Froude Number	2.04	
Tailwater Depth	1.91	ft
Tailwater Velocity	5.44	ft/s
Tailwater Slope (SO)	0.0260	
External Dissipator Data		
External Dissipator Category	Streambed Level Structures	
External Dissipator Type	Riprap Basin	
Restrictions		
Froude Number	<3	
Input Data		
Condition to be used to Compute Basin Outlet Velocity	Best Fit Curve	
D50 of the Riprap Mixture		
Note:	Minimum HS/D50 = 2 is Obtained if D50 = 0.802 ft	
D50 of the Riprap Mixture	0.825	ft
DMax of the Riprap Mixture	1.500	ft
Results		
Brink Depth	2.487	ft
Brink Velocity	16.103	ft/s
Depth (YE)	2.390	ft
Riprap Thickness	2.250	ft
Riprap Foreslope	3.0000	ft
Check HS/D50		
Note:	OK if HS/D50 > 2.0	
HS/D50	1.822	
HS/D50 Check	HS/D50 is NOT OK	
Check D50/YE		
Note:	OK if 0.1 < D50/YE < 0.7	

Check D50/YE	0.345	
D50/YE Check	D50/YE is OK	
Basin Length (LB)	25.516	ft
Basin Width	23.011	ft
Apron Length	7.516	ft
Pool Length	18.000	ft
Pool Depth (HS)	1.503	ft
TW/YE	0.801	
Tailwater Depth (TW)	1.915	ft
Average Velocity with TW	3.579	ft/s
Critical Depth (Yc)	1.212	ft
Average Velocity with Yc	5.965	ft/s
Downstream Riprap for High TW		
Distance: 1 LB		
Velocity	12.714	ft/s
Size	1.054	ft
Distance: 2 LB		
Velocity	7.300	ft/s
Size	0.347	ft
Distance: 3 LB		
Velocity	4.853	ft/s
Size	0.153	ft
Distance: 4 LB		
Velocity	3.632	ft/s
Size	0.086	ft

80 LF 72" RCP @ 2.60%
UPSTREAM INV. = 347.00'
DOWNSTREAM INV. = 344.92'
EMBEDMENT DEPTH = 1.00'

SUB 1 TO CULVERT
TOTAL AREA = 36.37 AC

POA 1

100-yr
BACKWATER ELEVATION = 356.97'

NORTH SITE

PROJECT SITE

LOUISBURG RD - ROUTE 401

REACH

SUB 2 TO CULVERT
TOTAL AREA = 54.26 AC

SOUTH SITE
(UNDER CONSTRUCTION)

ROLESVILLE RD - E. YOUNG ST

TC PATH 1

S1

S2

S3

TC PATH 2

CENTURY FARM RD

ROLESVILLE RD

GRAPHIC SCALE
0 60.5 125 250
1 inch = 125 ft.

PRELIMINARY DRAWING - NOT RELEASED FOR CONSTRUCTION

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Durham, NC 27713

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PHONE: 919. 232. 3695
CONTACT: BOB MISHLER

THE POINT
PHASES 1-10 AND 14
PRELIMINARY PLAT PLANS
EAST YOUNG STREET
TOWN OF ROLESVILLE, WAKE FOREST TOWNSHIP,
WAKE COUNTY, NORTH CAROLINA

REVISIONS

NO.	DATE	
1	04. 09. 2020	REV PER TOWN COMMENTS
2	06. 19. 2020	REV PER MUNICIPAL COMMENTS
3	08. 21. 2020	REV PER MUNICIPAL COMMENTS

PLAN INFORMATION

PROJECT NO.	AWH-20000
FILENAME	AWH-20000 POST
CHECKED BY	KEG
DRAWN BY	JDV
SCALE	1" = 125'
DATE	10.20.2022

SHEET

POST DEVELOPMENT
CULVERT HYDROLOGY MAP

POST

M:\Projects\AWH\AWH-20000\04-Production\Water Resources\Culvert Sizing\North Site\Current Drawings\AWH20000x - CULVERT.dwg, 10/20/2022 11:06:27 AM, Joshua Vinson