SPECIAL USE PERMIT APPLICATION

TOWN OF CHAPEL HILL
Planning Department
405 Martin Luther King Jr. Blvd
Chapel Hill, NC 27514
phone (919) 968-2728 *fax* (919) 969-2014
www.townofchapelhill.org

Parcel Identifier Number (PIN): 978955152B Date:

Section A: Project Information

Project Name: Chapel Hill Retirement Residence

Property Address: NE Corner of N. Estes & Somerset Drive, Chapel Hill NC Zip Code: 27514

Use Groups (A, B, and/or C): Existing Zoning District: R-1

Project Description: 3 & 4 story, Independent Senior Living / Congregate Care Failcity

Section B: Applicant, Owner and/or Contract Purchaser Information

Applicant Information (to whom correspondence will be mailed)

Name: Hawthorn Development LLC - Mark D. Lowen, Authorized Agent

Address: 3150 Kettle Court SE

City: Salem State: OR Zip Code: 97301

Phone: 503-399-1090 Email: markl@lenityarchitecture.com

The undersigned applicant hereby certifies that, to the best of his knowledge and belief, all information supplied with this application is true and accurate.

Signature: Date:

Owner/Contract Purchaser Information:

☐ **Owner** ☒ **Contract Purchaser**

Name: Hawthorn Development LLC

Address: C/O Mark Lowen, Dan Roach Architecture 3150 Kettle Ct SE

City: Salem State: OR Zip Code: 97301

Phone: 503-399-1090 Email: markl@lenityarchitecture.com

The undersigned applicant hereby certifies that, to the best of his knowledge and belief, all information supplied with this application is true and accurate.

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The undersigned applicant hereby certifies that, to the best of his knowledge and belief, all information supplied with this application is true and accurate.

Signature: Date: 4/26/16

Owner/Contract Purchaser Information:

☐ **Owner** ☒ **Contract Purchaser**

Name: Hawthorn Development LLC, a Washington limited liability company
By: Hawthorn Management Services Corp., a Washington corporation, its Manager

Address: C/O Mark Lowen, Dan Roach Architect 3150 Kettle Ct SE

City: Salem State: OR Zip Code: 97301

Phone: 503-399-1090 Email: markl@lenityarchitecture.com

The undersigned applicant hereby certifies that, to the best of his knowledge and belief, all information supplied with this application is true and accurate.

Signature: Date: 4/26/16

By: Barton G. Colson,

Revised 02.04.14

Permit Number:

PROJECT FACT SHEET

TOWN OF CHAPEL HILL
Planning Department

Section A: Project Information

Application type: SUP Date: 4/26/16

Project Name: CHAPEL HILL RETIREMENT RESIDENCE

Use Type: *(check/list all that apply)*

☐ Office/Institutional ☐ Residential ☐ Mixed-Use ☒ Other: INDEPENDENT SENIOR LIVING FACILITY ~~Senior Housing~~

Overlay District: (check all those that apply)

☐ Historic District ☐ Neighborhood Conservation District ☒ Airport Hazard Zone

Section B: Land Area

Net Land Area (NLA): Area within zoning lot boundaries		NLA=	280,439	sq. ft.
Choose one, or both, of the following (a or b,) not to exceed 10% of NLA	a) Credited Street Area (total adjacent frontage) x ½ width of public right-of-way	CSA=	—	sq. ft.
	b) Credited Permanent Open Space (total adjacent frontage) x ½ public or dedicated open space	COS=	—	sq. ft.
TOTAL: NLA + CSA and/or COS = Gross Land Area (not to exceed NLA + 10%)		GLA=	280,439	sq. ft.

Section C: Special Protection Areas, Land Disturbance, and Impervious Area

Special Protection Areas: (*check all those that apply)*

☐ Jordan Buffer ☐ Resource Conservation District ☐ 100 Year Floodplain ☐ Watershed Protection District

Land Disturbance	**Total (sq ft)**
Area of Land Disturbance (Includes: Footprint of proposed activity plus work area envelope, staging area for materials, access/equipment paths, all grading, including off-site clearing)	230,868
Area of Land Disturbance within RCD	—
Area of Land Disturbance within Jordan Buffer	—

Impervious Areas	**Existing (sq ft)**	**Demolition (sq ft)**	**Proposed (sq ft)**	**Total (sq ft)**
Impervious Surface Area (ISA)	0	0	104,544	104,544
Impervious Surface Ratio: Percent Impervious Surface Area of Gross Land Area (ISA/GLA) %	0%	0%	37.5%	37.5%
If located in Watershed Protection District, % of impervious surface on 7/1/1993	—	—	—	—

Permit Number: _____

PROJECT FACT SHEET

TOWN OF CHAPEL HILL
Planning Department

Section D: Dimensions

Dimensional Unit (sq ft)	Existing (sq ft)	Demolition (sq ft)	Proposed (sq ft)	Total (sq ft)
Number of Buildings	—	—	1(ALSO 1 GARAGE)	1
Number of Floors	—	—	3/4	3/4
Recreational Space	—	—		

Residential Space				
Dimensional Unit (sq ft)	**Existing (sq ft)**	**Demolition (sq ft)**	**Proposed (sq ft)**	**Total (sq ft)**
Floor Area (all floors – heated and unheated)	—	—	—	—
Total Square Footage of All Units	—	—	—	—
Total Square Footage of Affordable Units	—	—	—	—
Total Residential Density	—	—	—	—
Number of Dwelling Units	—	—	—	—
Number of Affordable Dwelling Units	—	—	—	—
Number of Single Bedroom Units	—	—	—	—
Number of Two Bedroom Units	—	—	—	—
Number of Three Bedroom Units	—	—	—	—

Non-Residential Space *(Gross Floor Area in Square Feet)*					
Use Type	**Existing**	**Proposed**	**Uses**	**Existing**	**Proposed**
Commercial	—	—			
Restaurant	-0-		**# of Seats**		
Government					
Institutional					
Medical					
Office					
Hotel			**# of Rooms**		
Industrial					
Place of Worship	—	—	**# of Seats**		
Other (ISLF)	—	138,673	ISLF	—	152 SUITES

Dimensional Requirements		Required by Ordinance	Existing	Proposed
Setbacks (minimum)	Street	20'	28'	10'
	Interior (neighboring property lines)	6'	14'	6'
	Solar (northern property line)	6'	17'	6'
Height (maximum)	Primary	39'	29'	49'
	Secondary	60'	40'	60'
Streets	Frontages	40'	64'	40'
	Widths	50'	80'	50'

Permit Number:_____

Section F: Adjoining or Connecting Streets and Sidewalks

(Note: For approval of proposed street names, contact the Engineering Department)

Street Name	Right-of-way Width	Pavement Width	Number of Lanes	Existing Sidewalk*	Existing curb/gutter
NORTH ESTES DRIVE	60	24'	2	☐ Yes	☐ Yes
SOMERSET DRIVE	60	36'	2	☑ Yes (ONE SIDE)	☑ Yes

List Proposed Points of Access (Ex: Number, Street Name): 1 ACCESS POINT OF OF SOMERSET DRIVE

*If existing sidewalks do not exist and the applicant is adding sidewalks, please provide the following information:

Sidewalk Information			
Street Names	**Dimensions**	**Surface**	**Handicapped Ramps**
SOMERSET (EAST SIDE FROM ESTES TO ENTRANCE)	5'	CONCRETE	☑ Yes ☐ No ☐ N/A
			☐ Yes ☐ No ☐ N/A

Section G: Parking Information

Parking Spaces	Minimum	Maximum	Proposed
Regular Spaces	76	107	83
Handicap Spaces	4	5	4
Total Spaces	80	112	99 (12 COVERED)
Loading Spaces	–	–	–
Bicycle Spaces	4	1/SENIOR HOUSING UNIT	10
Surface Type	CONCRETE AND PAVEMENT		

Section H: Landscape Buffers

Location (North, South, Street, Etc.)	Minimum Width	Proposed Width	Alternate Buffer	Modify Buffer
NORTH	20'	20'	☐ Yes	☐ Yes
EAST	10'	10'	☐ Yes	☐ Yes
SOMERSET	20'	15'	☐ Yes	☑ Yes
ESTES	30'	0'	☐ Yes	☑ Yes

Revised 02.04.14

Permit Number:_____

Section I: Land Use Intensity

Existing Zoning District:
Proposed Zoning Change *(if any)*:

Note: Refer to Table 3.8-1 (Dimensional Matrix) in the Land Use Management Ordinance for help completing this table.

Zoning – Area – Ratio			Impervious Surface Thresholds			Minimum and Maximum Limitations	
Zoning District(s)	Floor Area Ratio (FAR)	Recreation Space Ratio (RSR)	Low Density Residential (0.24)	High Density Residential (0.50)	Non-Residential (0.70)	Maximum Floor Area (MFA) = FAR x GLA	Minimum Recreation Space (MSR) = RSR x GLA
R-5	0.49	30,100 SF	67,326 SF	140,263 SF	196,368 SF	169,998 SF	14,021 SF
TOTAL							
RCD Streamside		0.01					
RCD Managed		0.019					
RCD Upland							

Section J: Utility Service

Check all that apply				
Water	☑ OWASA	☐ Individual Well	☐ Community Well	☐ Other
Sewer	☑ OWASA	☐ Individual Septic Tank	☐ Community Package Plant	☐ Other
Electrical	☑ Underground	☐ Above Ground		
Telephone	☑ Underground	☐ Above Ground		
Solid Waste	☐ Town	☑ Private		

SPECIAL USE PERMIT APPLICATION
SUBMITTAL REQUIREMENTS
TOWN OF CHAPEL HILL
Planning Department

The following must accompany your application. Failure to do so will result in your application being considered incomplete. For assistance with this application, please contact the Chapel Hill Planning Department (Planning) at (919)968-2728 or at planning@townofchapelhill.org.

✓	**Application fee** (including Engineering Review fee) (refer to fee schedule) Amount Paid $ 51,925
✓	**Pre-application meeting** – with appropriate staff
✓	**Digital Files** - provide digital files of all plans and documents
✓	**Recorded Plat or Deed of Property**
✓	**Project Fact Sheet**
✓	**Traffic Impact Statement** – completed by Town's consultant (or exemption)
N/A	**Description of Public Art Proposal**
✓	**Statement of Justification** (INCLUDED WITH WRITTEN NARRATIVE)
✓	**Response to Community Design Commission and Town Council Concept Plan comments**
N/A	**Affordable Housing Proposal, if applicable**
N/A	**Provide existing Special Use Permit, if Modification**
✓	**Mailing list of owners of property within 1,000 feet perimeter of subject property** (see GIS notification tool)
✓	**Mailing fee for above mailing list (mailing fee is double due to 2 mailings)** Amount Paid $ 177.60
✓	**Written Narrative describing the proposal** (INCLUDED WITH STATEMENT OF JUSTIFICATION)
✓	**Resource Conservation District, Floodplain, & Jordan Buffers Determination** - necessary for all submittals
✓	**Jurisdictional Wetland Determination – if applicable**
N/A	**Resource Conservation District Encroachment Exemption or Variance (determined by Planning)**
N/A	**Jordan Buffer Authorization Certificate or Mitigation Plan Approval (determined by Planning)**
✓	**Reduced Site Plan Set (reduced to 8.5"x11")**

Stormwater Impact Statement (1 copy to be submitted)

a) Written narrative describing existing & proposed conditions, anticipated stormwater impacts and management structures and strategies to mitigate impacts
b) Description of land uses and area (in square footage)
c) Existing and proposed Impervious surface area in square feet for all subareas and project area
d) Ground cover and uses information
e) Soil information (classification, infiltration rates, depth to groundwater and bedrock)
f) Time of concentration calculations and assumptions
g) Topography (2-foot contours)
h) Pertinent on-site and off-site drainage conditions
i) Upstream and/or downstream volumes
j) Discharges and velocities
k) Backwater elevations and effects on existing drainage conveyance facilities
l) Location of jurisdictional wetlands and regulatory FEMA Special Flood Hazard Areas

Permit Number:_____

m) Water quality volume calculations
n) Drainage areas and sub-areas delineated
o) Peak discharge calculations and rates (1, 2, and 25-year storms)
p) Hydrographs for pre- & post-development without mitigation, post-development with mitigation
q) Volume calculations and documentation of retention for 2-year storm
r) 85% TSS removal for post-development stormwater run-off
s) Nutrient loading calculations
t) BMP sizing calculations
u) Pipe sizing calculations and schedule (include HGL & EGL calculations and profiles)

Plan Sets (10 copies to be submitted no larger than 24"x36")

Plans should be legible and clearly drawn. All plan sets sheets should include the following:

- Project Name
- Legend
- Labels
- North Arrow (North oriented toward top of page)
- Property Boundaries with bearing and distances
- Scale (Engineering), denoted graphically and numerically
- Setbacks
- Streams, RCD Boundary, Jordan Riparian Buffer Boundary, Floodplain, and Wetlands Boundary, where applicable
- Revision dates and professional seals and signatures, as applicable

Cover Sheet

a) Include Project Name, Project fact information, PIN, Design team

Area Map

a) Project name, applicant, contact information, location, PIN, & legend
b) Dedicated open space, parks, greenways
c) Overlay Districts, if applicable
d) Property lines, zoning district boundaries, land uses, project names of site and surrounding properties, significant buildings, corporate limit lines
e) Existing roads (public & private), rights-of-way, sidewalks, driveways, vehicular parking areas, bicycle parking, handicapped parking, street names.
f) 1,000' notification boundary

Existing Conditions Plan

a) Slopes, soils, environmental constraints, existing vegetation, and any existing land features
b) Location of all existing structures and uses
c) Existing property line and right-of-way lines

d) Existing utilities & easements including location & sizes of water, sewer, electrical, & drainage lines
e) Nearest fire hydrants
f) Nearest bus shelters and transit facilities
g) Existing topography at minimum 2-foot intervals and finished grade
h) Natural drainage features & water bodies, floodways, floodplain, RCD, Jordan Buffers & Watershed boundaries

Detailed Site Plan

a) Existing and proposed building locations
b) Description & analysis of adjacent land uses, roads, topography, soils, drainage patterns, environmental constraints, features, existing vegetation, vistas (on & off-site)
c) Location, arrangement, & dimension of vehicular parking, width of aisles and bays, angle of parking, number of spaces, handicapped parking, bicycle parking . Typical pavement sections & surface type
d) Location of existing and proposed fire hydrants
e) Location and dimension of all vehicle entrances, exits, and drives
f) Dimensioned street cross-sections and rights-of-way widths
g) Pavement and curb & gutter construction details
h) Dimensioned sidewalk and tree lawn cross-sections
i) Proposed transit improvements including bus pull-off and/or bus shelter
j) Required landscape buffers (or proposed alternate/modified buffers)
k) Required recreation area/space (including written statement of recreation plans)
l) Refuse collection facilities (existing and proposed) or shared dumpster agreement
m) Construction parking, staging, storage area, and construction trailer location
n) Sight distance triangles at intersections
o) Proposed location of street lights and underground utility lines and/or conduit lines to be installed
p) Easements
q) Clearing and construction limits
r) Traffic Calming Plan – detailed construction designs of devices proposed & associated sign & marking plan

Stormwater Management Plan

a) Topography (2-foot contours)
b) Existing drainage conditions
c) RCD and Jordan Riparian Buffer delineation and boundary (perennial & intermittent streams, note ephemeral streams on site)
d) Proposed drainage and stormwater conditions
e) Drainage conveyance system (piping)
f) Roof drains
g) Easements
h) BMP plans, dimensions, details, and cross-sections
i) Planting and stabilization plans and specifications

Landscape Protection Plan

a) Rare, specimen, and significant tree survey within 50 feet of construction area
b) Rare and specimen tree critical root zones
c) Rare and specimen trees proposed to be removed
d) Certified arborist tree evaluation, if applicable
e) Significant tree stand survey
f) Clearing limit line
g) Proposed tree protection /silt fence location
h) Pre-construction/demolition conference note
j) Landscape protection supervisor note
k) Existing and proposed tree canopy calculations, if applicable

Planting Plan

a) Dimensioned and labeled perimeter landscape bufferyard
b) Off-site buffer
c) Landscape buffer and parking lot planting plan (including planting strip between parking and building, entryway planting, and 35% shading requirement

Steep Slope Plan

a) Classify and quantify slopes 0-10%, 10-15%, 15-25% and 25% and greater
b) Show and quantify areas of disturbance in each slope category
c) Provide/show specialized site design and construction techniques

Grading and Erosion Control Plan

a) Topography (2-foot contours)
b) Limits of Disturbance
c) Pertinent off-site drainage features
d) Existing and proposed impervious surface tallies

Streetscape Plan, if applicable

a) Public right-of-way existing conditions plan
b) Streetscape demolition plan
c) Streetscape proposed improvement plan
d) Streetscape proposed utility plan and details
e) Streetscape proposed pavement/sidewalk details
f) Streetscape proposed furnishing details
g) Streetscape proposed lighting details

Solid Waste Plan

a) Preliminary Solid Waste Management Plan
b) Existing and proposed dumpster pads
c) Proposed dumpster pad layout design
d) Proposed heavy duty pavement locations and pavement construction detail

Construction Management Plan

a) Construction trailer location
b) Location of construction personnel parking and construction equipment parking
c) Location and size of staging and materials storage area
d) Description of emergency vehicle access to and around project site during construction
e) Delivery truck routes shown or noted on plan sheets

Energy Management Plan

a) Description of how project will be 20% more energy efficient than ASHRAE Standards
b) Description of utilization of sustainable forms of energy (Solar, Wind, Hydroelectric, and Biofuels)
c) Participation in NC GreenPower program
d) Description of how project will ensure indoor air quality, adequate access to natural lighting, and allow for proposed utilization of sustainable energy
e) Description of how project will maintain commitment to energy efficiency and reduced carbon footprint over time
f) Description of how the project's Transportation Management Plan will support efforts to reduce energy consumption as it affects the community

Exterior Elevations

a) An outline of each elevation of the building, including the finished grade line along the foundation (height of building measured from mean natural grade).

I. INTRODUCTION – CHAPEL HILL RETIREMENT RESIDENCE

Site Description

The subject parcel is located on 6.44 acres (+/-) located at the NE corner of N Estes Drive and Somerset Drive in Chapel Hill, North Carolina. The proposed site is generally rectangular in shape with frontage along both N. Estes Drive and Somerset. Drive)

Abutted by:

- Four single family homes on large lots abut the northerly lot line.
- The tennis courts for the Phillips Middle School abut the easterly lot line.
- N. Estes drive runs along the southerly lot line with 3 or 4 larger residential sites on the south side of this street.
- Somerset Drive lies along the westerly side of the site with a large undeveloped parcel on the westerly side of Somerset.

Current Zoning: R-1 Residential

Current Use: Vacant Undeveloped Site

Parcel Number: #9789551528

Acreage

The parcel is 6.438 acres (280,439 sq ft) in size and is currently undeveloped.

Proposed Development

Hawthorn Development LLC proposes a Zoning Atlas Amendment to R-5-C with a Residential and Special Use Permit to allow the use of Independent Senior Living Facility for this site, with the intent to develop a 152-suite, 3 story + partial daylight basement, Senior Housing Development.

Independent Senior Living Facility (ISLF) / Congregate Care Concept

The Congregate Care (ISLF) concept is designed for residents with an average age of 82 who are still ambulatory; the ISLF does not offer medical or nursing care. This development will be privately funded and operated, and will not receive government subsidies.

The ISLF's private residential suite offers the advantages of independent living while the services included provide support, security, and friendship. The private suites include studio, one, and two bedroom versions. Each suite includes a kitchenette consisting of a small refrigerator, counter top and bar sink. No cooking facilities are provided within the suites; therefore they are not dwelling

units. All resident meals are prepared in the central kitchen and served in a central dining room.

Services for residents include three prepared meals daily, housekeeping, laundering service, private van transportation, and various social and physical activities. The Management Team lives on the premises and is available to residents 24 hours a day. The residents monthly rent payment covers the cost of their private suite, all meals, services and utilities, no “buy in fee” is required.

Our typical resident is a single woman in her late 70’s or 80’s who lives within 10 miles of the site. Approximately 10% of suites will be rented by couples resulting in a total building population of approximately 167.

Fewer than 20% of the residents will be driving their own cars. Because most of our residents prefer not to drive, we provide private van transportation for their use. Van service is included in the monthly rent and available 24/7 and offers residents independence and mobility while providing their families peace of mind.

This type of use does not create the problems typically associated with higher density developments, such as traffic, noise, or increased demand on public services.

Site Design

The Site design and configuration has taken into account the need for efficient land use in order to provide careful conservation of the onsite and nearby natural resources. The location of the building, accessory structures, parking, drive access, and other site improvements have been intentionally designed and located to meet the standards of the Chapel Hill LUMA and the Central West Small Area Plan. Additional care and attention has been devoted to providing substantial buffers and the preservation of natural site amenities benefiting both our residents and the surrounding neighbors.

Building Design

The building is designed to be balance between the urban standards of the CWSAP and well as being residential in nature to blend with and complement its residential surroundings. Neighborhood compatibility is achieved via the SUP, site planning and building design process. The building and site exposed to N Estes encourages the urban / community outreach objectives of the CWASP by incorporating pedestrian access and landscape features to encouraging our residents and the local community to join together in sharing these community spaces. The buildings wing ends and the building center step down from three stories to two to one-story sections. This arrangement provides for privacy and a gentle change of scale for the portions of the building nearest to the less intense residential uses. Care is taken to minimize the impact to the existing residential

community as well as to complement the surrounding local architecture. Exterior siding materials will include horizontal siding and rock or brick. The roofing material will be architectural composition shingles.

The interior of the retirement residence features common areas for a variety of uses; a+ central dining room and kitchen for shared meals, multi-purpose room, beauty shop, crafts room, TV room, media/computer room, Movie Theater, lounges, and an exercise room. The circulation is organized around a central atrium. The common areas are the "social hub" and an essential part of the residents' lifestyle.

Residents will be able to contact the manager with both emergency pull cords and voice communications in each suite.

Proposed vehicle access is provided from a single access point on Somerset Drive. Since our residents prefer not to drive and van service is available at all times, the traffic impact to Somerset / N Estes and the surrounding area will be minimal. Peak-hour traffic impact is very low as our resident's mealtime and activities take place on site during those hours.

II ZONING, LAND USE AND DENSITY

Intent of the proposed Special Use Permit within the R-5-C zone

The current land use for this site is R-1 Residential
It is our intent to complete a Zoning Atlas Amendment to rezone this is to a R-5-C zoning classification with a Special Use Permit allowing the use of Independent Senior Living Facility as well as. Additionally with the ISLF we will utilize the Special Standards allowing a FAR of 0.606.for this use

In respect this request for a Special Use Permit to allow the development of an Independent Senior Living Facility for this site

We request you consider the following information in you findings under Land Use Management Ordinance Section 4.4:

a) "In order to establish and maintain sound, stable, and desirable development within the planning jurisdiction of the town it is intended that, this appendix shall not be amended except a) to correct a manifest error in the appendix,

The possible error was the lack of any use definition for this type on senior housing. This error was corrected earlier in 2016 with the completions of the addition of **I**ndependent Senior Living Facility (ISLF) to the current land use ordinances

b) because of changed or changing conditions in a particular area or in the jurisdiction generally, Demand for senior housing in Chapel Hill, the Research Triangle and North Carolina is not being met forcing seniors to relocate outside of the area, this conditions has been recognized by the 2020 Comp Plan and the Central West SAP as outlined in "c)' below.

c) Achieve the purposes of the 2020 Comprehensive Plan.

CHAPEL HILL 2020 COMPREHENSIVE PLAN:

The Chapel Hill Comprehensive Plans 2000 & 2020 includes many themes, goals and strategies and this proposed addition of a higher density residential zoning in CWSAP supports and will assist in achieving goals set out in the Comprehensive Plans. In specific the following themes relate directly:

A Place for everyone:

A range of housing options for current and future residents (PFE.3)

By adding an Independent Senior Living Facility to the local housing mix it broadens the options for senior residential development, expanding those housing options.

Community Prosperity and engagement: Promote a safe, vibrant, and connected (physical and person) community (CPE.3)

Locating an Independent Senior Living Facility within the existing community as adjacent or "in fill" development, when properly designed, provides opportunities for community space, connectivity, and other amenities to "Promote a safe, vibrant, and connected (physical and personally) community" for its residents and the surrounding neighborhood.

Getting Around:

A connected community that links neighborhoods, businesses, and schools through the provision of greenways, sidewalks, bike facilities, and public transportation (GA.2); Connect to a comprehensive regional transportation system (GA.3); a transportation system that accommodates transportation needs and demands while mitigating congestion and promoting air quality, sustainability, and energy conservation (GA.6)

This Independent Senior Housing Facility is located near easy access to the Chapel Hill Transit System allowing senior residents, a demographic more likely to utilize the public transit system. This adds to the overall community benefit of reduced tip counts, fuel and emissions savings. Additionally the facilities shuttle van service provides a low impact option with personal convenience to access, community activities, services and events with the benefit of reduced tip counts, fuel and emissions savings.

Nurturing Our Community:

Maintain and improve air quality and water quality, and manage stormwater to heal local waterways and conserve biological ecosystems within the town boundaries and the Extra Territorial Jurisdiction (NOC.2); Support the Parks and Recreation Master Plan and the Greenways Master Plan to provide recreation opportunities and ensure safe pedestrian and bicycle connections (NOC.4);

Protect neighborhoods from the impact of development such as stormwater runoff, light and noise Pollution, and traffic (NOC.8)

The development of this Independent Senior Living Facility creates the opportunity for more seniors on a "smaller footprint' as compared to single family residential allowing for more pervious area and open space reducing impacts on stormwater runoff, light and noise pollution, traffic, etc

III. DESIGN STANDARDS

Access
The point of access will be from Somerset Drive. (See site plan)

Building Height
Preliminary height is 39 feet or less and the secondary height will not exceed 60 feet as defined in the Town of Chapel Hill Code of Ordinances,
(See attached Building Height exhibit)

Parking

99 parking spaces proposed:
- 83 open spaces
- 12 covered spaces
- 4 accessible spaces

Parking Ratio: 0.65 spaces per suite

Hawthorn Retirement Group has developed over 300 retirement residences in North America. Experience from this extensive portfolio has shown that 0.70 parking space per suite ratio is an ideal parking space standard for our residents, staff, and visitors. In part, the reason for this parking ratio is because most of our residents do not drive, (less than 20%) therefore we provide private van transportation for their use. The van is available to take the residents to places they need to visit, such as church, banks, medical offices, shopping areas, etc.

Additionally this parking ratio allows us to increase landscaping and open space areas on the site to create a better residential environment for our residents and adjacent property owners.

Site Parking		
Classification	**Current Standard**	**Proposed Parking**
Independent Senior Living Facility	Minimum Parking Spaces 0.5 per Senior Unit Maximum 0.7 per Senior Unit	99 Parking Spaces (0.65 per Senior Unit)

Dedications
Any additional easements, rights of ways or agreements to accommodate rights of way, utilities, and services to the site will be accommodated as needed.

Fences & Screening
Fences and screening will be provided per the Town of Chapel Hill Ordinances.

Area Regulations		
	Current Standard	**Provided**
Minimum Lot Size	5,500 sq ft	280.416 sq ft
Minimum Southerly Setback/ Buffer (N Estes Drive) Variance Requested	20' Set Back	10' Set Back*
Minimum Side Setbacks & Buffers	10' Side Set Back 6' Internal Set Back	West 10'' Set Back 15' "Type B" Buffer East 6' Internal 10 ft "Type B" Buffer
Minimum Rear Setback	6 feet	. 8'.Solar Set Back 20' "Type C" Buffer
Maximum Building Height (See attached Exhibit)	39 / 60 feet	39 / 60 feet
Density / FAR	*0.606	0.495

*FAR standard for ISLF

IV. Modifications within the Special Use Permit

In order to accommodate the development on this site we are requesting two (2) modifications within the Special Use Permit

#1: Reduction of Building Set Back Lines
#2: Reduction of Bicycle Parking Standards

Modifications #1 – Reduction of Building Setback line(s)

In order to accommodate the intent of the Center West SAP and Fire and Safety requirements and the stormwater and topographical challenges for this site we respectfully request a modification to allow for the reduction of the building set back line of 10 feet in width along the southerly (N. Estes Drive) portion of the site. NOTE: Canopy Trees and other landscape enhancements have been included on the southerly portion of the site outside the N. Estes right-of-way (Please see the associated revised site plan(s) for additional details)

Applying the "four findings of fact" from Land Use Management Ordinance 4.5.2(a) for this request for modification they are as follows:

a. That the use or development is located, designed, and proposed to be operated so as to maintain or promote the public health, safety, and general welfare;
The proximity of the building near N Estes Street aids in several aspects, regarding public health and safety, placing the southerly side of the building closer to N Estes Street provides better access to the site for fire and safety apparatus. This design has been carefully worked to the satisfaction of Chapel Hill Fire and safety representatives.

b. That the use or development complies with all required regulations and standards of this chapter, including all applicable provisions of articles 3 and 5, the applicable specific standards contained in the supplemental use regulations (article 6), and with all other applicable regulations;
With the exception of the reduction of the southerly set back line on this site the proposed development meets the required regulations and standards

c. That the use or development is located, designed, and proposed to be operated so as to maintain or enhance the value of contiguous property, or that the use or development is a public necessity;
Great care has been applied to the site and building design to enhance and protect the value and character of the surrounding properties. This site and its use can supplement the abutting schools and the extensive, setbacks, buffers; including approximately 1.4 acres on undisturbed naturally vegetated buffer as well as generous landscape enhanced buffer areas. This provides protection for the integrity and privacy of the SFR sites along our northerly lot line. The buildings wing ends and the building center step down from three/four stories to two to one-story sections. This arrangement provides for privacy and a gentle change of scale for the portions of the building nearest to the less intense residential uses. Care is taken to minimize the impact to the existing residential community as well as to complement the surrounding local architecture. Exterior siding materials will include horizontal siding and rock or brick. The roofing material will be architectural composition shingles, further promoting the "residential feel" for our SFR neighbors
All of these design elements come together to protect our neighbors as well as promote the goals of the Central West SAP promoting the future goals for this SAP area

d. That the use or development conforms to the general plans for the physical development of the town as embodied in this appendix and in the comprehensive plan.
The Chapel Hill Comprehensive plan and the Central West Small area plan specifically call out for senior housing uses as part of future development This building and site design creates a balance between the urban standards of the CWSAP as well as being a transitional buffer by being residential in nature blending with and complementing its residential surroundings. Neighborhood compatibility is achieved via the SUP, site planning and building design process. The building and site exposure to N Estes encourages the urban / community outreach objectives of the CWASP by incorporating pedestrian access and landscape features to encouraging our residents and the local community to join together in sharing these community spaces.

Modifications #2 – Reduction in bicycle parking standards

In order to provide a balance and appropriate amount of onsite type "A" and Type "B" bike storage for our site we respectfully request a modification for a reduction in bike parking storage from 152 spaces to a total of 30 bicycle parking and storage spaces.
Providing: 10 "Type "A' and 20 Type "B" spaces
(Please see the associated revised site plan(s) for additional details)

Applying the "four findings of fact" from Land Use Management Ordinance 4.5.2(a) for this request for modification they are as follows:

a. That the use or development is located, designed, and proposed to be operated so as to maintain or promote the public health, safety, and general welfare;
The benchmark of 152 bicycle parking spaces does not provide the best design and limits the overall function for this retirement residence site, limiting and other beneficial amenities and uses on the site.
Our experience shows that:
    - **Less than 10 of our residents per faculty have a bicycle on site and if they do they usually store the bike in their own suite or on their private deck**
    - **1 or 2 employees per shift may use the bicycle parking**
    - **Visitors may have as many as 3-4 bicycles parked on site from time to time**

After reviewing the use and site configuration we are showing a total of 30 total bike parking spaces, 10 type "A" and 20 type "B" spaces as shown on the revised site plan. This provides an excellent balance of use and utility on the site based on a realistic application for bicycle use and storage demands for this site. This design will promote a positive environment for public health, safety and general welfare for our residents and the greater community.

b. That the use or development complies with all required regulations and standards of this chapter, including all applicable provisions of articles 3 and 5, the applicable specific standards contained in the supplemental use regulations (article 6), and with all other applicable regulations;
With the exception of the reduction of the southerly set back line and a lower bicycle parking ratio on this site the proposed development meets the required regulations and standards

c. That the use or development is located, designed, and proposed to be operated so as to maintain or enhance the value of contiguous property, or that the use or development is a public necessity; and
Great care has been applied to the site and building design to enhance and protect the value and character of the surrounding properties. Bicycle parking and storage has been strategically located:
Type "A" near the community courtyard on N. Estes Drive and adjacent to the main entrance porte-cochere of the senior housing faculty.
Type "B" incorporated into one of our parking garage bays

This allows easy access and security for residents, staff and visitors
All of these design elements come together to protect our neighbors as well as promote the goals of the Central West SAP promoting the future goals for this SAP area

d. That the use or development conforms with the general plans for the physical development of the town as embodied in this appendix and in the comprehensive plan.
The Chapel Hill Comprehensive plan (2020 Theme #3 " Getting Around") and the Central West Small area plan (Transportation – Pg# 51) both call out for bike and pedestrian amentias & improvements.
Within the Central West Small Area Plan design guidelines, a bicycle path running along our N Estes Rd boundary of our site is called out and is part or the design plans for our site and the pending N Estes Rd improvements. Our intentional locating of "visitor" (type "A") bike parking, adjacent to this pathway, as well our other site appropriate bicycle parking and storage, complements this objective, further encouraging our residents and the local community to join together in sharing these community spaces and amenities.

V. Overview and Summary

Existing Zoning:	R-1 Residential
Proposed Zoning:	R-5-C Residential & Special Use Permit (Special Standards for the use of Independent Senior Living Facility)
Land Area:	6.44 acres (280,416 sq ft)
Existing Use:	Undeveloped

Proposed Use:	152-suite Congregate Care Facility
Proposed Parking:	99 total spaces: 83 open spaces 12 covered spaces 4 handicap accessible (Ratio of 0.65 spaces per Senior Unit)
Bicycle Parking/ Storage	30 spaces (10 type “A’ + 20 type “B”)

Modifications:

Building set back line reduction from 20 feet to10 feet along the southerly (N. Estes Drive) Lot line
Bicycle Parking / Storage Reduction to 30 total spaces

V. PHASING

This 152-suite retirement facility and accessory buildings will be developed in a single phase.

Construction expected in 2017 - 2018

VI. JUSTIFICATION

In accordance with the Chapel Hill Land Use Management Ordinance, Sections 4.4 we assert that regarding sub section b) “because of changed or changing conditions in a particular area or in the jurisdiction generally”

The growing demand and short supply for senior housing in Chapel Hill clearly supports the need to free up existing developable sites within Chapel Hill.
The current projected increase in seniors 65+ in Chapel Hill and Orange County by 2017 is predicted to be at a 31% growth rate.
The site at 700 Block of N. Estes Drive is an excellent example of how an active senior housing use can be integrated into the local community, adding to the community’s depth and character, while meeting many of the objectives for the Central West Small Area Plan.

Providing the additional bonus of allowing local Chapel Hill seniors to remain in Chapel Hill to “age in place” instead of being forced to relocate to less familiar surrounding communities.

As well as sub section c) ‘to achieve the purposes of the comprehensive plan”:

The Chapel Hill 2020 Comprehensive Plans includes many themes, goals and strategies and this proposed addition of a higher density residential zoning in CWSAP supports and will assist in achieving goals set out in the Comprehensive Plans. In specific the following themes relate directly:

CHAPEL HILL 2020 COMPREHENSIVE PLAN

The proposed Chapel Hill Retirement Residence is also consistent with principals of the Chapel Hill 2000 Comprehensive Plan. These provisions are described in the following text.

Maintain the Urban Services/Rural Buffer Boundary:
By including the use of Independent Senior Living Facility within the Town’s Urban Services/Rural Boundaries the town can better providing residents with convenient access to essential service via alternative modes (public transit and pedestrian options) of transportation.

Conserve and protect existing neighborhoods:
Providing opportunities for senior housing as infill upgrade on undeveloped remainder parcels within existing neighborhoods further adds to the housing options for the current senior residents of Chapel Hill to “age in place” Preventing them from relocating out of the area in order to find housing that meets their current needs allowing for their continued participation in existing neighborhoods.

Conserve and protect the natural setting of Chapel Hill:
A typical design component of the proposed Chapel Hill Retirement Residence is to create a “park like setting” on the site. This is accomplished by preserving existing trees (evergreen and deciduous) as well as providing additional landscape plantings and other site features benefiting the residents and surrounding community. A unique feature of this site is that approximately 1.4 acres that will remain undisturbed protecting a small wetlands area and further enhance and protect the natural setting.

Create and preserve affordable housing opportunities:
Adding this facet of Senior Housing allows for more variety in senior housing settings and services. This provides cost saving options to seniors who do not require the more intense and costly personal care services.

Cooperatively plan with the University of North Carolina at Chapel Hill:
The use of Independent Senior Housing Living Facility and Senior Housing in general should have no direct impact on the UNC at Chapel Hill campus.

Work toward a balanced transportation system:
The Chapel Hill Retirement Residence will generate fewer daily trips and peak hour trips than other uses of similar density. Reducing the traffic impact, as well as providing local senior easy access to utilize the Chapel Hill Transit System as well as site provided shared transportation.

Complete the bikeway/greenway/sidewalk systems:
Development the Chapel Hill Retirement Residence can address pedestrian access and connectivity as a part of the improvements along N. Estes Drive with its improved pedestrian / bike pathways as we;;; as providing another future link to the Chapel Hill Greenway Trails System. (See site plan)

Provide quality community facilities and services:
The Chapel Hill Retirement Residence will provide an important contribution to smart local development while allowing Chapel Hill seniors to age in place. As well as providing the natural benefit of additional tax base dollars to support community services, transportation and infrastructure by keeping Chapel Hill Seniors in Chapel Hill.

Central West Small Area Plan

The Chapel Hill Retirement Residence addresses the following goals and principles as outlined within the Central West Small Area Plan:

Create a strong sense of place;

The interior building and exterior site are expressly designed in manner to create a “sense of place” for our residents and the community. The interior central core of the building with its many amenities and features

creates a welcoming environment for our residents, visitors and the surrounding community. The exterior site with its walking paths, and community features and gathering areas promotes a strong sense of place for the local community.

Ensure community compatibility;

Our site and building has undergone very careful review and scrutiny to provide a compatible and complementary addition to the surrounding community. Our residential design and features addressing the goals and objectives of the CW SAP allows for a residential look with a genital change of scale while being a transitional site between our residential neighbors to the north from the more intense use and activities along N. Estes Street. The onsite community courtyard and its interconnections between our residence and the new bike/pedestrian paths on N. Estes is an excellent example of site features that promote local compatibility

Create social connections;

Our site and use provide many opportunities for social connections. The community courtyard with its interconnections to N Estes Drive provides an excellent environment for our senior residents to connect and interact with their surrounding community. Additionally many our active senior residents are involved locally, with clubs, church and volunteer activities. The nearby elementary school will provide additional volunteer opportunities and the social connections the naturally follow.

Improve transit system;

Our site will likely include a new or improved transit stop on N Estes Drive, this part of the current N Estes improvement project that abuts our southerly lot line and surrounding area. Details are available from the local transportation authorizes.

Additionally our retirement residence provides a local private on demand shuttle to transport our residents further reducing traffic impact especially during peak hours

Encourage a diverse mix of uses;

Our site and its use provides a complementary departure from the other residential and residential oriented uses in the vicinity. Adding to the mix while supporting and enriching the area and its SW SAP goals and objectives

A diverse population;

Our site provides Chapel Hill seniors with a new positive option in senior housing, these residence will reflect the diverse population that is Chapel

Hill, with the benefit of allowing Chapel Hill seniors to remain in their town of choice.

Respect existing neighbors;

Great care has been taken to work with and listen to our surrounding neighbors (5 local neighborhood meetings) resulting in our site design providing:

- Substantial buffers, landscaping and grade changes to mitigate any impact
- 1.3 acres of “undisturbed natural vegetation” along our northerly border
- Sidewalks, Bike / Pedestrian Paths, future Greenway Paths and interconnections with our site to encourage access and allow for safe pedestrian access to the nearby schools and local neighborhoods

Employ environmentally sound practices;

- Our building utilizes many energy efficient designs and devices.
- Our site has a comprehensive trash / recycling center to reuse and reduce environmental impact.
- Our onsite storm water control and pre-treatment design will meet and exceed all state and local design requirements.

Feature, repair, and enhance natural resources;

Our site design allows for 1.3 acres of “undisturbed natural vegetation”, as well as design features that protect many other on site trees allowing us to exceed the required canopy protection standard of 30% with a protection rate of 35%

Consider economic impacts in development decisions

This development will provide several positive economic impacts:

First, a short term, economic boost during the construction process utilizing local trades, services and suppliers

Followed by the long term impact of:

- 24 (+/-) full time equivalent staff positions
- Additional impact by contracting with local providers of support supplies, materials and services

- The benefit of keeping local Chapel Hill seniors in Chapel Hill to continue their shopping and spending routines in Chapel Hill

VIII. CONCLUSION

We respectfully request a Zoning Atlas Amendment and Special Use Permit with modifications for the 6.44-acre site located at the 700 Block of N Estes Drive in Chapel Hill North Carolina. This land use action is sought to allow the development of a 152-suite Independent Living Senior Facility on the site. This development will provide a positive, quality, low impact addition to the neighborhood and the greater community of Chapel Hill.

This site is ideally suited for our senior housing use. It has close proximity to services such as shopping, recreation, and medical services while being near established residential uses. The proposed residence provides an attractive and quiet home that meets the growing demand for senior housing in Chapel Hill. This benefits local seniors by providing a quality option to "age in place" within their own community.

Hawthorn Development intends to utilize the Zoning Atlas Amendment and Special use Permit process acquire the approvals needed to develop a 152-suite Independent Senior Living Facility. The Special Permit process also provides assurance to the Town of Chapel Hill and the surrounding neighbors as to what will be developed on this site. The SP approval will prevent a more intensive use from occurring on the site without input from the community as well as the required reviews and approvals by the Town of Chapel Hill.

This proposed development is an important component in meeting the current needs and growing demands of seniors in Chapel Hill and the surrounding community.

This project offers benefits, which include:

- Large open spaces and generous setbacks - Over 62% of the site will be landscaped open space, providing a park-like setting and ample buffers to neighboring properties.

- Quiet Senior Residential Use – The proposed retirement residence has 150-suites, which include studios, one bedroom, and two bedroom types.

- Low Traffic Generation – Our project will generate less than 30 peak hour trips per day.

- Low Impact on Public Services - Including parks, schools, libraries, utilities, and transportation systems.

- Fulfills Need for Retirement Housing - Our research has found there is a high demand in the area for Hawthorn Retirement's unique program. Recent reports by the HGAC have determined that the demand for senior housing outpaces development in the coming years. This development will complement other senior housing choices available in the area and allows seniors in Chapel Hill to remain near neighborhoods they have enjoyed for many years.

This site is ideally suited for this use and the proposed retirement residence would be a positive addition to Chapel Hill and the surrounding community.

Thank you for your consideration.

EMH&T
Engineers, Surveyors, Planners, Scientists

MEMO

Date: June 10, 2016

To: Wes Smith, PE

From: Douglas A. Bender, PE, PTOE

Subject: Charlotte Retirement Residence – Trip Generation

This memo has been prepared to provide a trip generation analysis for the proposed Charlotte Retirement Residence site, located at the northeast corner of the intersection of Somerset Drive and North Estes Road in Chapel Hill, North Carolina.

The development is planned to consist of a 152-suite living facility designed for seniors who maintain a mostly independent living lifestyle, but need some support. Site generated trip ends were forecast using data and methodology contained in Trip Generation, 9th Edition (Institute of Transportation Engineers, 2012). Daily, morning, and afternoon peak hour traffic volumes were estimated using trip generation rates published for ITE land use code 253, Congregate Care Facility. As shown in **Table 1** below, the proposed development is expected to generate 308 total daily trips, 9 external trips in the morning peak hour (5 entering, 4 exiting) and 26 external trips in the afternoon peak hour (14 entering, 12 exiting).

Table 1 - Trip Generation – Congregate Care Facility

Land Use	Square Feet or Units	ITE Code	Time Period	ITE Formula	Total Trips	Trips Entering	Trips Exiting
Congregate Care Facility	152 units	253	Weekday (ADT)	Average Rate=2.02	308	154	154
			AM Peak Hr of Adjacent St.	Average Rate=0.06	9	5	4
			PM Peak Hr of Adjacent St.	Average Rate=0.17	26	14	12

The number of daily weekday trips expected to be generated by the proposed facility was also estimated based on trip data from similar existing facilities, as provided by the developer. As shown in **Table 2** below, the similar facility-based estimate results in fewer daily trips compared to the ITE-based estimate (234 vs. 308).

Table 2 - Trip Generation – Similar Retirement Residence Data

	Units	Time Period	Trip Source	Total Trips	Trips Entering	Trips Exiting
Congregate Care Facility	152 units	Weekday (ADT)	Employees: 20 empl. x 4 trips per day[1]	80	40	40
			Visitors: 20% of residents per day	60	30	30
			Residents: <25% possess vehicles	76	38	38
			Shuttle Service: 3-4 excursions per day	8	4	4
			Deliveries/Service Trips: 5 per day	10	5	5
			WEEKDAY TOTAL	***234***	***117***	***117***

Note:

1. 4 trips per day = arrive for shift, depart for lunch, return from lunch, depart after shift (Conservative - assumes no employees on vacation or sick leave, and all leave site for lunch break)

Since the number of daily trips estimated via the similar facility data is close to but somewhat less than the ITE estimate of daily trips, it is reasonable to assume that the number of peak hour trips will be similar to or slightly less than the number of trips estimated via the ITE trip generation methodology.

In summary, the analysis results indicate that the retirement facility is expected to generate a relatively low number of vehicular and bicycle trips. Traffic impacts resulting from the proposed 152-unit retirement facility can be expected to be relatively minor due to several factors:

- Typically, less than 25% of residents drive vehicles.
- On any given weekday, only 20% of residents will have visitors traveling to and from the site.
- The 20 employees (approx.) arrive and depart the site at shift change times which do not typically coincide with the normal morning/afternoon peak hours of the adjacent street traffic.
- Pedestrians and bicyclists are not typically associated with this type of use.

Please let me know if you have any questions or if I may be of further assistance in this matter.

Sincerely,

Douglas A. Bender, PE, PTOE
Senior Traffic Engineer

Daniel Roach architect

July 25, 2016

Chapel Hill Retirement Residence: #16-057
700 North Estes Drive
Chapel Hill, NC 27415

RE: Planning Comment #15 Response

The only activity at this project that produces potential electrical signals that may interfere with air traffic is the in-house Wi-Fi system. This is a low power system and should pose no issue for aircraft. In addition, in reviewing the site plan there is a University of North Carolina complex near the 27 approach to the airport. There is also numerous commercial and residential building closer to the airport than this project. All of these buildings will probably have similar Wi-Fi systems.

Finally, all lighting on this project will be 100 percent cutoff. That is, all light will be directed down so there will no glare produced by this project.

Sincerely,

Robert J. Hazleton, Jr. PE

3150 Kettle Court SE, Salem, OR 97301 p 503 399 1090 f 503 399 0565 w lenityarchitecture.com ARCHITECTURE & PLANNING

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
10101 Hillwood Parkway
Fort Worth, TX 76177

Aeronautical Study No.
2016-ASO-23016-OE
Prior Study No.
2016-ASO-21161-OE

Issued Date: 12/08/2016

Mark Lowen
Hawthorn Retirement Group
9310 NE Vancouver Mall Dr
Vancouver, WA 98662

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Building Chapel Hill Retirement Residence
Location:	Chapel Hill, NC
Latitude:	35-56-08.28N NAD 83
Longitude:	79-03-01.92W
Heights:	445 feet site elevation (SE)
	54 feet above ground level (AGL)
	499 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

It is required that FAA Form 7460-2, Notice of Actual Construction or Alteration, be e-filed any time the project is abandoned or:

_____ At least 10 days prior to start of construction (7460-2, Part 1)
__X__ Within 5 days after the construction reaches its greatest height (7460-2, Part 2)

Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking/ lighting are accomplished on a voluntary basis, we recommend it be installed and maintained in accordance with FAA Advisory circular 70/7460-1 L Change 1.

This determination expires on 06/08/2018 unless:

(a) the construction is started (not necessarily completed) and FAA Form 7460-2, Notice of Actual Construction or Alteration, is received by this office.
(b) extended, revised, or terminated by the issuing office.
(c) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

This determination is based, in part, on the foregoing description which includes specific coordinates , heights, frequency(ies) and power . Any changes in coordinates , heights, and frequencies or use of greater power will void this determination. Any future construction or alteration , including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

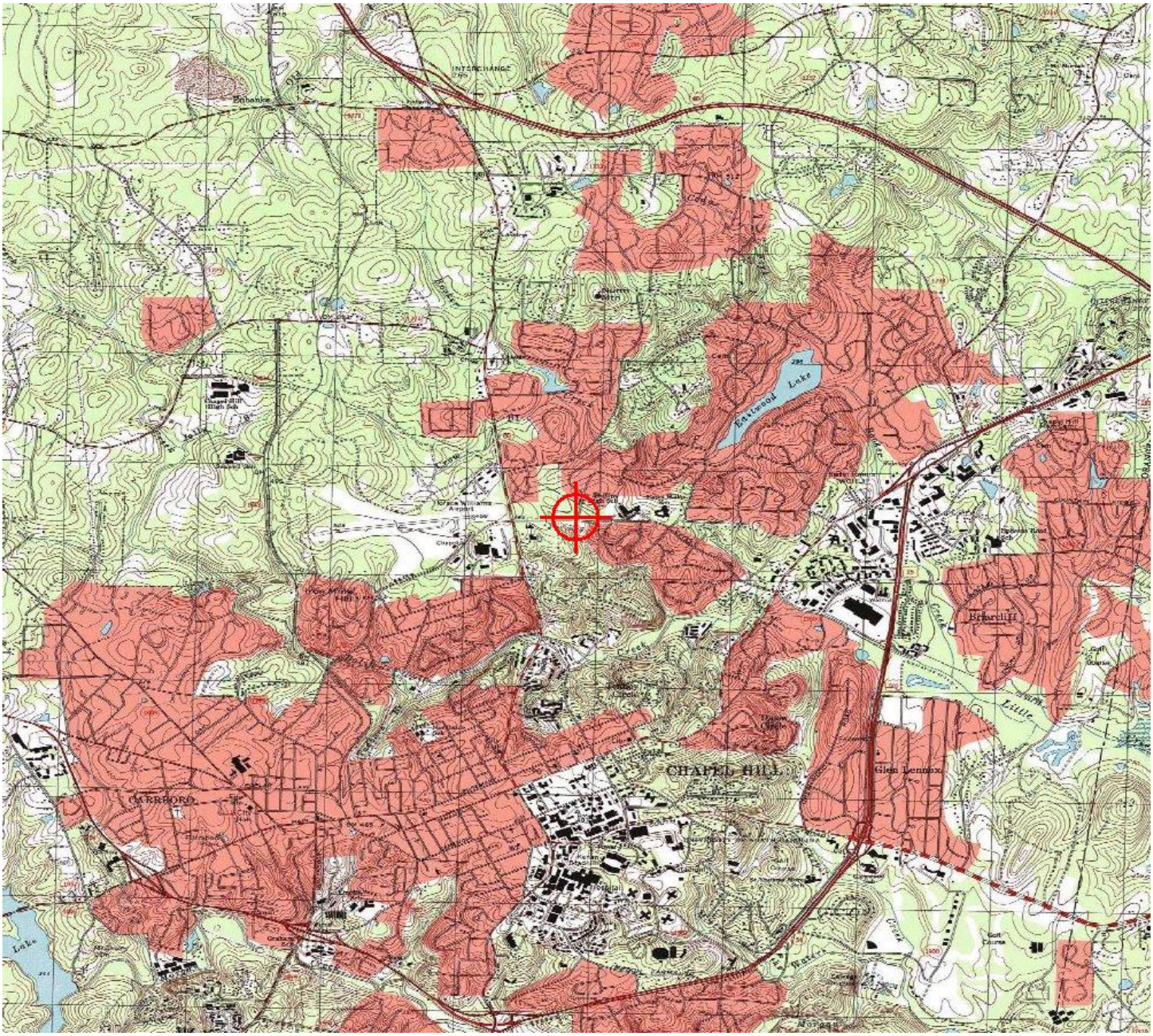
Any failure or malfunction that lasts more than thirty (30) minutes and affects a top light or flashing obstruction light, regardless of its position, should be reported immediately to (877) 487-6867 so a Notice to Airmen (NOTAM) can be issued. As soon as the normal operation is restored, notify the same number.

If we can be of further assistance, please contact our office at (817) 222-5933. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2016-ASO-23016-OE.

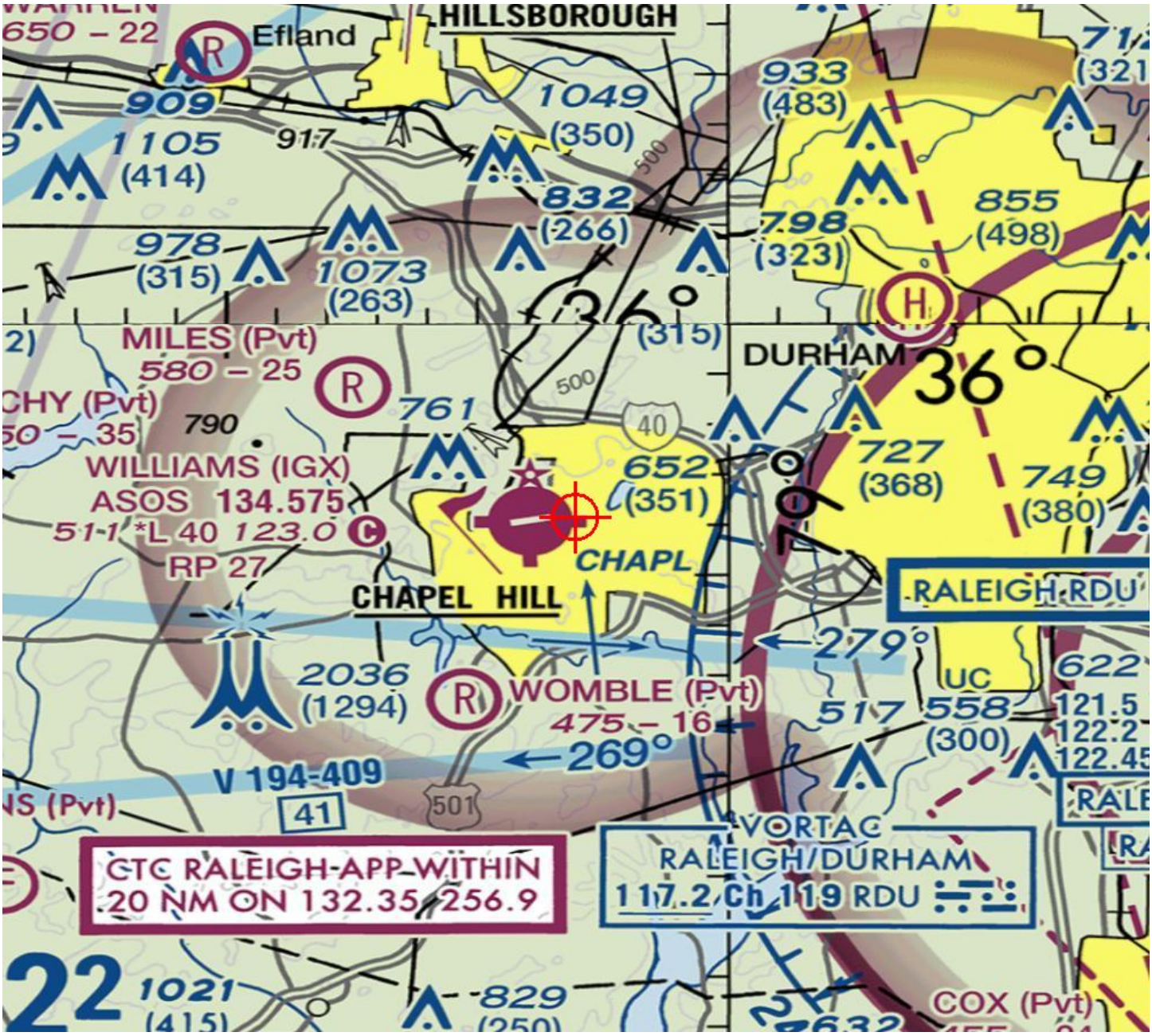
Signature Control No: 303641938-312048465 (DNE)
Andrew Hollie
Specialist

Attachment(s)
Map(s)

TOPO Map for ASN 2016-ASO-23016-OE



Sectional Map for ASN 2016-ASO-23016-OE



WASTE INDUSTRIES

www.wasteindustries.com

148 Stone Park Court | Durham, NC 27703

Chapel Hill Retirement Residence
Chapel Hill, NC 27516
25 July 2016

To Whom It May Concern,

Waste Industries is a private waste collector headquartered in Raleigh, NC. We verify that we have reviewed the plans dated 28 March 2016 (sheet A1.0), provided by Daniel Roach, Architect. Based upon those plans, Waste Industries is prepared to provide service for Chapel Hill Retirement Residence, located in Chapel Hill, NC.

Regards,

Jason McMillan
Account Manager
Waste Industries USA, Inc.

ORANGE COUNTY 03-03-95

$430.00

STATE OF NORTH CAROLINA

Real Estate Excise Tax

Excise Tax $430.00

FILED
03 MAR 1995, at 11:53:48AM
Book 1331, Page 63 - 65
Betty June Hayes,
Register of Deeds,
Orange County, N. C.

Recording Time, Book and Page

Tax Lot No. 7.29..3C & 7.29..3D Parcel Identifier No. 9789-55-1528 & 9789-45-5646 ABC

Verified by ..... County on the day of ....., 19 .....

by .....

Mail after recording to KENDALL H. PAGE, 210 N. COLUMBIA, CHAPEL HILL, NC 27514

This instrument was prepared by Alison R. Cayton of Manning, Fulton & Skinner, P.A. (without title examination)

Brief description for the Index Coker Hill West Property

NORTH CAROLINA GENERAL WARRANTY DEED

THIS DEED made this 1st day of March, 1995, by and between

GRANTOR	GRANTEE
GOFORTH PROPERTIES, INC., a North Carolina Corporation	WHITCOMB RUMMEL 201 Hillcrest Road Chapel Hill, NC 27514

Enter in appropriate block for each party: name, address, and, if appropriate, character of entity, e.g. corporation or partnership.

The designation Grantor and Grantee as used herein shall include said parties, their heirs, successors, and assigns, and shall include singular, plural, masculine, feminine or neuter as required by context.

WITNESSETH, that the Grantor, for a valuable consideration paid by the Grantee, the receipt of which is hereby acknowledged, has and by these presents does grant, bargain, sell and convey unto the Grantee in fee simple, all that certain lot or parcel of land situated in the City of Chapel Hill, Township, Orange County, North Carolina and more particularly described as follows:

SEE EXHIBIT A ATTACHED HERETO, THE TERMS OF WHICH ARE INCORPORATED HEREIN.

The property hereinabove described was acquired by Grantor by instrument recorded in .....

.....

A map showing the above described property is recorded in Plat Book ..... page .....

TO HAVE AND TO HOLD the aforesaid lot or parcel of land and all privileges and appurtenances thereto belonging to the Grantee in fee simple.

And the Grantor covenants with the Grantee, that Grantor is seized of the premises in fee simple, has the right to convey the same in fee simple, that title is marketable and free and clear of all encumbrances, and that Grantor will warrant and defend the title against the lawful claims of all persons whomsoever except for the exceptions hereinafter stated. Title to the property hereinabove described is subject to the following exceptions:

This property is conveyed subject to 1995 as valorem taxes, not yet due and payable and to enforceable easements, restrictions and rights of way of record.

IN WITNESS WHEREOF, the Grantor has hereunto set his hand and seal, or if corporate, has caused this instrument to be signed in its corporate name by its duly authorized officers and its seal to be hereunto affixed by authority of its Board of Directors, the day and year first above written.

GOFORTH PROPERTIES, INC.
(Corporate Name)

By: _____

_____ President

ATTEST: _____

_____ Asst Secretary (Corporate Seal)

USE BLACK INK ONLY

_____ (SEAL)

_____ (SEAL)

_____ (SEAL)

_____ (SEAL)

SEAL-STAMP

Use Black Ink

NORTH CAROLINA, _____ County.

I, a Notary Public of the County and State aforesaid, certify that _____

_____ Grantor,

personally appeared before me this day and acknowledged the execution of the foregoing instrument. Witness my hand and official stamp or seal, this _____ day of _____, 19_____.

My commission expires: _____ Notary Public

SEAL-STAMP

MARJORIE JILL COOPER
NOTARY PUBLIC
JOHNSTON COUNTY, N.C.
My Commission Expires 3-24-99

Use Black Ink

NORTH CAROLINA, WAKE County.

I, a Notary Public of the County and State aforesaid, certify that Stephen T. Byrd,

personally came before me this day and acknowledged that he is Assistant Secretary of Goforth Properties Inc a North Carolina corporation, and that by authority duly given and as the act of the corporation, the foregoing instrument was signed in its name by its President, sealed with its corporate seal and attested by him as its Assistant Secretary.

Witness my hand and official stamp or seal, this 1st day of March, 19 95.

My commission expires: 3/24/99 Marjorie Jill Cooper Notary Public

The foregoing Certificate(s) of Marjorie Jill Cooper, A Notary Public of Johnston County, NC

is/~~are~~ certified to be correct. This instrument and this certificate are duly registered at the date and time and in the Book and Page shown on the first page hereof. This 31st day of March, 1995

Betty Jane Hayes REGISTER OF DEEDS FOR ORANGE COUNTY

By Priscilla O. Mayo Deputy/~~Assistant~~ - Register of Deeds

N. C. Bar Assoc. Form No. 3 © 1976, Revised © 1977
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EXHIBIT A

Tract I:

BEGINNING at an iron stake located in the southeastern corner of Lot No. 51, Section X, COKER HILLS WEST, according to Plat Book 33, at Page 91, Orange County Registry; running thence with the western margin of the property of the Guy B. Phillips School South 10° 26' 35" West 396.28 feet to a stake located in the northern margin of the right-of-way of Estes Drive; running thence along the northern margin of the right-of-way of Estes Drive the following courses and distances: North 88° 07' 56" West 487.07 feet to a stake and North 80° 00' 08" West 70.71 feet to a stake located in the northeastern intersection of Estes Drive and Somerset Drive; running thence with the eastern margin of Somerset Drive the following courses and distances: North 01° 52' 04" East 49.90 feet to a stake, along the curve of a circle to the left having a radius of 1804.42 feet and a length of 253.81 feet to a stake, along the curve of a circle to the right having a radius of 389.73 feet and a length of 225.51 feet, and along the curve of a circle to the left having a radius of 1030.00 feet and a length of 5.96 feet to a stake located in the southwestern corner of Lot No. 48, Section X, COKER HILLS WEST; running thence with the southern margin of Lots No. 48-51, Section X, COKER HILLS WEST South 74° 16' 05" East 616.39 feet to the point and place of BEGINNING.

Tract II:

BEGINNING at an iron stake located in the southeastern corner of Lot No. 47, Section X, COKER HILLS WEST, according to Plat Book 33, at Page 91, Orange County Registry; running thence with the western margin of the right-of-way of Somerset Drive the following courses and distances: along the curve of a circle to the left having a radius of 449.73 feet and a length of 254.39 feet to a stake, along the curve of a circle to the right having a radius of 1744.42 feet and a length of 245.37 feet to a stake, and South 01° 52' 04" West 49.90 feet to an iron stake located in the northwestern intersection of Estes Drive and Somerset Drive; running thence along the northern margin of the right-of-way of Estes Drive the following courses and distances: South 83° 44' 16" West 70.71 feet to a stake and South 89° 51' 15" West 396.39 feet to a stake located in the centerline of a sixty-eight (68) foot Duke Power Company right-of-way; running thence with the centerline of the Duke Power Company right-of-way North 00° 44' 18" East 835.58 feet to a stake; running thence with the southern margin of Lot No. 44, Section IX and Lots No. 45-47, Section X, COKER HILLS WEST the following courses and distances: South 57° 20' 06" East 482.99 feet to a stake and South 74° 16' 05" East 88.66 feet to the point and place of BEGINNING.

PIN #9789-55-1528 TM 7.29. .3C
PIN #9789-45-5646 TM 7.29. .3D

Δ = 8-03-33
Δ = 33-10-04
Δ = 06-19-54

Daniel Roach architect

Fiscal Impact Analysis for Chapel Hill Retirement Residence
700 North Estes Drive

Prepared September 28, 2016

Development Context and Assumptions

The Chapel Hill Retirement Residence is an Independent Senior Living Facility proposed on a vacant 6.44-acre site located at the NE Corner of N Estes Drive and Somerset drive. The intent is to develop a 152-suite, 3-story structure with partial daylight basement.

The Hawthorn model of congregate care provides seniors in-house services, which allows the development to have little negative impact on the community. Services for residents include three prepared meals daily, housekeeping, laundering service, private van transportation, and various social and physical activities. The Management Team lives on the premises and is available to residents 24 hours a day. Hawthorn provides private van transportation for residents use given that less than 20% of residents typically drive their own cars. Van service offers residents independence and mobility while providing their families peace of mind.

Hawthorn Development Group has a 30-year history of developing high quality senior living residences. Their developments provide much needed housing for an aging population, bring employment opportunities, and can free up existing single-family housing. Their developments increase property values which increases property tax revenue while having no negative fiscal impact on public services. This low impact use does not create the problems typically associated with higher density developments, such as traffic, noise, or increased demand on public services.

Based on existing facilities and the current building plans layout, we estimate the following:

Proposed use by square foot

Retirement Residence	138,673 SF
Onsite Garage	1,400 SF
Onsite Van Garage	1,800 SF

Site improvements needed to facilitate project

The site is currently vacant. Site improvements include the construction of the retirement residence, internal roadways, surface parking, parking garages, stormwater management areas, outdoor amenity spaces, and natural preservation areas. The development includes utility extensions and the addition of public sidewalks along part of Somerset Drive. The design provides substantial buffers to adjacent homeowners and preserves natural site amenities to benefit both our residents and surrounding neighbors. The development also includes a sewer main extension that will be paid for by the developer and a fee in lieu that will be charged to the development for city installed street improvements along N. Estes Drive.

Timeline for completion of project

Construction is expected to begin in 2017 or 2018 following land use, site, and building permit approvals. Construction is expected to take approximately 18 months.

Property Tax Revenue

According to the Orange County Tax office, the property in 2014 was valued at $220,364 with the following taxes:

Agency	Tax Rate	Charged in 2014
Orange County	.8780	$1,934.80
Chapel Hill	.5240	$1,154.71
Chapel Hill Carrboro City Schools	.2084	$459.24

Once the development is complete, the property is conservatively estimated to have an assessed value of $16,000,000. Using the same property tax rates from 2014, future taxes are estimated as follows:

Agency	Tax Rate	Projected for 2018
Orange County	.8780	$140,480
Chapel Hill	.5240	$83,840
Chapel Hill Carrboro City Schools	.2084	$33,344

In summary, the proposed development offers the following increase in property tax revenue:

Agency	Tax Rate	Increase
Orange County	.8780	**$138,545.20**
Chapel Hill	.5240	**$82,685.29**
Chapel Hill Carrboro City Schools	.2084	**$32,884.76**

Town of Chapel Hill Revenue vs. Cost Table

		One Time	Annually
Property Taxes			
	General Fund (police, fire, sanitation, street maintenance) & Transportation Fund (public transit services)		**$83,840**
Planning Fees		**$81,909**[4]	
Permit Fees		**$120,461**[4]	
OWASA Development Charges		**$177,018**[4]	
Public Works			
	Solid waste collection	Collection provided by private contractor	
	Street maintenance services	Onsite maintenance of roadways provided by private contractor[1]	
	Stormwater Management Fee		**$2,750**[5]
Parks & Recreation		No impact anticipated[2]	
Library Services		No impact anticipated[2]	
Police Services		No impact anticipated[2]	
Fire Services			**$2,500**[3]
Public Transportation/Transit		No impact anticipated[2]	
Planning/Inspections		No impact anticipated[2]	

General Government	No impact anticipated[2]	
Public Works	No impact anticipated[2]	
Total	**$379,388**	**$84,090**

1. No new public streets will be constructed as part of this development and there is a negligible increase in trip generation; therefore, there is no change to offsite street maintenance expected.
2. No impact expected based on services provided within the development.
3. Estimate 3-4 first responder calls per month. Cost to be verified with Fire Department.
4. See the attached permit and development fee estimate.
5. Stormwater Management Fee may not apply due to onsite storm management. If required, $156.90 + $26.15 for each additional 1,000 SF of impervious area. Total amount estimated based on 37.5% impervious area on the site.

Orange County Revenue vs. Cost Table

	One Time	Annually
Property Taxes		**$140,480**
Orange County Solid Waste Programs Fee (recycling, waste management, and waste reduction services)		**$16,264**
Total	**0**	**$156,744**

Chapel Hill Carrboro City Schools Revenue vs. Cost Table

	One Time	Annually
Property Taxes		**$33,344**
System Development Fees	Exempt*	
Total	**0**	**$33,344**

*This development has no fiscal impact on schools and is age-restricted and therefore exempt from school impact fees.

Conclusion

In summary, the data above shows that the cost to the Town for the proposed development is minimal, but the positive fiscal impact to the community is high. With the increased property taxes alone, over $250,000 of additional revenue is expected annually.

Additionally, the project estimates the following local expenditures, which may also increase revenue to the community:

	Annual Expenditure
Employee Payroll & Benefit packages	$800,000
Electricity	$107,000
Water/Sewer/Garbage	$53,000
Fuel/Heating	$13,000
Cable	$45,000
Sales & Use taxes	$15,000

Chapel Hill Retirement Residence

NE Corner of Estes Dr & Somerset Dr, Chapel Hill, NC 27514

Permit & Development Fee Estimate

Date: September 28, 2016

Planning Fees	Formula	Total
Concept Plan Review		$360
Zoning Atlas Amendment (ZAA)	$1,200 plus $60/acre @ 6.25 acres	$1,575
Land Use Management Text Amendments (LUMTA)	Use definition	$1,199
	Zoning Designation	$1,199
	Airport overlay	$1,619
Community Design Commission (CDC)		$397
Special Use Permit (SUP)	$7,787 + $30/100 sq ft @ 140,000 sq ft	$49,787
Final Plan Fee	1/2 of SUP fee	$24,894
Traffic Impact Exemption		$350
Sign Plan Review	individual sign, single business on one zoning lot	$181
Notification Fee	Concpet Plan Mailing Fee	$85
	Text Amendment Mailing Fee	$85
	SUP & Rezone Mailing Fee	$178
Total		**$81,909**

Permit Fees	Formula	Total
Building Permits		
Administrative Review Fee	Paid up front and credited toward Final Permit Fees.	$2,500
Plan Review	≥ 40,000 sq ft, $1420 for first review, subsequent reviews charged at	$6,000
Building Permit (note 6)	Base fee of $2,500 plus $3.50/$1,000 over $500,001 in costs	$56,750
Building Permit - Van Garage	Base fee of $500 plus $4.50/$1,000 over $50,001 + trade fees	$599
Building Permit - Garage	Base fee of $500 plus $4.50/$1,000 over $50,001 + trade fees	$527
Electrical	meter estimate of $200 plus $41 for the first 10 fixtures plus an	$1,200
Mechanical	price varies per fixture, estimate	$1,400
Plumbing	$10 per fixture, estimate 645 fixtures + $50 sewer connection	$6,500
Fire Permits	Sprinkler $150 per riser, Fire Alarm & Detection $150, Kitchen Hood	$600
Civil Permits		
Engineering Plan Review	$500 + $350 / acre @6.438 acres	$2,753
Roadway Improvements	$2/LF, estimate	$2,500
Private Fire Line	$1/LF, estimate	$800
Sanitary Sewer Line	in public right of way, $1/LF, estimate	$800
Water Line	in public right of way, $1/LF, estimate	$100
Stormwater Lines	$0.50/LF, estimate	$300
Driveway Permit		$100
Stream Determination	no fee required	$0
NPDES Permit	general	$100
NPDES Permit	state, post-construction	$505
NCDOT	ROW Permit, estimate	$25,000
NCDENR - DWR Fee	$480 for a gravity sewer main extension; $150 for a water main	$630
Grease Interceptor		$1,200
Other Permits		
Sign Permit		$35
Construction Trailer		$55
Health Review		$250
Orange County Recyclable	8% on all permits	$8,896
Fire Flow Test		$280
Certificate of Occupancy	temporary CO $80 each	$80
Total		**$120,461**

System Devlp Fees	Formula	Total
OWASA Plan Review and Construction Observation Fee	length of main extension in feet x $7.32 (estimate 800 ft)	$5,856
OWASA Tapping Fee	traffic control and water tap, no sewer tap fee, minimum $335, charge for time and equipment, estimate	$1,200
OWASA Fire Meter Fee		$370
OWASA Water Service Availability Fee	3 " meter - $59,262, 1" irrigation meter - $9,260	$68,522
OWASA Sewer Service Availability Fee	3" meter	$101,070
Schools Fees	Exempt per Orange County	$0
Total		**$177,018**

Total Project Costs		**$379,388**

Costs provided are estimates only. Fees are not guaranteed and are subject to change.

MEMO

Date: September 13, 2016

To: Benjamin Vanager

From: Erik Meininger, PE

Subject: Chapel Hill Retirement Residence – Water Distribution System Analysis

Copies: File

As requested, an analysis of the proposed water distribution system for the referenced project has been completed. The following information provides a brief summary of the design items incorporated into the analysis.

Recent fire flow data for the existing 16-inch water main in the North Estes Drive right-of-way near the project site has been provided to EMH&T by Orange County Water and Sewer Authority and is summarized in Table 1. This data indicates a static pressure of 88 psi. The test indicates that a flow of 1,405 gpm is available at 84 psi on the existing system. Fire flow test results have varying factors that may directly impact the results (e.g., hourly fluctuations in water levels at the water tanks, changes in consumer demands in the area of the flow test, and seasonal changes in water plant discharge pressures). The net effect of these changes may shift static pressures by approximately five to ten psi. The reported flow test data was used to calibrate the model.

Table 1: Fire Flow Test Information

Description	Fire Flow Test
Static Pressure (psi)	88
Residual Pressure (psi)	84
Flow (gpm)	1,405
Calculated Flow @ 20 psi (gpm)	>5,000
Flow Hydrant	2nd Hydrant east of the project site on the north side of North Estes Drive
Pressure Hydrant	1st Hydrant east of the project site on the north side of North Estes Drive
Water Main Size	16-inch
Test Date	August 10, 2016

The project site was evaluated for the performance of the proposed private water service. The layout of the water service was taken from the engineering base drawing current when the water analysis was initiated. The system was sized as follows to provide domestic and fire protection service in accordance with the town and state standards. It was determined that the existing 16-inch main in North Estes Drive should be tapped with an 8-inch line that will branch into a 6-inch lead to the hydrant south of the building and to an 8-inch lead to the hydrant north of the building. The domestic service will be a 2-inch line, run through a 2-inch MVR meter and RPZA backflow preventer then to the building. For improved pressures in the peak condition, the domestic service line could be increased in diameter to a 3-inch service downstream of the meter and backflow preventer. Please note that sprinkler system was not sized as part of this analysis because no performance requirements were available when the analysis was prepared.

Demand information was calculated using building information provided by the project engineer and the North Carolina Division of Water Resources Rules Governing Public Water Systems Section .0409. There are a total of 152 residential suites on the site, and it was assumed that laundry will be handles on site. An Average Daily Flow (ADF) was calculated for the development then projected to calculate the Peak Domestic Flow (PDF), an instantaneous flow modeling the maximum number of fixtures all operating simultaneously (10x the ADF) and the Maximum Daily Flow (MDF), a sustained flow that would be expected during peak hours (2x the ADF). See Table 2 for detailed design demands.

Table 2: Domestic Design Demands

Structure Information		Calculated Flows			
Structure	**No. of Units**	**Daily Usage per suite (gpd)**	**ADF (gpm)**	**MDF (gpm)**	**PDF (gpm)**
Housing Suites	152	120	12.67	25.34	126.67

No fire protection system (i.e. sprinkler system) demands were available at the time this analysis was prepared, so the fire protection system service line, meter, and backflow preventer were not sized during this analysis.

All elevation data used in this study for the project is based on proposed site grading. Elevations of features outside of the proposed site area were set using topo survey data information.

The pipe sizes were added to the model per the engineering plan and nodes were added at intersections and termination points on the water mains. These nodes, and the pressures related to them, are located on the water mains and do not evaluate the pressure delivered at the service connection inside the building. Calculations were run for the PDF condition, the MDF & Fire Flow condition, and ADF condition for a total of three sets of calculations.

Scenario 1 - Peak Daily Flow

For Scenario 1, the peak daily flow was applied to the domestic service line. The system can provide 42 psi in the Peak condition at the point of connection to the building if a 2-inch service line is used from the backflow preventer to the building. The pressure would improve to 58 psi if the domestic service line in upsized to a 3-inch line from the backflow preventer to the building. Either way, the domestic service line will provide a pressure of more than 30 psi during the peak condition as required by North Carolina Administrative Codes Title 15A, Subchapter 18C. Additional detail including layout and pipe sizes can be seen on the Exhibit “Scenario: PDF.”

Scenario 2 – Max Daily Flow + Fire Flow

The site was evaluated to determine the pressure available at a fire flow of 2,500 gpm at each of the two private hydrants proposed for the site under the maximum daily flow conditions. Calculations showed that flows of 2,500 gpm could be supplied at 64 psi at the proposed hydrant south of the proposed building and at 36 psi at the proposed hydrant north of the building. Because of the length of the service to the hydrant, an 8-inch pipe was used to serve the hydrant north of the building. Each hydrant proposed on the site exceed the 2,500 gpm required by the Chapel Hill Town Engineering Standards. Additional detail including layout and pipe sizes can be seen on the Exhibit "Scenario: MDF+FF."

CONCLUSION / SUMMARY

Based on the analysis described herein, the proposed system is sized and routed adequately to provide the required flows and pressures for domestic and fire hydrant service to the development. The analysis performed showed that the system can provide flows exceeding 2,500 gpm at 20 psi to both of the proposed hydrants. The analysis also showed that the system can provide domestic service exceeding 30 psi during the peak demand condition as required by North Carolina Administrative Codes Title 15A, Subchapter 18C.

Orange Water And Sewer Authority

Fire Flow Test Report

Location N. Estes Dr and Somerset Dr

Test Made By: Crew 4 **Time:** 08:00 AM **Date:** 08/10/16

Requested By: Benjamin Vanager **Phone:** (704) 353-9964

Date Requested: 8/2/2016 **FAX:**

Flow Hydrant No. 516 **Gauge Hydrant No.** 2041

Hydrant Make Flow: Mueller **Nozzle Size:** 2½"

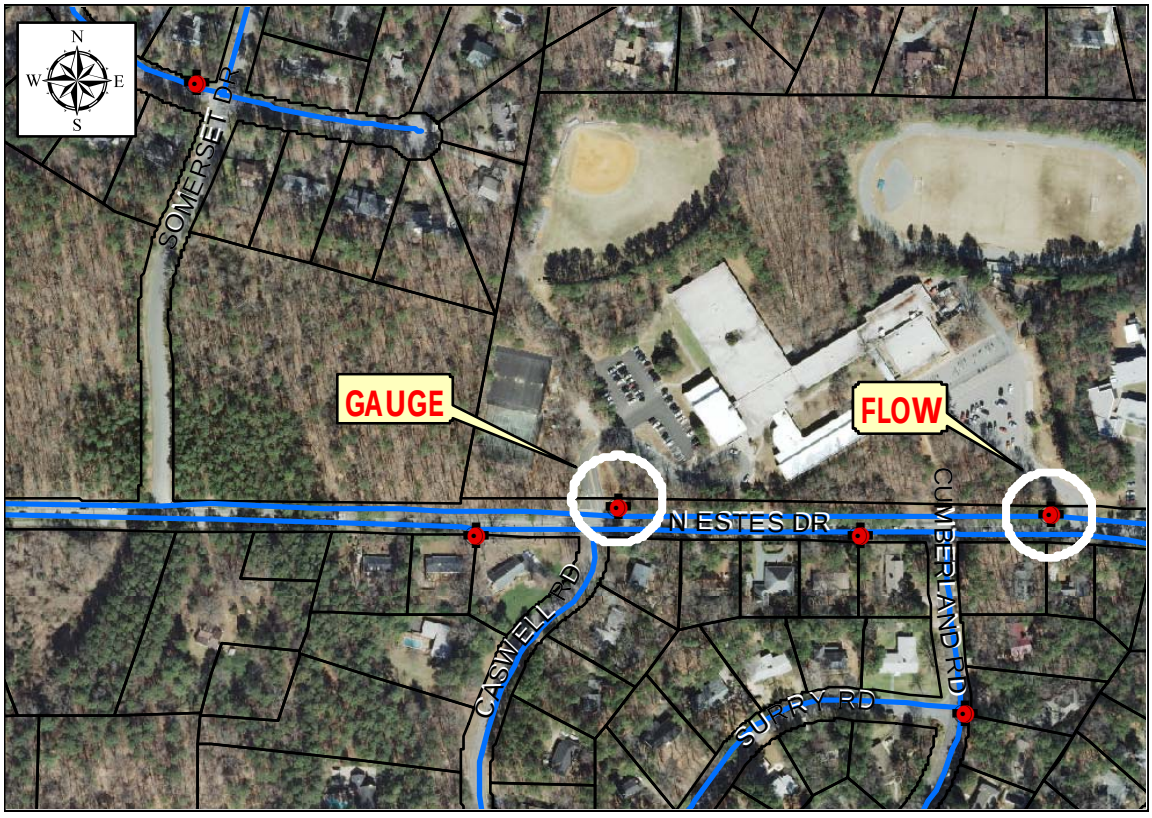
Hydrant Make Gauge: American Darling **Nozzle Size:** 2½"

Expected Static Pressure (PSI): **(Approx.)**

Static Pressure (PSI): 88 **Pitot Reading:** 70

Residual Pressure (PSI) 84 **Flow (GPM):** 1405

Sketch:



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NORTH CAROLINA PROFESSIONAL SEAL 032959 ENGINEER DOUGLAS C. TURNEY

9-27-16

Preliminary Stormwater Management Plan
Chapel Hill Retirement Residences

Town of Chapel Hill

Revised April 25, 2016
Revised June 30, 2016
Revised September 27, 2016

Engineers | Surveyors | Planners | Scientists

EMH&T

A legacy of **experience**. A reputation for **excellence**.

Project Summary:

Project Name:	Chapel Hill Retirement Residence
Location:	Chapel Hill, North Carolina
Type:	Preliminary Stormwater Management Plan
Reviewing Agency:	Delaware County, Ohio EPA

Hydrologic Summary:

Rainfall Data: NOAA Atlas 14, Volume 2, Version 3, 2004

1-yr	2.96”
2-yr	3.60”
5-yr	4.65”
10-yr	5.38”
25-yr	6.41”
50-yr	7.21”
100-yr	8.00”

Rainfall Distribution:	NRCS Type II 24 hour
Detention Policy:	Town of Chapel Hill
Water Quality:	NC DENR, Jordan Lake
Hydrology Modeling Program:	HydroCAD 10.00

Design Summary:

Detention:	Sand Filter
Water Quality:	Sand Filter
Receiving Water Body:	Bolin Creek

Appendices

Appendix A:	HydroCAD Output
Appendix B:	Water Quality Calculations
Appendix C:	Nutrient Calculations
Appendix D:	Geotech Report

1.0 INTRODUCTION

The following report provides a preliminary stormwater plan for the Chapel Hill Retirement Residences in the Town of Chapel Hill. The site is located at the northeast corner of Somerset Drive and North Estes Drive and involves the partial development of a wooded area. The site generally drains north to south and will be serviced by three sand filters in the post developed condition for water quality, recharge, and peak flow rate control.

2.0 HYDROLOGIC ANALYSIS

Hydrologic parameters such as Runoff Curve Number (RCN) and Time of Concentration were determined using standard Natural Resources Conservation Service (NRCS) methodology. The 2-, 5-, 10-, 25-, 50-, and 100-year storm event discharge amounts were calculated using the NRCS TR-55 method. This analysis reflects the NRCS Type II distribution, 24-hr storm duration. Rainfall depths were obtained from NOAA Atlas 14, Volume 2, Version 3, 2004. The peak flow rates were computed using the HydroCAD 10.0 computer program.

3.0 PRE-DEVELOPED ANALYSIS

The predeveloped conditions watershed boundaries and time of concentration paths are shown on Exhibit 1 and consist of one onsite area and one offsite area. The predeveloped runoff characteristics of each subarea are shown on Table 1. The resulting predeveloped peak flow rates are shown on Table 2. HydroCAD output has been provided in Appendix A. The predominant soil type for this site is Enon Loam, which is a Type "C" soil with minimal infiltration potential. The site has several rock outcroppings and shallow bedrock, so a depth to groundwater table was not observed in the geotech report. Infiltration rates would be controlled by the native rock layer and have not been performed at this time.

Table 1
Pre-developed Subarea Characteristics

Subarea	Tributary Area (acres)	Runoff Curve Number	Time of Concentration (minutes)	2-year Runoff Volume (ac-ft)
Onsite	4.99	70	14.6	0.445
Undeveloped Onsite/Offsite	2.98	72	16.6	0.295

Table 2
Pre-developed Peak Flow Rates

Storm Event (year)	Onsite (cfs)	Undeveloped Onsite/Offsite (cfs)
1	4.00	2.62
2	6.56	4.15
5	11.36	6.96
10	14.98	9.06
25	20.33	12.15
50	24.64	14.61
100	28.97	17.09

4.0 POST-DEVELOPED ANALYSIS

With development, a portion of the property is being developed and routed to one of three sand filters for water quality, recharge, and peak flow rate control. The peak flow rate control is the 1, 2, and 25-year storms detained to predeveloped conditions. The water quality requirement is 85%. Nutrient requirements are also required according to the Jordan Lake nutrient reduction spreadsheet. Recharge is recommended to reduce the 2-year post runoff volume to the 2-year pre runoff volume, but given the nature of the shallow bedrock, our ability to infiltrate is limited. However, the sand filter underdrains will be raised off the bottom to promote infiltration. The basins are all in parallel and combine together to discharge at a point along North Estes Road and discharge into an existing 24" culvert. Table 4 lists the tributary area, RCN, and time of concentration to each basin. A value of 5 minutes was used for the onsite post-developed area to be conservative. The 2-year onsite runoff volume increases from 0.366 ac-ft in the predeveloped condition to 0.869 ac-ft in the post-developed condition. HydroCAD output has been provided in Appendix A.

Table 4
Onsite Post-developed Subarea Characteristics

Subarea	Tributary Area (acres)	Runoff Curve Number	Time of Concentration (minutes)	2-year Runoff Volume (ac-ft)
Post to BMP 1	0.53	88	5	0.104
Post to BMP 2	0.49	89	5	0.100
Post to BMP 3	3.08	89	5	0.629
Undeveloped to BMP 3	2.98	72	16.6	0.295

Table 5
Allowable & Post Developed Peak Flows Peak Flow Rates

Storm Event (year)	Predeveloped (cfs)	Undeveloped to Site (cfs)	Allowable (cfs)	Post Onsite Only w/o Controls (cfs)	BMP 1 Release (cfs)	BMP 2 Release (cfs)	BMP 3 Release (cfs)	Post w/Controls & Undetained (cfs)
1	4.00	2.62	6.62	15.15	0.01	0.01	2.63	2.88
2	6.56	4.15	10.71	19.91	0.01	0.01	8.64	10.21
25	20.33	12.15	32.48	41.11	0.01	0.33	32.01	37.61

5.0 OUTLET DESIGN

Basin 1

- Top sand – 429.00
- Sand Area – 175 SF
- 1st stage/WQ outlet – Sand Filter
- 2nd stage outlet – 24" x 24" Horizontal Grate Opening @ 432.00
- Top of Bank – 432.00

Basin 2

- Top sand – 430.00
- Sand Area – 180 SF
- 1st stage/WQ outlet – Sand Filter
- 2nd stage outlet – 24" x 24" Horizontal Grate Opening @ 433.00
- Top of Bank – 434.00

Basin 3

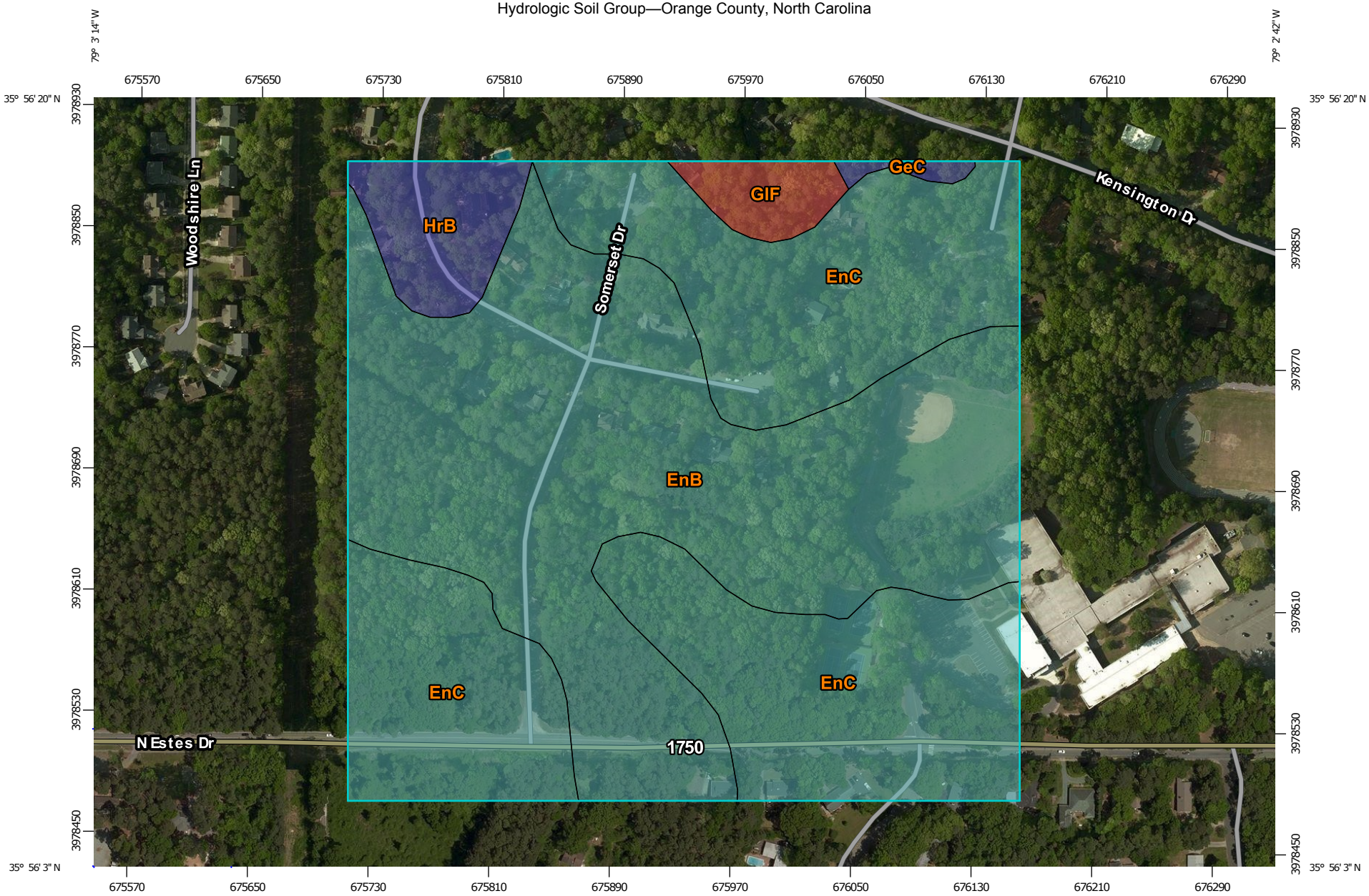
- Top sand – 431.00
- Sand Area – 1410 SF
- 1st stage/WQ outlet – Sand Filter
- 2nd stage outlet – 36" x 36" Horizontal Grate Opening @ 433.80
- Top of Bank – 435.00

6.0 WATER QUALITY

Water quality calculations have been provided in Appendix B for each basin using a sand filter.

7.0 NUTRIENT CONTROL

The Jordan Lake Nutrient control worksheets have been provided in Appendix C. The calculations show sufficient nutrient control is being provided by the onsite BMPs to meet minimum onsite thresholds. It appears, offsite mitigation credits will need to be purchased for nitrogen, totaling 294 lbs. Nutrient credits will be required to be purchased from a private nutrient bank or the EEP program through NC DENR.



Map Scale: 1:3,580 if printed on A landscape (11" x 8.5") sheet.

N

0 50 100 200 300 Meters

0 150 300 600 900 Feet

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 1:20,000.

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: http://websoilsurvey.nrcs.usda.gov
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: Orange County, North Carolina
Survey Area Data: Version 15, Sep 16, 2015

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

Date(s) aerial images were photographed: Apr 27, 2014—May 6, 2014

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Orange County, North Carolina (NC135)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
EnB	Enon loam, 2 to 6 percent slopes	C	22.2	47.6%
EnC	Enon loam, 6 to 12 percent slopes	C	21.0	44.9%
GeC	Georgeville silt loam, 6 to 10 percent slopes	B	0.2	0.5%
GlF	Goldston channery silt loam, 15 to 45 percent slopes	D	1.1	2.3%
HrB	Herndon silt loam, 2 to 6 percent slopes	B	2.2	4.7%
Totals for Area of Interest			**46.7**	**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

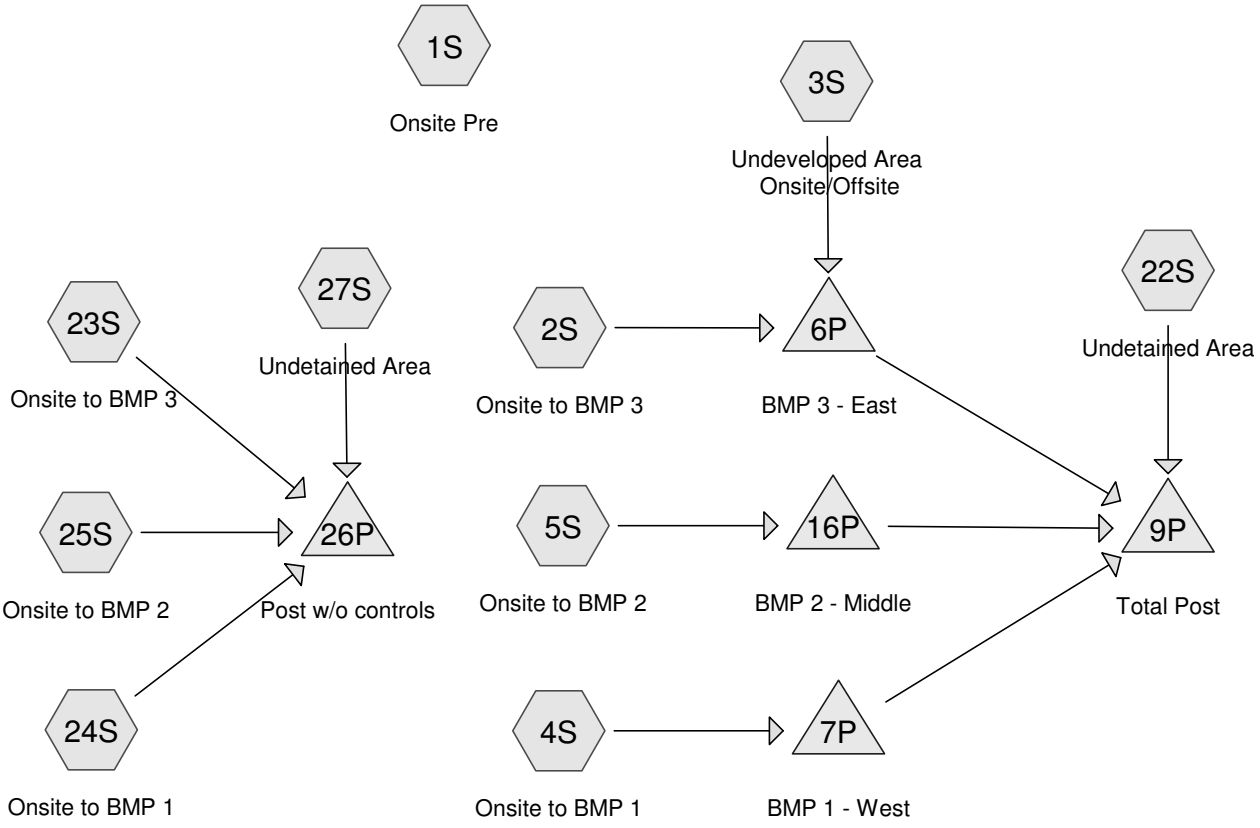
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Appendix A

HydroCAD Output



Subcat Reach Pond Link

Routing Diagram for 20141832-rev2
Prepared by Symanetc, Printed 9/27/2016

Summary for Subcatchment 1S: Onsite Pre

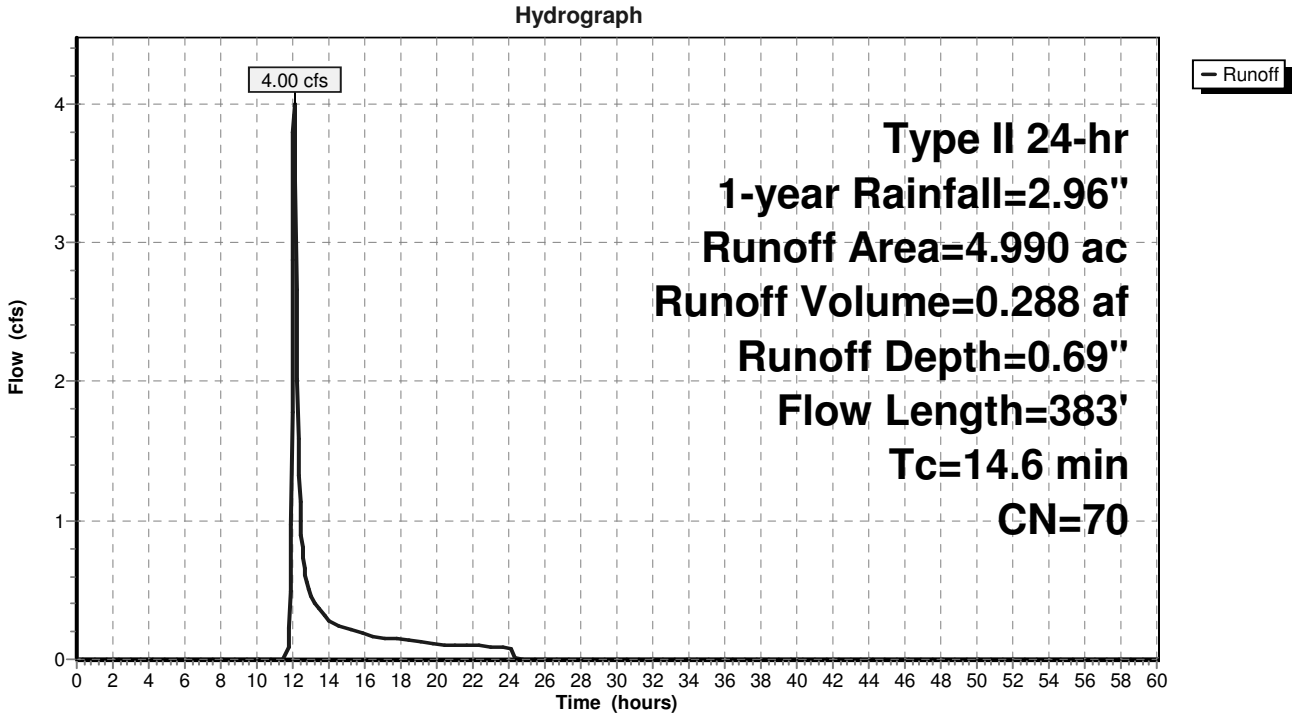
Runoff = 4.00 cfs @ 12.09 hrs, Volume= 0.288 af, Depth= 0.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-year Rainfall=2.96"

Area (ac)	CN	Description
4.990	70	Woods, Good, HSG C
4.990		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.9	100	0.0750	0.14		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.60"
2.7	283	0.1200	1.73		**Shallow Concentrated Flow, B to C shallow flow** Woodland Kv= 5.0 fps
14.6	383	Total			

Subcatchment 1S: Onsite Pre



Summary for Subcatchment 2S: Onsite to BMP 3

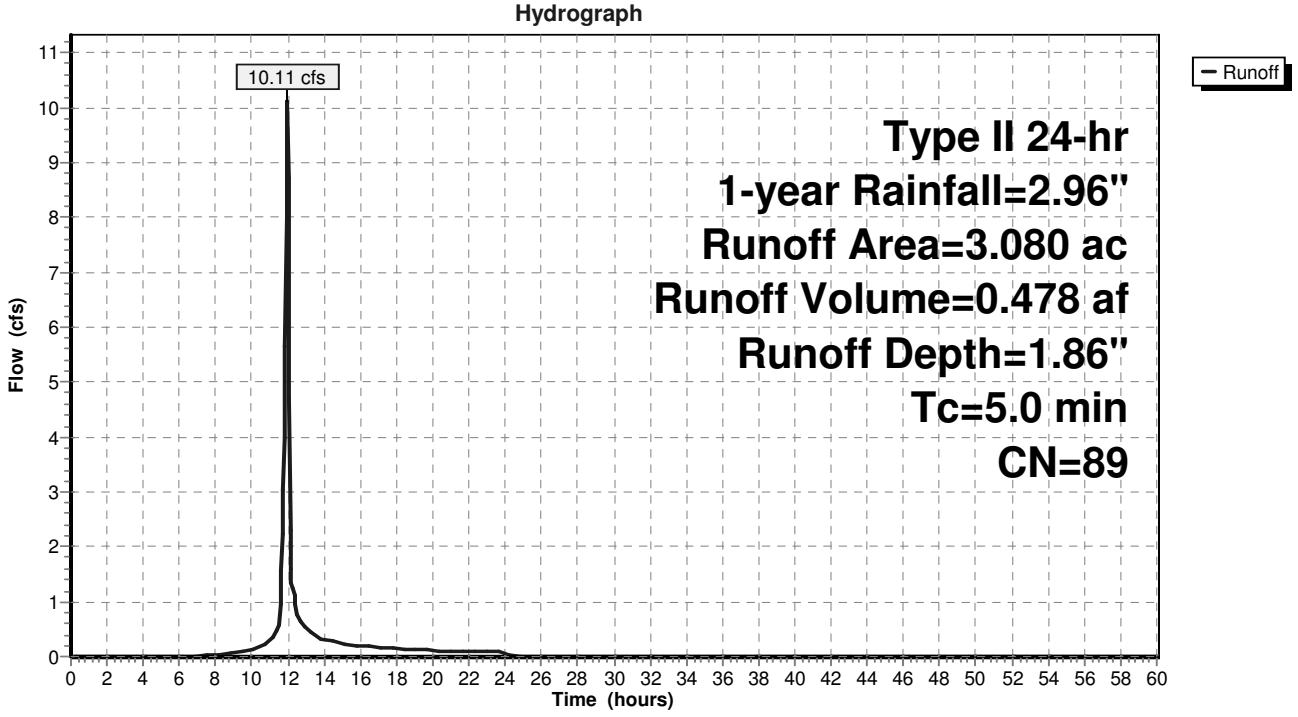
Runoff = 10.11 cfs @ 11.95 hrs, Volume= 0.478 af, Depth= 1.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-year Rainfall=2.96"

	Area (ac)	CN	Description
*	1.950	98	impervious area
*	1.130	74	open space
	3.080	89	Weighted Average
	1.130		36.69% Pervious Area
	1.950		63.31% Impervious Area

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

Subcatchment 2S: Onsite to BMP 3



Summary for Subcatchment 3S: Undeveloped Area Onsite/Offsite

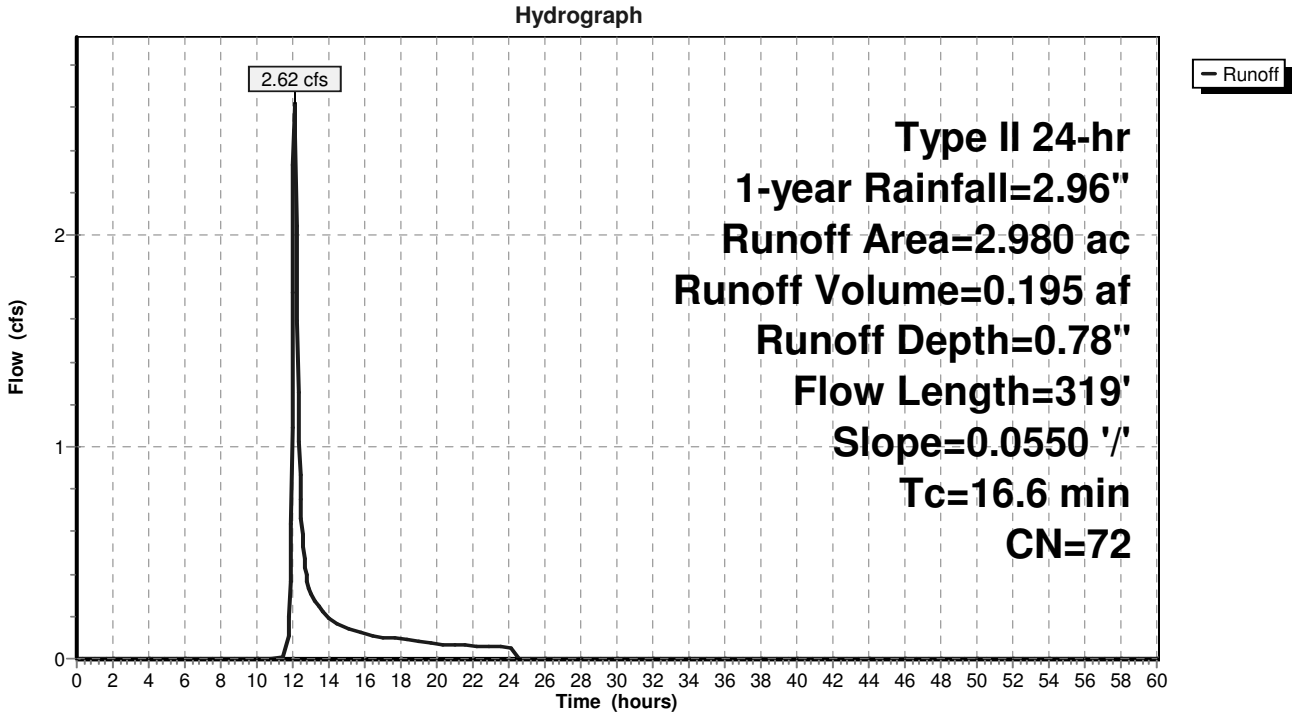
Runoff = 2.62 cfs @ 12.11 hrs, Volume= 0.195 af, Depth= 0.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-year Rainfall=2.96"

	Area (ac)	CN	Description
	2.740	70	Woods, Good, HSG C
*	0.240	98	roof area
	2.980	72	Weighted Average
	2.740		91.95% Pervious Area
	0.240		8.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0550	0.12		**Sheet Flow, A to B sheet flow** Woods: Light underbrush n= 0.400 P2= 3.60"
3.1	219	0.0550	1.17		**Shallow Concentrated Flow, B to C shallow flow** Woodland Kv= 5.0 fps
16.6	319	Total			

Subcatchment 3S: Undeveloped Area Onsite/Offsite



Summary for Subcatchment 4S: Onsite to BMP 1

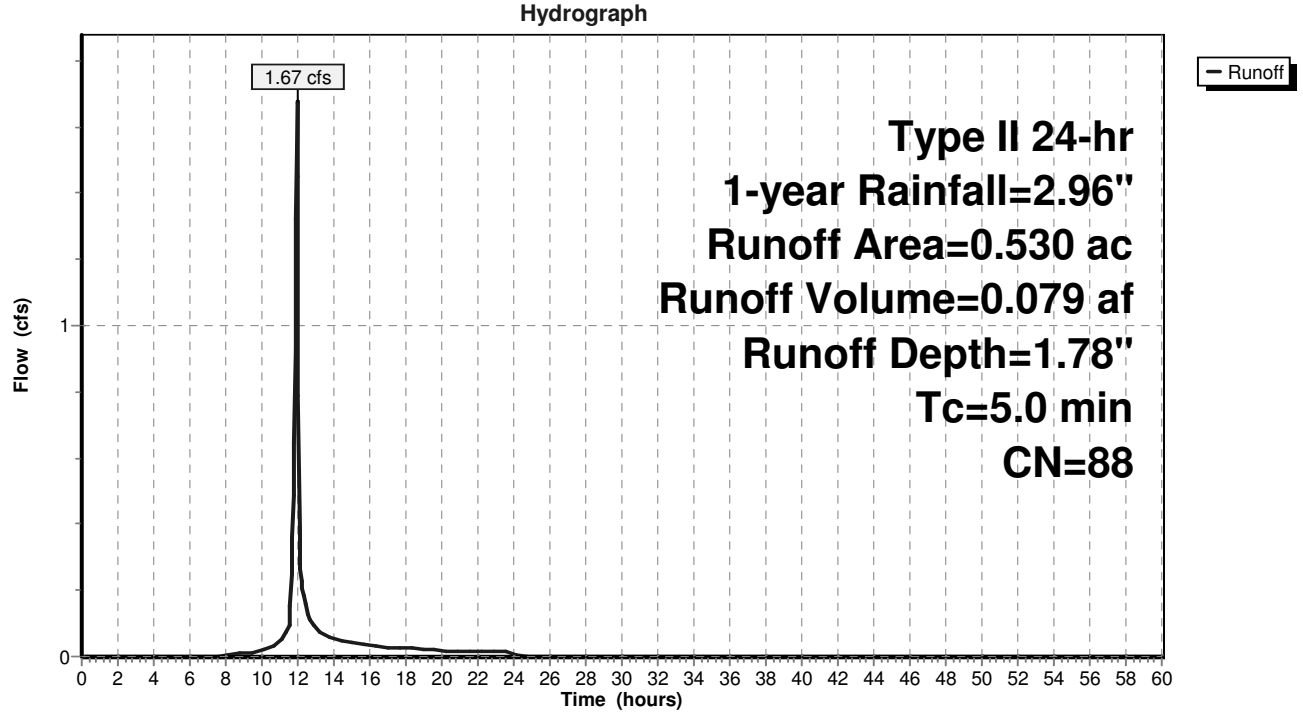
Runoff = 1.67 cfs @ 11.96 hrs, Volume= 0.079 af, Depth= 1.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-year Rainfall=2.96"

	Area (ac)	CN	Description
*	0.310	98	impervious area
*	0.220	74	open space
	0.530	88	Weighted Average
	0.220		41.51% Pervious Area
	0.310		58.49% Impervious Area

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

Subcatchment 4S: Onsite to BMP 1



Summary for Subcatchment 5S: Onsite to BMP 2

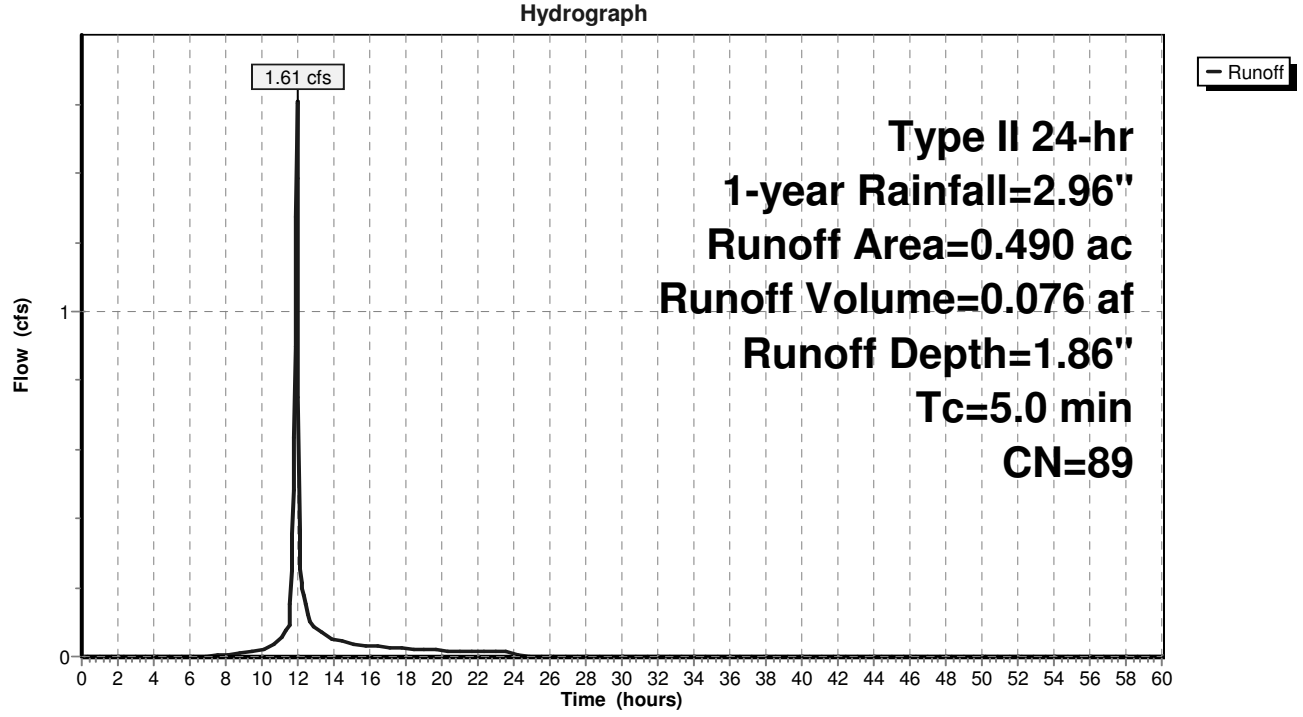
Runoff = 1.61 cfs @ 11.95 hrs, Volume= 0.076 af, Depth= 1.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-year Rainfall=2.96"

	Area (ac)	CN	Description
*	0.310	98	impervious area
*	0.180	74	open space
	0.490	89	Weighted Average
	0.180		36.73% Pervious Area
	0.310		63.27% Impervious Area

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

Subcatchment 5S: Onsite to BMP 2



Summary for Subcatchment 22S: Undetained Area

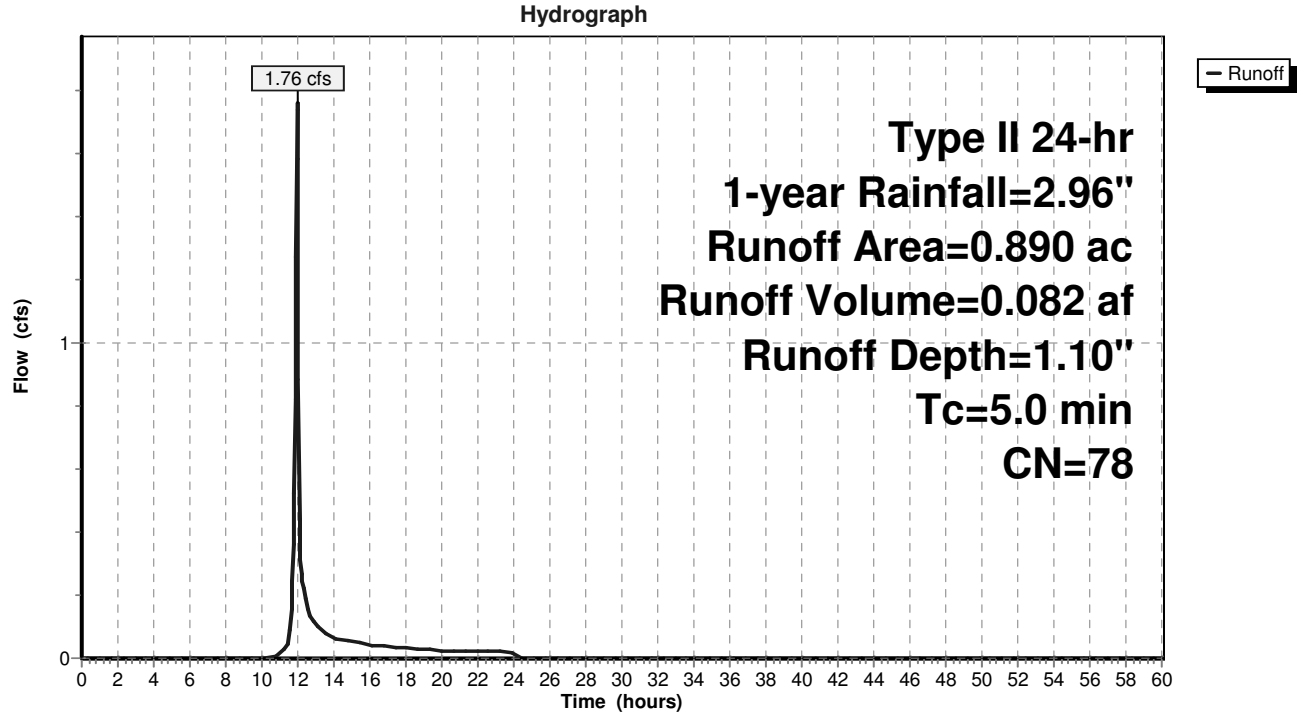
Runoff = 1.76 cfs @ 11.96 hrs, Volume= 0.082 af, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-year Rainfall=2.96"

	Area (ac)	CN	Description
*	0.370	70	woods good condition
*	0.200	98	impervious area
	0.320	74	>75% Grass cover, Good, HSG C
	0.890	78	Weighted Average
	0.690		77.53% Pervious Area
	0.200		22.47% Impervious Area

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

Subcatchment 22S: Undetained Area



Summary for Subcatchment 23S: Onsite to BMP 3

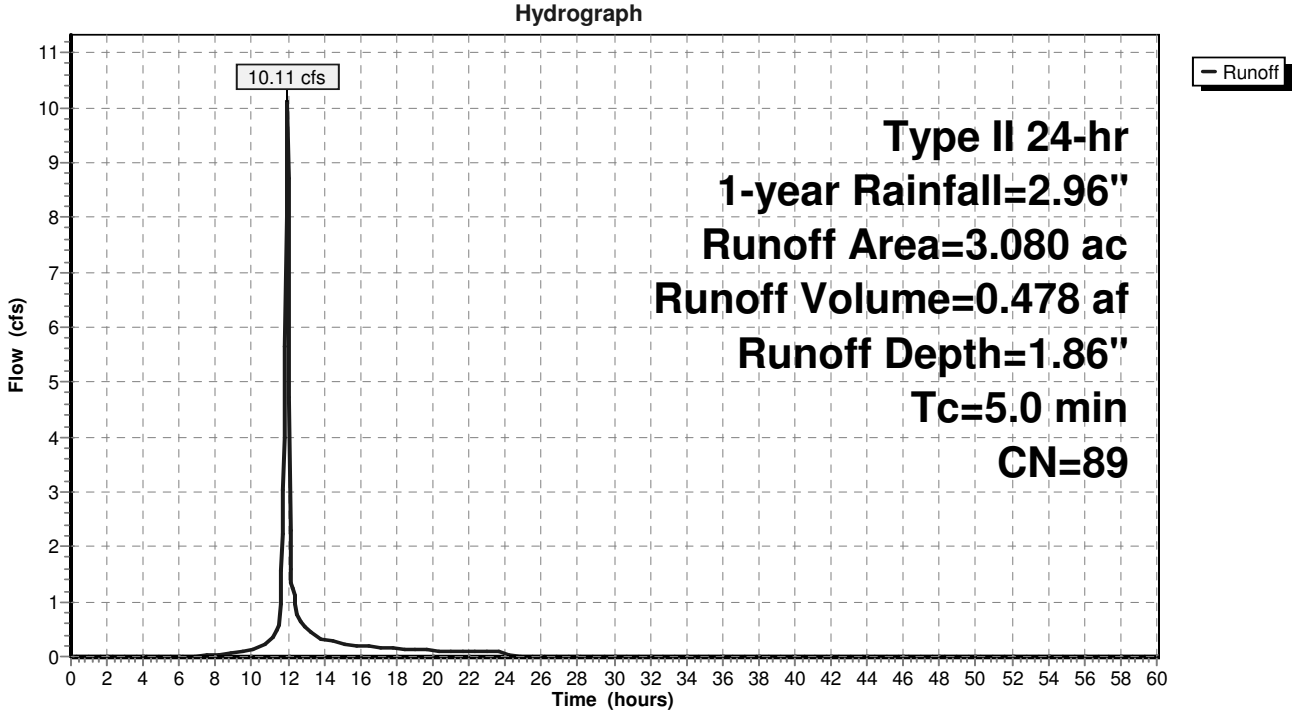
Runoff = 10.11 cfs @ 11.95 hrs, Volume= 0.478 af, Depth= 1.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-year Rainfall=2.96"

	Area (ac)	CN	Description
*	1.950	98	impervious area
*	1.130	74	open space
	3.080	89	Weighted Average
	1.130		36.69% Pervious Area
	1.950		63.31% Impervious Area

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

Subcatchment 23S: Onsite to BMP 3



Summary for Subcatchment 24S: Onsite to BMP 1

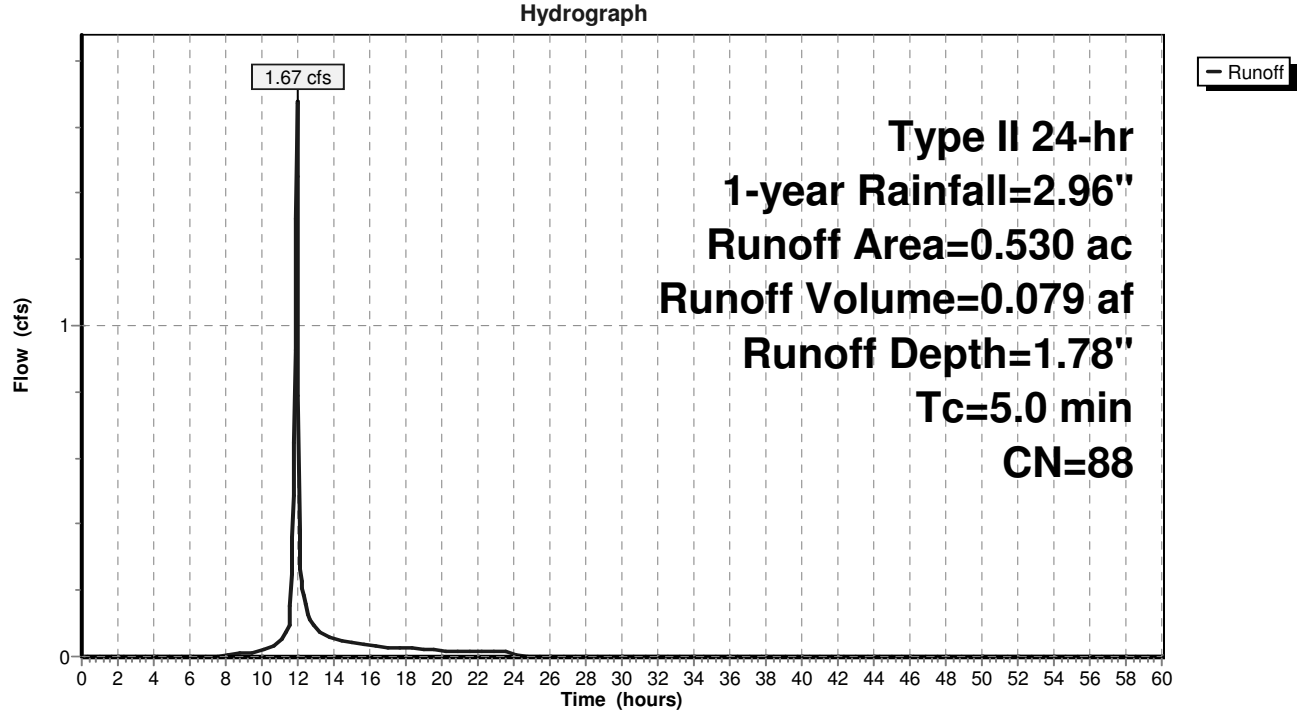
Runoff = 1.67 cfs @ 11.96 hrs, Volume= 0.079 af, Depth= 1.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-year Rainfall=2.96"

	Area (ac)	CN	Description
*	0.310	98	impervious area
*	0.220	74	open space
	0.530	88	Weighted Average
	0.220		41.51% Pervious Area
	0.310		58.49% Impervious Area

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

Subcatchment 24S: Onsite to BMP 1



Summary for Subcatchment 25S: Onsite to BMP 2

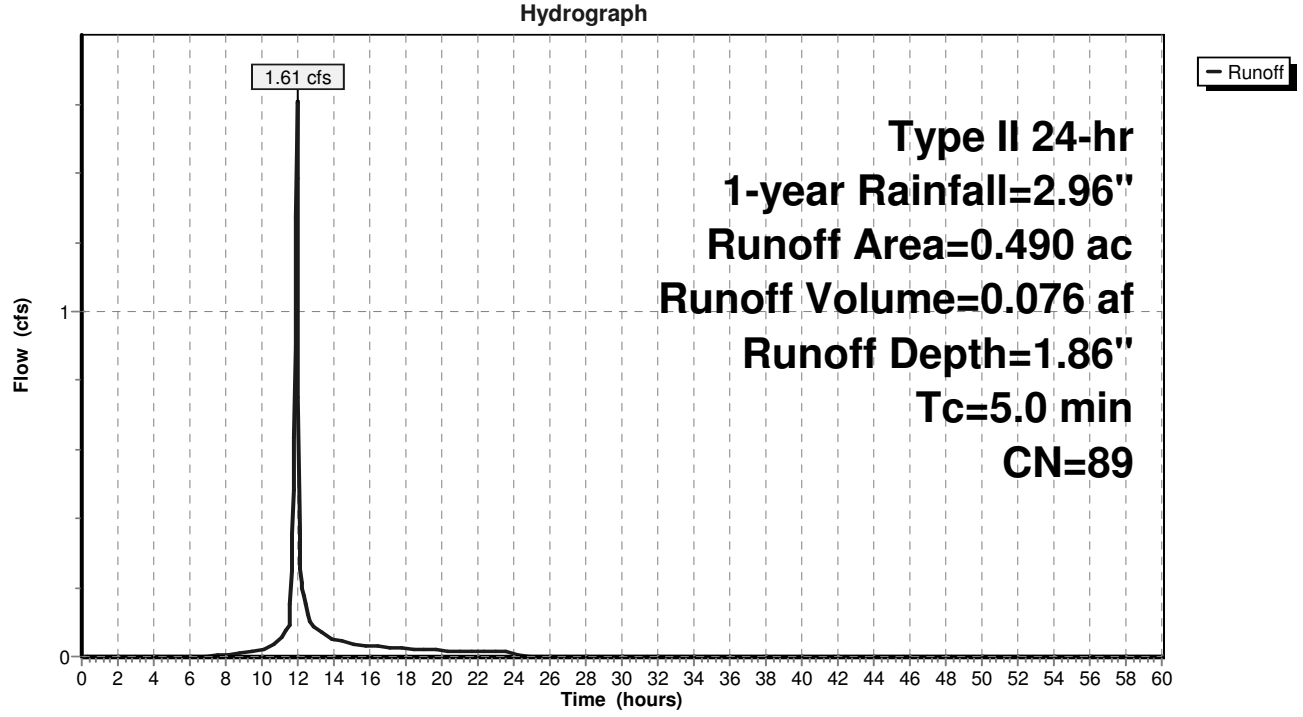
Runoff = 1.61 cfs @ 11.95 hrs, Volume= 0.076 af, Depth= 1.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-year Rainfall=2.96"

	Area (ac)	CN	Description
*	0.310	98	impervious area
*	0.180	74	open space
	0.490	89	Weighted Average
	0.180		36.73% Pervious Area
	0.310		63.27% Impervious Area

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

Subcatchment 25S: Onsite to BMP 2



Summary for Subcatchment 27S: Undetained Area

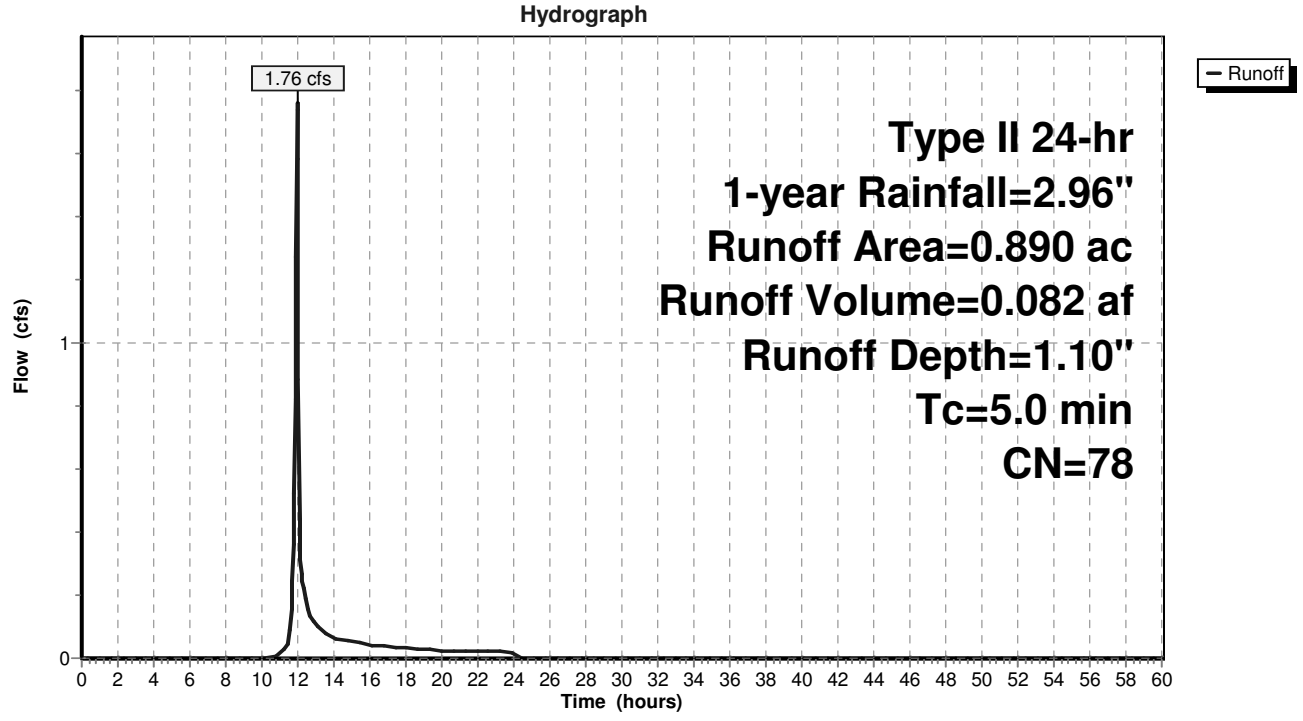
Runoff = 1.76 cfs @ 11.96 hrs, Volume= 0.082 af, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-year Rainfall=2.96"

	Area (ac)	CN	Description
*	0.370	70	woods good condition
*	0.200	98	impervious area
	0.320	74	>75% Grass cover, Good, HSG C
	0.890	78	Weighted Average
	0.690		77.53% Pervious Area
	0.200		22.47% Impervious Area

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

Subcatchment 27S: Undetained Area



Summary for Pond 6P: BMP 3 - East

Inflow Area = 6.060 ac, 36.14% Impervious, Inflow Depth = 1.33" for 1-year event
Inflow = 11.31 cfs @ 11.96 hrs, Volume= 0.673 af
Outflow = 2.63 cfs @ 12.28 hrs, Volume= 0.657 af, Atten= 77%, Lag= 19.0 min
Primary = 2.63 cfs @ 12.28 hrs, Volume= 0.657 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Peak Elev= 433.96' @ 12.28 hrs Surf.Area= 5,283 sf Storage= 13,102 cf

Plug-Flow detention time= 706.7 min calculated for 0.657 af (98% of inflow)
Center-of-Mass det. time= 693.9 min (1,524.6 - 830.7)

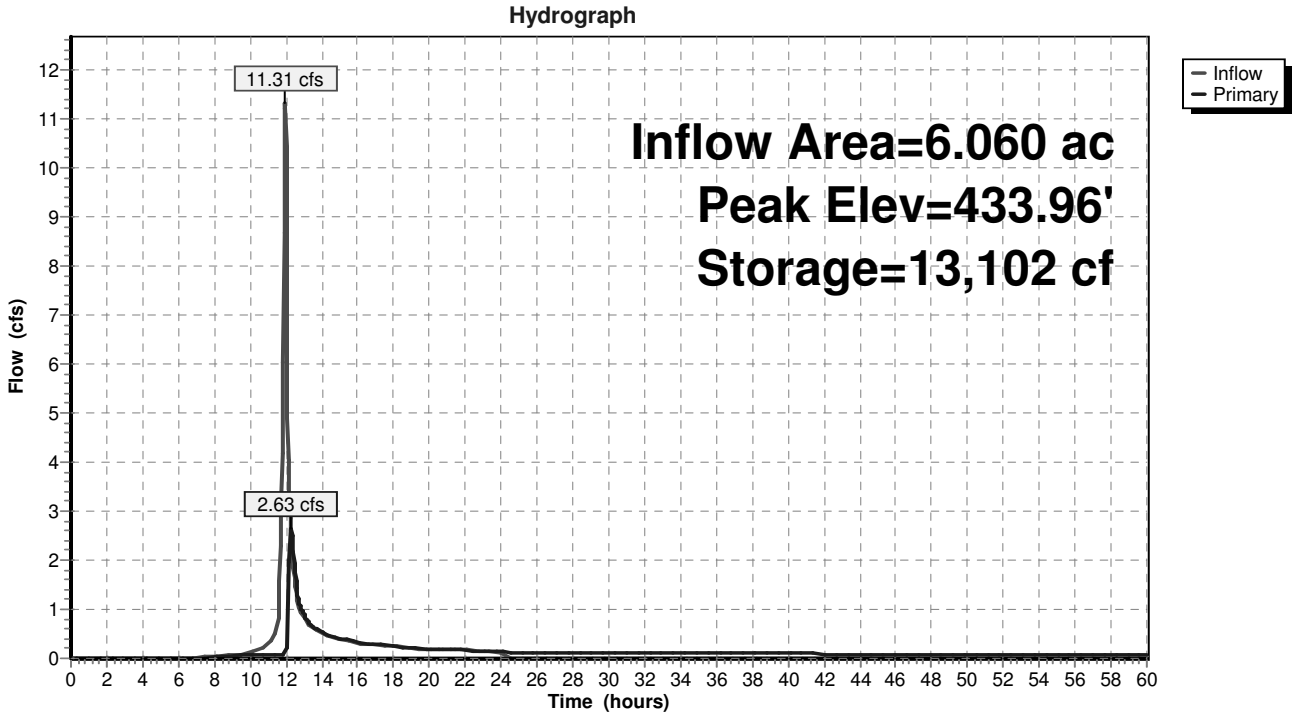
Volume	Invert	Avail.Storage	Storage Description
#1	431.00'	19,126 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
431.00	3,602	0	0
432.00	4,148	3,875	3,875
433.00	4,714	4,431	8,306
434.00	5,307	5,011	13,317
435.00	6,312	5,810	19,126

Device	Routing	Invert	Outlet Devices
#1	Primary	431.00'	**Special & User-Defined** Head (feet) 0.00 0.05 0.10 0.25 0.50 0.75 1.00 2.00 3.00 4.00 Disch. (cfs) 0.000 0.058 0.059 0.063 0.069 0.074 0.080 0.103 0.126 0.149
#2	Primary	433.80'	**36.0" x 36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.60 cfs @ 12.28 hrs HW=433.96' (Free Discharge)
└**1=Special & User-Defined** (Custom Controls 0.13 cfs)
└**2=Orifice/Grate** (Weir Controls 2.47 cfs @ 1.30 fps)

Pond 6P: BMP 3 - East



Summary for Pond 7P: BMP 1 - West

Inflow Area = 0.530 ac, 58.49% Impervious, Inflow Depth = 1.78" for 1-year event
Inflow = 1.67 cfs @ 11.96 hrs, Volume= 0.079 af
Outflow = 0.01 cfs @ 24.05 hrs, Volume= 0.039 af, Atten= 99%, Lag= 725.9 min
Primary = 0.01 cfs @ 24.05 hrs, Volume= 0.039 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Peak Elev= 430.02' @ 24.05 hrs Surf.Area= 3,291 sf Storage= 2,945 cf

Plug-Flow detention time= 1,383.5 min calculated for 0.039 af (49% of inflow)
Center-of-Mass det. time= 1,267.3 min (2,081.6 - 814.3)

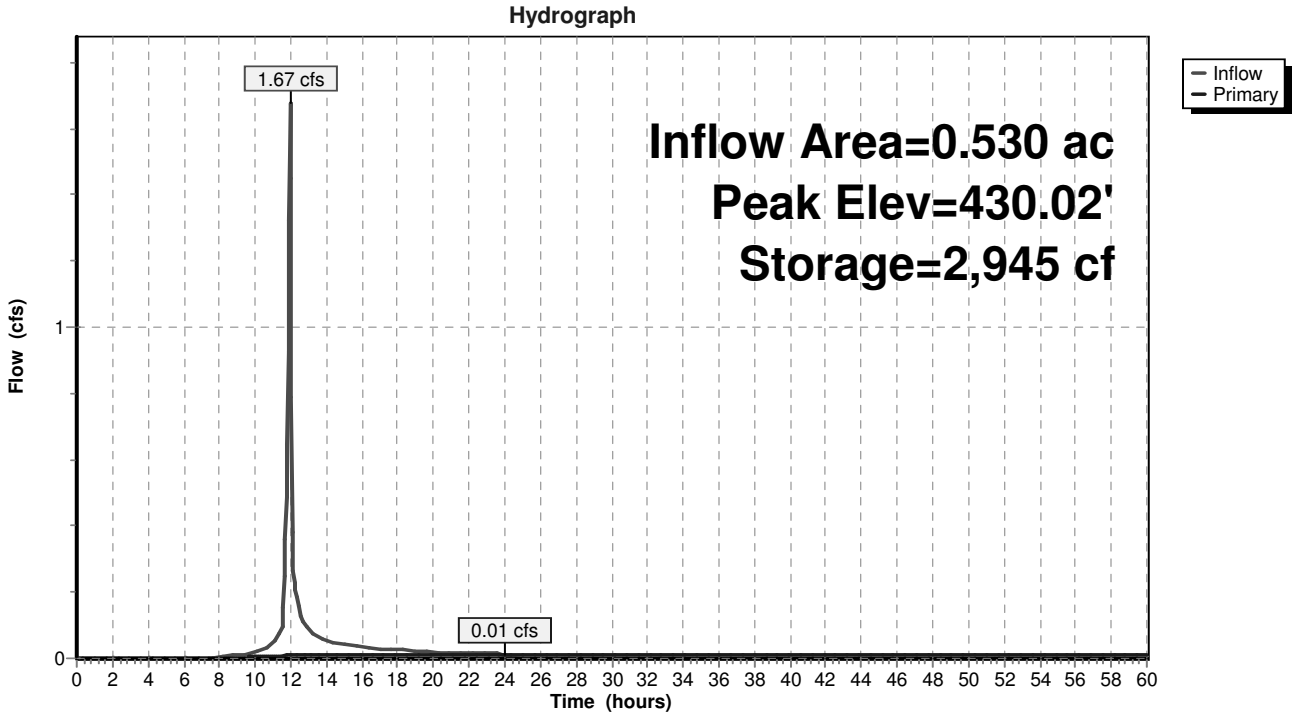
Volume	Invert	Avail.Storage	Storage Description
#1	429.00'	12,638 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
429.00	2,485	0	0
430.00	3,274	2,880	2,880
431.00	4,120	3,697	6,577
432.00	5,335	4,728	11,304
432.25	5,335	1,334	12,638

Device	Routing	Invert	Outlet Devices
#1	Primary	429.00'	**Special & User-Defined** Head (feet) 0.00 0.05 0.10 0.25 0.50 0.75 1.00 2.00 3.00 Disch. (cfs) 0.000 0.007 0.008 0.008 0.009 0.009 0.010 0.013 0.016
#2	Primary	432.00'	**24.0" W x 24.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.01 cfs @ 24.05 hrs HW=430.02' (Free Discharge)
1=Special & User-Defined (Custom Controls 0.01 cfs)
2=Orifice/Grate (Controls 0.00 cfs)

Pond 7P: BMP 1 - West

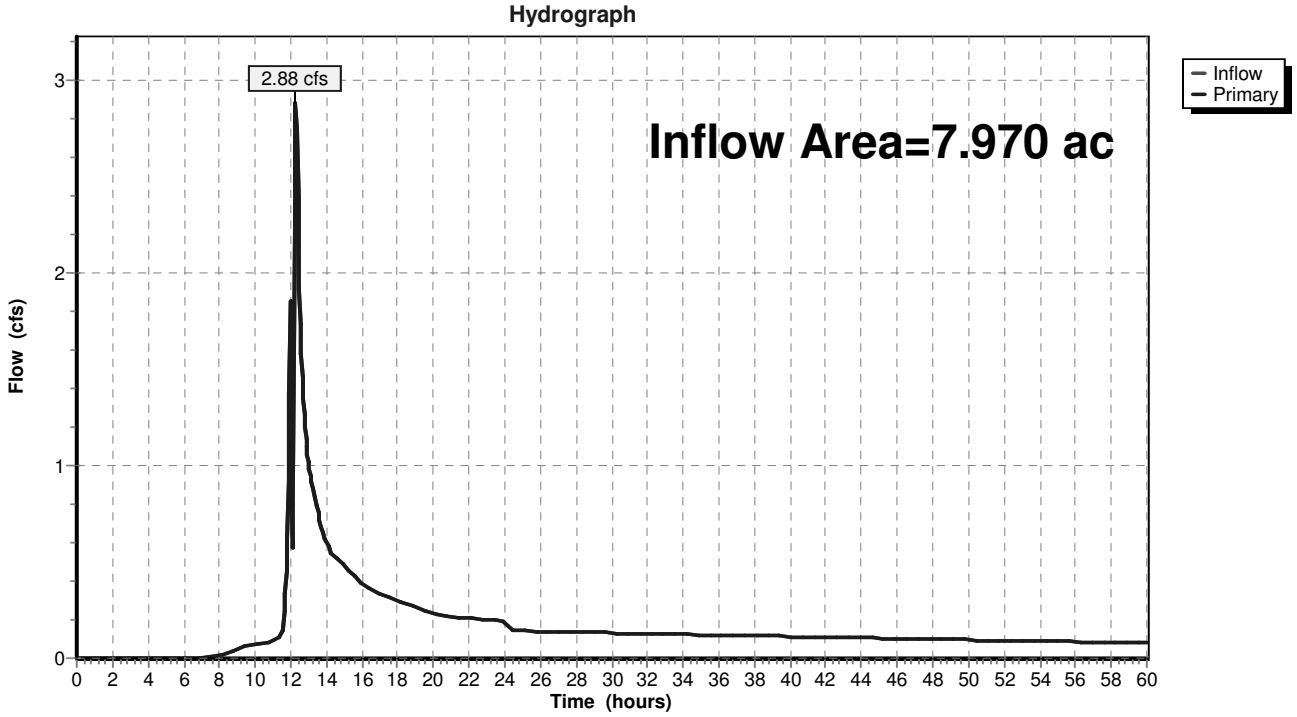


Summary for Pond 9P: Total Post

Inflow Area = 7.970 ac, 37.77% Impervious, Inflow Depth > 1.24" for 1-year event
Inflow = 2.88 cfs @ 12.28 hrs, Volume= 0.825 af
Primary = 2.88 cfs @ 12.28 hrs, Volume= 0.825 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs

Pond 9P: Total Post



Summary for Pond 16P: BMP 2 - Middle

Inflow Area = 0.490 ac, 63.27% Impervious, Inflow Depth = 1.86" for 1-year event
Inflow = 1.61 cfs @ 11.95 hrs, Volume= 0.076 af
Outflow = 0.01 cfs @ 24.03 hrs, Volume= 0.047 af, Atten= 99%, Lag= 724.4 min
Primary = 0.01 cfs @ 24.03 hrs, Volume= 0.047 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Peak Elev= 431.79' @ 24.03 hrs Surf.Area= 1,995 sf Storage= 2,704 cf

Plug-Flow detention time= 1,346.4 min calculated for 0.047 af (62% of inflow)
Center-of-Mass det. time= 1,238.7 min (2,048.9 - 810.2)

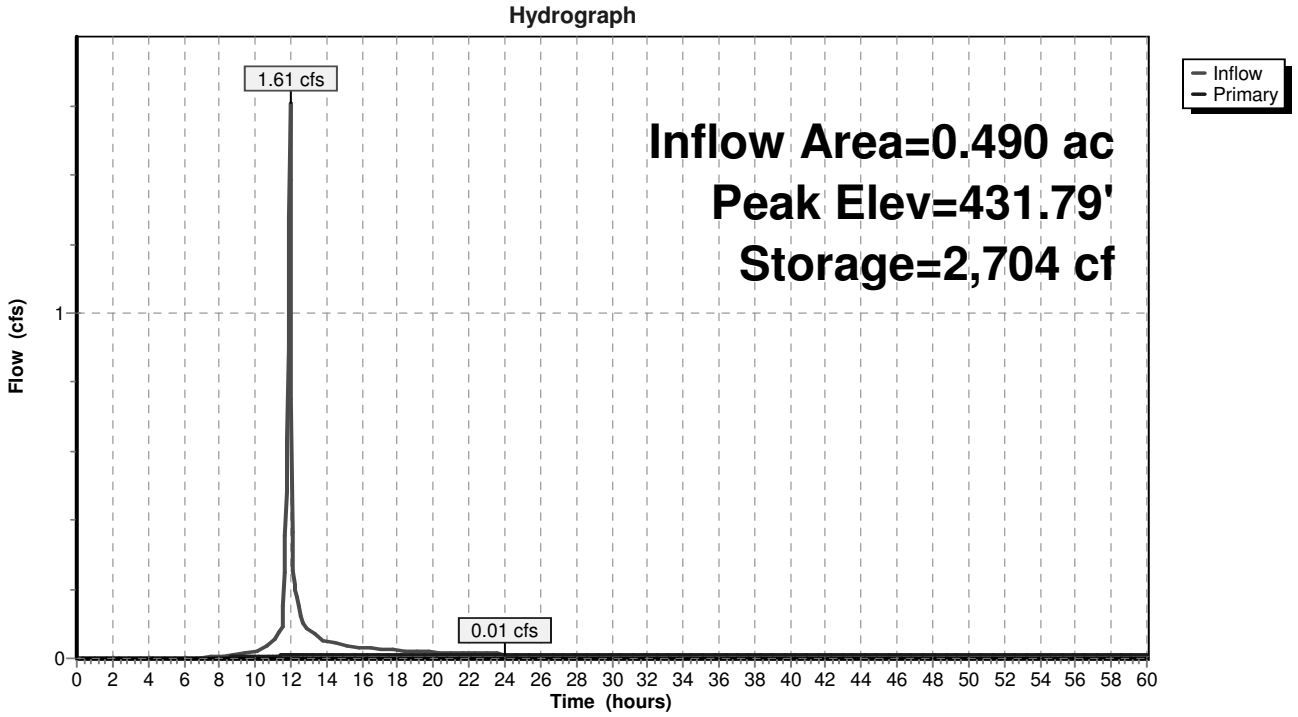
Volume	Invert	Avail.Storage	Storage Description
#1	430.00'	8,740 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
430.00	1,051	0	0
431.00	1,553	1,302	1,302
432.00	2,113	1,833	3,135
433.00	2,729	2,421	5,556
434.00	3,638	3,184	8,740

Device	Routing	Invert	Outlet Devices
#1	Primary	430.00'	**Special & User-Defined** Head (feet) 0.00 0.05 0.10 0.25 0.50 0.75 1.00 2.00 3.00 4.00 5.00 Disch. (cfs) 0.000 0.007 0.007 0.008 0.009 0.009 0.010 0.013 0.016 0.018 0.021
#2	Primary	433.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.01 cfs @ 24.03 hrs HW=431.79' (Free Discharge)
└**1=Special & User-Defined** (Custom Controls 0.01 cfs)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 16P: BMP 2 - Middle

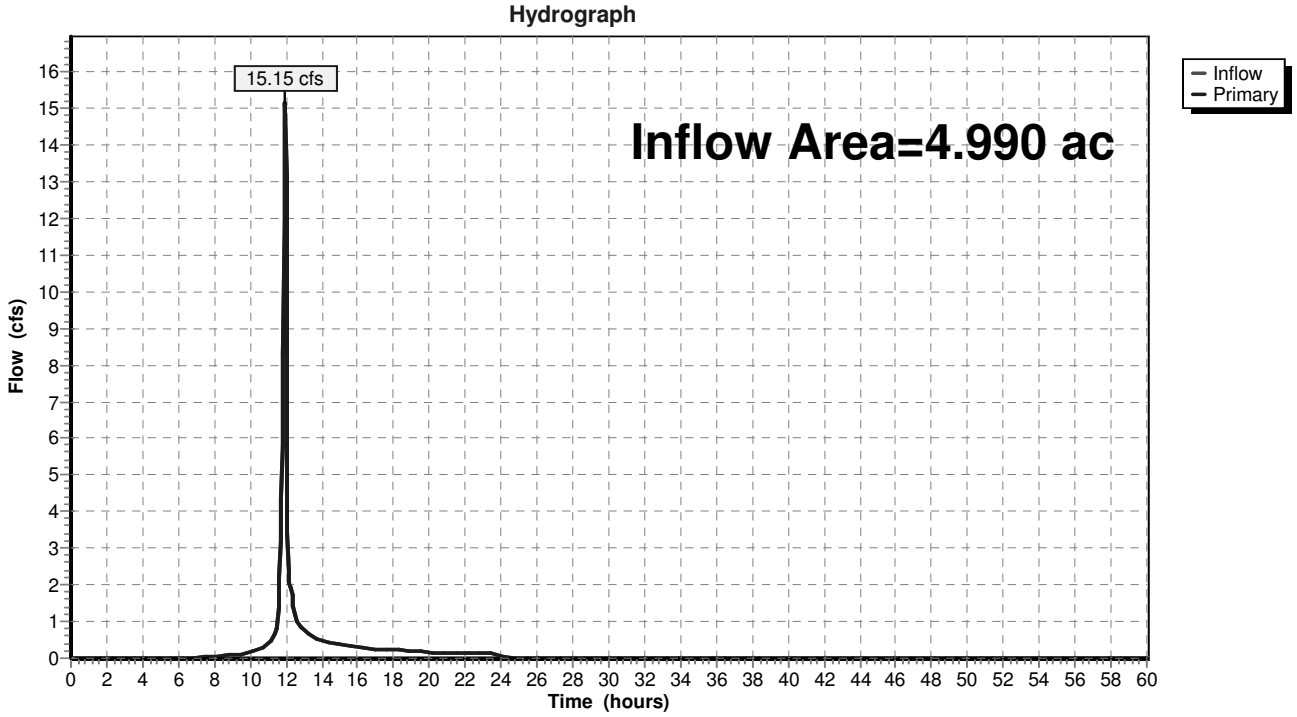


Summary for Pond 26P: Post w/o controls

Inflow Area = 4.990 ac, 55.51% Impervious, Inflow Depth = 1.72" for 1-year event
Inflow = 15.15 cfs @ 11.96 hrs, Volume= 0.715 af
Primary = 15.15 cfs @ 11.96 hrs, Volume= 0.715 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs

Pond 26P: Post w/o controls



Summary for Subcatchment 1S: Onsite Pre

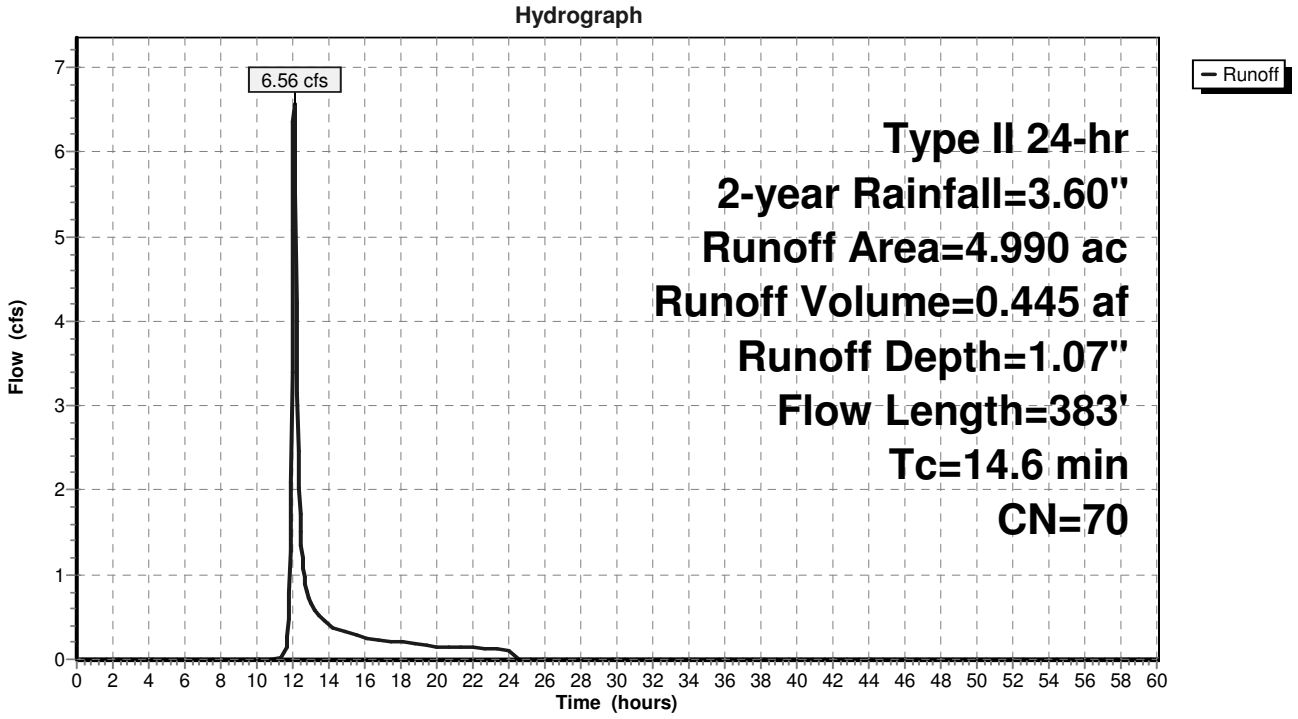
Runoff = 6.56 cfs @ 12.08 hrs, Volume= 0.445 af, Depth= 1.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-year Rainfall=3.60"

Area (ac)	CN	Description
4.990	70	Woods, Good, HSG C
4.990		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.9	100	0.0750	0.14		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.60"
2.7	283	0.1200	1.73		**Shallow Concentrated Flow, B to C shallow flow** Woodland Kv= 5.0 fps
14.6	383	Total			

Subcatchment 1S: Onsite Pre



Summary for Subcatchment 2S: Onsite to BMP 3

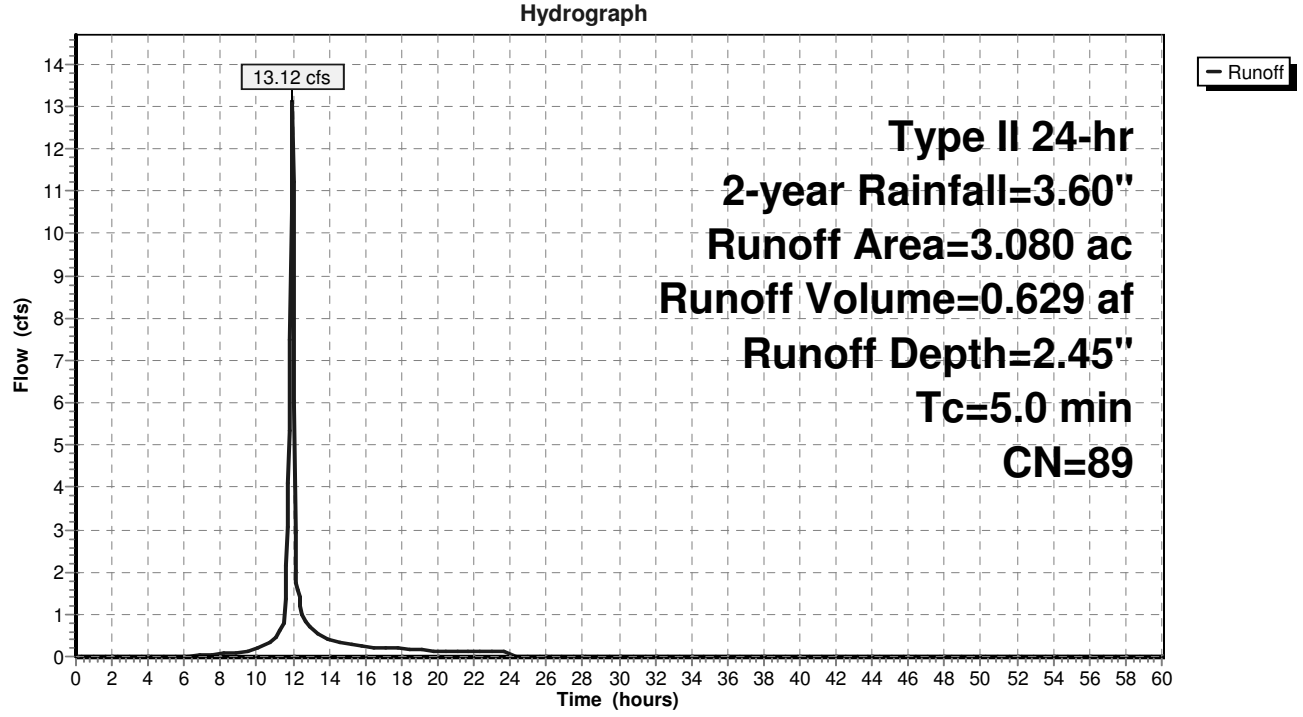
Runoff = 13.12 cfs @ 11.95 hrs, Volume= 0.629 af, Depth= 2.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-year Rainfall=3.60"

	Area (ac)	CN	Description
*	1.950	98	impervious area
*	1.130	74	open space
	3.080	89	Weighted Average
	1.130		36.69% Pervious Area
	1.950		63.31% Impervious Area

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

Subcatchment 2S: Onsite to BMP 3



Summary for Subcatchment 3S: Undeveloped Area Onsite/Offsite

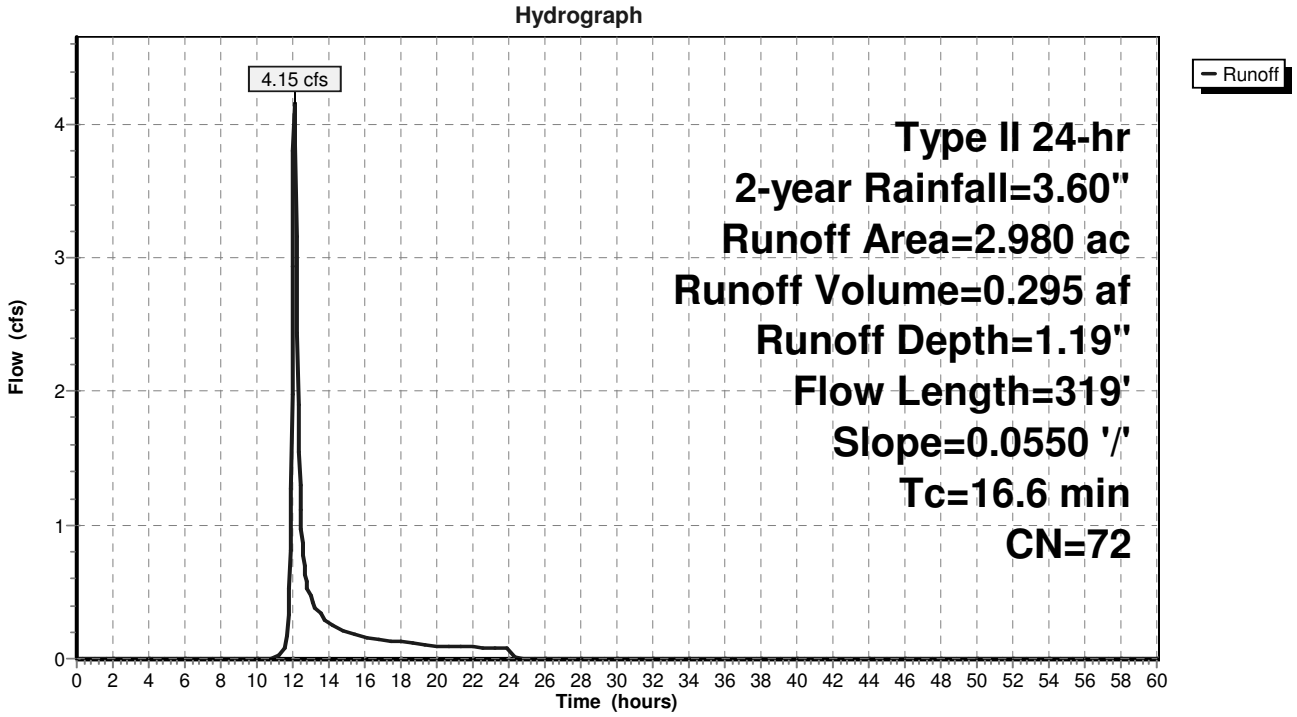
Runoff = 4.15 cfs @ 12.10 hrs, Volume= 0.295 af, Depth= 1.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-year Rainfall=3.60"

	Area (ac)	CN	Description
	2.740	70	Woods, Good, HSG C
*	0.240	98	roof area
	2.980	72	Weighted Average
	2.740		91.95% Pervious Area
	0.240		8.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0550	0.12		**Sheet Flow, A to B sheet flow** Woods: Light underbrush n= 0.400 P2= 3.60"
3.1	219	0.0550	1.17		**Shallow Concentrated Flow, B to C shallow flow** Woodland Kv= 5.0 fps
16.6	319	Total			

Subcatchment 3S: Undeveloped Area Onsite/Offsite



Summary for Subcatchment 4S: Onsite to BMP 1

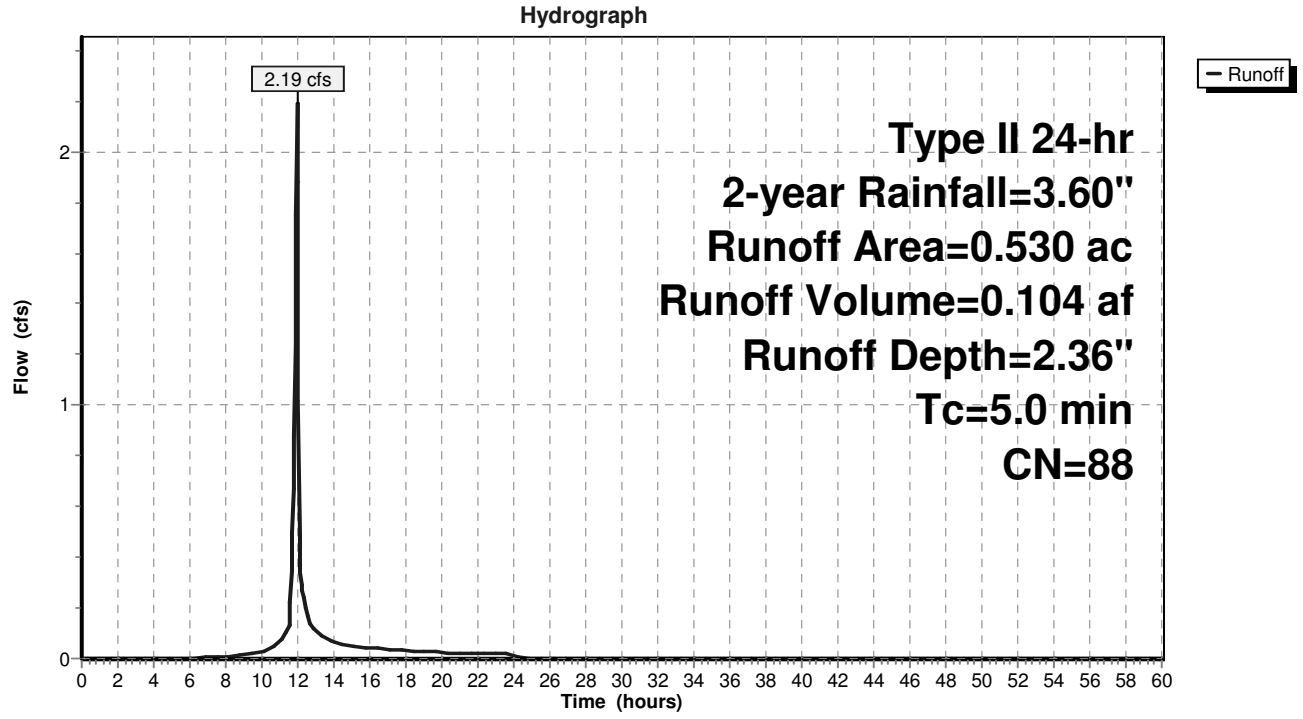
Runoff = 2.19 cfs @ 11.95 hrs, Volume= 0.104 af, Depth= 2.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-year Rainfall=3.60"

	Area (ac)	CN	Description
*	0.310	98	impervious area
*	0.220	74	open space
	0.530	88	Weighted Average
	0.220		41.51% Pervious Area
	0.310		58.49% Impervious Area

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

Subcatchment 4S: Onsite to BMP 1



Summary for Subcatchment 5S: Onsite to BMP 2

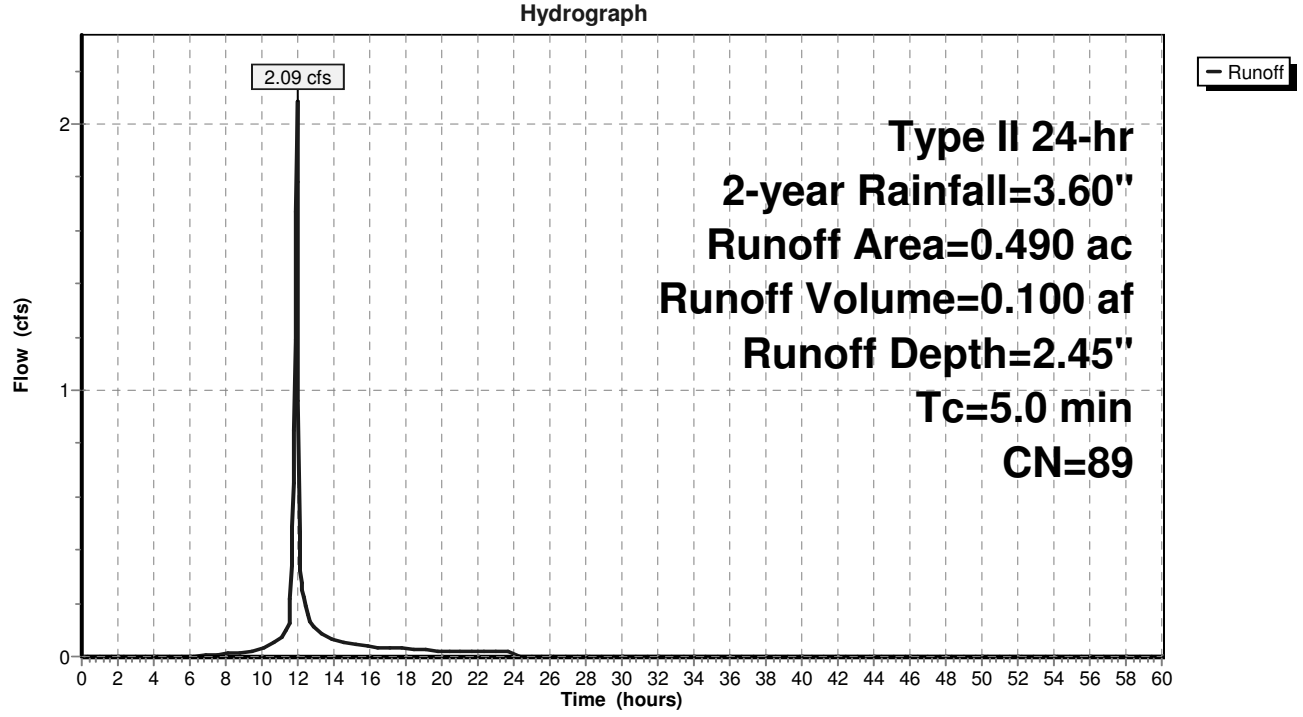
Runoff = 2.09 cfs @ 11.95 hrs, Volume= 0.100 af, Depth= 2.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-year Rainfall=3.60"

	Area (ac)	CN	Description
*	0.310	98	impervious area
*	0.180	74	open space
	0.490	89	Weighted Average
	0.180		36.73% Pervious Area
	0.310		63.27% Impervious Area

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

Subcatchment 5S: Onsite to BMP 2



Summary for Subcatchment 22S: Undetained Area

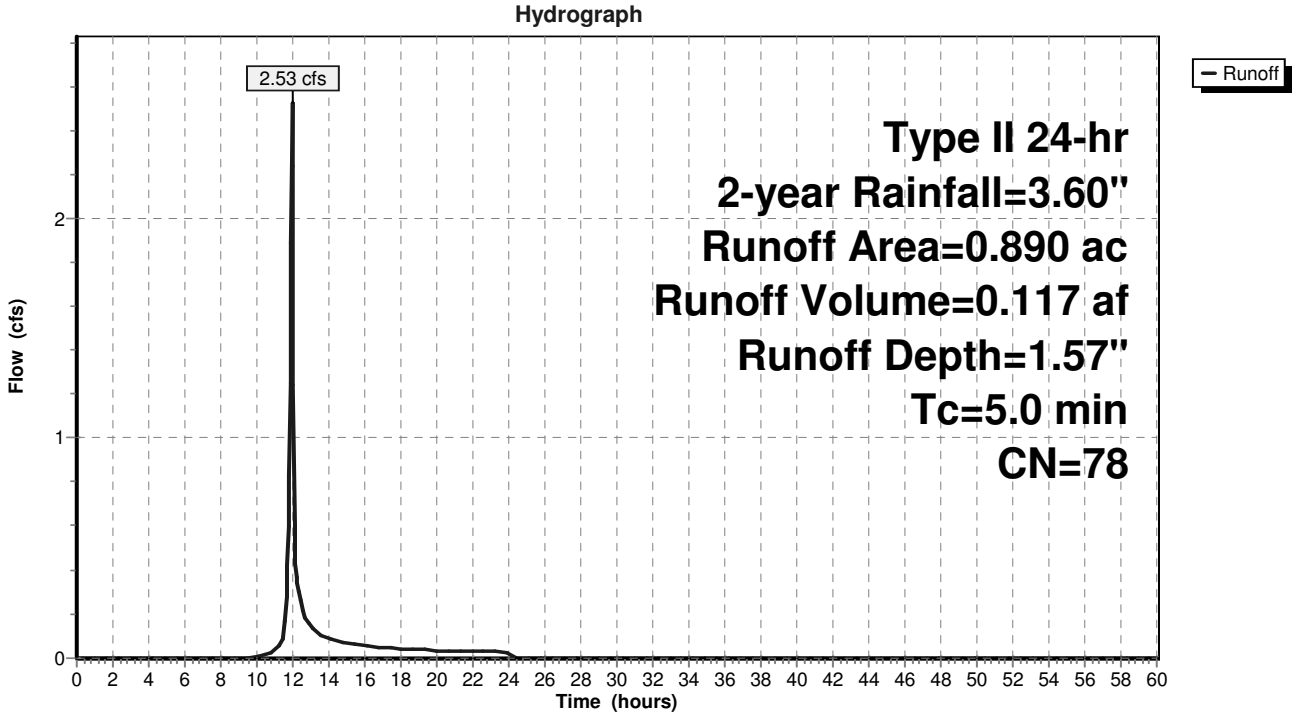
Runoff = 2.53 cfs @ 11.96 hrs, Volume= 0.117 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-year Rainfall=3.60"

	Area (ac)	CN	Description
*	0.370	70	woods good condition
*	0.200	98	impervious area
	0.320	74	>75% Grass cover, Good, HSG C
	0.890	78	Weighted Average
	0.690		77.53% Pervious Area
	0.200		22.47% Impervious Area

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

Subcatchment 22S: Undetained Area



Summary for Subcatchment 23S: Onsite to BMP 3

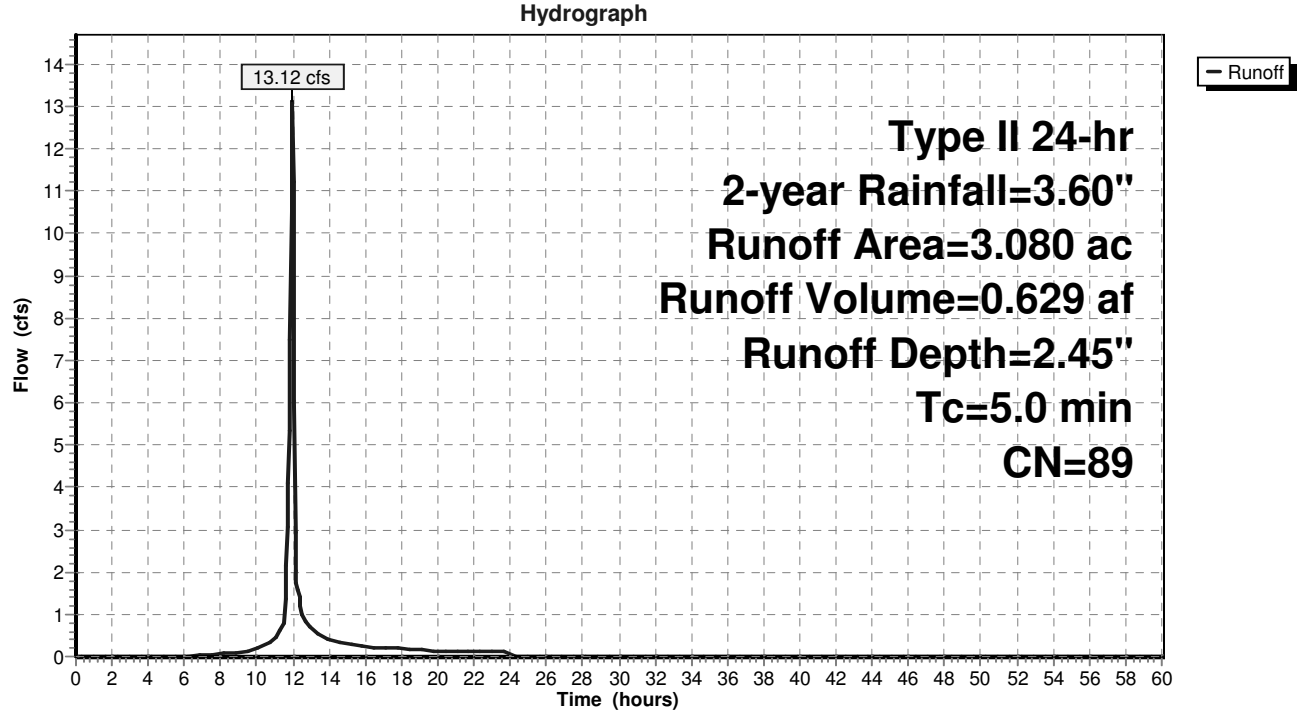
Runoff = 13.12 cfs @ 11.95 hrs, Volume= 0.629 af, Depth= 2.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-year Rainfall=3.60"

	Area (ac)	CN	Description
*	1.950	98	impervious area
*	1.130	74	open space
	3.080	89	Weighted Average
	1.130		36.69% Pervious Area
	1.950		63.31% Impervious Area

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

Subcatchment 23S: Onsite to BMP 3



Summary for Subcatchment 24S: Onsite to BMP 1

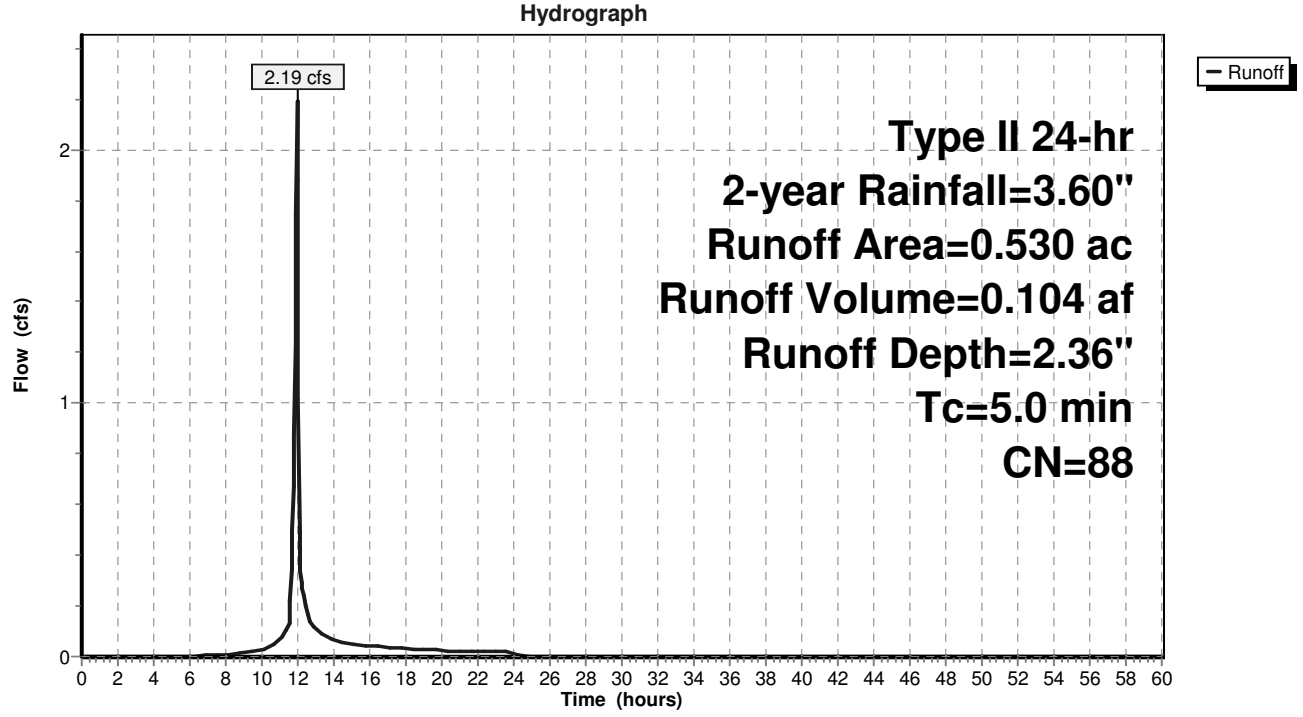
Runoff = 2.19 cfs @ 11.95 hrs, Volume= 0.104 af, Depth= 2.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-year Rainfall=3.60"

	Area (ac)	CN	Description
*	0.310	98	impervious area
*	0.220	74	open space
	0.530	88	Weighted Average
	0.220		41.51% Pervious Area
	0.310		58.49% Impervious Area

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

Subcatchment 24S: Onsite to BMP 1



Summary for Subcatchment 25S: Onsite to BMP 2

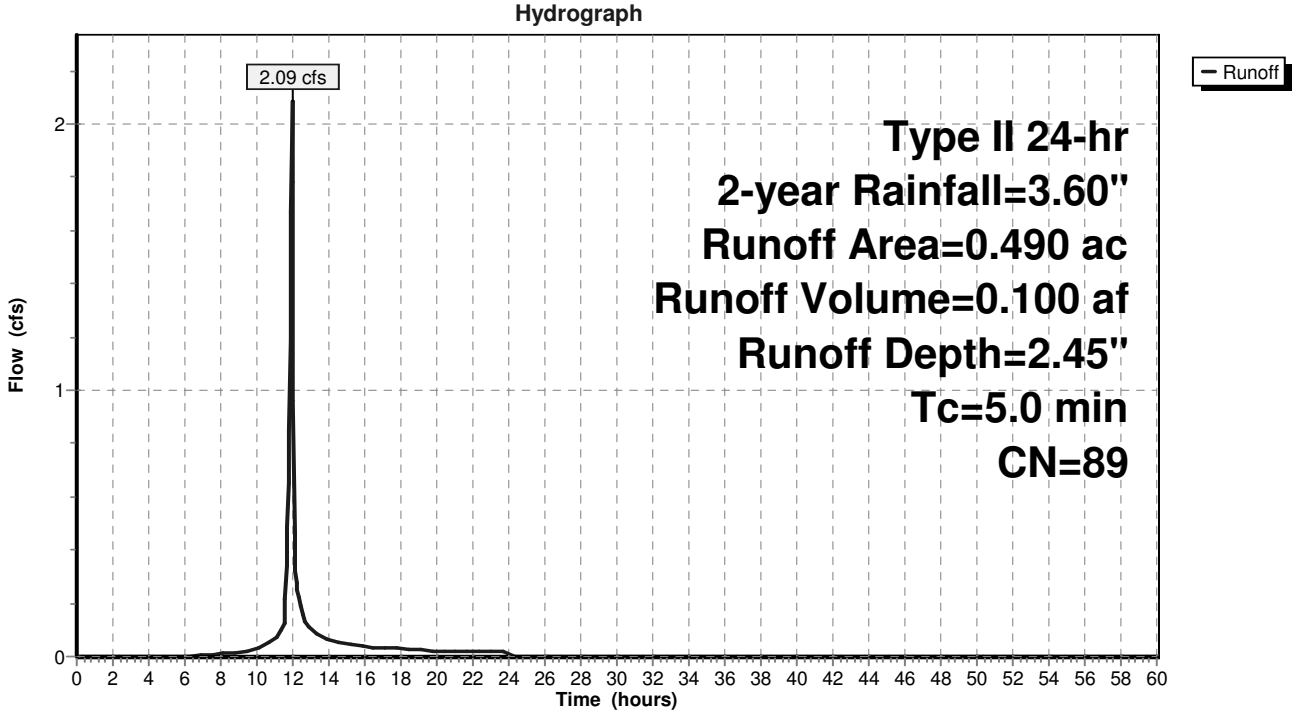
Runoff = 2.09 cfs @ 11.95 hrs, Volume= 0.100 af, Depth= 2.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-year Rainfall=3.60"

	Area (ac)	CN	Description
*	0.310	98	impervious area
*	0.180	74	open space
	0.490	89	Weighted Average
	0.180		36.73% Pervious Area
	0.310		63.27% Impervious Area

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

Subcatchment 25S: Onsite to BMP 2



Summary for Subcatchment 27S: Undetained Area

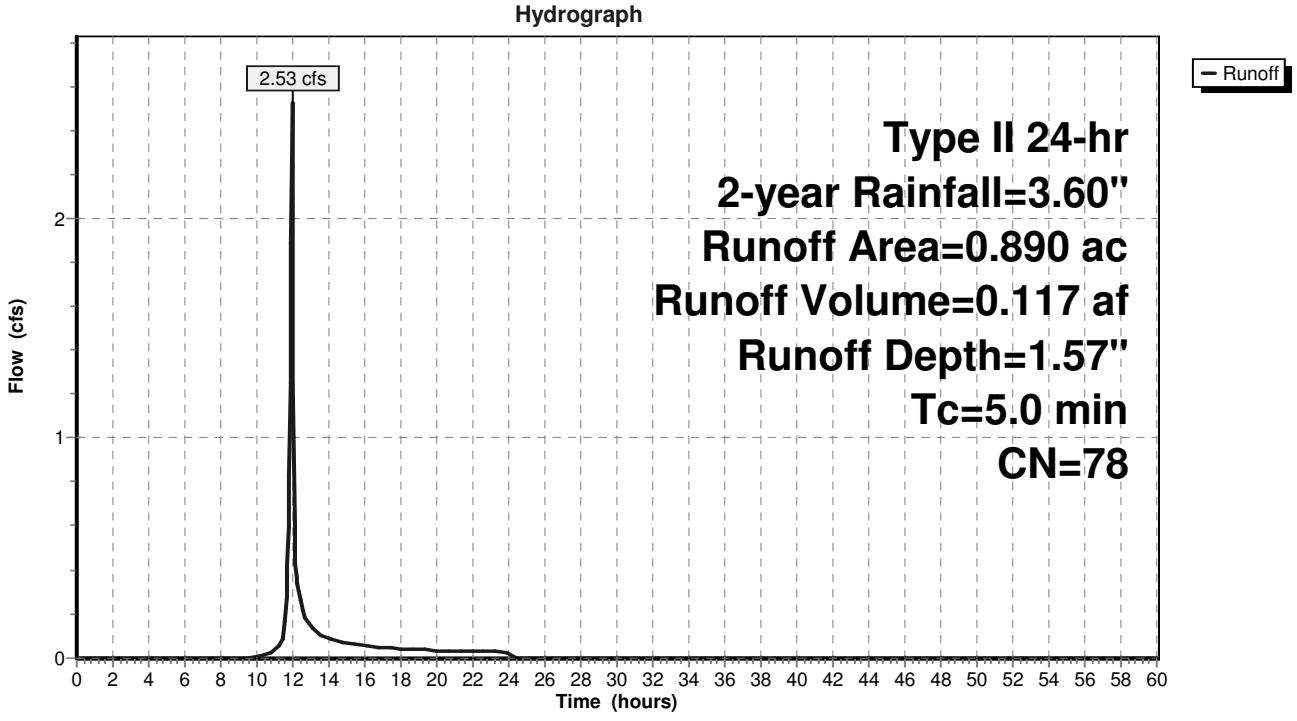
Runoff = 2.53 cfs @ 11.96 hrs, Volume= 0.117 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-year Rainfall=3.60"

	Area (ac)	CN	Description
*	0.370	70	woods good condition
*	0.200	98	impervious area
	0.320	74	>75% Grass cover, Good, HSG C
	0.890	78	Weighted Average
	0.690		77.53% Pervious Area
	0.200		22.47% Impervious Area

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

Subcatchment 27S: Undetained Area



Summary for Pond 6P: BMP 3 - East

Inflow Area = 6.060 ac, 36.14% Impervious, Inflow Depth = 1.83" for 2-year event
Inflow = 15.25 cfs @ 11.96 hrs, Volume= 0.923 af
Outflow = 8.64 cfs @ 12.08 hrs, Volume= 0.907 af, Atten= 43%, Lag= 6.7 min
Primary = 8.64 cfs @ 12.08 hrs, Volume= 0.907 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Peak Elev= 434.16' @ 12.08 hrs Surf.Area= 5,469 sf Storage= 14,184 cf

Plug-Flow detention time= 516.8 min calculated for 0.907 af (98% of inflow)
Center-of-Mass det. time= 507.6 min (1,330.8 - 823.2)

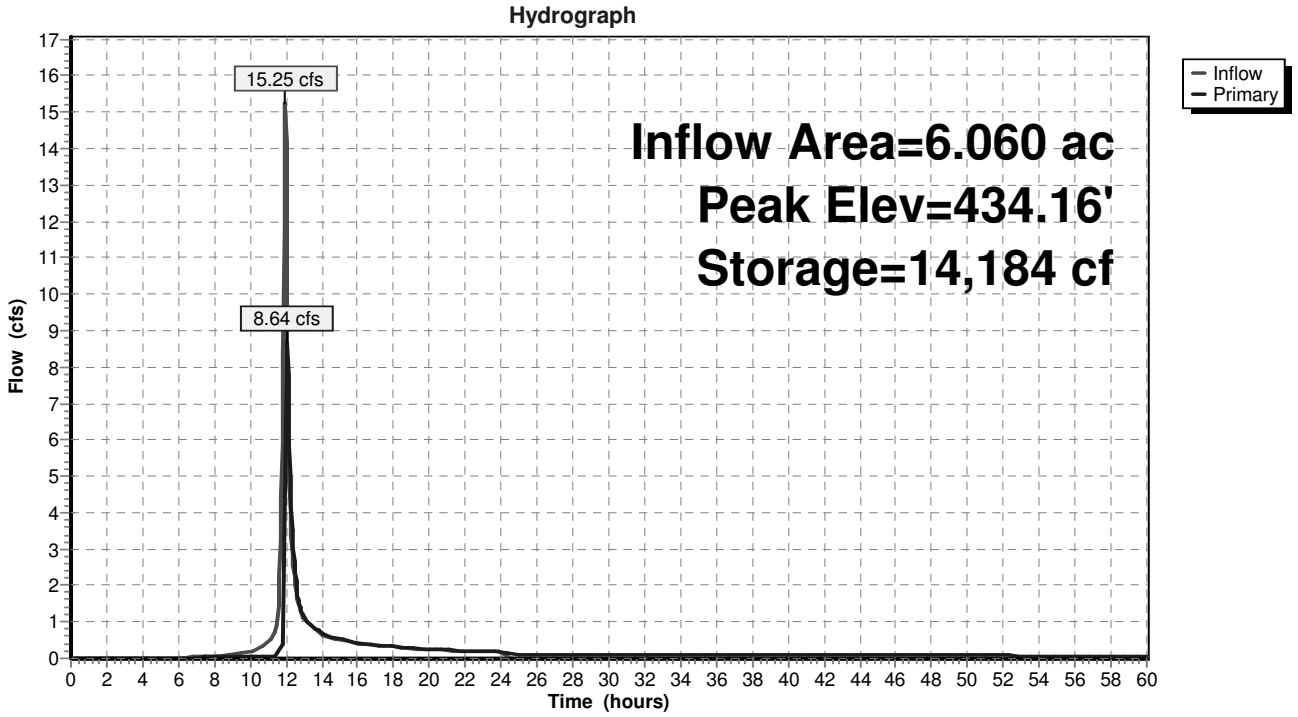
Volume	Invert	Avail.Storage	Storage Description
#1	431.00'	19,126 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
431.00	3,602	0	0
432.00	4,148	3,875	3,875
433.00	4,714	4,431	8,306
434.00	5,307	5,011	13,317
435.00	6,312	5,810	19,126

Device	Routing	Invert	Outlet Devices
#1	Primary	431.00'	**Special & User-Defined** Head (feet) 0.00 0.05 0.10 0.25 0.50 0.75 1.00 2.00 3.00 4.00 Disch. (cfs) 0.000 0.058 0.059 0.063 0.069 0.074 0.080 0.103 0.126 0.149
#2	Primary	433.80'	**36.0" x 36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=8.45 cfs @ 12.08 hrs HW=434.16' (Free Discharge)
└**1=Special & User-Defined** (Custom Controls 0.13 cfs)
└**2=Orifice/Grate** (Weir Controls 8.33 cfs @ 1.95 fps)

Pond 6P: BMP 3 - East



Summary for Pond 7P: BMP 1 - West

Inflow Area = 0.530 ac, 58.49% Impervious, Inflow Depth = 2.36" for 2-year event
Inflow = 2.19 cfs @ 11.95 hrs, Volume= 0.104 af
Outflow = 0.01 cfs @ 24.07 hrs, Volume= 0.043 af, Atten= 99%, Lag= 726.7 min
Primary = 0.01 cfs @ 24.07 hrs, Volume= 0.043 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Peak Elev= 430.33' @ 24.07 hrs Surf.Area= 3,550 sf Storage= 3,991 cf

Plug-Flow detention time= 1,384.0 min calculated for 0.043 af (42% of inflow)
Center-of-Mass det. time= 1,264.4 min (2,070.7 - 806.3)

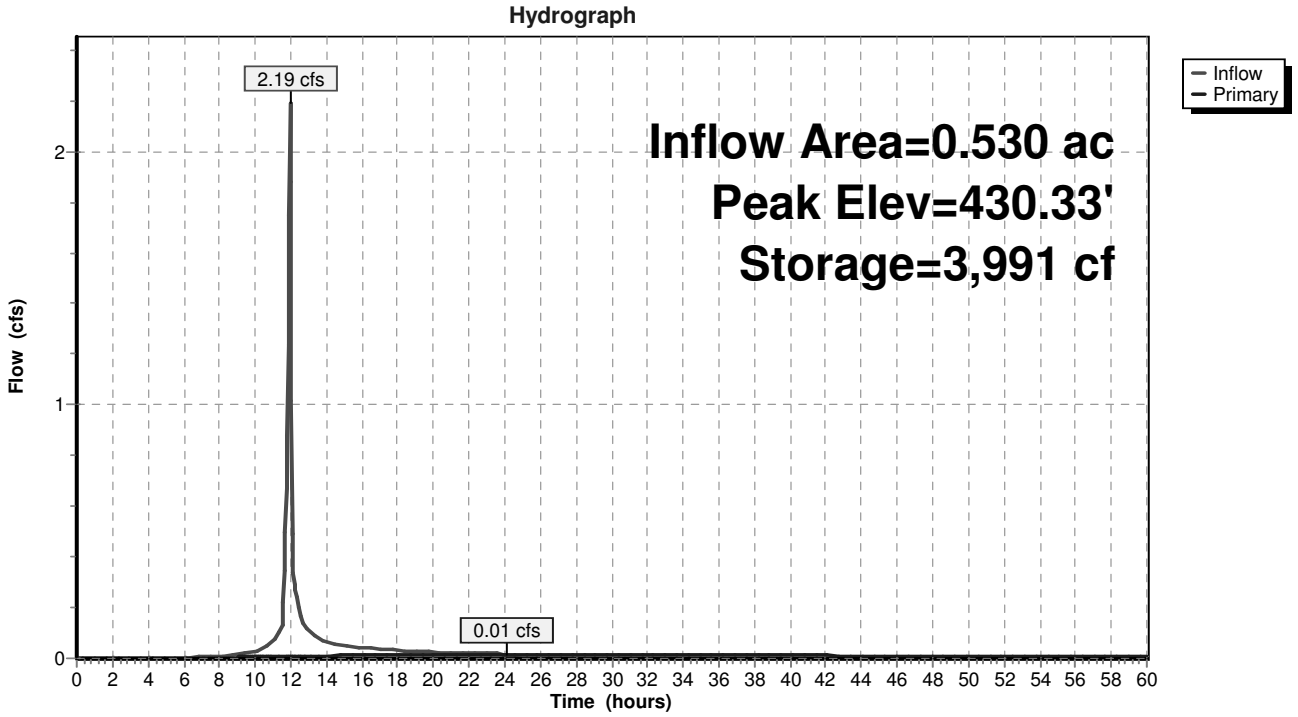
Volume	Invert	Avail.Storage	Storage Description
#1	429.00'	12,638 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
429.00	2,485	0	0
430.00	3,274	2,880	2,880
431.00	4,120	3,697	6,577
432.00	5,335	4,728	11,304
432.25	5,335	1,334	12,638

Device	Routing	Invert	Outlet Devices
#1	Primary	429.00'	**Special & User-Defined** Head (feet) 0.00 0.05 0.10 0.25 0.50 0.75 1.00 2.00 3.00 Disch. (cfs) 0.000 0.007 0.008 0.008 0.009 0.009 0.010 0.013 0.016
#2	Primary	432.00'	**24.0" W x 24.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.01 cfs @ 24.07 hrs HW=430.33' (Free Discharge)
1=Special & User-Defined (Custom Controls 0.01 cfs)
2=Orifice/Grate (Controls 0.00 cfs)

Pond 7P: BMP 1 - West

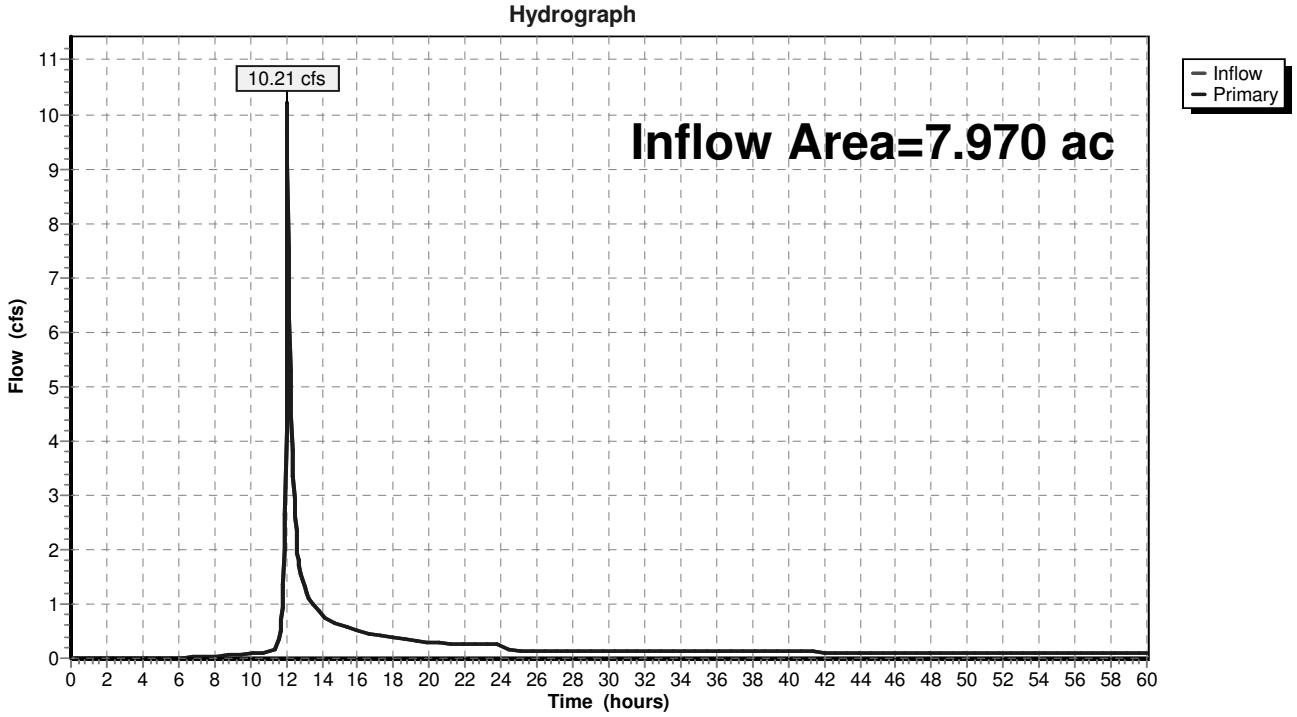


Summary for Pond 9P: Total Post

Inflow Area = 7.970 ac, 37.77% Impervious, Inflow Depth > 1.69" for 2-year event
Inflow = 10.21 cfs @ 12.07 hrs, Volume= 1.121 af
Primary = 10.21 cfs @ 12.07 hrs, Volume= 1.121 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs

Pond 9P: Total Post



Summary for Pond 16P: BMP 2 - Middle

Inflow Area = 0.490 ac, 63.27% Impervious, Inflow Depth = 2.45" for 2-year event
Inflow = 2.09 cfs @ 11.95 hrs, Volume= 0.100 af
Outflow = 0.01 cfs @ 24.04 hrs, Volume= 0.053 af, Atten= 99%, Lag= 725.2 min
Primary = 0.01 cfs @ 24.04 hrs, Volume= 0.053 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Peak Elev= 432.24' @ 24.04 hrs Surf.Area= 2,262 sf Storage= 3,663 cf

Plug-Flow detention time= 1,352.8 min calculated for 0.053 af (53% of inflow)
Center-of-Mass det. time= 1,242.6 min (2,045.0 - 802.4)

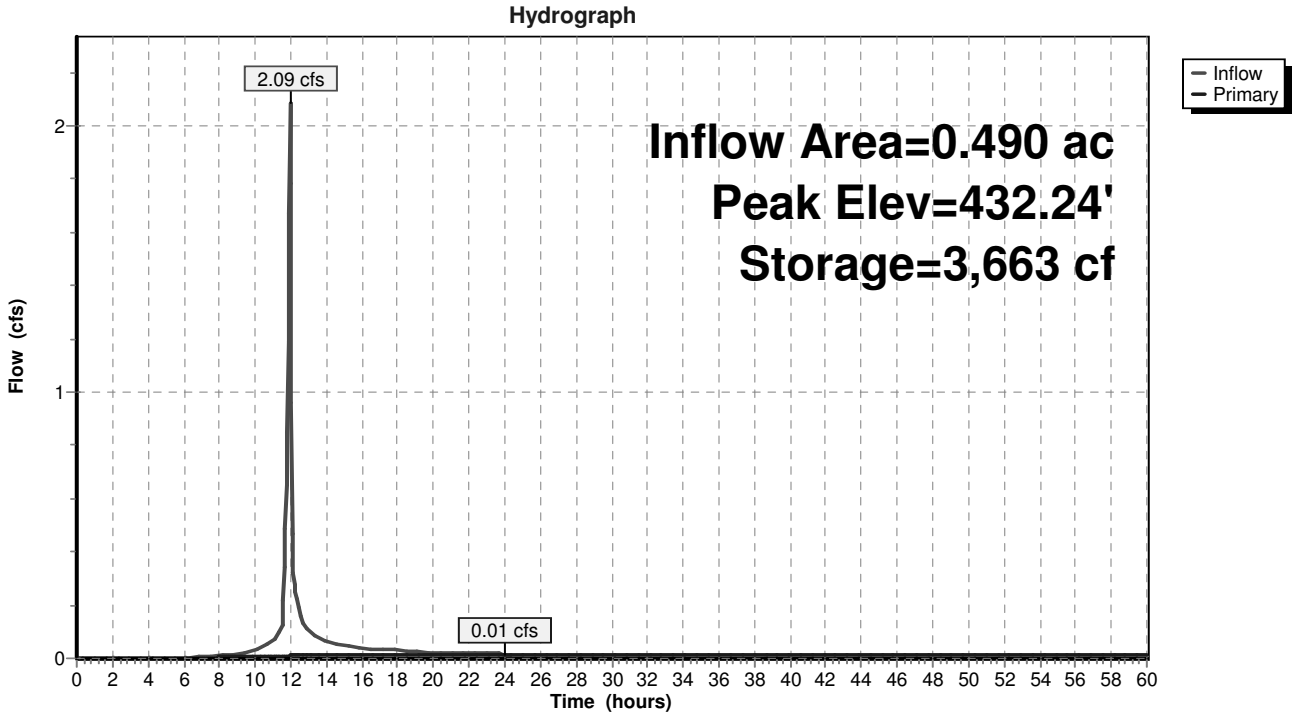
Volume	Invert	Avail.Storage	Storage Description
#1	430.00'	8,740 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
430.00	1,051	0	0
431.00	1,553	1,302	1,302
432.00	2,113	1,833	3,135
433.00	2,729	2,421	5,556
434.00	3,638	3,184	8,740

Device	Routing	Invert	Outlet Devices
#1	Primary	430.00'	**Special & User-Defined** Head (feet) 0.00 0.05 0.10 0.25 0.50 0.75 1.00 2.00 3.00 4.00 5.00 Disch. (cfs) 0.000 0.007 0.007 0.008 0.009 0.009 0.010 0.013 0.016 0.018 0.021
#2	Primary	433.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.01 cfs @ 24.04 hrs HW=432.24' (Free Discharge)
└**1=Special & User-Defined** (Custom Controls 0.01 cfs)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 16P: BMP 2 - Middle

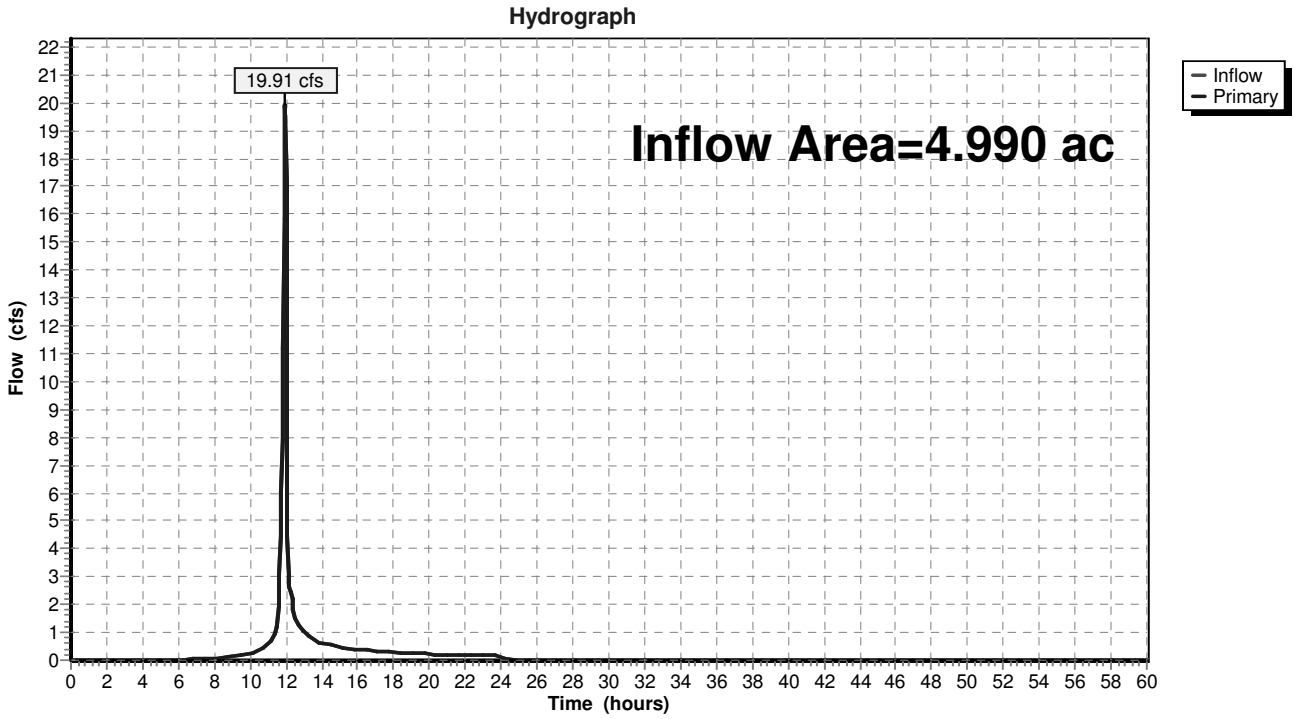


Summary for Pond 26P: Post w/o controls

Inflow Area = 4.990 ac, 55.51% Impervious, Inflow Depth = 2.28" for 2-year event
Inflow = 19.91 cfs @ 11.95 hrs, Volume= 0.950 af
Primary = 19.91 cfs @ 11.95 hrs, Volume= 0.950 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs

Pond 26P: Post w/o controls



Summary for Subcatchment 1S: Onsite Pre

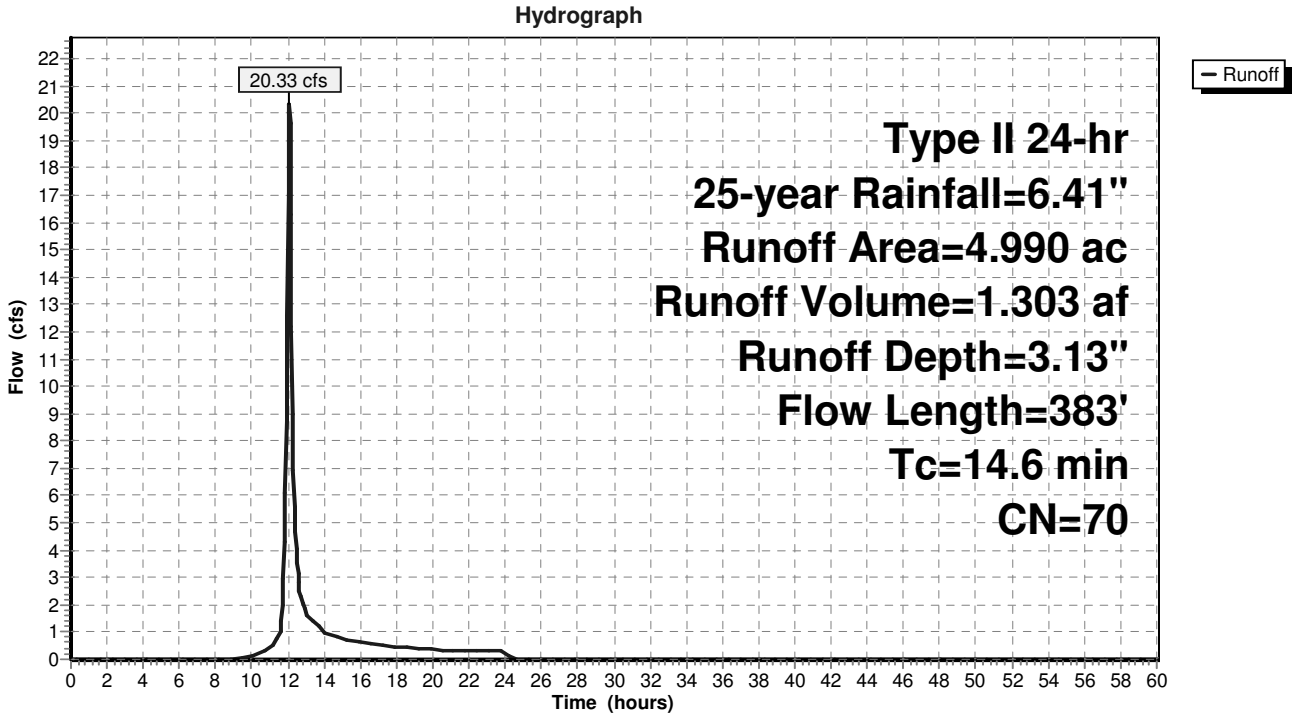
Runoff = 20.33 cfs @ 12.07 hrs, Volume= 1.303 af, Depth= 3.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.41"

Area (ac)	CN	Description
4.990	70	Woods, Good, HSG C
4.990		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.9	100	0.0750	0.14		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.60"
2.7	283	0.1200	1.73		**Shallow Concentrated Flow, B to C shallow flow** Woodland Kv= 5.0 fps
14.6	383	Total			

Subcatchment 1S: Onsite Pre



Summary for Subcatchment 2S: Onsite to BMP 3

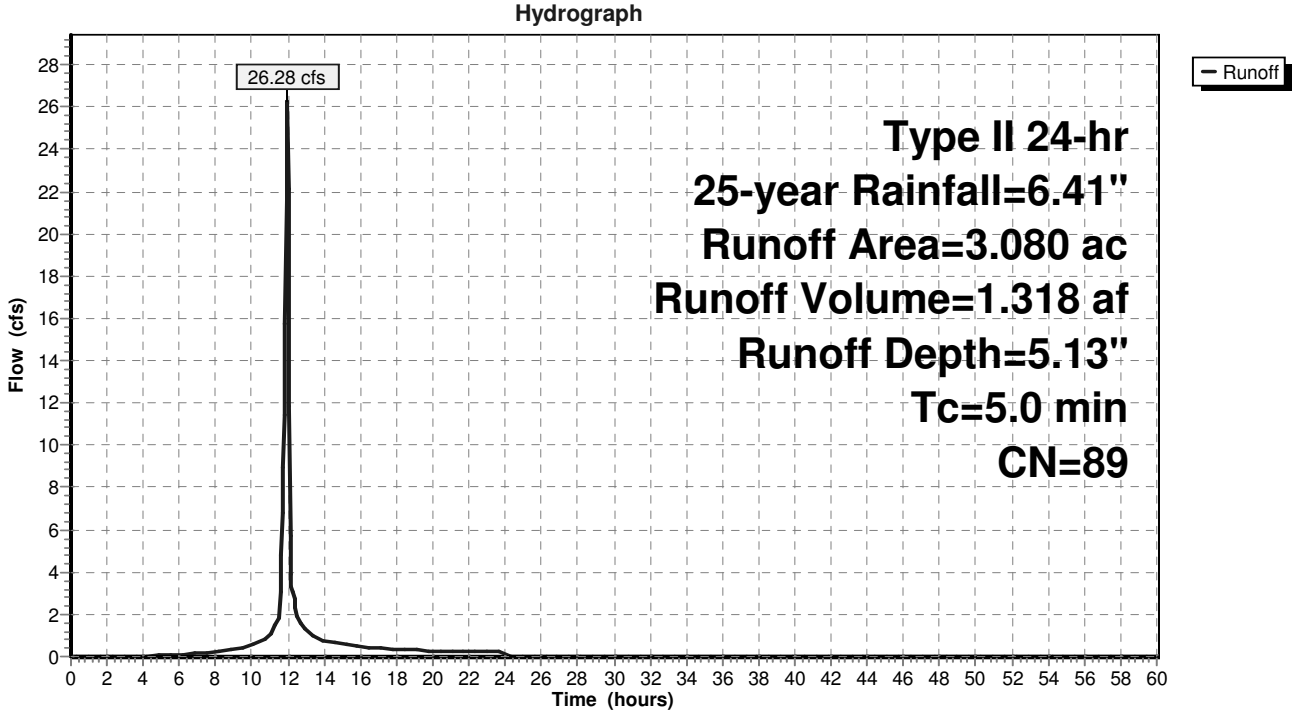
Runoff = 26.28 cfs @ 11.95 hrs, Volume= 1.318 af, Depth= 5.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.41"

	Area (ac)	CN	Description
*	1.950	98	impervious area
*	1.130	74	open space
	3.080	89	Weighted Average
	1.130		36.69% Pervious Area
	1.950		63.31% Impervious Area

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

Subcatchment 2S: Onsite to BMP 3



Summary for Subcatchment 3S: Undeveloped Area Onsite/Offsite

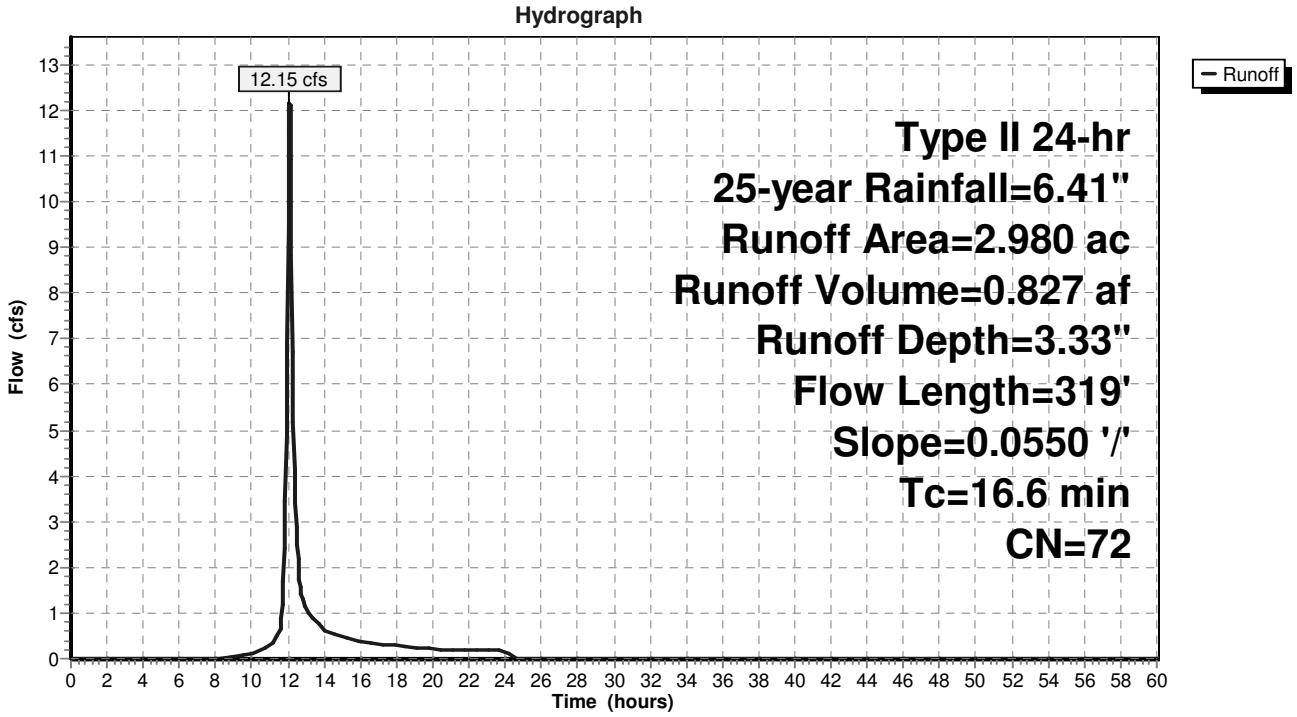
Runoff = 12.15 cfs @ 12.09 hrs, Volume= 0.827 af, Depth= 3.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.41"

	Area (ac)	CN	Description
	2.740	70	Woods, Good, HSG C
*	0.240	98	roof area
	2.980	72	Weighted Average
	2.740		91.95% Pervious Area
	0.240		8.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0550	0.12		**Sheet Flow, A to B sheet flow** Woods: Light underbrush n= 0.400 P2= 3.60"
3.1	219	0.0550	1.17		**Shallow Concentrated Flow, B to C shallow flow** Woodland Kv= 5.0 fps
16.6	319	Total			

Subcatchment 3S: Undeveloped Area Onsite/Offsite



Summary for Subcatchment 4S: Onsite to BMP 1

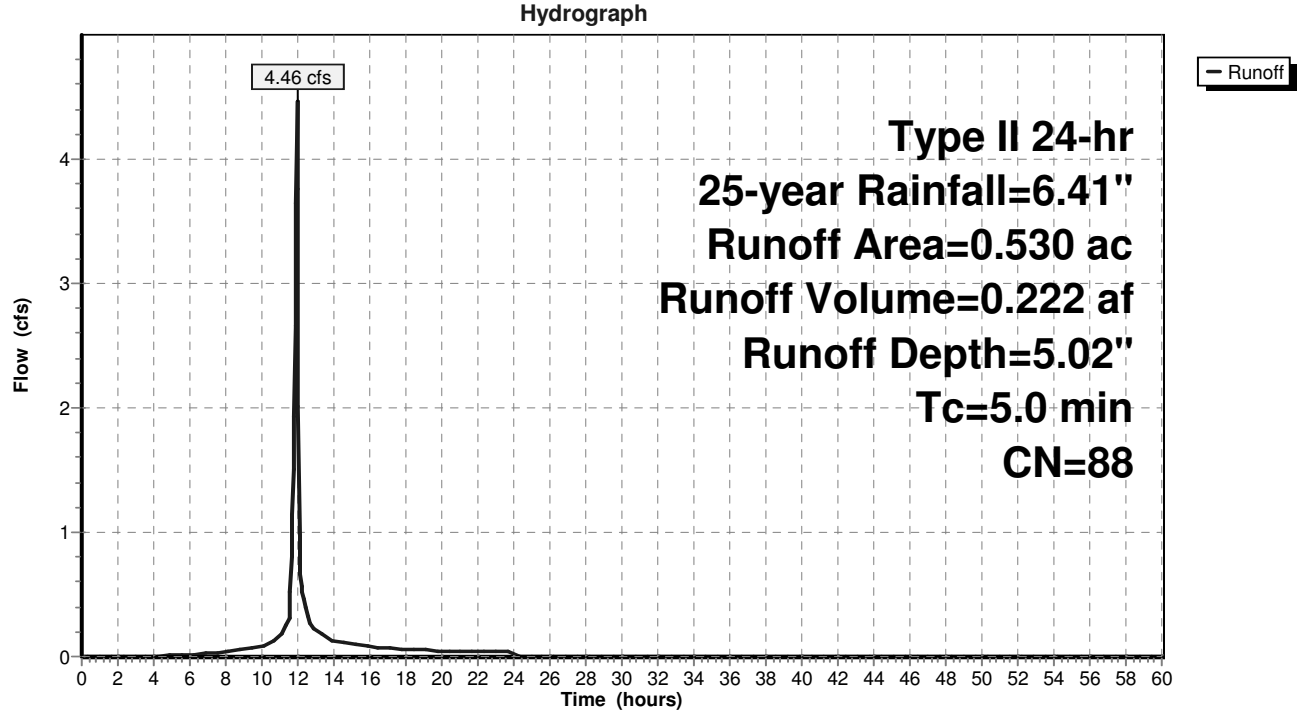
Runoff = 4.46 cfs @ 11.95 hrs, Volume= 0.222 af, Depth= 5.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.41"

	Area (ac)	CN	Description
*	0.310	98	impervious area
*	0.220	74	open space
	0.530	88	Weighted Average
	0.220		41.51% Pervious Area
	0.310		58.49% Impervious Area

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

Subcatchment 4S: Onsite to BMP 1



Summary for Subcatchment 5S: Onsite to BMP 2

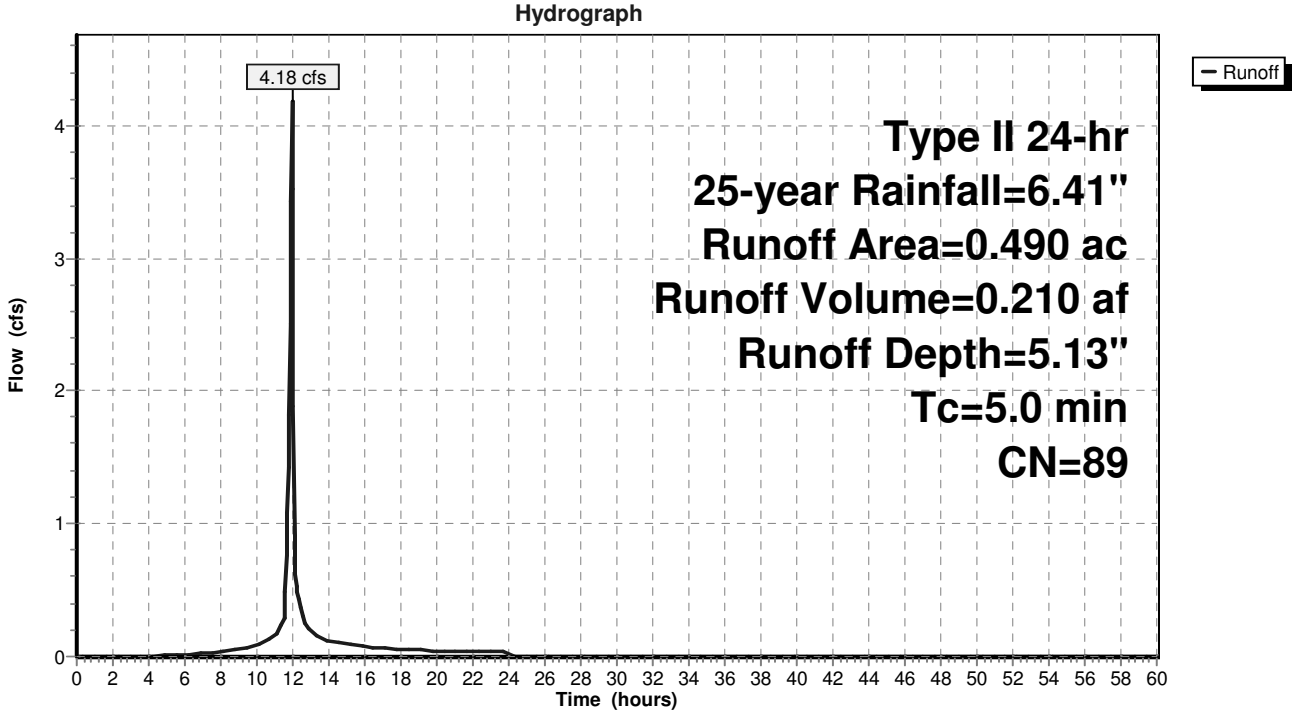
Runoff = 4.18 cfs @ 11.95 hrs, Volume= 0.210 af, Depth= 5.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.41"

	Area (ac)	CN	Description
*	0.310	98	impervious area
*	0.180	74	open space
	0.490	89	Weighted Average
	0.180		36.73% Pervious Area
	0.310		63.27% Impervious Area

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

Subcatchment 5S: Onsite to BMP 2



Summary for Subcatchment 22S: Undetained Area

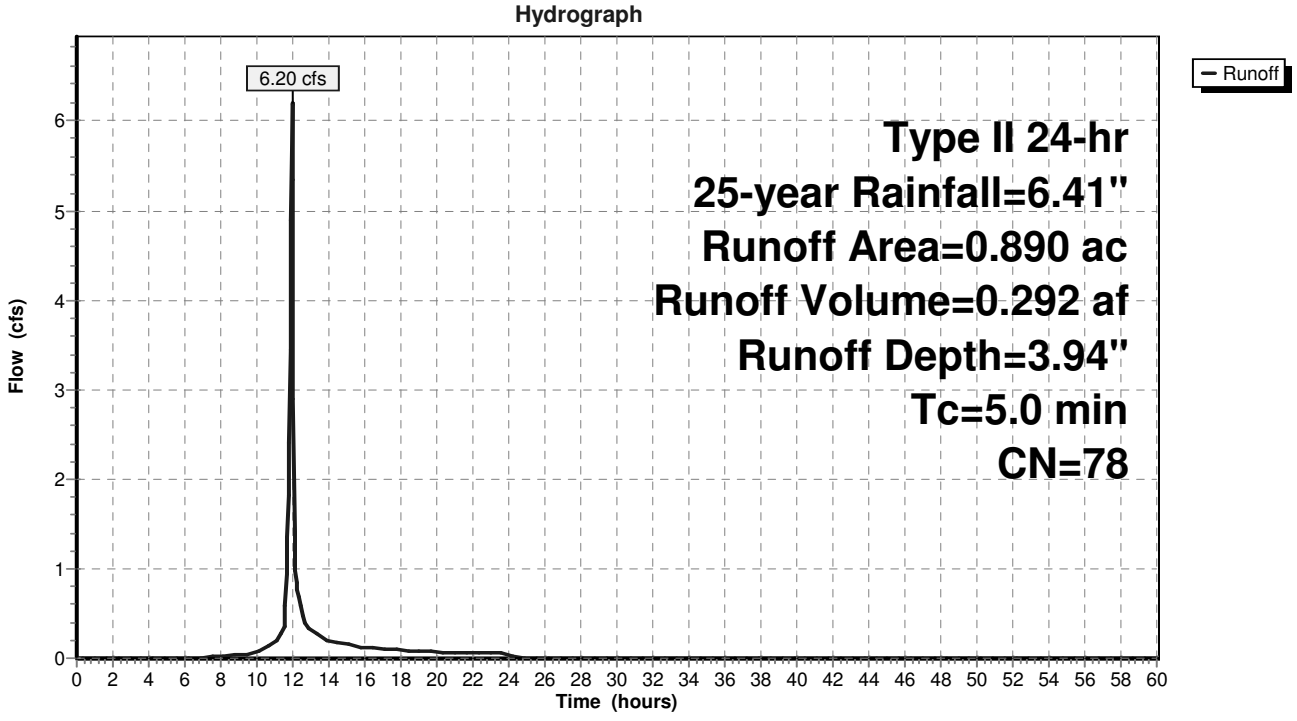
Runoff = 6.20 cfs @ 11.96 hrs, Volume= 0.292 af, Depth= 3.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.41"

	Area (ac)	CN	Description
*	0.370	70	woods good condition
*	0.200	98	impervious area
	0.320	74	>75% Grass cover, Good, HSG C
	0.890	78	Weighted Average
	0.690		77.53% Pervious Area
	0.200		22.47% Impervious Area

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

Subcatchment 22S: Undetained Area



Summary for Subcatchment 23S: Onsite to BMP 3

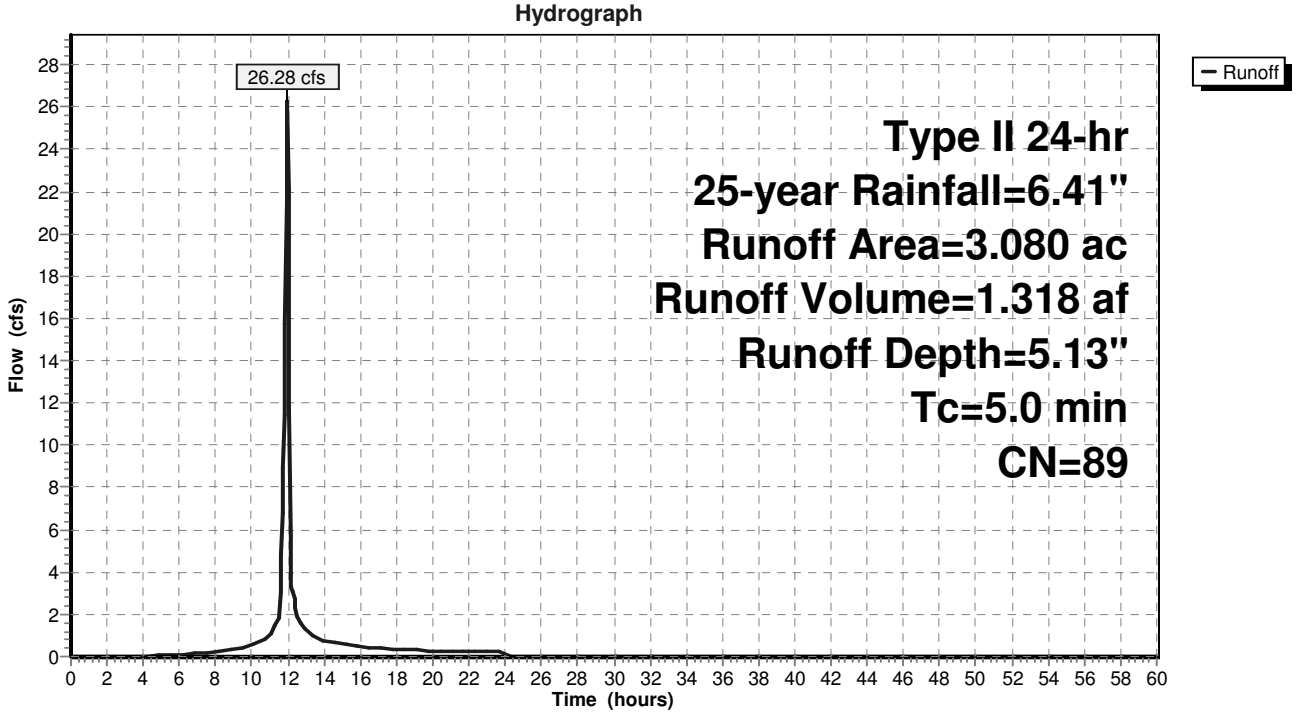
Runoff = 26.28 cfs @ 11.95 hrs, Volume= 1.318 af, Depth= 5.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.41"

	Area (ac)	CN	Description
*	1.950	98	impervious area
*	1.130	74	open space
	3.080	89	Weighted Average
	1.130		36.69% Pervious Area
	1.950		63.31% Impervious Area

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

Subcatchment 23S: Onsite to BMP 3



Summary for Subcatchment 24S: Onsite to BMP 1

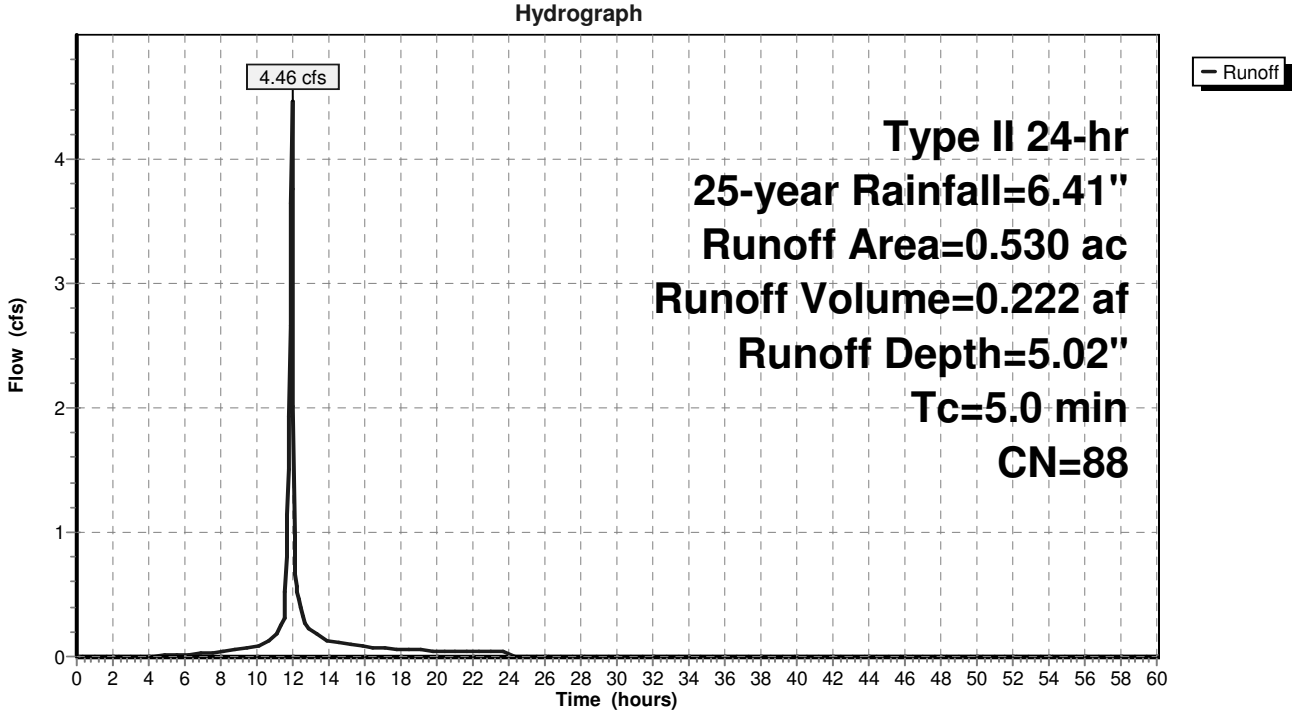
Runoff = 4.46 cfs @ 11.95 hrs, Volume= 0.222 af, Depth= 5.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.41"

	Area (ac)	CN	Description
*	0.310	98	impervious area
*	0.220	74	open space
	0.530	88	Weighted Average
	0.220		41.51% Pervious Area
	0.310		58.49% Impervious Area

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

Subcatchment 24S: Onsite to BMP 1



Summary for Subcatchment 25S: Onsite to BMP 2

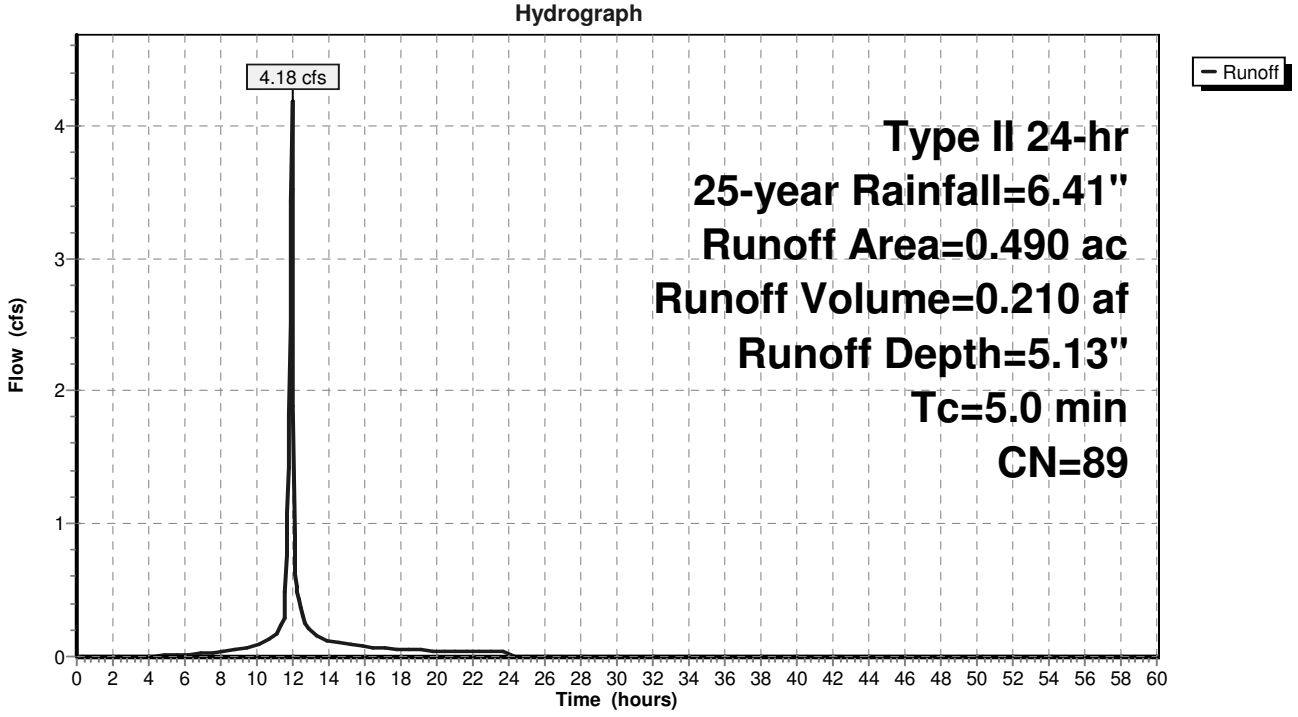
Runoff = 4.18 cfs @ 11.95 hrs, Volume= 0.210 af, Depth= 5.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.41"

	Area (ac)	CN	Description
*	0.310	98	impervious area
*	0.180	74	open space
	0.490	89	Weighted Average
	0.180		36.73% Pervious Area
	0.310		63.27% Impervious Area

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

Subcatchment 25S: Onsite to BMP 2



Summary for Subcatchment 27S: Undetained Area

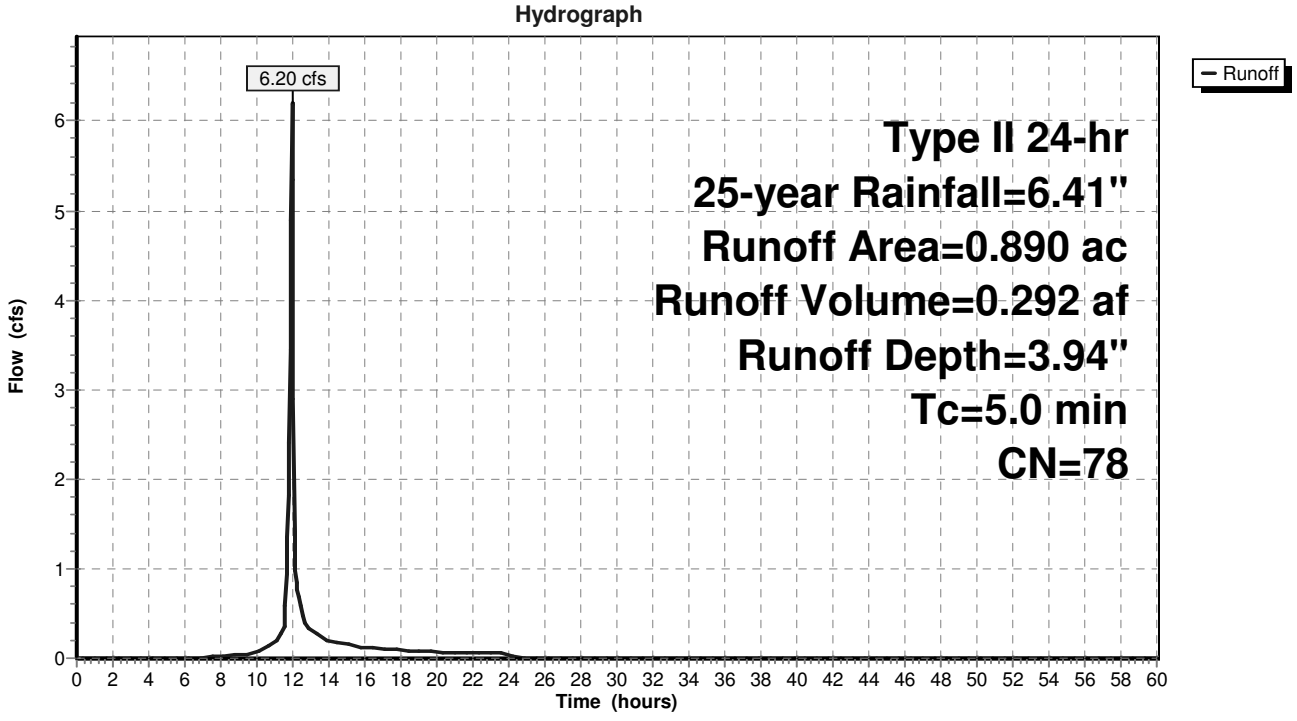
Runoff = 6.20 cfs @ 11.96 hrs, Volume= 0.292 af, Depth= 3.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.41"

	Area (ac)	CN	Description
*	0.370	70	woods good condition
*	0.200	98	impervious area
	0.320	74	>75% Grass cover, Good, HSG C
	0.890	78	Weighted Average
	0.690		77.53% Pervious Area
	0.200		22.47% Impervious Area

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

Subcatchment 27S: Undetained Area



Summary for Pond 6P: BMP 3 - East

Inflow Area = 6.060 ac, 36.14% Impervious, Inflow Depth = 4.25" for 25-year event
Inflow = 33.57 cfs @ 11.97 hrs, Volume= 2.145 af
Outflow = 32.01 cfs @ 12.00 hrs, Volume= 2.128 af, Atten= 5%, Lag= 1.9 min
Primary = 32.01 cfs @ 12.00 hrs, Volume= 2.128 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Peak Elev= 434.67' @ 12.00 hrs Surf.Area= 5,981 sf Storage= 17,100 cf

Plug-Flow detention time= 231.4 min calculated for 2.126 af (99% of inflow)
Center-of-Mass det. time= 228.0 min (1,031.1 - 803.1)

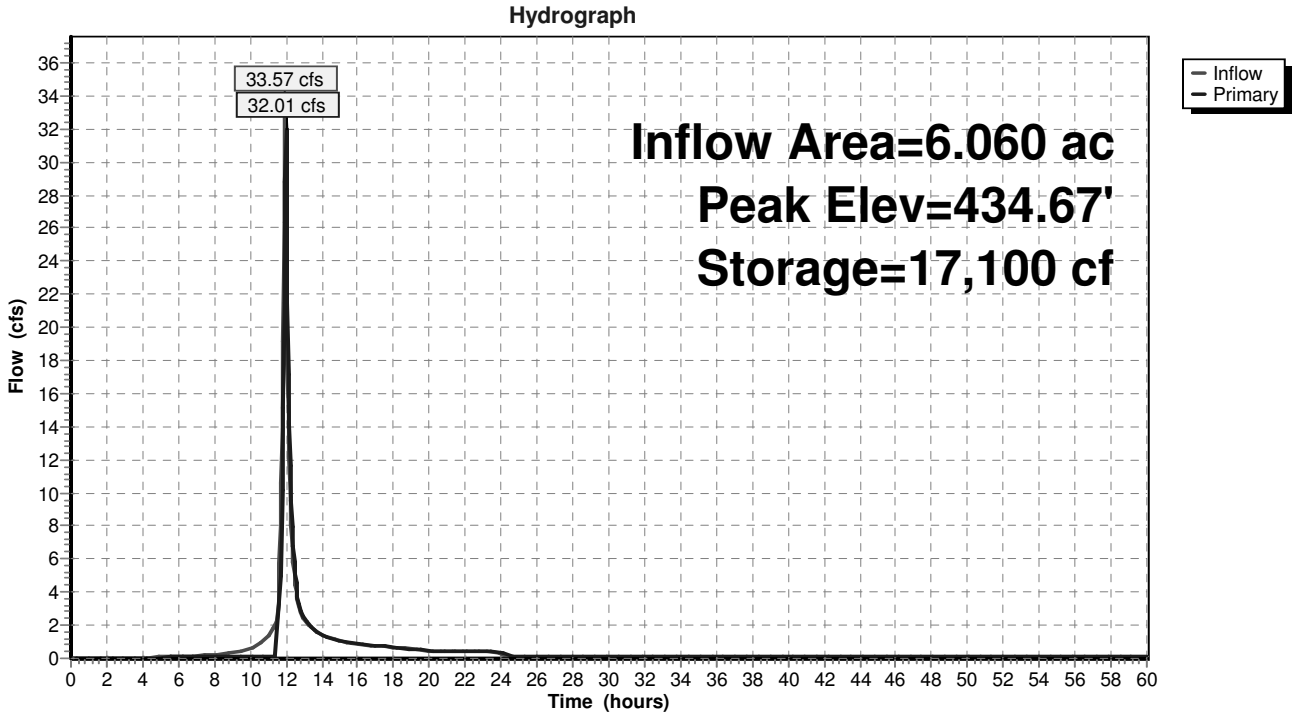
Volume	Invert	Avail.Storage	Storage Description
#1	431.00'	19,126 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
431.00	3,602	0	0
432.00	4,148	3,875	3,875
433.00	4,714	4,431	8,306
434.00	5,307	5,011	13,317
435.00	6,312	5,810	19,126

Device	Routing	Invert	Outlet Devices
#1	Primary	431.00'	**Special & User-Defined** Head (feet) 0.00 0.05 0.10 0.25 0.50 0.75 1.00 2.00 3.00 4.00 Disch. (cfs) 0.000 0.058 0.059 0.063 0.069 0.074 0.080 0.103 0.126 0.149
#2	Primary	433.80'	**36.0" x 36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=31.81 cfs @ 12.00 hrs HW=434.67' (Free Discharge)
└**1=Special & User-Defined** (Custom Controls 0.14 cfs)
└**2=Orifice/Grate** (Weir Controls 31.67 cfs @ 3.04 fps)

Pond 6P: BMP 3 - East



Summary for Pond 7P: BMP 1 - West

Inflow Area = 0.530 ac, 58.49% Impervious, Inflow Depth = 5.02" for 25-year event
Inflow = 4.46 cfs @ 11.95 hrs, Volume= 0.222 af
Outflow = 0.01 cfs @ 24.09 hrs, Volume= 0.059 af, Atten= 100%, Lag= 728.2 min
Primary = 0.01 cfs @ 24.09 hrs, Volume= 0.059 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Peak Elev= 431.52' @ 24.09 hrs Surf.Area= 4,751 sf Storage= 8,880 cf

Plug-Flow detention time= 1,411.0 min calculated for 0.059 af (27% of inflow)
Center-of-Mass det. time= 1,259.8 min (2,044.9 - 785.1)

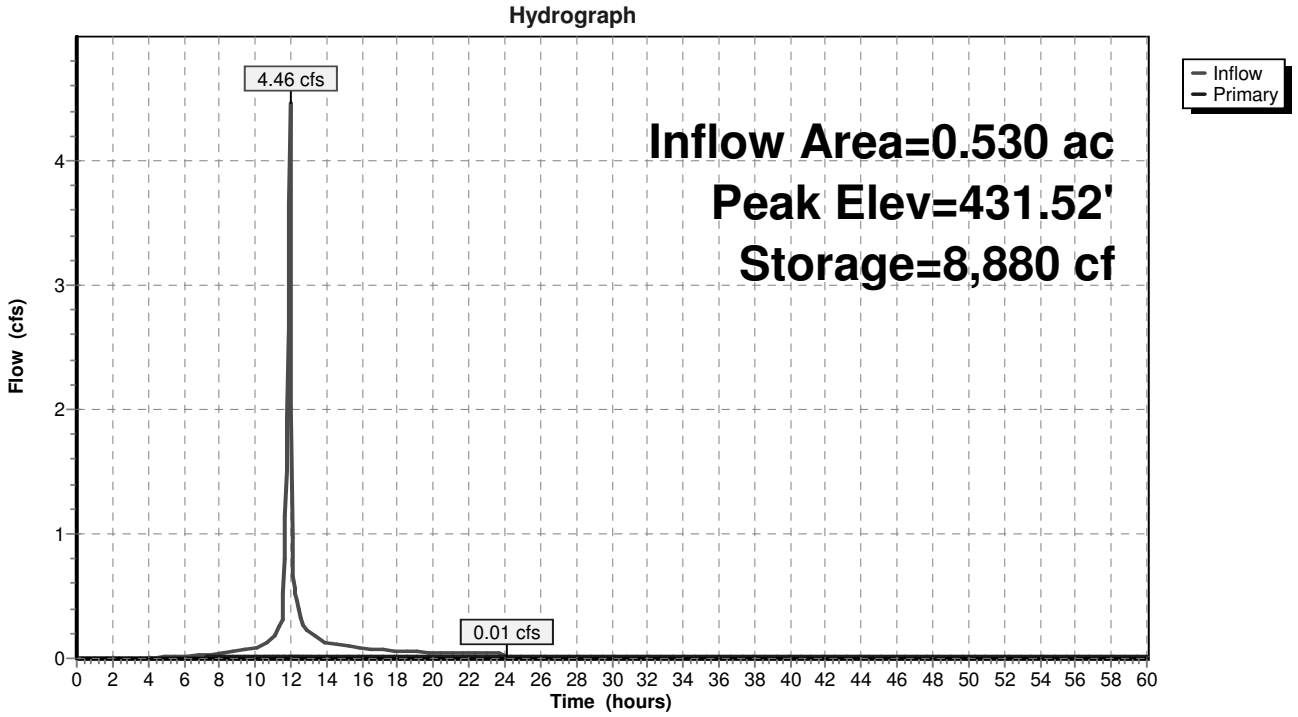
Volume	Invert	Avail.Storage	Storage Description
#1	429.00'	12,638 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
429.00	2,485	0	0
430.00	3,274	2,880	2,880
431.00	4,120	3,697	6,577
432.00	5,335	4,728	11,304
432.25	5,335	1,334	12,638

Device	Routing	Invert	Outlet Devices
#1	Primary	429.00'	**Special & User-Defined** Head (feet) 0.00 0.05 0.10 0.25 0.50 0.75 1.00 2.00 3.00 Disch. (cfs) 0.000 0.007 0.008 0.008 0.009 0.009 0.010 0.013 0.016
#2	Primary	432.00'	**24.0" W x 24.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.01 cfs @ 24.09 hrs HW=431.52' (Free Discharge)
1=Special & User-Defined (Custom Controls 0.01 cfs)
2=Orifice/Grate (Controls 0.00 cfs)

Pond 7P: BMP 1 - West

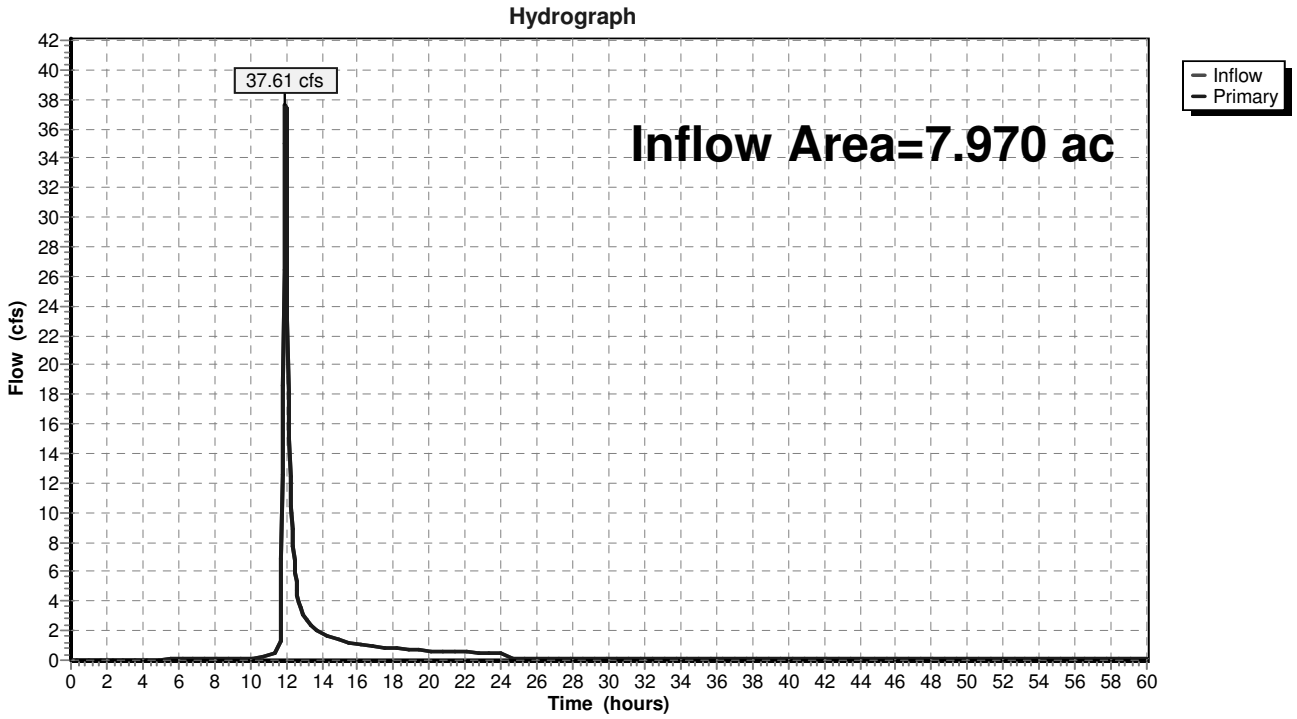


Summary for Pond 9P: Total Post

Inflow Area = 7.970 ac, 37.77% Impervious, Inflow Depth > 3.92" for 25-year event
Inflow = 37.61 cfs @ 11.99 hrs, Volume= 2.606 af
Primary = 37.61 cfs @ 11.99 hrs, Volume= 2.606 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs

Pond 9P: Total Post



Summary for Pond 16P: BMP 2 - Middle

Inflow Area = 0.490 ac, 63.27% Impervious, Inflow Depth = 5.13" for 25-year event
Inflow = 4.18 cfs @ 11.95 hrs, Volume= 0.210 af
Outflow = 0.33 cfs @ 12.48 hrs, Volume= 0.126 af, Atten= 92%, Lag= 31.8 min
Primary = 0.33 cfs @ 12.48 hrs, Volume= 0.126 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Peak Elev= 433.05' @ 12.48 hrs Surf.Area= 2,776 sf Storage= 5,699 cf

Plug-Flow detention time= 805.7 min calculated for 0.126 af (60% of inflow)
Center-of-Mass det. time= 700.8 min (1,482.6 - 781.8)

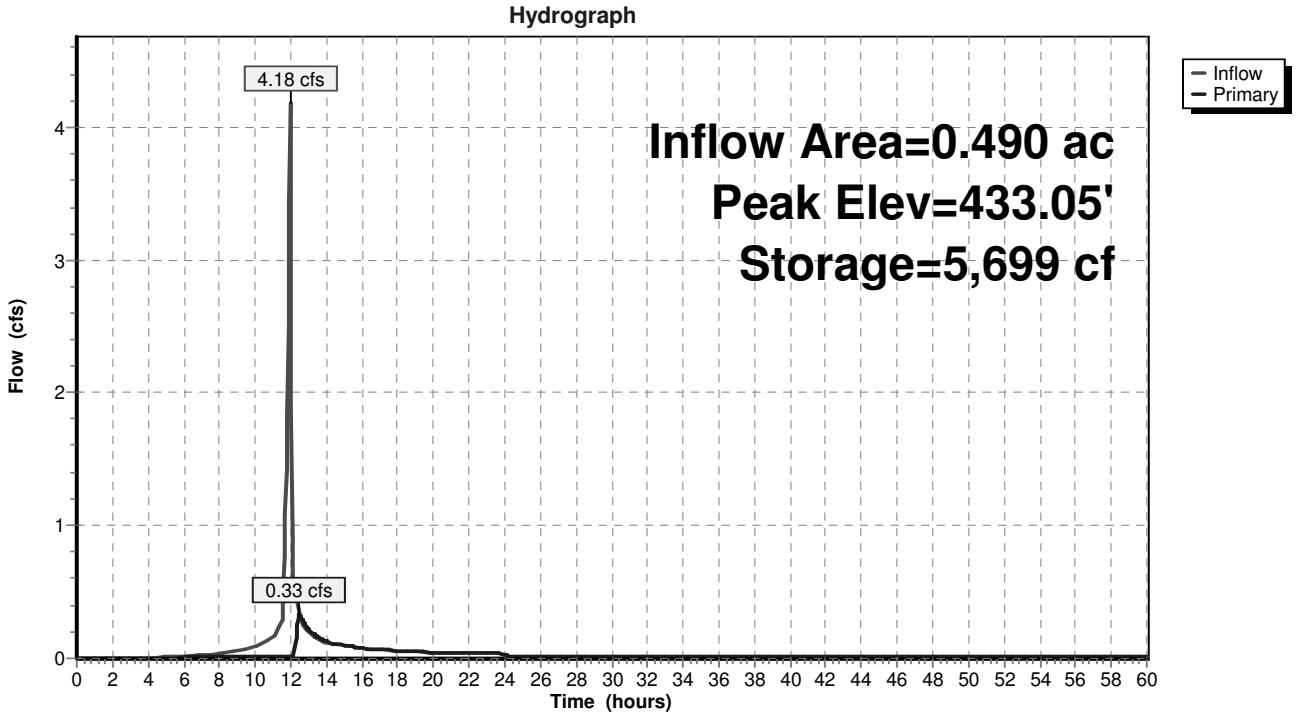
Volume	Invert	Avail.Storage	Storage Description
#1	430.00'	8,740 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
430.00	1,051	0	0
431.00	1,553	1,302	1,302
432.00	2,113	1,833	3,135
433.00	2,729	2,421	5,556
434.00	3,638	3,184	8,740

Device	Routing	Invert	Outlet Devices
#1	Primary	430.00'	**Special & User-Defined** Head (feet) 0.00 0.05 0.10 0.25 0.50 0.75 1.00 2.00 3.00 4.00 5.00 Disch. (cfs) 0.000 0.007 0.007 0.008 0.009 0.009 0.010 0.013 0.016 0.018 0.021
#2	Primary	433.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.33 cfs @ 12.48 hrs HW=433.05' (Free Discharge)
└**1=Special & User-Defined** (Custom Controls 0.02 cfs)
└**2=Orifice/Grate** (Weir Controls 0.31 cfs @ 0.75 fps)

Pond 16P: BMP 2 - Middle

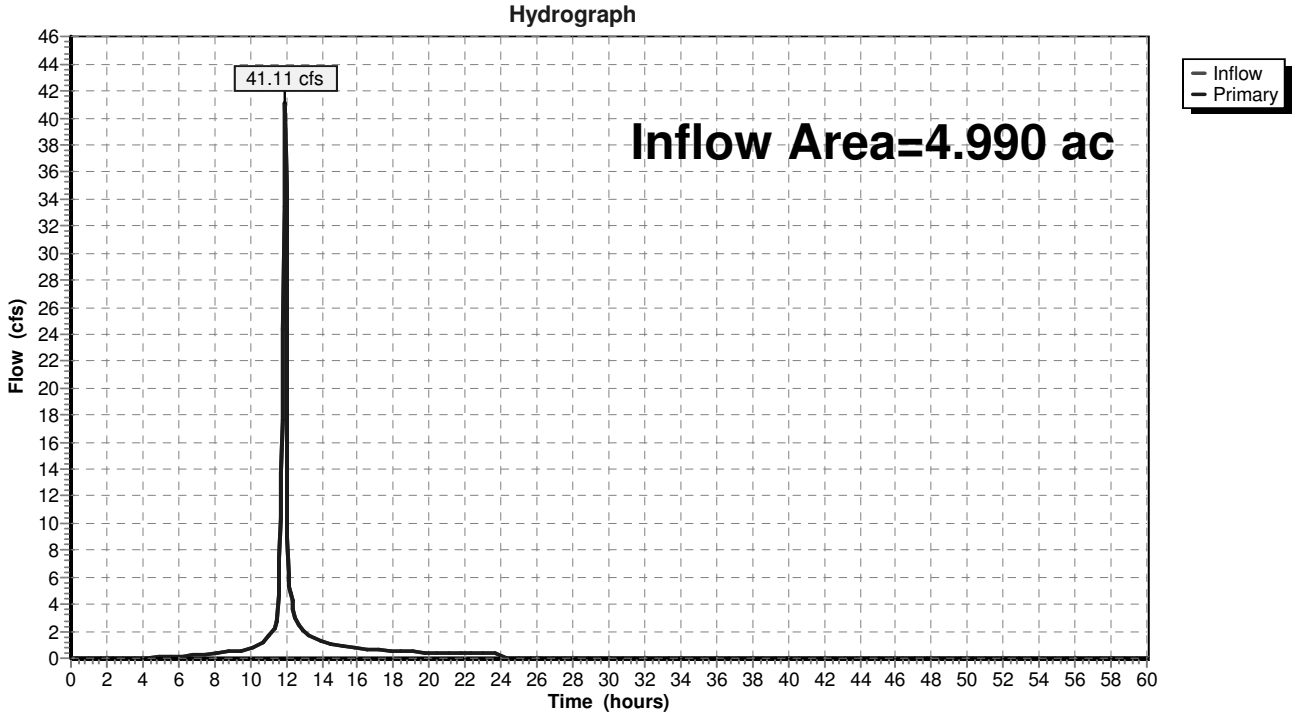


Summary for Pond 26P: Post w/o controls

Inflow Area = 4.990 ac, 55.51% Impervious, Inflow Depth = 4.91" for 25-year event
Inflow = 41.11 cfs @ 11.95 hrs, Volume= 2.041 af
Primary = 41.11 cfs @ 11.95 hrs, Volume= 2.041 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs

Pond 26P: Post w/o controls



Appendix B

Water Quality Calculations

Subarea 001 Sand Filter

Total Area =	0.47	acres
Impervious =	0.31	acres
% Imp =	65%	

Rv =	0.05+(0.009I)		
Rv =	0.64		
WQv =	0.025	ac-ft	
WQv =	1083	cu-ft	
Forebay Vol =	217	cu-ft	(required)

Filtration Media Surface Area

Af = (WQv)(df)/[(k)(hf+df)(tf)]

WQv	1083	cubic-feet	water quality volume
Top of Sand	429.00	ft	
WQv Elev	429.41	ft	
hf	0.21	ft	average height of water above surface of bed
df	2.5	ft	filter bed depth
k	3.5	ft/day	coefficient of permeability (3.5 feet/day)
tf	2	days	
Af	143	square feet	minimum required area of sand filter
Af	150	square feet	area provided

Flow Rate Rating Curve

Q = (Af)[3.5*(hf+df)]/df

Sand filter surface elevation =	429.00	ft
Water Quality Volume Elevation =	429.41	ft
Area of Sand filter =	150	sf
df =	2.5	ft

elev. (ft)	flow (cfs)
429.00	0.000
429.05	0.006
429.10	0.006
429.25	0.007
429.50	0.007
429.75	0.008
430.00	0.009
431.00	0.011
432.00	0.013

Subarea 002 Sand Filter

Total Area =	0.49	acres
Impervious =	0.32	acres
% Imp =	65%	

Rv =	0.05+(0.009I)	
Rv =	0.64	
WQv =	0.026	ac-ft
WQv =	1129	cu-ft
Forebay Vol =	226	cu-ft

Filtration Media Surface Area

Af = (WQv)(df)/[(k)(hf+df)(tf)]

WQv	1129	cubic-feet	water quality volume
Top of Sand	430.00	ft	
WQv Elev	430.89	ft	
hf	0.45	ft	average height of water above surface of bed
df	2.5	ft	filter bed depth
k	3.5	ft/day	coefficient of permeability (3.5 feet/day)
tf	2	days	
Af	137	square feet	minimum required area of sand filter
Af	150	square feet	area provided

Flow Rate Rating Curve

Q = (Af)[3.5*(hf+df)]/df

Sand filter surface elevation =	430.00	ft
Water Quality Volume Elevation =	430.89	ft
Area of Sand filter =	150	sf
df =	2.5	ft

elev. (ft)	flow (cfs)
430.00	0.000
430.05	0.006
430.10	0.006
430.25	0.007
430.50	0.007
430.75	0.008
431.00	0.009
432.00	0.011
433.00	0.013
434.00	0.016
435.00	0.018

Subarea 003 Sand Filter

Total Area =	6.06	acres	(includes 2.90 acres of offsite area, with 0.14 acres of impervious area)
Impervious =	2.19	acres	
% Imp =	36%		

Rv =	0.05+(0.009I)	
Rv =	0.38	
WQv =	0.190	ac-ft
WQv =	8255	cu-ft
Forebay Vol =	1651	cu-ft

Filtration Media Surface Area

Af = (WQv)(df)/[(k)(hf+df)(tf)]

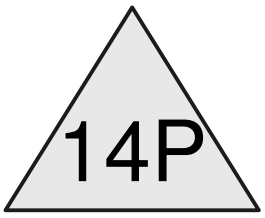
WQv	8255	cubic-feet	water quality volume
Top of Sand	431.00	ft	
WQv Elev	432.99	ft	
hf	1.26	ft	average height of water above surface of bed
df	2.5	ft	filter bed depth
k	3.5	ft/day	coefficient of permeability (3.5 feet/day)
tf	1.6666667	days	
Af	942	square feet	minimum required area of sand filter
Af	1410	square feet	area provided

Flow Rate Rating Curve

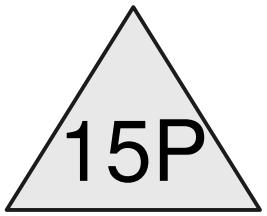
Q = (Af)[3.5*(hf+df)]/df

Sand filter surface elevation =	431.00	ft
Water Quality Volume Elevation =	432.99	ft
Area of Sand filter =	1410	sf
df =	2.5	ft

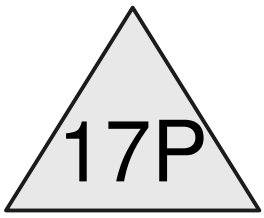
elev. (ft)	flow (cfs)
431.00	0.000
431.05	0.058
431.10	0.059
431.25	0.063
431.50	0.069
431.75	0.074
432.00	0.080
433.00	0.103
434.00	0.126
435.00	0.149



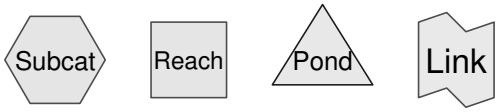
BMP 3 - East WQ



BMP 2 - Middle WQ



BMP 1 - West WQ



Routing Diagram for 20141832-rev2
Prepared by Symanetc, Printed 9/27/2016

Summary for Pond 14P: BMP 3 - East WQ

Inflow	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af
Outflow	=	0.10 cfs @	0.00 hrs,	Volume=	0.190 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.10 cfs @	0.00 hrs,	Volume=	0.190 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Starting Elev= 432.99' Surf.Area= 4,708 sf Storage= 8,259 cf
Peak Elev= 432.99' @ 0.00 hrs Surf.Area= 4,708 sf Storage= 8,259 cf

Plug-Flow detention time= (not calculated: no plugs found)
Center-of-Mass det. time= (not calculated: no inflow)

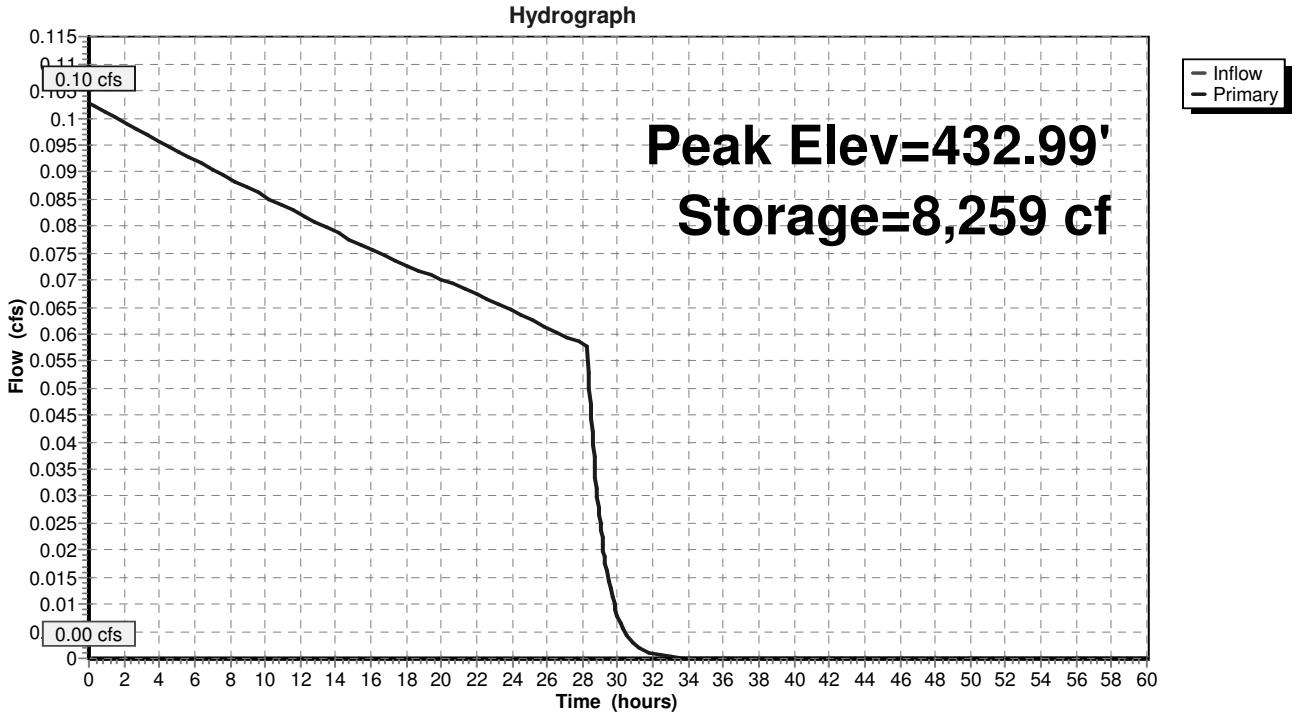
Volume	Invert	Avail.Storage	Storage Description
#1	431.00'	19,126 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
431.00	3,602	0	0
432.00	4,148	3,875	3,875
433.00	4,714	4,431	8,306
434.00	5,307	5,011	13,317
435.00	6,312	5,810	19,126

Device	Routing	Invert	Outlet Devices
#1	Primary	431.00'	**Special & User-Defined** Elev. (feet) 431.00 431.05 431.10 431.25 431.50 431.75 432.00 433.00 434.00 435.00 Disch. (cfs) 0.000 0.058 0.059 0.063 0.069 0.074 0.080 0.103 0.126 0.149

Primary OutFlow Max=0.10 cfs @ 0.00 hrs HW=432.99' (Free Discharge)
↑—**1=Special & User-Defined** (Custom Controls 0.10 cfs)

Pond 14P: BMP 3 - East WQ



Summary for Pond 15P: BMP 2 - Middle WQ

Inflow	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af
Outflow	=	0.01 cfs @	0.00 hrs,	Volume=	0.023 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.01 cfs @	0.00 hrs,	Volume=	0.023 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Starting Elev= 430.81' Surf.Area= 1,458 sf Storage= 1,016 cf
Peak Elev= 430.81' @ 0.00 hrs Surf.Area= 1,458 sf Storage= 1,016 cf

Plug-Flow detention time= (not calculated: no plugs found)
Center-of-Mass det. time= (not calculated: no inflow)

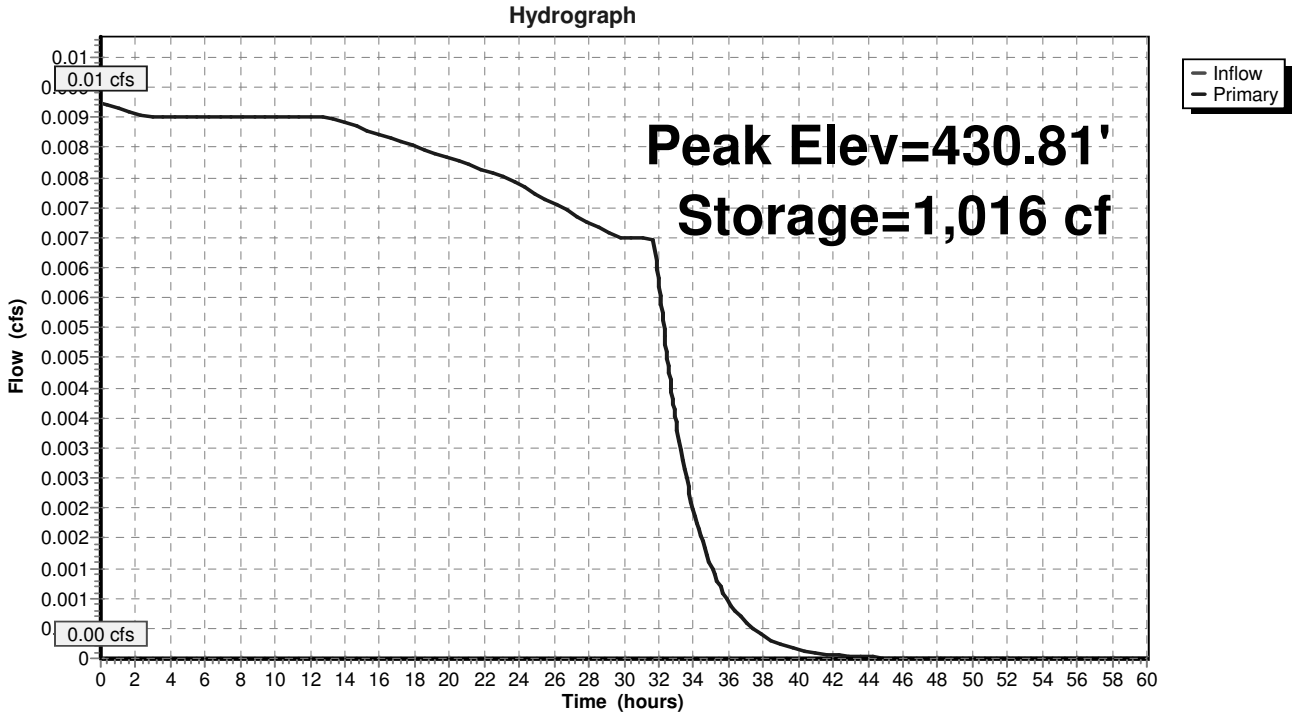
Volume	Invert	Avail.Storage	Storage Description
#1	430.00'	8,740 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
430.00	1,051	0	0
431.00	1,553	1,302	1,302
432.00	2,113	1,833	3,135
433.00	2,729	2,421	5,556
434.00	3,638	3,184	8,740

Device	Routing	Invert	Outlet Devices
#1	Primary	430.00'	**Special & User-Defined** Head (feet) 0.00 0.05 0.10 0.25 0.50 0.75 1.00 2.00 3.00 4.00 5.00 Disch. (cfs) 0.000 0.007 0.007 0.008 0.009 0.009 0.010 0.013 0.016 0.018 0.021

Primary OutFlow Max=0.01 cfs @ 0.00 hrs HW=430.81' (Free Discharge)
↑—**1=Special & User-Defined** (Custom Controls 0.01 cfs)

Pond 15P: BMP 2 - Middle WQ



Summary for Pond 17P: BMP 1 - West WQ

Inflow	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af
Outflow	=	0.01 cfs @	0.00 hrs,	Volume=	0.024 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.01 cfs @	0.00 hrs,	Volume=	0.024 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Starting Elev= 429.39' Surf.Area= 2,793 sf Storage= 1,029 cf
Peak Elev= 429.39' @ 0.00 hrs Surf.Area= 2,793 sf Storage= 1,029 cf

Plug-Flow detention time= (not calculated: no plugs found)
Center-of-Mass det. time= (not calculated: no inflow)

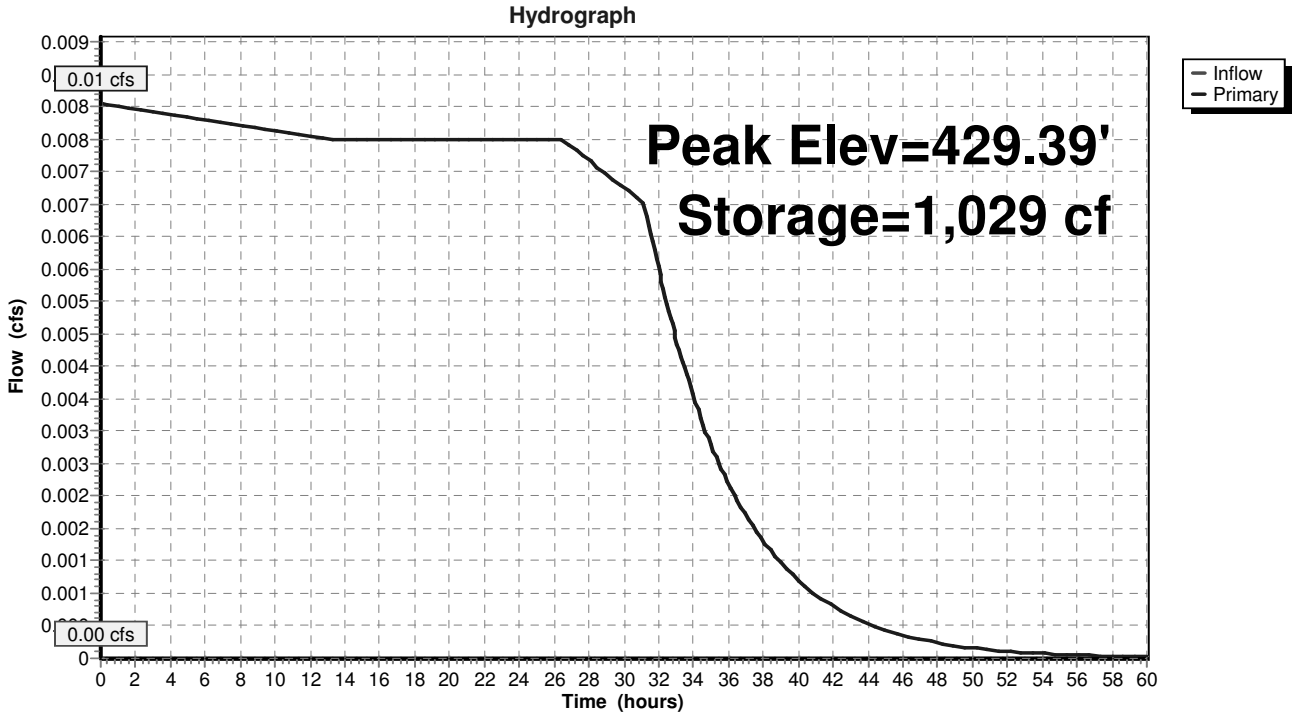
Volume	Invert	Avail.Storage	Storage Description
#1	429.00'	11,304 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
429.00	2,485	0	0
430.00	3,274	2,880	2,880
431.00	4,120	3,697	6,577
432.00	5,335	4,728	11,304

Device	Routing	Invert	Outlet Devices
#1	Primary	429.00'	**Special & User-Defined** Head (feet) 0.00 0.05 0.10 0.25 0.50 0.75 1.00 2.00 3.00 Disch. (cfs) 0.000 0.007 0.008 0.008 0.009 0.009 0.010 0.013 0.016

Primary OutFlow Max=0.01 cfs @ 0.00 hrs HW=429.39' (Free Discharge)
1=Special & User-Defined (Custom Controls 0.01 cfs)

Pond 17P: BMP 1 - West WQ



Appendix C

Nutrient Calculations

Watershed Characteristics Ver2.0

Clear All Values | Return to Instructions | Proceed to BMP Characteristics | Skip to Development Summary

Instructions

1. Select your physiographic/geologic region. (see map on 'instructions' page)
2. Enter the area of the entire development in square feet (ft^2).
3. Select the location that is most representative of the site's precipitation characteristics. (see map on 'instructions' page)
4. For each applicable land use, enter the total area of that land use that lies within the development under pre-development conditions.
5. For each applicable land use, enter the total area of that land use that lies within the development under post-development conditions, before BMP implementation.
6. Ensure that the sum of pre- and post-development areas entered equal the orginal development area.
7. Continue to "BMP Characteristics" tab.

Additional Guidelines

- For non-residential watersheds, indicate acreages of each land use type in Column 1 for both pre- and post-development conditions.
- For residential watersheds, complete the required information in Column 2 for both pre- and post-development conditions.
- If a given land use is not present in the given watershed, leave the cell blank or enter a zero.
- Ensure that land use areas entered for both pre- and post-development conditions match the total development area entered in cell O21.
- Residential areas may be entered by average lot size (column, part A), or may be separated into individual land uses (column 2, part B) -- do NOT list out individual land uses within an area already described by lot size.
- Unless runoff flowing onto the development from offsite is routed separately around or through the site, the offsite catchment area draining in must be included in the acreage values of the appropriate land use(s) and treated.

Physiographic/Geologic Region:	**Triassic Basin**
Soil Hydrologic Group	**C**
Precipitation location:	**Raleigh**

Total Development Area (ft^2):	**280,439**
Development Name:	Hendrick Southpoint - Worksheet 2
Model Prepared By:	Doug Turney

COLUMN 1 -- NON-RESIDENTIAL LAND USES

	TN EMC (mg/L)	TP EMC (mg/L)	Pre-Development (ft^2)	Post-Development (ft^2)
COMMERCIAL				
Parking lot	1.44	0.16		49,120
Roof	1.08	0.15		57,799
Open/Landscaped	2.24	0.44		
INDUSTRIAL				
Parking lot	1.44	0.39		
Roof	1.08	0.15		
Open/Landscaped	2.24	0.44		
TRANSPORTATION				
High Density (interstate, main)	3.67	0.43		
Low Density (secondary, feeder)	1.4	0.52		
Rural	1.14	0.47		
Sidewalk	1.4	1.16		13,743
PERVIOUS				
Managed pervious	3.06	0.59		73,447
Unmanaged (pasture)	3.61	1.56		
Forest	1.47	0.25	280,439	79,192
JURISDICTIONAL LANDS*				
Natural wetland	--	--		
Riparian buffer	--	--		
Open water	--	--		
LAND TAKEN UP BY BMPs	1.08	0.15		7,138

*Jurisdictional land uses are not included in nutrient/flow calculations.

COLUMN 2 -- RESIDENTIAL LAND USES

	Custom Lot Size (ac)	Age (yrs)	TN EMC (mg/L)	TP EMC (mg/L)	Pre-Development (ft^2)	Post-Development (ft^2)
PART A						
⅛-ac lots	--		--	--		
¼-ac lots	--		--	--		
½-ac lots	--		--	--		
1-ac lots	--		--	--		
2-ac lots	--		--	--		
Multi-family	--		--	--		
Townhomes	--		--	--		
Custom Lot Size			--	--		
PART B						
Roadway		--	1.4	0.52		
Driveway		1.0	1.44	0.39		
Parking lot		--	1.44	0.39		
Roof		--	1.08	0.15		
Sidewalk/Patio		--	1.4	1.16		
Lawn		--	2.24	0.44		
Managed pervious		--	3.06	0.59		
Forest		--	1.47	0.25		
Natural wetland*		--	--	--		
Riparian buffer*		--	--	--		
Open water*		--	--	--		
LAND TAKEN UP BY BMPs		--	1.08	0.15		

LAND USE AREA CHECK

Total Development Area Entered (ft^2):	**280,439**
Total Pre-Development Calculated Area (ft^2):	**280,439**
Total Post-Development Calculated Area (ft^2):	**280,439**

BMP Characteristics Ver2.0

Clear All Values | Return to Instructions | Return to Watershed Characteristics | Proceed to Development Summary

Instructions

1. Select the type of BMP for each catchment.
2. Enter the area of each land use type in the contributing drainage area for each BMP.
3. Continue to "Development Summary" tab.

Additional Guidelines

- This spreadsheet allows the development to be divided into as many as 6 smaller catchments.
- BMPs 1, 2, and 3 for a given catchment are assumed to operate in series, with the outflow from 1 serving as the inflow to 2, etc.
- If the outflow from an entire catchment (including outflow from selected BMPs) drains to another BMP, indicate this in the drop down menu below the BMP type and leave all cells for individual land uses blank.
- Not all BMP or catchments must be utilized. Simply leave fields blank in the columns not needed.
- Leave cells blank or insert zeroes if a land use is not present in the area draining to the BMP.
- For water harvesting BMPs, be sure to enter the percent volume reduction that will be achieved by your system. Volume detention (catch-and-release mechanisms) will not be considered - only proven volume reductions are valid inputs.
- The BMP undersizing option should only be used for existing development or retrofit sites.
- Volume reduction efficiencies for undersized BMPs are calculated based on a 1:1 ratio (a BMP that is 60% smaller than the required design size is assigned a removal efficiency equal to 60% of the standard efficiency value). Effluent concentrations remain the same as full-sized BMPs.
- IMPORTANT: for the land area calculation checks to occur, you MUST press enter after entering a value for area to be treated by a BMP (not just click on the next cell).
- See User's Manual for instructions on modeling oversized BMPs.

BMP DETAILS			
BMP	**Volume Reduction (%)**	**TN Effluent Concen. (mg/L)**	**TP Effluent Concen. (mg/L)**
Bioretention with IWS	35%	0.95	0.12
Bioretention without IWS	15%	1.00	0.12
Dry Detention Pond	0%	1.20	0.20
Grassed Swale	0%	1.21	0.26
Green Roof	50%	1.08	0.15
Level Spreader, Filter Strip	20%	1.20	0.15
Permeable Pavement*	0%	1.44	0.39
Sand Filter	5%	0.92	0.14
Water Harvesting	user defined	1.08	0.15
Wet Detention Pond	5%	1.01	0.11
Wetland	15%	1.08	0.12

*if treating commercial parking lot, TP effluent concentration = 0.16 mg/L

	CATCHMENT 1			CATCHMENT 2			CATCHMENT 3			CATCHMENT 4			CATCHMENT 5			CATCHMENT 6		
	BMP #1	BMP #2	BMP #3	BMP #1	BMP #2	BMP #3	BMP #1	BMP #2	BMP #3	BMP #1	BMP #2	BMP #3	BMP #1	BMP #2	BMP #3	BMP #1	BMP #2	BMP #3
Type of BMP:	Sand Filter			Sand Filter			Sand Filter											
If BMP is undersized, indicate the BMP's size relative to the design size required to capture the designated water quality depth (i.e. 0.75 = BMP is 75% of required design size):																		
***For water harvesting BMP, enter percent volume reduction in decimal form.**																		
	Does BMP accept the outflow from another Catchment? If so, indicate which one(s). (Land use areas entered below are in addition to the watershed areas treated by contributing catchment(s).)																	
Catchment 1:	--	--	--	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
Catchment 2:	no	no	no	--	--	--	no	no	no	no	no	no	no	no	no	no	no	no
Catchment 3:	no	no	no	no	no	no	--	--	--	no	no	no	no	no	no	no	no	no
Catchment 4:	no	no	no	no	no	no	no	no	no	--	--	--	no	no	no	no	no	no
Catchment 5:	no	no	no	no	no	no	no	no	no	no	no	no	--	--	--	no	no	no
Catchment 6:	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	--	--	--

Drainage Area Land Use	**Catchment 1: Area Treated by BMP (ft^2)**	**Catchment 1: Area treated by BMP #2 that is not treated by BMP #1 (ft^2)**	**Catchment 1: Area treated by BMP #3 that is not treated by BMPs #1 or #2 (ft^2)**	**Catchment 2: Area Treated by BMP (ft^2)**	**Catchment 2: Area treated by BMP #2 that is not treated by BMP #1 (ft^2)**	**Catchment 2: Area treated by BMP #3 that is not treated by BMPs #1 or #2 (ft^2)**	**Catchment 3: Area Treated by BMP (ft^2)**	**Catchment 3: Area treated by BMP #2 that is not treated by BMP #1 (ft^2)**	**Catchment 3: Area treated by BMP #3 that is not treated by BMPs #1 or #2 (ft^2)**
COMMERCIAL									
Parking lot							40,408		
Roof	9,129			10,859			48,265		
Open/Landscaped									
INDUSTRIAL									
Parking lot									
Roof									
Open/Landscaped									
TRANSPORTATION									
High Density (interstate, main)									
Low Density (secondary, feeder)									
Rural									
Sidewalk	4,375			2,645			6,723		
MISC. PERVIOUS									
Managed pervious	7,098			6,790			45,621		
Unmanaged (pasture)									
Forest							57,610		
RESIDENTIAL									
2-ac lots (New)									
2-ac lots (Built after 1995)									
2-ac lots (Built before 1995)									
1-ac lots (New)									
1-ac lots (Built after 1995)									
1-ac lots (Built before 1995)									
½-ac lots (New)									
½-ac lots (Built after 1995)									
½-ac lots (Built before 1995)									
¼-ac lots (New)									
¼-ac lots (Built after 1995)									
¼-ac lots (Built before 1995)									
⅛-ac lots (New)									
⅛-ac lots (Built after 1995)									
⅛-ac lots (Built before 1995)									
Townhomes (New)									
Townhomes (Built after 1995)									
Townhomes (Built before 1995)									
Multi-family (New)									
Multi-family (Built after 1995)									
Multi-family (Built before 1995)									
Custom Lot Size (New)									
Custom Lot Size (Built after 1995)									
Custom Lot Size (Built before 1995)									
Roadway									
Driveway									
Parking lot									
Roof									
Sidewalk									
Lawn									
Managed pervious									
Forest									
LAND TAKEN UP BY BMP	2,485			1,051			3,602		
TOTAL AREA TREATED BY BMP (ft^2):	**23,087**	**0**	**0**	**21,345**	**0**	**0**	**202,229**	**0**	**0**
TOTAL AREA TREATED BY SERIES (ft^2):		**23,087**			**21,345**			**202,229**	

Drainage Area Land Use	**Catchment 4: Area Treated by BMP (ft^2)**	**Catchment 4: Area treated by BMP #2 that is not treated by BMP #1 (ft^2)**	**Catchment 4: Area treated by BMP #3 that is not treated by BMPs #1 or #2 (ft^2)**	**Catchment 5: Area Treated by BMP (ft^2)**	**Catchment 5: Area treated by BMP #2 that is not treated by BMP #1 (ft^2)**	**Catchment 5: Area treated by BMP #3 that is not treated by BMPs #1 or #2 (ft^2)**	**Catchment 6: Area Treated by BMP (ft^2)**	**Catchment 6: Area treated by BMP #2 that is not treated by BMP #1 (ft^2)**	**Catchment 6: Area treated by BMP #3 that is not treated by BMPs #1 or #2 (ft^2)**	**Total Land Use Area Treated By All BMPs (ft^2)**	**Allowable Total Land Use Area to be Treated Based on Post-Dev. Areas (ft^2)**
COMMERCIAL											
Parking lot										40,408	49,120
Roof										68,253	57,799
Open/Landscaped										0	0
INDUSTRIAL											
Parking lot										0	0
Roof										0	0
Open/Landscaped										0	0
TRANSPORTATION											
High Density (interstate, main)										0	0
Low Density (secondary, feeder)										0	0
Rural										0	0
Sidewalk										13,743	13,743
MISC. PERVIOUS											
Managed pervious										59,509	73,447
Unmanaged (pasture)										0	0
Forest										57,610	79,192
RESIDENTIAL											
2-ac lots (New)										0	0
2-ac lots (Built after 1995)										0	0
2-ac lots (Built before 1995)										0	0
1-ac lots (New)										0	0
1-ac lots (Built after 1995)										0	0
1-ac lots (Built before 1995)										0	0
½-ac lots (New)										0	0
½-ac lots (Built after 1995)										0	0
½-ac lots (Built before 1995)										0	0
¼-ac lots (New)										0	0
¼-ac lots (Built after 1995)										0	0
¼-ac lots (Built before 1995)										0	0
⅛-ac lots (New)										0	0
⅛-ac lots (Built after 1995)										0	0
⅛-ac lots (Built before 1995)										0	0
Townhomes (New)										0	0
Townhomes (Built after 1995)										0	0
Townhomes (Built before 1995)										0	0
Multi-family (New)										0	0
Multi-family (Built after 1995)										0	0
Multi-family (Built before 1995)										0	0
Custom Lot Size (New)										0	0
Custom Lot Size (Built after 1995)										0	0
Custom Lot Size (Built before 1995)										0	0
Roadway										0	0
Driveway										0	0
Parking lot										0	0
Roof										0	0
Sidewalk										0	0
Lawn										0	0
Managed pervious										0	0
Forest										0	0
LAND TAKEN UP BY BMP										7,138	7,138
TOTAL AREA TREATED BY BMP (ft^2):	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		
TOTAL AREA TREATED BY SERIES (ft^2):		**0**			**0**			**0**			

Development:	**Hendrick Southpoint - Worksheet 2**
Prepared By:	Doug Turney
Date:	September 27, 2016

WATERSHED SUMMARY Ver2.0

REGION:	Triassic Basin
TOTAL DEVELOPMENT AREA (ft²):	280,439

	Pre-Development Conditions	Post-Development Conditions	Post-Development w/ BMPs
Percent Impervious (%)	0.0%	45.6%	45.6%
Annual Runoff Volume (c.f.)	53,061	488,316	465,206
Total Nitrogen EMC (mg/L)	1.47	1.31	1.00
Total Nitrogen Loading (lb/ac/yr)	0.76	6.21	4.48
Total Phosphorus EMC (mg/L)	0.25	0.30	0.16
Total Phosphorus Loading (lb/ac/yr)	0.13	1.29	0.71

Percent Difference Between:

	Pre-Dev. & Post-Dev. without BMPs	Pre-Development & Post-Development with BMPs	Post-Dev without BMPs & Post-Dev with BMPs
Percent Impervious (%)	46%	46%	0%
Annual Runoff Volume (c.f.)	820%	777%	-5%
Total Nitrogen EMC (mg/L)	-11%	-32%	-24%
Total Nitrogen Loading (lb/ac/yr)	721%	493%	-28%
Total Phosphorus EMC (mg/L)	20%	-37%	-48%
Total Phosphorus Loading (lb/ac/yr)	899%	451%	-45%

*Negative percent difference values indicate a decrease in runoff volume, pollutant concentration or pollutant loading. Positive values indicate an increase.

BMP VOLUME REDUCTIONS/EFFLUENT CONCENTRATIONS

	Volume Reduction (%)	TN Effluent Concen. (mg/L)	TP Effluent Concen. (mg/L)
Bioretention with IWS	35%	0.95	0.12
Bioretention without IWS	15%	1.00	0.12
Dry Detention Pond	0%	1.20	0.20
Grassed Swale	0%	1.21	0.26
Green Roof	50%	1.08	0.15
Level Spdr, Filter Strip	20%	1.20	0.15
Permeable Pavement*	0%	1.44	0.39
Sand Filter	5%	0.92	0.14
Water Harvesting	user defined	1.08	0.15
Wet Detention Pond	5%	1.01	0.11
Wetland	15%	1.08	0.12

*if treating commercial parking lot, TP effluent concentration = 0.16 mg/L

Return to Instructions
Return to Watershed Characteristics
Return to BMP Characteristics
Print Summary

BMP SUMMARY Ver2.0

	CATCHMENT 1			CATCHMENT 2			CATCHMENT 3			CATCHMENT 4			CATCHMENT 5			CATCHMENT 6		
	BMP 1	**BMP 2**	**BMP 3**	**BMP 1**	**BMP 2**	**BMP 3**	**BMP 1**	**BMP 2**	**BMP 3**	**BMP 1**	**BMP 2**	**BMP 3**	**BMP 1**	**BMP 2**	**BMP 3**	**BMP 1**	**BMP 2**	**BMP 3**
	Sand Filter	--	--	**Sand Filter**	--	--	**Sand Filter**	--	--	--	--	--	--	--	--	--	--	--
Total Area Treated (ac)	0.53	--	--	0.49	--	--	4.64	--	--	--	--	--	--	--	--	--	--	--
Total Inflow Volume (c.f.)	59,293	--	--	53,808	--	--	376,107	--	--	--	--	--	--	--	--	--	--	--
Percent Volume Reduced (%)	5%	--	--	5%	--	--	5%	--	--	--	--	--	--	--	--	--	--	--
Inflow Nitrogen EMC (mg/L)	1.21	--	--	1.18	--	--	1.30	--	--	--	--	--	--	--	--	--	--	--
Total Inflow Nitrogen (lb/ac/yr)	8.45	--	--	8.12	--	--	6.56	--	--	--	--	--	--	--	--	--	--	--
Inflow Phosphorus EMC (mg/L)	0.428	--	--	0.339	--	--	0.232	--	--	--	--	--	--	--	--	--	--	--
Total Inflow Phosphorus (lb/ac/yr)	2.99	--	--	2.32	--	--	1.17	--	--	--	--	--	--	--	--	--	--	--
BMP Outflow Nitrogen (lbs/ac/yr)	6.29	--	--	6.16	--	--	4.60	--	--	--	--	--	--	--	--	--	--	--
BMP Outflow Phosphorus (lbs/ac/yr)	1.13	--	--	1.05	--	--	0.72	--	--	--	--	--	--	--	--	--	--	--

Catchment Outflow Nitrogen EMC (mg/L)	0.95	0.95	0.96	--	--	--
Catchment Outflow Total Nitrogen (lb/ac/yr)	6.29	6.16	4.60	--	--	--
Percent Reduction in Nitrogen Load (%)	26%	24%	30%	--	--	--
Catchment Outflow Phosphorus EMC (mg/L)	0.170	0.161	0.150	--	--	--
Catchment Outflow Total Phosphorus (lb/ac/yr)	1.128	1.046	0.718	--	--	--
Percent Reduction in Phosphorus Load (%)	62%	16%	39%	--	--	--

COMPLIANCE WORKSHEET

Watershed (Select from Menu)

○	2	Falls Lake Basin
◉		Jordan Lake Basin
○		Lower Neuse Basin

Note that if a nutrient bank is used to buy offset credits in order to achieve compliance with the alternative selected below, the bank must be located in the same watershed as the project site.

Compliance Alternative (Pick one alternative, see descriptions and calculations below)

◉	1	Nutrient loading limits and on-site treatment minimum (Sections 70-740(a) and Sections 70-741(a))
○	0	Hendrick Southpoint Site Plan 5 & 6
○	0	Alternative percentage reduction option for Redevelopment that does not increase impervious area (Section 70-740(c))
○	0	Alternative for low impact development in Falls Basin.
○		Exempt from Stormwater Pollutant standards (Section 70-739)

Project Area Disturbance (Fill in yellow cell below)

278,386 square feet 6.39 acres

10

70

TABLE 1 THRESHOLDS FOR APPLICATION OF STORMWATER POLLUTANT REQUIREMENTS

Project Location	Land Disturbance	
	Limited Residential	Multifamily & Other
Jordan Basin	1 acre	0.5 acres
Falls Basin	0.5 acres	12,000 square feet
Lower Neuse Basin	1 acre	0.5 acres

Note: Thresholds are based upon land disturbance since the applicable basin Baseline date.

The Project is Located Outside **the Downtown Area (select from menu list)**

Per Section 70-736, ***Downtown Area*** means the Downtown Tier, Compact Neighborhoods, and Suburban Transit Zones as shown on the Durham Comprehensive Land Use Plan most recently approved by the Durham City Council.

The Project Type is Multifamily and Other **(select from menu list)**

Per Section 70-736,

Limited Residential means single family and duplex residential and recreational development.

Multifamily and Other Development means development not included in Limited Resdiential, and includes but is not limited to multifamily and townhomes, and office, industrial, institutional (including local government institutional), and commercial development.

Other key definitions from Section 70-736:

Development means Land Disturbance which increases impervious surface on a property, or alters its location, or results in an increase in runoff from a property or a decrease in infiltration of precipitation into the soil. It includes both existing development and new development. It does not include agriculture, mining, or forestry activities.

Redevelopment means Development on a site where structures or impervious surface already exists. It is a category of new development.

Nutrient Loading Limits and On-Site Treatment Minimum

ORDINANCE REQUIREMENTS

Sec. 70-740. 2476733

(a) Nutrient Loading Rate Limits. Development not exempt under subsection 70-739 shall construct and implement SCMs so as to limit the post construction loading rate of nitrogen and phosphorus from the project area to the limits set forth in Table 2 below, or shall comply with an allowed alternative as set forth in (b) through (d) below. A portion of the reduction requirements for nitrogen and phosphorus may be met through off site measures or payments as set forth in 70-741.

TABLE 2 NUTRIENT EXPORT LOADING RATE LIMITS		
Project Location	**Export Limit lbs/acre/year**	
	Nitrogen	**Phosphorus**
Jordan Basin	2.2	0.82
Falls Basin	2.2	0.33
Lower Neuse Basin	3.6	not required

Sec. 70-741

(a) On site nutrient treatment requirements. Nitrogen and phosphorus reduction requirements may be met, in part, through offsite management measures or the purchase of nutrient credits. At a minimum, however, in the Jordan and Falls Basins a percentage of the required nitrogen and phosphorus reductions must be achieved through onsite treatment, in the amount shown in Table 4 below. In addition to meeting the percentage reductions below, in the Jordan and Lower Neuse Basins, nitrogen export load from the site must not exceed 6 lbs. per acre per year for Limited Residential, and and 10 lbs per acre per year for Multifamily and Other.

(Note: offsite credit purchases do not meet TSS removal requirements, which must be met onsite.)

TABLE 4 ONSITE NUTRIENT TREATMENT REQUIREMENTS		
Project	**Minimum Onsite Nutrient Treatment**	
	Nitrogen	**Phosphorus**
Jordan - General	*40% of required reduction	*40% of required reduction
Falls - General	*50% of required reduction	*50% of required reduction
Falls and Jordan within Downtown Area	*30% of required reduction	*30% of required reduction

Falls and Jordan exceeding thresholds but with less than 1 acre land disturbance	*30% of required reduction	*30% of required reduction
Lower Neuse	No percentage reductions apply, but the 6/10 nitrogen export limit described in paragraph (a) above must be met	No percentage reductions apply, but the 6/10 nitrogen export limit described in paragraph (a) above must be met

*The "required reduction" is the difference between the post development loading in pounds per acre per year multiplied by the site area in acres before treatment minus the loading target, in pounds per acre per year multiplied by the acres. The percentage shown in the chart above is applied to that difference and the resulting number is the amount in pounds/year of nutrient reduction that must be achieved onsite.

CALCULATIONS - ENTER VALUES IN YELLOW CELLS

Nitrogen			
Post Loading Rate Untreated (lbs/ac/yr)	Post Loading Rate Treated (lbs/ac/yr)	Load Rate Target (lbs/ac/yr)	Reduction Needed (lbs/ac/yr)
6.21	4.48	2.2	2.28

Phosphorus			
Post Loading Rate Untreated (lbs/ac/yr)	Post Loading Rate Treated (lbs/ac/yr)	Load Rate Target (lbs/ac/yr)	Reduction Needed (lbs/ac/yr)
1.29	0.71	0.82	0.00

ONSITE CALCULATIONS - ENTER VALUE IN YELLOW CELLS BASED ON TABLE 4

Onsite Reduction Required (%)	Required Onsite Reduction Achieved?	
	Nitrogen	***Phosphorus***
40	YES	YES

In the Jordan and Lower Neuse Basins, the nitrogen export loading rate from the site does not exceed 6 lb/ac/yr for Limited Residential, or 10 lb/ac/yr for Multifamily and Other.	**TRUE**

Exempt from Stormwater Pollutant standards (Section 70-739)

ORDINANCE REQUIREMENTS

Sec. 70-739.

(a) *Exemptions for limited disturbances.* Development in which Land Disturbance, calculated cumulatively as of the Applicable Baseline Date, is less than the thresholds in Table 1 below is exempt from the standards in subsections 70-740 and 70-741, subject to paragraphs (1) and (2) below.

TABLE 1 THRESHOLD FOR APPLICATION OF STORMWATER POLLUTANT REQUIREMENTS		
Project Location	**Land Disturbance**	
	Limited Residential	**Multifamily & Other**
Jordan Basin	1 acre	0.5 acre
Falls Basin	0.5 acre	12,000 sq. ft
Lower Neuse Basin	1 acre	0.5 acre

(1) *Common Plan of Development*. Development that is part of a Common Plan of Development shall be included in the calculation. If the applicable threshold set forth in Table 1 is exceeded, all other portions of the Common Plan are subject to the requirements of this Article;

(2) *Redevelopment and Existing Development; maintenance of treatment.* Redevelopment and Existing Development that are exempt under these thresholds must continue to maintain and reconstruct all SCMs in compliance with approved plans, prior ordinance requirements, and City Standards.

(b) *Other exemptions*. Additionally, Development is exempt if:

A. it qualifies in its entirety as Existing Development; or

B. it is located in the Downtown Area and does not increase impervious area over the Applicable Baseline Date; or

C. it is undertaken by a state or federal entity. (Note: Review and approval by the state must be demonstrated); or

D. it is a City transportation project in the Jordan basin.

☐ This project is exempt because it is below the applicable land disturbance threshold.

☐ This project is exempt because it qualifies entirely as Existing Development.

☐ This project is exempt because
- It is located in the Downtown Area ***and***
- It does not increase impervious area over the Applicable Baseline Date.

☐ This project exempt because
- It is undertaken by a state or federal entity, ***and***
- A demonstration of review and approval by the state has been provided.

☐ This project is exempt because it is a City transportation project in the Jordan Basin.

Appendix D

Geotech Report

NOVA
ENGINEERING AND
ENVIRONMENTAL

REPORT OF
SUBSURFACE EXPLORATION AND
GEOTECHNICAL ENGINEERING EVALUATION

CHAPEL HILL RETIREMENT RESIDENCE

Somerset Drive and Estes Drive
Chapel Hill, North Carolina

Prepared For:

HAWTHORNE DEVELOPMENT, LLC
C/O Lenity Architecture
3150 Kettle Court SE
Salem, Oregon 97301

NOVA Project Number: 10705-2014014

December 29, 2014

NOVA
ENGINEERING AND
ENVIRONMENTAL

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December 29, 2014

HAWTHORNE DEVELOPMENT, LLC
C/O Lenity Architecture
3150 Kettle Court SE
Salem, Oregon 97301

Attention: Mr. Mark Lowen
Land Use Manager

Subject: Report of Subsurface Exploration and
Geotechnical Engineering Evaluation
CHAPEL HILL RETIREMENT RESIDENCE
Chapel Hill, North Carolina
NOVA Project Number 10705-2014014

Dear Mr. Lowen:

NOVA Engineering and Environmental (NOVA) has completed the authorized subsurface exploration and geotechnical engineering evaluation for the Chapel Hill Retirement Residence project located in Chapel Hill, North Carolina. The work was performed in general accordance with NOVA Proposal Number 05362-G dated October 24, 2014. This report briefly discusses our understanding of the project at the time of the subsurface exploration, describes the geotechnical consulting services provided by NOVA, and presents our findings, conclusions and recommendations.

We appreciate your selection of NOVA and the opportunity to be of service on this project. If you have any questions, or if we may be of further assistance, please do not hesitate to contact us.

Sincerely,
NOVA ENGINEERING AND ENVIRONMENTAL

NORTH CAROLINA PROFESSIONAL SEAL 38693 ENGINEER DAVID E. PEÑALVA, JR.
12/29/2014

David E. Peñalva, P.E
Project Engineer
NC PE Number: 038693
Copies Submitted: Addressee (3)

Kenneth Houseman, P.E.
Executive Vice President
NC PE Number: 041793

TABLE OF CONTENTS

1.0 SUMMARY

A brief summary of pertinent findings, conclusions and recommendations are presented below. This information should not be utilized in design or construction without reading the report in its entirety and paying particular attention to the recommendations presented in the text and Appendix.

1.1 GENERAL

- Twelve (12) soil test borings (B-1 through B-12) and fifteen (15) test pits were performed at the subject site during this exploration. Generally, the borings encountered a surface veneer of approximately two to seven inches of topsoil and residual soils which transitioned with depth to partially weathered rock (PWR) and auger refusal materials.

- Based on the results of limited laboratory testing program, plastic clays and elastic silts were encountered within borings B-7 and B-8 at depths of 0.5 and 6.0 feet, respectively. These types of soils are moisture sensitive and have a tendency to display shrink/swell characteristics and lose some strength when exposed to changes in moisture content.

- Partially weathered rock/rock was encountered in borings B-2, B-4 to B-6, and B-11 to B-12 as well as in test pits TP-2 and TP-4 to TP-15 at depths ranging from 1 to 23.5 feet below the existing ground surface.

- Refusal materials were encountered in borings B-1 and B-3 to B-5 as well as in TP-8 to TP-11, and TP-13 to TP-15 at depths ranging from 1 to 8 feet below the existing ground surface.

- Cobbles were observed in the residuum at TP-6, TP-9, TP-11, TP-12, and TP-15 extending from the ground surface to 1 foot below the existing grade. The cobbles ranged from 6 to 12 inches in size.

1.2 SITE PREPARATION

Plastic Soils: Based on the limited laboratory testing, plastic clays and elastic silts (Liquid Limits > 50 and Plasticity Index > 25) were encountered during this exploration. These types of soils encountered have a tendency to display shrink/swell characteristics when exposed to changes in the moisture content. These soils also have the potential to lose some of their strength when exposed to the combination of wet weather and construction traffic. These soils are generally not suitable for support of structural elements or re-use as structural fill unless placed in deep fill areas and 3 feet of separation is maintained between the finish subgrade elevation for slabs and pavements, additionally, these soils can be difficult to work and meet specified compaction requirements because of their moisture sensitivity.

PWR/Rock: The near surface rock located in the northwest corner of the proposed site may require blasting for foundation and utility installation. Shot rock fill with maximum particle sizes of 18 inches may be utilized in deep fill areas, up to within the top 5 feet of finished grades. It is recommended, if possible, to utilize maximum particle sizes of 3 inches within 5 feet of finished grade to ease excavation processes for utilities and other improvements that require excavation processes. In addition, utility line excavation should be over shot by a least one foot to provide a 12 inch cushion for bedding of the pipe, and foundations that transition from rock bearing to fill bearing should be over-excavated a minimum of one foot.

1.3 DIFFICULT EXCAVATION

- Partially weathered rock was encountered in borings B-2, B-4 to B-6, and B-11 to B-12 as well as in test pits TP-2 and TP-4 to TP-15 at depths ranging from 1 to 23.5 feet below the existing ground surface. Additionally, refusal materials were encountered in borings B-1 and B-3 to B-5 as well as in TP-8 to TP-11, and TP-13 to TP-15 at depths ranging from 1 to 8 feet below the existing ground surface. The refusal material could not be excavated with a CAT 320 L track mounted hoe and appeared to be continuous within the confines of the test pits. ***Based on the assumed excavation depths at the site for foundations and utilities, we anticipate that materials requiring difficult excavation techniques will be encountered during mass grading and utility/foundation excavations in the western portion of the proposed development.*** Depending on utility depths within other areas of the site, material requiring difficult excavation may also be encountered.

1.4 GROUNDWATER CONTROL

- Groundwater was not encountered in any of the borings at the proposed site.

1.5 FOUNDATIONS

- We recommend that the proposed structure(s) be supported on conventional shallow foundations designed for a maximum allowable soil bearing pressure of 3,000 pounds per square foot (psf). Foundations that bear on the PWR/Rock should be over-excavated approximately 8 to 12 inches to provide a uniform bearing surface and to minimize differential settlement between rock and soil bearing transitions.

1.6 SEISMIC

- In accordance with Section 1613.5.2 of the 2012 IBC, the seismic Site Class was estimated using the standard penetration resistance values obtained from the soil test borings performed during this study. Based upon this analysis, and our knowledge of

general subsurface conditions in the area, we believe the soil profiles associated with a Site Class "C" are generally appropriate for this site.

1.7 MISCELLANEOUS

- **Pavements:** Based on the traffic loading and design life provided and the estimated soil subgrade strength based published data and on our experience with similar soils, the following pavement sections are recommended:

    - **Light-Duty Pavements:** Asphalt pavement section of 1 inches of surface course, 2 inches of binder, underlain by 6 inches of graded aggregate base.

    - **Heavy-duty Pavements:** Asphalt pavement section of 1 inches of surface course, 2.5 inches of binder, underlain by 8 inches of graded aggregate base.

    - **Rigid Concrete Pavement:** 5 inches of concrete paving can be used and is actually recommended in areas where dumpster, truck braking or sharp turning radius exist. It is recommended that the concrete paving have a minimum of 4 inches of graded aggregate base course material placed beneath the concrete section, the concrete meet a minimum flexural strength of 650 psi, and have control/construction joints placed in accordance with ACI requirements.

2.0 INTRODUCTION

2.1 PROJECT INFORMATION

Our understanding of this project is based on a review of your request for proposal dated October 21, 2014 and the site plan dated October 20, 2014. We also performed a site reconnaissance during the boring layout and test pit exploration.

The Subject Property consists of an approximately 6.3 acre site located at the intersection of Somerset Drive and North Estes Drive (Orange County Parcel Number: 9789551528) in Chapel Hill, North Carolina. The subject site is bordered by:

North:	Residential Development	**East:**	Phillips Middle School
South:	Estes Drive	**West**:	Somerset Drive

The approximate latitude and longitude coordinates of the Subject Property are 35°56'10.24"N and 79°2'59.06"W, respectively.

The proposed facility will consist of a three-level light gauge steel framed building and surrounding paved parking lots and driveways. A detention pond is also planned in the southern portion of the site. The building will have an approximate footprint of 43,000 square feet. We understand that the maximum individual column and continuous wall foundation loads will be less than 80 kips and 3.5 kips per linear foot, respectively.

The proposed building will be constructed with a finished floor elevation of 456 feet. Based on the provided site plan the site appears to slope from the north towards the south with an approximate elevation change of 40 feet (430 to 470 MSL). Therefore, we anticipate cuts and fills on the order of up to 10 feet within the building foot print and up to 20 feet outside of the building foot print to establish design grades. The site development will most likely require retaining walls structures to establish the proposed design grades. We have not been provided the location and type of walls at this time.

2.2 SCOPE OF WORK

Hawthorne Development, LLC, engaged NOVA to provide geotechnical engineering consulting services for the Chapel Hill Retirement Residence. This report briefly discusses our understanding of the project, describes our exploratory procedures and presents our findings, conclusions and recommendations.

The primary objective of this study was to perform a geotechnical exploration within the area of the proposed construction and to assess these findings as they relate to geotechnical

aspects of the planned site development. The authorized geotechnical engineering services included a site reconnaissance, a soil test boring and sampling program, test pit exploration, in-situ testing, laboratory testing, engineering evaluation of the field and laboratory data, and the preparation of this report.

The services were performed substantially as outlined in our proposal dated October 24, 2014 (Proposal No.: 05362-G) and our proposal for additional services dated December 4, 2014 (Proposal No.: 05376-G), and in general accordance with industry standards.

As authorized per the above referenced proposal, the completed geotechnical report was to include:

- A description of the site, fieldwork, laboratory testing and general soil conditions encountered, as well as a Boring Location Plan, and individual Boring Records.
- Discussion on potential earthwork-related issues indicated by the exploration, such as old fills, materials that would require difficult excavation techniques, shallow groundwater table, etc.
- Information on potentially expansive, deleterious, chemically active or corrosive materials, conditions, or presence of gas.
- Recommendations for controlling groundwater and/or run-off during construction and, the need for permanent de-watering systems based on the anticipated post construction groundwater levels.
- Foundation system recommendations for the proposed structures, including allowable bearing capacities and recommended bearing depths.
- Frost penetration depth and effect.
- Recommendations for lateral earth pressure coefficients for the design of below-grade walls.
- Suitability of on-site soils for re-use as structural fill and backfill. Additionally, the criteria for suitable fill materials will be provided.
- Lateral earth pressures for design of walls below grade including backfill, compaction and sub-drainage and their requirements.
- Recommended quality control measures (i.e. sampling, testing, and inspection requirements) for foundation construction.
- Slab-on-grade construction considerations based on the geotechnical findings, including the need for a sub-slab vapor barrier or a capillary barrier.
- Recommendations for typical asphalt and concrete pavement design.

The assessment of the presence of wetlands, floodplains or water classified as State Waters of North Carolina was beyond the scope of this study. Additionally, the assessment of site environmental conditions, including the detection of pollutants in the soil, rock or groundwater, at the site was also beyond the scope of this geotechnical study.

3.0 SITE DESCRIPTION

3.1 GENERAL

The Subject Property consists of an approximately 6.3 acre site located at the intersection of Somerset Drive and North Estes Drive (Orange County Parcel Number: 9789551528) in Chapel Hill, North Carolina. The subject site is bordered by:

North:	Residential Development
South:	Estes Drive
East:	Phillips Middle School
West:	Somerset Drive

The site is predominately wooded acreage. The topography at the site can best be described as sloping from the north to south. Based on the provided proposed site plan, there is an approximate elevation change of up to 40 feet (430 to 470 feet-MSL) across the entire site. Rock outcrops were observed across the site.

3.2 GEOLOGY / HYDROLOGY

3.2.1 Site and Area Geology

The site is located in the Piedmont Geologic Region, a broad northeasterly trending province underlain by crystalline rocks up to 600 million years old. The Piedmont is bounded on the northwest by the Blue Ridge Range of the Appalachian Mountains, and on the southeast by the leading edge of Coastal Plain sediments, commonly referred to as the "Fall Line". Numerous episodes of crystal deformation have produced varying degrees of metamorphism, folding and shearing in the underlying rock. The resulting metamorphic rock types in this area of the Piedmont are predominantly a series of Precambrian age schists and gneisses, with scattered granitic or quartzite intrusions.

According to the "Geologic Map of North Carolina: Department of Natural Resources and Community Development, Division of Land Resources, and the NC Geological Survey" by Rhodes and Conrad, 1985, the site is generally underlain by the Metamorphosed Granitic Rock Formation. This geologic formation typically consists of metamorphic rock of the Cambrian and late Proterozoic era.

Residual soils in the region are primarily the product of in-situ chemical decomposition of the parent rock. The extent of the weathering is influenced by the mineral composition of the rock and defects such as fissures, faults and fractures. The residual profile can generally be divided into three zones:

- An upper zone near the ground surface consisting of clayey silts which have undergone the most advanced weathering,

- An intermediate zone of less weathered micaceous sandy silts and silty sands, frequently described as "saprolite", whose mineralogy, texture and banded appearance reflects the structure of the original rock, and

- A transitional zone between soil and rock termed partially weathered rock (PWR). Partially weathered rock is defined locally by standard penetration resistances exceeding 100 blows per foot.

The boundaries between zones of soil, partially weathered rock and bedrock are erratic and poorly defined. Weathering is often more advanced next to fractures and joints that transmit water, and in mineral bands that are more susceptible to decomposition. Boulders and rock lenses are sometimes encountered within the overlying PWR or soil matrix. Consequently, significant fluctuations in depths to materials requiring difficult excavation techniques may occur over short horizontal distances.

3.2.2 Groundwater

Groundwater in the Piedmont typically occurs as an unconfined or semi-confined aquifer condition. Recharge is provided by the infiltration of rainfall and surface water through the soil overburden. More permeable zones in the soil matrix, as well as fractures, joints and discontinuities in the underlying bedrock can affect groundwater conditions. The groundwater table in the Piedmont is expected to be a subdued replica of the original surface topography.

4.0 FIELD AND LABORATORY PROCEDURES

4.1 FIELD EXPLORATION

Boring locations were established in the field by EMH&T surveyors, while test pit locations were established in the field by NOVA personnel using the provided site plan, and estimating/taping distances and angles from staked boring locations. Boring and test pit elevations were then extrapolated from the site plan provided by Lenity Architecture and dated October 20, 2014. Consequently, referenced boring locations and elevations are approximate. If increased accuracy is desired by the client, NOVA recommends that the boring locations and elevations be surveyed.

Our field exploration included soil test borings and test pit explorations, which were conducted on November 20 and December 17, 2014, respectively, and included:

- Eight (8) soil test borings (B-1 to B-8) were drilled to depths of 1.5 to 30 feet below the existing ground surface in the proposed building footprint.

- Four (4) soil test borings (B-9 to B-12) were drilled to depths of 10 feet below the existing ground surface in the proposed parking areas.

- Fifteen (15) test pits (TP-1 through TP-15) excavated with a track hoe to depths of 1 to 12 feet below the existing ground surface.

All drilling and sampling operations were performed in general accordance with ASTM designations.

Test Boring Records in the Appendix show the standard penetration test (SPT) resistances, or "N- values", and present the soil conditions encountered in the borings. These records represent our interpretation of the subsurface conditions based on the field exploration data, visual examination of the split-barrel samples, laboratory test data and, generally accepted geotechnical engineering practices. The stratification lines and depth designations represent approximate boundaries between various subsurface strata. Actual transitions between materials may be gradual.

The groundwater levels reported on the Test Boring Records represent measurements made at the completion of the soil test boring and 24 hours thereafter. The soil test borings were subsequently backfilled with the soil cuttings.

The test pits were excavated CAT 3200L to refusal or to a termination depth of 12 feet below the existing ground surface. A NOVA representative was on site to visually observe and

classify the materials being removed from the excavations. The descriptions are shown in the attached Summary of Test Pit Subsurface Data.

4.2 LABORATORY TESTING

Split-barrel samples were returned to our testing laboratory, where they were classified using visual/manual methods in accordance with the Unified Soil Classification System (USCS) and ASTM designations. The descriptions presented in the boring logs should be considered approximate.

To aid in classifying the soils and determining their engineering properties, laboratory tests were performed on representative soil samples obtained from the soil test borings. Laboratory tests results are summarized in Table 1 below and are presented in the Appendix. All laboratory testing was performed in general accordance with current ASTM standards and included:

- Two (2) Moisture Content tests (ASTM D 2216)
- Two (2) Liquid and Plastic Limits tests (ASTM D 423 and D 424)
- Two (2) Grain Size Analysis (ASTM D 422)

Table 1: Summary of Laboratory Test Results

Boring	Depth (ft)	Atterberg			%Fines	Natural Moisture	USCS
		LL	PL	PI			
B-6	0.5	79.9	34.3	45.6	41.9	31.3	CH
B-7	6.0	56.8	34.1	22.7	96.1	24.0	MH

5.0 SUBSURFACE CONDITIONS

5.1 SOIL CONDITIONS

The following paragraphs provide generalized descriptions of the subsurface profiles and soil conditions encountered by the borings conducted during this study. The Test Boring Records in the Appendix should be reviewed to provide more detailed descriptions of the subsurface conditions encountered at each boring location. Conditions may vary at other locations and times.

5.1.1 Surface Materials

Topsoil: Up to approximately 12 inches of topsoil was encountered in borings B-1 to B-12 and test pits TP-1 to TP-15. Topsoil thickness is frequently erratic and due to the wooded condition of the site, thicker zones of topsoil may be encountered.

5.1.2 Residual Soils

Residual soils were encountered in borings B-1 to B-12 and test pits TP-1 to TP-15 beneath the topsoil. The Residuum consisted primarily of silty SAND or sandy SILT. Standard penetration resistance values ranged from 9 to 82 bpf, but more typically varied from 17 to 36 bpf. Cobbles ranging in size from 6 to 12 inches were observed in the upper foot of the residuum in test pits TP-6, TP-9, TP-11, TP-12, and TP-15.

5.1.3 Partially Weathered Rock

Partially weathered rock (PWR) is a transitional material between soil and the underlying parent rock that is defined locally as materials that exhibit a standard penetration resistance exceeding 100 bpf.

PWR was encountered in several of the borings and test pits performed during this study at depths ranging from 1 to 23.5 feet below the ground surface (approximate elevations ranging from 458.0 to 435.5 feet-MSL. PWR was typically observed immediately above refusal levels. Table 2 depicts locations and depths and approximate elevations where PWR was encountered.

Table 2: Summary of Partially Weathered Rock (PWR) Material

BORING	DEPTH (ft)	APPROXIMATE ELEVATION OF TOP OF PWR (ft-msl)
B-2*	6.0	449
B-4*	3.0	452
B-5*	3.5	446.5
B-6*	23.5	435.5
B-11	8.5	435.5
B-12	8.5	437.5
TP-2*	4.0	453
TP-4*	2.0	453
TP-5*	6.5	450
TP-6	7.0	439
TP-7*	1.0	436
TP-9*	2.0	451
TP-10*	4.0	454
TP-11*	3.0	452
TP-12*	1.0	447
TP-13*	5.0	452
TP-14*	2.0	449
TP-15*	1.0	458

*Boring or test pit performed in building foot print with proposed finished floor elevation of 456 ft-msl

5.1.4 Auger Refusal Materials

Auger refusal materials are any very hard or very dense material, frequently boulders or the upper surface of bedrock, which cannot be penetrated by a power auger. Auger refusal was encountered in four (4) of the twelve (12) borings at depths ranging from 1 to 6 feet below the existing ground surface (approximate elevations ranging from 442.0 to 451.9 feet-MSL). Additionally, test pit refusal on hard rock was encountered in TP-8, TP-10, TP-11, TP-13, TP-14, and TP-15 at depths ranging from 2.5 to 11 feet below the existing ground surface (approximate elevations ranging from 435.5 to 454 feet MSL). Table 3 depicts the locations, depths, and approximate elevations where auger refusal materials were encountered.

Table 3: Summary of Auger Refusal Materials

BORING	DEPTH (ft)	APPROXIMATE ELEVATION OF TOP OF REFUSAL MATERIAL (ft-msl)
B-1*	6.0	451
B-3*	1.0	442
B-4*	3.1	451.9
B-5*	4.1	445.9
TP-8*	2.5	451.5
TP-10*	8.0	450
TP-11*	11.0	444
TP-13*	7.5	446.5
TP-14*	7.0	444
TP-15*	8.0	451

*Boring or test pit performed in building foot print with proposed finished floor elevation of 456 ft-msl

5.2 GROUNDWATER CONDITIONS

Groundwater was not encountered in any of the borings performed during this study. Many of the borings caved upon retrieval of the augers thus preventing groundwater measurements. Caved depths may be indicative of groundwater levels and have been included on the test boring records in the Appendix. In addition, based on the proposed elevations of the building and parking areas, some excavations for utilities may extend beyond the termination depths of our borings and/or test pits, so the possibility of encountering groundwater may exist in those deeper excavations. At a minimum, contractors should be prepared to have temporary dewatering systems available during site development activities.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are based on our understanding of the proposed construction, site observations, our evaluation and interpretation of the field and laboratory data obtained during this exploration, our experience with similar subsurface conditions, and generally accepted geotechnical engineering principles and practices.

Subsurface conditions in unexplored locations or at other times may vary from those encountered at specific boring locations. If such variations are noted during construction, or if project development plans are changed, we request the opportunity to review the changes and amend our recommendations, if necessary.

As previously noted, boring locations were established by estimating distances and angles from site landmarks. If increased accuracy is desired by the client, we recommend that the boring locations and elevations be surveyed.

6.1 SITE GRADING

6.1.1 Site Preparation

General: Prior to proceeding with construction, all vegetation, root systems, topsoil, and other deleterious non-soil materials should be stripped from proposed construction areas. Clean topsoil may be stockpiled and subsequently re-used in landscaped areas. Debris-laden materials should be excavated, transported and disposed of off-site in accordance with appropriate solid waste rules and regulations.

After clearing and stripping, areas, which are at grade or will receive fill should be carefully evaluated by a NOVA geotechnical engineer. The engineer will require proof-rolling of the subgrade with multiple passes of a 20 to 30 ton loaded truck or other pneumatic-tired vehicle of similar size and weight. The purpose of the proof-rolling is to locate soft, weak, or excessively wet fill or residual soils present at the time of construction. Any unstable materials observed during the evaluation and proof-rolling operations should be undercut and replaced with structural fill or stabilized in-place by scarifying and re-densifying.

Plastic Soils: Based on the limited laboratory testing, plastic clays and elastic silts (Liquid Limits > 50 and Plasticity Index > 25) were encountered during this exploration. The soils encountered have a tendency to display shrink/swell characteristics when exposed to changes in the moisture content. These soils may also lose some of their strength when exposed to the combination of wet weather and construction traffic.

The severity of these potential problems depends to a great extent on the weather conditions during construction. A concerted effort should be made to control construction traffic and surface water while subgrade soils are exposed.

Based on current grading information, it appears some to these soils will be cut and/or exposed when establishing finish subgrade elevations. Soils of this type are not suitable for the direct support of structural elements due to the potential for swell and loss of strength if exposed to changes in moisture. Should these soils be encountered at or near proposed finished grade elevations within the building and parking areas, some over excavation and replacement should be anticipated to maintain a separation of 24 inches between the expansive soils and slabs, foundations, or paved areas. Provided moisture contents are maintained at or near optimum, these soils may be used as backfill in deep fill areas to elevations up to 3 feet below proposed finished subgrade elevation. These soils are not suitable for use as backfill within 3 feet below proposed finished subgrade elevations in slab and pavement areas. As an alternative, stabilization of the expansive soils may be accomplished through the addition of cement. Rate and depth of application will be dependent on the conditions encountered at the proposed finished subgrade elevations.

We note that the current geotechnical investigation consisted of widely spaced borings and limited laboratory testing. Expansive soils should be expected at other areas across the site.

6.1.2 Difficult Excavation

Very dense soils, PWR, and/or refusal materials were encountered in several of the borings and test pits at depths above planned grades. ***As a result, we anticipate that materials requiring difficult excavation techniques will be encountered during site grading and utility/foundation excavations during construction, most notably in the western portion of the site.***

As discussed in the geology section of this report, the weathering process is erratic and variations in the PWR or rock profile can occur in small lateral distances. Therefore, it is likely that very dense soils, PWR and/or rock pinnacles or ledges requiring difficult excavation techniques may be encountered in site areas intermediate of our boring locations. Mass excavation of very hard or very dense soils ($\geq$ 50 bpf) and PWR will likely require loosening the material with a large single-toothed ripper or track-mounted backhoe before removal with conventional earthmoving equipment. Some light blasting could be required in isolated pockets of very dense material for efficient excavation.

The gradation of the material removed by ripping or blasting will probably be erratic. Re-use of these materials in fills will require additional effort and control, as described in the Fill Placement section of this report.

In confined areas, such as utility trenches and footings, excavations of very hard or very dense soils ($\geq$ 50 bpf) and PWR, may require either the use of pneumatic tools or light blasting.

The definition of rock can be a source of conflict during construction, if a classified excavation contract is bid. The following definitions have been incorporated into classified excavation specifications in an attempt to reduce conflict on other projects and are provided for your general guidance. We recommend that the determination and measurement of difficult excavation materials be performed by a NOVA geotechnical engineer, or a designated representative of the owner, in accordance with the project specifications.

GENERAL EXCAVATION	
Rip Rock	Any material that cannot be removed by scrapers, loaders, pans, dozers, or graders; and, requires the use of a single-tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds.
Blast Rock	Any material which cannot be excavated with a single-tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds (Caterpillar D-8K or equivalent) or by a Caterpillar 977 front-end loader or equivalent, and occupying an original volume of at least one (1) cubic yard.

TRENCH EXCAVATION	
Trench Rock	Any material which cannot be excavated with a backhoe having a bucket curling force rated at not less than 25,700 pounds (Caterpillar Model 225 or equivalent), and occupying an original volume of at least one-half (1/2) cubic yard.

6.1.3 Fill Placement

Soil: Fill materials should be low plasticity soil (Plasticity Index less than 30), free of non-soil materials and rock fragments larger than 3 inches in any one dimension. Based on visual examination, the existing residual soils and much of the existing fill, which does not contain appreciable amounts of debris, rock, organics or other deleterious materials encountered during this exploration generally appear suitable for re-use as structural fill. Prior to construction, bulk samples of the proposed fill materials should be laboratory tested to confirm their suitability.

Plastic silts (Liquid Limits > 50 and Plasticity Index > 25) were encountered during this exploration. Soils of this type are not suitable for the direct support of structural elements due to the potential for swell and loss of strength if exposed to changes in moisture. Provided moisture contents are maintained at or near optimum, these soils may be used as backfill in deep fill areas to elevations up to 3 feet below proposed finished subgrade elevation. These soils are not suitable for use as backfill within 3 feet below proposed finished subgrade elevations in slab and pavement areas. As an alternative, stabilization of the expansive soils may be accomplished through the addition of cement. Rate and depth of application will be dependent on the conditions encountered at the proposed finished subgrade elevations.

Organic and/or debris laden material is not suitable for re-use as structural fill. Topsoil, mulch and similar organic materials can be wasted in architectural areas. Debris-laden materials should be excavated, transported and disposed of off-site in accordance with appropriate solid waste rules and regulations.

Fill should be placed in thin, horizontal loose lifts (maximum 8-inch) and compacted to at least 95 percent of the standard Proctor maximum dry density (ASTM D 698). The upper 8 inches of soil beneath pavements and slab-on-grade should be compacted to at least 98 percent. In confined areas, such as utility trenches or behind retaining walls, portable compaction equipment and thinner fill lifts (3 to 4 inches) may be necessary. Fill materials used in structural areas should have a target maximum dry density of at least 95 pounds per cubic foot (pcf). If lighter weight fill materials are used, the NOVA geotechnical engineer should be consulted to assess the impact on design recommendations.

Soil moisture content should be maintained within 3 percent of the optimum moisture content. We recommend that the grading contractor have equipment on site during earthwork for both drying and wetting fill soils. Moisture control may be difficult during rainy weather.

All filling operations should be observed by a NOVA soils technician, who can confirm suitability of material used and uniformity and appropriateness of compaction efforts. He/she can also document compliance with the specifications by performing field density

tests using thin-walled tube, nuclear, or sand cone testing methods (ASTM D 2937, D 2922, or D 1556, respectively). One test per 400 cubic yards and every 2 feet of placed fill is recommended, with test locations well distributed throughout the fill mass. When filling in small areas, at least one test per day per area should be performed.

PWR/Rock: Based upon the planned finished grades, we anticipate partially weathered rock (PWR) and/or rock that requires difficult excavation techniques or blasting will be encountered during foundation and utility installation. The following guidelines have been prepared for the use, placement and compaction of PWR and/or fractured rock within fill areas.

Preferably, the widespread use of these materials in structural fill areas should be avoided. However, these materials may be placed in structural areas provided the material is placed and compacted in accordance with the following recommendations.

Fractured rock may be utilized within the fill depths, provided stringent supervision is provided by the Geotechnical Engineer. The fractured rock will need to remain 18 inches in diameter or less, be mixed with soil, and be placed in a manner that does not allow nesting of the material. It is recommended that these materials be restricted to areas a minimum of 5 feet below finished subgrade elevations. This mixture of material will hinder utility installation excavations, and would not be appropriate for pipe backfill. These materials should be limited to lifts of 18 inches or less so that proper visual assessments of nesting materials are conducted.

Rock or PWR pieces 3 inches in diameter or less may be mixed with soils and utilized within the top 5 feet of the site development. Soil should be intermixed with the PWR/Rock materials in sufficient quantities to prevent void formation within the mass. The soil should be at or near their optimum moisture content. Lift thickness should be as thin as practical and should not exceed 1 foot prior to compaction.

Heavy compaction equipment will be required in order to adequately compact the soil matrix to its required density and to break down PWR and/or rock. Additional effort will be required to pulverize the dense materials in structural fill areas to provide a well-compacted, relatively homogeneous fill. Our experience has been that these materials generally require at least 6 passes of heavy vibratory compaction equipment; however, we recommend that actual compaction requirements be determined in the field.

Where fill contains substantial quantities of rock and cannot be adequately tested, its placement and compaction should be observed on a full-time basis by a NOVA senior engineering technician. The technician will note the stability of the rock fill based on observations of compaction methods performed using heavy equipment. On a periodic

basis, the rock fill procedure should be evaluated by the geotechnical engineer to ensure that the PWR/rock fill materials are properly placed and compacted, with sufficient soil fines to prevent void formation.

6.2 GROUNDWATER CONTROL

6.2.1 General

Groundwater was not encountered above auger refusal in any of the borings performed. Therefore, we do not anticipate that significant amounts of groundwater will be encountered during shallow grading operations. However, it is possible that groundwater may be encountered within the rock mass in deeper excavations. In addition, based on the proposed elevations of the building and parking areas, some excavations for utilities may extend beyond the termination depths of our borings and/or test pits, so the possibility of encountering groundwater may exist in those deeper excavations. At a minimum, contractors should be prepared to have temporary dewatering systems available during site development activities.

As previously noted, groundwater levels are subject to seasonal, climatic and other variations and may be different at other times and locations. The extent and nature of any dewatering required during construction will be dependent on the actual groundwater conditions prevalent at the time of construction and the effectiveness of construction drainage to prevent run-off into open excavations.

6.3 SLOPES

Slope stability analysis using laboratory shear strength data was beyond the scope of this study. However, based on our experience with similar subsurface conditions and construction, permanent slopes no steeper than 2.0(H): 1.0(V) should be stable long term, if limited in height to 20 feet, and are not inundated or subjected to rapid draw-down conditions, or subjected to groundwater seepage.

Adjacent to building, a top of slope set-back of 10 feet is recommended. In pavement areas, a minimum top of slope setback of 5 feet is acceptable. During construction, temporary slopes should be regularly inspected for signs of movement or unsafe condition. Soil slopes should be covered for protection from rain, and surface run-off should be diverted away from the slopes. For erosion protection, a protective cover of grass or other vegetation should be established on permanent soil slopes as soon as possible. As previously mentioned, depending on conditions at the time of construction, slope stability associated with the construction of the proposed detention pond may need to be addressed depending on planned finished grades.

6.4 FOUNDATIONS

6.4.1 Shallow Foundations

After the recommended site and subgrade preparation and fill placement, we recommend that the proposed structure be supported by conventional shallow foundations. Foundations bearing on undisturbed residual soils and/or compacted structural fill may be designed for a maximum allowable bearing pressure of 3,000 pounds per square foot (psf). Foundations that bear on the PWR/Rock should be over-excavated approximately 8 to 12 inches to provide a uniform bearing surface and to minimize differential settlement between rock and soil bearing transitions. Although higher bearing pressures may be available in some of the very dense residual materials, we have recommended a uniform bearing pressure for:

- Ease of design and construction,
- To reduce total and differential settlements, and
- To help reduce the amount of remedial foundation preparation anticipated.

Plastic clays and elastic silts (Liquid Limits > 50 and Plasticity Index > 25) were encountered during this exploration. These soils have the potential to lose some of their strength when exposed to the combination of wet weather and construction traffic. The severity of these potential problems depends to a great extent on the weather conditions during construction. A concerted effort should be made to control construction traffic and surface water while subgrade soils are exposed.

Soils of this type are not suitable for the direct support of foundation elements due to the potential for swell and loss of strength if exposed to changes in moisture. Should these soils be encountered at or near proposed foundation bearing elevations some over excavation and replacement should be anticipated to maintain a separation of 3 feet between the elastic soils and foundations. If these materials are encountered, a geotechnical engineer should evaluate the soils expansive characteristics.

We recommend minimum footing widths of 24 inches for ease of construction and to reduce the possibility of localized shear failures. Exterior footing bottoms should be at least 18 inches below exterior grades for protection against frost damage.

Settlements for spread foundations bearing on the higher consistency residual materials were assessed using SPT values to estimate elastic modulus, based on published correlations and previous NOVA experience. We note that the settlements presented are based on field data and encountered subsoil profiles. Conditions may be better or worse in other areas, however, we believe the estimated settlements are reasonably conservative. The time rate of settlement

was estimated based on NOVA's experience with similar data and soil profiles.

Based on column loadings, soil bearing capacities and the presumed foundation elevations as discussed above, we expect primary total settlement beneath individual footings to be on the order of up to 1 inch.

The amount of differential settlement is difficult to predict because the subsurface and foundation loading conditions can vary considerably across the site. However, we anticipate differential settlement between adjacent footings could vary but will likely be on the order of 50% of the total settlement or approximately 1/2 inch. The final deflected shape of the structure will be dependent on actual footing locations and loading.

Foundation support conditions are highly erratic and may vary dramatically in short horizontal distances. To reduce the differential settlement if lower consistency materials are encountered, a lower bearing capacity should be used or the foundations should be extended to more competent materials. In addition, foundation subgrades which are excavated into PWR/rock may need to be slightly undercut with controlled structural fill placed between the PWR/rock and the bottom of the footing to produce some settlement of the footing, thus reducing differential settlements with nearby footings founded on less dense material. We anticipate that timely communication between the geotechnical engineer and the structural engineer, as well as other design and construction team members, will be required.

All footing excavations should be evaluated by the NOVA geotechnical engineer prior to reinforcing steel placement to observe foundation subgrade preparation and confirm bearing pressure capacity.

Footing excavations should be level and free of debris, ponded water, mud, and loose, frozen or water-softened soils. Concrete should be placed as soon as is practical after the footing is excavated and the subgrade evaluated. Foundation concrete should not be placed on frozen or saturated soil. If a footing excavation remains open overnight, or if rain or snow is imminent, a 3 to 4-inch thick "mud mat" of lean concrete should be placed in the bottom of the footing to protect the bearing soils until reinforcing steel and concrete can be placed.

6.5 SLAB-ON-GRADE

The conditions exposed at subgrade levels will vary across the site and may include structural fill, residual soils, PWR and/or rock. Slabs-on-grade may be adequately supported on these subgrade conditions subject to the recommendations in this report. Slabs-on-grade should be jointed around columns and along walls to reduce cracking due to differential movement. A 6-inch layer of crushed stone may be placed beneath the building slabs to reduce non-uniform support conditions.

An underdrain system is not necessary beneath the slabs, but an impermeable vapor barrier is recommended beneath finished spaces to reduce dampness.

Where PWR or rock is exposed at finished grade, we recommend over-excavation and placement of a 6-inch layer of structural fill or crushed stone to act as a cushion to reduce differential stresses and subsequent slab cracking because of support on hard points.

Once grading within the building footprint is completed, the subgrade is usually exposed to adverse construction activities and weather conditions during the period of sub-slab utility installation. The subgrade should be well-drained to prevent the accumulation of water. If the exposed subgrade becomes saturated or frozen, the geotechnical engineer should be consulted.

After utilities have been installed and backfilled, a final subgrade evaluation should be performed by the geotechnical engineer immediately prior to slab-on-grade placement. If practical, proofrolling may be used to redensify the surface and to detect any soil that has become excessively wet or otherwise loosened.

6.6 BELOW GRADE WALLS

6.6.1 Cast-In-Place Walls

The magnitude and distribution of earth pressures against below grade walls depends on the deformation condition (rotation) of the wall, soil properties and water conditions. When the soil behind the wall is prevented from lateral strain, the resulting force is known as the at-rest earth pressure (K_O). If the retaining structure moves away from the soil mass, the earth pressure decreases with the increasing lateral expansion until a minimum pressure, known as the active earth pressure (K_A), is reached. If the wall is forced into the soil mass, the earth pressure increases until a maximum pressure, known as the passive earth pressure (K_P), is obtained.

Free-standing retaining walls are usually designed for active earth pressures. Rigid basement walls are typically designed for at-rest earth pressures. If basement walls will be backfilled before they are braced by the floor slabs, they should also be designed to withstand active earth pressures as self-supporting cantilever walls. However, the earth pressures must be compatible with the wall rotation, which is limited by the wall rigidity, foundation support conditions and connections to adjoining structures. If active earth pressure development requires horizontal wall movements that cannot occur, or which are architecturally undesirable, walls should be designed for an intermediate pressure based on restraint conditions.

Laboratory analysis to determine actual soil shear strength properties was beyond the authorized scope of services. Based on our experience with similar soils and construction, we have provided the earth pressure estimates shown below:

EARTH PRESSURE	EQUIVALENT FLUID PRESSURE
Active (K_A)	40 pcf
At-Rest (K_O)	60 pcf
Passive (K_P)	150 pcf *

* *Passive earth pressure is frequently used in retaining wall design to resist active earth pressures. Wall movements required to develop full passive earth pressures are significantly greater than movements necessary for active earth pressures. Consequently, this passive pressure value has been reduced by at least 50% for wall design.*

We recommend a value of 0.35 as the coefficient of friction (sliding resistance) between wall foundations and the underlying residual or fill soils. A coefficient of friction of 0.45 is recommended for foundations bearing on PWR. A coefficient of friction of 0.5 is recommended for foundations bearing on rock.

Our lateral earth pressure recommendations assume that:

- The ground surface adjacent to the wall is level,
- Residual soils will be reused for wall backfill,
- Heavy construction equipment does not operate within 5 feet of the walls,
- A constantly functioning drainage system is installed between the wall and the soil backfill,
- Footings or other significant surcharge loads are located outside the wall a distance at least equal to the wall height.

6.6.2 Alternative Walls – Fill Areas

Based on discussions with Lenity Architecture, we understand that mechanically stabilized earth (MSE) wall systems may be used on the site.

MSE wall systems consist of thin strips or grids made of metal or plastic that are placed horizontally between backfill layers at right angles to the wall face. The strips/grids provide tensile reinforcement within the fill, as well as tie the precast concrete wall facing to the soil mass. Because the system is a self-supporting soil mass, the "design bearing pressure" concept, typically used in conventional cast-in-place retaining wall design to size the wall foundations, is generally not applicable. The reinforced soil system is interpreted to behave as a flexible, mass gravity wall, consequently, the design usually considers the resistance to wall overturning and global slope stability, as well as the internal stability of the reinforced earth system. Wall system design must also consider any surcharges caused by sloping fill, the potential impact of leaks from water or sewer lines, and the proximity of adjacent buildings.

Typically, these walls are a design/build system that are the responsibility of the contractor and his specialty wall subcontractor. The specifications usually state that the wall supplier is to design, install, warrant and guarantee the MSE wall without reliance on other entities. This includes the determination and confirmation of foundation and fill parameters used in design, such as total and effective shear stress parameters, as well as settlement and deformation characteristics of the wall system.

Please note that NOVA has not performed a geotechnical study for an MSE wall system. The bearing pressures and earth pressures presented in other sections of this report may not be appropriate for MSE wall design. Consequently, we recommend that the wall supplier confirm the parameters used in his MSE wall design.

6.7 PAVEMENT SECTIONS

Flexible Pavement: Based on subsurface conditions encountered at this site, the recommended site preparation, an estimated CBR of 4 and the assumed traffic loading conditions, provided by the project architect, of 600 automobiles per day for 7 days per week with the occasional delivery truck, our recommended pavement design is as follows:

- **Light Duty -** For driveways and parking lots restricted to automobile traffic, a light duty section consisting of 6 inches of compacted aggregate base overlain by 2 inches of asphaltic concrete binder course (such as NCDOT I19.0B) and 1 inch of asphaltic surface course (such as NCDOT S9.5B).

- **Heavy Duty -** For parking lots and driveways subject to both automobile and truck traffic, a heavy duty section that consists of 8 inches of compacted aggregate base overlain by 2½ inches of asphaltic concrete binder course (such as NCDOT I19.0B) and 1 inches of asphaltic surface course (such as NCDOT S9.5B).

We recommend a minimum compaction of 98 percent of the maximum dry density for the crushed stone material as determined by the modified Proctor compaction test (ASTM D 1557, Method D). The crushed stone should conform to applicable sections of the State of North Carolina Department of Transportation Standard Specifications Construction of Transportation Systems. All asphalt material and paving operations should meet applicable specifications of the Asphalt Institute and North Carolina Department of Transportation. A NOVA technician should observe placement and perform density testing of the base course material and asphalt.

Rigid Pavement: In dumpster pad areas or where trucks will be making sharp turns, braking or parking, we recommend that a rigid pavement section be used. Based on the assumed traffic data and an estimated subgrade modulus (k) of 100 psi/inch for traffic or wheel loading where slabs bear upon at least 4 inches of compacted graded aggregate base (GAB), we recommend 5 inches of concrete for the required pavement section. All concrete joints should conform to applicable specifications of the North Carolina Department of Transportation. We recommend that a non-woven geotextile (about 3 feet wide) be placed beneath the construction joints to prevent upward "pumping" movement of soil fines through the joints. The concrete should have a minimum flexural strength of 650 psi, and have control/construction joints placed in accordance with ACI requirements.

6.8 SEISMIC

6.8.1 Soil Site Class

In accordance with Section 1613.5.2 of the 2012 IBC, the seismic Site Class was estimated using the standard penetration resistance values obtained from the soil test borings performed during this study. Based upon this analysis, and our knowledge of general subsurface conditions in the area, we believe the soil profiles associated with a Site Class "C" are generally appropriate for this site.

6.9 CONSTRUCTION OBSERVATIONS

6.9.1 Shallow Foundations

Footing excavations should be level and free of debris, ponded water, mud, and loose, frozen or water-softened soils. All footing excavations should be evaluated by the NOVA geotechnical engineer prior to reinforcing steel placement to observe foundation subgrade

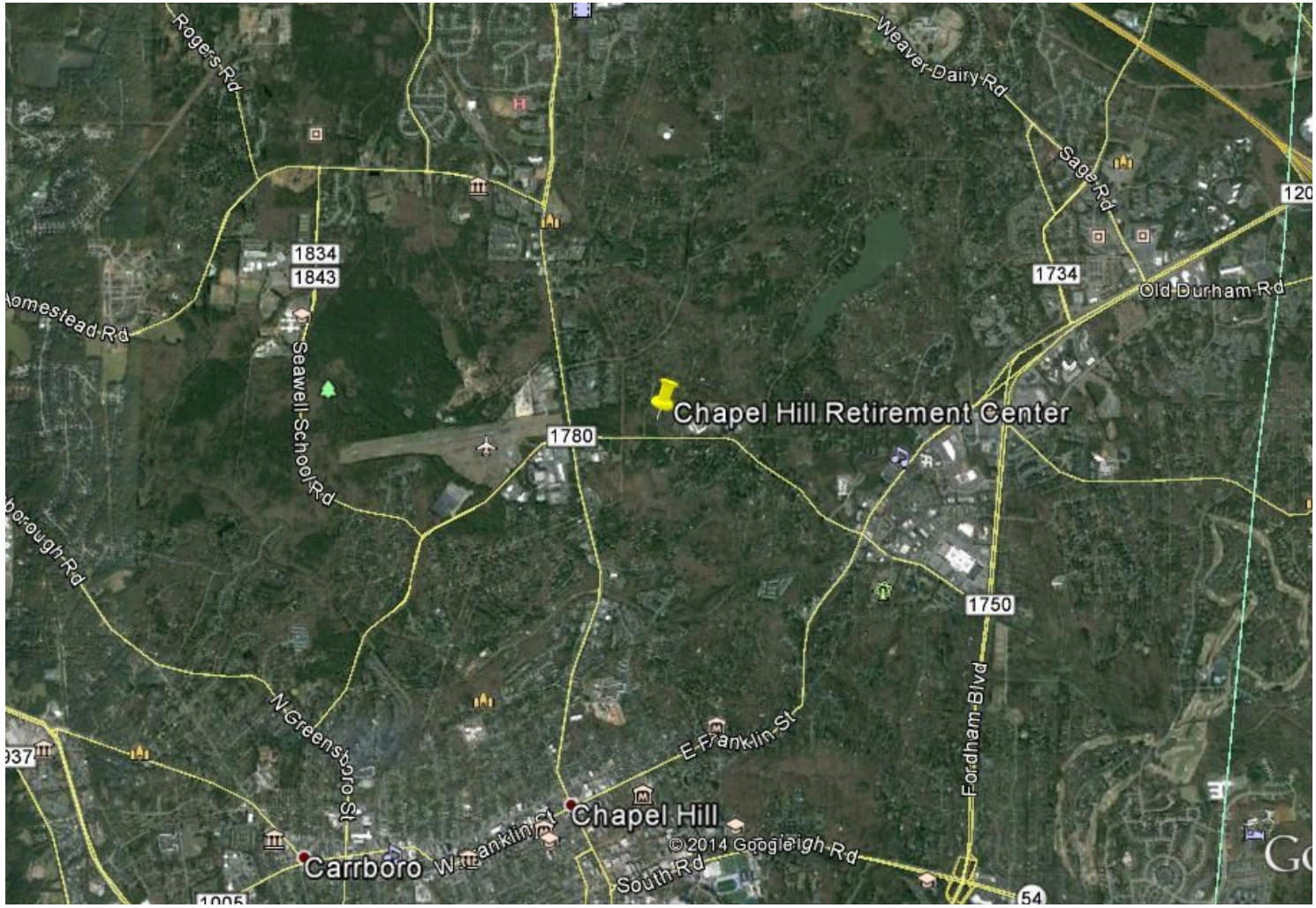
preparation and confirm bearing pressure capacity. Due to variable site subsurface and construction conditions, some adjustments in isolated foundation bearing pressures, depth of footings or undercutting and replacement with controlled structural fill may be necessary.

6.9.2 Subgrade

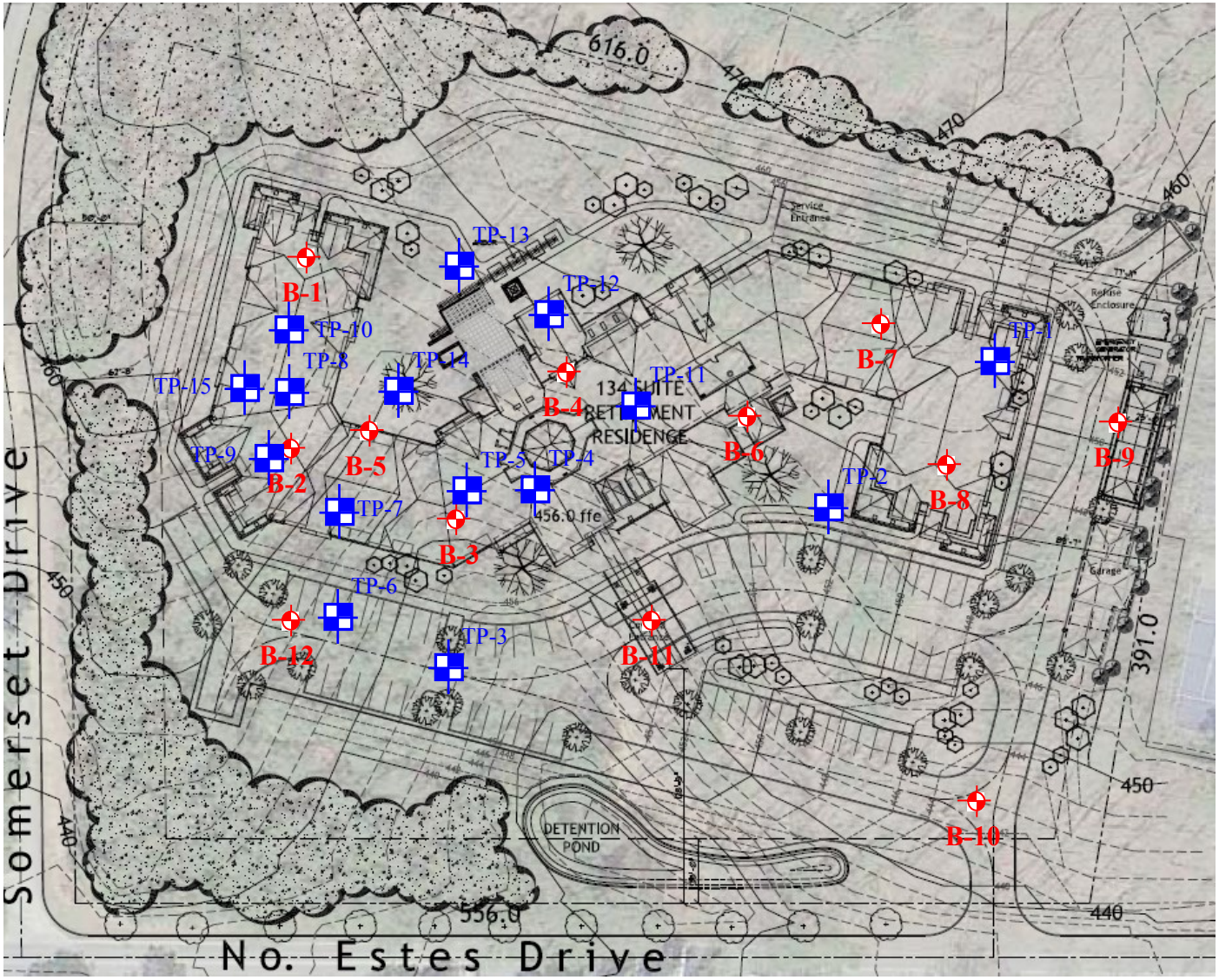
Once site grading is completed, the subgrade may be exposed to adverse construction activities and weather conditions. The subgrade should be well-drained to prevent the accumulation of water. If the exposed subgrade becomes saturated or frozen, the NOVA geotechnical engineer should be consulted.

A final subgrade evaluation should be performed by the NOVA geotechnical engineer immediately prior to pavements or slab-on-grade placement. If practical, proofrolling may be used to re-densify the surface and to detect any soil, which has become excessively wet or otherwise loosened.

APPENDIX A



Site Plan Provided by Lenity Group SCALE: Graphic	NOVA ENGINEERING AND ENVIRONMENTAL	**Site Vicinity Map** Chapel Hill Retirement Residence Chapel Hill, NC NOVA Project No.: 10705-2014014



Key

TP-# — Test Pit Location

B-# — Boring Location

Site Plan Provided by Lenity Group

SCALE: Graphic

NOVA ENGINEERING AND ENVIRONMENTAL

Sampling Location Plan

Chapel Hill Retirement Residence
Chapel Hill, NC
NOVA Project No.: 10705-2014014

APPENDIX B

KEY TO SYMBOLS AND CLASSIFICATIONS

DRILLING SYMBOLS

	Split Spoon Sample
	Undisturbed Sample (UD)
	Standard Penetration Resistance (ASTM D1586-67)
	Water Table at least 24 Hours after Drilling
	Water Table 1 Hour or less after Drilling
100/2”	Number of Blows (100) to Drive the Spoon a Number of Inches (2)
NX, NQ	Core Barrel Sizes: 2⅛- and 2-Inch Diameter Rock Core, Respectively
REC	Percentage of Rock Core Recovered
RQD	Rock Quality Designation – Percentage of Recovered Core Segments 4 or more Inches Long
	Loss of Drilling Water
MC	Moisture Content Test Performed

CORRELATION OF PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY

	Number of Blows, “N”	Approximate Relative Density
	0 – 4	Very Loose
	5 – 10	Loose
SANDS	11 – 30	Medium Dense
	31 – 50	Dense
	Over 50	Very Dense

	Number of Blows, “N”	Approximate Consistency
	0 – 2	Very Soft
	3 – 4	Soft
SILTS	5 – 8	Firm
and	9 – 15	Stiff
CLAYS	16 – 30	Very Stiff
	31 – 50	Hard
	Over 50	Very Hard

DRILLING PROCEDURES

Soil sampling and standard penetration testing performed in accordance with ASTM D1586-67. The standard penetration resistance is the number of blows of a 140 pound hammer falling 30 inches to drive a 2-inch O.D., 1⅜-inch I.D. split spoon sampler one foot. Core drilling performed in accordance with ASTM D2113-62T. The undisturbed sampling procedure is described by ASTM D1587-67. Soil and rock samples will be discarded 60 days after the date of the final report unless otherwise directed.

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SOIL CLASSIFICATION CHART

COARSE GRAINED SOILS	**GRAVELS**	Clean Gravel less than 5% fines	GW	Well graded gravel
			GP	Poorly graded gravel
		Gravels with Fines more than 12% fines	GM	Silty gravel
			GC	Clayey gravel
	SANDS	Clean Sand less than 5% fines	SW	Well graded sand
			SP	Poorly graded sand
		Sands with Fines more than 12% fines	SM	Silty sand
			SC	Clayey sand
FINE GRAINED SOILS	**SILTS AND CLAYS** Liquid Limit less than 50	Inorganic	CL	Lean clay
			ML	Silt
		Organic	OL	Organic clay and silt
	SILTS AND CLAYS Liquid Limit 50 or more	Inorganic	CH	Fat clay
			MH	Elastic silt
		Organic	OH	Organic clay and silt
HIGHLY ORGANIC SOILS		Organic matter, dark color, organic odor	PT	Peat

PARTICLE SIZE IDENTIFICATION

GRAVELS	Coarse	¾ inch to 3 inches
	Fine	No. 4 to ¾ inch
SANDS	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40
SILTS AND CLAYS		Passing No. 200

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TEST BORING RECORD B-1

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: North Carolina **ELEVATION:** 457
DRILLER: Soil Drilling Services **LOGGED BY:** ABR
DRILLING METHOD: CME 550X **DATE:** 11/20/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼ DRY **CAVING>** C 4.3

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	N-Value
0	457	TOPSOIL (7 Inches)				
		RESIDUUM: Medium dense, moist, brown, silty fine to coarse SAND (SM) with gravel				17
5	455			C		89
	452	AUGER REFUSAL AT 6 FEET				
10	450					
	445					
15						
	440					
20						
	435					
25						
	430					
30						
	425					
35						
	420					

Graphic Depiction

● BLOW COUNT
▲ NATURAL MOISTURE
PLASTIC LIMIT ⊢⊣ LIQUID LIMIT

10 20 30 40 60 100

This information pertains only to this boring and should not be interpreted as being indicative of the site.

NOVA ENGINEERING AND ENVIRONMENTAL

TEST BORING RECORD B-2

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: North Carolina **ELEVATION:** 455
DRILLER: Soil Drilling Services **LOGGED BY:** ABR
DRILLING METHOD: CME 550X **DATE:** 11/24/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼ DRY **CAVING>** ⌭ 10.9

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	N-Value
0	455	TOPSOIL (4 Inches)				
		RESIDUUM: Loose, moist, brown and black, silty fine to coarse SAND (SM) with trace organics				9
5	450	Dense, moist, light brown and white, silty fine to coarse SAND (SM)				43
		PARTIALLY WEATHERED ROCK: Sampled as very dense, moist, light brown, silty fine to coarse SAND (SM) with rock fragments				100
						100
10	445			⌭		
						100
15	440					
						100
20	435	BORING TERMINATED AT 20 FEET				
25	430					
30	425					
35	420					

Graphic Depiction

● BLOW COUNT
▲ NATURAL MOISTURE
PLASTIC LIMIT ⊢⊣ LIQUID LIMIT

10 20 30 40 60 100

This information pertains only to this boring and should not be interpreted as being indicative of the site.

NOVA ENGINEERING AND ENVIRONMENTAL

TEST BORING RECORD B-3

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: North Carolina **ELEVATION:** 443
DRILLER: Soil Drilling Services **LOGGED BY:** ABR
DRILLING METHOD: CME 550X **DATE:** 11/20/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼ DRY **CAVING>** C

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	N-Value	Graphic Depiction
		AUGER REFUSAL AT 1 FOOT					● BLOW COUNT ▲ NATURAL MOISTURE PLASTIC LIMIT ⊢⊣ LIQUID LIMIT 10 20 30 40 60 100
5	440						
10	435						
15	430						
20	425						
25	420						
30	415						
35	410						
	405						

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Driller executed three offsets approximatel 3 feet to the north, south, and west.

NOVA ENGINEERING AND ENVIRONMENTAL

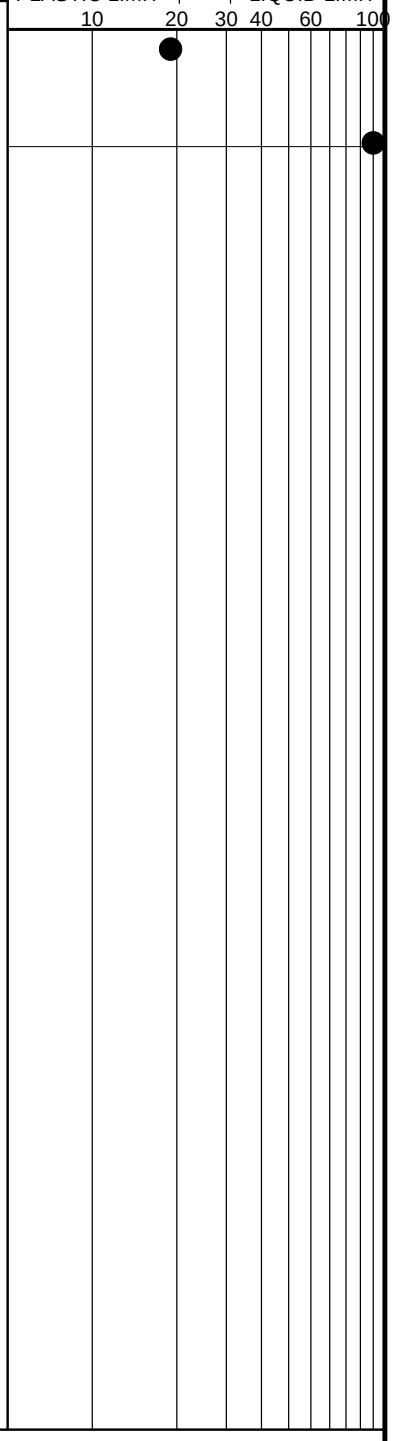
TEST BORING RECORD B-4

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: North Carolina **ELEVATION:** 455
DRILLER: Soil Drilling Services **LOGGED BY:** ABR
DRILLING METHOD: CME 550X **DATE:** 11/20/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼ DRY **CAVING>** ℄

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	N-Value
0	455	TOPSOIL (4 Inches)				
		RESIDUUM: Medium dense, moist, brown and light brown, silty fine to coarse SAND (SM) with trace organics				19
		PATIALLY WEATHERED ROCK - No Recovery				100
5	450	AUGER REFUSAL AT 3.1 FEET				
10	445					
15	440					
20	435					
25	430					
30	425					
35	420					

Graphic Depiction

● BLOW COUNT
▲ NATURAL MOISTURE
PLASTIC LIMIT ⊢⊣ LIQUID LIMIT



This information pertains only to this boring and should not be interpreted as being indicative of the site.

NOVA ENGINEERING AND ENVIRONMENTAL

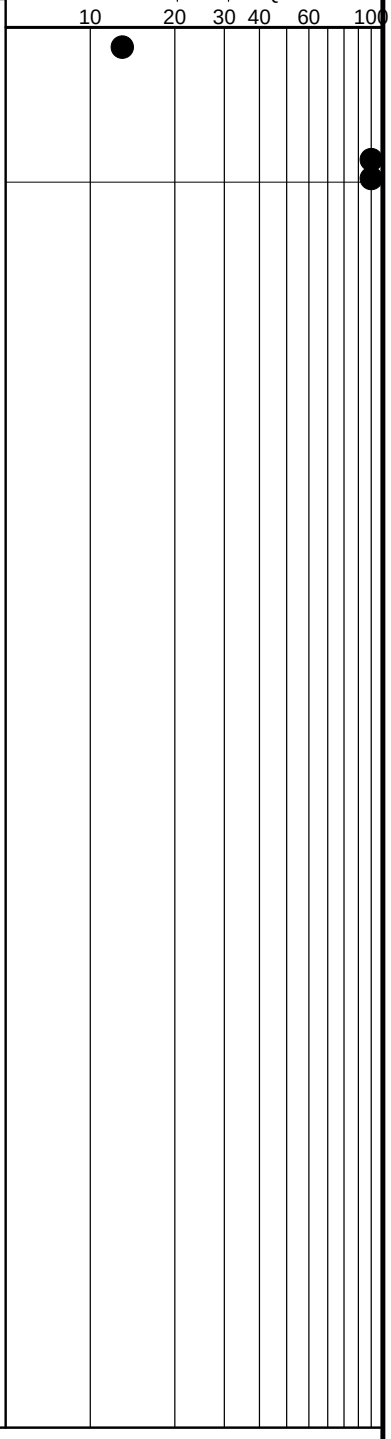
TEST BORING RECORD B-5

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: North Carolina **ELEVATION:** 450
DRILLER: Soil Drilling Services **LOGGED BY:** ABR
DRILLING METHOD: CME 550X **DATE:** 11/20/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▽ DRY **CAVING>** C

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	N-Value
0	450	TOPSOIL (2 Inches)				
		RESIDUUM: Medium dense, moist, dark brown, silty fine to coarse SAND (SM) with trace organics				13
		PARTIALLY WEATHERED ROCK: Sampled as very dense, moist, light brown, silty fine to coarse SAND (SM)				100
5	445	AUGER REFUSAL AT 4.1 FEET				100
10	440					
15	435					
20	430					
25	425					
30	420					
35	415					

Graphic Depiction

● BLOW COUNT
▲ NATURAL MOISTURE
PLASTIC LIMIT ⊢⊣ LIQUID LIMIT



This information pertains only to this boring and should not be interpreted as being indicative of the site.

NOVA ENGINEERING AND ENVIRONMENTAL

TEST BORING RECORD B-6

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: North Carolina **ELEVATION:** 459
DRILLER: Soil Drilling Services **LOGGED BY:** ABR
DRILLING METHOD: CME 550X **DATE:** 11/20/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▽ DRY **CAVING>** ⌭ 15.3

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	N-Value
0		TOPSOIL (6 Inches)				
		RESIDUUM: Stiff, moist, reddish brown, fine to coarse sandy CLAY (CH) with trace organics				14
5	455	Medium dense, moist, tan and light brown, silty fine to coarse SAND (SM)				23
						21
10	450					17
	445	Very stiff, moist, light brown, fine to coarse sandy SILT (ML)		⌭		29
15						
	440					51
20						
	435	PARTIALLY WEATHERED ROCK: Sampled as very dense, moist, tan and brown, silty fine to coarse SAND (SM)				100
25		BORING TERMINATED AT 25 FEET				
	430					
30						
	425					
35						

Graphic Depiction

● BLOW COUNT
▲ NATURAL MOISTURE
PLASTIC LIMIT ⊢⊣ LIQUID LIMIT

10 20 30 40 60 100

This information pertains only to this boring and should not be interpreted as being indicative of the site.

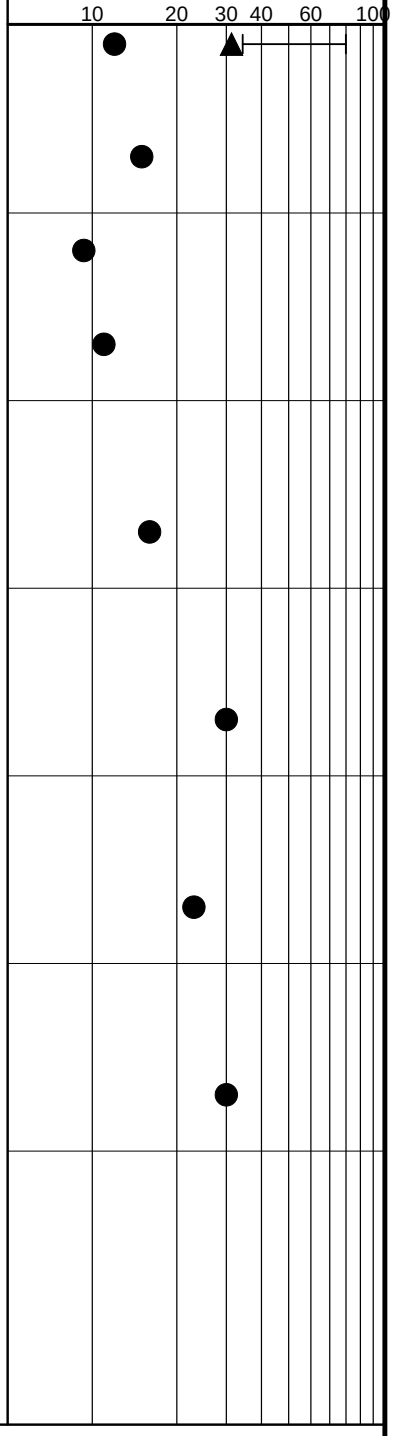
NOVA ENGINEERING AND ENVIRONMENTAL

TEST BORING RECORD B-7

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: North Carolina **ELEVATION:** 465
DRILLER: Soil Drilling Services **LOGGED BY:** ABR
DRILLING METHOD: CME 550X **DATE:** 11/20/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼ DRY **CAVING>** ⌭ 20.9

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	N-Value
0	465	TOPSOIL (5 Inches)				
		RESIDUUM: Stiff, moist, reddish brown, fine to coarse sandy CLAY (CL) with trace organics				12
		Medium dense to loose, moist, brown and tan, silty fine to coarse SAND (SM)				15
5	460	Firm, moist, brown and tan, fine to coarse sandy SILT (MH)				9
						11
10	455					
		Very stiff, moist, tan and black, fine to coarse sandy SILT (ML)				16
15	450					
				⌭		30
20	445					
		Medium dense, moist, tan and black, silty fine to coarse SAND (SM)				23
25	440					
						30
30	435	BORING TERMINATED AT 30 FEET				
35	430					

Graphic Depiction



This information pertains only to this boring and should not be interpreted as being indicative of the site.

NOVA ENGINEERING AND ENVIRONMENTAL

TEST BORING RECORD B-8

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: North Carolina **ELEVATION:** 461
DRILLER: Soil Drilling Services **LOGGED BY:** ABR
DRILLING METHOD: CME 550X **DATE:** 11/20/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼ DRY **CAVING>** ⌭ 24

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	N-Value
0	460	TOPSOIL (5 Inches) RESIDUUM: Stiff to very stiff, moist, reddish-brown, fine to coarse sandy CLAY (CL)				12
						22
5	455	Stiff, moist, brown and tan, fine to coarse sandy SILT (ML)				10
		Dense, moist, tan, silty fine to coarse SAND (SM)				36
10	450					
						30
15	445					
		Medium dense, moist, dark brown and black, silty fine to coarse SAND (SM)				26
20	440					
				⌭		15
25	435					
		Medium dense, moist, dark brown and black, silty fine to coarse SAND (SM)				22
30	430	BORING TERMINATED AT 30 FEET				
35	425					

Graphic Depiction

● BLOW COUNT
▲ NATURAL MOISTURE
PLASTIC LIMIT ⊢⊣ LIQUID LIMIT

10 20 30 40 60 100

This information pertains only to this boring and should not be interpreted as being indicative of the site.

NOVA ENGINEERING AND ENVIRONMENTAL

TEST BORING RECORD B-9

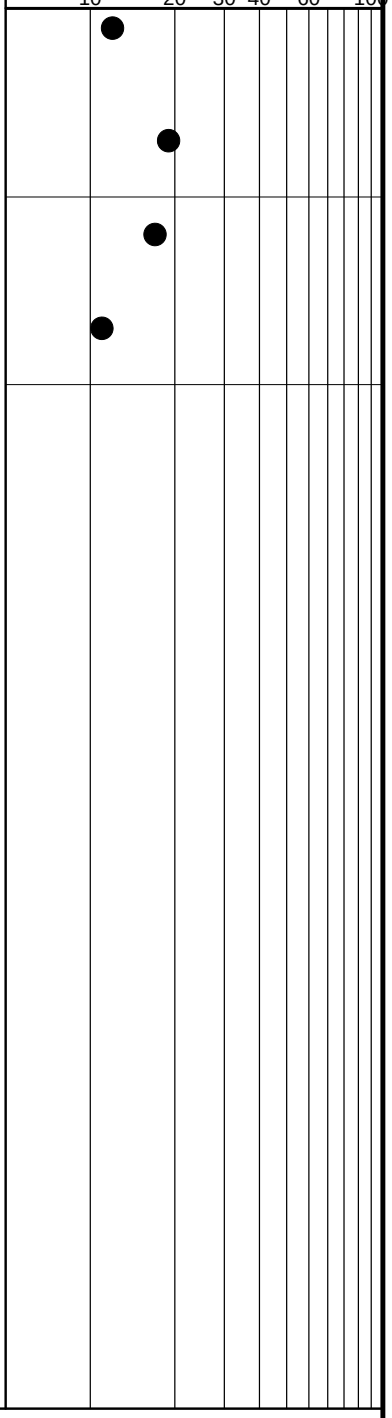
PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: North Carolina **ELEVATION:** 459
DRILLER: Soil Drilling Services **LOGGED BY:** ABR
DRILLING METHOD: CME 550X **DATE:** 11/20/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼ DRY **CAVING>** ⌭ 6.7

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	N-Value
0		TOPSOIL (5 Inches)				
		RESIDUUM: Stiff, moist, reddish brown, fine to coarse sandy CLAY (CL) with trace organics				12
	455	Medium dense, moist, pink and tan, silty fine to coarse SAND (SM)				19
5		Very stiff, moist, brown and tan, fine to coarse sandy CLAY (CL)		⌭		17
	450	Medium dense, moist, white and brown, silty fine to coarse SAND (SM)				11
10		BORING TERMINATED AT 10 FEET				
	445					
15						
	440					
20						
	435					
25						
	430					
30						
	425					
35						

Graphic Depiction

● BLOW COUNT
▲ NATURAL MOISTURE
PLASTIC LIMIT ⊢⊣ LIQUID LIMIT

10 20 30 40 60 100



This information pertains only to this boring and should not be interpreted as being indicative of the site.

NOVA ENGINEERING AND ENVIRONMENTAL

TEST BORING RECORD B-10

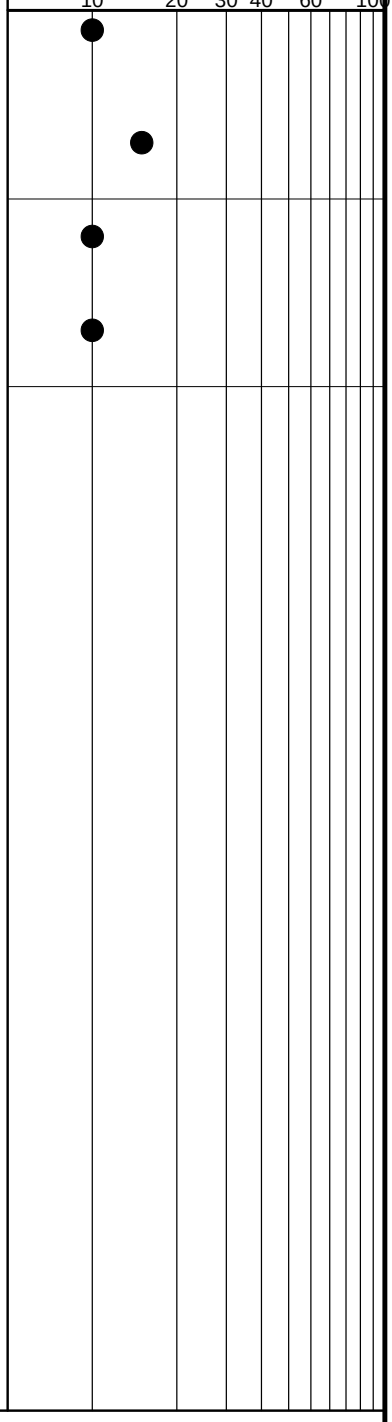
PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: **ELEVATION:** 446
DRILLER: **LOGGED BY:**
DRILLING METHOD: **DATE:**
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▽ DRY **CAVING>** C

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	N-Value
0	445	TOPSOIL (5 Inches) RESIDUUM: Stiff, moist, reddish brown, fine to coarse sandy CLAY (CL)				10
5	440	Stiff, moist, reddish-brown and tan, fine to coarse sandy SILT (ML)				15 10 10
10	435	BORING TERMINATED AT 10 FEET				
15	430					
20	425					
25	420					
30	415					
35	410					

Graphic Depiction

● BLOW COUNT
▲ NATURAL MOISTURE
PLASTIC LIMIT ⊢⊣ LIQUID LIMIT

10 20 30 40 60 100



This information pertains only to this boring and should not be interpreted as being indicative of the site.

NOVA ENGINEERING AND ENVIRONMENTAL

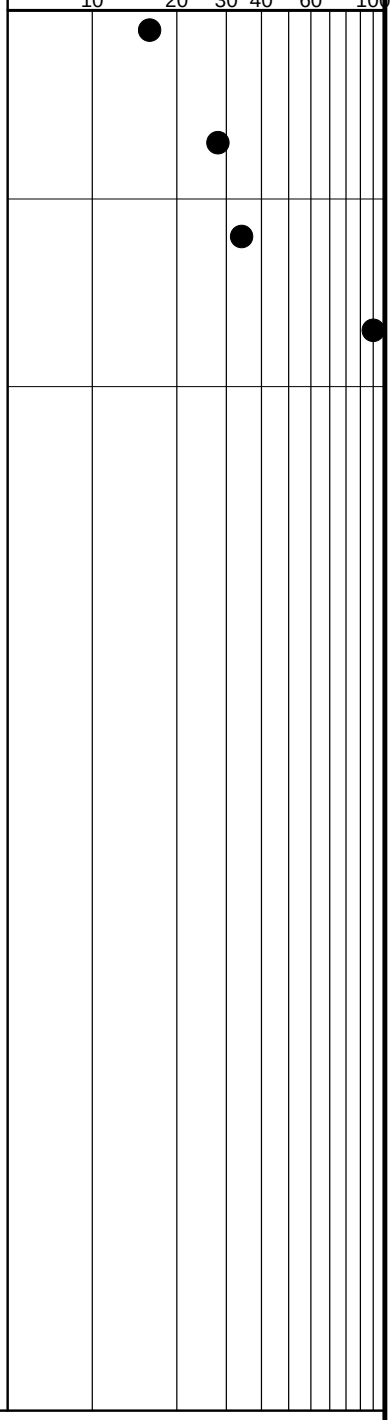
TEST BORING RECORD B-11

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: North Carolina **ELEVATION:** 444
DRILLER: Soil Drilling Services **LOGGED BY:** ABR
DRILLING METHOD: CME 550X **DATE:** 11/20/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼ DRY **CAVING>** ⌭ 6.4

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	N-Value
0		TOPSOIL (5 Inches)				
		RESIDUUM: Medium dense, moist, brown, silty fine to coarse SAND (SM)				16
5	440	Medium dense to very dense, light brown and tan, silty fine to coarse SAND (SM)		⌭		28
						34
10	435					100
		BORING TERMINATED AT 10 FEET				
15	430					
20	425					
25	420					
30	415					
35	410					

Graphic Depiction

● BLOW COUNT
▲ NATURAL MOISTURE
PLASTIC LIMIT ⊢⊣ LIQUID LIMIT



This information pertains only to this boring and should not be interpreted as being indicative of the site.

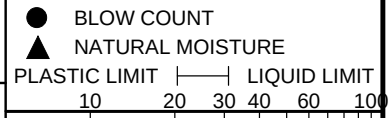
NOVA ENGINEERING AND ENVIRONMENTAL

TEST BORING RECORD B-12

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: North Carolina **ELEVATION:** 446
DRILLER: Soil Drilling Services **LOGGED BY:** ABR
DRILLING METHOD: CME 550X **DATE:** 11/20/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▽ DRY **CAVING>** ⊂ 6

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	N-Value
0	445	TOPSOIL (6 Inches) RESIDUUM: Medium dense to very dense, moist, light brown and tan, clayey fine to coarse SAND (SC)				19
5	440			⊂		82
		Very dense, moist, brown, silty fine to coarse SAND (SM)				82
10	435	PARTIALLY WEATHERED ROCK: Very dense, moist, brown, silty fine to coarse SAND (SM) BORING TERMINATED AT 10 FEET				100
15	430					
20	425					
25	420					
30	415					
35	410					

Graphic Depiction



This information pertains only to this boring and should not be interpreted as being indicative of the site.

NOVA ENGINEERING AND ENVIRONMENTAL

TEST PIT RECORD TP-1

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: Chapel Hill, North Carolina **ELEVATION:** 463
DRILLER: Barhill Excavating **LOGGED BY:** JLJ
DRILLING METHOD: Test Pit Excavation **DATE:** 12/17/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▽ N/A **CAVING>** C

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	DCP Blows per 1-3/4 inches	Graphic Depiction
0		TOPSOIL (12 Inches)					
	460	RESIDUUM: Moist, orange and brown, fine to coarse sandy SILT (ML)					
5							
	455	Moist, tan and brown, fine to coarse sandy SILT (ML)					
10							
	450	Test Pit Terminated at 13.0 Feet					
15							
	445						
20							
	440						
25							
	435						
30							
	430						

Graphic Depiction: ● BLOW COUNT ▲ NATURAL MOISTURE PLASTIC LIMIT ⊢⊣ LIQUID LIMIT
10 20 30 40 60 100

This information pertains only to this test pit and should not be interpreted as being indicative of the site.

NOVA ENGINEERING AND ENVIRONMENTAL

TEST PIT RECORD TP-2

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: Chapel Hill, North Carolina **ELEVATION:** 456
DRILLER: Barhill Excavating **LOGGED BY:** JLJ
DRILLING METHOD: Test Pit Excavation **DATE:** 12/17/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼ N/A **CAVING>** C

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	DCP Blows per 1-3/4 inches	Graphic Depiction
0	455	TOPSOIL (8 Inches) RESIDUUM: Moist, orange and tan, fine to coarse sandy SILT (ML)					● BLOW COUNT ▲ NATURAL MOISTURE PLASTIC LIMIT ⊢⊣ LIQUID LIMIT 10 20 30 40 60 100
5	450	PARTIALLY WEATHERED ROCK: Sampled as very dense, tan and brown, silty SAND (SM) with rock fragments					
10	445						
15	440	Test Pit Terminated at 13.0 Feet					
20	435						
25	430						
30	425						

This information pertains only to this test pit and should not be interpreted as being indicative of the site.

NOVA ENGINEERING AND ENVIRONMENTAL

TEST PIT RECORD TP-3

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: Chapel Hill, North Carolina **ELEVATION:** 436
DRILLER: Barhill Excavating **LOGGED BY:** JLJ
DRILLING METHOD: Test Pit Excavation **DATE:** 12/17/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▽ N/A **CAVING>** C

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	DCP Blows per 1-3/4 inches	Graphic Depiction
0	435	TOPSOIL (8 Inches) RESIDUUM: Moist, orange and tan, silty fine to coarse SAND (SM)					● BLOW COUNT ▲ NATURAL MOISTURE PLASTIC LIMIT ⊢⊣ LIQUID LIMIT 10 20 30 40 60 100
5	430	PARTIALLY WEATHERED ROCK: Sampled as very dense, orange and tan, silty SAND (SM) with rock fragments					
10	425						
		Test Pit Terminated at 12.0 Feet					
15	420						
20	415						
25	410						
30	405						

This information pertains only to this test pit and should not be interpreted as being indicative of the site.

NOVA ENGINEERING AND ENVIRONMENTAL

TEST PIT RECORD TP-4

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: Chapel Hill, North Carolina **ELEVATION:** 445
DRILLER: Barhill Excavating **LOGGED BY:** JLJ
DRILLING METHOD: Test Pit Excavation **DATE:** 12/17/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▽ N/A **CAVING>** C

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	DCP Blows per 1-3/4 inches	Graphic Depiction
0	445	TOPSOIL (8 Inches)					● BLOW COUNT ▲ NATURAL MOISTURE PLASTIC LIMIT ⊢⊣ LIQUID LIMIT 10 20 30 40 60 100
		RESIDUUM: Moist, orange and tan, fine to coarse sandy SILT (ML)					
5	440	PARTIALLY WEATHERED ROCK: Sampled as very dense, orange and tan, silty SAND (SM) with rock fragments					
10	435						
		Test Pit Terminated at 12.0 Feet					
15	430						
20	425						
25	420						
30	415						

This information pertains only to this test pit and should not be interpreted as being indicative of the site.

NOVA ENGINEERING AND ENVIRONMENTAL

TEST PIT RECORD TP-5

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: Chapel Hill, North Carolina **ELEVATION:** 444
DRILLER: Barhill Excavating **LOGGED BY:** JLJ
DRILLING METHOD: Test Pit Excavation **DATE:** 12/17/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▽ N/A **CAVING>** C

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	DCP Blows per 1-3/4 inches	Graphic Depiction
0		TOPSOIL (4 Inches)					
		RESIDUMM: Moist, tan and gray, fine to coarse sandy SILT (ML)					
5	440						
		PARTIALLY WEATHERED ROCK: Sampled as very dense, brown and tan, silty SAND (SM) with rock fragments					
10	435						
15	430	Test Pit Terminated at 14.0 Feet					
20	425						
25	420						
30	415						
	410						

Graphic Depiction: ● BLOW COUNT ▲ NATURAL MOISTURE PLASTIC LIMIT ⊢⊣ LIQUID LIMIT
10 20 30 40 60 100

This information pertains only to this test pit and should not be interpreted as being indicative of the site.

NOVA ENGINEERING AND ENVIRONMENTAL

TEST PIT RECORD TP-6

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: Chapel Hill, North Carolina **ELEVATION:** 444
DRILLER: Barhill Excavating **LOGGED BY:** JLJ
DRILLING METHOD: Test Pit Excavation **DATE:** 12/17/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▽ N/A **CAVING>** C

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	DCP Blows per 1-3/4 inches	Graphic Depiction
0		TOPSOIL (10 Inches) COBBLES (6 to 10 Inches in Diameter) RESIDUUM: Moist, tan and gray, fine to coarse sandy SILT (ML)					● BLOW COUNT ▲ NATURAL MOISTURE PLASTIC LIMIT ⊢⊣ LIQUID LIMIT 10 20 30 40 60 100
5	440	Moist, tan and brown, silty fine to coarse SAND (SM)					
10	435	PARTIALLY WEATHERED ROCK: Sampled as very dense, tan, silty SAND (SM) with rock fragments					
15	430	Test Pit Terminated at 12.0 Feet					
20	425						
25	420						
30	415						
	410						

This information pertains only to this test pit and should not be interpreted as being indicative of the site.

NOVA ENGINEERING AND ENVIRONMENTAL

TEST PIT RECORD TP-7

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: Chapel Hill, North Carolina **ELEVATION:** 448
DRILLER: Barhill Excavating **LOGGED BY:** JLJ
DRILLING METHOD: Test Pit Excavation **DATE:** 12/17/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▽ N/A **CAVING>** C

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	DCP Blows per 1-3/4 inches	Graphic Depiction
0		TOPSOIL (4 Inches)					● BLOW COUNT ▲ NATURAL MOISTURE PLASTIC LIMIT ⊢⊣ LIQUID LIMIT 10 20 30 40 60 100
	445	PARTIALLY WEATHERED ROCK (Rock Fragments > 12 Inches): Sampled as very dense, tan and brown, silty SAND (SM) with rock framgents					
5							
	440						
10							
	435	Test Pit Refusal at 12.0 Feet					
15							
	430						
20							
	425						
25							
	420						
30							
	415						

This information pertains only to this test pit and should not be interpreted as being indicative of the site.

NOVA ENGINEERING AND ENVIRONMENTAL

TEST PIT RECORD TP-8

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: Chapel Hill North Carolina **ELEVATION:** 456
DRILLER: Barhill Excavating **LOGGED BY:** JLJ
DRILLING METHOD: Test Pit Excavation **DATE:** 12/17/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼ N/A **CAVING>** C

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	DCP Blows per 1-3/4 inches	Graphic Depiction
0		TOPSOIL (4 Inches)					
	455	RESIDUUM: Moist, orange and tan, fine to coarse sandy SILT (ML) with rock fragments					
5		PARTIALLY WEATHERED ROCK: Sampled as very dense, orange and tan, silty SAND (SM) with rock fragments					
	450	Test Pit Refusal at 2.5 Feet					
10	445						
15	440						
20	435						
25	430						
30	425						

Graphic Depiction: ● BLOW COUNT ▲ NATURAL MOISTURE PLASTIC LIMIT ⊢⊣ LIQUID LIMIT
10 20 30 40 60 100

This information pertains only to this test pit and should not be interpreted as being indicative of the site.

NOVA ENGINEERING AND ENVIRONMENTAL

TEST PIT RECORD TP-9

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: Chapel Hill, North Carolina **ELEVATION:** 454
DRILLER: Barhill Excavating **LOGGED BY:** JLJ
DRILLING METHOD: Test Pit Excavation **DATE:**
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▽ N/A **CAVING>** C

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	DCP Blows per 1-3/4 inches	Graphic Depiction
0		TOPSOIL (6 Inches) COBBLES (4 to 10 Inches in Diameter)					● BLOW COUNT ▲ NATURAL MOISTURE PLASTIC LIMIT ⊢⊣ LIQUID LIMIT 10 20 30 40 60 100
		RESIDUUM: Moist, reddish-brown, fine to coarse sandy SILT (ML)					
5	450	PARTIALLY WEATHERED ROCK: Sampled as very dense, tan and brown, silty SAND (SM) with rock fragments					
		Test Pit Refusal at 8.0 Feet					
10	445						
	440						
15							
	435						
20							
	430						
25							
	425						
30							
	420						

This information pertains only to this test pit and should not be interpreted as being indicative of the site.

Rock Shelf along north end of Test Pit Excavation at a depth of 2.0 Feet.

NOVA ENGINEERING AND ENVIRONMENTAL

TEST PIT RECORD TP-10

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: Chapel Hill, North Carolina **ELEVATION:** 458
DRILLER: Barhill Excavating **LOGGED BY:** JLJ
DRILLING METHOD: Test Pit Excavation **DATE:** 12/17/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▽ N/A **CAVING>** C

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	DCP Blows per 1-3/4 inches	Graphic Depiction
0		TOPSOIL (4 Inches)					
	455	RESIDUUM: Moist, orange and tan, clayey fine to coarse SAND (SM)					
5		PARTIALLY WEATHERED ROCK: Sampled as very dense, tan and brown, silty SAND (SM) with rock frangments					
	450	Test Pit Refusal at 8.0 Feet					
10							
	445						
15							
	440						
20							
	435						
25							
	430						
30							
	425						

● BLOW COUNT
▲ NATURAL MOISTURE
PLASTIC LIMIT ⊢⊣ LIQUID LIMIT
10 20 30 40 60 100

This information pertains only to this test pit and should not be interpreted as being indicative of the site.

NOVA ENGINEERING AND ENVIRONMENTAL

TEST PIT RECORD TP-11

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: Chapel Hill, North Carolina **ELEVATION:** 456
DRILLER: Barhill Excavating **LOGGED BY:** JLJ
DRILLING METHOD: Test Pit Excavation **DATE:** 12/17/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▽ N/A **CAVING>** C

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	DCP Blows per 1-3/4 inches	Graphic Depiction
0	455	TOPSOIL (4 Inches) COBBLES (4 to 10 Inches in Diameter) RESIDUUM: Moist, brown and tan, fine to coarse sandy SILT (ML)					● BLOW COUNT ▲ NATURAL MOISTURE PLASTIC LIMIT ⊢⊣ LIQUID LIMIT 10 20 30 40 60 100
5	450	PARTIALLY WEATHERED ROCK (Firm): Sampled as very dense, orange and tan, silty SAND (SM) with rock fragments					
10	445	Test Pit Terminated at 11.0 Feet					
15	440						
20	435						
25	430						
30	425						

This information pertains only to this test pit and should not be interpreted as being indicative of the site.

NOVA ENGINEERING AND ENVIRONMENTAL

TEST PIT RECORD TP-12

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: Chapel Hill, North Carolina **ELEVATION:** 454
DRILLER: Barhill Excavating **LOGGED BY:** JLJ
DRILLING METHOD: Test Pit Excavation **DATE:** 12/17/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▽ N/A **CAVING>** C

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	DCP Blows per 1-3/4 inches	Graphic Depiction
0		TOPSOIL (12 Inches) COBBLES (6 to 12 Inches in Diameter) PARTIALLY WEATHERED ROCK: Sampled as very dense, tan and brown, silty SAND (SM) with rock fragments					● BLOW COUNT ▲ NATURAL MOISTURE PLASTIC LIMIT ⊢⊣ LIQUID LIMIT 10 20 30 40 60 100
5	450						
		Test Pit Terminated at 7.0 Feet					
10	445						
15	440						
20	435						
25	430						
30	425						
	420						

This information pertains only to this test pit and should not be interpreted as being indicative of the site.

NOVA ENGINEERING AND ENVIRONMENTAL

TEST PIT RECORD TP-13

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: Chapel Hill, North Carolina **ELEVATION:** 454
DRILLER: Barhill Excavating **LOGGED BY:** JLJ
DRILLING METHOD: Test Pit Excavation **DATE:** 12/17/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▽ N/A **CAVING>** C

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	DCP Blows per 1-3/4 inches	Graphic Depiction
0		TOPSOIL (4 Inches)					● BLOW COUNT ▲ NATURAL MOISTURE PLASTIC LIMIT ⊢⊣ LIQUID LIMIT 10 20 30 40 60 100
		RESIDUUM: Moist, tan, fine to coarse sandy SILT (ML)					
5	450	PARTIALLY WEATHERED ROCK: Sampled as very dense, tand and brown silty SAND (SM) with rock fragments					
		Test Pit Refusal at 7.5 Feet					
10	445						
	440						
15							
	435						
20							
	430						
25							
	425						
30							
	420						

This information pertains only to this test pit and should not be interpreted as being indicative of the site.

NOVA ENGINEERING AND ENVIRONMENTAL

TEST PIT RECORD TP-14

PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: Chapel Hill, North Carolina **ELEVATION:** 451
DRILLER: Barhill Excavating **LOGGED BY:** JLJ
DRILLING METHOD: Test Pit Excavation **DATE:** 12/17/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▽ N/A **CAVING>** C

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	DCP Blows per 1-3/4 inches	Graphic Depiction
0		TOPSOIL (4 Inches)					● BLOW COUNT ▲ NATURAL MOISTURE PLASTIC LIMIT ⊢⊣ LIQUID LIMIT 10 20 30 40 60 100
	450	RESIDUUM: Moist, tan and brown, fine to coarse sandy SILT (ML)					
5		PARTIALLY WEATHERED ROCK: Sampled as very dense, orange and tan, silty SAND (SM) with rock fragments					
	445						
		Test Pit Refusal at 7.0 Feet					
10	440						
15	435						
20	430						
25	425						
30	420						

This information pertains only to this test pit and should not be interpreted as being indicative of the site.

NOVA ENGINEERING AND ENVIRONMENTAL

TEST PIT RECORD TP-15

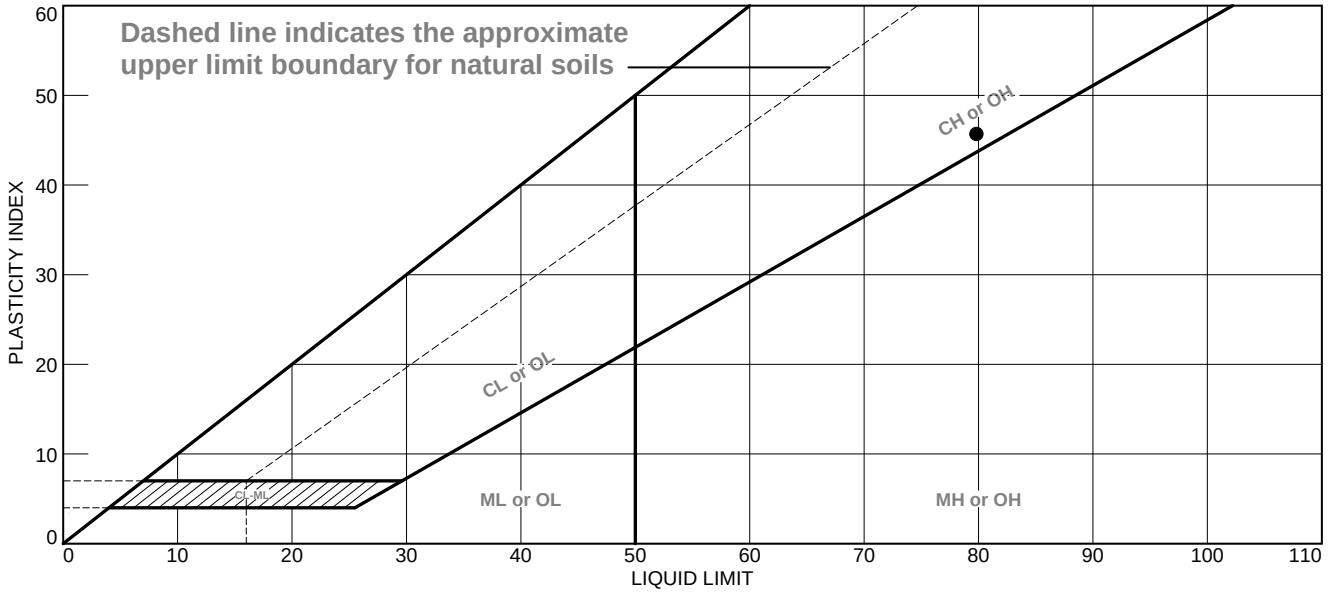
PROJECT: Chapel Hill Retirement Center **PROJECT NO.:** 2014014
CLIENT: Lenity Architecture
PROJECT LOCATION: Somerset Drive
LOCATION: Chapel Hill, North Carolina **ELEVATION:** 457
DRILLER: Barhill Excavating **LOGGED BY:** JLJ
DRILLING METHOD: Test Pit Excavation **DATE:** 12/17/14
DEPTH TO - WATER> INITIAL: ▽ DRY **AFTER 24 HOURS:** ▽ N/A **CAVING>** C

Depth (feet)	Elevation (ft-MSL)	Description	Graphic	Groundwater	Sample Type	DCP Blows per 1-3/4 inches	Graphic Depiction
0							● BLOW COUNT ▲ NATURAL MOISTURE PLASTIC LIMIT ⊢⊣ LIQUID LIMIT 10 20 30 40 60 100
	455	TOPSOIL (12 Inches) COBBLES (6 to 10 Inches in Diameter) PARTIALLY WEATHERED ROCK: Sampled as very dense, orange and tan, silty SAND (SM) with rock fragments					
5							
	450						
10		Test Pit Refusal at 8.0 Feet					
	445						
15							
	440						
20							
	435						
25							
	430						
30							
	425						

This information pertains only to this test pit and should not be interpreted as being indicative of the site.

APPENDIX C

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	FILL: Sampled as stiff, moist, reddish brown, fine to coarse sandy CLAY (CH) with trace organics	79.9	34.3	45.6		41.9	CH

Project No. 2014014 **Client:** Lenity Architecture

Project: Chapel Hill Retirement Center

Source of Sample: B-7 **Depth:** 0.5

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Charlotte, NC

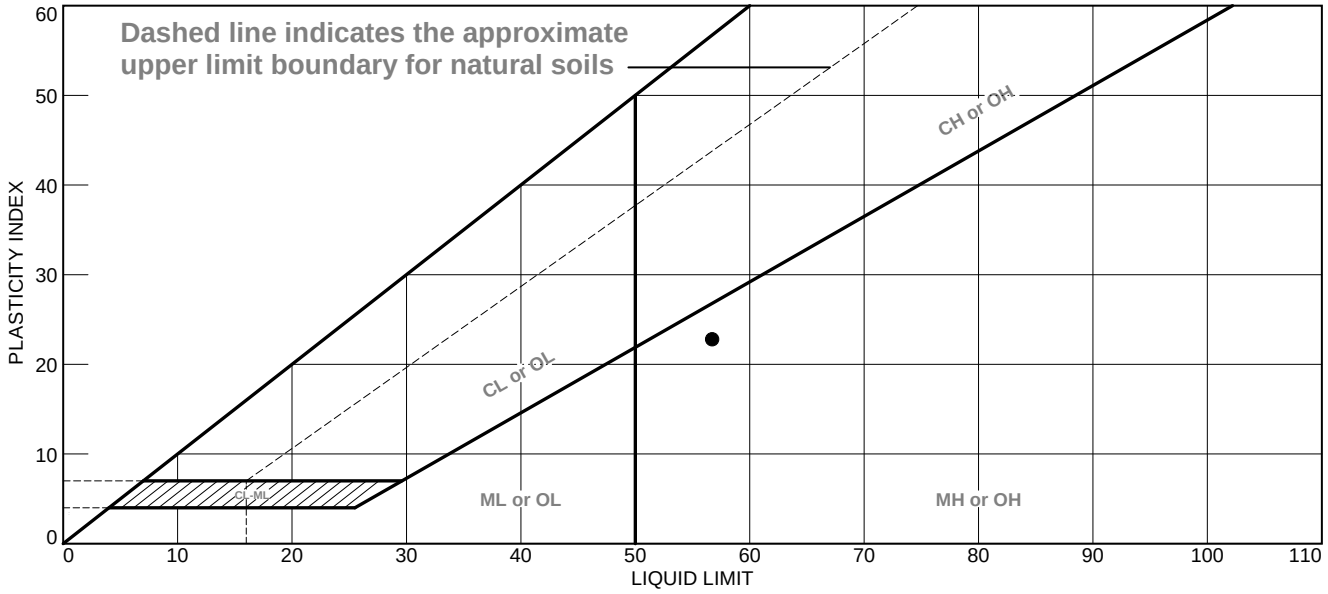
Remarks:

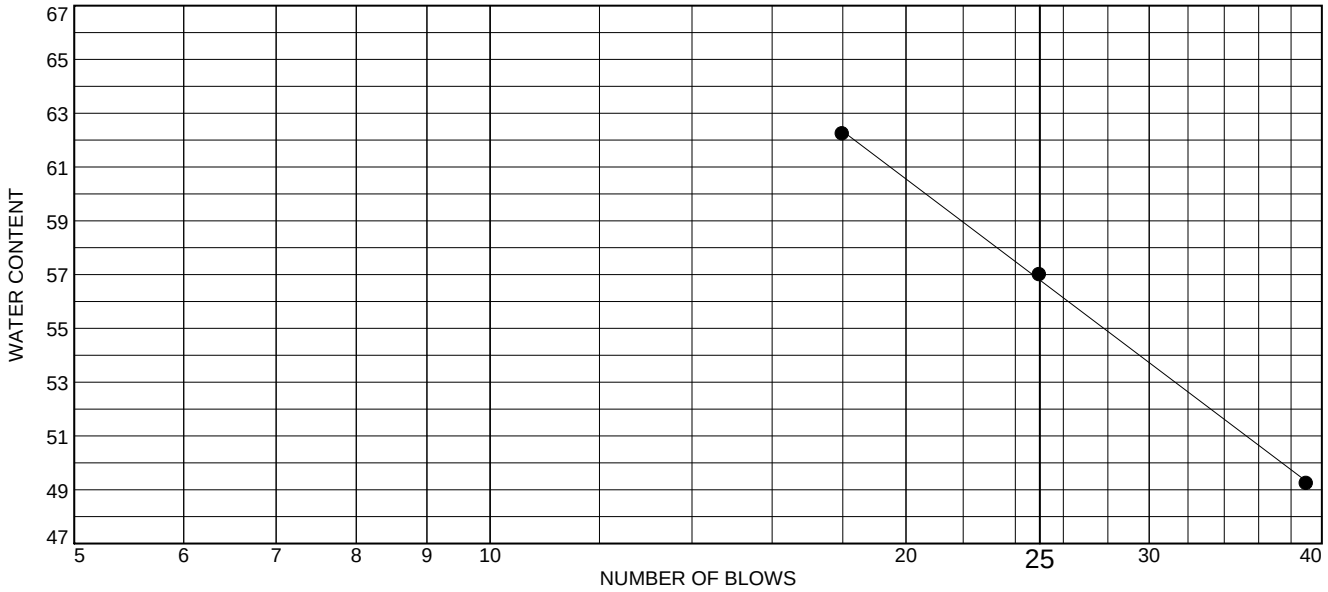
●NMC = 31.3%

Figure

Tested By: CM **Checked By:** DP

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	RESIDUUM: Stiff, moist, brown and tan, fine to coarse sandy SILT (MH)	56.8	34.1	22.7		96.1	MH

Project No. 2014014 **Client:** Lenity Architecture

Project: Chapel Hill Retirement Center

Source of Sample: B-8 **Depth:** 6

Nova Engineering & Environmental

Charlotte, NC

Remarks:

●NMC = 24.0%

Figure

Tested By: CM **Checked By:** DP

APPENDIX D

Important Information about Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

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

Read the Full Report

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

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

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

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

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

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

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

Subsurface Conditions Can Change

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

Most Geotechnical Findings Are Professional Opinions

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

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

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

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

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

Read Responsibility Provisions Closely

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

Geoenvironmental Concerns Are Not Covered

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

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE THE GEOPROFESSIONAL BUSINESS ASSOCIATION

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e-mail: info@asfe.org www.asfe.org

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QUALIFICATIONS OF RECOMMENDATIONS

The findings, conclusions and recommendations presented in this report represent our professional opinions concerning subsurface conditions at the site. The opinions presented are relative to the dates of our site work and should not be relied on to represent conditions at later dates or at locations not explored. The opinions included herein are based on information provided to us, the data obtained at specific locations during the study and our past experience. If additional information becomes available that might impact our geotechnical opinions, it will be necessary for NOVA to review the information, reassess the potential concerns, and re-evaluate our conclusions and recommendations.

Regardless of the thoroughness of a geotechnical exploration, there is the possibility that conditions between borings will differ from those encountered at specific boring locations, that conditions are not as anticipated by the designers and/or the contractors, or that either natural events or the construction process have altered the subsurface conditions. These variations are an inherent risk associated with subsurface conditions in this region and the approximate methods used to obtain the data. These variations may not be apparent until construction.

The professional opinions presented in this geotechnical report are not final. Field observations and foundation installation monitoring by the geotechnical engineer, as well as soil density testing and other quality assurance functions associated with site earthwork and foundation construction, are an extension of this report. Therefore, NOVA should be retained by the owner to observe all earthwork and foundation construction to document that the conditions anticipated in this study actually exist, and to finalize or amend our conclusions and recommendations. NOVA is not responsible or liable for the conclusions and recommendations presented in this report if NOVA does not perform these observation and testing services.

This report is intended for the sole use of Lenity Group only. The scope of work performed during this study was developed for purposes specifically intended by Lenity Group and may not satisfy other users requirements. Use of this report or the findings, conclusions or recommendations by others will be at the sole risk of the user. NOVA is not responsible or liable for the interpretation by others of the data in this report, nor their conclusions, recommendations or opinions.

Our professional services have been performed, our findings obtained, our conclusions derived and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices in the State of North Carolina. This warranty is in lieu of all other statements or warranties, either expressed or implied.