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The Preserve at Jones Dairy South

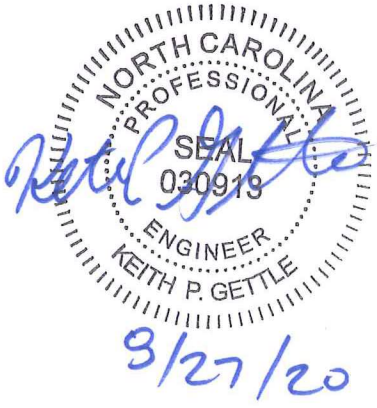
Rolesville, NC
Wake County

STORMWATER MANAGEMENT Analysis

August 27, 2020

Prepared for:

Preserve at Jones Dairy, LLC
10534 Arnold Palmer Lane
Raleigh, NC 27617



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Preserve at Jones Dairy - South

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Stormwater Management

Project Address: Jones Dairy Road
Rolesville, NC

Pins: 1759-88-8240, 1759.02-88-8240, 1759.02-78-6199

Latitude: N 35° 56' 31.32"
Longitude: W 78° 27' 36.44"

Developer: Preserve at Jones Dairy, LLC
10534 Arnold Palmer Lane
Raleigh, NC 27617

Telephone: (914) 422-1847

Site Description

The project consists of a single parcel approximately 54.10 acres located on Jones Dairy Road in Rolesville, NC. The parcels are vacant and the property is zoned R & PUD. The site is in the Neuse River Basin, and the Town of Rolesville, and subjected to those rules regarding stormwater nutrient management and post development runoff.

The parcel is located within an "Area of Minimal Flood Hazard" as noted per FEMA map 3720175900J, dated May 2, 2006.

Based on the Wake County GIS and SCS soils map (attached) the onsite soils are VaB, VaC2 (Vance Series), Wy (Worsham) and WkC (Wake).

Proposed Development --The stormwater analysis considers a development that will include 215 single family residential lots. The BMP's proposed are a Water Quality Wet Pond and a Bioretention device to treat the first inch of rainfall and control runoff within drainage areas, as shown, on the attached Drainage Map EX1. Also, included in this report is an impervious summary table accounting for sidewalk, roadway and lot impervious estimates.

Proposed Stormwater Management

The proposed stormwater facilities for the project will consist of one Water Quality Wet Pond and one Bioretention device. Drainage from the majority of the property will be collected within the storm pipe system and routed to the BMPs. The devices are designed in accordance with NCDENR DWR's BMP Manual. The devices are is designed to manage the 2 and10, 24-hour storm events as

noted below. The post development runoff from the noted storm events are less than the pre-development rates for the site in total. As a result, per the Town of Rolesville UDO 7.5.4, a Downstream Impact Analysis is not required since the post development runoff rate is less than pre-development.

The proposed BMPs will capture the runoff from the impervious areas from the lots and roadways throughout the project. Runoff from the parcels adjacent to the Southern portion of the project are not routed to the BMPs due to the grade elevation difference. However, the impervious associated with the development has been accounted for treatment within the two BMPs.

Methodology (Peak Flow and Nutrient Management)

The project is located within the Town of Rolesville permitting authority, and within the Neuse River Basin and the project is subjected to those rules. Under the Town's UDO stormwater requirements as noted below. The project is considered a High-Density project.

Development Standards for High-Density Projects

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

(a) The measures shall control and treat runoff from the first inch of rain. Runoff volume drawdown time shall be a minimum of 48 hours, but not more than 120 hours.
(b) All structural stormwater treatment systems used to meet these requirements shall be designed to have a minimum of 85 percent average annual removal for Total Suspended Solids (TSS).
(c) All Development and Redevelopment projects required to manage storm water shall provide permanent on-site BMPs to lower the nitrogen export amounts as part of the storm water management plan. BMPs are to be in accordance with and as specified in the Design Manual.
(d) Structural and Non-structural BMPs shall be used to ensure there is no net increase in peak flow leaving the site from the pre-Development conditions for the 1-year, 24-hour storm. Runoff volume drawdown time shall be a minimum of 48 hours, but not more than 120 hours.
(e) General engineering design criteria for all projects shall be in accordance with 15A NCAC 2H .1008(c), as explained in the Design Manual; 10 lb/ac/yr for residential and commercial development respectively.

Peak flow – The methodology used to determine the runoff is the Rational Method and modeled using the Hydraflow Hydrograph software (report and summary attached).

Total site peak runoff in cfs (noted in the attached Hydraflow report) is as follows.

	Pre	Post
Q2	93.41	69.65
Q10	117.13	87.33

Nutrient Management

The BMPs provide treatment for drainage areas within the project and also provides the TSS removal of 85%.

O&M Manual

A sample copy of the project's O&M manuals are attached for the Water Quality Pond and Bioretention devices.

Seasonal High-Water Table (SHWT)

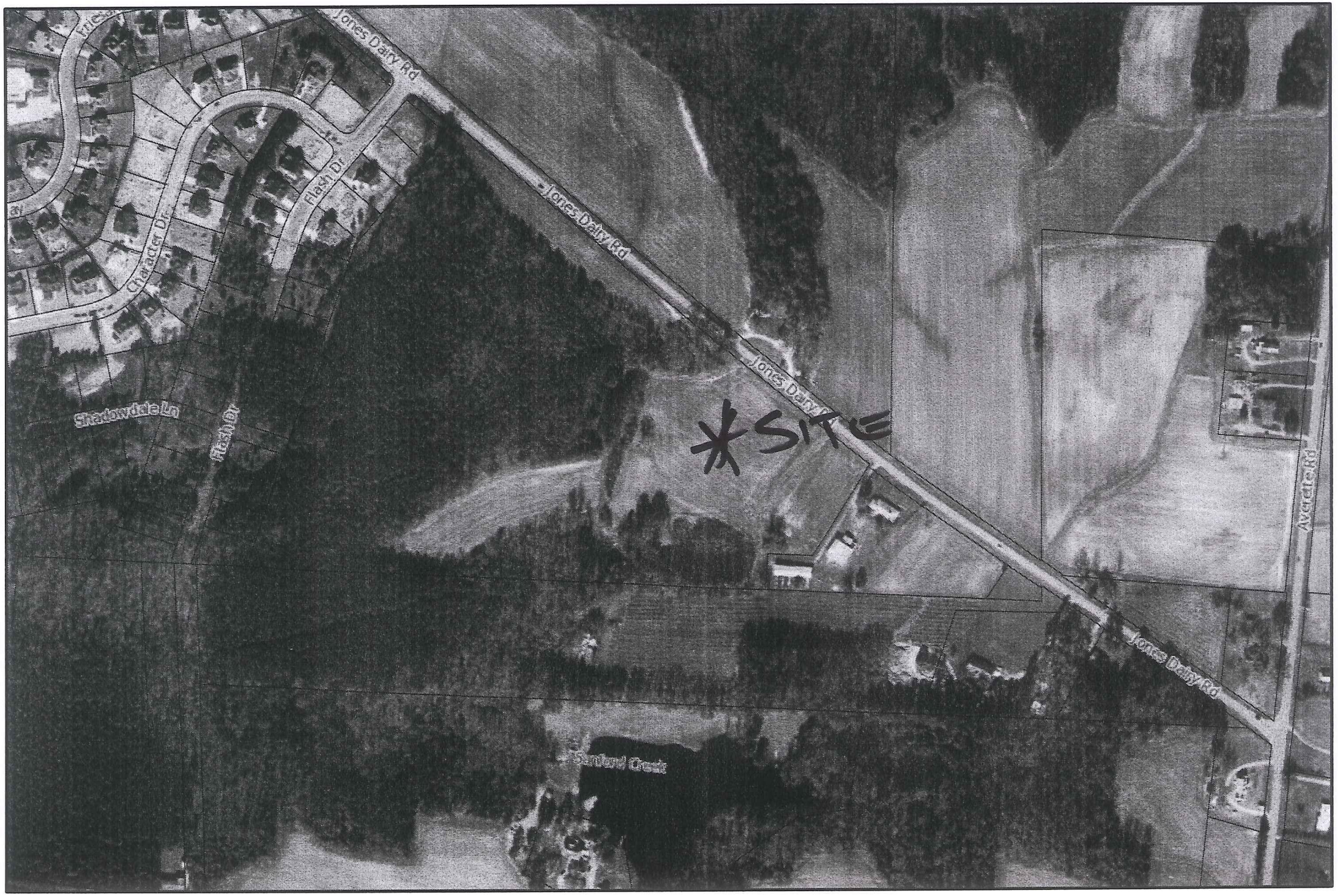
The Town of Rolesville UDO indicates the following.

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

Based on information in the Wake County Soil Survey (attached) the depth to seasonally high-water table is 10 + feet for the Vance and Wake series. The proposed BMPs are located in the Vance Series soil types.

Flood Hazard Area (Soils)

There are Flood Hazard Soils on site and per Wake County UDO Article 14 an analysis is required to determine the high water, or flood, elevation. Although, the FEMA flood map does not indicate the project area is in a 100-year flood zone; an analysis is attached note the 100 year flood elevation within the drainage feature of the project. As shown on the project plan documents a stream with an associated buffer (NRB) is located on site. The 100-year flood review indicates an approximate rise of 1 foot of change due a significant event. As a result, it appears any rise in water elevation would stay within the limits of the noted Neuse River Buffer. The drainage area map and calculations are included with the attachments.



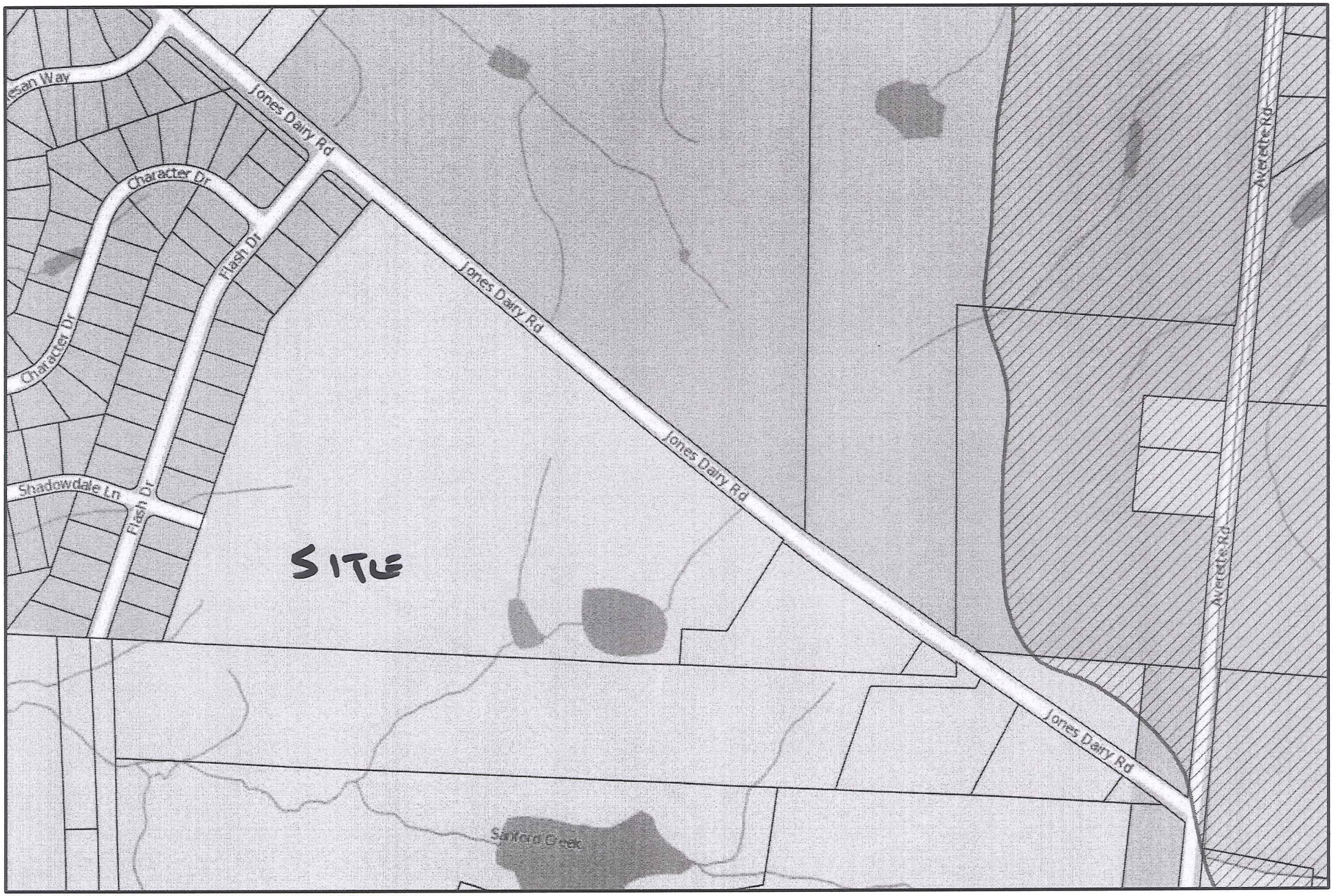
N

0 215 430 860 ft

1 inch = 400 feet

Disclaimer

*iMaps makes every effort to produce and publish the most current and accurate information possible. However, the maps are produced for information purposes, and are **NOT** surveys. No warranties, expressed or implied ,are provided for the data therein, its use,or its interpretation.*



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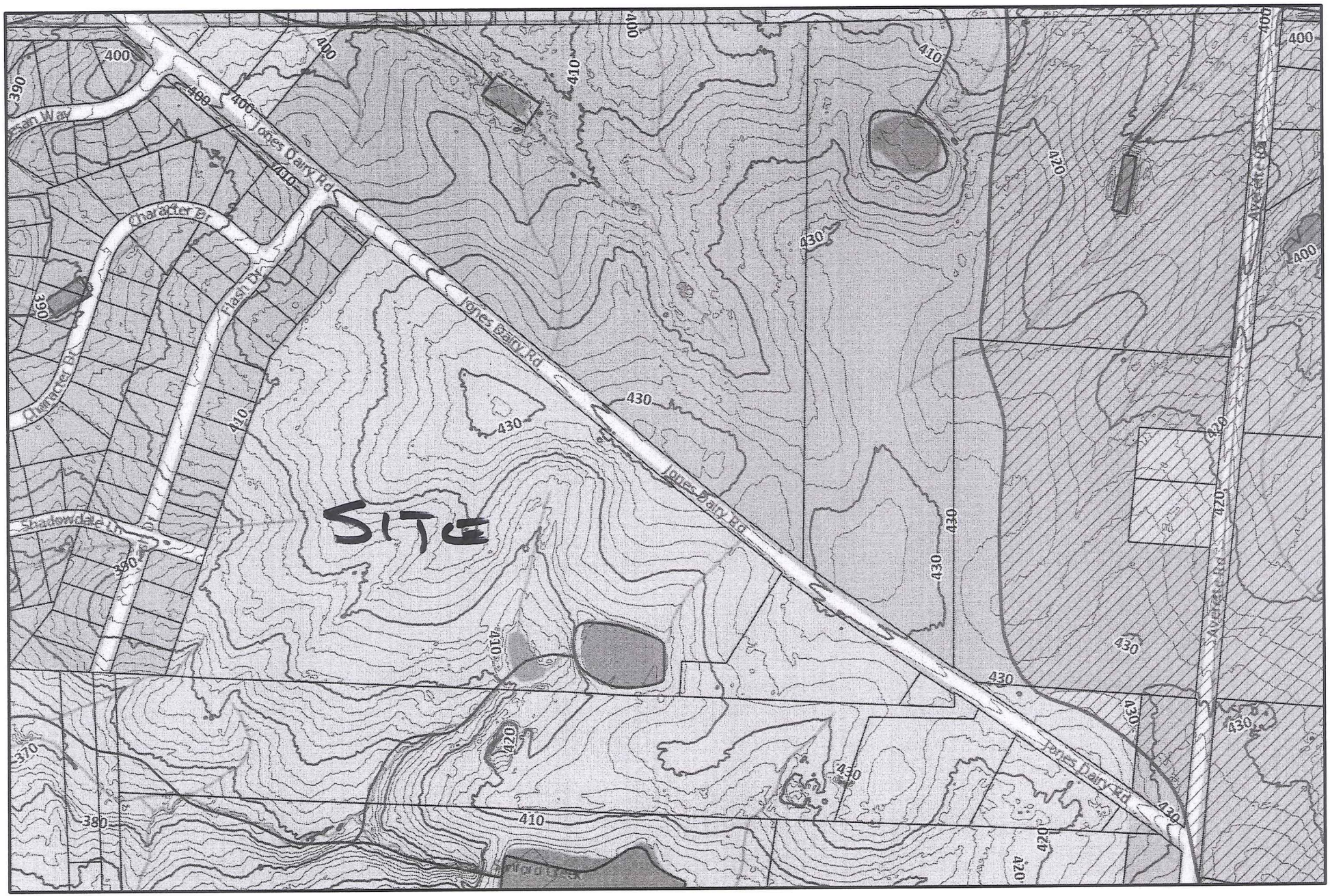

Jones Dairy Preserve - South

N

0 215 430 860 ft

1 inch = 400 feet

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LINA — SHEET NUMBER 15

JONES DAIRY PRESERVE

15

N

* = SITE

NORTH CAROLINA

ROAD CLASSIFICATION

Expressway	Local Connector
Secondary Hwy	Local Road
Ramp	4WD

Interstate Route | US Route | State Route

QUADRANGLE LOCATION

Grissom	Franklinton	Louisburg
Wake Forest	Rolesville	Bunn West
Raleigh East	Knightdale	Zebulon

ADJOINING 7.5' QUADRANGLES

JONES DAIRY PRESERVE

* = SITE

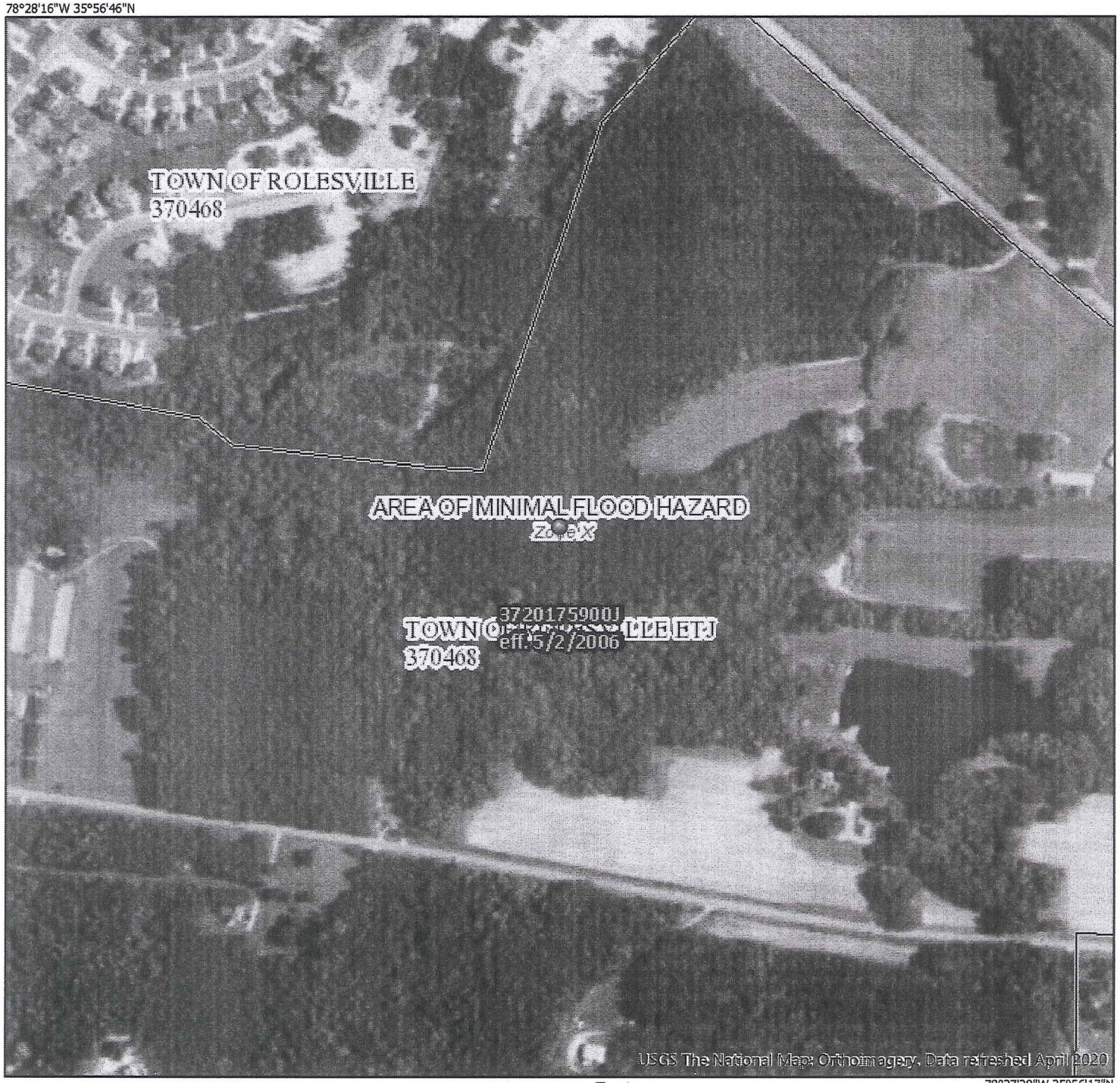
ROLESVILLE, NC

2013

National Flood Hazard Layer FIRMette

FEMA

78°28'16"W 35°56'46"N



78°27'39"W 35°56'17"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) *Zone A, V, A99*
	With BFE or Depth *Zone AE, AO, AH, VE, AR*
	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Area of 1% annual chance flood with average depth less than one foot or with drainag areas of less than one square mile *Zone*
	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
	Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
	Area with Flood Risk due to Levee *Zone D*
OTHER AREAS	NO SCREEN Area of Minimal Flood Hazard *Zone X*
	Effective LOMRs
	Area of Undetermined Flood Hazard *Zone*
GENERAL STRUCTURES	Channel, Culvert, or Storm Sewer
	Levee, Dike, or Floodwall
OTHER FEATURES	20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
	Coastal Transect
	513 Base Flood Elevation Line (BFE)
	Limit of Study
	Jurisdiction Boundary
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
MAP PANELS	Digital Data Available
	No Digital Data Available
	Unmapped

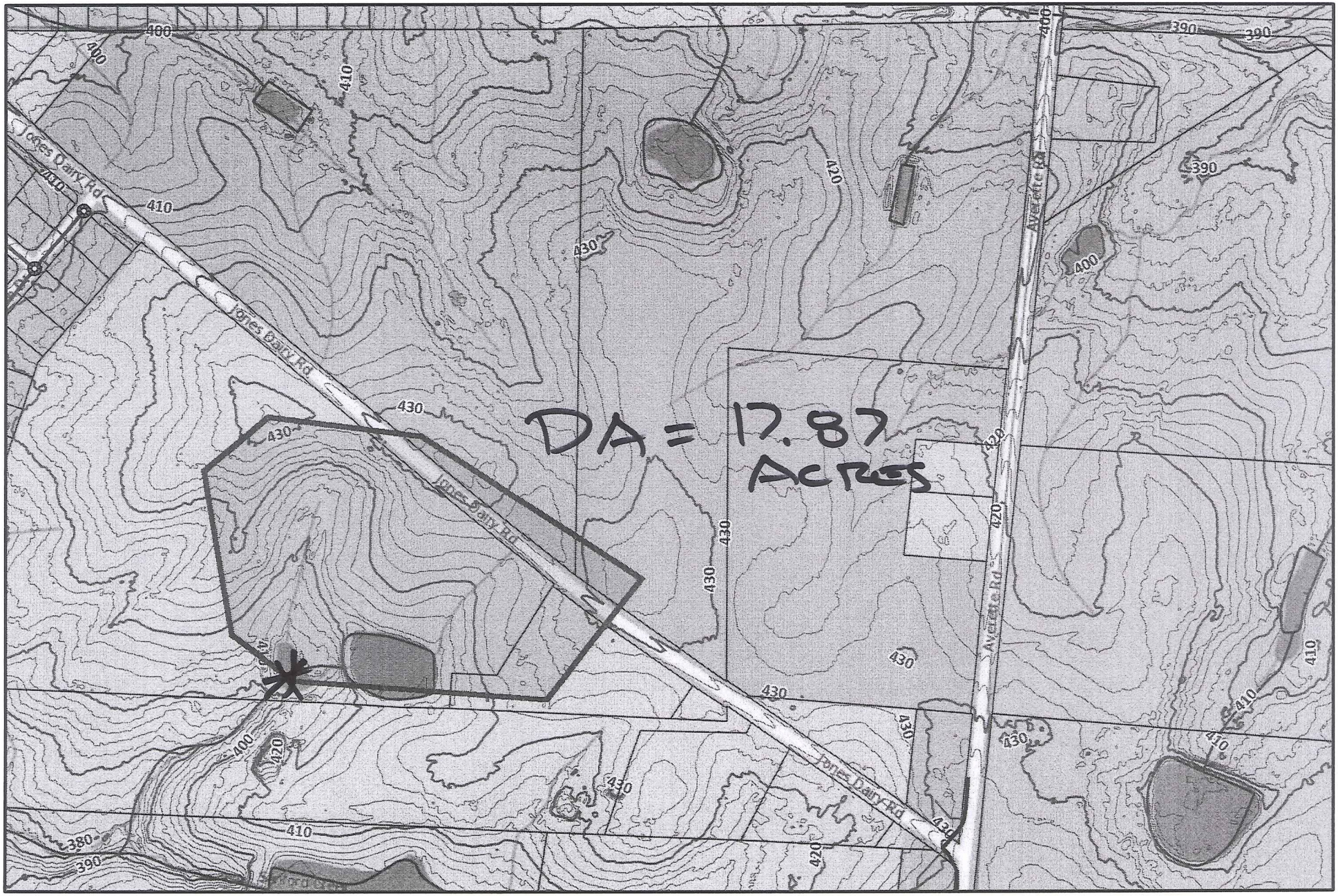
N

The pin displayed on the map is an approximate point selected by the user and does not represe an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/15/2020 at 5:11 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



100 Flood Evaluation

N

0 215 430 860 ft

1 inch = 400 feet

Disclaimer

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JDP - South

MANNING'S EQUATION for OPEN CHANNEL FLOW

Project: J D P - South 100 Year Flood Evaluation Location: Rolesville, NC

By: KPG Date: 8/24/20

Chk By: Date: version 12-2004

Mannings Formula

$Q = (1.486/n)AR_h^{2/3}S^{1/2}$

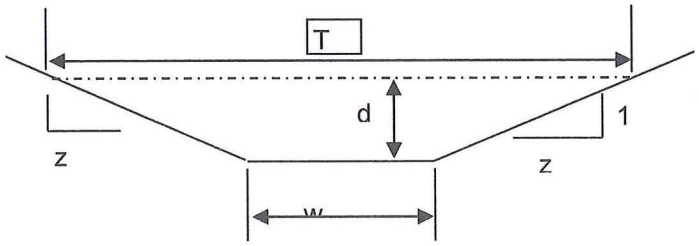
R = A/P

A = cross sectional area

P= wetted perimeter

S = slope of channel

n = Manning's roughness coefficient



$V = (1.49/n)R_h^{2/3}S^{1/2}$

Q = V x A

INPUT

z (sideslope)=	8
z (sideslope)=	8
b (btm width, ft)=	4
d (depth, ft)=	1
S (slope, ft/ft)	0.035
n_{low} =	0.013
n_{high} =	0.013

Clear Data Entry Cells

				Low N		High N			
Depth, ft	Area, sf	Wetted Perimeter, ft	Hydraulic Radius, ft	Velocity, fps	Flow, cfs	Velocity, fps	Flow, cfs		
1	12.00	20.12	0.60	15.1497641	181.797	15.14976	181.797	T =	20
								Dm =	0.600

Sc low = 0.0029 Sc high = 0.0029

.7 Sc	1.3 Sc	.7 Sc	1.3 Sc
0.0021	0.0038	0.0021	0.0038

s_c = critical slope ft / ft

T = top width of the stream

d_m = a/T = mean depth of flow

100 YR FLOOD EVALUATION

- DRAINAGE AREA = 17.87 AC
- I = 8.15 IN (NOAA)
- 'C' = .85

$Q_{100} = CIA = .85 \times 8.15 \times 17.87$

$= 123.8$ CFS

* 100 YR FLOOD ELEVATION APPROX 1' ABOVE ON SITE STREAM BOTTOM AREA CONTAINED WITHIN BUFFER.

Wilkes soils, 20 to 45 percent slopes (WwF).—These soils are on side slopes bordering major drainageways in the uplands. They have a surface layer of yellowish-brown or grayish-brown to dark-brown sandy loam to silt loam 3 to 8 inches thick. Their subsoil ranges from brown or dark brown to gray or yellowish red in color, from very friable to firm in consistence, and from sandy loam to clay loam in texture.

Infiltration is good. Surface runoff is very rapid.

Practically all of the acreage is in forest. Because of the strong slopes and bedrock near the surface, these soils should be kept in forest. (Capability unit VIIe–1, woodland suitability group 12, wildlife suitability group 4)

Wilkes stony soils, 15 to 25 percent slopes (WxE).—The soils of this unit are on side slopes that border major drainageways in the uplands. Their surface layer is yellowish-brown or grayish-brown to dark-brown stony sandy loam 6 to 10 inches thick. Large stones occupy from 1 to 2 percent of the surface. The subsoil ranges from brown or dark brown to gray or yellowish red in color, from very friable to firm in consistence, and from sandy loam to clay loam in texture.

Infiltration is good. Surface runoff is very rapid.

Practically all of the acreage is in forest. Because of the strong slopes and bedrock near the surface, these soils should remain in forest. (Capability unit VIIe–1, woodland suitability group 12, wildlife suitability group 4)

Worsham Series

The Worsham series consists of nearly level and gently sloping, deep, poorly drained soils of Piedmont uplands. These soils occupy small areas throughout the county, at the heads of drainageways, on foot slopes, and in slight depressions. They have formed under forest in translocated material and in material that weathered from most kinds of rocks underlying this area. A seasonally high water table is approximately at the surface.

Natural fertility and the content of organic matter are low, and permeability is moderately slow. The available water capacity is medium, and the shrink-swell potential is moderate. Except in areas that have received lime, these soils are strongly acid. Response is fairly good if suitable applications of lime and fertilizer are made.

The Worsham soils of Wake County are of only minor importance for farming. Some areas have been cleared and are used for pasture or waterways, but most of the acreage is in forest. The areas that have been cleared and have then been allowed to revert to forest are in pines or in mixed pines and hardwoods.

Representative profile of Worsham sandy loam in a wooded area 2 miles southwest of Wendell on county road No. 2358, one-fourth of a mile north on county road No. 1003, and 25 yards east of road:

O1—5 to 2 inches, undecomposed forest litter.

O2—2 inches to 0, dark-brown, decomposed forest litter; part of litter is disintegrated, and part is not disintegrated; many fine and medium, woody roots.

A11—0 to 2 inches, gray (10YR 5/1) sandy loam; weak, medium and coarse, granular structure; very friable when moist; many fine and medium, woody roots; common fine pores; very strongly acid; abrupt, smooth boundary.

A12—2 to 7 inches, gray (10YR 5/1) sandy loam; weak medium, granular structure; very friable when moist common, fine and medium, woody roots; many fin pores; very strongly acid; abrupt, wavy boundary

A2—7 to 11 inches, gray (10YR 6/1) sandy loam; weak medium, granular structure; very friable when moist common, fine, woody roots; common fine pores strongly acid; abrupt, smooth boundary.

B1g—11 to 13 inches, light brownish-gray (10YR 6/2) sandy clay loam; common, medium, prominent, yellowish brown mottles; weak, medium and coarse, subangular blocky structure; firm when moist, slightly sticky and slightly plastic when wet; common, fine, woody roots common fine pores; strongly acid; abrupt, wavy boundary.

B21tg—13 to 18 inches, gray (10YR 6/1) heavy sandy clay loam; common, medium, prominent, strong-brown mottles; weak, medium and coarse, subangular blocky structure; firm when moist, sticky and plastic when wet; few, fine, woody roots; fine pores; thin clay film on ped surfaces; strongly acid; abrupt, wavy boundary.

B22tg—18 to 26 inches, gray (10YR 6/1) heavy sandy clay loam; few, medium, prominent, strong-brown and few, fine, prominent, yellowish-red mottles; weak medium and coarse, subangular blocky structure firm when moist, sticky and plastic when wet; few fine pores; few thin clay films on ped surfaces strongly acid; abrupt, smooth boundary.

B23tg—26 to 38 inches, gray (10YR 6/1) light sandy clay few, medium, prominent, strong-brown and few, fine prominent, yellowish-red mottles; weak, medium, subangular blocky structure; firm when moist, slightly sticky and slightly plastic when wet; few fine pores few thin clay films on ped surfaces; few small pebbles; strongly acid; abrupt, smooth boundary.

B3g—38 to 45 inches +, light-gray (10YR 7/1) sandy loam few, medium, prominent, brownish-yellow mottles massive; friable when moist, slightly sticky and slightly plastic when wet; common fine pores; many fragments of feldspar; strongly acid.

The A horizons range from 8 to 20 inches in total thickness and from gray or very dark gray to grayish brown or brown in color. The B horizons range from 20 to 50 inches in combined thickness and from sandy clay loam or sandy loam to sandy clay in texture. The Bt horizons have a gray color in 10YR and 2.5Y hues. In many places the Bt horizons are mottled with yellowish red to pale yellow. The solum ranges from 24 inches to 45 inches in thickness. Depth to hard rock ranges from 5 to 15 or more feet.

Worsham soils occur with Colfax and Bibb soils. They are more poorly drained than the Colfax soils and have a finer textured subsoil than the Bibb soils.

Worsham sandy loam (0 to 4 percent slopes) (Wy).—This is the only soil of the Worsham series mapped in Wake County. It occurs at the heads of drainageways on foot slopes, and in slight depressions in the uplands. The surface layer is very dark brown or brown sandy loam 8 to 20 inches thick. The subsoil is 24 to 40 inches thick and consists of gray, firm silty clay loam or sandy clay, with common mottles of strong brown to pale yellow.

Infiltration is good, and surface runoff is slow to ponded. Permeability is moderately slow. Where this soil has been drained, it is easy to keep in good tilth, but tillage may be restricted after hard rains.

If this soil is cleared and properly drained, it is suited to corn, soybeans, and pasture. Most of the acreage is in forest, but some of it is cultivated or in pasture. (Capability unit IVw–1, woodland suitability group 2, wildlife suitability group 3)

woodland suitability group 14, wildlife suitability group 3)

Troup Series

The Troup series consists of nearly level or gently sloping, very deep, well-drained soils on Coastal Plain uplands in the southern part of the county. These soils are on broad flats and on smooth, rounded divides where the difference in elevation is about 10 feet between the highest and the lowest points. The water table remains below the solum.

Natural fertility and the content of organic matter are low, permeability is rapid, and the available water capacity is very low. The shrink-swell potential is low. Except in areas that have received lime, these soils are strongly acid. Response is moderately good if suitable applications of lime and fertilizer are made.

Though most of the acreage is cultivated, these soils are not important for farming. In Wake County they are mapped only with the Wagram soils.

Representative profile of a Troup sand in a cultivated field 2½ miles south-southeast of Varina on N.C. Highway No. 42, one-eighth of a mile north on a farm road, and 10 yards west of that road:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) sand; single grain; loose when moist or dry; many, fine, fibrous roots; many fine pores; slightly acid; abrupt, wavy boundary.

A21—8 to 27 inches, light yellowish-brown (2.5Y 6/4) sand; single grain; loose when moist or dry; few, fine, fibrous roots; few fine pores; slightly acid; gradual, smooth boundary.

A22—27 to 49 inches, light yellowish-brown (2.5Y 6/4) sand; common, medium, faint, pale-yellow mottles; single grain; loose when moist or dry; few, fine, fibrous roots; few fine pores; strongly acid; clear, smooth boundary.

B1—49 to 58 inches, yellowish-brown (10YR 5/6) sandy loam; common, coarse, distinct, strong-brown (7.5YR 5/6) mottles; weak, fine and medium, subangular blocky structure; friable when moist, sticky and slightly plastic when wet; few, fine, fibrous roots; few fine pores; strongly acid; clear, smooth boundary.

B21t—58 to 64 inches, yellowish-brown (10YR 5/6) sandy clay loam; common, medium, prominent, yellowish-red and common, medium, distinct, strong-brown mottles; weak, fine and medium, subangular blocky structure; friable when moist, sticky and slightly plastic when wet; few fine pores; thick coatings on sand grains; few small quartz pebbles; strongly acid; abrupt, smooth boundary.

B22t—64 to 74 inches, mottled brownish-yellow (10YR 6/8), strong-brown (7.5YR 5/6), and yellowish-red (5YR 5/8) clay loam; moderate, medium, subangular blocky structure; friable when moist, sticky and slightly plastic when wet; few fine pores; thick coatings on sand grains; few clay bridges; few small quartz pebbles; red (2.5YR 4/6), brittle sesquioxide nodules; strongly acid; clear, smooth boundary.

B3—74 to 83 inches, strong-brown (7.5YR 5/6) sandy clay loam; few, fine, prominent, red mottles; weak, fine and medium, subangular blocky structure; friable when moist, slightly sticky and slightly plastic when wet; few fine pores; strongly acid; gradual, smooth boundary.

C—83 to 88 inches +, mottled reddish-yellow (7.5YR 6/8) and yellowish-red (5YR 5/8) loamy sand; massive; brittle and friable when moist; few, thin, discontinuous iron coatings on sand grains; medium acid.

The A horizons range from 40 to 60 inches in thickness and from dark grayish brown to light yellowish brown in color. The B horizons range from 30 to more than 72 inches in combined thickness and from sandy loam to sandy clay loam in texture. The color of the B horizons ranges from yellowish brown to strong brown in 10YR and 7.5YR hues, and generally the B horizons are mottled with yellowish red and strong brown. The combined thickness of the A horizons and B horizons ranges from 60 to more than 80 inches. Depth to hard rock is generally more than 20 feet.

Troup soils occur with Wagram soils. They have a thicker surface layer, however, than the Wagram soils.

Vance Series

The Vance series consists of gently sloping and sloping, moderately deep, well-drained soils on Piedmont uplands that are mostly in the northeastern and eastern parts of the county. These soils are on side slopes and on rounded divides where the difference in elevation is about 20 feet between the highest and the lowest points. They have formed under forest in material that weathered from granite, gneiss, and other acidic rocks. The water table remains below the solum.

Natural fertility is medium, and the content of organic matter is low. Permeability is slow, and the available water capacity is medium. The shrink-swell potential is moderate. Except in areas that have received lime, these soils are medium acid to strongly acid. Response is good if suitable applications of lime and fertilizer are made.

The Vance soils of Wake County are moderately important for farming. Most of the acreage is cultivated or in pasture, but a small acreage is in forest.

Representative profile of a Vance sandy loam in a cultivated field 3.5 miles west of the Wakefield Church, 600 feet northeast on a farm road, and 15 feet south of the farm road:

Ap—0 to 5 inches, grayish-brown (10YR 5/2) sandy loam; weak, medium and coarse, granular structure; very friable when moist; many fine, fibrous roots; few fine pores; medium acid; abrupt, smooth boundary.

B21t—5 to 14 inches, yellowish-brown (10YR 5/8) clay; few, fine, prominent, red mottles; weak, coarse, prismatic primary structure breaking to moderate, coarse, angular blocky structure; very firm when moist, sticky and plastic when wet; common, fine, fibrous roots in cracks between the peds; common fine pores; medium clay films on ped surfaces; strongly acid; clear, smooth boundary.

B22t—14 to 23 inches, strong-brown (7.5YR 5/6) clay; common, fine, prominent, red mottles; moderate, medium, angular blocky structure; very firm when moist, sticky and plastic when wet; few, fine, fibrous roots in cracks between the peds; few fine pores; medium clay films on ped surfaces; strongly acid; clear, wavy boundary.

B3—23 to 29 inches, yellowish-brown (10YR 5/8) clay; many, medium, prominent, red mottles; moderate, very fine and fine, angular blocky structure; firm when moist, sticky and plastic when wet; few, fine, fibrous roots in cracks; many fine pores; thin clay films in cracks; common particles of weatherable material from the C horizon; strongly acid; abrupt, irregular boundary.

C—29 to 35 inches +, mottled strong-brown and yellowish-red weathered granite or gneiss that has a texture of clay loam; massive; friable when moist; strongly acid. This layer contains common pieces of weathered feldspar.

The Ap horizon ranges from 4 to 15 inches in thickness and from grayish brown to yellowish brown in color. The B horizons range from 8 inches to 30 inches in total thickness and from clay to sandy clay in texture. The color of the Bt horizons ranges from yellowish brown to yellowish red of 10YR

and 5YR hues, and those horizons are mottled with brown and red. The combined thickness of the A horizon and B horizons ranges from 20 inches to 40 inches. Depth to hard rock is generally more than 4 feet and is commonly more than 10 feet.

Vance soils occur with Appling, Wedowee, Enon, and Helena soils. They are firmer when moist and are more plastic when wet than are the Appling and Wedowee soils. Vance soils are more acid and less brownish than the Enon soils and are better drained than the Helena soils.

Vance sandy loam, 2 to 6 percent slopes (VaB).—This soil is on smooth interstream divides in the uplands. The surface layer is grayish-brown to yellowish-brown sandy loam 7 to 15 inches thick. The subsoil is 8 to 30 inches thick and consists of yellowish-brown to yellowish-red, very firm clay to sandy clay, with common mottles of red (fig. 9).

Infiltration is good, but permeability is slow and surface runoff is medium. The hazard of erosion is moderate. This soil is easy to keep in good tilth, but tillage is sometimes delayed after heavy rains because of the slowly permeable subsoil.

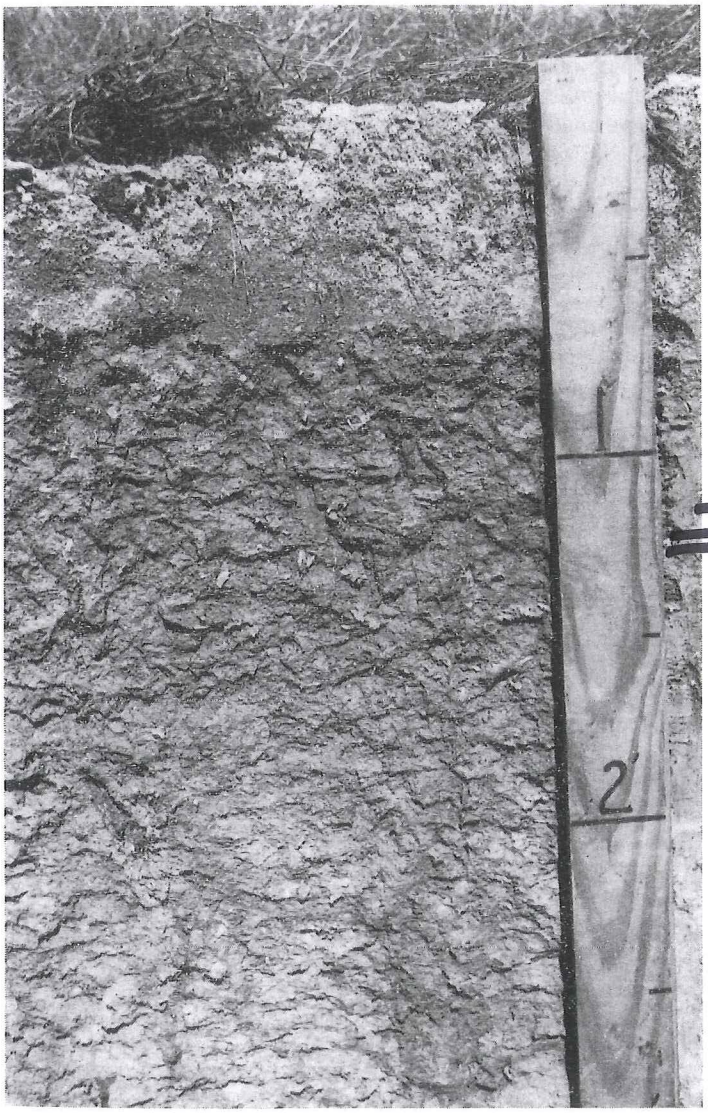


Figure 9.—**Profile of a Vance sandy loam. In this soil the subsoil is clay that is very firm when moist and very plastic when wet.**

About two-thirds of the acreage is cultivated or in pasture, and the rest is in forest. This soil is well suited to most of the locally grown crops, but the cultivated areas are used chiefly for row crops. Practices that effectively control runoff and erosion are needed in the cultivated areas. (Capability unit IIe–3, woodland suitability group 11, wildlife suitability group 1)

Vance sandy loam, 2 to 6 percent slopes, eroded (VaB2).—This soil is on smooth interstream divides in the uplands. The surface layer is 4 to 7 inches thick. The subsoil is 8 to 30 inches thick and consists of yellowish-brown to yellowish-red, very firm clay to sandy clay that has common mottles of red.

Included with this soil in mapping were some severely eroded spots where the subsoil is exposed. These areas make up from 5 to 25 percent of the acreage in the mapping unit.

Infiltration is fair, but permeability is slow and surface runoff is medium. The hazard of further erosion is moderate. This soil is difficult to keep in good tilth, and tillage is restricted after heavy rains because of the slowly permeable subsoil. A crust forms on the severely eroded spots after hard rains, and clods form if those areas are worked when wet. The crust and the clods interfere with germination. As a result, stands of crops are poor and replanting of those areas may be necessary. An even stand of tobacco is hard to obtain. Plants in an uneven stand mature at different times, which makes harvesting and curing difficult and reduces the quality of the tobacco.

About two-thirds of the acreage is cultivated or in pasture, and the rest is in forest. This soil is well suited to most of the locally grown crops, but the cultivated areas are used chiefly for row crops. Practices that effectively control runoff and erosion are needed in the cultivated areas. (Capability unit IIe–3, woodland suitability group 11, wildlife suitability group 1)

Vance sandy loam, 6 to 10 percent slopes, eroded (VaC2).—This soil is on narrow side slopes in the uplands. Where erosion is moderate, the surface layer ranges from brown to yellowish brown in color, from sandy loam to sandy clay in texture, and from 4 to 6 inches in thickness. Where erosion is only slight, the surface layer is grayish-brown to yellowish-brown sandy loam 6 to 12 inches thick. The subsoil is 8 to 30 inches thick and consists of yellowish-brown to yellowish-red, very firm clay to sandy clay, with common mottles of red. In some places some severely eroded spots where the subsoil is exposed were included with this soil in mapping.

Infiltration is fair to good, but permeability is slow and surface runoff is rapid. The hazard of further erosion is severe. Where this soil is only slightly eroded, it is easy to keep in good tilth. Where it is moderately eroded, it is difficult to keep in good tilth. Because of the slowly permeable subsoil, tillage is restricted after heavy rains. A crust forms on the severely eroded spots after hard rains, and clods form if those areas are worked when wet. The crust and the clods interfere with germination. As a result, stands of crops are poor and replanting of those areas is sometimes necessary. An even stand of tobacco is hard to obtain. Plants in an uneven stand

Infiltration is good, and surface runoff is slow to ponded. If this soil has been drained, it is easy to keep in good tilth. Because of a slowly permeable subsoil, however, tillage can be performed within only a fairly narrow range of moisture content.

Most of the acreage is in forest, but a small acreage is in pasture or is cultivated. Where this soil is properly drained, it is fairly well suited to pasture, hay, and some row crops. Wetness and the slowly permeable subsoil are the main limitations to use for crops. Drainage of this soil is difficult. Nevertheless, if cultivated crops are to be grown, a complete system of surface and subsurface drainage is needed. (Capability unit IIIw–2, woodland suitability group 4, wildlife suitability group 2)

Wake Series

The Wake series consists of gently sloping to moderately steep, somewhat excessively drained soils that are very shallow over hard rock. These soils occupy rather large areas on Piedmont uplands, primarily in the northeastern part of the county. They are on side slopes and on rounded divides where the difference in elevation is about 50 feet between the highest and the lowest points. The soils have formed under forest in material that weathered from granite, gneiss, and other acidic rocks. The water table remains below the solum.

Natural fertility and the content of organic matter are low. Permeability is moderately rapid, the available water capacity is very low, and the shrink-swell potential is low. Except in areas that have received lime, these soils are strongly acid. Response is fairly good if suitable applications of lime and fertilizer are made.

In this county Wake soils are not important for farming. Most of the acreage is in forest.

Representative profile of a Wake gravelly loamy sand, 1.4 miles east of Wake Crossroads on county road No. 2224, 0.15 of a mile south on a private road, in a small cultivated field south of the road:

Ap—0 to 6 inches, brown (10YR 5/3) gravelly loamy sand; single grain; loose when moist or dry; contains many coarse quartz sand particles and many feldspar particles; strongly acid; abrupt, wavy boundary.

C—6 to 15 inches, yellow (10YR 7/6) loamy sand; single grain; loose when moist or dry; contains common fine pebbles and many feldspar particles; strongly acid; clear, wavy boundary.

R—15 inches +, light-colored granite that is high in content of quartz.

The color of the surface layer ranges from brown or very dark grayish brown to light yellowish brown. The color of the C horizon ranges from yellow to yellowish brown. In places the C horizon contains particles of unweathered feldspar, mica, and other dark minerals, as well as particles of quartz. In places the texture throughout the profile is gravelly loamy sand instead of loamy sand. Depth to hard rock is only 20 inches or less.

Wake soils occur with Louisburg soils. They are shallower over bedrock than are the Louisburg soils.

Wake soils, 2 to 10 percent slopes (WkC).—These soils are on small ridges and side slopes in the uplands. They have a surface layer of very dark grayish-brown to light yellowish-brown loamy sand or gravelly loamy sand 2 to 10 inches thick. Beneath the surface layer is yellow to yellowish-brown loamy sand 0 to 14 inches thick.

Infiltration is good, and surface runoff is medium to rapid. The hazard of erosion is very severe. These soils are easy to keep in good tilth and can be worked throughout a wide range of moisture content. The coarse texture and the bedrock near the surface make the soils very droughty during dry seasons. Leaching of mobile plant nutrients takes place during rainy seasons.

Most of the acreage is in forest, but some of it is cultivated or in pasture. These soils are suited to only a few of the locally grown crops. Very intensive practices that effectively control runoff and erosion are needed in the cultivated areas. (Capability unit IVe–3, woodland suitability group 12, wildlife suitability group 4)

Wake soils, 10 to 25 percent slopes (WkE).—These soils are on side slopes bordering drainageways in the uplands. Their surface layer is very dark grayish-brown to light yellowish-brown loamy sand or gravelly loamy sand 2 to 10 inches thick. It is underlain by yellow to yellowish-brown loamy sand 0 to 10 inches thick.

Infiltration is good. Surface runoff is very rapid.

Because of bedrock near the surface and slopes, these soils should be kept in forest. They are not suitable for cultivation. (Capability unit VIIe–1, woodland suitability group 12, wildlife suitability group 4)

Wedowee Series

The Wedowee series consists of gently sloping to moderately steep soils that are deep and well drained. These soils are on Piedmont uplands, mostly in the northeastern part of the county, but some scattered areas are in other parts. They are on side slopes and on rounded divides where the difference in elevation is about 50 feet between the highest and the lowest points. The soils have formed under forest in material that weathered from granite, gneiss, and other acidic rocks. The water table remains below the solum.

Natural fertility and the content of organic matter are low, permeability is moderate, and the available water capacity is medium. The shrink-swell potential is moderate. Except in areas that have received lime, these soils are strongly acid. Response is good if suitable applications of lime and fertilizer are made.

The Wedowee soils of Wake County are important for farming. Much of the acreage is cultivated or in pasture, but part of it is in forest or in other uses.

Representative profile of a Wedowee sandy loam in a cultivated field one-half mile north and one-fourth mile west of the Lockhart School on a paved road, 1 mile north on a gravel road, and 10 yards east of road:

Ap—0 to 7 inches, brown (10YR 5/3) sandy loam; weak, fine and medium, granular structure; very friable when moist; many fine, fibrous roots; many fine pores; few fine mica flakes; medium acid; abrupt, wavy boundary.

B21t—7 to 12 inches, strong-brown (7.5YR 5/6) clay loam; weak, fine and medium, subangular blocky structure; firm when moist, sticky and slightly plastic when wet; common, fine, fibrous roots; common fine pores; thick clay films on most ped surfaces; few fine mica flakes; strongly acid; abrupt, smooth boundary.

B22t—12 to 18 inches, yellowish-red (5YR 5/6) clay loam; common, medium, faint, reddish-yellow mottles; moderate, medium and fine, subangular blocky structure; friable when moist, sticky and slightly plastic when

TABLE 5.—*Estimated properties*

Soil series and map symbol	Depth to bedrock	Depth to seasonally high water table	Depth from surface (typical profile)	Classification: Dominant USDA texture
	Feet	*Feet*	*Inches*	
Vance (VaB, VaB2, VaC2)	4–10+	10+	0–5	Sandy loam
			5–29	Clay
			29–35	Clay loam
Wagram (WaA, WaB, WaC, WgA) (For properties of the Troup soil in WgA, refer to the Troup series.)	20+	10+	0–25	Loamy sand or sand
			25–65	Sandy clay loam
			65–100	Clay
Wahee (Wh)	5–15+	1½	0–14	Fine sandy loam, sandy clay loam
			14–36	Clay
			36–45	Fine sandy clay loam
Wake (WkC, WkE)	<20 inches	10+	0–15	Gravelly loamy sand
			15	Hard rock.
Wedowee (WmB, WmB2, WmC, WmC2, WmD2, WmE).	4– 6+	10+	0–7	Sandy loam
			7–24	Clay loam to sandy clay loam
			24–40	Sandy loam
Wehadkee (Wn, Wo) (For properties of the Bibb soil in Wo, refer to the Bibb series.)	3–15+	0	0– 6	Silt loam
			6–30	Fine sandy clay loam
			30–40	Sandy loam
White Store: (WsB, WsB2, WsC, WsC2, WsE, WtB)	4–8+	(1)	0–6	Sandy loam
			6–31	Clay
			31–35	Sandy clay to clay loam
(WvD3)		10+	0–5	Clay loam
			5–27	Clay
			27–38	Sandy clay to clay loam
Wilkes: (WwC, WwE, WwF)	2–4+	(1)	0–8	Sandy loam
			8–19	Clay to clay loam
			19–38	Silt loam
			38	Hard rock.
(WxE)		10+	0–8	Stony sandy loam
			8–15	Clay to clay loam
			15–24	Silt loam
			24	Hard rock.
Worsham (Wy)	5–15+	0	0–11	Sandy loam
			11–38	Sandy clay loam
			38–45	Sandy loam

[1] Has perched water table for short periods because subsoil is very slowly permeable.

Some engineers prefer to use the Unified Soil Classification System (*17*). In this system, soil materials are identified as coarse grained (eight classes), fine grained (six classes), or highly organic.

The classification of a soil by either the AASHO or the Unified system identifies the soil material with regard to gradation and plasticity. The classification permits the engineer to appraise the soil quickly by comparing it with other soils that have the same classification.

Soil test data

Samples of nine profiles, representing six soil series, were tested by the North Carolina State Highway Commission so that the soils could be evaluated for engineering purposes. The test data are given in table 4, and they indicate the characteristics of the soil at the specified location. The physical characteristics of each soil at other locations may vary somewhat from those of the soil sampled. All samples were obtained at a depth of less than 10 feet. The data, therefore, probably are not adequate for estimating the characteristics of soil materials in strongly sloping or steep areas, where deep cuts are required.

The engineering classifications in table 4 are based on data obtained by mechanical analyses and by tests made to determine liquid limit and plastic limit. Mechanical analyses were made by combined sieve and hydrometer methods.

The tests to determine plastic limit and liquid limit measure the effect of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a semisolid to a plastic state. As the moisture content is further increased, the material changes from a

NOAA Atlas 14, Volume 2, Version 3
Location name: Wake Forest, North Carolina, USA*
Latitude: 35.945°, Longitude: -78.4375°
Elevation: 364.52 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.403 (0.370-0.441)	0.468 (0.430-0.511)	0.533 (0.489-0.582)	0.599 (0.548-0.654)	0.666 (0.606-0.725)	0.719 (0.652-0.783)	0.766 (0.690-0.834)	0.808 (0.724-0.881)	0.854 (0.759-0.933)	0.896 (0.790-0.981)
10-min	0.644 (0.591-0.705)	0.749 (0.687-0.818)	0.854 (0.783-0.931)	0.959 (0.877-1.05)	1.06 (0.966-1.16)	1.15 (1.04-1.25)	1.22 (1.10-1.33)	1.28 (1.15-1.40)	1.35 (1.20-1.48)	1.41 (1.24-1.54)
15-min	0.806 (0.739-0.881)	0.942 (0.864-1.03)	1.08 (0.990-1.18)	1.21 (1.11-1.32)	1.35 (1.23-1.47)	1.45 (1.31-1.58)	1.54 (1.39-1.68)	1.62 (1.45-1.76)	1.70 (1.51-1.86)	1.77 (1.56-1.94)
30-min	1.10 (1.01-1.21)	1.30 (1.19-1.42)	1.54 (1.41-1.67)	1.76 (1.61-1.92)	1.99 (1.81-2.17)	2.18 (1.98-2.38)	2.36 (2.12-2.57)	2.52 (2.25-2.74)	2.71 (2.40-2.96)	2.87 (2.53-3.14)
60-min	1.38 (1.26-1.51)	1.63 (1.50-1.78)	1.97 (1.80-2.15)	2.29 (2.09-2.50)	2.65 (2.42-2.89)	2.96 (2.68-3.22)	3.25 (2.93-3.54)	3.53 (3.16-3.85)	3.88 (3.45-4.24)	4.19 (3.69-4.58)
2-hr	1.61 (1.47-1.78)	1.92 (1.75-2.10)	2.34 (2.13-2.56)	2.75 (2.49-3.01)	3.23 (2.92-3.53)	3.66 (3.29-4.00)	4.07 (3.63-4.45)	4.50 (3.99-4.91)	5.05 (4.43-5.51)	5.54 (4.82-6.06)
3-hr	1.71 (1.55-1.89)	2.04 (1.86-2.24)	2.49 (2.26-2.74)	2.95 (2.67-3.24)	3.50 (3.16-3.85)	4.00 (3.58-4.39)	4.49 (3.99-4.93)	5.01 (4.42-5.49)	5.70 (4.97-6.25)	6.34 (5.47-6.97)
6-hr	2.05 (1.87-2.27)	2.44 (2.23-2.69)	2.99 (2.72-3.29)	3.54 (3.22-3.89)	4.23 (3.82-4.63)	4.85 (4.35-5.31)	5.47 (4.87-5.98)	6.13 (5.40-6.69)	7.02 (6.11-7.66)	7.85 (6.73-8.58)
12-hr	2.42 (2.21-2.66)	2.88 (2.64-3.16)	3.54 (3.24-3.88)	4.22 (3.86-4.62)	5.07 (4.60-5.54)	5.86 (5.27-6.37)	6.65 (5.92-7.23)	7.51 (6.61-8.16)	8.69 (7.53-9.44)	9.79 (8.35-10.6)
24-hr	2.86 (2.66-3.08)	3.46 (3.22-3.73)	4.34 (4.04-4.68)	5.05 (4.68-5.43)	6.01 (5.56-6.46)	6.78 (6.25-7.29)	7.57 (6.96-8.15)	8.39 (7.69-9.04)	9.53 (8.68-10.3)	10.4 (9.46-11.3)
2-day	3.32 (3.09-3.57)	4.00 (3.73-4.30)	4.98 (4.64-5.36)	5.76 (5.35-6.20)	6.82 (6.32-7.34)	7.66 (7.08-8.24)	8.53 (7.85-9.18)	9.43 (8.64-10.2)	10.7 (9.71-11.5)	11.6 (10.5-12.6)
3-day	3.52 (3.28-3.77)	4.23 (3.95-4.54)	5.25 (4.89-5.63)	6.05 (5.63-6.49)	7.15 (6.64-7.67)	8.03 (7.43-8.61)	8.93 (8.23-9.59)	9.87 (9.05-10.6)	11.1 (10.2-12.0)	12.2 (11.0-13.1)
4-day	3.72 (3.48-3.98)	4.46 (4.17-4.77)	5.52 (5.15-5.89)	6.35 (5.92-6.78)	7.49 (6.95-8.00)	8.40 (7.78-8.98)	9.34 (8.61-9.99)	10.3 (9.47-11.0)	11.6 (10.6-12.5)	12.7 (11.5-13.6)
7-day	4.32 (4.04-4.61)	5.15 (4.83-5.50)	6.28 (5.88-6.71)	7.19 (6.71-7.67)	8.42 (7.84-8.99)	9.41 (8.74-10.0)	10.4 (9.64-11.1)	11.5 (10.6-12.3)	12.9 (11.8-13.8)	14.0 (12.8-15.1)
10-day	4.91 (4.61-5.24)	5.85 (5.48-6.23)	7.04 (6.60-7.50)	7.98 (7.47-8.50)	9.25 (8.63-9.86)	10.3 (9.54-10.9)	11.3 (10.5-12.0)	12.3 (11.4-13.2)	13.7 (12.6-14.7)	14.8 (13.6-15.9)
20-day	6.59 (6.20-7.01)	7.79 (7.33-8.28)	9.22 (8.67-9.80)	10.4 (9.73-11.0)	11.9 (11.1-12.6)	13.1 (12.2-13.9)	14.3 (13.3-15.3)	15.6 (14.5-16.6)	17.3 (16.0-18.5)	18.6 (17.1-19.9)
30-day	8.19 (7.73-8.68)	9.63 (9.09-10.2)	11.2 (10.6-11.9)	12.5 (11.7-13.2)	14.1 (13.2-15.0)	15.3 (14.4-16.3)	16.6 (15.5-17.7)	17.9 (16.7-19.0)	19.5 (18.1-20.8)	20.8 (19.3-22.2)
45-day	10.4 (9.90-11.0)	12.2 (11.6-12.9)	14.0 (13.3-14.8)	15.4 (14.6-16.2)	17.2 (16.3-18.1)	18.6 (17.5-19.6)	19.9 (18.7-21.0)	21.2 (19.9-22.5)	23.0 (21.5-24.4)	24.3 (22.7-25.8)
60-day	12.5 (11.9-13.1)	14.6 (13.9-15.4)	16.6 (15.7-17.4)	18.1 (17.1-19.0)	20.0 (18.9-21.0)	21.4 (20.3-22.6)	22.8 (21.6-24.1)	24.2 (22.8-25.5)	26.0 (24.4-27.5)	27.3 (25.6-28.9)

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

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

2.2.2 Runoff Coefficient

The runoff coefficient (C) is the variable of the rational method least susceptible to precise determination and requires judgment and understanding on the part of the design engineer. While engineering judgment will always be required in the selection of runoff coefficients, typical coefficients represent the integrated effects of many drainage basin parameters. Table 2.2 gives the recommended runoff coefficients for the rational method.

Table 2.2 Recommended Runoff Coefficient Values

(Sources: North Carolina Erosion and Sediment Control Planning and Design Manual and The City of Raleigh's Storm Drainage Design Manual, 1989)

Description of Area	Runoff Coefficient, C
Woodlands	0.20 - .025
Parks, cemeteries	0.25
Playgrounds	0.35
Lawns:	
Sandy soil, flat, 2%	0.10
Sandy soil, average, 2 - 7%	0.15
Sandy soil, steep, > 7%	0.20
Clay soil, flat, 2%	0.17
Clay soil, average, 2 - 7%	0.22
Clay soil, steep, > 7%	0.35
Graded or no plant cover:	
Sandy soil, flat, 0 - 5%	0.30
Sandy soil, flat, 5 - 10%	0.40
Clayey soil, flat, 0 - 5%	0.50
Clayey soil, average, 5 - 10%	0.60
Residential:	
Single-family (R - 4)	0.50
Single-family (R - 6)	0.55
Multi-family (R - 10)	0.60
Multi-family (R - 20)	0.70
Multi-family (R - 30)	0.75
Business:	
O & I (I, II, III)	0.85
I1 & I2	0.85 – 0.95
Shopping Centers	0.85 – 0.95
Streets:	
Gravel areas	0.50
Drives, walks, and roofs	0.95
Asphalt and Concrete	0.95 – 1.00

KELLER ENVIRONMENTAL
ENVIRONMENTAL CONSULTANTS

August 25, 2020

Glenn Hartman
Managing Partner
Jones Dairy Development LLC
5711 Six Forks Rd
Suite 200
Raleigh, NC 27609

Re: Jones Dairy Rd South
Rolesville, NC
Wetland and Stream Jurisdictional Assessment

Dear Glenn:

Thank you for allowing Keller Environmental (KE) to provide assistance for this important project. This work is associated with the proposed residential development on the attached project map. The assessment area is located near 1512 Jones Dairy Rd, Rolesville, NC 27571. The purpose of this report is to address the following environmental concerns for the subject tract.

I. Background

The approximately 80-acre site is located near 1512 Jones Dairy Rd, Rolesville, NC 27571. Based on the United States Geological Survey (USGS) Topographic Map, unnamed tributaries to Sanford Creek are located on the site. The western side of the site is predominately a mature mixed hardwood-pine forest. Tobacco is being farmed on the eastern side of the site.

Wetlands are defined by the United States Army Corps of Engineers (COE) and the United States Environmental Protection Agency (EPA) as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances, do support a prevalence of vegetation typically adapted for life in saturated soil conditions." In order for an area to be classified as wetland, hydrophytic vegetation, hydric soils and wetland hydrology indicators must be present.

II. Literature Review

Initially, an off-site wetland and stream investigation was undertaken using the following secondary source information identify high probability jurisdictional wetland areas, watercourses, and non-tidal wetlands of special State concern.

- USGS 7.5 minute topographic mapping;
- NRCS Wake County, North Carolina Soil Survey;
- Wake County GIS maps;
- Google Earth Aerials;

The USGS Topographic Map, Rolesville, NC Quadrangle (Figure 1) depicts unnamed tributaries to Sanford Creek are located on the site. The NRCS Soil Survey of Wake County indicates that soils on the site have been mapped as follows.

Map Unit Symbol	Map Unit Name	Location	Slope %	Hydric Inclusions	Drainage Classification
LoC	Louisburg loamy sand	Upland side slopes	6-10	no	Somewhat Excessively
VaB	Vance sandy loam	Upland smooth interstream divides	2-6	no	Well
VaB2	Vance sandy loam eroded	Upland smooth interstream divides	2-6	no	Well
VaC2	Vance sandy loam eroded	Upland narrow side slopes	6-10	no	Well
WkC	Wake soil	Upland small ridges & side slopes	2-10	no	Somewhat Excessively
Wy	Worsham sandy loam	Heads of drainageways, Depressions	0-4	yes	Poor

III. Site Reconnaissance

Jurisdictional Waters of the US – There is one jurisdictional (JD) waterway on the subject tract subject to the Clean Water Act. It is depicted on the attached February 4, 2019 Google Aerial Stream Map. Confirmation of the potential jurisdictional areas occurred at the December 18, 2015, August 16, 2016 and August 2, 2018 site meetings. They include the following.

Central stream- small tributary that starts at 35.9427; -78.4625 and drains southwest. It confluences with a perennial stream off-site. This stream has protected riparian buffer areas that begin at the stream bank and extend 50-feet on both sides of the stream.

Removed pond- There was an agricultural pond immediately upstream of the jurisdictional stream start. It was permanently removed in 2016 after the dam area received damage from significant storms in 2015. Confirmation that the jurisdictional areas start below this old pond area occurred at the August 16, 2016 and August 2, 2018 site meetings. This area was properly restored to agriculture practices and is currently being farmed.

IV. Clean Water Action Sections 404 & 401

Section 404 of the Clean Water Act regulates the discharge of dredge and fill materials into waters of the United States (lakes, rivers, ponds, streams, etc.), including wetlands. Activities that could be regulated under Section 404 include the placement of fill for construction of roadways; residential, commercial or industrial structures; and the construction of water retention ponds along tributaries. The EPA and the USACE jointly administer the Section 404

program. Section 401 of the Clean Water Act grants each state the authority to approve, condition, or deny Federal permits that could result in a discharge to State waters.

Streams, ponds, and wetlands are regulated by the COE and DWR. Permits are required prior to impacting wetlands, open waters, including ponds, lakes, and perennial or intermittent streams. Mitigation and stormwater management plans will be a condition of permits issued for the site.

If we can be of assistance, please do not hesitate to contact us. Thank you once again for the opportunity to assist you on this important project.

Sincerely,

Keller Environmental LLC

Jay Keller
Principal

(919) 749-8259
jay@kellerenvironmental.com

Attachments:

- February 4, 2019 Jones Dairy Rd South Google Aerial Stream & Wetland Map
- December 18, 2015 DWR Letter
- August 16, 2016 DWR Letter
- August 2, 2018 DWR Letter

Water Resources
ENVIRONMENTAL QUALITY

PAT MCCRORY
Governor

DONALD R. VAN DER VAART
Secretary

S. JAY ZIMMERMAN
Director

August 23, 2016

Perry Family Farm, LLC
1512 Jones Dairy Road
Rolesville, NC 27587

Subject: Buffer Determination Letter
NBRRO #16-262
Wake County

Determination Type:	
Buffer	Intermittent/Perennial
☒ Neuse (15A NCAC 2B .0233) ☐ Tar-Pamlico (15A NCAC 2B .0259) ☐ Jordan (15A NCAC 2B .0267) (governmental and/or interjurisdictional projects)	☐ Intermittent/Perennial Determination (where local buffer ordinances apply)

Project Name: Farmstead at Dukes Place

Address/Location: 1512 Jones Dairy Road, Rolesville, NC 27587

Stream(s): Unnamed Tributary to Sanford Creek in the Neuse River Basin

Determination Date: 08/16/2016 **Staff: Erin Deck and Stephanie Goss**

Stream	E/I/P *	Not Subject	Subject	Start@	Stop@	Soil Survey	USGS Topo
Stream A*			X	Approx. 35.9427 -78.4625	Throughout	X	X

Please note: See Buffer Determination NBRRO# 15-535, for the buffer applicability for the remainder of the site. This determination is just in reference to the drained pond

**E/I/P = Ephemeral/Intermittent/Perennial*

Explanation: The stream(s) listed above has been located on the most recent published NRCS Soil Survey of Wake County, North Carolina and/or the most recent copy of the USGS Topographic map at a 1:24,000 scale. Each stream that is checked "Not Subject" has been determined to not be at least intermittent or is not present. Streams that are checked "Subject" have been located on the property and possess characteristics that qualify it to be at least an intermittent stream. There may be other streams located on the property that do not show up on the maps referenced above but may be considered jurisdictional according to the US Army Corps of Engineers.

Division of Water Resources, Raleigh Regional Office, Water Quality Operations Section http://portal.ncdenr.org/web/wq/aps
1628 Mail Service Center, Raleigh, NC 27699-1628 Phone: (919) 791-4200
Location: 3800 Barrett Drive, Raleigh, NC 27609 Fax: (919) 788-7159

This on-site determination shall expire five (5) years from the date of this letter. Landowners or affected parties that dispute a determination made by the DWR may request a determination by the Director. An appeal request must be made within sixty (60) days of date of this letter. A request for a determination by the Director shall be referred to the Director in writing. ***If sending via US Postal Service:*** **c/o** ***Karen Higgins; DWR – 401 & Buffer Permitting Unit; 1617 Mail Service Center; Raleigh, NC 27699-1617. If sending via delivery service (UPS, FedEx, etc.): Karen Higgins; DWR – 401 & Buffer Permitting Unit; 512 N. Salisbury Street; Raleigh, NC 27604.***

This determination is final and binding unless, as detailed above, unless an appeal is requested within sixty (60) days.

This project may require a Section 404/401 Permit for the proposed activity. Any inquiries should be directed to the US Army Corp of Engineers (Raleigh Regulatory Field Office) at (919)-554-4884.

If you have questions regarding this determination, please feel free to contact Erin Deck or Stephanie Goss at (919) 791-4200

Sincerely,

Danny Smith
Supervisor, Water Quality Regional Operations Center

cc: RRO DWR File Copy
Jeff Harbour, 4901 Trademark Drive, Raleigh, NC 27601

Farmstead at Dukes Place 16-262

Legend:

-Approximate Site boundary:

Map provided by NCDEQ Division of Water Resources

:: Locations are approximate and are provided for reference only ::

N

Farmstead at Dukes Place 16-262

Legend:

-Approximate Site boundary:

Map provided by NCDEQ Division of Water Resources

:: Locations are approximate and are provided for reference only ::

N

Water Resources
ENVIRONMENTAL QUALITY

PAT MCCRORY
Governor

DONALD R. VAN DER VAART
Secretary

S. JAY ZIMMERMAN
Director

December 21, 2015

Perry Family Farm, LLC
1512 Jones Dairy Road
Rolesville, NC 27587

Subject: Buffer Determination
NBRRO #15-535
Wake County

Determination Type:	
Buffer Call	Isolated or EIP Call
☒ Neuse (15A NCAC 2B .0233) ☐ Tar-Pamlico (15A NCAC 2B .0259) ☐ Jordan (15A NCAC 2B .0267)	☐ Ephemeral/Intermittent/Perennial Determination ☐ Isolated Wetland Determination

Project Name: Duke-Perry Property

Location/ Directions: Property is located at 1512 Jones Dairy Road, Rolesville, Wake County, NC

Subject Stream: Sanford Creek

Determination Date: December 18, 2015 **Staff: Laura Robertson**

	Not Subject To Buffers	Subject To Buffers	E/I/P*	Start@	Stop@	Soil Survey	USGS Topo
A	X		E	SW property (yellow star)	SW property corner	X	

*E/I/P - Ephemeral/Intermittent/Perennial

Explanation: The feature listed above was located on the Soil Survey of Wake County, North Carolina, but was not present on the property. There may be other streams located on your property that do not show up on the maps referenced above but, still may be considered jurisdictional according to the US Army Corps of Engineers and/or to the Division of Water Resources (DWR).

This on-site determination shall expire five (5) years from the date of this letter. Landowners or affected parties that dispute a determination made by the DWR or Delegated Local Authority may request a determination by the Director. An appeal request must be made within sixty (60) days of date of this letter or from the date the affected party (including downstream and/or adjacent owners) is notified of this letter. A request for a determination by the Director shall be referred to the Director in writing c/o Karen Higgins, DWR WeBSCaPe Unit, 1650 Mail Service Center, Raleigh, NC 27699.

This determination is final and binding unless, as detailed above, you ask for a hearing or appeal within sixty (60) days.

The owner/future owners should notify the Division of Water Resources (including any other Local, State, and Federal Agencies) of this decision concerning any future correspondences regarding the subject property (stated above). This project may require a Section 404/401 Permit for the proposed activity. Any inquiries should be directed to the Division of Water Resources (Central Office) at (919)-807-6300, and the US Army Corp of Engineers (Raleigh Regulatory Field Office) at (919)-554-4884.

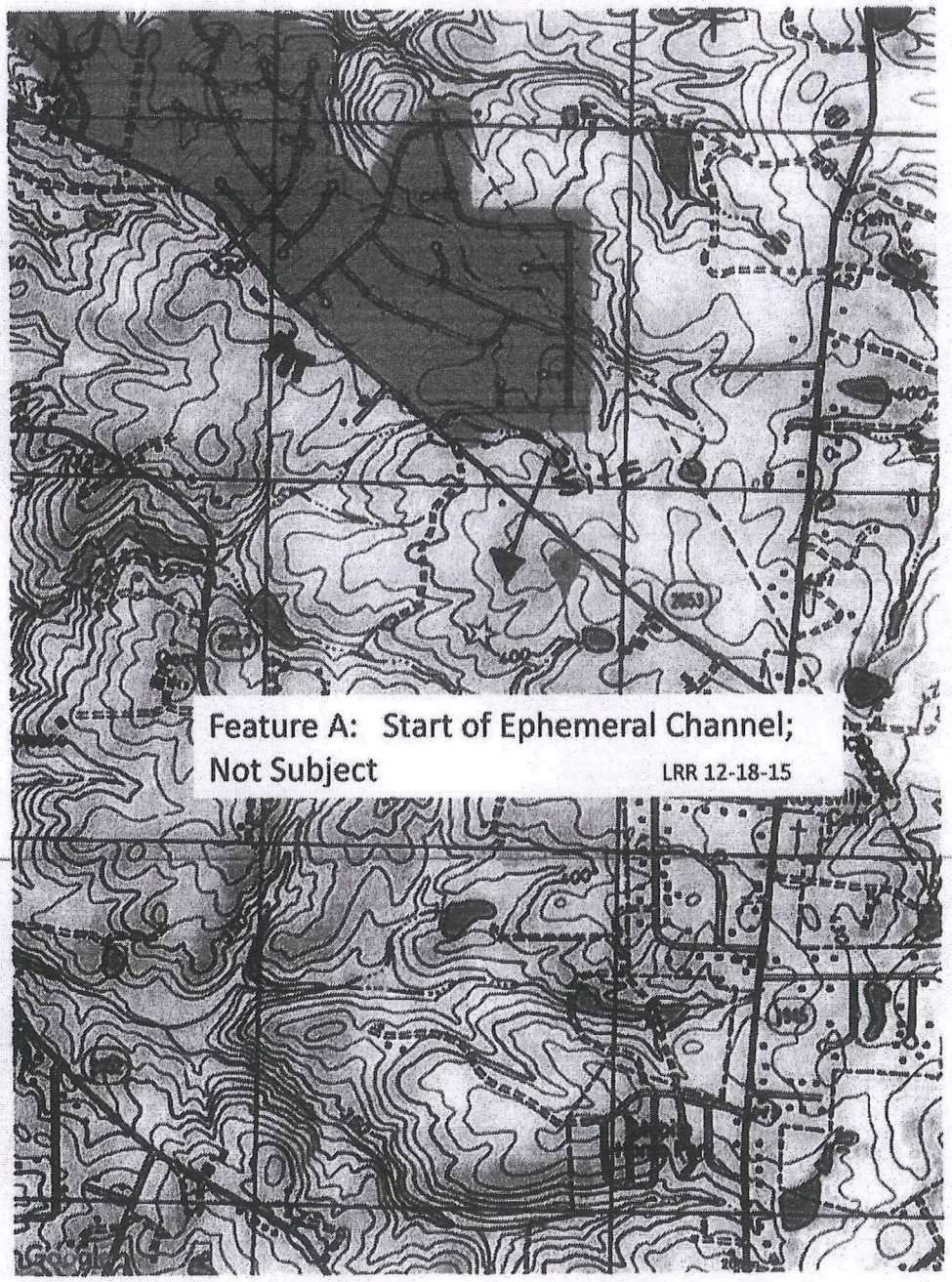
If you have questions regarding this determination, please feel free to contact Laura Robertson at (919) 791-4247.

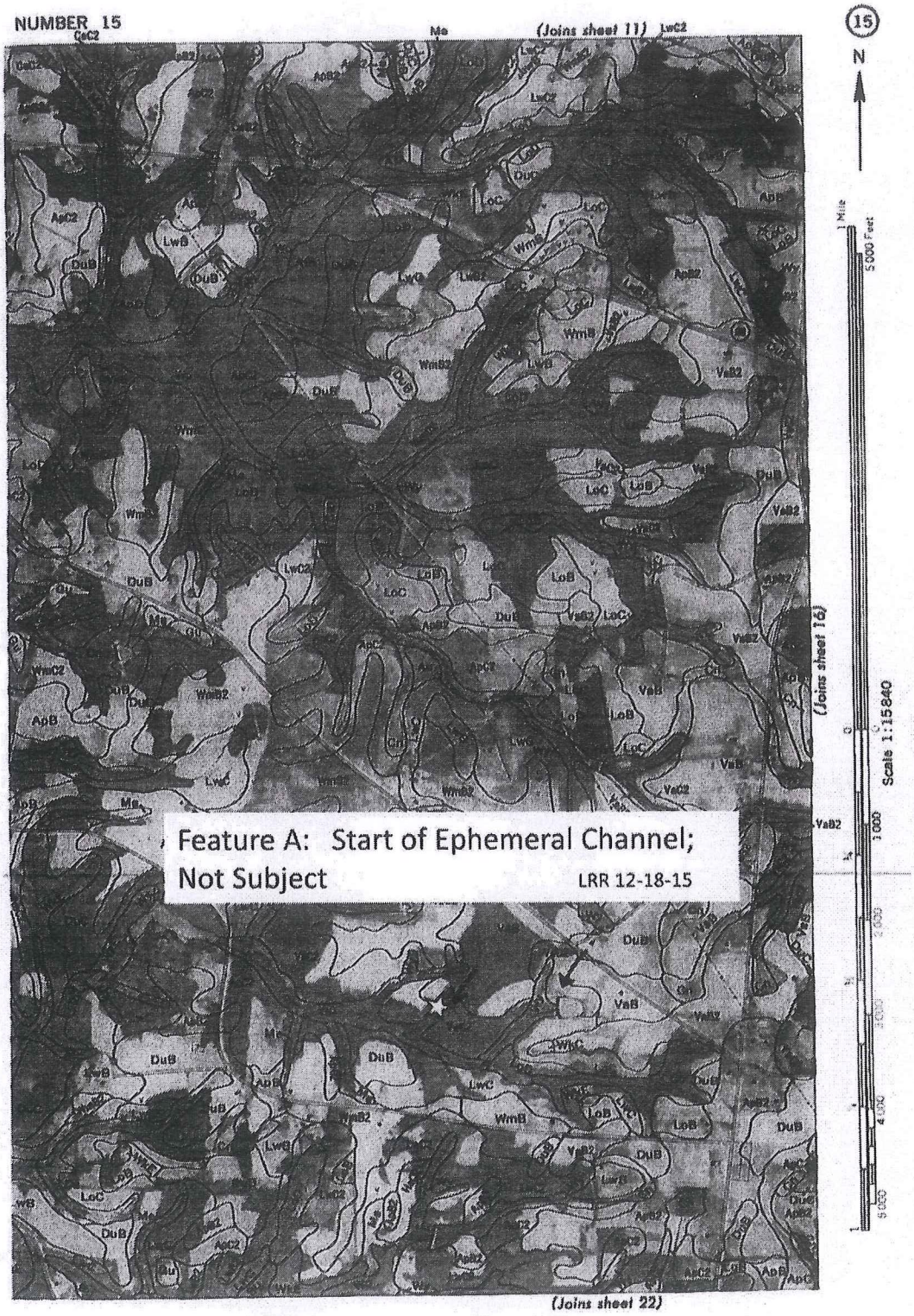
Respectfully,

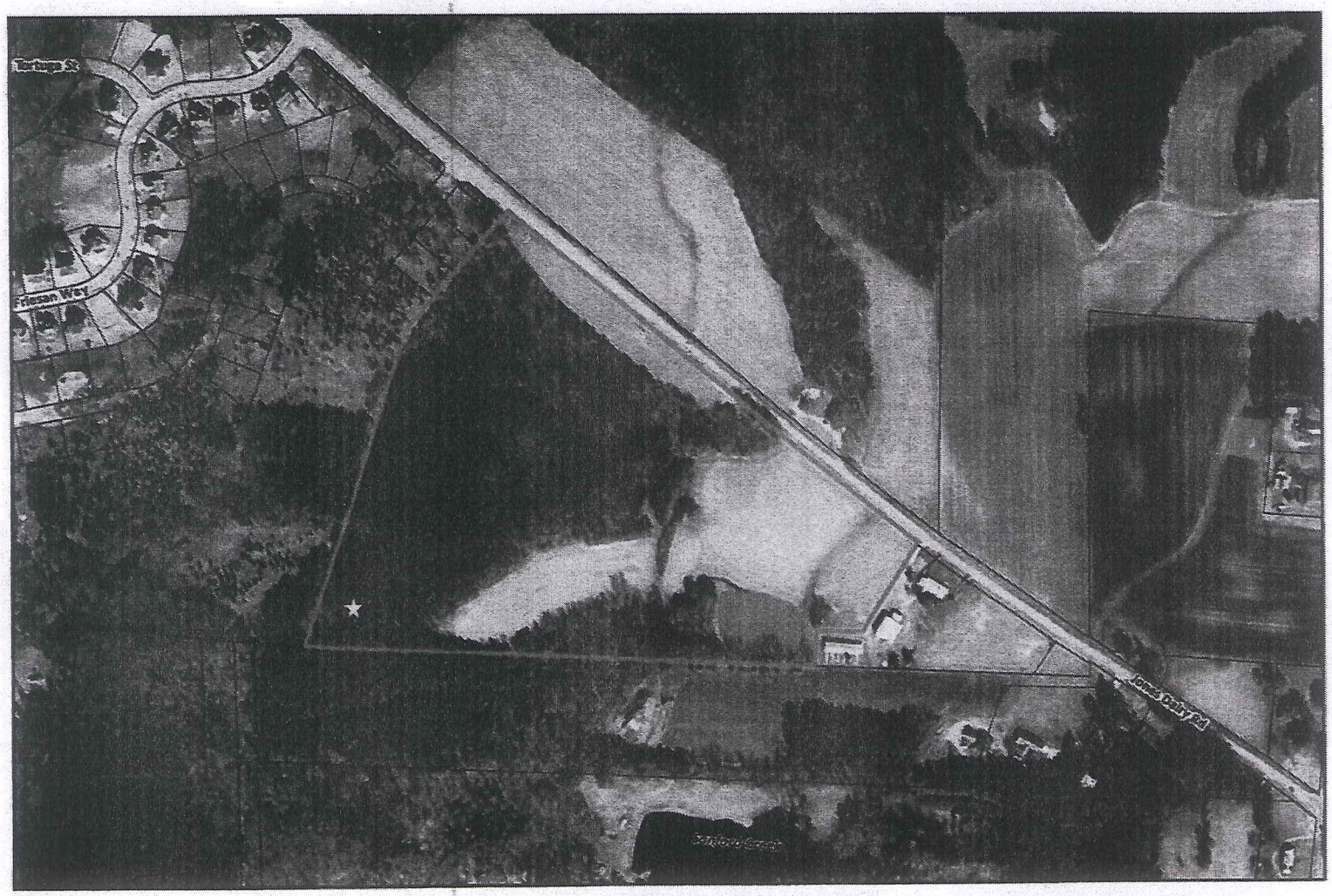
Danny Smith, Supervisor
Water Quality Section
Raleigh Regional Office

cc:

RRO/SWP File Copy
Jeff Harbour, Environmental Service, Inc.
4901 Trademark Drive, Raleigh, NC, 27610


Feature A: Start of Ephemeral Channel;
Not Subject
LRR 12-18-15


NUMBER 15
(Joins sheet 11)
(Joins sheet 16)
(Joins sheet 22)
15
N
1 Mile
5000 Feet
Scale 1:15840
Feature A: Start of Ephemeral Channel;
Not Subject
LRR 12-18-15



Title

N

0 205 410 820 Feet

4 inch = 820 feet

Disclaimer
Maps makes every effort to produce and publish the most current and accurate information possible. However, the maps are produced for information purposes, and are NOT surveys. No warranties, expressed or implied

N

0 215 430 860 ft

1 inch = 400 feet

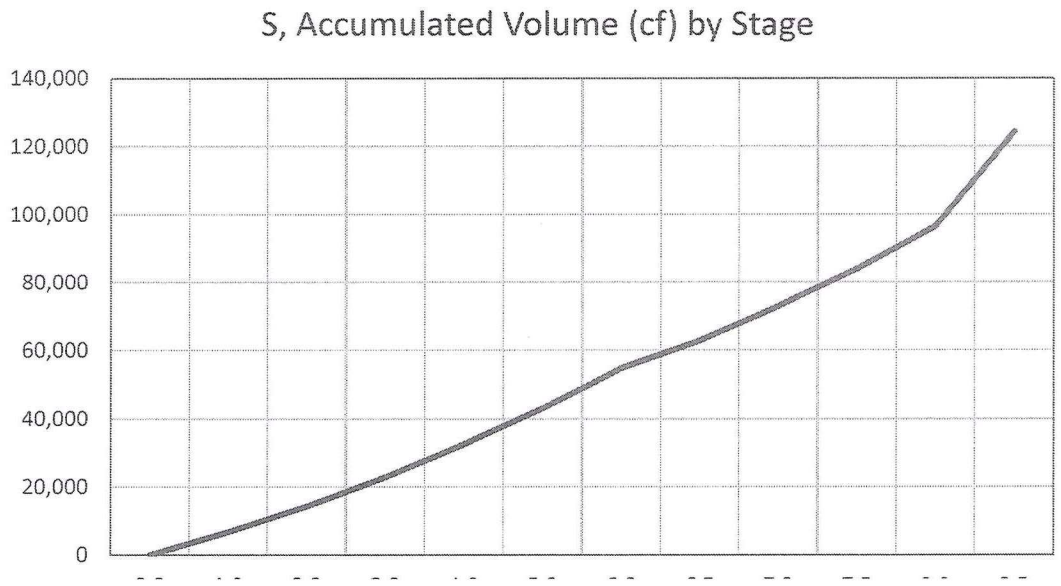
Disclaimer

*iMaps makes every effort to produce and publish the most current and accurate information possible. However, the maps are produced for information purposes, and are **NOT** surveys. No warranties, expressed or implied ,are provided for the data therein, its use,or its interpretation.*

Impervious Summary - Jones Dairy Preserve South			
		Square Feet	Acres
Overal Site		2,356,596.00	54.10
Impervious Summary		**Square Feet**	**Acres**
Lots (3500 SF)	216	756,000.00	17.36
Walking Trail		27,660.00	0.63
Roadway (27' width)		161,082.00	3.70
Roadway (35' width)		76,927.00	1.77
Sidewalk (both sides)		93,960.00	2.16
Total Impervious			**25.61**

Calculate Stage-Storage of Wet Detention Basin 1

Stage	Contour	Contour Area (sf)	Incremental Volume (cf)	S, Accumulated Volume (cf)	
0.0	389	6,181	0	0	
1.0	390	7,129	6,655	6,655	
2.0	391	8,104	14,276	14,276	
3.0	392	9,107	22,891	22,891	
4.0	393	10,135	9,621	32,512	
5.0	394	11,188	20,287	43,177	
6.0	395	12,266	11,727	54,904	*Bottom of shelf*
6.5	395.5	19,221	7,872	62,776	*Permanent pool elevation*
7.0	396	21,392	10,153	72,929	*Top of shelf*
7.5	396.5	23,621	11,253	84,183	*Top of Riser Pipe*
8.0	397	25,905	12,382	96,564	*Emergency Spillway*
9.5	398	29,840	27,873	124,437	



Tabulate Sub-Basin Drainage Areas

	Drainage Area	Impervious Area

(See Wake County storm water tool for sub basin areas)
Commerical area to be excluded from wet detention basin.

Calculate the runoff coefficient, Rv

Impervious portion of drainage area	17.50	acres	***Estimated***
Drainage area	18.19	acres	I_A=(*Impervious portion of drainage area* (*acre*))
IA	96%		
Rv	0.92		R_v=0.05+0.9×I_A

Calculate the volume of runoff to be controlled, V

RD	1	inch	*Design storm rainfall depth*
A	18.19	acres	*Watershed area*
V required	60,474	cf	V=3630×R_D×R_v×A
V provided	62,776	cf	
V Forebay	12,080	cf	V Forebay to Main Pond 19.2%

Determine the required surface area of the permanent pool

Actual average depth,

$$d\_av=[0.25\times(1+A\_(bot\_shelf)/A\_(perm\_pool))]+[((A\_(bot\_shelf)+A\_(bc$$

dav	5.30	ft
dav rounded down to nearest 0.5'	5.00	ft

IA rounded to nearest 10%	100%

SA/DA ratio required for 85% TSS removal:	2.52%	*Ref: Table 10-1 from NC DENR BMP Manual*
SA/DA ratio required for 90% TSS removal:	#N/A	*Ref: Table 10-3 from NC DENR BMP Manual*

Permanent pool surface area, SA	19,221	sf
Drainage area, DA	792,356	sf
Actual SA/DA ratio	**2.43%**	

Check length to width ratio

Length of BMP	220	ft
Width of BMP	68	ft

Ratio Required	1.5	*Ref: Section 10.3.4 from NC DENR BMP Manual*
Ratio Provided	3.2	

Forebay

Stage	Contour	Contour Area (sf)	Incremental Volume (cf)	Accumulated Volume (cf)
0.0	392	2,329	0	0
1.0	393	3,173	2,751	2,751
2.0	394	3,623	3,398	6,149
3.0	395	4,113	7,273	10,024
4.0	396	-	2,057	12,080

Jones Dairy Preserve - South
Riser Pipe for Wet Pond 1

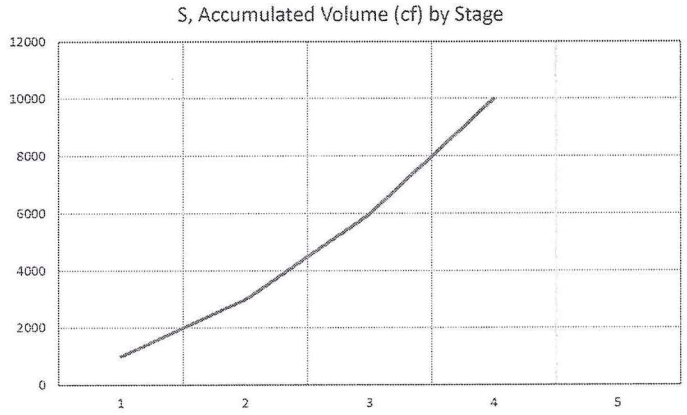
Buoyancy Protection

Ground elevation at wet well (feet)	388.0	
Maximum groundwater elevation (feet)	389.0	
Wet well top elevation (feet)	396.5	
Wet well invert elevation (feet)	390.2	
Thickness of wet well wall (inches)	0.5	
Thickness of wet well top (inches)	0.0	
Percent of top deducted for hatch opening	90	
Thickness of wet well floor (inches)	30.0	
Length of wet well base extension (inches)	12.0	
Dry unit weight of soil (pcf)	120.0	
Unit weight of water (pcf)	62.4	
Unit weight of concrete (pcf)	150.0	
Buoyant force, with empty wet well		
Submerged volume of wet well interior (cf)	-95	
Submerged volume of wet well walls (cf)	-2	
Submerged volume of floor & base ext. (cf)	287	
Submerged volume of wet well top (cf)	0	
Total volume of displaced water (cf)	190	
Total weight of displaced water (lbs)		**11,860**
Downward forces		
Volume of wet well structure (cf)	295	
Volume of concrete added for invert (cf)	27	
Total volume of concrete (cf)	322	
Total weight of concrete (lbs)		48,293
Volume of wet soil over base extension (cf)	-77	
Buoyant weight of wet soil column (lbs)		-4,432
Volume of dry soil over base extension (cf)	25	
Dead weight of dry soil column (lbs)	1000	3,000
Total downward force (lbs)		**46,860**
Factor of safety against flotation	**3.95**	

R1	= *Radius of wet well interior (ft)*	*5.000*
R2	= *Radius of wet well exterior (ft)*	*5.042*
R3	= *Radius of base extension (ft)*	*6.042*
A1	= *Area of wet well interior (sf)*	*78.540*
A2	= *Area bounded by wet well exterior (sf)*	*79.854*
A3	= *Area bounded by outer edge of base ext. (sf)*	*114.674*
A4	= *Wall area of wet well (sf)*	*1.314*
A5	= *Soil column area above base extension (sf)*	*34.819*
A6	= *Net concrete area of top excluding hatch*	*7.985*

Calculate Stage-Storage of Bioretention Basin

Stage	Contour	Contour Area (sf)	Incremental Volume (cf)	S, Accumulated Volume (cf)		
Media Volume						
0.0	0	27,966	0	0		
1.0	1	26,282	27,124	27,124		
2.0	2	24,624	25,453	52,577		
Water Volume						
0.0	100	27,966	0	0	*Top of Media*	Trial
1.0	101	30,539	29,253	29,253	*1" storm volume pool elevation*	
1.5	101.5	31,847	15,597	44,849	*Top of Riser*	
2.0	102	33,168	16,254	61,103	*Emergency Spillway*	
3.0	103	35,854	34,511	95,614	*Top Of Dam*	



Calculate the runoff coefficient, Rv

Impervious portion of drainage area	8.11	acres	
Drainage area	11.73	acres	$I\_A=(Impervious\ portion\ of\ drainage\ area\ (acre)$
IA	69%		
Rv	0.67		$R\_v=0.05+0.9\times I\_A$

Calculate the volume of runoff to be controlled, V

RD	1	inch	*Design storm rainfall depth*
A	11.73	acres	*Watershed area*
V required	28,624	cf	$V=3630\times R\_D\times R\_v\times A$
V provided	29,253	cf	

Underdrain

Media Volume	52577.00	cu ft	
Q (1" /hr)	6.09	cfs	1" / hour (safety factor of 10)
D	15.67	in	Diameter of pipe
n	0.011		Roughness factor
s	0.005	ft/ft	internal slope
# of Pipes Req'd	**6 (6" pipes req)**		See table 5-1

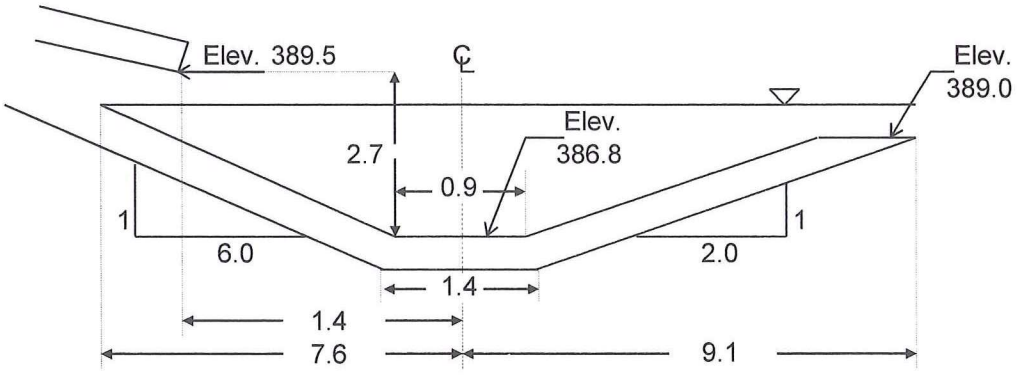
Table 5-1 (From Section 5.7 BMP Manual)

if D is less than	# of 4" pipes	If D is less than	# of 6" pipes
5.13	2	7.84	2
5.95	3	9.11	3
6.66	4	10.13	4
7.22	5		
7.75	6		
8.2	7		

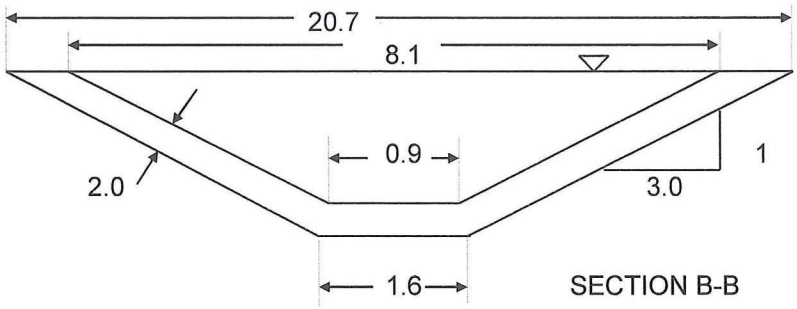
JONES DAIRY - SOUTH
WET POND 1

RIPRAP LINED PLUNGE POOL FOR CANTILEVER OUTLET

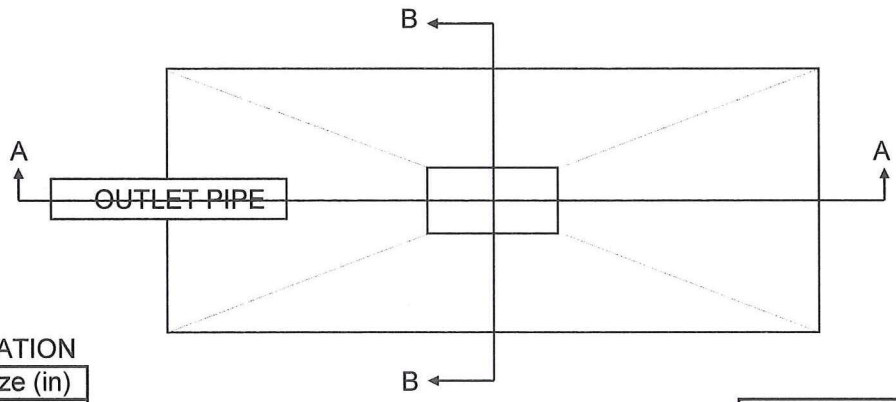
Reference Design Note No. 6 (Second Edition), Jan. 23, 1986



SECTION A-A



SECTION B-B



ROCK GRADATION

% Passing	Size (in)
100	16.08
60-85	12.06
25-50	8.04
5-20	4.02
0-5	1.608

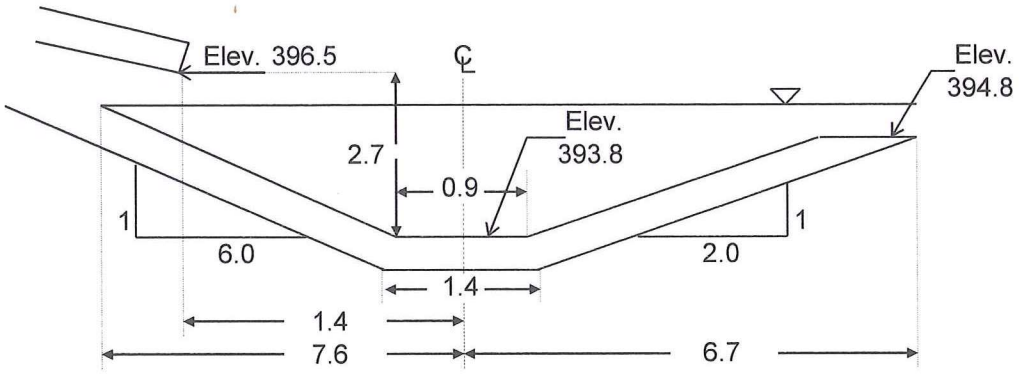
Jones Dairy Preserve South
LANDOWNER

DESIGNER: KPG
SHEET ___ OF ___

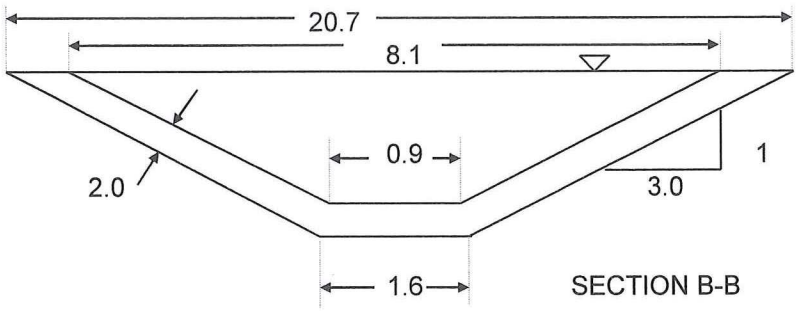
JONES DAIRY SOUTH
BIO POND 2

RIPRAP LINED PLUNGE POOL FOR CANTILEVER OUTLET

Reference Design Note No. 6 (Second Edition), Jan. 23, 1986



SECTION A-A



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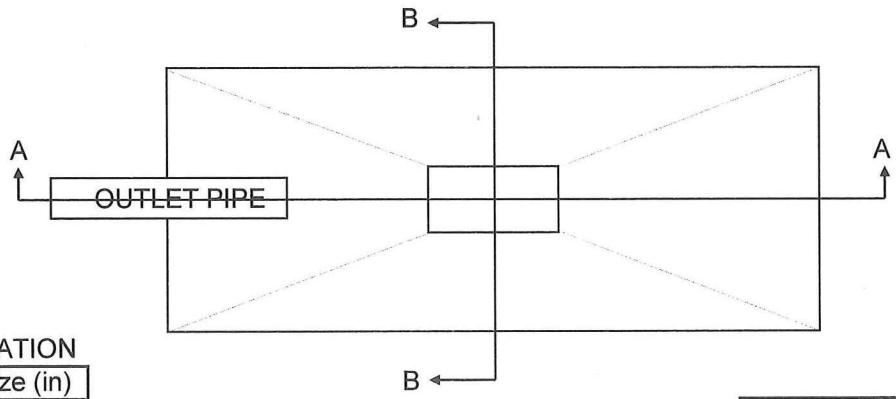


ROCK GRADATION

% Passing	Size (in)
100	16.08
60-85	12.06
25-50	8.04
5-20	4.02
0-5	1.608

Jones Dairy Preserve South
LANDOWNER

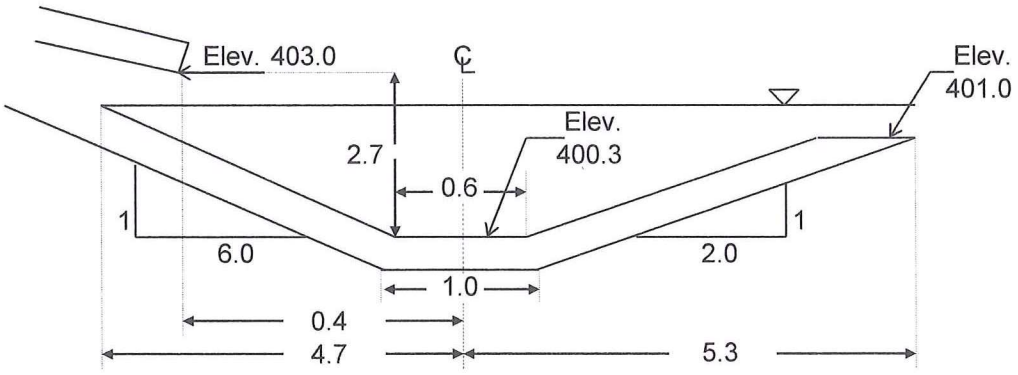
DESIGNER: KPG
SHEET ___ OF ___

JDP - SOUTH

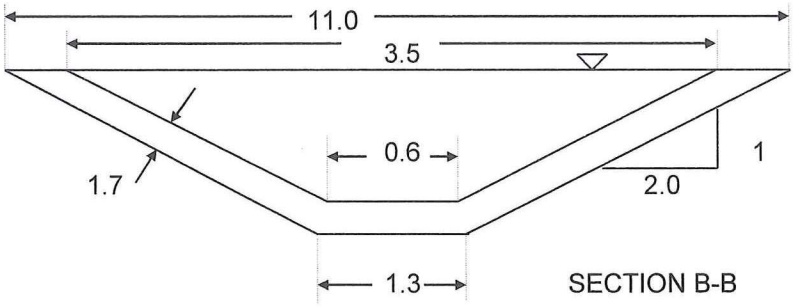
FES #91

RIPRAP LINED PLUNGE POOL FOR CANTILEVER OUTLET

Reference Design Note No. 6 (Second Edition), Jan. 23, 1986



SECTION A-A



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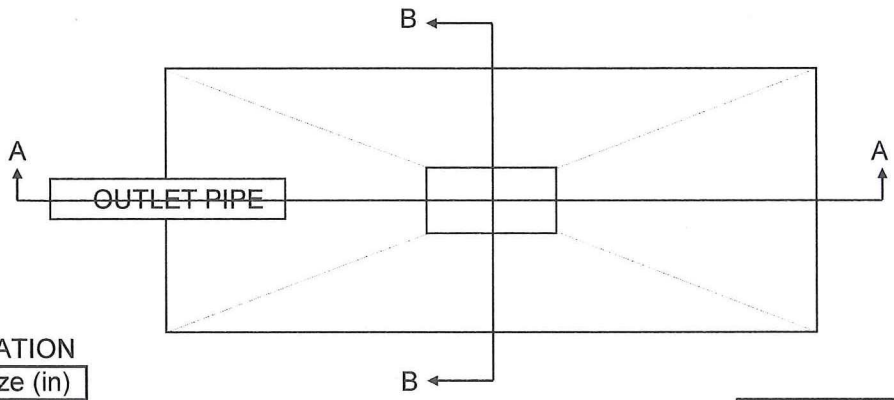


ROCK GRADATION

% Passing	Size (in)
100	16.08
60-85	12.06
25-50	8.04
5-20	4.02
0-5	1.608

JDP South - FES #91
LANDOWNER

DESIGNER: KPG
SHEET ___ OF ___

Q10

JDP SOUTH
FES #91

RIPRAP LINED PLUNGE POOL FOR CANTILEVER OUTLET (Version 8.99)
(Reference Design Note No. 6 (Second Edition), Jan. 23, 1986

JOB:	JDP South - FES #91		
DESIGNER:	KPG	Date:	8/21/2020
CHECKER:		Date:	

INPUT DATA:

Conduit Diameter	D =	1.30	ft
Conduit Discharge:	Q =	0.92	cfs
Conduit Slope at Outlet:	S =	0.03	ft/ft
Conduit Outlet Invert Elevation:	El, CO =	403.00	ft
Tailwater Elevation:	El, TW =	401.00	ft
Outlet Channel Invert Elevation:	El, CH =	401.00	ft
Water Density:	RHO =	1.00	
Bed/Riprap Particle Density: (Default 2.64)	RHOS =	2.64	
D, 50 Riprap Size:	RS =	0.67	ft
Riprap Thickness: (2.5*D, 50 recommended)	RT =	1.68	ft
Bedding Thickness: (6 inch min. rec.) (Enter 0 for geotextile)	BT =	0.50	ft
Side Slope Ratio:	Zw =	2.00	ft/ft
Upstream End Slope Ratio:	Zlu =	6.00	ft/ft
Downstream End Slope Ratio:	Zld =	2.00	ft/ft
Combined End Slope Ratio:	Z1 =	4.00	ft/ft

OUTPUT---POOL LOCATION AND DIMENSIONS:

Vert. Dist. from Tailwater to Conduit Invert:	Zp =	2.00	ft
Submergence Check: (If Zp < 0 , Use Zp = 0)	Use Zp =	2.00	ft
Beaching Check: [Q/(gD^5)^0.5 <= (1.0+25*D,50/D)]		O.K.	
Beaching Controlled			
Distance from Conduit Exit to C/L Pool:	Xm =	0.37	ft
Pool depth at C/L Below Conduit Invert:	Zp+0.8Zm =	2.73	ft
Pool Bottom Elev:	El,PB =	400.27	ft
Pool Bottom Length:	2Lr2 =	0.56	ft
Pool Bottom Width:	2Wr2 =	0.55	ft
Upstream Pool Length at Tailwater Elev.:	Lru =	4.68	ft
Downstream Pool Length at Tailwater Elev.:	Lrd =	1.75	ft
Pool Width at Tailwater Elev.:	2Wr =	3.49	ft
Check Side Slope Ratio: (Wr>=We)		O.K.	
Side Slope Ratio Zw O.K.			
Check Min. End Slope Ratio: (Lru & Lrd >= Le)		O.K.	
End Slope Ratios O.K.			
Check Upstream Length: (Lru >= Xm)		O.K.	
End Slope Ratio Zlu O.K.			
Pool Bottom Elev. at Bottom of Riprap:	El, BR =	398.59	ft
Pool Bottom Elev. at Bottom of Bedding:	El, BB =	398.09	ft

OUTPUT—VOLUMES BELOW WATER SURFACE ELEVATION:

Volume of Excavation (measured from bottom surface of bedding):	V,pbs =	12.4	cu yd
Volume of Rock Riprap:	V,rs =	6.9	cu yd
Volume of Bedding:	V,bs =	5.3	cu yd

Spreadsheet developed by D. Hurtz, Midwest NTC, 1/90
Spreadsheet modified by M. Dreischmeier, Eau Claire TC, Wis., 3/98
Design Note No. 6 (Second Edition), Jan. 23, 1986
"Riprap Lined Plunge Pool for Cantilever Outlet"
Natural Resources Conservation Service
Engineering Division

FORMULAS & COMPUTATIONS

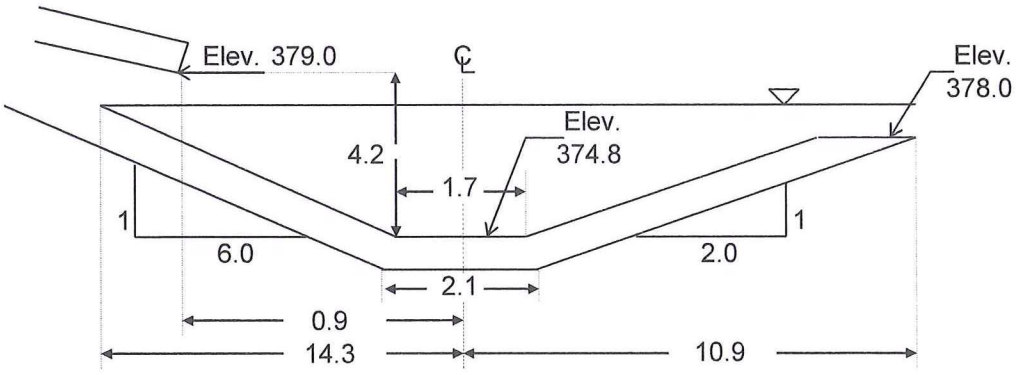
g = acceleration of gravity	32.20
Q/(g*d^5)^(1/2) = dimensionless parameter	0.08
Zd = water depth above channel invert	0.00
Vo = conduit discharge velocity	0.69
Vh = horiz. velocity component of jet impingement	0.69
Vv = vert. velocity component of jet impingement	13.06
TAN,a = jet impingement slope	18.90
Vp = jet velocity at impingement	13.08
Xp = horiz. distance from conduit exit to center of jet at impingement with tailwater	0.28
Fd = densimetric Froude number	2.20
Zp/D	1.54
Zma = maximum pool depth when Zp/D<=1	1.09
Zmb = maximum pool depth when Zp/D > 1	0.92
Zm = pool depth to be used	0.92
1+25*RS/D = parameter used in beaching check	13.88
Xm = horiz. distance from conduit exit to center of plunge pool	0.37
Le = min. horiz. distance from center of pool to water surface contour at upstream or downstream end of pool	1.40
We2 = one-half pool width at center at water surface elevation	1.39
Lr2 = one-half pool length at bottom of pool	0.28
Wr2 = one-half pool width at bottom of pool	0.28
Lru = adjusted upstream horiz. length from center of pool to water surface contour at upstream end of pool	4.68
Lrd = adjusted downstream horiz. length from center of pool to water surface contour at downstream end of pool	1.75
Lr = adjusted horiz. length from center of pool to water surface contour at upstream or downstream end of pool	3.21
Wr = adjusted horiz. width from center of pool to water surface contour	1.74
A,2 = horiz. pool area at bottom of pool	0.31
A,1 = horiz. pool area at channel invert elev.	22.38
V,p = pool volume between bottom and outlet channel invert elevation	0.23
A,2r = horiz. pool area at bottom of riprap elev.	1.31
A,1r = horiz. pool area at channel invert elevation contour at bottom surface of riprap	222.10
V,pr = volume of pool measured from bottom surface of riprap	7.15
A,2b = horiz. pool area at bottom of bedding elev.	1.73
A,1b = horiz. pool area at channel invert elevation contour at bottom surface of bedding	321.82
V,pb = volume of pool measured from bottom surface of bedding	12.46
2Lr2e = excavation length at bottom of riprap	0.97
2Wr2e = excavation width at bottom of riprap	1.35
Wre = adjusted horiz. width across pool from bottom of riprap at water surface contour	10.98
Lrue = adjusted upstream horiz. length from center of pool to bottom of riprap at water surface contour at upstream end of pool	14.93
Lrde = adjusted downstream horiz. length from center of pool to bottom of riprap at outlet channel invert elevation at downstream end of pool	5.30
Lre = adjusted horiz. length from center of pool to bottom of riprap at water surface contour at upstream or downstream end of pool	10.12
A,2 = horiz. pool area at bottom of pool	0.31
A,1s = horiz. pool area at water surface elev	22.38
V,ps = pool volume between bottom and water surface elevation	0.23
A,2r = horiz. pool area at bottom of riprap elev	1.31
A,1rs = horiz. pool area at water surface elevation contour at bottom surface of riprap	222.10
V,prs = volume of pool measured from bottom surface of riprap to water surface elevation	7.15
2Lr2b = excavation length at bottom of bedding	1.10
2Wr2b = excavation width at bottom of bedding	1.58
Wrb = adjusted horiz. width from center of pool to bottom of bedding at water surface contour	13.21
Lrub = adjusted upstream horiz. length from center of pool to bottom of bedding at water surface contour at upstream end of pool	17.93
Lrdb = adjusted downstream horiz. length from center of pool to bottom of bedding at outlet channel invert elevation at downstream end of pool	6.30
Lrb = adjusted horiz. length from center of pool to bottom of bedding at water surface contour at upstream or downstream end of pool	12.12
A,2b = horiz. pool area at bottom of bedding elev	1.73
A,1bs = horiz. pool area at water surface elevation contour at bottom surface of bedding	320.19
V,pbs = volume of pool measured from bottom surface of bedding to water surface elevation	12.40
Areas for geotextile:	
A,b = bottom	1.31
A,lr = left & right sides	114.18
A,us = u.s. end	90.23
A,ds = d.s. end	33.17
A,p = perimeter	62.42
A,gt = total area	33.48

JDP - SOUTH
FES #63

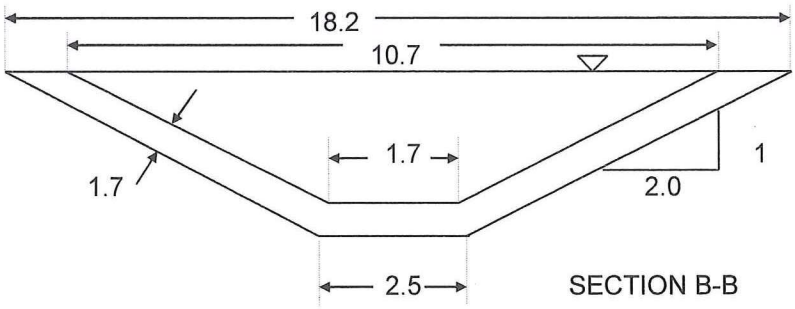
Q10

RIPRAP LINED PLUNGE POOL FOR CANTILEVER OUTLET

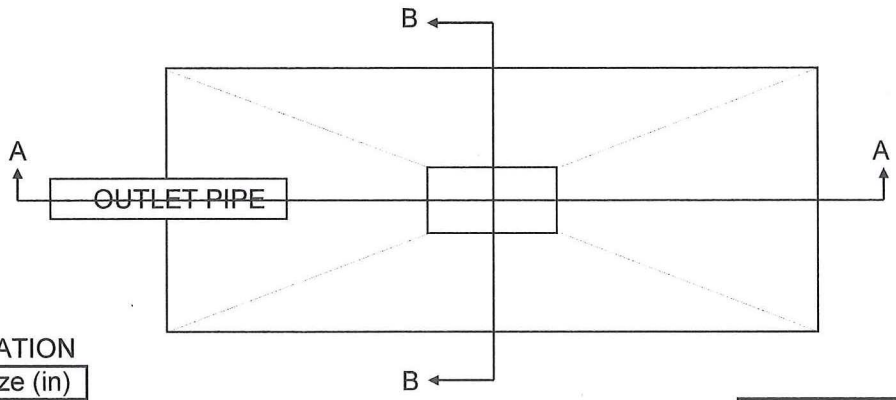
Reference Design Note No. 6 (Second Edition), Jan. 23, 1986



SECTION A-A



SECTION B-B



ROCK GRADATION

% Passing	Size (in)
100	16.08
60-85	12.06
25-50	8.04
5-20	4.02
0-5	1.608

JDP South - FES #63
LANDOWNER

DESIGNER: KPG
SHEET ___ OF ___

JONES DAIRY PRESERVE
SOUTH FES #63

RIPRAP LINED PLUNGE POOL FOR CANTILEVER OUTLET (Version 8.99)
(Reference Design Note No. 6 (Second Edition), Jan. 23, 1986

JOB: JDP South - FES #63
DESIGNER: KPG Date: 8/21/2020
CHECKER: Date:

INPUT DATA:

Conduit Diameter	D =	2.00	ft
Conduit Discharge:	Q =	3.90	cfs
Conduit Slope at Outlet:	S =	0.03	ft/ft
Conduit Outlet Invert Elevation:	El, CO =	379.00	ft
Tailwater Elevation:	El, TW =	377.00	ft
Outlet Channel Invert Elevation:	El, CH =	378.00	ft
Water Density:	RHO =	1.00	
Bed/Riprap Particle Density: (Default 2.64)	RHOS =	2.64	
D, 50 Riprap Size:	RS =	0.67	ft
Riprap Thickness: (2.5*D, 50 recommended)	RT =	1.63	ft
Bedding Thickness: (6 inch min. rec.) (Enter 0 for geotextile)	BT =	0.50	ft
Side Slope Ratio:	Zw =	2.00	ft/ft
Upstream End Slope Ratio:	Zlu =	6.00	ft/ft
Downstream End Slope Ratio:	Zld =	2.00	ft/ft
Combined End Slope Ratio:	Z1 =	4.00	ft/ft

OUTPUT---POOL LOCATION AND DIMENSIONS:

Vert. Dist. from Tailwater to Conduit Invert:	Zp =	2.00	ft
Submergence Check: (If Zp < 0 , Use Zp = 0)	Use Zp =	2.00	ft
Beaching Check: [Q/(gD^5)^0.5 <= (1.0+25*D,50/D)]		O.K.	
Beaching Controlled			
Distance from Conduit Exit to C/L Pool:	Xm =	0.88	ft
Pool depth at C/L Below Conduit Invert:	Zp+0.8Zm =	4.24	ft
Pool Bottom Elev:	El,PB =	374.76	ft
Pool Bottom Length:	2Lr2 =	1.73	ft
Pool Bottom Width:	2Wr2 =	1.70	ft
Upstream Pool Length at Tailwater Elev.:	Lru =	14.32	ft
Downstream Pool Length at Tailwater Elev.:	Lrd =	5.35	ft
Pool Width at Tailwater Elev.:	2Wr =	10.67	ft
Check Side Slope Ratio: (Wr>=We)		O.K.	
Side Slope Ratio Zw O.K.			
Check Min. End Slope Ratio: (Lru & Lrd >= Le)		O.K.	
End Slope Ratios O.K.			
Check Upstream Length: (Lru >= Xm)		O.K.	
End Slope Ratio Zlu O.K.			
Pool Bottom Elev. at Bottom of Riprap:	El, BR =	373.08	ft
Pool Bottom Elev. at Bottom of Bedding:	El, BB =	372.58	ft

OUTPUT---VOLUMES BELOW WATER SURFACE ELEVATION:

Volume of Excavation (measured from bottom surface of bedding):	V,pbs =	45.8	cu yd
Volume of Rock Riprap:	V,rs =	25.8	cu yd
Volume of Bedding:	V,bs =	13.4	cu yd

Spreadsheet developed by D. Hurtz, Midwest NTC, 1/90
Spreadsheet modified by M. Dreischmeier, Eau Claire TC, Wis., 3/98
Design Note No. 6 (Second Edition), Jan. 23, 1986
"Riprap Lined Plunge Pool for Cantilever Outlet"
Natural Resources Conservation Service
Engineering Division

FORMULAS & COMPUTATIONS

g = acceleration of gravity	32.20
Q/(g*d^5)^(1/2) = dimensionless parameter	0.12
Zd = water depth above channel invert	-1.00
Vo = conduit discharge velocity	1.24
Vh = horiz. velocity component of jet impingement	1.24
Vv = vert. velocity component of jet impingement	13.89
TAN,a = jet impingement slope	11.23
Vp = jet velocity at impingement	13.95
Xp = horiz. distance from conduit exit to center of jet at impingement with tailwater	0.53
Fd = densimetric Froude number	2.34
Zp/D	1.00
Zma = maximum pool depth when Zp/D<=1	2.80
Zmb = maximum pool depth when Zp/D > 1	2.39
Zm = pool depth to be used	2.80
1+25*RS/D = parameter used in beaching check	9.38
Xm = horiz. distance from conduit exit to center of plunge pool	0.88
Le = min. horiz. distance from center of pool to water surface contour at upstream or downstream end of pool	4.32
We2 = one-half pool width at center at water surface elevation	4.26
Lr2 = one-half pool length at bottom of pool	0.86
Wr2 = one-half pool width at bottom of pool	0.85
Lru = adjusted upstream horiz. length from center of pool to water surface contour at upstream end of pool	14.32
Lrd = adjusted downstream horiz. length from center of pool to water surface contour at downstream end of pool	5.35
Lr = adjusted horiz. length from center of pool to water surface contour at upstream or downstream end of pool	9.83
Wr = adjusted horiz. width from center of pool to water surface contour	5.34
A,2 = horiz. pool area at bottom of pool	2.94
A,1 = horiz. pool area at channel invert elev.	406.01
V,p = pool volume between bottom and outlet channel invert elevation	17.76
A,2r = horiz. pool area at bottom of riprap elev.	5.34
A,1r = horiz. pool area at channel invert elevation contour at bottom surface of riprap	919.42
V,pr = volume of pool measured from bottom surface of riprap	60.40
A,2b = horiz. pool area at bottom of bedding elev.	6.18
A,1b = horiz. pool area at channel invert elevation contour at bottom surface of bedding	1112.79
V,pb = volume of pool measured from bottom surface of bedding	80.39
2Lr2e = excavation length at bottom of riprap	2.14
2Wr2e = excavation width at bottom of riprap	2.49
Wre = adjusted horiz. width across pool from bottom of riprap at water surface contour	18.16
Lrue = adjusted upstream horiz. length from center of pool to bottom of riprap at water surface contour at upstream end of pool	24.58
Lrde = adjusted downstream horiz. length from center of pool to bottom of riprap at outlet channel invert elevation at downstream end of pool	10.91
Lre = adjusted horiz. length from center of pool to bottom of riprap at water surface contour at upstream or downstream end of pool	16.74
A,2 = horiz. pool area at bottom of pool	2.94
A,1s = horiz. pool area at water surface elev	209.95
V,ps = pool volume between bottom and water surface elevation	6.58
A,2r = horiz. pool area at bottom of riprap elev	5.34
A,1rs = horiz. pool area at water surface elevation contour at bottom surface of riprap	608.18
V,prs = volume of pool measured from bottom surface of riprap to water surface elevation	32.43
2Lr2b = excavation length at bottom of bedding	2.26
2Wr2b = excavation width at bottom of bedding	2.73
Wrb = adjusted horiz. width from center of pool to bottom of bedding at water surface contour	20.40
Lrub = adjusted upstream horiz. length from center of pool to bottom of bedding at water surface contour at upstream end of pool	27.58
Lrdb = adjusted downstream horiz. length from center of pool to bottom of bedding at outlet channel invert elevation at downstream end of pool	11.91
Lrb = adjusted horiz. length from center of pool to bottom of bedding at water surface contour at upstream or downstream end of pool	18.74
A,2b = horiz. pool area at bottom of bedding elev	6.18
A,1bs = horiz. pool area at water surface elevation contour at bottom surface of bedding	764.65
V,pbs = volume of pool measured from bottom surface of bedding to water surface elevation	45.79
Areas for geotextile:	
A,b = bottom	5.34
A,lr = left & right sides	312.06
A,us = u.s. end	246.15
A,ds = d.s. end	113.58
A,p = perimeter	103.29
A,gt = total area	86.71

WAKE COUNTY
NORTH CAROLINA

SITE DATA

Project Information		
Project Name:		Jones Dairy Preserve - South
Applicant:		Caaengineers, Inc.
Applicant Contact Name:		Keith P. Gettle, PE
Applicant Contact Number:		919-210-3934
Contact Email:		Kgettle@Caaengineers.com
Municipal Jurisdiction (Select from dropdown menu):		Rolesville
Last Updated:		Tuesday, August 18, 2020
Site Data:		
Total Site Area (Ac):		54.10
Existing Lake/Pond Area (Ac):		0.00
Proposed Disturbed Area (Ac):		54.10
Impervious Surface Area (acre):		25.06
Type of Development (Select from Dropdown menu):		Residential
Percent Built Upon Area (BUA):		46%
Project Density:		High
Is the proposed project a site expansion?		No
Number of Drainage Areas on Site:		4
NOAA	1-Year, 24-Hour Storm (inches) (See NOAA Website):	2.87
	2-Year, 24-Hour Storm (inches) (See NOAA Website):	3.46
	10-Year, 24-Hour Storm (inches) (See NOAA Website):	5.05
Lot Data (if applicable):		
Total Acreage in Lots:		45.94
Number of Lots:		215
Average Lot Size (SF):		6500.00
Total Impervious Surface Area on Lots (SF):		3500.00
Average Impervious Surface Area Per Lot (SF):		3500.00

Stormwater Narrative (limit to 1,200 characters - attach additional pages with submittal if necessary):

Project Address: Jones Dairy Road
Rolesville, NC

Pins: 1759-88-8240, 1759.02-88-8240, 1759.02-78-8199

Latitude:N 35° 56' 31.32"
Longitude:W 78° 27' 36.44"

Developer: Preserve at Jones Dairy, LLC
10534 Arnold Palmer Lane
Raleigh, NC 27617

Telephone: (914) 422-1847

Site Description

The project consists of a single parcel approximately 54.01 acres located on Jones Dairy Road in Rolesville, NC. The parcels are vacant and the property is zoned R & PUD. The site is in the Neuse River Basin, and the Town of Rolesville, and subjected to those rules regarding stormwater nutrient management and post development runoff.

The parcel is located within an "Area of Minimal Flood Hazard" as noted per FEMA map 3720175900J, dated May 2, 2006.

Based on the Wake County GIS and SCS soils map (attached) the onsite soils are VaB, VaC2 (Vance Series), Wy (Worsham) and WkC (Wake).

Proposed Development --The stormwater analysis considers a development that will include 215 single family residential lots. The BMP's proposed are a water quality pond and a bioretention device to treat the first inch of rainfall and control runoff within drainage areas as shown on the attached Drainage Map EX1.

Proposed Stormwater Management

The proposed stormwater facilities for the project will consist of one wet pond and one Bioretention device. Drainage from the majority of the property will be collected within the storm pipe system and routed to the BMPs. The devices are designed in accordance with NCDENR DWR's BMP Manual. The devices are is designed to manage the 2 and10, 24-hour storm, events as noted below. The post development runoff from the noted storm events are less than the pre-development rates for the site in total. As a result, per the Town of Rolesville UDO 7.5.4, a Downstream Impact Analysis is not required since the post development runoff rate is less than pre-development.

The proposed SCM will capture the runoff from the impervious areas from the lots and roadways throughout the project. Runoff from the lots adjacent to the southern portion of the project are not routed to the BMPs due to the grade elevation difference. However, the impervious associated in this area has been accounted for treatment within the two BMPs.

WAKE COUNTY
NORTH CAROLINA

Project Name: Jones Dairy Preserve - South

DRAINAGE AREA 1
STORMWATER PRE-POST CALCULATIONS

LAND USE & SITE DATA	PRE-DEVELOPMENT				POST-DEVELOPMENT			
Drainage Area (Acres)=	22.25				18.19			
Site Acreage within Drainage=	22.25				18.19			
One-year, 24-hour rainfall (in)=	2.87							
Two-year, 24-hour rainfall (in)=	3.46							
Ten-year, 24-hour storm (in)=	5.05							
Total Lake/Pond Area (Acres)=	0.00				0.00			
Lake/Pond Area not in the Tc flow path (Acres)=	0.00				0.00			
Site Land Use (acres):	A	B	C	D	A	B	C	D
Pasture								
Woods, Poor Condition								
Woods, Fair Condition								
Woods, Good Condition								
Open Space, Poor Condition		22.00		0.25				
Open Space, Fair condition								
Open Space, Good Condition						0.69		
Reforestation (in dedicated OS)								
Connected Impervious						17.50		
Disconnected Impervious								

SITE FLOW	PRE-DEVELOPMENT T_c	POST-DEVELOPMENT Tc
Sheet Flow		
Length (ft)=	50.00	100.00
Slope (ft/ft)=	0.035	0.035
Surface Cover:	Woods	Grass
n-value=	0.400	0.240
T_t (hrs)=	0.174	0.201
Shallow Flow		
Length (ft)=	1379.00	182.00
Slope (ft/ft)=	0.035	0.035
Surface Cover:	Unpaved	Unpaved
Average Velocity (ft/sec)=	3.02	3.02
T_t (hrs)=	0.13	0.02
Channel Flow 1		
Length (ft)=	189.00	1483.00
Slope (ft/ft)=	0.035	0.010
Cross Sectional Flow Area (ft^2)=	6.50	3.53
Wetted Perimeter (ft)=	9.50	4.71
Channel Lining:	Weeds	Concrete, finished
n-value=	0.040	0.012
Hydraulic Radius (ft)=	0.68	0.75
Average Velocity (ft/sec)=	5.41	10.24
T_t (hrs)=	0.01	0.04

WAKE COUNTY
NORTH CAROLINA

Project Name: Jones Dairy Preserve - South

DRAINAGE AREA 1
STORMWATER PRE-POST CALCULATIONS

Channel Flow 2		
Length (ft)=	0.00	0.00
Slope (ft/ft)=		
Cross Sectional Flow Area (ft^2)=		
Wetted Perimeter (ft)=		
Channel Lining:		
n-value=		
Hydraulic Radius (ft)=		
Average Velocity (ft/sec)=		
T_t (hrs)=		
Channel Flow 3		
Length (ft)=	0.00	0.00
Slope (ft/ft)=		
Cross Sectional Flow Area (ft^2)=		
Wetted Perimeter (ft)=		
Channel Lining:		
n-value=		
Hydraulic Radius (ft)=		
Average Velocity (ft/sec)=		
T_t (hrs)=		
Tc (hrs)=	0.31	0.26
RESULTS	**PRE-DEVELOPMENT**	**POST-DEVELOPMENT**
Composite Curve Number=	79	97
Disconnected Impervious Adjustment		
Disconnected impervious area (acre) =		
$CN_{adjusted\ (1\text{-}year)}$=	**97**	
High Density Only		
Volume of runoff from 1" rainfall for DA HIGH DENSITY REQUIREMENT = (ft^3) =	60,474	
1-year, 24-hour storm (Peak Flow)		
Runoff (inches) = $Q^*_{1\text{-}year}$=	1.10	2.49
Volume of runoff (ft^3) =	88,903	164,212
Volume change (ft^3) =	75,309	
Peak Discharge (cfs)= $Q_{1\text{-}year}$=	25.493	51.037
2-year, 24-hour storm (LID)		
Runoff (inches) = $Q^*_{2\text{-}year}$=	1.54	3.07
Volume of runoff (ft^3) =	124,588	202,761
Peak Discharge (cfs)= $Q_{2\text{-}year}$=	35.725	63.017
10-year, 24-hour storm (DIA)		
Runoff (inches) = $Q^*_{10\text{-}year}$=	2.85	4.65
Volume of runoff (ft^3) =	230,573	375,640
Peak Discharge (cfs)= $Q_{10\text{-}year}$=	66.116	95.444

Project Name: Jones Dairy Preserve - South

DRAINAGE AREA 2
STORMWATER PRE-POST CALCULATIONS

LAND USE & SITE DATA	PRE-DEVELOPMENT				POST-DEVELOPMENT			
Drainage Area (Acres)=	18.40				11.73			
Site Acreage within Drainage=	18.40				11.73			
One-year, 24-hour rainfall (in)=	2.87							
Two-year, 24-hour rainfall (in)=	3.46							
Ten-year, 24-hour storm (in)=	5.05							
Total Lake/Pond Area (Acres)=								
Lake/Pond Area not in the Tc flow path (Acres)=								
Site Land Use (acres):	A	B	C	D	A	B	C	D
Pasture								
Woods, Poor Condition								
Woods, Fair Condition								
Woods, Good Condition								
Open Space, Poor Condition		16.29		2.11				
Open Space, Fair condition						1.51		2.11
Open Space, Good Condition								
Reforestation (in dedicated OS)								
Connected Impervious						8.11		
Disconnected Impervious								
SITE FLOW	**PRE-DEVELOPMENT T_c**				**POST-DEVELOPMENT Tc**			
Sheet Flow								
Length (ft)=	100.00				100.00			
Slope (ft/ft)=	0.030				0.030			
Surface Cover:	Grass				Grass			
n-value=	0.240				0.240			
T_t (hrs)=	0.214				0.214			
Shallow Flow								
Length (ft)=	593.00				76.00			
Slope (ft/ft)=	0.030				0.030			
Surface Cover:	Unpaved				Unpaved			
Average Velocity (ft/sec)=	2.79				2.79			
T_t (hrs)=	0.06				0.01			
Channel Flow 1								
Length (ft)=	794.00				597.00			
Slope (ft/ft)=	0.030				0.010			
Cross Sectional Flow Area (ft^2)=	18.75				3.53			
Wetted Perimeter (ft)=	17.59				4.71			
Channel Lining:	Weeds				Concrete, finished			
n-value=	0.040				0.012			
Hydraulic Radius (ft)=	1.07				0.75			
Average Velocity (ft/sec)=	6.73				10.24			
T_t (hrs)=	0.03				0.02			

WAKE COUNTY
NORTH CAROLINA

Project Name: Jones Dairy Preserve - South

DRAINAGE AREA 2
STORMWATER PRE-POST CALCULATIONS

Channel Flow 2		
Length (ft)=		
Slope (ft/ft)=		
Cross Sectional Flow Area (ft^2)=		
Wetted Perimeter (ft)=		
Channel Lining:		
n-value=		
Hydraulic Radius (ft)=		
Average Velocity (ft/sec)=		
T_t (hrs)=		
Channel Flow 3		
Length (ft)=		
Slope (ft/ft)=		
Cross Sectional Flow Area (ft^2)=		
Wetted Perimeter (ft)=		
Channel Lining:		
n-value=		
Hydraulic Radius (ft)=		
Average Velocity (ft/sec)=		
T_t (hrs)=		
Tc (hrs)=	0.31	0.24
RESULTS	**PRE-DEVELOPMENT**	**POST-DEVELOPMENT**
Composite Curve Number=	80	92
Disconnected Impervious Adjustment		
Disconnected impervious area (acre) =		
$CN_{adjusted\ (1\text{-}year)}$=	**92**	
High Density Only		
Volume of runoff from 1" rainfall for DA HIGH DENSITY REQUIREMENT = (ft^3) =	28,624	
1-year, 24-hour storm (Peak Flow)		
Runoff (inches) = $Q^*_{1\text{-}year}$=	1.16	2.02
Volume of runoff (ft^3) =	77,639	85,851
Volume change (ft^3) =	8,212	
Peak Discharge (cfs)= $Q_{1\text{-}year}$=	22.421	27.616
2-year, 24-hour storm (LID)		
Runoff (inches) = $Q^*_{2\text{-}year}$=	1.62	2.57
Volume of runoff (ft^3) =	107,889	109,619
Peak Discharge (cfs)= $Q_{2\text{-}year}$=	31.157	35.261
10-year, 24-hour storm (DIA)		
Runoff (inches) = $Q^*_{10\text{-}year}$=	2.95	4.11
Volume of runoff (ft^3) =	197,063	274,590
Peak Discharge (cfs)= $Q_{10\text{-}year}$=	56.910	56.309

Project Name: Jones Dairy Preserve - South

DRAINAGE AREA 3
STORMWATER PRE-POST CALCULATIONS

LAND USE & SITE DATA	PRE-DEVELOPMENT				POST-DEVELOPMENT			
Drainage Area (Acres)=	13.45				24.18			
Site Acreage within Drainage=	13.45				24.18			
One-year, 24-hour rainfall (in)=	2.87							
Two-year, 24-hour rainfall (in)=	3.46							
Ten-year, 24-hour storm (in)=	5.05							
Total Lake/Pond Area (Acres)=	0.00				0.00			
Lake/Pond Area not in the Tc flow path (Acres)=	0.00				0.00			
Site Land Use (acres):	A	B	C	D	A	B	C	D
Pasture								
Woods, Poor Condition								
Woods, Fair Condition								
Woods, Good Condition								
Open Space, Poor Condition		11.34		2.11				
Open Space, Fair condition								
Open Space, Good Condition						22.07		2.11
Reforestation (in dedicated OS)								
Connected Impervious								
Disconnected Impervious								

SITE FLOW	PRE-DEVELOPMENT T_c	POST-DEVELOPMENT Tc
Sheet Flow		
Length (ft)=	23.00	23.00
Slope (ft/ft)=	0.270	0.270
Surface Cover:	Woods	Woods
n-value=	0.400	0.400
T_t (hrs)=	0.041	0.041
Shallow Flow		
Length (ft)=		
Slope (ft/ft)=		
Surface Cover:		
Average Velocity (ft/sec)=		
T_t (hrs)=		
Channel Flow 1		
Length (ft)=	794.00	794.00
Slope (ft/ft)=	0.030	0.030
Cross Sectional Flow Area (ft^2)=	18.75	18.75
Wetted Perimeter (ft)=	17.59	17.59
Channel Lining:	Weeds	Weeds
n-value=	0.040	0.040
Hydraulic Radius (ft)=	1.07	1.07
Average Velocity (ft/sec)=	6.73	6.73
T_t (hrs)=	0.03	0.03

WAKE COUNTY
NORTH CAROLINA

Project Name: Jones Dairy Preserve - South

DRAINAGE AREA 3
STORMWATER PRE-POST CALCULATIONS

Channel Flow 2		
Length (ft)=		
Slope (ft/ft)=		
Cross Sectional Flow Area (ft^2)=		
Wetted Perimeter (ft)=		
Channel Lining:		
n-value=		
Hydraulic Radius (ft)=		
Average Velocity (ft/sec)=		
T_t (hrs)=		
Channel Flow 3		
Length (ft)=		
Slope (ft/ft)=		
Cross Sectional Flow Area (ft^2)=		
Wetted Perimeter (ft)=		
Channel Lining:		
n-value=		
Hydraulic Radius (ft)=		
Average Velocity (ft/sec)=		
T_t (hrs)=		
Tc (hrs)=	0.07	0.07
RESULTS	**PRE-DEVELOPMENT**	**POST-DEVELOPMENT**
Composite Curve Number=	81	63
Disconnected Impervious Adjustment		
Disconnected impervious area (acre) =		
$CN_{adjusted\ (1\text{-}year)}$=	**63**	
High Density Only		
Volume of runoff from 1" rainfall for DA HIGH DENSITY REQUIREMENT = (ft^3) =	4,389	
1-year, 24-hour storm (Peak Flow)		
Runoff (inches) = $Q^*_{1\text{-}year}$=	1.19	0.37
Volume of runoff (ft^3) =	57,998	32,366
Volume change (ft^3) =		
Peak Discharge (cfs)= $Q_{1\text{-}year}$=	27.319	12.979
2-year, 24-hour storm (LID)		
Runoff (inches) = $Q^*_{2\text{-}year}$=	1.65	0.63
Volume of runoff (ft^3) =	80,326	54,885
Peak Discharge (cfs)= $Q_{2\text{-}year}$=	37.837	22.009
10-year, 24-hour storm (DIA)		
Runoff (inches) = $Q^*_{10\text{-}year}$=	2.99	1.52
Volume of runoff (ft^3) =	145,953	74,029
Peak Discharge (cfs)= $Q_{10\text{-}year}$=	68.750	53.369

WAKE COUNTY
NORTH CAROLINA

Project Name: Jones Dairy Preserve - South

DA SITE SUMMARY
STORMWATER PRE-POST CALCULATIONS

SITE SUMMARY

DRAINAGE AREA SUMMARIES

DRAINAGE AREA:	DA1	DA2	DA3	DA4	DA5	DA6	DA7	DA8	DA9	DA10
Pre-Development (1-year, 24-hour storm)										
Runoff (in) = $Q_{pre,1\text{-}year}$ =	1.10	1.16	1.19							
Peak Flow (cfs)=$Q_{1\text{-}year}$ =	25.493	22.421	27.319							
Post-Development (1-year, 24-hour storm)										
Proposed Impervious Surface (acre) =	17.50	8.11	0.00							
Runoff (in)=$Q_{1\text{-}year}$ =	2.49	2.02	0.37							
Peak Flow (cfs)=$Q_{1\text{-}year}$ =	51.037	27.616	12.979							
Increase in volume per DA (ft^3)_1-yr storm=	75,309	8,212								
Minimum Volume to be Managed for DA HIGH DENSITY REQUIREMENT = (ft^3) =	60,474	28,624	4,389							

TARGET CURVE NUMBER (TCN)

Site Data

SITE \SOIL COMPOSITION

HYDROLOGIC SOIL GROUP	Site Area	%	Target CN
A	0.00	0%	N/A
B	49.88	92%	N/A
C	0.00	0%	N/A
D	4.22	8%	N/A

Total Site Area (acres) =	54.10
Percent BUA (Includes Existing Lakes/Pond Areas) =	47%
Project Density =	High
Target Curve Number (TCN) =	N/A
$CN_{adjusted\ (1\text{-}year)}$=	80
Minimum Volume to be Managed (Total Site) Per TCN Requirement= ft^3 =	N/A

Site Nitrogen Loading Data

HSG	TN export coefficient (lbs/ac/yr)	Site Acreage	N Export
Pasture	1.2	0.00	0.00
Woods, Poor Condition	1.6	0.00	0.00
Woods, Fair Condition	1.2	0.00	0.00
Woods, Good Condition	0.8	0.00	0.00
Open Space, Poor Condition	1.0	0.00	0.00
Open Space, Fair Condition	0.8	3.62	2.90
Open Space, Good Condition	0.6	24.87	14.92
Reforestation (in dedicated OS)	0.6	0.00	0.00
Impervious	21.2	25.61	542.93
SITE NITROGEN LOADING RATE (lbs/ac/yr)=	10.37		
Nitrogen Load (lbs/yr)=	560.75		
TOTAL SITE NITROGEN TO MITIGATE (lbs/yr)_Wendell Only=	365.99		

Site Nitrogen Loading Data For Expansions Only

	Existing	New
Impervious(acres)=	NA	NA
"Expansion Area" (acres=)		
Nitrogen Load (lbs/yr)=	NA	NA
SITE NITROGEN LOADING RATE (lbs/ac/yr)=	NA	NA
Total Site loading rate (lbs/ac/yr)		
TOTAL SITE NITROGEN TO MITIGATE (lbs/yr)=	NA	

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Project Name: Jones Dairy Preserve - South

DRAINAGE AREA 1
BMP CALCULATIONS

DRAINAGE AREA 1 - BMP DEVICES AND ADJUSTMENTS

DA1 Site Acreage=	18.19			
DA1 Off-Site Acreage=				
Total Required Storage Volume for Site TCN Requirement (ft^3)=	N/A			
Total Required Storage Volume for DA1 1" Rainfall for High Density (ft^3)=	60,474			
Will site use underground detention/cistern?	No	Enter % of the year water will be reused=		Note: Supporting information/details should be submitted to demonstrate water usage.

ENTER ACREAGE FOR ALL SUB-DRAINAGE AREAS IN DA

HSG	Sub-DA1(a) (Ac)		Sub-DA1(b) (Ac)		Sub-DA1(c) (Ac)		Sub-DA1(d) (Ac)		Sub-DA1(e) (Ac)	
	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site
Pasture										
Woods, Poor Condition										
Woods, Fair Condition										
Woods, Good Condition										
Open Space, Poor Condition										
Open Space, Fair Condition	0.69									
Open Space, Good Condition										
Reforestation (in dedicated OS)										
Impervious	17.50									

Sub-DA1(a) BMP(s)

Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
Wet Pond 1	Wet Detention Basin	60,474	62,776	25%	371.55	92.89	
				0%	278.66	0.00	
				0%	278.66	0.00	
				0%	278.66	0.00	
				0%	278.66	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):					**278.66**		

Sub-DA1(b) BMP(s)

If Sub-DA1(b) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):

Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

Sub-DA1 (c) BMP(s)

If Sub-DA1(c) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):

Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

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DRAINAGE AREA 1
BMP CALCULATIONS

Sub-DA1(d) BMP(s)							
If Sub-DA1(d) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):							
Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

Sub-DA1(e) BMP(s)							
If Sub-DA1(e) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):							
Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

DA1 BMP SUMMARY	
Total Volume Treated (ft^3)=	62,776
Nitrogen Mitigated(lbs)=	92.89
1-year, 24-hour storm	
Post BMP Volume of Runoff (ft^3)$_{(1\text{-year})}$=	101,436
Post BMP Runoff (inches) = $Q^*_{(1\text{-year})}$=	1.54
Post BMP $CN_{(1\text{-year})}$=	85
Post BMP Peak Discharge (cfs)= $Q_{1\text{-year}}$=	1.350
2-year, 24-hour storm (LID)	
Post BMP Volume of Runoff (ft3)$_{(2\text{-year})}$=	139,985
Post BMP Runoff (inches) = $Q^*_{(2\text{-year})}$=	2.12
Post BMP $CN_{(2\text{-year})}$=	86
Post BMP Peak Discharge (cfs)= $Q_{(2\text{-year})}$=	1.350
10-year, 24-hour storm (DIA)	
Post BMP Volume of Runoff (ft^3)$_{(10\text{-year})}$=	312,864
Post BMP Runoff (inches) = $Q^*_{(10\text{-year})}$=	4.74
Post BMP $CN_{(10\text{-year})}$=	98
Post BMP Peak Discharge (cfs)= $Q_{(10\text{-year})}$=	7.900

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DRAINAGE AREA 2
BMP CALCULATIONS

DRAINAGE AREA 1 - BMP DEVICES AND ADJUSTMENTS				
DA2 Site Acreage=	11.73			
DA2 Off-Site Acreage=				
Total Required Storage Volume TCN Requirement (ft^3)=	N/A			
Total Required Storage Volume for DA2 1" Rainfall for High Density (ft3)=	28,624			
Will site use underground detention/cistern?		Enter % of the year water will be reused=		Note: Supporting information/details should be submitted to demonstrate water usage.

ENTER ACREAGE FOR ALL SUB-DRAINAGE AREAS IN DA

HSG	Sub-DA2(a) (Ac)		Sub-DA2(b) (Ac)		Sub-DA2(c) (Ac)		Sub-DA2(d) (Ac)		Sub-DA2(e) (Ac)	
	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site
Pasture										
Woods, Poor Condition										
Woods, Fair Condition										
Woods, Good Condition										
Open Space, Poor Condition										
Open Space, Fair Condition	3.62									
Open Space, Good Condition										
Reforestation (in dedicated OS)										
Impervious	8.11									

Sub-DA1(a) BMP(s)

Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
Bioretention 2	Bioretention with IWS	28,624	29,253	40%	174.83	69.93	
				0%	104.90	0.00	
				0%	104.90	0.00	
				0%	104.90	0.00	
				0%	104.90	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):		**104.90**					

Sub-DA1(b) BMP(s)

If Sub-DA1(b) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):

Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

Sub-DA1 (c) BMP(s)

If Sub-DA1(c) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):

Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

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DRAINAGE AREA 2
BMP CALCULATIONS

Sub-DA1(d) BMP(s)							
If Sub-DA1(d) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):							
Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

Sub-DA1(e) BMP(s)							
If Sub-DA1(e) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):							
Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

DA2 BMP SUMMARY	
Total Volume Treated (ft^3)=	29,253
Nitrogen Mitigated(lbs)=	69.93
1-year, 24-hour storm	
Post BMP Volume of Runoff $(ft^3)_{(1\text{-year})}$=	56,598
Post BMP Runoff (inches) = $Q^*_{(1\text{-year})}$=	1.33
Post BMP $CN_{(1\text{-year})}$=	82
Post BMP Peak Discharge (cfs)= $Q_{1\text{-year}}$=	0.500
2-year, 24-hour storm (LID)	
Post BMP Volume of Runoff $(ft3)_{(2\text{-year})}$=	80,366
Post BMP Runoff (inches) = $Q^*_{(2\text{-year})}$=	1.89
Post BMP $CN_{(2\text{-year})}$=	83
Post BMP Peak Discharge (cfs)= $Q_{(2\text{-year})}$=	0.500
10-year, 24-hour storm (DIA)	
Post BMP Volume of Runoff $(ft^3)_{(10\text{-year})}$=	245,337
Post BMP Runoff (inches) = $Q^*_{(10\text{-year})}$=	5.76
Post BMP $CN_{(10\text{-year})}$=	98
Post BMP Peak Discharge (cfs)= $Q_{(10\text{-year})}$=	0.500

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DRAINAGE AREA 3
BMP CALCULATIONS

DRAINAGE AREA 1 - BMP DEVICES AND ADJUSTMENTS				
DA3 Site Acreage=	24.18			
DA3 Off-Site Acreage=				
Total Required Storage Volume TCN Requirement (ft^3)=	N/A			
Total Required Storage Volume for DA3 1" Rainfall for High Density (ft3)=	4,389			
Will site use underground detention/cistern?	No	Enter % of the year water will be reused=		Note: Supporting information/details should be submitted to demonstrate water usage.

ENTER ACREAGE FOR ALL SUB-DRAINAGE AREAS IN DA

HSG	Sub-DA3(a) (Ac)		Sub-DA3(b) (Ac)		Sub-DA3(c) (Ac)		Sub-DA3(d) (Ac)		Sub-DA3(e) (Ac)	
	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site
Pasture										
Woods, Poor Condition										
Woods, Fair Condition										
Woods, Good Condition										
Open Space, Poor Condition										
Open Space, Fair Condition	24.27									
Open Space, Good Condition										
Reforestation (in dedicated OS)										
Impervious										

Sub-DA1(a) BMP(s)

Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
None		4,405	0	0%	19.42	0.00	0
				0%	19.42	0.00	0
				0%	19.42	0.00	0
				0%	19.42	0.00	0
				0%	19.42	0.00	0
Total Nitrogen remaining leaving the subbasin (lbs):		**19.42**					

Sub-DA1(b) BMP(s)

If Sub-DA1(b) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):

Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
			0	0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

Sub-DA1 (c) BMP(s)

If Sub-DA1(c) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):

Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
			0	0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

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DRAINAGE AREA 3
BMP CALCULATIONS

Sub-DA1(d) BMP(s)							
If Sub-DA1(d) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):							
Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
				0%	0.00	0.00	
				0%	0.00	0.00	
			0	0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

Sub-DA1(e) BMP(s)							
If Sub-DA1(e) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):							
Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
				0%	0.00	0.00	
				0%	0.00	0.00	
			0	0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

DA3 BMP SUMMARY	
Total Volume Treated (ft^3)=	
Nitrogen Mitigated(lbs)=	
1-year, 24-hour storm	
Post BMP Volume of Runoff $(ft^3)_{(1\text{-year})}$=	32,366
Post BMP Runoff (inches) = $Q^*_{(1\text{-year})}$=	0.37
Post BMP $CN_{(1\text{-year})}$=	62
Post BMP Peak Discharge (cfs)= $Q_{1\text{-year}}$=	69.580
2-year, 24-hour storm (LID)	
Post BMP Volume of Runoff $(ft3)_{(2\text{-year})}$=	54,885
Post BMP Runoff (inches) = $Q^*_{(2\text{-year})}$=	0.63
Post BMP $CN_{(2\text{-year})}$=	62
Post BMP Peak Discharge (cfs)= $Q_{(2\text{-year})}$=	69.580
10-year, 24-hour storm (DIA)	
Post BMP Volume of Runoff $(ft^3)_{(10\text{-year})}$=	74,029
Post BMP Runoff (inches) = $Q^*_{(10\text{-year})}$=	0.84
Post BMP $CN_{(10\text{-year})}$=	67
Post BMP Peak Discharge (cfs)= $Q_{(10\text{-year})}$=	87.250

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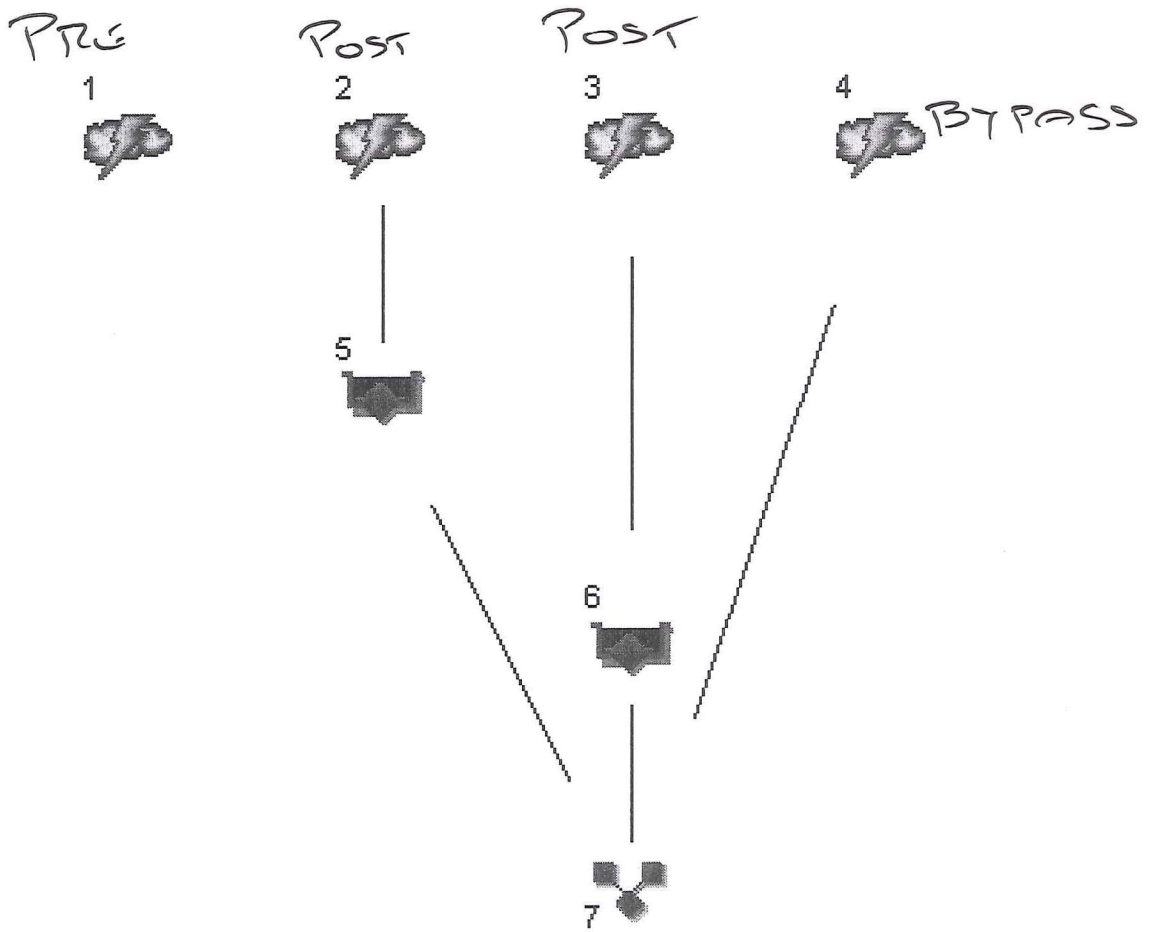
DA SITE SUMMARY
BMP CALCULATIONS

BMP SUMMARY										
DRAINAGE AREA SUMMARIES										
DRAINAGE AREA:	DA1	DA2	DA3	DA4	DA5	DA6	DA7	DA8	DA9	DA10
Pre-Development (1-year, 24-hour storm)										
Runoff (in)=$Q^*_{1\text{-year}}$ =	1.10	1.16	1.19							
Peak Flow (cfs)=$Q_{1\text{-year}}$ =	25.493	22.421	27.319							
Post-Development (1-year, 24-hour storm)										
Target Curve Number (TCN) =	NA									
Post BMP Runoff (inches) = $Q^*_{(1\text{-year})}$=	1.54	1.33	0.37							
Post BMP Peak Discharge (cfs)= $Q_{1\text{-year}}$=	1.350	0.500	69.580							
Post BMP $CN_{(1\text{-year})}$=	74									
Post-BMP Nitrogen Loading										
TOTAL SITE NITROGEN MITIGATED (lbs)=	162.82									
SITE NITROGEN LOADING RATE (lbs/ac/yr)=	7.36									
TOTAL SITE NITROGEN LEFT TO MITIGATE_Wendell Only (lbs)=	**203.17**									



Legend

Hyd.	Origin	Description
1	Rational	Pre Development - Total
2	Rational	Post To Pond
3	Rational	Post to Bio
4	Rational	Post Bypass
5	Reservoir	Post from Pond 1
6	Reservoir	Post from Bio Pond 2
7	Combine	Total Site - Post Development

Q_2 & Q_{10}

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Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	Rational	93.41	1	5	28,023	----	------	------	Pre Development - Total
2	Rational	78.52	1	5	23,556	----	------	------	Post To Pond
3	Rational	47.26	1	5	14,177	----	------	------	Post to Bio
4	Rational	69.58	1	5	20,875	----	------	------	Post Bypass
5	Reservoir	1.35	1	10	14,399	2	396.58	23,426	Post from Pond 1
6	Reservoir	0.00	1	0	0	3	399.48	14,177	Post from Bio Pond 2
7	Combine	69.65	1	5	35,274	4, 5, 6	------	------	Total Site - Post Development

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

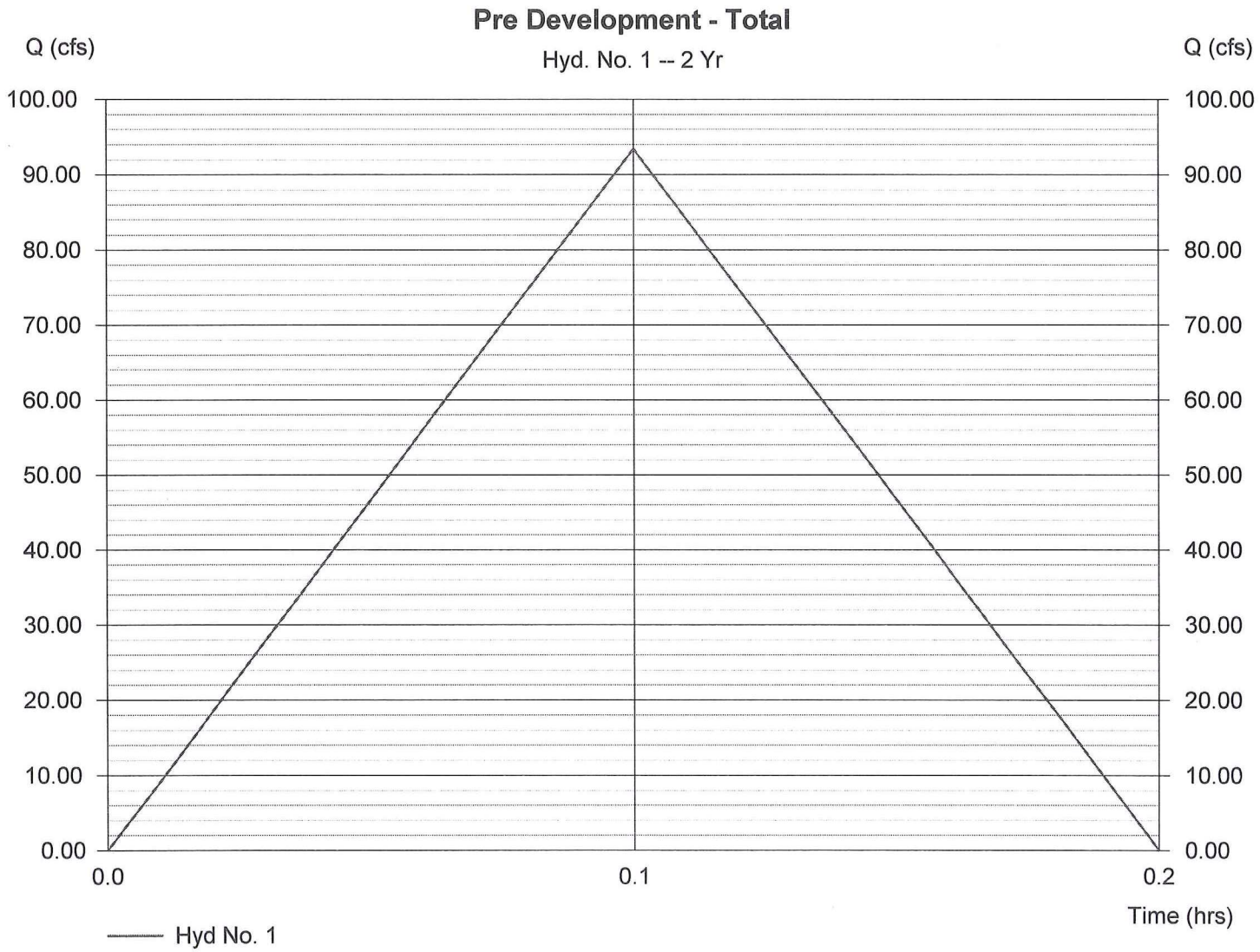
Wednesday, Jul 15 2020, 3:32 PM

Hyd. No. 1

Pre Development - Total

Hydrograph type	= Rational	Peak discharge	= 93.41 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 54.1 ac	Runoff coeff.	= 0.3
Intensity	= 5.755 in/hr	Tc by User	= 5 min
IDF Curve	= Raleigh-2002.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Volume = 28,023 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

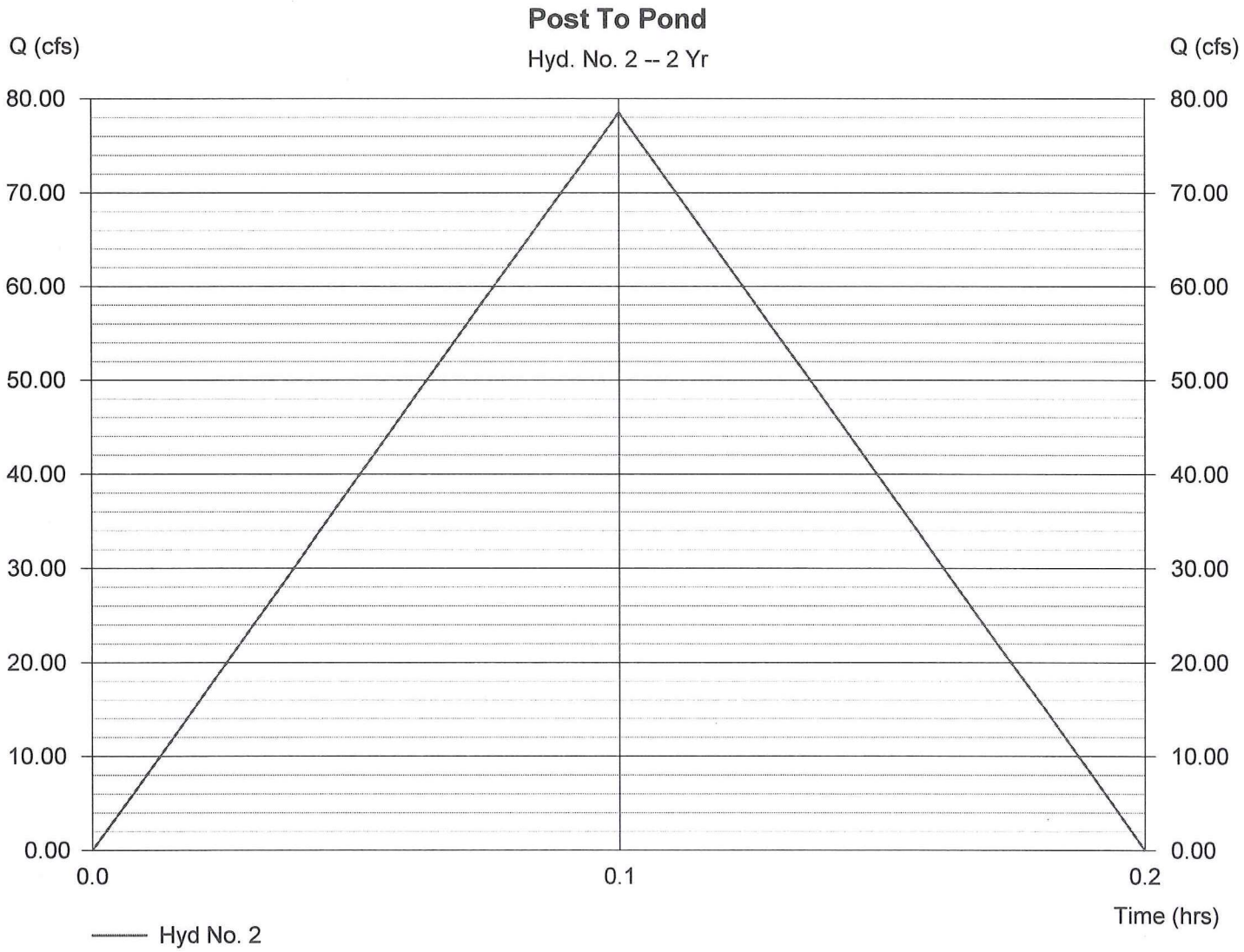
Wednesday, Jul 15 2020, 3:32 PM

Hyd. No. 2

Post To Pond

Hydrograph type	= Rational	Peak discharge	= 78.52 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 18.2 ac	Runoff coeff.	= 0.75
Intensity	= 5.755 in/hr	Tc by User	= 5 min
IDF Curve	= Raleigh-2002.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Volume = 23,556 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

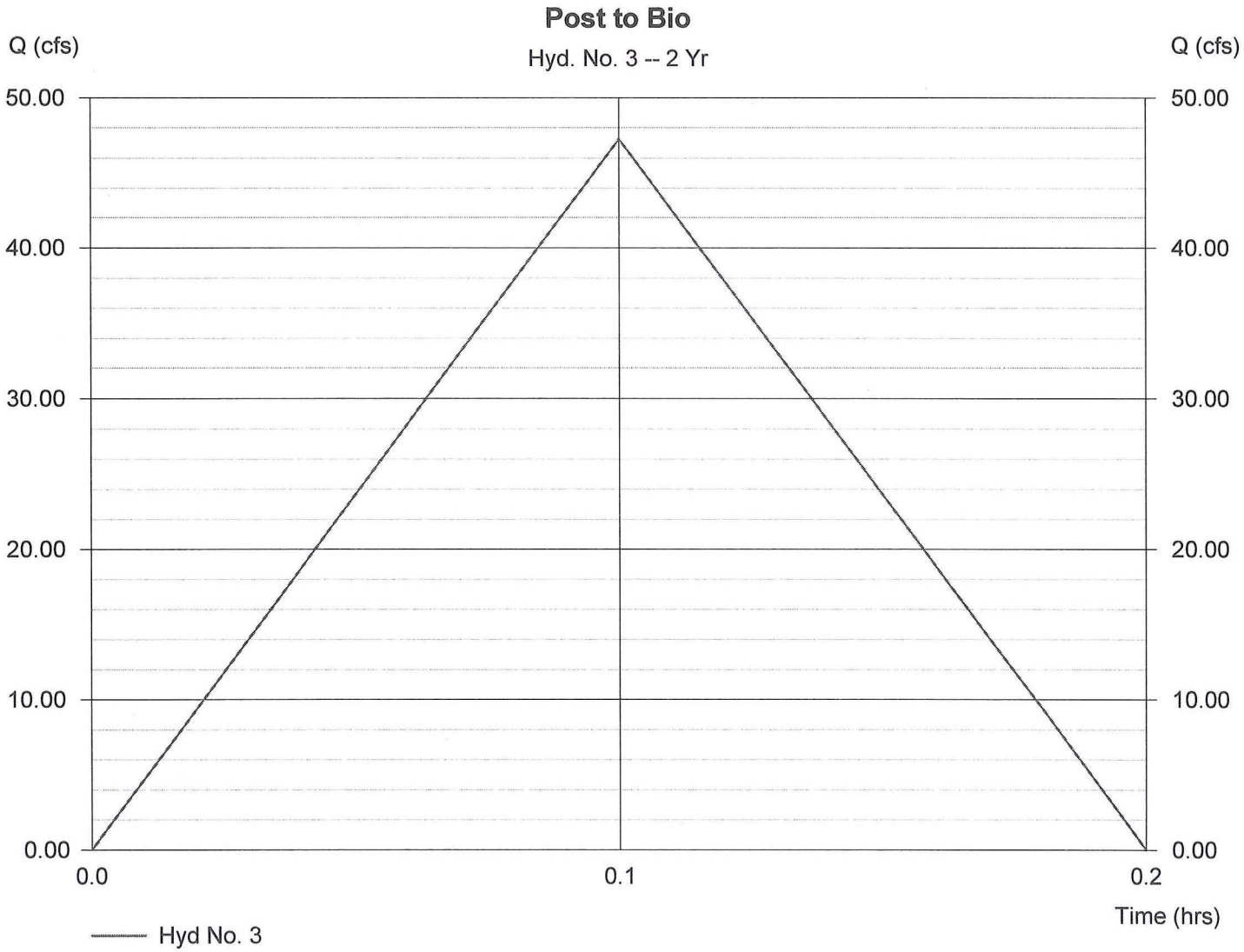
Wednesday, Jul 15 2020, 3:32 PM

Hyd. No. 3

Post to Bio

Hydrograph type	= Rational	Peak discharge	= 47.26 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 11.7 ac	Runoff coeff.	= 0.7
Intensity	= 5.755 in/hr	Tc by User	= 5 min
IDF Curve	= Raleigh-2002.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Volume = 14,177 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

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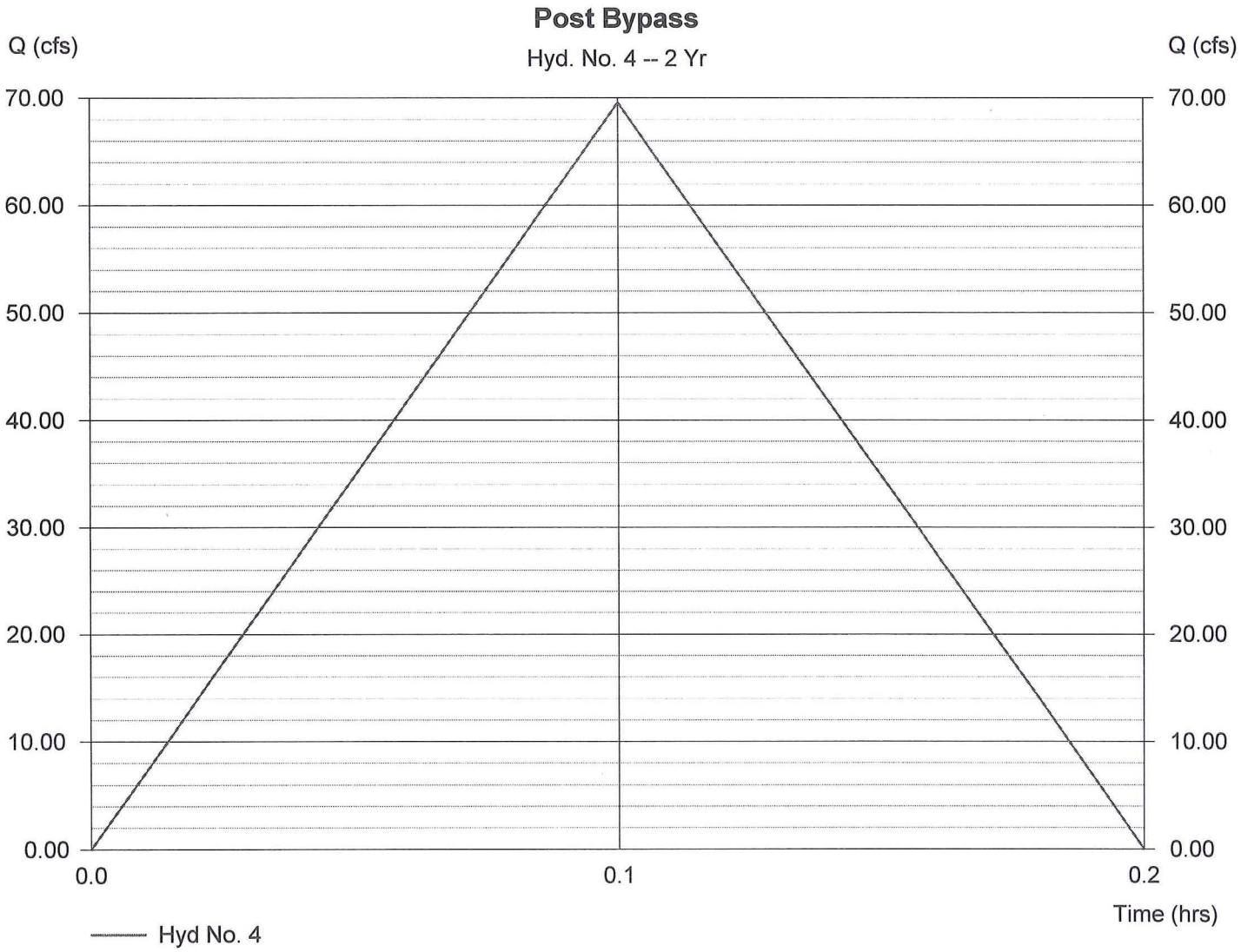
Hyd. No. 4

Post Bypass

Hydrograph type	= Rational	Peak discharge	= 69.58 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 24.2 ac	Runoff coeff.	= 0.5
Intensity	= 5.755 in/hr	Tc by User	= 5 min
IDF Curve	= Raleigh-2002.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Volume = 20,875 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

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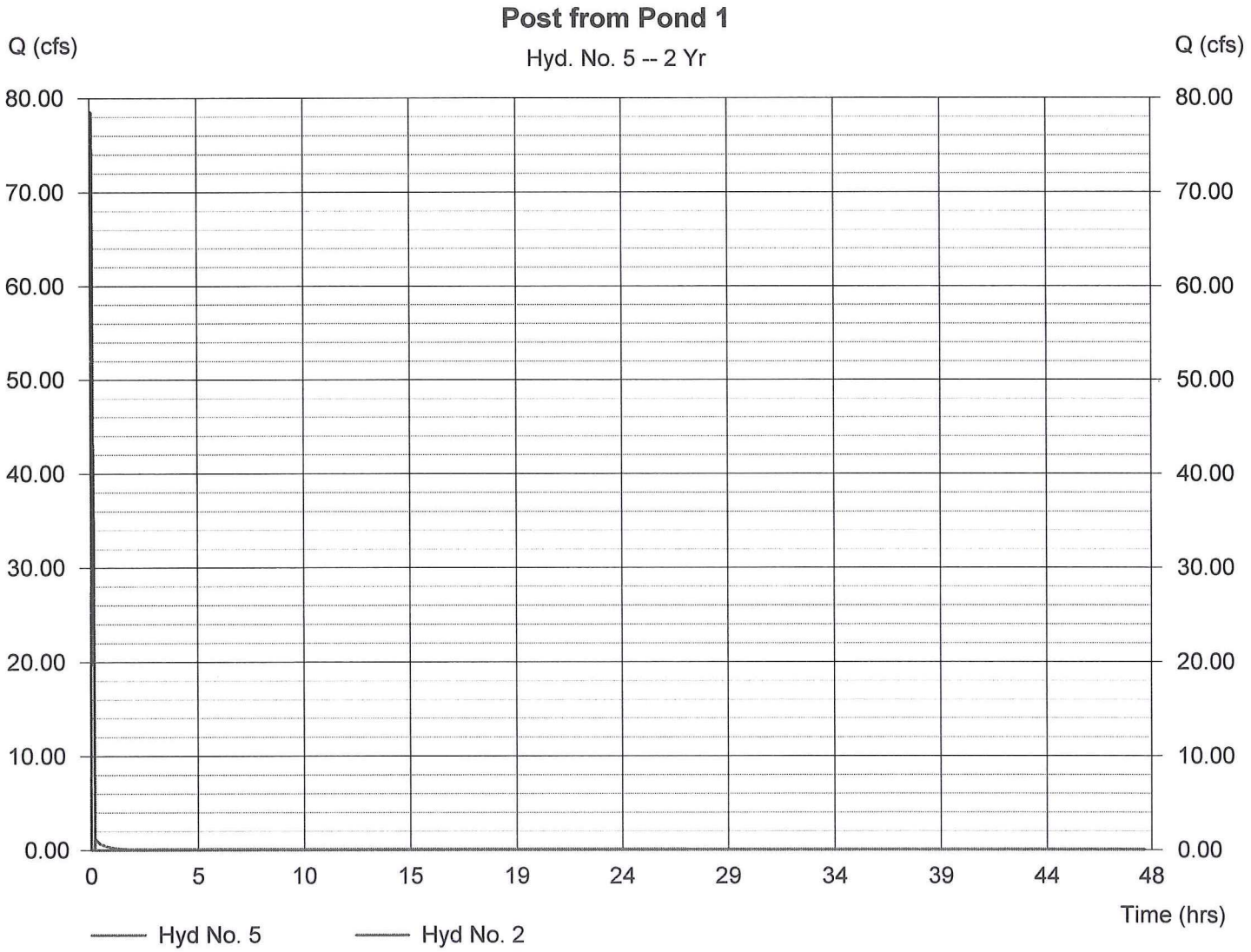
Hyd. No. 5

Post from Pond 1

Hydrograph type	= Reservoir	Peak discharge	= 1.35 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyd. No.	= 2	Max. Elevation	= 396.58 ft
Reservoir name	= Pond 1	Max. Storage	= 23,426 cuft

Storage Indication method used.

Hydrograph Volume = 14,399 cuft



Pond Report

Hydraflow Hydrographs by Intelisolve

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Pond No. 1 - Pond 1

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	395.50	19,221	0	0
1.00	396.50	23,621	21,421	21,421
1.50	397.00	25,905	12,382	33,803
2.50	398.00	29,840	27,873	61,675

Culvert / Orifice Structures

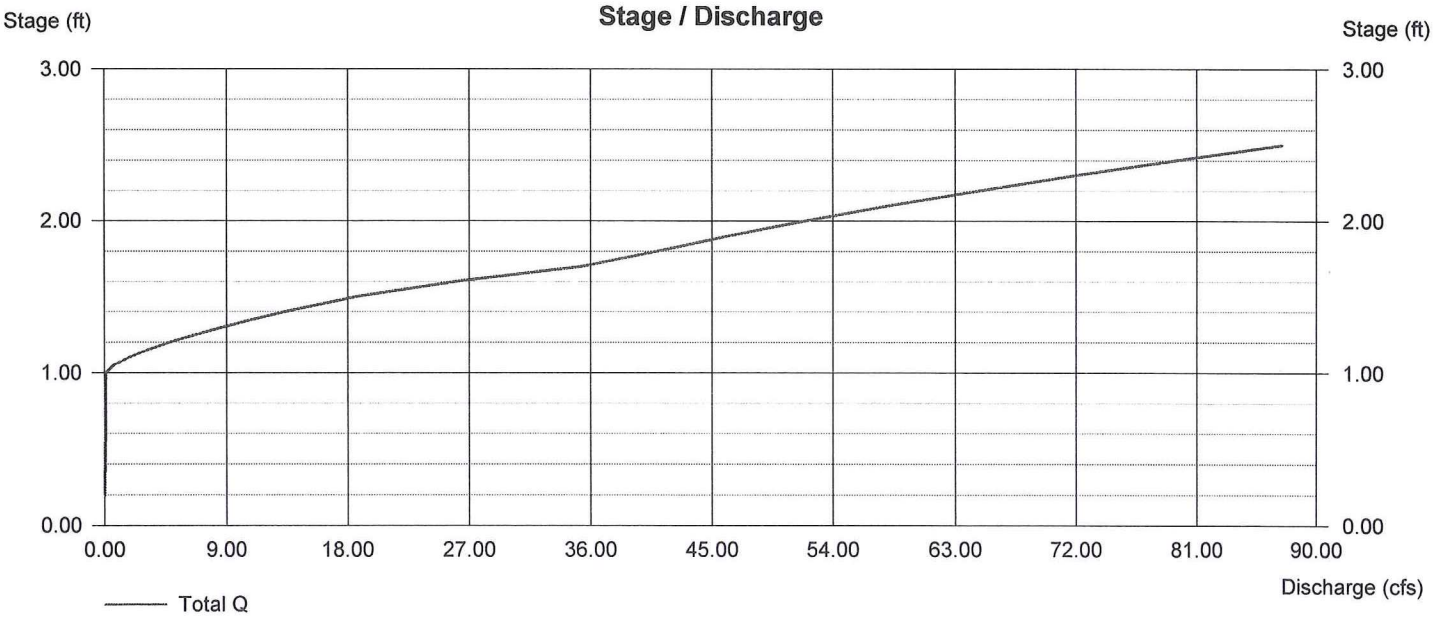
	[A]	[B]	[C]	[D]
Rise (in)	= 24.00	2.00	0.00	0.00
Span (in)	= 24.00	2.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 390.21	395.60	0.00	0.00
Length (ft)	= 143.00	0.50	0.00	0.00
Slope (%)	= 0.50	0.50	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 15.70	20.00	0.00	0.00
Crest El. (ft)	= 396.50	397.00	0.00	0.00
Weir Coeff.	= 3.33	2.60	0.00	0.00
Weir Type	= Riser	Broad	---	---
Multi-Stage	= Yes	No	No	No

Exfiltration = 0.000 in/hr (Contour) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Wednesday, Jul 15 2020, 3:32 PM

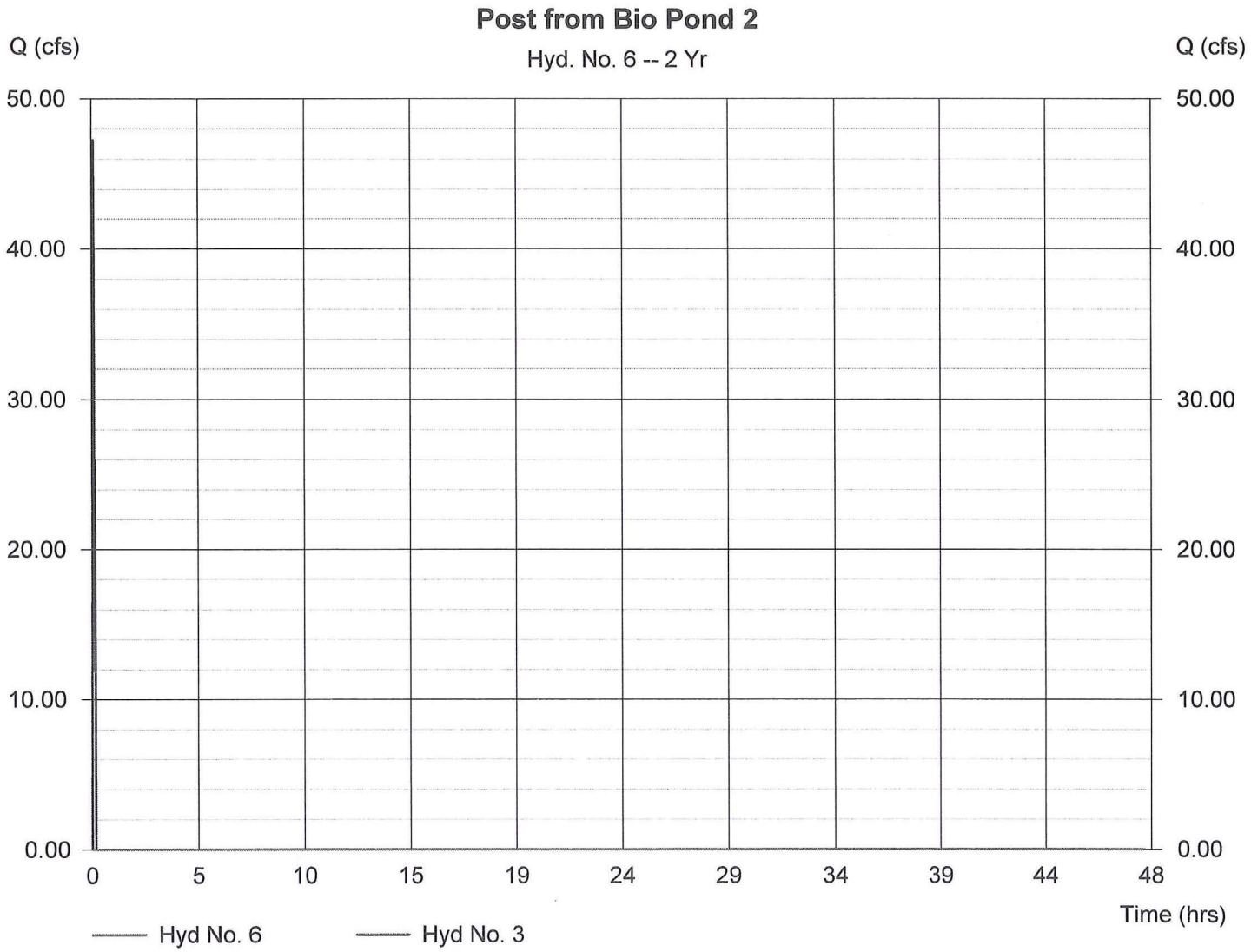
Hyd. No. 6

Post from Bio Pond 2

Hydrograph type	= Reservoir	Peak discharge	= 0.00 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyd. No.	= 3	Max. Elevation	= 399.48 ft
Reservoir name	= Bio Pond 2	Max. Storage	= 14,177 cuft

Storage Indication method used.

Hydrograph Volume = 0 cuft



Pond Report

Pond No. 2 - Bio Pond 2

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	399.00	27,966	0	0
1.00	400.00	30,539	29,253	29,253
1.50	400.50	31,847	15,597	44,849
2.00	401.00	33,168	16,254	61,103
3.00	402.00	35,854	34,511	95,614

Culvert / Orifice Structures

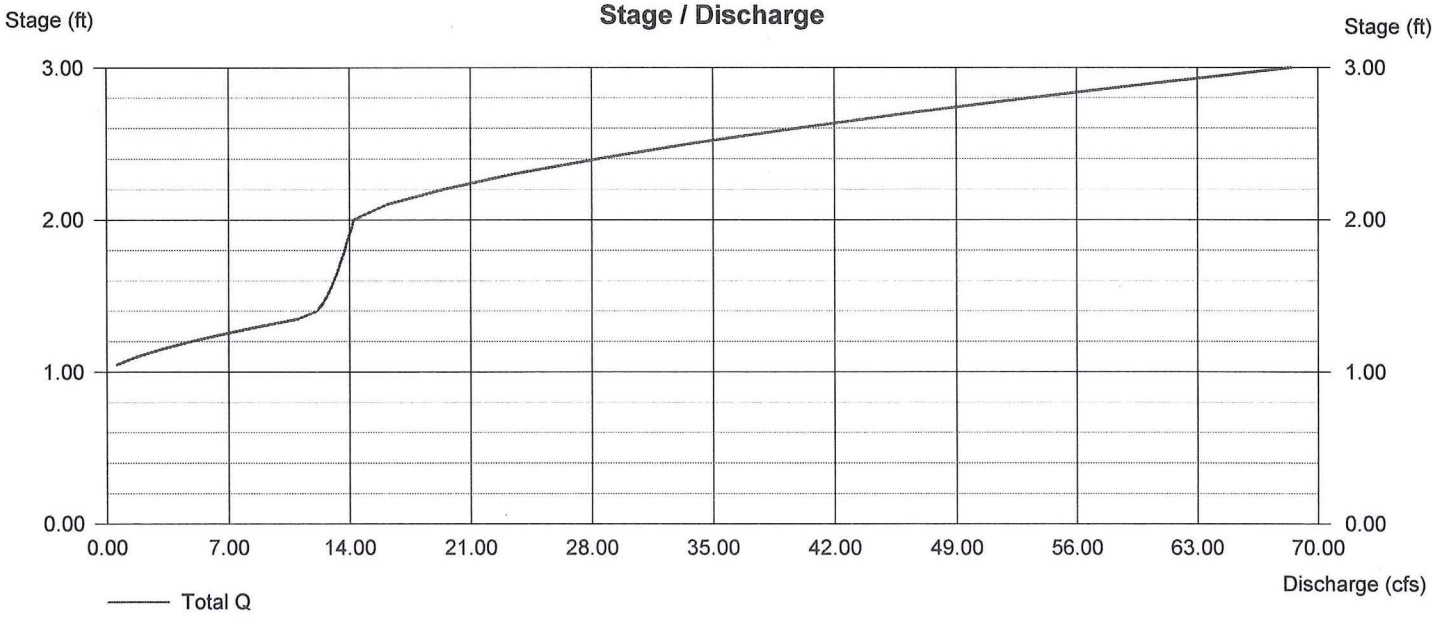
	[A]	[B]	[C]	[D]
Rise (in)	= 18.00	0.00	0.00	0.00
Span (in)	= 18.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 396.95	0.00	0.00	0.00
Length (ft)	= 76.00	0.00	0.00	0.00
Slope (%)	= 0.50	0.00	0.00	0.00
N-Value	= .013	.000	.000	.000
Orif. Coeff.	= 0.60	0.00	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	20.00	0.00	0.00
Crest El. (ft)	= 400.00	401.00	0.00	0.00
Weir Coeff.	= 3.33	2.60	0.00	0.00
Weir Type	= Riser	Broad	---	---
Multi-Stage	= Yes	No	No	No

Exfiltration = 0.000 in/hr (Contour) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.



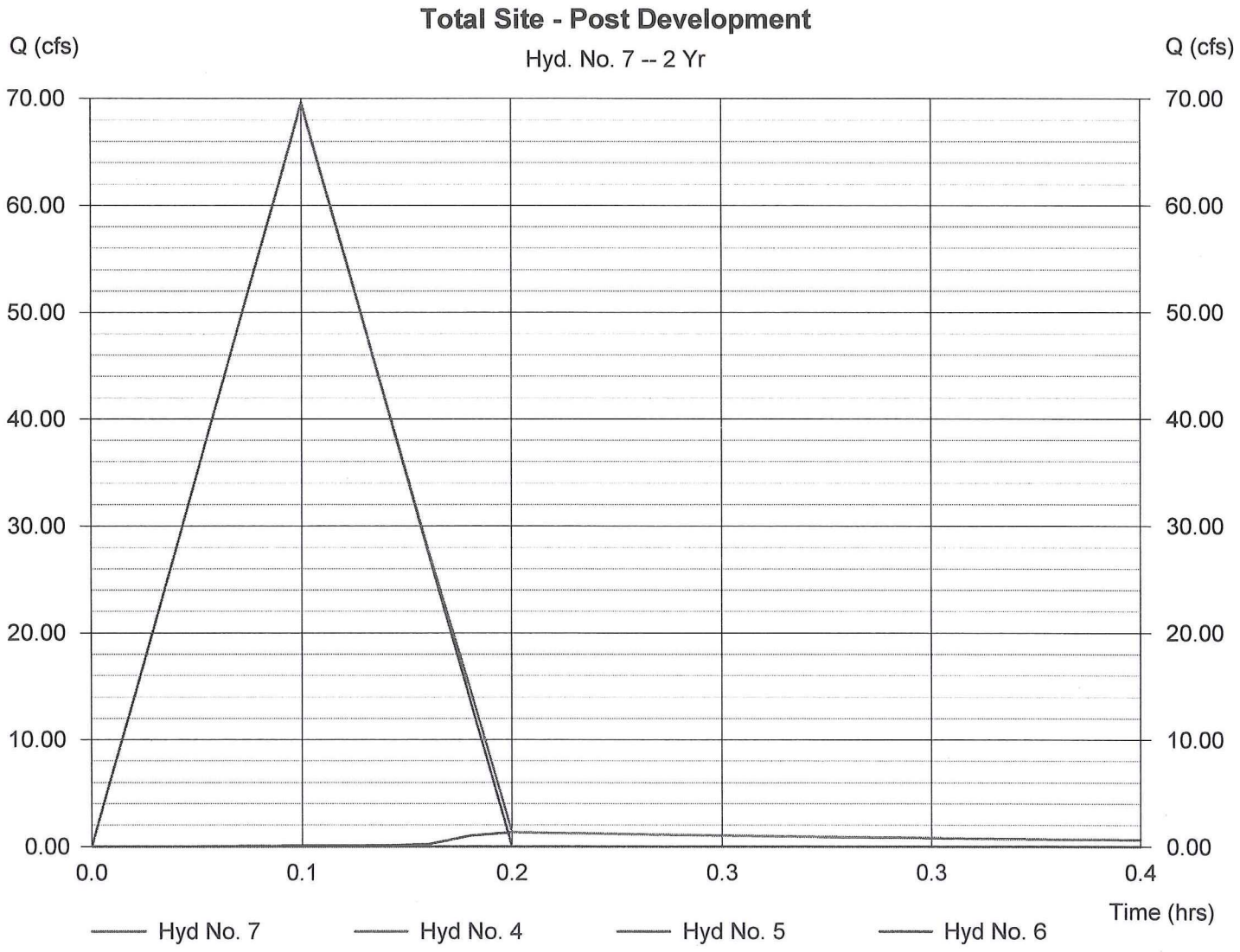
Hydrograph Plot

Hyd. No. 7

Total Site - Post Development

Hydrograph type	= Combine	Peak discharge	= 69.65 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyds.	= 4, 5, 6		

Hydrograph Volume = 35,274 cuft



Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	Rational	117.13	1	5	35,139	----	------	------	Pre Development - Total
2	Rational	98.46	1	5	29,537	----	------	------	Post To Pond
3	Rational	59.26	1	5	17,777	----	------	------	Post to Bio
4	Rational	87.25	1	5	26,176	----	------	------	Post Bypass
5	Reservoir	7.90	1	10	20,305	2	396.78	28,370	Post from Pond 1
6	Reservoir	0.00	1	0	0	3	399.61	17,777	Post from Bio Pond 2
7	Combine	87.33	1	5	46,480	4, 5, 6	------	------	Total Site - Post Development

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

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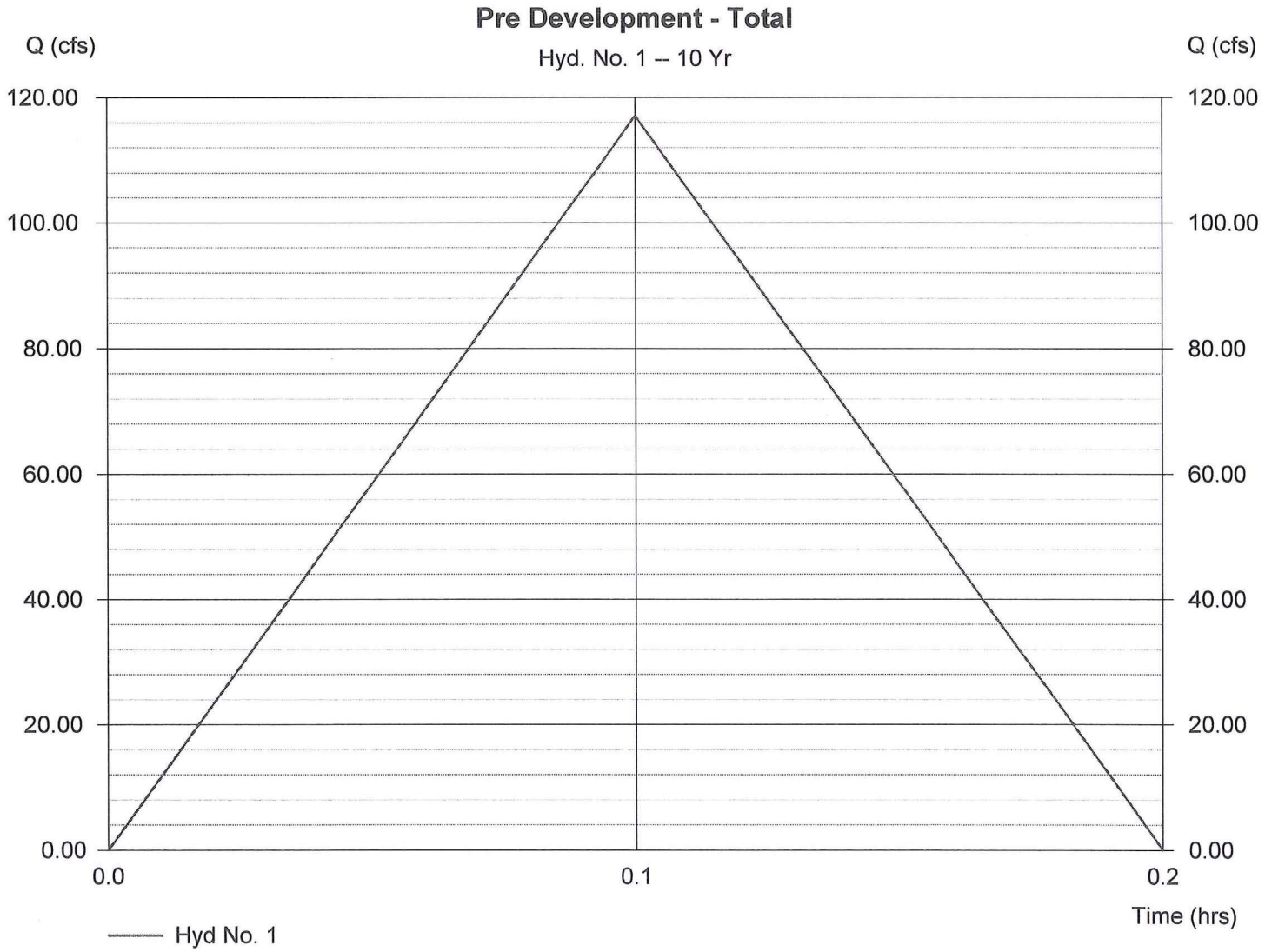
Hyd. No. 1

Pre Development - Total

Hydrograph type	= Rational	Peak discharge	= 117.13 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 54.1 ac	Runoff coeff.	= 0.3
Intensity	= 7.217 in/hr	Tc by User	= 5 min
IDF Curve	= Raleigh-2002.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Volume = 35,139 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

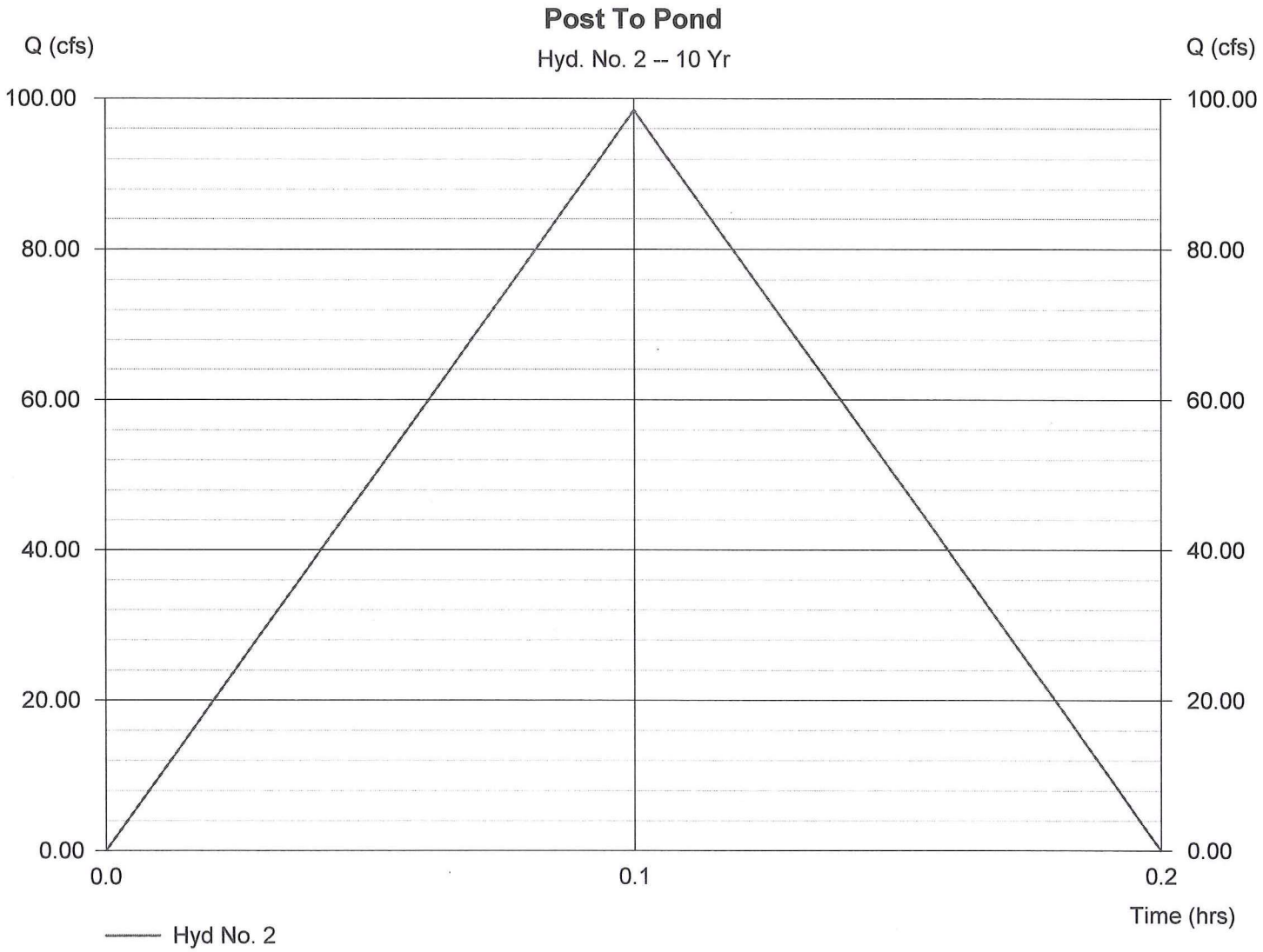
Wednesday, Jul 15 2020, 3:32 PM

Hyd. No. 2

Post To Pond

Hydrograph type	= Rational	Peak discharge	= 98.46 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 18.2 ac	Runoff coeff.	= 0.75
Intensity	= 7.217 in/hr	Tc by User	= 5 min
IDF Curve	= Raleigh-2002.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Volume = 29,537 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

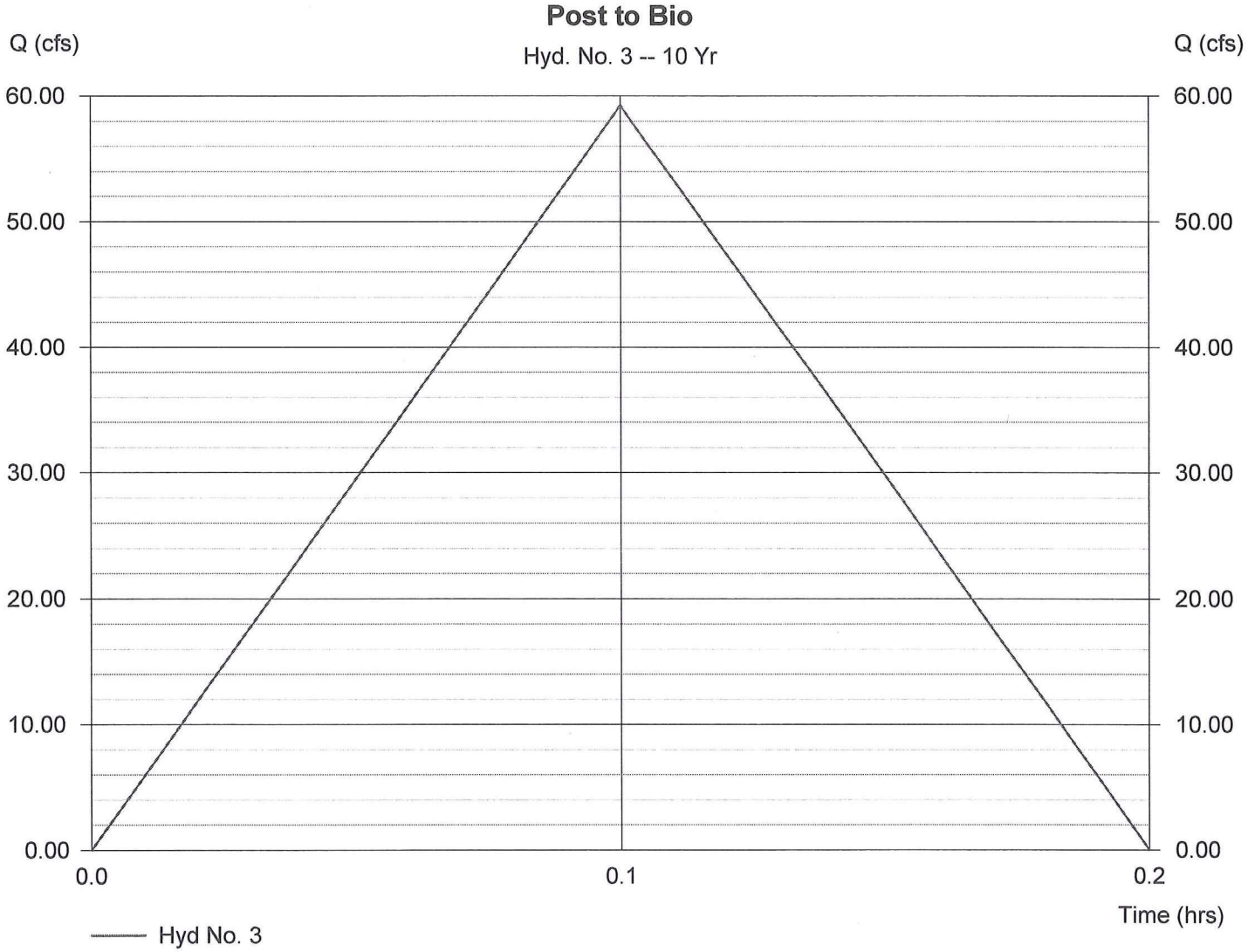
Wednesday, Jul 15 2020, 3:32 PM

Hyd. No. 3

Post to Bio

Hydrograph type	= Rational	Peak discharge	= 59.26 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 11.7 ac	Runoff coeff.	= 0.7
Intensity	= 7.217 in/hr	Tc by User	= 5 min
IDF Curve	= Raleigh-2002.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Volume = 17,777 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

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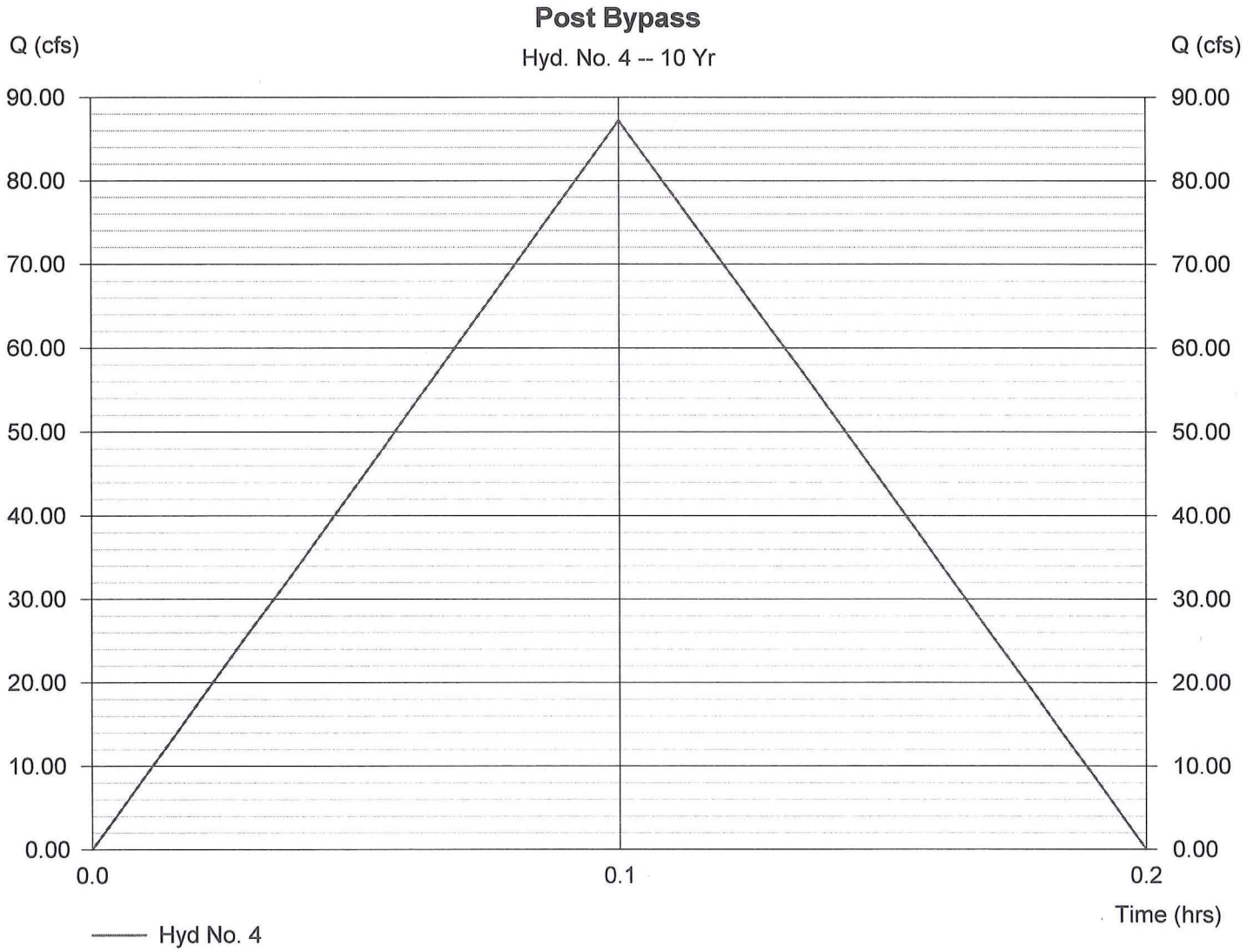
Hyd. No. 4

Post Bypass

Hydrograph type	= Rational	Peak discharge	= 87.25 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 24.2 ac	Runoff coeff.	= 0.5
Intensity	= 7.217 in/hr	Tc by User	= 5 min
IDF Curve	= Raleigh-2002.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Volume = 26,176 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

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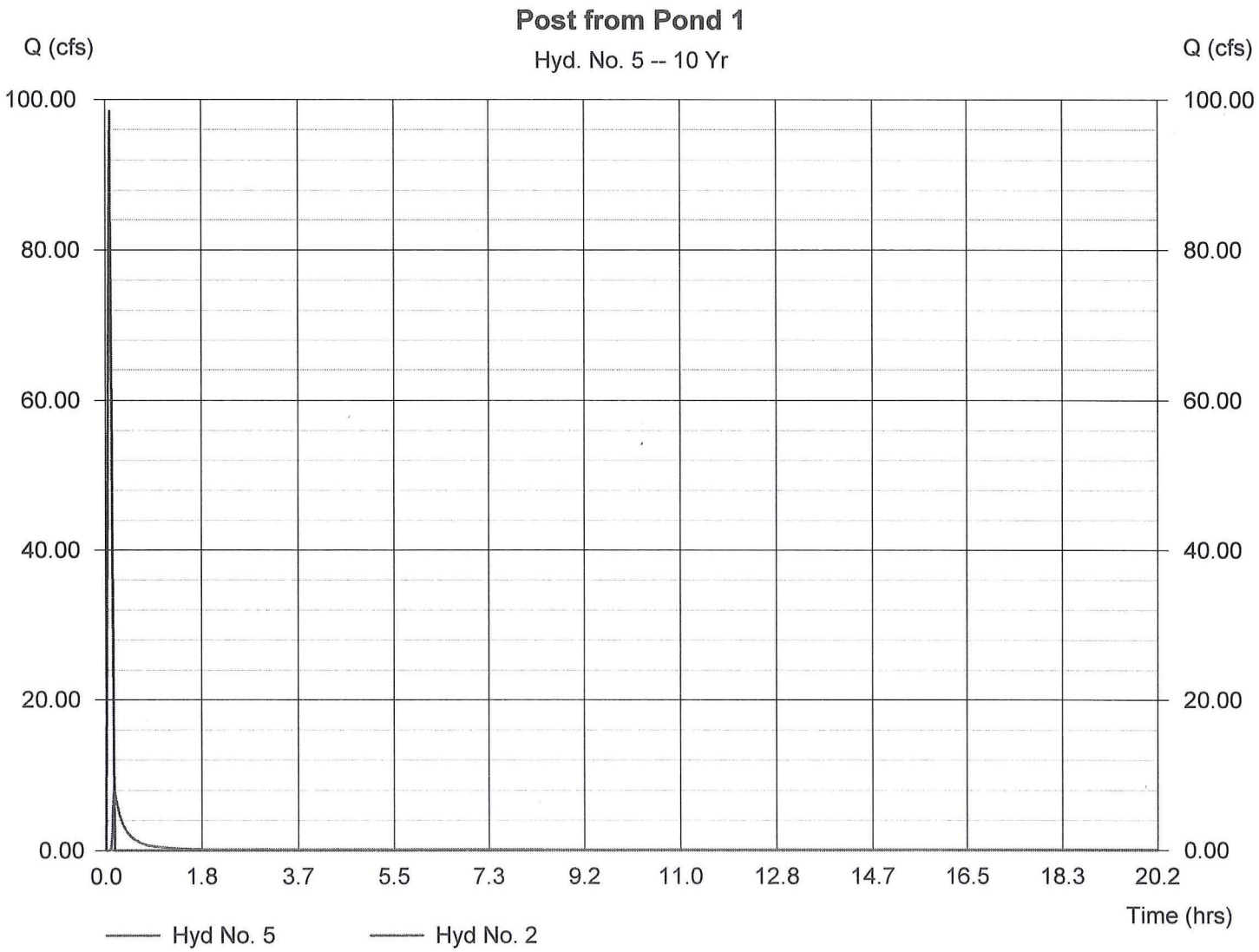
Hyd. No. 5

Post from Pond 1

Hydrograph type	= Reservoir	Peak discharge	= 7.90 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyd. No.	= 2	Max. Elevation	= 396.78 ft
Reservoir name	= Pond 1	Max. Storage	= 28,370 cuft

Storage Indication method used.

Hydrograph Volume = 20,305 cuft



Pond Report

Pond No. 1 - Pond 1

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	395.50	19,221	0	0
1.00	396.50	23,621	21,421	21,421
1.50	397.00	25,905	12,382	33,803
2.50	398.00	29,840	27,873	61,675

Culvert / Orifice Structures

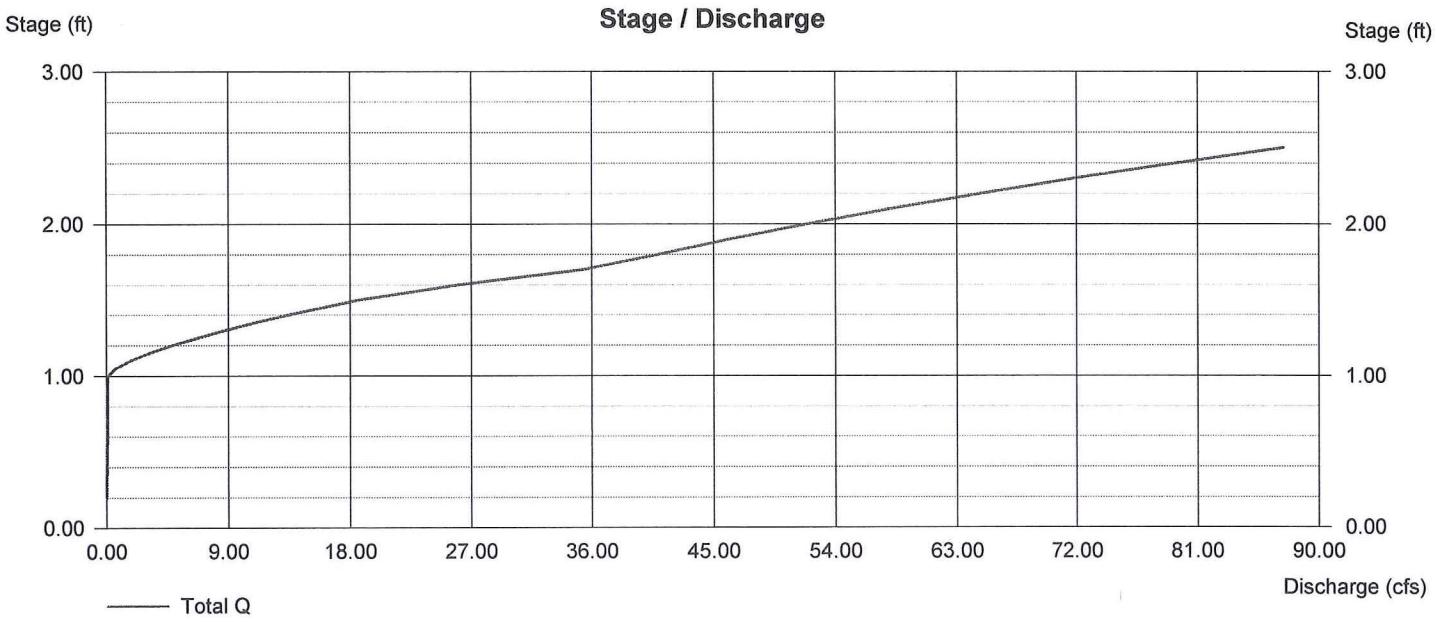
	[A]	[B]	[C]	[D]
Rise (in)	= 24.00	2.00	0.00	0.00
Span (in)	= 24.00	2.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 390.21	395.60	0.00	0.00
Length (ft)	= 143.00	0.50	0.00	0.00
Slope (%)	= 0.50	0.50	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 15.70	20.00	0.00	0.00
Crest El. (ft)	= 396.50	397.00	0.00	0.00
Weir Coeff.	= 3.33	2.60	0.00	0.00
Weir Type	= Riser	Broad	---	---
Multi-Stage	= Yes	No	No	No

Exfiltration = 0.000 in/hr (Contour) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Wednesday, Jul 15 2020, 3:32 PM

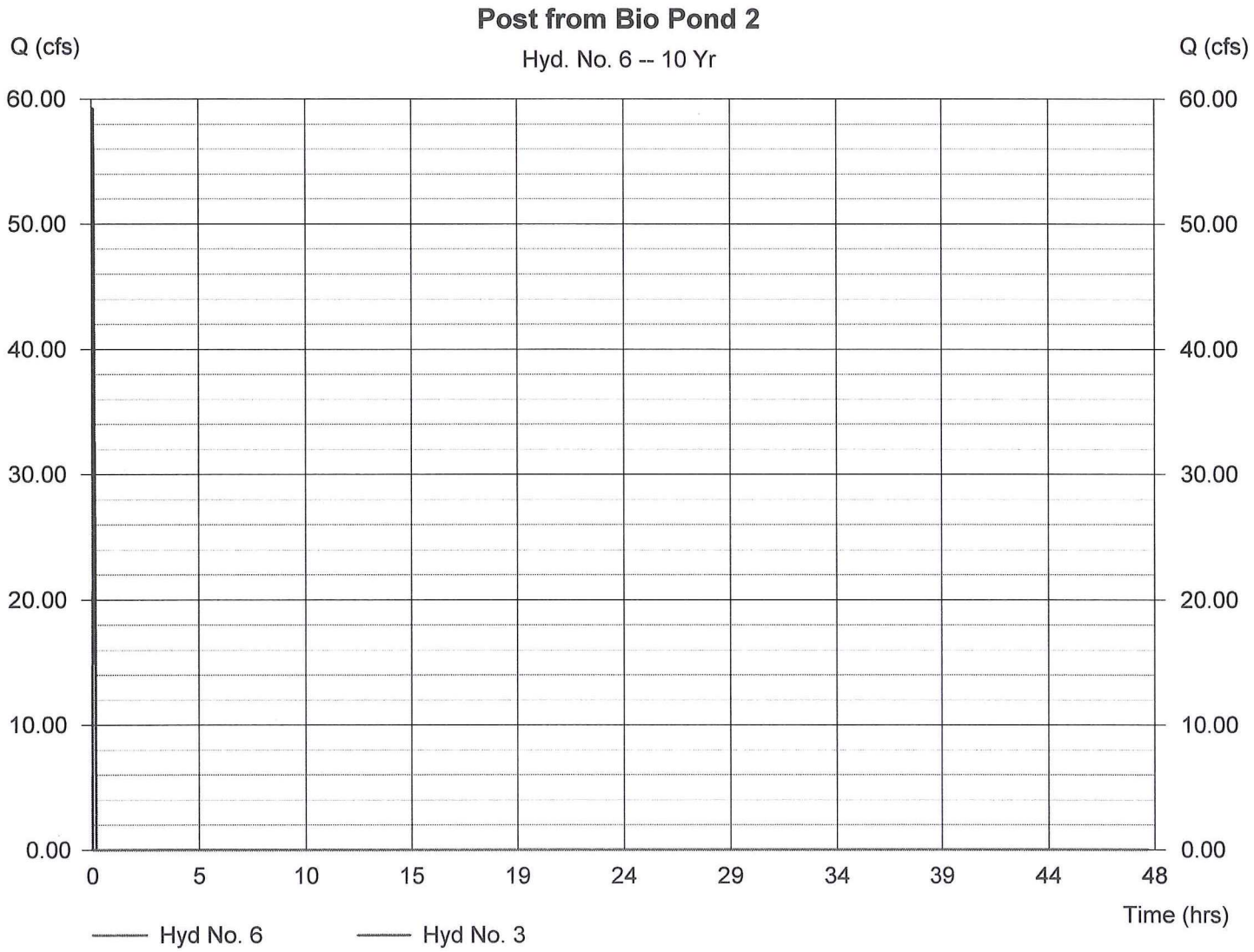
Hyd. No. 6

Post from Bio Pond 2

Hydrograph type	= Reservoir	Peak discharge	= 0.00 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyd. No.	= 3	Max. Elevation	= 399.61 ft
Reservoir name	= Bio Pond 2	Max. Storage	= 17,777 cuft

Storage Indication method used.

Hydrograph Volume = 0 cuft



Pond Report

Hydraflow Hydrographs by Intelisolve

Wednesday, Jul 15 2020, 3:32 PM

Pond No. 2 - Bio Pond 2

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	399.00	27,966	0	0
1.00	400.00	30,539	29,253	29,253
1.50	400.50	31,847	15,597	44,849
2.00	401.00	33,168	16,254	61,103
3.00	402.00	35,854	34,511	95,614

Culvert / Orifice Structures

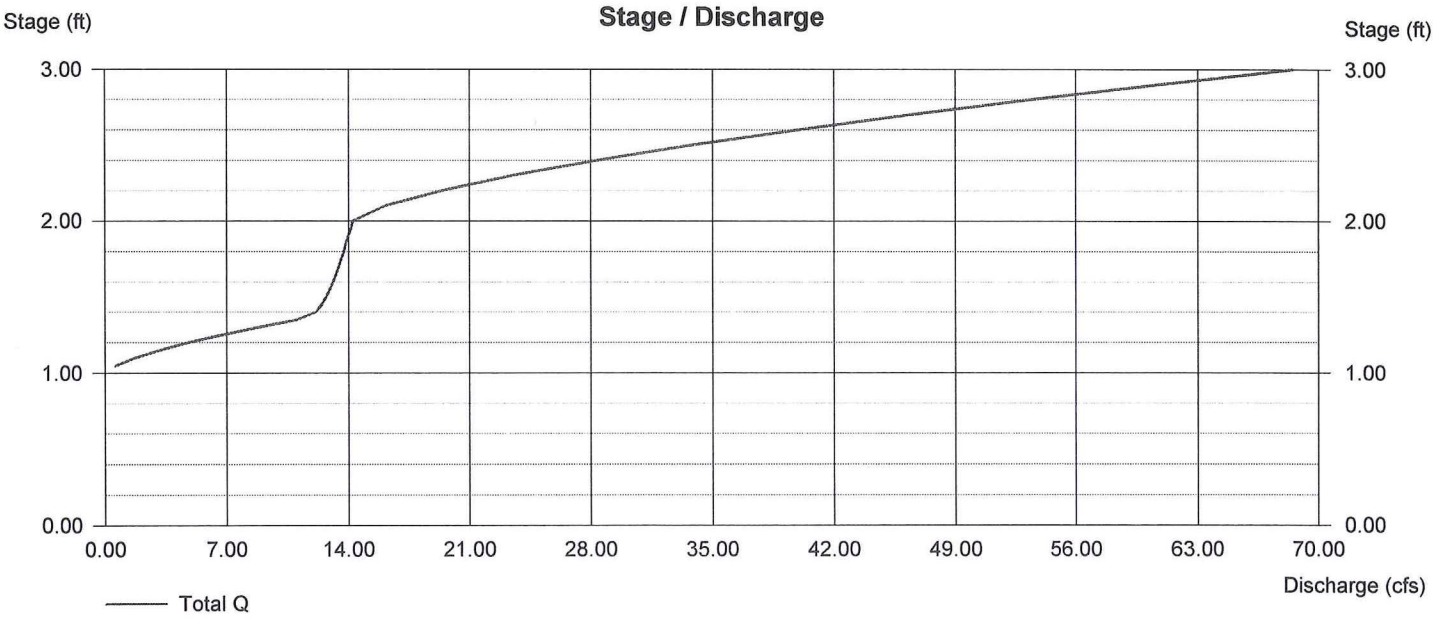
	[A]	[B]	[C]	[D]
Rise (in)	= 18.00	0.00	0.00	0.00
Span (in)	= 18.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 396.95	0.00	0.00	0.00
Length (ft)	= 76.00	0.00	0.00	0.00
Slope (%)	= 0.50	0.00	0.00	0.00
N-Value	= .013	.000	.000	.000
Orif. Coeff.	= 0.60	0.00	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	20.00	0.00	0.00
Crest El. (ft)	= 400.00	401.00	0.00	0.00
Weir Coeff.	= 3.33	2.60	0.00	0.00
Weir Type	= Riser	Broad	---	---
Multi-Stage	= Yes	No	No	No

Exfiltration = 0.000 in/hr (Contour) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

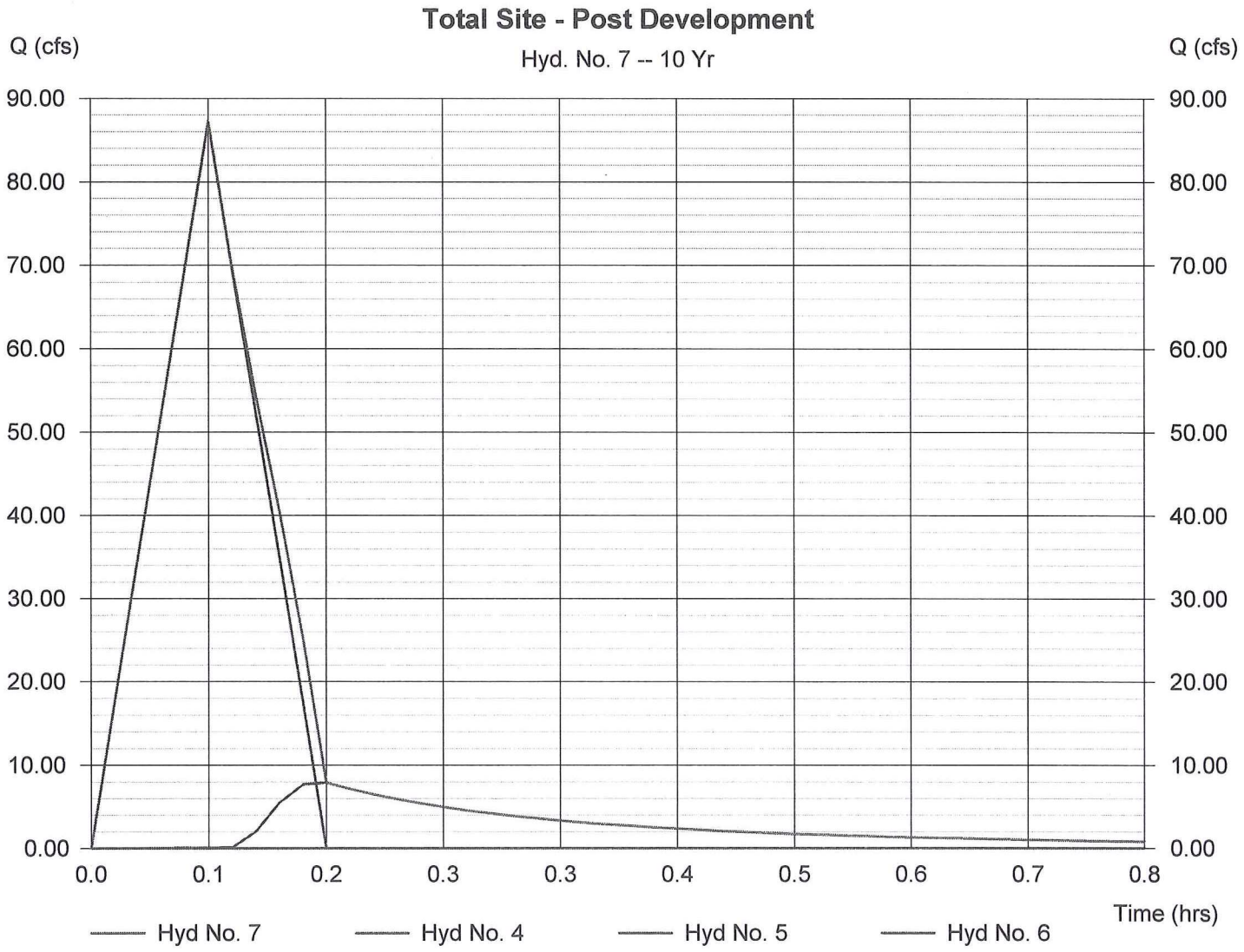
Wednesday, Jul 15 2020, 3:32 PM

Hyd. No. 7

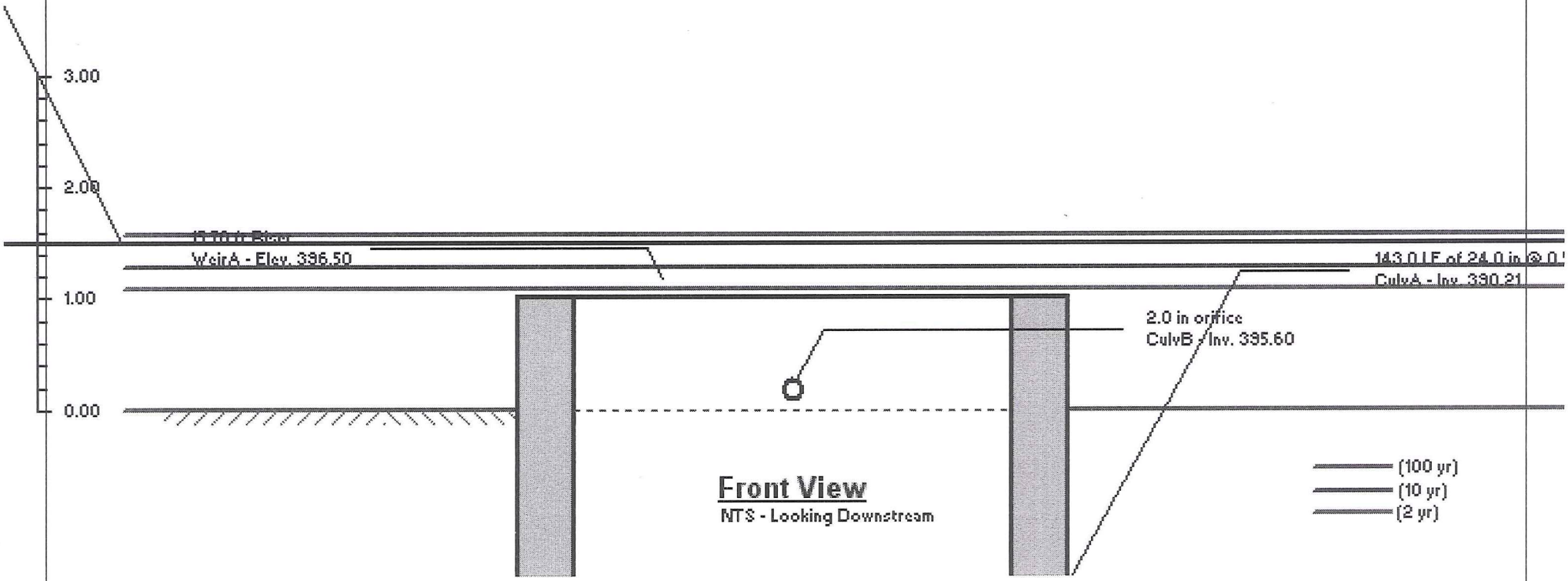
Total Site - Post Development

Hydrograph type	= Combine	Peak discharge	= 87.33 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyds.	= 4, 5, 6		

Hydrograph Volume = 46,480 cuft



Pond 1

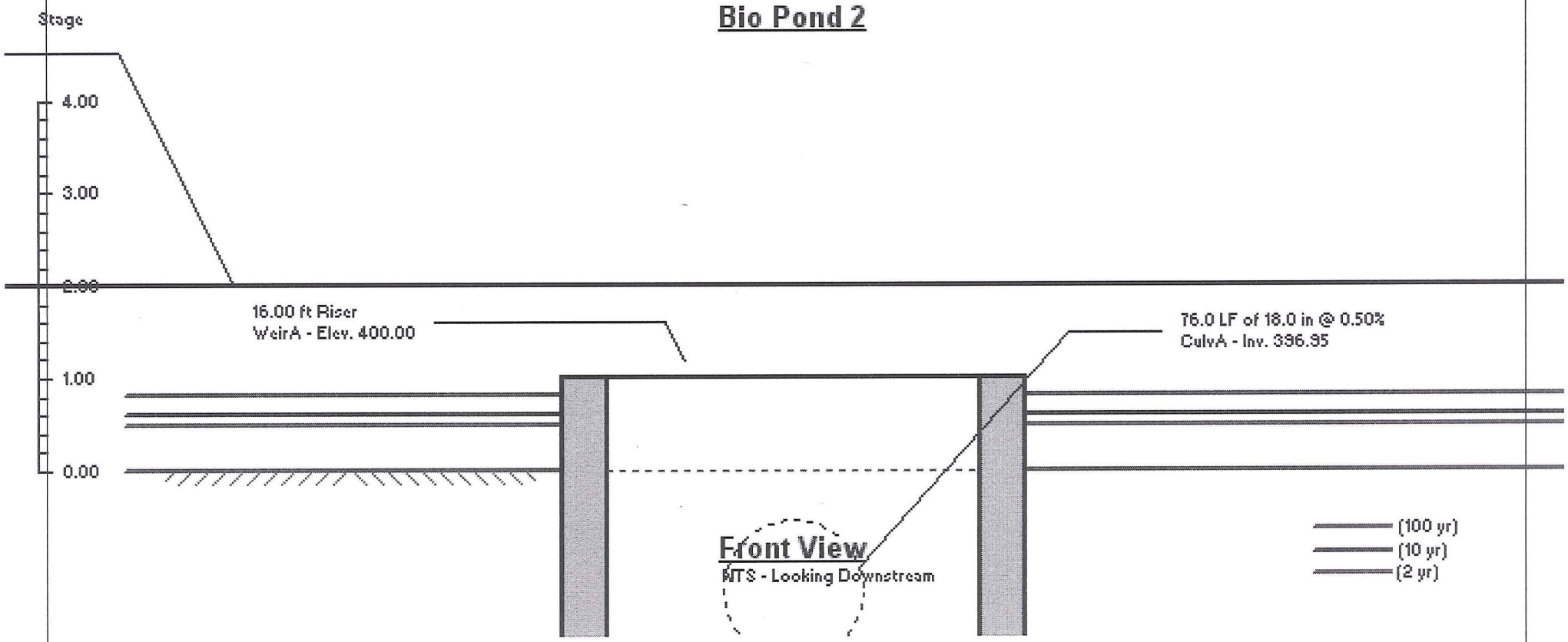


Front View
NTS - Looking Downstream

Schematic only. Not for construction.

Hydraflow Hydrographs Pond Draw	Project: JDP South Ponds.gpw	Wednesday, Jul 15 2020, 3:34 PM

Bio Pond 2



Schematic only. Not for construction.

Operation & Maintenance Agreement

Project Name:	**Jones Dairy Preserve - South**
Project Location:	**Rolesville, NC**

Cover Page

Maintenance records shall be kept on the following BMP(s). This maintenance record shall be kept in a log in a known set location. Any deficient BMP elements noted in the inspection will be corrected, repaired, or replaced **immediately.** These deficiencies can affect the integrity of structures, safety of the public, and the pollutant removal efficiency of the BMP(s).

The BMP(s) on this project include (check all that apply & corresponding O&M tables will be added automatically):

Bioretention Cell	Quantity:	1	Location(s):	Jones Dairy Preserve South
Dry Detention Basin	Quantity:		Location(s):	
Grassed Swale	Quantity:		Location(s):	
Green Roof	Quantity:		Location(s):	
Infiltration Basin	Quantity:		Location(s):	
Infiltration Trench	Quantity:		Location(s):	
Level Spreader/VFS	Quantity:		Location(s):	
Permeable Pavement	Quantity:		Location(s):	
Proprietary System	Quantity:		Location(s):	
Rainwater Harvesting	Quantity:		Location(s):	
Sand Filter	Quantity:		Location(s):	
Stormwater Wetland	Quantity:		Location(s):	
Wet Detention Basin	Quantity:	0	Location(s):	
Disconnected Impervious Area	Present:	No	Location(s):	
User Defined BMP	Present:	No	Location(s):	

I acknowledge and agree by my signature below that I am responsible for the performance of the maintenance procedures listed for each BMP above, and attached O&M tables. I agree to notify NCDENR of any problems with the system or prior to any changes to the system or responsible party.

* Responsible Party:	
Title & Organization:	
Street address:	
City, state, zip:	
Phone number(s):	
Email:	

Signature: _____ Date: _____

I, _____, a Notary Public for the State of _____

County of _____, do hearby certify that _____

personally appeared before me this _____ day of _____ and

acknowledge the due execution of the Operations and Maintenance Agreement .

Witness my hand and official seal, _____.

Seal My commission expires _____

Bioretention Maintenance Requirements

Important operation and maintenance procedures:

- Immediately after the bioretention cell is established, the plants will be watered twice weekly if needed until the plants become established (commonly six weeks).
- Snow, mulch or any other material will NEVER be piled on the surface of the bioretention cell.
- Wheeled or tracked equipment will NEVER be driven over the bioretention planting surface.
- Special care will be taken to prevent sediment from entering the bioretention cell.
- If standing water is present 2 days after rainfall, conduct an infiltration test of the soil media.

After the bioretention cell is established, inspect it **quarterly.** Inspection activities shall be performed as follows and maintenance activites shall commence **immediately** to remediate any problems observed per the table below.

BMP element:	Potential problem:	How to remediate the problem:
The entire BMP	Trash/debris is present.	Remove the trash/debris.
The perimeter of the BMP	Areas of bare soil and/or erosive gullies have formed.	Regrade the soil to remove the gully, and plant a ground cover and water until it is established. Provide lime and a one-time fertilizer application.
	Vegetation is too short or too long.	Maintain vegetation at a height of approximately six inches.
The inlet device	The pipe is clogged.	Unclog the pipe. Dispose of the sediment off-site.
	The pipe is cracked or otherwise damaged.	Replace the pipe.
	Erosion is occurring in the swale.	Regrade the swale to smooth it over and provide erosion control devices such as reinforced turf matting or riprap to avoid future problems.
	Stone verge is clogged or covered in sediment (if applicable).	Remove sediment and replace with clean stone.
The pretreatment area	Flow is bypassing pretreatment area and/or gullies have formed.	Regrade if necessary to route all flow to the pretreatment area. Restabilize the area after grading.
	Sediment has accumulated to a depth greater than three inches.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and restabilize the pretreatment area.
	Erosion has occurred.	Provide additional erosion protection such as reinforced turf matting or riprap if needed to prevent future erosion problems.
	Weeds are present.	Remove the weeds, preferably by hand.
The bioretention cell: vegetation	Best professional practices show that pruning is needed to maintain optimal plant health.	Prune according to best professional practices.
	Plants are dead, diseased or dying.	Determine the source of the problem: soils, hydrology, disease, etc. Remedy the problem and replace plants. Provide a one-time fertilizer application to establish the ground cover if a soil test indicates it is necessary.
	Tree stakes/wires are present six months after planting.	Remove tree stake/wires (which can kill the tree if not removed).

Bioretention Maintenance Requirements (continued)

BMP element:	Potential problem:	How to remediate the problem:
The bioretention cell: soils and mulch	Mulch is breaking down or has floated away.	Spot mulch if there are only random void areas. Replace whole mulch layer if necessary. Remove the remaining much and replace with triple shredded hard wood mulch at a maximum depth of three inches.
	Soils and/or mulch are clogged with sediment.	Determine the extent of the clogging - remove and replace either just the top layers or the entire media as needed. Dispose of the spoil in an appropriate off-site location. Use triple shredded hard wood mulch at a maximum depth of three inches. Search for the source of the sediment and remedy the problem if possible.
	An annual soil test shows that pH has dropped or heavy metals have accumulated in the soil media.	Dolomitic lime shall be applied as recommended per the soil test and toxic soils shall be removed, disposed of properly and replaced with new planting media.
The underdrain system (if applicable)	Clogging has occurred.	Wash out the underdrain system.
The drop inlet	Clogging has occurred.	Clean out the drop inlet. Dispose of the sediment off-site.
	The drop inlet is damaged	Repair or replace the drop inlet.
The receiving water	Erosion or other signs of damage have occurred at the outlet.	Contact the local NC Department of Environment and Natural Resources Regional Office.

Operation & Maintenance Agreement

Project Name:	**Jones Dairy Preserve - South**
Project Location:	**Rolesville, NC**

Cover Page

Maintenance records shall be kept on the following BMP(s). This maintenance record shall be kept in a log in a known set location. Any deficient BMP elements noted in the inspection will be corrected, repaired, or replaced **immediately.** These deficiencies can affect the integrity of structures, safety of the public, and the pollutant removal efficiency of the BMP(s).

The BMP(s) on this project include (check all that apply & corresponding O&M tables will be added automatically):

Bioretention Cell	Quantity:	0	Location(s):	
Dry Detention Basin	Quantity:		Location(s):	
Grassed Swale	Quantity:		Location(s):	
Green Roof	Quantity:		Location(s):	
Infiltration Basin	Quantity:		Location(s):	
Infiltration Trench	Quantity:		Location(s):	
Level Spreader/VFS	Quantity:		Location(s):	
Permeable Pavement	Quantity:		Location(s):	
Proprietary System	Quantity:		Location(s):	
Rainwater Harvesting	Quantity:		Location(s):	
Sand Filter	Quantity:		Location(s):	
Stormwater Wetland	Quantity:		Location(s):	
Wet Detention Basin	Quantity:	1	Location(s):	Jones Dairy Preserve South
Disconnected Impervious Area	Present:	No	Location(s):	
User Defined BMP	Present:	No	Location(s):	

I acknowledge and agree by my signature below that I am responsible for the performance of the maintenance procedures listed for each BMP above, and attached O&M tables. I agree to notify NCDENR of any problems with the system or prior to any changes to the system or responsible party.

* Responsible Party:	
Title & Organization:	
Street address:	
City, state, zip:	
Phone number(s):	
Email:	

Signature: _____ Date: _____

I, _____, a Notary Public for the State of _____

County of _____, do hearby certify that _____

personally appeared before me this _____ day of _____ and

acknowledge the due execution of the Operations and Maintenance Agreement .

Witness my hand and official seal, _____.

Seal My commission expires _____

Wet Detention Pond Maintenance Requirements

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

Important maintenance procedures:

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

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

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

BMP element:	Potential problem:	How I will remediate the problem:
The entire BMP	Trash/debris is present.	Remove the trash/debris.
The perimeter of the BMP	Areas of bare soil and/or erosive gullies have formed.	Regrade the soil if necessary to remove the gully, and then plant a ground cover and water until it is established. Provide lime and a one-time fertilizer application.
	Vegetation is too short or too long.	Maintain vegetation at a height of approximately six inches.
The inlet device	The pipe is clogged.	Unclog the pipe. Dispose of the sediment off-site.
	The pipe is cracked or otherwise damaged.	Replace the pipe.
	Erosion is occurring in the swale.	Regrade the swale if necessary to smooth it over and provide erosion control devices such as reinforced turf matting or riprap to avoid future problems with erosion.
	Stone verge is clogged or covered in sediment (if applicable).	Remove sediment and replace with clean stone.
The forebay	Sediment has accumulated to a depth greater than the original design depth for sediment storage.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the BMP.
	Erosion has occurred.	Provide additional erosion protection such as reinforced turf matting or riprap if needed to prevent future erosion problems.
	Weeds are present.	Remove the weeds, preferably by hand. If pesticide is used, wipe it on the plants rather than spraying.
The vegetated shelf	Best professional practices show that pruning is needed to maintain optimal plant health.	Prune according to best professional practices
	Plants are dead, diseased or dying.	Determine the source of the problem: soils, hydrology, disease, etc. Remedy the problem and replace plants. Provide a one-time fertilizer application to establish the ground cover if a soil test indicates it is necessary.
	Weeds are present.	Remove the weeds, preferably by hand. If pesticide is used, wipe it on the plants rather than spraying.

Wet Detention Pond Maintenance Requirements (Continued)

The main treatment area	Sediment has accumulated to a depth greater than the original design sediment storage depth.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the BMP.
	Algal growth covers over 50% of the area.	Consult a professional to remove and control the algal growth.
	Cattails, phragmites or other invasive plants cover 50% of the basin surface.	Remove the plants by wiping them with pesticide (do not spray).
The embankment	Shrubs have started to grow on the embankment.	Remove shrubs immediately.
	Evidence of muskrat or beaver activity is present.	Use traps to remove muskrats and consult a professional to remove beavers.
	A tree has started to grow on the embankment.	Consult a dam safety specialist to remove the tree.
	An annual inspection by an appropriate professional shows that the embankment needs repair. (if applicable)	Make all needed repairs.
The outlet device	Clogging has occurred.	Clean out the outlet device. Dispose of the sediment off-site.
	The outlet device is damaged	Repair or replace the outlet device.
The receiving water	Erosion or other signs of damage have occurred at the outlet.	Contact the local NC Department of Environment and Natural Resources Regional Office.
The measuring device used to determine the sediment elevation shall be such that it will give an accurate depth reading and not readily penetrate into accumulated sediments.		

Wet Detention Pond Design Summary

Wet Pond Diagram

WET POND ID	
JDP South Wet Pond	
Pretreatment other than forebay?	No
Has Veg. Filter?	No

FOREBAY	
Permanent Pool El.	395.5
Temporary Pool El:	397
Clean Out Depth:	4
Sediment Removal El:	391.5
Bottom Elevation:	392

MAIN POND	
Permanent Pool El.	395.5
Temporary Pool El:	397
Clean Out Depth:	7
Sediment Removal El:	388.5
Bottom Elevation:	389

Stormwater Summary
Jones Dairy Preserve - South
Rolesville, North Carolina
Date:

		Square Feet	Acres
Overal Site		2,356,596.00	54.10

Drainage Area 1 to Pond 1

Impervious Summary		**Square Feet**	**Acres**
Lots (3500 SF)	104	364,000.00	8.36
Walking Trail		0.00	0.00
Roadway (27' width)		89,748.00	2.06
Roadway (35' width)		51,415.00	1.18
Sidewalk (both sides)		57,516.00	1.32
Impervious to Pond 1			**12.92**
Drainage Area 1 to Pond 1		**792561**	**18.19**

Additional Imp Area 1 to Pond 1 Impervious considered in treatment volume of Pond 1 - (area drainage bypass Pond 1)

Impervious Summary		**Square Feet**	**Acres**
Lots (3500 SF)	36	126,000.00	2.89
Walking Trail		20,890.00	0.48
Roadway (27' width)		28,323.00	0.65
Roadway (35' width)		0.00	0.00
Sidewalk (both sides)		12,588.00	0.29
Total Impervious			**4.31**

Drainage Area 2 to Bio 2

Impervious Summary		**Square Feet**	**Acres**
Lots (3500 SF)	76	266,000.00	6.11
Walking Trail		6,770.00	0.16
Roadway (27' width)		43,011.00	0.99
Roadway (35' width)		25,512.00	0.59
Sidewalk (both sides)		0.00	0.00
Total Impervious			7.84
Drainage Area 2 to Bio 2		**510901**	**11.73**

Total South Project Impervious	**25.06**