RICHARDSON SMITH GARDNER
& ASSOCIATES
ENGINEERING & GEOLOGICAL
SERVICES

February 9, 2012

Mr. Edward F. Mussler, III, P.E.
Permitting Branch Supervisor
NC DENR - Division of Waste Management
1646 Mail Service Center
Raleigh, NC 27699-1646

RE: Halifax County - Transfer Station
Permit Application

Dear Mr. Mussler:

On behalf of Halifax County, Richardson Smith Gardner & Associates, Inc. (RSG) is submitting the attached permit application for construction of a municipal solid waste (MSW) transfer station at the County's existing landfill facility located on Liles Road near Littleton.

Please contact me at your earliest convenience with any questions or comments on this application or if you require any additional information at this time.

Sincerely,
Richardson Smith Gardner & Associates, Inc.

Pieter K. Scheer, P.E.
Principal, Senior Engineer
pieter@rsgengineers.com

Attachment

cc: Gwen Matthews, Halifax County
Larry Garriss, Halifax County

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Permit Application

Halifax County Transfer Station
Halifax County, North Carolina

Prepared For:

Halifax County Department of Public Utilities
26 North King Street
Halifax, North Carolina 27839

Prepared By:

RICHARDSON SMITH GARDNER
& ASSOCIATES
ENGINEERING & GEOLOGICAL
SERVICES
14 N. BOYLAN AVENUE
RALEIGH, NORTH CAROLINA 27603
NC LIC. NO. C-0828 (ENGINEERING)

January 2012

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PERMIT APPLICATION

Halifax County Transfer Station
Halifax County, North Carolina

Prepared for:
Halifax County Department of Public Utilities
Halifax, North Carolina

RSG Project No. HALIFAX-11-5

NORTH CAROLINA PROFESSIONAL SEAL 021666 ENGINEER PIETER K. SCHEER

1/31/12

Pieter K. Scheer, P.E.
Principal, Senior Engineer

January 2012

RICHARDSON SMITH GARDNER & ASSOCIATES
ENGINEERING & GEOLOGICAL SERVICES
14 N. BOYLAN AVENUE
RALEIGH, NORTH CAROLINA 27603
NC LIC. NO. C-0828 (ENGINEERING)

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HALIFAX COUNTY TRANSFER STATION

PERMIT APPLICATION

TABLE OF CONTENTS

A guide to specific North Carolina Solid Waste Management (15A NCAC 13B.0400) and Sedimentation Control (15A NCAC 4) rules addressed in each section of this document is shown in italics after each section.

EXECUTIVE SUMMARY

ATTACHMENT A	SIGNATURE PAGE
ATTACHMENT B	GENERAL INFORMATION *(15A NCAC 13B.0401(3))*
ATTACHMENT C	OPERATIONS MANUAL *(15A NCAC 13B.0402)*
ATTACHMENT D	EROSION AND SEDIMENTATION CONTROL PLAN *(15A NCAC 13B.0401(3); 15A NCAC 4)*
ATTACHMENT E	PERMIT DRAWINGS *(15A NCAC 13B.0401(1))*
ATTACHMENT F	ZONING DOCUMENTATION *(15A NCAC 13B.0401(2))*
ATTACHMENT G	TRAFFIC REQUIREMENTS *(§ 130A-295.5)*

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EXECUTIVE SUMMARY

GENERAL

The following is a Permit Application submitted on behalf of Halifax County, North Carolina for the construction of a municipal solid waste (MSW) transfer station at the County's existing landfill facility located near Littleton (Permit 42-04). This permit application has been prepared to satisfy the requirements of 15A NCAC 13B.0400 et. seq. of the North Carolina Solid Waste Management Rules and applicable sections of the North Carolina General Statutes.

The proposed transfer station will consist of an approximately 6,400 square foot metal building with a reinforced concrete tipping floor, single loading chute, and loading bay all under roof.

It is the intent of the County to proceed with construction in July 2012 such that construction is substantially complete by the end of the first quarter of 2013.

ATTACHMENTS

This submittal has been prepared in accordance with the requirements of the North Carolina Solid Waste Management Rules (15A NCAC 13B.0400 et. seq.) and the North Carolina Sedimentation Control Rules (15A NCAC 4) which are enforced by the Division of Waste Management (DWM) and the Division of Land Quality, respectively, of the North Carolina Department of Environment and Natural Resources (DENR). Included in this submittal are the following attachments *(with applicable rule(s) in italics)*:

A. Signature Page

B. General Information *(15A NCAC 13B.0401(3))*

This section includes general information related to the facility including contacts, a description of the facility, and property information.

C. Operations Manual *(15A NCAC 13B.0402)*

The Operations Manual outlines and describes protocols for facility operation and maintenance and was prepared to provide landfill personnel with a clear understanding of how the Design Engineer assumed that the completed facility would be operated. Along with the Project Drawings, the Operations Manual has been prepared to comply with the requirements of 15A NCAC 13B.0402.

D. Erosion and Sedimentation Control Plan *(15A NCAC 13B.0401(3); 15A NCAC 4)*

The Erosion and Sedimentation Control Plan was prepared to describe erosion and sedimentation control measures used at the site. This document, along with the Project Drawings, was prepared to satisfy the requirements of 15A NCAC

13B.1624 and 15A NCAC 4. Approval from the Land Quality Section of the NC Division of Land Resources will be obtained prior to construction.

E. Permit Drawings *(15A NCAC 13B.0401(1))*

The permit drawings include a site grading and drainage plan, floor plans, building elevations, and key building and erosion and sedimentation control details.

F. Zoning Documentation *(15A NCAC 13B.0401(2))*

A letter from Halifax County is provided which demonstrates that the transfer station is consistent with current County zoning requirements for the property.

G. Traffic Requirements *(§ 130A-295.5)*

A memorandum from Martin, Alexiou, Bryson, P.C. to the North Carolina Department of Transportation (NC DOT) is provided which demonstrates that the proposed transfer station will not have a substantial impact on highway traffic and requests certification from the Division Engineer. Correspondence from the NC DOT will be provided when received.

Attachment A

Signature Page

Halifax County, North Carolina
Transfer Station
Permit Application

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Applicant Signature Page

Name of Facility: Halifax County Transfer Station

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision and that the information provided in this application is true, accurate, and complete to the best of my knowledge.

I understand that North Carolina General Statute 130A-22 provides for administrative penalties of up to fifteen thousand dollars ($15,000.00) per day per each violation of the Solid Waste Management Rules. I further understand that the Solid Waste Management Rules may be revised or amended in the future and that the facility siting and operations of this solid waste management facility will be required to comply with all such revisions or amendments.

Gwen Matthews	Gwen Matthews	2/3/2012
Signature	Print Name	Date
Director	Halifax County Public Utilities	
Title	Business or Organization Name	

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Attachment B

General Information

Halifax County, North Carolina
Transfer Station
Permit Application

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HALIFAX COUNTY TRANSFER STATION

GENERAL INFORMATION

1. Transfer Station Name:

Halifax County Transfer Station

2. Owner Contact Information:

Halifax County Department of Public Utilities
26 N. King Street (Public Works Bldg.)
P.O. Box 70
Halifax, NC 27839
Phone: (252) 583-1451
Fax: (252) 593-5014
Contact: Gwen Matthews, Director
matthewsg@halifaxnc.com

Halifax County Landfill
921 Liles Road
Littleton, NC 27850
Phone: (252) 586-7516
Fax: (252) 586-2685
Contact: Larry Garriss, Solid Waste Director
solidwaste@embarqmail.com

3. Consulting Engineer Contact Information:

Richardson Smith Gardner & Associates, Inc.
14 N. Boylan Ave.
Raleigh, NC 27603
Phone: (919) 828-0577
Fax: (919) 828-3899
Contact: Pieter Scheer, P.E., Principal, Senior Engineer
pieter@rsgengineers.com

4. Permit/Annual Fee Invoices:

Direct to Gwen Matthews, Halifax County Public Utilities Director
(See Contact Information in #2 Above)

5. Facility Description:

Halifax County, North Carolina currently owns and operates a landfill facility on Liles Road near Littleton. The landfill is permitted under NC Permit 42-04 for the disposal of construction and demolition debris (C&D) waste and the disposal of coal combustion by-products in separate disposal areas. The County also conducts several other solid waste management activities at the facility.

The County has operated the landfill under the current permit since 1981. From 1981 through December 1997, the landfill was permitted to receive municipal solid waste (MSW). The MSW was disposed of in one unlined disposal unit. It is estimated that approximately 900,000 tons of MSW was disposed of in the landfill, which has a total waste footprint of approximately 24 acres. The MSW unit was closed in accordance with applicable State Solid Waste Management Rules.

Beginning in January 1998, and in accordance with State solid waste rules, MSW was no longer disposed of in the landfill. The landfill has continued to operate since 1997 as a C&D landfill (Area 1 disposal unit). The Area 1 C&D disposal unit is a vertical expansion over the MSW disposal unit and has a waste footprint of approximately 6.5 acres.

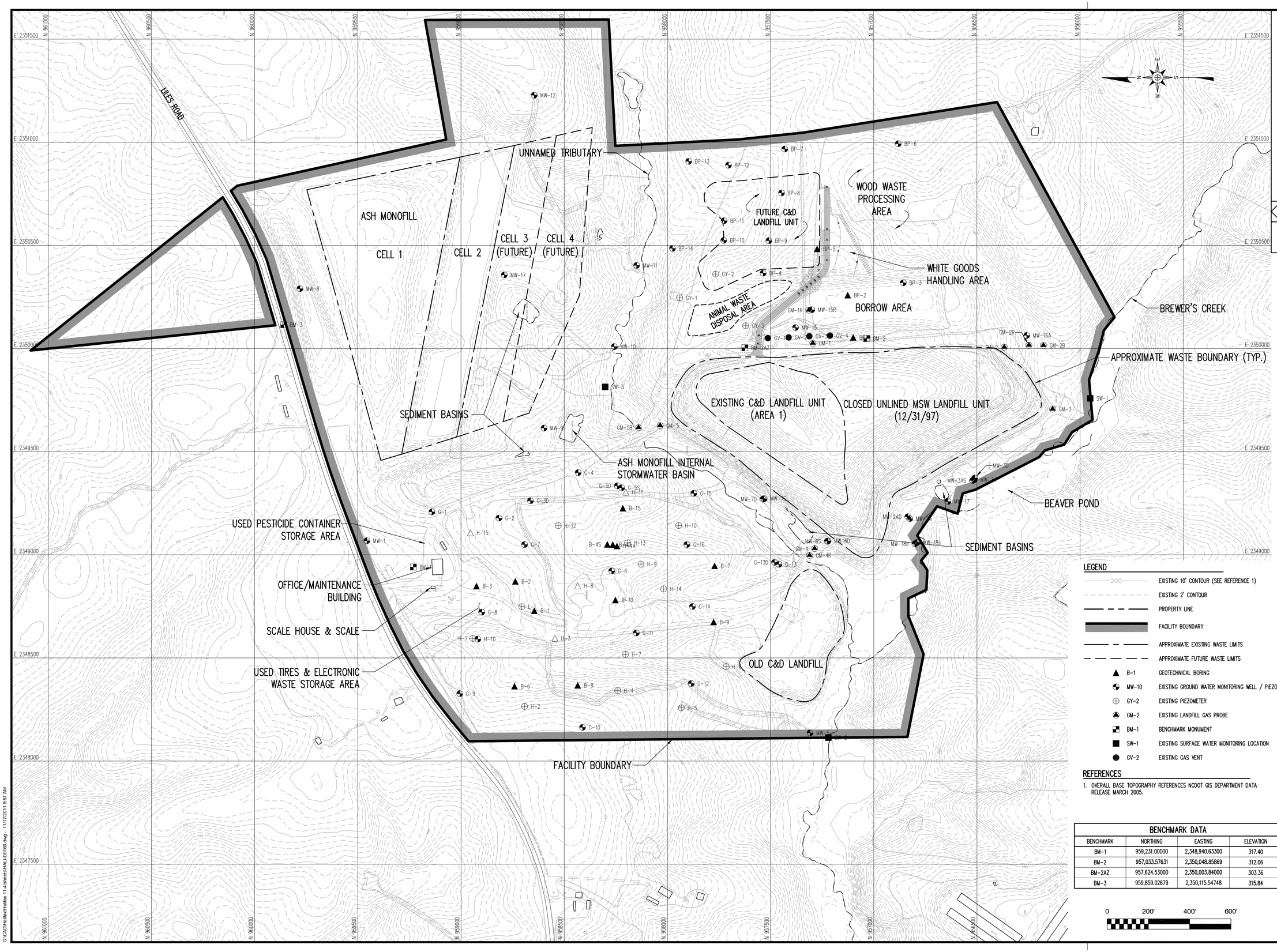
Beginning in May 1994, the County has operated a lined monofill for the disposal of coal combustion by-products (residuals including fly ash, bottom ash, boiler slag, and flue gas desulfurization (FGD) residue produced by coal fired electrical or steam generation units) and minor amounts of coal fines. Cell 1 (12 acres) was constructed in 1993-94. Cell 2 (9 acres) was subsequently constructed in 1998-99. The liner system for the ash monofill consists of a geomembrane installed over prepared on-site subgrade soils.

The proposed transfer station will be located near the front of the facility near the existing scale house and scale and across the existing access road from the office/maintenance building.

Refer to the attached **Figure 1** which shows existing and proposed landfill units and solid waste management activities.

6. Property Information:

See **attached** plat and deed information describing the 240.53 acres that comprise the facility. Note that the most recently issued permit for the C&D landfill reflects the 210.53 acres shown on the first plat. The landfill facility also includes the 30 acre Hawkins tract purchased in 1995 (reference second plat and deed as downloaded from the County Register of Deeds website (www.halifaxnc.com/registerofdeeds.cfm)).



LEGEND

200	EXISTING 10' CONTOUR (SEE REFERENCE 1)
	EXISTING 2' CONTOUR
	PROPERTY LINE
	FACILITY BOUNDARY
	APPROXIMATE EXISTING WASTE LIMITS
	APPROXIMATE FUTURE WASTE LIMITS
B-1	GEOTECHNICAL BORING
MW-10	EXISTING GROUND WATER MONITORING WELL / PIEZOMETER
GY-2	EXISTING PIEZOMETER
GM-2	EXISTING LANDFILL GAS PROBE
BM-1	BENCHMARK MONUMENT
SW-1	EXISTING SURFACE WATER MONITORING LOCATION
GV-2	EXISTING GAS VENT

REFERENCES

1. OVERALL BASE TOPOGRAPHY REFERENCES NCDOT GIS DEPARTMENT DATA RELEASE MARCH 2005.

BENCHMARK DATA

BENCHMARK	NORTHING	EASTING	ELEVATION
BM-1	959,231.00000	2,348,940.63300	317.40
BM-2	957,033.57631	2,350,048.85869	312.06
BM-2AZ	957,624.53000	2,350,003.84000	303.36
BM-3	959,859.02679	2,350,115.54748	315.84

0 200' 400' 600'

RICHARDSON SMITH GARDNER & ASSOCIATES
NC LICENSED Civil Engineering
14 N. Boylan Ave. Raleigh, N.C. 27603
ph: 919-828-0577 fax: 919-828-3899
www.rsgengineers.com

REVISION | NO. | DATE

SEAL

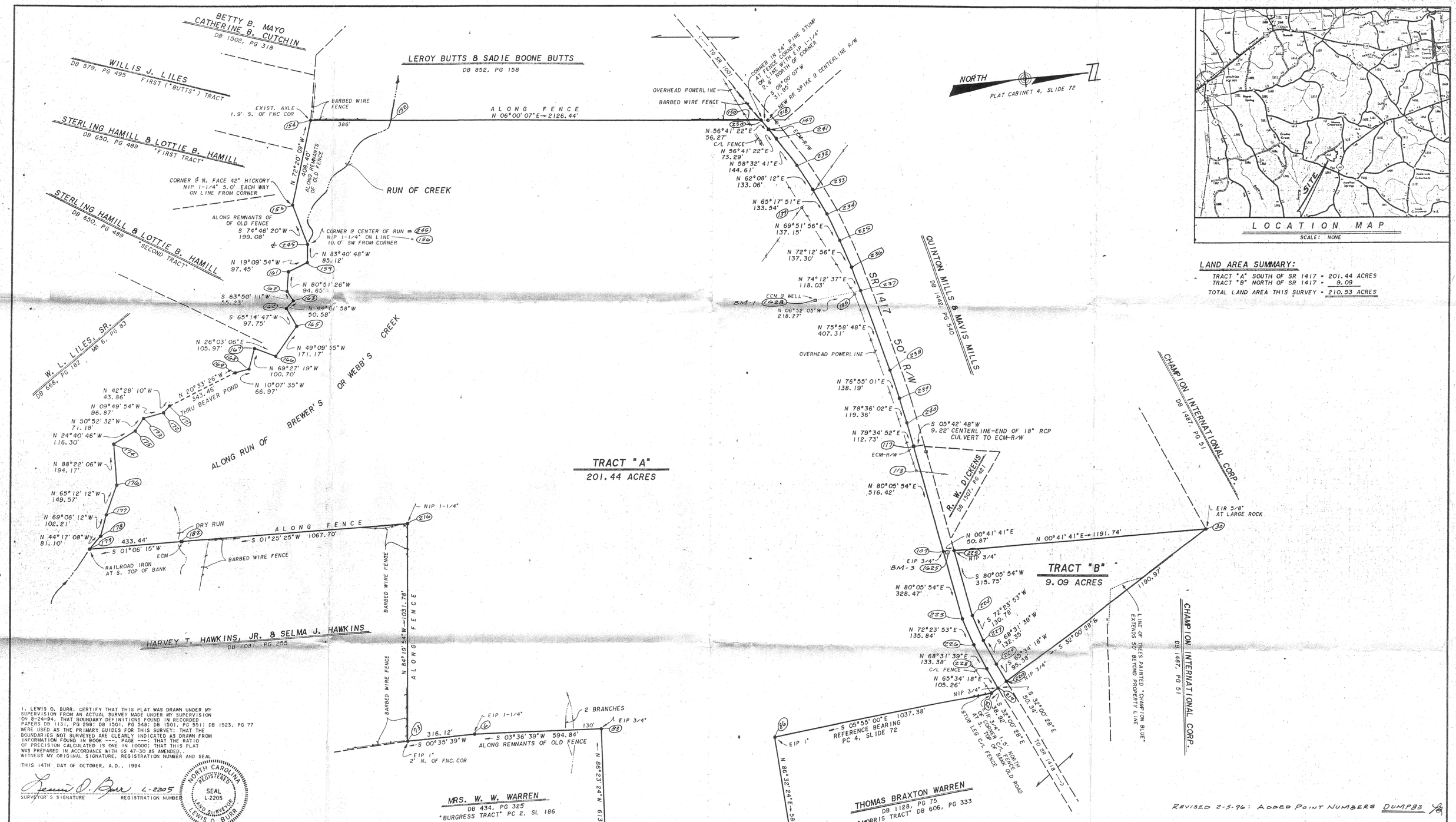
SEAL

PROJECT TITLE: HALIFAX COUNTY LANDFILL FACILITY

DRAWING TITLE: EXISTING AND PROPOSED LANDFILL UNITS AND SOLID WASTE MANAGEMENT ACTIVITIES

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY:	PROJECT NO.: HALIFAX 11-4
SCALE: AS SHOWN	DATE: NOV. 2011
FILE NAME: HALI-D0160	
SHEET NO.	DRAWING NO. FIG. 1

G:\CAD\Halifax\Halifax 11-4\sheets\HALI-D0160.dwg - 11/17/2011 9:07 AM



LAND AREA SUMMARY:

TRACT "A" SOUTH OF SR 1417 = 201.44 ACRES
TRACT "B" NORTH OF SR 1417 = 9.09
TOTAL LAND AREA THIS SURVEY = 210.53 ACRES

I, LEWIS O. BURR, CERTIFY THAT THIS PLAT WAS DRAWN UNDER MY SUPERVISION FROM AN ACTUAL SURVEY MADE UNDER MY SUPERVISION ON 8-24-94, THAT BOUNDARY DEFINITIONS FOUND IN RECORDED PAPERS DB 1131, PG 298; DB 1501, PG 548; DB 1501, PG 551; DB 1523, PG 77 WERE USED AS THE PRIMARY GUIDES FOR THIS SURVEY; THAT THE BOUNDARIES NOT SURVEYED ARE CLEARLY INDICATED AS DRAWN FROM INFORMATION FOUND IN BOOK ---; PAGE ---; THAT THE RATIO OF PRECISION CALCULATED IS ONE IN 10000; THAT THIS PLAT WAS PREPARED IN ACCORDANCE WITH GS 47-30 AS AMENDED.. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER AND SEAL.

THIS 14TH DAY OF OCTOBER, A.D., 1994

Lewis O. Burr L-2205
SURVEYOR'S SIGNATURE REGISTRATION NUMBER

NORTH CAROLINA REGISTERED SEAL L-2205 LAND SURVEYOR LEWIS O. BURR

NORTH CAROLINA, HALIFAX COUNTY
I, A NOTARY PUBLIC OF THE COUNTY AND STATE AFORESAID, CERTIFY THAT LEWIS O. BURR, A REGISTERED LAND SURVEYOR, PERSONALLY APPEARED BEFORE ME THIS DAY AND ACKNOWLEDGED THE EXECUTION OF THE FOREGOING INSTRUMENT.
WITNESS MY HAND AND OFFICIAL STAMP OR SEAL

THIS 14TH DAY OF OCTOBER, 1994

Ann Burr
NOTARY PUBLIC

MY COMMISSION EXPIRES MARCH 5, 1996

ANN BURR NOTARY PUBLIC HALIFAX COUNTY, N.C.

LEGEND:

ECM = EXISTING CONCRETE MONUMENT
EIR = EXISTING IRON ROD
EIP = EXISTING IRON PIPE
NIP = NEW IRON PIPE SET THIS SURVEY
R/W = RIGHT OF WAY
RCP = REINFORCED CONCRETE PIPE
C/L = CHAIN LINK

REFERENCES:

MAP SHOWING PROPERTY OF WILLIAM DOW BRYANT & WILLIAM A. STANSBURY; J. W. TRAYLOR & SON REGISTERED LAND SURVEYORS; APRIL 20, 1990; PLAT CABINET 4, SLIDE 72.

MAP SHOWING PROPERTY OF DENNIS A. ROSE; J. C. SHEARIN, SURVEYOR; FEBRUARY 9, 1962; MAP BOOK 10, PAGE 41.

MAP SHOWING PROPERTY OF CARRIE L. COOPER, A PORTION OF THE WEBB TRACT; SHEARIN & TRAYLOR, SURVEYORS; FEBRUARY 7, 9, 1951; MAP BOOK 6, PAGE 83.

I HEREBY CERTIFY THAT THE SURVEY IS OF AN EXISTING PARCEL OR PARCELS OF LAND.

Lewis O. Burr L-2205
SURVEYOR'S SIGNATURE REGISTRATION NUMBER

200 0 200 400 600
GRAPHIC SCALE - FEET

REVISED 2-5-96: ADDED POINT NUMBERS DUMP83

PLAT SHOWING PROPERTY STANDING IN THE NAME OF
HALIFAX COUNTY
DB 1131, PG 298; DB 1501, PG 548; DB 1501, PG 551; DB 1523, PG 77
SR 1417 BETWEEN SR 1001 AND SR 1418 JUST NORTH OF NC ROUTE 48

SCALE: 1" = 200'	APPROVED:	DRAWN BY: L.B.
DATE: 10-1-94		REVISED: 2-5-96

BUTTERWOOD TOWNSHIP HALIFAX COUNTY NORTH CAROLINA

BURR & ASSOCIATES, P.A.
1400 GEORGIA AVENUE
ROANOKE RAPIDS, NC 27870
(919) 537-0369

DRAWING NUMBER: B & A 6-223

Cab 5 Slide 323

I, LEWIS O. BURR, CERTIFY THAT THIS PLAT WAS DRAWN UNDER MY SUPERVISION FROM AN ACTUAL SURVEY MADE UNDER MY SUPERVISION (IN BOOK & PAGE) THAT BOUNDARY DEFINITIONS FOUND IN REFERENCE PAPERS DB 1081, PG 255 WERE USED AS THE PRIMARY GUIDES FOR THIS SURVEY; THAT THE BOUNDARIES NOT SURVEYED ARE CLEARLY INDICATED AS DRAWN FROM INFORMATION FOUND IN BOOK ——, PAGE ——; THAT THE RATIO OF PRECISION CALCULATED IS ONE IN 10000; THAT THIS PLAT WAS PREPARED IN ACCORDANCE WITH G.S. 47-30 AS AMENDED. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER AND SEAL

THIS 19TH DAY OF APRIL, A.D., 1995

SURVEYOR'S SIGNATURE — L2205 REGISTRATION NUMBER

NORTH CAROLINA REGISTERED LAND SURVEYOR SEAL L-2205 LEWIS O. BURR

NORTH CAROLINA, HALIFAX COUNTY

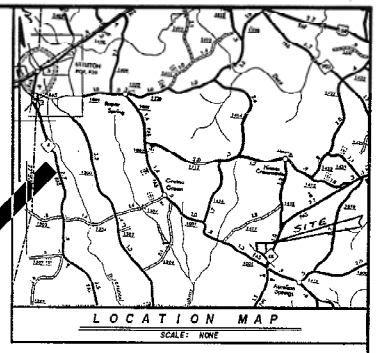
I, A NOTARY PUBLIC OF THE COUNTY AND STATE AFORESAID, CERTIFY THAT LEWIS O. BURR, A REGISTERED LAND SURVEYOR, PERSONALLY APPEARED BEFORE ME THIS DAY AND ACKNOWLEDGED THE EXECUTION OF THE FOREGOING INSTRUMENT.
WITNESS MY HAND AND OFFICIAL STAMP OR SEAL

THIS 19TH DAY OF APRIL, 1995

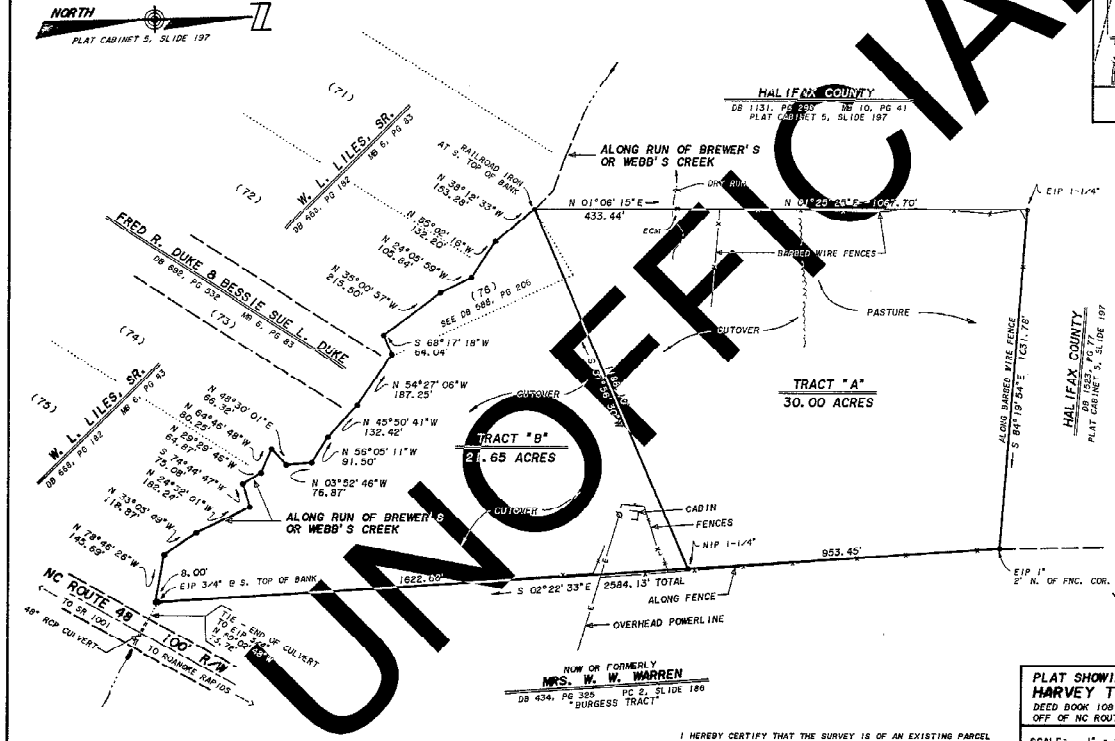
NOTARY PUBLIC

MY COMMISSION EXPIRES MARCH 5, 1996

ANN BURR NOTARY PUBLIC HALIFAX COUNTY, N.C.



LOCATION MAP
SCALE: NONE



UNOFFICIAL

NORTH CAROLINA, HALIFAX COUNTY
THE FOREGOING CERTIFICATE OF ANN BURR, NOTARY PUBLIC OF HALIFAX COUNTY, IS CERTIFIED TO BE CORRECT.
THIS 1 DAY OF August, 19 95.
RECORDED 2:21 P M. IN PLAT CABINET 5, SLIDE 323.
JUDY EVANS-BARBEE, HALIFAX COUNTY REGISTER OF DEEDS

LEGEND:
- ECM = EXISTING CONCRETE MONUMENT
- EIR = EXISTING IRON ROD
- EIP = EXISTING IRON PIPE
- RCP = REINFORCED CONCRETE PIPE
- NIP = NEW IRON PIPE SET THIS SURVEY

I HEREBY CERTIFY THAT THE SURVEY IS OF AN EXISTING PARCEL OR PARCELS OF LAND.

SURVEYOR'S SIGNATURE — L2205 REGISTRATION NUMBER

200 0 200 400 600
GRAPHIC SCALE - FEET

PLAT SHOWING PROPERTY STANDING IN THE NAME OF HARVEY T. HAWKINS, JR & SELMA J. HAWKINS
DEED BOOK 1081, PAGE 255 ~~ FORMERLY M. C. CRAWLEY
OFF OF NC ROUTE 48 JUST EAST OF SR 1001 @ BREWER'S CREEK

SCALE: 1" = 200'	APPROVED:	DRAWN BY: L.B.
DATE: 4-15-95		REVISED:

BUTTERWOOD TOWNSHIP HALIFAX COUNTY NORTH CAROLINA

BURR & ASSOCIATES, P.A.
1400 GEORGIA AVENUE
ROANOKE RAPIDS, NC 27870
(919) 537-0369

DRAWING NUMBER: B & A 7-158

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BOOK 1649 PAGE 602

HALIFAX COUNTY
2168

09-22-95

STATE OF NORTH CAROLINA

$120.00

Real Estate Excise Tax

Excise Tax $120.00

FILED FOR REGISTRATION AND RECORDED
3:30 O'CLOCK PM
Sept. 22 1995 IN BOOK 1649 PAGE 602
Judy Wynn-Barfield
Register of Deeds, Halifax County

RF 12.00

Recording Time, Book and Page

Tax Lot No. ..... Parcel Identifier No. .....

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

by .....

Mail after recording to Godwin & Stephenson, P. O. Box 429, Roanoke Rapids, NC 27870

This instrument was prepared by W. Turner Stephenson, III

Brief description for the Index BUTTWD.TWNSP.CO.LANDFILL

NORTH CAROLINA GENERAL WARRANTY DEED

THIS DEED made this 13th day of July, 1995, by and between

GRANTOR	GRANTEE
H. T. Hawkins, Jr., and wife, Selma J. Hawkins	Halifax County P. O. Box 38 Halifax, NC 27839

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

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

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

[See Schedule A attached]

UNOFFICIAL

N. C. Bar Assoc. Form No. 3 © 1976, Revised © 1977 — James Williams & Co., Inc., Box 127, Yanceyville, N. C. 27665
Printed by Agreement with the N. C. Bar Assoc. — 1981

SCHEDULE A

That certain tract or parcel of land lying and being situate on the west side of NC Route 48, Butterwood Township, Halifax County, North Carolina, more particularly described as follows: BEGINNING at a railroad iron at the southern top of the bank of Brewer's or Webb's Creek, said point lying the following courses and distances from the end of a culvert under NC Route 48 through which Brewer's or Webb's Creek runs; thence generally along said creek (the dividing line between Grantor's property and the property of W. L. Liles, Sr., Fred R. Duke and Bessie Sue L. Duke) N.59°02'48"W.73.72' to an existing iron pipe located 8' from an existing iron pipe on southern top of the bank of said creek; thence N.78°46'26"W.145.69'; thence N.33°03'49"W.118.87'; thence N.24°32'01"W.182.24'; thence S.74°44'47"W.75.08'; thence N.29°29'46"W.64.87'; thence N.64°46'48"W.80.25'; thence N.48°30'01"E.66.32'; thence N.03°52'46"W.76.87'; thence N.56°05'11"W.91.50'; thence N.45°50'41"W.132.42'; thence N.54°27'06"W.187.25'; thence S.68°17'18"W.64.04'; thence N.35°00'57"W.215.50'; thence N.24°05'59"W.105.84'; thence N.55°02'16"W.132.20'; thence N.38°12'33"W.153.28' to the railroad iron at the southern top of the bank of said creek, being the point of beginning; thence leaving said creek N.01°06'15"E.433.44' to an existing concrete monument; thence N.01°25'25"E.1067.70' to an existing iron pipe; thence S.48°19'54"E.1031.78' to an existing iron pipe; thence along the property line of property now or formerly belonging to Mrs. W. W. Warren S.02°22'33"E.953.45' to a new iron pipe; thence S.67°56'30"W.1188.10' to the point of beginning and shown as Tract "A", containing 30 acres on that map or plat entitled Plat Showing Property Standing in the Name of Harvey T. Hawkins, Jr. and Selma J. Hawkins recorded in Plat Cabinet 5, Slide 323, Halifax County Public Registry. Reference to said map being hereby maid for greater certainty of description.

WDL 9-13

UNOFFICIAL

Grantee agree to erect a chain link fence along the property line with the grantees and install two hundred fifty feet (250') of screening material in said fence.

The property hereinabove described was acquired by Grantor by instrument recorded in Deed Book 1081, Page 255.

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

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

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

UNOFFICIAL

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

USE BLACK INK ONLY

..... (Corporate Name)

By: .....

..... President

ATTEST:

.....

..... Secretary (Corporate Seal)

H. T. Hawkins, Jr. (SEAL)

H. T. Hawkins, Jr.

Selma J. Hawkins (SEAL)

Selma J. Hawkins

..... (SEAL)

Ernestine S. Stephenson (SEAL)

Subscribing Witness

SEAL-STAMP

OFFICIAL SEAL
NOTARY PUBLIC
COUNTY OF HALIFAX
STATE OF NORTH CAROLINA
My Commission Expires 8-7-2000

NORTH CAROLINA, ... County.

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

Ernestine S. Stephenson Subscribing Witness

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

being duly sworn, stated that in her presence H. T. Hawkins, Jr. and Selma J. Hawkins signed the foregoing instrument. Witness my hand and official seal, this the 24th day of August, 1995.

Use Black Ink

My commission expires: 8-7-2000 Leigh Ann Eatman Notary Public

SEAL-STAMP

NORTH CAROLINA, ... County.

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

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

Witness my hand and official stamp or seal, this ..... day of ..... 19.....

My commission expires: .... Notary Public

The foregoing Certificate(s) of Leigh Ann Eatman NP of Halifax Co

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

Judy Evans-Barber REGISTER OF DEEDS FOR Halifax COUNTY

By Carolyn D. Pulley ~~Deputy~~/Assistant - Register of Deeds

N. C. Bar Assoc. Form No. 3 © 1976, Revised © 1977 — James Williams & Co., Inc., Box 127, Youngsville, N. C. 27596
Printed by Agreement with the N. C. Bar Assoc. 1981

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Attachment C

Operations Manual

Halifax County, North Carolina
Transfer Station
Permit Application

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Operations Manual

Halifax County Transfer Station
Halifax County, North Carolina

Prepared for:

Halifax County Department of Public Utilities
Halifax, North Carolina

January 2012

RICHARDSON SMITH GARDNER
& ASSOCIATES
ENGINEERING & GEOLOGICAL
SERVICES

14 N. BOYLAN AVENUE
RALEIGH, NORTH CAROLINA 27603
NC LIC. NO. C-0828 (ENGINEERING)

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HALIFAX COUNTY
TRANSFER STATION

OPERATIONS MANUAL

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SECTION 1.0
GENERAL FACILITY OPERATIONS

1.1 OVERVIEW

This Operations Manual was prepared for the Halifax County Transfer Station (Permit No.42-04T) located on Liles Road near Littleton (see **Figure 1**). This document discusses the operation of the transfer station, which is used for the collection and transport of municipal solid waste (MSW), and specifically addresses requirements of North Carolina Solid Waste Management Rules *Section .0402 - Operational Requirements*. Refer to **Figure 2** for the general layout of the facility.

1.2 CONTACT INFORMATION

All correspondence and questions concerning the operation of the Halifax County Transfer Station should be directed to the appropriate County and State personnel listed below. For fire or police emergencies dial 911.

1.2.1 Halifax County

Halifax County Department of Public Utilities
26 N. King Street (Public Works Bldg.)
P.O. Box 70
Halifax, NC 27839
Phone: (252) 583-1451
Fax: (252) 593-5014
Contact: Gwen Matthews, Director

Halifax County Landfill
921 Liles Road
Littleton, NC 27850
Phone: (252) 586-7516
Fax: (252) 586-2685
Contact: Larry Garriss, Solid Waste Director

1.2.2 North Carolina Department of Environment and Natural Resources

North Carolina DENR - Fayetteville Regional Office (FRO)
225 Green Street, Suite 714
Fayetteville, NC 28301
Phone: (910) 486-1541
Fax: (910) 486-0707

North Carolina DENR - Raleigh Central Office (RCO)
1646 Mail Service Center
Raleigh, NC 27699-1646
217 West Jones Street
Raleigh, NC 27603
Phone: (919) 707-8200

North Carolina DENR - Raleigh Regional Office (RRO)
3800 Barrett Drive
Raleigh, NC 27609
Phone: (919) 571-4700
Fax: (919) 571-4718

Division of Waste Management (DWM) - Solid Waste Section:

Field Operations Branch Head:	Mark Poindexter (RCO)
Eastern District Supervisor:	Dennis Shackelford (FRO)
Waste Management Specialist:	Mary Whaley (RCO)

Division of Land Resources - Land Quality Section:

Regional Engineer:	John Holley, P.E. (RRO)

1.3 FACILITY OPERATING HOURS

Normal hours of operation will be 8:00 A.M. to 4:00 P.M. Monday to Friday. The facility will be closed on Sundays and on observed holidays which include: New Year's Day, Martin Luther King Jr. Day, Good Friday, Memorial Day, Thanksgiving Eve, Thanksgiving Day, Christmas Eve, and Christmas Day.

The County may elect to modify these hours and scheduled holidays from time to time.

1.4 ACCESS CONTROL

Limiting access to the solid waste management facility is important for the following reasons:

- Unauthorized and illegal dumping of waste materials is prevented.
- Trespassing, and injury resulting therefrom, is discouraged.
- The risk of vandalism is greatly reduced.

Access to active areas of the facility will be controlled by a combination of fences and natural barriers, and strictly enforced operating hours. An attendant will be on duty at all times when the facility is open for public use to enforce access restrictions (see also **Section 1.10**).

1.4.1 Physical Restraints

The site will be accessed by the existing entrance on Liles Road. A scale and scale house is provided at this entrance. All waste will have been weighed prior to being processed through the transfer station. The facility entrance has a gate which will be securely locked during non-operating hours.

1.4.2 Security

Frequent inspections of gates and fences will be performed by facility personnel. The County will arrange for a random security patrol of the main gate to further discourage trespassing. Evidence of trespassing, vandalism, or illegal operation will be reported to the County Solid Waste Director.

1.5 SIGNAGE

A prominent sign(s) containing the information required by the DWM will be placed at the main facility entrance. This sign(s) will provide information on operating hours, operating procedures, and acceptable wastes. Additional signage will be provided as necessary within the facility complex to distinctly distinguish the roadway to the transfer station from other solid waste management activities. Service and maintenance roads for use by operations personnel will be clearly marked and barriers (e.g., traffic cones, barrels, etc.) will be provided as required.

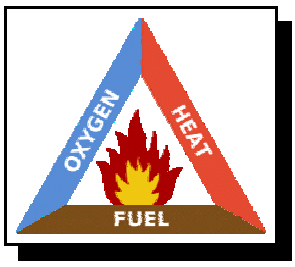
1.6 COMMUNICATIONS

Two way radio communication will be maintained between the transfer station and the facility scale house and office. The scale house and office have telephones in case of emergency and for the conduct of day-to-day business. Emergency telephone numbers are displayed.

1.7 FIRE CONTROL

Although no open burning of waste is allowed at the facility, the possibility of fire within the transfer station or a piece of equipment must be anticipated in the daily operation of the facility.

1.7.1 Fire Triangle



The "triangle" illustrates the rule that in order to ignite and burn, a fire requires three (3) elements: heat, fuel, and oxygen. A fire is prevented or extinguished by "removing" any one of them. A fire naturally occurs when the elements are combined in the right mixture (e.g., more heat needed for igniting some fuels, unless there is concentrated oxygen). These principles are integral in the prevention and management of potential fire situations.

1.7.2 Equipment

A combination of factory installed fire suppression systems and/or portable fire extinguishers will be operational on all pieces of heavy equipment at all times. Potential fire hazards are created from the build-up of fine, dry dust particles on and around operational motors and control panels. The presence of these build-ups can cause overheating and potential fire if periodic equipment cleaning and maintenance are not practiced. Portable fire extinguishers should be maintained in a state of readiness on each piece of moving equipment and equipment should be cleaned periodically.

1.7.3 General Fire Management Strategies

Each fire situation is site specific; however, general strategies for active fire management include the following (in no particular order):

- Covering of burning material with soil (reduce oxygen);
- Covering of burning material with foams (reduce oxygen);
- Flooding the burning material with water (reduce heat);
- Injecting an inert gas such as CO_2 (reduce oxygen); and
- Excavating the burning material (displacing fuel) and then extinguishing it in small controlled areas.

1.7.4 Fires within the Transfer Station or in Transfer Trailers

Fires within the transfer station or in transfer trailers will be limited by the control of "hot" loads entering the facility. Facility personnel at the scale house will turn away all vehicles containing waste that is suspected to be hot. If smoldering or burning waste is discovered on the tipping floor, then the waste will be segregated, spread as thin as possible, and the fire will be extinguished. No "hot" material will be loaded onto transfer trailers.

Transfer trailer fires are uncommon, but may occur when open trailers are loosely loaded with combustible waste materials. If smoke or fire are observed in a loaded waste transfer trailer, the fire must be immediately reported to the Solid Waste Director. If possible, the load should be immediately doused with water from the tipping floor loading chute. If possible, the transfer trailer should be slowly moved from the truck bay, moved at least 100 feet away from the building, and disconnected from the truck cab. The Solid Waste Director will evaluate the situation and response, and, if necessary, **call 911**.

1.7.5 Notification

The County will verbally notify the DWM (see **Section 1.2.2**) within 24 hours of discovery of a fire within the transfer station. In addition, written documentation describing the fire, the actions carried out to extinguish the fire, and a strategy for preventing future occurrences will be provided to the DWM within 15 days following

any such occurrence.

1.7.6 Coordination with Local Fire Department

A copy of this Operations Manual will be filed with the local fire department including all contact information for the facility.

1.8 SEVERE WEATHER CONDITIONS

Unusual weather conditions can directly affect the operation of the facility. Some of these weather conditions and recommended operational responses are as follows.

1.8.1 Ice Storms

An ice storm can make access to the facility dangerous, prevent movement and, thus, may require closure of the facility until the ice is removed or has melted.

1.8.2 Heavy Rains

Exposed soil surfaces can create a muddy situation in some portions of the facility during rainy periods. The control of drainage and use of crushed stone on unpaved roads should provide all-weather access for the site and promote drainage away from critical areas. In areas where the aggregate surface is washed away or otherwise damaged, new aggregate should be used for repair.

1.8.3 Electrical Storms

The open areas of the facility are susceptible to the hazards of an electrical storm. If necessary, activities will be temporarily suspended during such an event. Refuge will be taken as necessary in the on-site buildings or in rubber-tired vehicles.

1.8.4 Windy Conditions

Facility operations during a particularly windy period may require that the active tipping area be temporarily shifted to a more sheltered area and/or reduced in size.

1.8.5 Violent Storms

In the event of hurricane, tornado, or severe winter storm warning issued by the National Weather Service, facility operations may be temporarily suspended until the warning is lifted.

1.9 EQUIPMENT REQUIREMENTS

The County will maintain on-site equipment required to perform the necessary transfer activities. The County typically uses the following equipment in the daily operation of the transfer station:

- Wheel Loader - waste movement and trailer loading;
- Backhoe (or mini-excavator) - trailer loading and compaction;
- Truck - movement of transfer trailers on-site; and
- Transfer Vehicles (trucks/trailers).

Periodic maintenance of all equipment and minor and major repair work will be performed at designated maintenance zones.

1.10 PERSONNEL REQUIREMENTS

At least one member of the facility supervisory staff will be experienced in the management of transfer station operations. Each facility employee will go through an annual training course (led by supervisory staff). As part of this training, personnel will learn to recognize loads which may contain prohibited wastes.

1.11 HEALTH AND SAFETY

All aspects of the facility operations were developed with the health and safety of the operating staff, customers, and neighbors in mind. Prior to commencement of operations of the facility, a member of the operating staff will be designated site safety officer. This individual, together with the facility's management, will modify the site safety and emergency response program to remain consistent with national Solid Waste Management Association (SWANA) and Occupational Safety and Health Administration (OSHA) guidance.

Safety equipment provided includes equipment rollover protective cabs, seat belts, audible reverse warning devices, hard hats, safety shoes, and first aid kits. Facility personnel will be encouraged to complete the American Red Cross Basic First Aid Course. Other safety requirements as designated by the County will also be implemented.

Facility employees will be routinely trained in health and safety by supervisory staff. All training will be documented. The following are some general recommendations for the health and safety of workers:

1.11.1 <u>Personal Hygiene</u>

The following items are recommended as a minimum of practice:

- Wash hands before eating, drinking, or smoking.
- Wear personal protective equipment as described in **Section 1.11.2.**
- Wash, disinfect, and bandage ANY cut, no matter how small it is. Any break in the skin can become a source of infection.
- Keep fingernails closely trimmed and clean (dirty nails can harbor pathogens).

1.11.2 Personal Protective Equipment

Personal Protective Equipment (PPE) must be evaluated as to the level of protection necessary for particular operating conditions and then made available to facility employees. The list below includes the PPE typically used and/or required in a solid waste management facility workplace.

- Safety shoes with steel toes.
- Hearing protection should be used in areas where extended exposure to continuous high decibel levels are expected.
- Disposable rubber latex or chemical resistant gloves for handling and/or sampling of waste materials.
- Dust filter masks.
- Class 2 vest, shirt, or coat (at all times).

Following use, PPE's should be disposed of or adequately cleaned, dried, or readied for reuse.

1.11.3 Mechanical Equipment Hazard Prevention

All equipment should be operated with care and caution. All safety equipment such as horns, backup alarms, and lights should be functional. A Lockout-Tagout program will be used to identify equipment in need or under repair and insure that operation is "off-limits" prior to maintenance or repair. All operators will be trained in the proper operation of equipment.

1.11.4 Employee Health and Safety

Some general safety rules are:

- Consider safety first when planning and conducting activities.
- Review the equipment O&M manual(s) prior to attempting repairs/changes.
- Remember the buddy system in case of repair of mechanical equipment.
- Post emergency contact phone numbers.
- Provide easy and visible access to the Right to Know materials.
- Provide easy and visible access to first aid kits and fire extinguishers.

1.11.5 Physical Exposure

Facility personnel may come in contact with the fluids, solids, and airborne constituents found at the facility. Routine training should be conducted regarding the individual and collective materials used at the facility and their associated hazards. Training concerning safe work practices around these potential exposures should use equipment and proper disposal procedures.

1.11.6 Material Safety Data Sheets

Material Safety Data Sheets (MSDS) will be collected on every waste (if available) that enters the facility. Information will also be made available for all chemicals stored on site for use at the facility. MSDS sheets will be stored in a location with all other Right to Know information for the site.

1.12 UTILITIES

Electrical power, water, telephone, and restrooms will be provided at the facility scale house and office/maintenance building.

1.13 RECORD KEEPING PROGRAM

The Operator will maintain the following records related to the transfer station in an operating record at the facility:

A. Current permit(s);
B. Inspection reports;
C. Audit and compliance records;
D. Annual reports;
E. Waste inspection records (see **Section 2.5**);
F. Daily tonnage records - including source of generation;
G. Waste determination records;
H. List of generators and haulers that have attempted to dispose of restricted wastes;
I. Employee training procedures and records of training completed; and
J. Cost estimates or financial assurance documentation.

The operating record will be kept up to date by the Solid Waste Director or his designee. It will be presented upon request to the DWM for inspection. A copy of this Operations Manual will be kept at the facility and will be available for use at all times.

SECTION 2.0
WASTE HANDLING OPERATIONS

2.1 OVERVIEW

This section describes the required waste handling operations for the transfer station.

2.2 ACCEPTABLE WASTES

Only the waste as defined by NCGS 130A-290(a)(18a) generated within the approved service area (see **Section 2.2.1**) may be received at the transfer station. The waste processed at the transfer station includes wastes generated from residential, commercial, industrial, and institutional sources.

2.2.1 <u>Service Area</u>

The service area for the facility is Halifax County, NC.

2.3 PROHIBITED WASTES

Only wastes as defined in **Section 2.2** above may be accepted in the MSW transfer station. No other wastes may be accepted including the following wastes (per NCGS 130A-309.10)*:

- Used Oil
- Yard Trash (Yard Waste)
- White Goods
- Antifreeze
- Aluminum Cans
- Whole Scrap Tires
- Lead Acid Batteries
- Beverage Containers (those that are required to be recycled under NCGS 18B-1006.1)
- Motor Vehicle Oil Filters
- Recyclable Rigid Plastic Containers
- Wooden Pallets
- Oyster Shells
- Discarded Computer Equipment and Televisions.

**Note that incidental or occasional disposal of small amounts of the above listed wastes is not considered a violation.*

In addition, operating criteria prohibit other materials from receipt within the transfer station. These materials include:

- Hazardous waste as defined by NCGS 130A-290(a)(8), including hazardous waste from conditionally exempt small quantity generators.
- Polychlorinated biphenyls (PCB) wastes as defined in 40 CFR 761 with the exception of trace amounts found in materials such as consumer electronics.
- Bulk or non-containerized liquid wastes unless the waste is household waste other than septic waste and waste oil. A liquid determination will be performed by the paint filter test (see **Appendix A** for apparatus and procedure).
- Containers holding liquid wastes unless the waste is household waste.

At the County's discretion, or as may be required by law, recyclable materials may be separated and placed in roll-off, or other containers located near the transfer station. These containers will be stored on site until they are full, and will then be transported off site.

2.4 PROHIBITION OF OPEN BURNING

Open burning of waste is prohibited at the facility.

2.5 WASTE SCREENING PROGRAMS

In order to assure that prohibited wastes are not entering the facility, screening programs have been implemented. Waste received at both the scale house entrance and waste taken to the transfer station is inspected by trained personnel. These individuals have been trained to spot indications of suspicious wastes, including: hazardous placarding or markings, liquids, powders or dusts, sludges, bright or unusual colors, drums or commercial size containers, and "chemical" odors. Screening programs for visual and olfactory characteristics of prohibited wastes are an ongoing part of the operation of the facility.

Records of information gathered as part of the waste screening programs will be maintained at the facility during its active life and as long as required by the County and the DWM.

2.5.1 Waste Receiving and Inspection

All vehicles must stop at the scale house located at the main entrance of the facility and visitors are required to sign-in. All waste transportation vehicles are weighed and the content of the load assessed. The scale attendant(s) requests from the driver of the vehicle a description of the waste it is carrying to ensure that unacceptable waste is not allowed into the facility. The attendant(s) then visually checks the vehicle as it crosses the scale. Signs informing users of the acceptable and unacceptable types of waste are posted at the scale house. Once passing the scales, the vehicles are routed to the MSW transfer station or other area as appropriate.

Vehicles are randomly selected for screening on a regular basis, depending on personnel available. At least one vehicle per week, but not less than 1% by weight of the waste

stream entering the facility (based on the previous week's total), will be randomly selected by inspection personnel. A random truck number and time will be selected (e.g., the tenth load after 10:00 a.m.) on the day of inspections. However, if something looks suspicious is spotted in any waste load, that load is inspected further.

Vehicles selected for inspection at the transfer station are directed to an area on the tipping floor where the vehicle will be unloaded. Waste is carefully spread using suitable equipment. An attendant trained to identify wastes that are unacceptable inspects the waste discharged at the screening area. If unacceptable waste is found, including wastes generated from outside of the service area, the load will be isolated, reloaded, and the generator/hauler will be logged and escorted out of the facility. For unacceptable wastes that are non-hazardous, the Solid Waste Director will then notify officials of the DWM (see **Section 1.2.2**) within 24 hours of attempted disposal of any waste the facility is not permitted to receive in order to determine the proper course of action. For unacceptable wastes that are hazardous, the Hazardous Waste Contingency Plan outlined in **Section 2.4.2** will be followed. The hauler is responsible for removing unacceptable waste from the facility property.

If no unacceptable waste is found, the load will be loaded onto a transfer trailer. All random waste inspections will be documented by facility staff using the waste screening form provided in **Appendix B**.

In addition to random waste screening described above, waste unloaded on the tipping floor will be inspected by the equipment operators, trained to spot unacceptable wastes, before and during pushing into the transfer trailers. Any suspicious looking waste will be reported immediately to the designated primary inspector for further evaluation.

2.5.2 Hazardous Waste Contingency Plan

In the event that identifiable hazardous waste or waste of questionable character is detected at the facility, appropriate equipment, protective gear, personnel, and materials as necessary will be employed to isolate the wastes. The DWM will be notified immediately (see **Section 1.2.2**) that an attempt was made to dispose of hazardous waste at the facility. If the vehicle attempting disposal of such waste is known, all attempts will be made to prevent that vehicle from leaving the site or, if the vehicle has left the site, immediate notice will be served on the owner of the vehicle that hazardous waste, for which they have responsibility, has been disposed of at the facility.

The County will assist the DWM as necessary and appropriate in the removal and disposition of the hazardous waste and in the prosecution of responsible parties. If needed, the hazardous waste will be covered with either on-site soils or other tarping material until such time when an appropriate method can be implemented to properly handle the waste. The cost of the removal and disposing of the hazardous waste will be charged to the owner of the vehicle involved. Any vehicle owner or operator who knowingly dumps hazardous waste at the facility may be barred from future use.

Should an incident where hazardous waste is found at the facility occur, the event will be documented by facility staff using the waste screening form provided in **Appendix B**.

2.6 TRANSFER STATION OPERATIONS

2.6.1 Waste Receipt

All wastes received for processing at the transfer station will have been weighed-in and visually inspected by scale house personnel (see **Section 2.5**). Vehicles to be unloaded on the tipping floor will be directed by the waste spotter to back into the transfer station building and unload onto the tipping floor (approximate 4,500 square feet in area).

2.6.2 Tipping Floor Operations

Unloaded wastes will be visually inspected on the tipping floor (see **Section 2.5**). Acceptable wastes will be loaded into an awaiting open-top transfer trailer in the loading bay (lower floor of the building). The building has push walls on either side of the tipping floor to aid operations staff in pushing waste through the loading chute located above the loading bay.

2.6.3 Transfer Trailer Loading and Transport

The waste placed in each trailer should be adequately placed and to eliminate excessive surface voids, irregularities, and protruding wastes to the extent possible. The loaded transfer trailer will be immediately covered with a tarp prior to leaving the loading bay. Any partially loaded trailers will be covered overnight with a tarp and left in the loading bay. The movement of transfer trailers on the site is the responsibility of the County. The movement of transfer trailers to and from the site is the responsibility of either the County or contracted transfer trucking firm.

Once loaded, transfer trailers will be moved from the loading bay to await transport to the designated disposal facility(ies) (to be determined). The disposal facility will be appropriately permitted to receive waste from the transfer station's service area. Waste can be stored in covered transfer trailers at the facility after hours, but no longer than 48 hours.

2.6.4 Equipment Operations Within the Transfer Station

Equipment operations will be carried out in a safe manner to avoid damage to the structure and transport vehicles.

2.6.5 Daily Cleaning

Daily cleaning will be used to control the potential for disease vectors, fire, odors, blowing litter, and scavenging. Any waste remaining on the tipping floor at the end of each day shall be placed into a transfer trailer and the partially filled trailer will be

covered overnight with a tarp. Additionally, the tipping floor will be rinsed with water at the end of each working day. Wash-down water, which becomes leachate upon contact with waste or waste residue, will be directed toward the floor drain located in the loading bay. From the drain, the wash-down water flows to a concrete storage tank located near the back of the building (see **Section 3.3** for management of leachate). As small a working area as possible should be maintained on the tipping floor to minimize the amount of daily cleanup required and the amount of leachate generated.

In case of an emergency, a tarp may be used to cover wastes that must remain on the tipping floor overnight. A tarp cover will be used only when it is impossible to clear the tipping floor.

2.6.6 Weekly Cleaning

A thorough cleaning of the transfer station will be performed at least on a weekly basis. An anti-bacterial detergent shall be used once weekly to sanitize the work area (tipping floor, push walls, and loading bay). Waste handling equipment will also be washed at least weekly.

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SECTION 3.0
ENVIRONMENTAL MANAGEMENT

3.1 OVERVIEW

This section reviews the overall environmental management tasks required for the successful operation of the facility.

3.2 SURFACE WATER CONTROL

As used herein, the definition of "surface water" is water which results from precipitation or site run-on that has not contacted the waste.

Proper control of surface water at the transfer station will accomplish the following goals:

- Prevent the run-on of surface water into waste handling area(s);
- Prevent the run-off of surface water that has come into contact with the waste (i.e. leachate);
- Limit the erosion caused by surface waters; and
- Limit sediments carried off-site by surface waters.

The design of the transfer station (enclosure, slopes, etc.) minimize the potential for run-on or run-off problems.

Erosion control measures have been taken within the site drainage channels and at points of stormwater discharge. All site features will be inspected regularly for erosion damage and promptly repaired.

Stormwater run-off from the site is conveyed to an on-site sediment trap. The trap will be inspected regularly for sediment build-up or erosion damage. The trap will be cleaned out when sediment reaches the sediment cleanout elevation.

3.3 LEACHATE MANAGEMENT

All wash-down water which comes into contact with the waste, tipping floor, loading bay floor, or waste handling equipment will be treated as leachate. Wash-down water, which is collected in a floor drain in the loading bay and flows to a concrete storage tank located near the back of the building. The floor drain will be visually inspected during routine cleaning activities. If there is evidence that the drain is not working properly the County will initiate the necessary maintenance activities.

The leachate storage tank level will be checked at least once per week. The tank will be pumped out whenever the tank approaches full capacity (typically quarterly or more frequently if larger

storms are forecast). This water will then be hauled to an approved wastewater treatment plant for treatment and disposal. The tank will be routinely inspected during pumping activities. If there is evidence that the tank is not functioning properly, the County will initiate the necessary maintenance actions.

3.4 LITTER CONTROL

The transfer station building is enclosed on three sides and, thus, acts as a barrier to keep litter contained. Additionally, all outbound transfer trailers will have their load covered to minimize the potential for litter.

A litter control crew will pick up spilled or wind-blown waste around the site and on access roads daily as necessary. Facility staff will also make operational changes as practical based on wind conditions that may spread litter.

3.5 VECTOR CONTROL

Control of insects, rodents, and birds will be accomplished by regular cleaning of the transfer station and the control of litter. If vector control becomes a problem, additional measures will be taken to ensure the protection of human health.

3.6 ODOR CONTROL

Odorous or potentially odorous materials will be pushed into a transfer truck and covered as soon as possible to avoid odor problems. Additionally, regular cleaning of the transfer station will help minimize the potential for odor problems. If odor control becomes a problem, additional measures will be taken to ensure odor control.

3.7 DUST CONTROL

Dust related to waste hauler traffic on the access roads will be minimized by using a water truck to limit dust potential on the gravel portions of the road.

0 800' 1600'

REFERENCE:

1. AERIAL PHOTOGRAPHY OBTAINED FROM HALIFAX COUNTY GIS DEPARTMENT.

HALIFAX COUNTY TRANSFER STATION SITE LOCATION MAP

RICHARDSON SMITH GARDNER & ASSOCIATES
14 N. Boylan Ave.
Raleigh, N.C. 27603
NC LIC. NO. C-0828 (Engineering)
www.rsgengineers.com
ph: 919-828-0577
fax: 919-828-3899

SCALE:	DRAWN BY:	CHECKED BY:	DATE:	PROJECT NO.	FIGURE NO.	FILE NAME
AS SHOWN	W.R.B.	P.K.S.	Jan. 2012	HALIFAX 11-5	1	HALI-A0175

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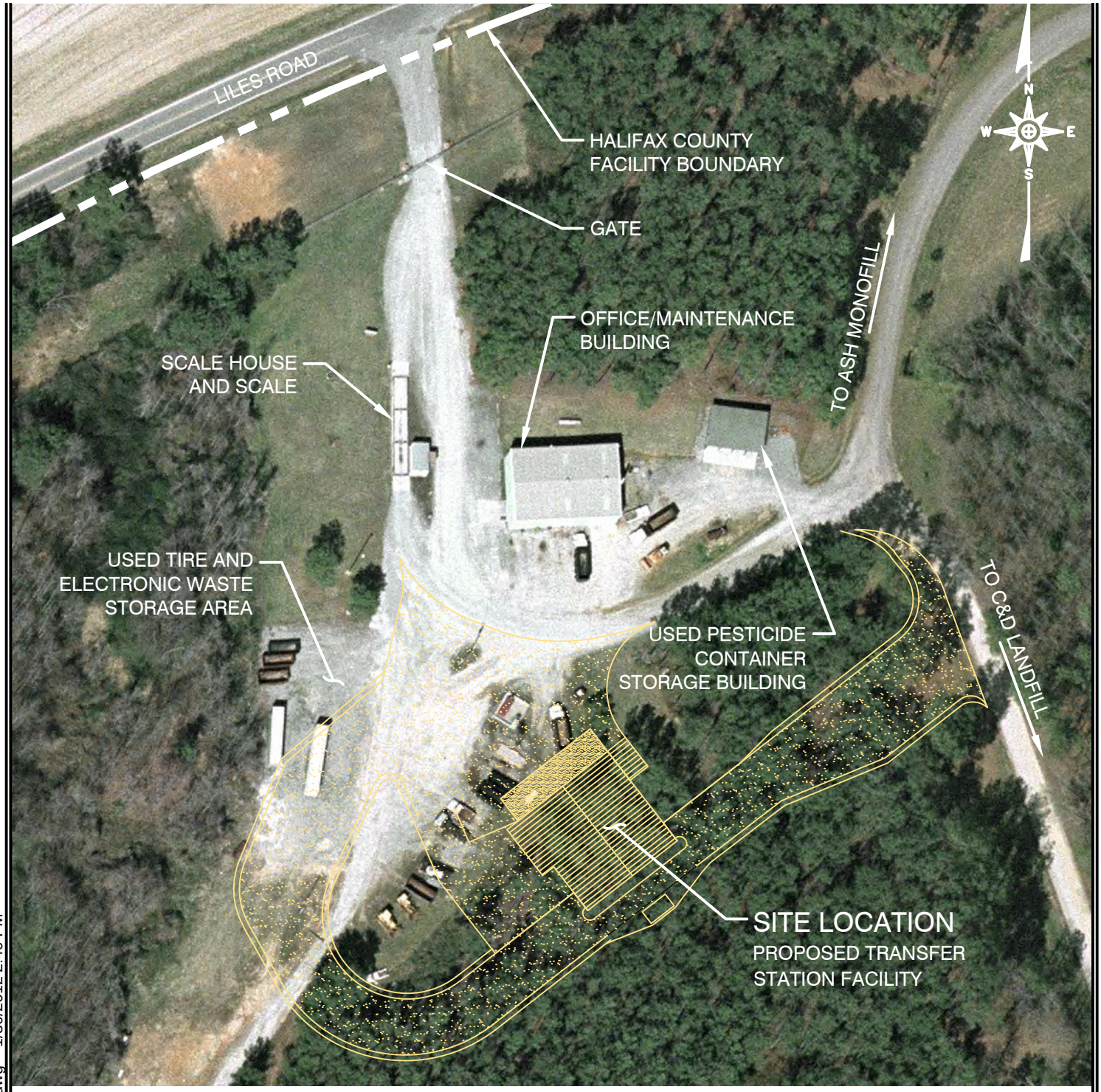

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REFERENCE:

1. AERIAL PHOTOGRAPHY OBTAINED FROM HALIFAX CO. GIS DEPARTMENT.

HALIFAX COUNTY TRANSFER STATION EXISTING CONDITIONS

RICHARDSON SMITH GARDNER & ASSOCIATES
14 N. Boylan Ave.
Raleigh, N.C. 27603
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www.rsgengineers.com
ph: 919-828-0577
fax: 919-828-3899

SCALE:	DRAWN BY:	CHECKED BY:	DATE:	PROJECT NO.	FIGURE NO.	FILE NAME
AS SHOWN	W.R.B.	P.K.S.	Jan. 2012	HALIFAX 11-5	2	HALI-A0176

G:\CAD\Halifax\Halifax 11-5\sheets\HALI-A0176.dwg - 1/30/2012 2:49 PM

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Appendix A

EPA Method 9095
Paint Filter Liquids Test

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METHOD 9095
PAINT FILTER LIQUIDS TEST
From EPA SW-846

1.0 SCOPE AND APPLICATION

1.1 This method is used to determine the presence of free liquids in a representative sample of waste.

1.2 The method is used to determine compliance with 40 CFR 264.314 and 265.314.

2.0 SUMMARY OF METHOD

2.1 A predetermined amount of material is placed in a paint filter. If any portion of the material passes through and drops from the filter within the 5 minute test period, the material is deemed to contain free liquids.

3.0 INTERFERENCES

3.1 Filter media were observed to separate from the filter cone on exposure to alkaline materials. This development causes no problem if the sample is not disturbed.

4.0 APPARATUS AND MATERIALS

4.1 Conical paint filter: Mesh number 60 (fine meshed size). Available at local paint stores such as Sherwin-Williams and Glidden for an approximate cost of $0.07 each.

4.2 Glass funnel: If the paint filter, with the waste, cannot sustain its weight on the ring stand, then a fluted glass funnel or glass funnel with a mouth large enough to allow at least 1 inch of the filter mesh to protrude should be used to support the filter. The funnel is to be fluted or have a large open mouth in order to support the paint filter yet not interfere with the movement, to the graduated cylinder, of the liquid that passes through the filter mesh.

4.3 Ring stand and ring or tripod.

4.4 Graduated cylinder or beaker: 100-mL.

5.0 REAGENTS

5.1 None.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 All samples must be collected according to the directions in Chapter Nine of EPA SW-846.

6.2 A 100 mL or 100 g representative sample is required for the test. If it is not possible to obtain a sample of 100 mL or 100 g that is sufficiently representative of the waste, the analyst may use larger size samples in multiples of 100 mL or 100 g, i.e., 200, 300, 400 mL or g. However, when larger samples are used, analysts shall divide the sample into 100-mL or 100-g portions and test each portion separately. If any portion contains free liquids, the entire sample is considered to have free liquids.

7.0 PROCEDURE

7.1 Assemble test apparatus as shown in Figure 1.

7.2 Place sample in the filter. A funnel may be used to provide support for the paint filter.

7.3 Allow sample to drain for 5 minutes into the graduated cylinder.

7.4 If any portion of the test material collects in the graduated cylinder in the 5-min. period, then the material is deemed to contain free liquids for purposes of 40 CFR 264.314 and 265.314.

8.0 QUALITY CONTROL

8.1 Duplicate samples should be analyzed on a routine basis.

9.0 METHOD PERFORMANCE

9.1 No data provided.

10.0 REFERENCES

10.1 None required.

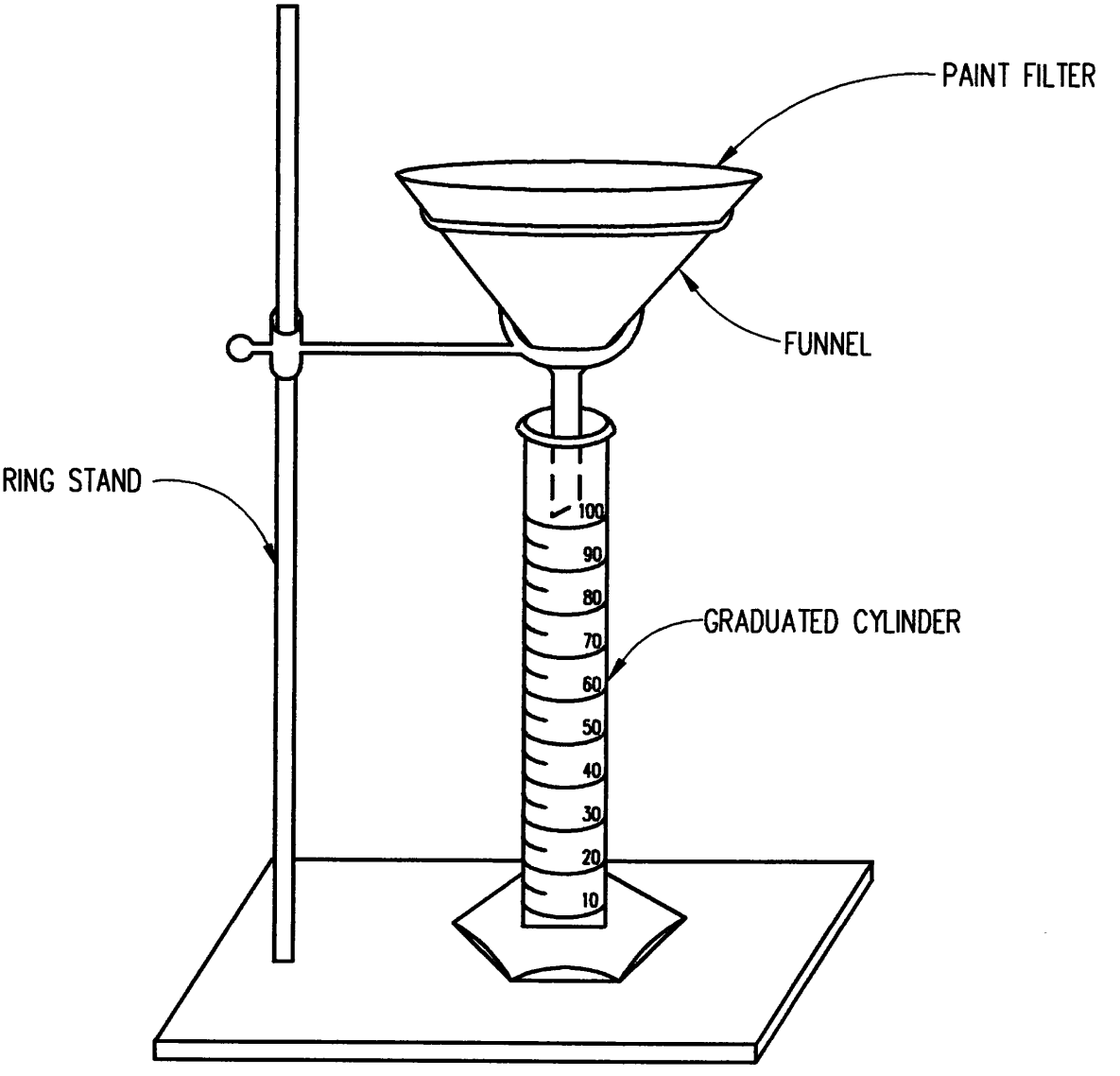
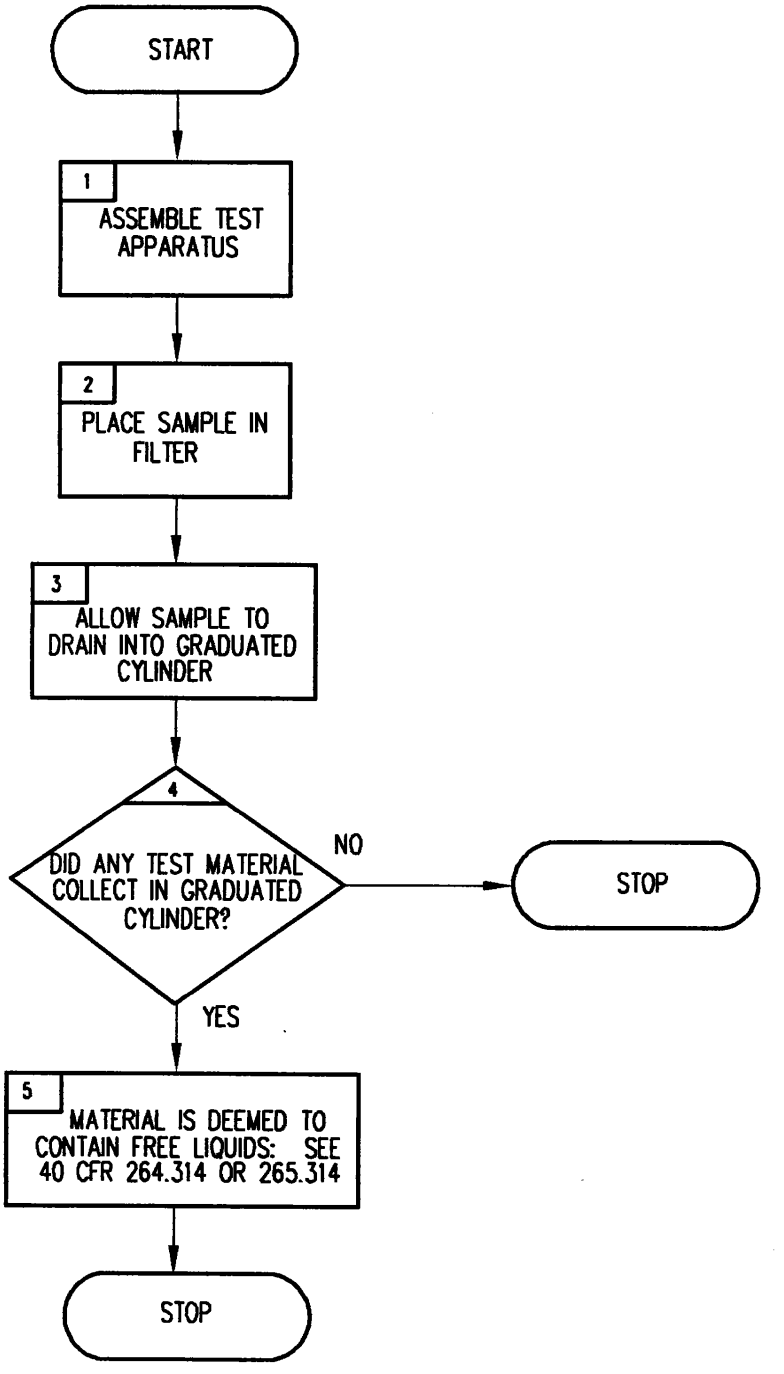


FIGURE 1. PAINT FILTER TEST APPARATUS.

METHOD 9095
PAINT FILTER LIQUIDS TEST



Appendix B

Waste Screening Form

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Halifax County Transfer Station
Permit No. 42-__T
(252) 586-7516

WASTE SCREENING FORM

Day / Date: _____ Time Weighed in: _____
Truck Owner: _____ Driver Name: _____
Truck Type: _____ Vehicle ID / Tag No: _____
Weight _____ Tare: _____
Waste Generator / Source: _____

Reason Load Inspected: Random Inspection _____ Staff Initials _____
Detained at Scales _____ Staff Initials _____
Detained by Operating Staff _____ Staff Initials _____

Inspection Location: _____

Approved Waste Determination Form Present? Yes _____ No _____ N/A _____

Description of Load: _____
_____
_____

Load Accepted (signature) _____ Date _____
Load Not Accepted (signature) _____ Date _____

Reason Load Not Accepted (complete only if load not accepted)

Description of Suspicious Contents: Color _____ Haz. Waste Markings _____
Texture _____ _____
Drums Present _____ Smell _____
Est. Cu. Yds. Present in Load _____
Est. Tons Present in Load _____

Halifax County Emergency Management Contacted? Yes _____ No _____

Company or Authority Contacted? _____
Hazardous Materials Present: _____
_____

Hauler Notified (if waste not accepted) Phone: Time Contacted:
Other Observations: _____
_____

Final Disposition
Signed _____ Date _____
Waste Screening Inspector or Solid Waste Director

Attach related correspondence to this form.
File completed form in Operating Record.

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Attachment D

Erosion and Sedimentation Control Plan

Halifax County, North Carolina
Transfer Station
Permit Application

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Erosion and Sedimentation Control Plan

Halifax County Transfer Station
Halifax County, North Carolina

Prepared for:

Halifax County Department of Public Utilities
Halifax, North Carolina

January 2012

RICHARDSON SMITH GARDNER
& ASSOCIATES
ENGINEERING & GEOLOGICAL
SERVICES

14 N. BOYLAN AVENUE
RALEIGH, NORTH CAROLINA 27603
NC LIC. NO. C-0828 (ENGINEERING)

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HALIFAX COUNTY
TRANSFER STATION

EROSION AND SEDIMENTATION CONTROL PLAN

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4.3 Culverts 3
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APPENDICES
Appendix A Erosion and Sedimentation Control Calculations
Appendix B Erosion and Sedimentation Control Plans and Details (see **Permit Drawing Set**)

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HALIFAX COUNTY
TRANSFER STATION

EROSION AND SEDIMENTATION CONTROL PLAN

1.0 NARRATIVE

1.1 Project Description

Halifax County plans to construct a municipal solid waste (MSW) transfer station at their landfill facility located off of Liles Road near Littleton. The construction and operation of the transfer station will require the disturbance of approximately 4.0 acres. This plan discusses the erosion and sedimentation control measures used on this project.

1.2 Contact Information

1.2.1 Engineer: For questions regarding this erosion and sedimentation control plan, please contact the following:

Richardson Smith Gardner & Associates, Inc.
Attn.: Pieter K. Scheer, P.E.
14 N. Boylan Ave.
Raleigh, NC 27603
Phone: (919) 828-0577
Fax: (919) 828-3899.

1.2.2 Owner: The owner of the site and the person to contact should sediment control issues arise during the land-disturbing activity is as follows:

Halifax County Department of Public Utilities
Attn: Mr. Larry Garriss, Solid Waste Director
P.O. Box 70
Halifax, NC 27839
Phone: (252) 586-7516
Fax: (252) 586-2685.

1.3 Existing Site Conditions

The proposed site for the transfer station is partially wooded. The cleared portion of the site is currently used for vehicle parking and as a storage area for roll-off containers. Existing ground surface elevations vary from El. 312 (feet) where the transfer station building will be situated to El. 290 at the outflow to the proposed sediment trap.

1.4 Adjacent Areas

The proposed site lies within County-owned property on all sides. Flow from the site

drains to an unnamed tributary of Brewer's Creek. The site will be accessed from Liles Road at the north end of the site.

1.5 Site Soils Information

The native surficial soils at the site fall under the general categories of Wedowee and Pacolet sandy loam according to the USGS (Halifax County) soil survey. These soils are classified as being in hydrologic soil group (HSG) "B" but have a clayey/silty substratum. Because much of the soils used at the site may be the lower clayey/silty soils, HSG "C" was conservatively used for purposes of runoff calculations.

2.0 DESIGN GUIDELINES AND PROCEDURES

The erosion and sediment control design for the landfill was conducted based on guidelines and procedures as set forth in the following references:

1. HydroCAD Software Solutions, LLC (2006), HydroCAD Stormwater Modeling System Owner's Manual - Version 8, Chocorua, NH.

2. North Carolina Division of Land Resources (2009 Update), North Carolina Erosion & Sediment Control Planning & Design Manual, Raleigh, NC.

3. Malcom, H. Rooney (1989 & 2003 Supplement), Elements of Urban Stormwater Design, NC State Univ., Raleigh, NC.

3.0 RUNOFF CALCULATIONS

All stormwater flow volumes were calculated using the HydroCAD computer program (utilizing USDA-NRCS (SCS) methods) and/or the Rational Method based on a 25-year 24-hour storm event. This storm event exceeds the 10-year event required by current North Carolina Sediment Control regulations. Rainfall quantities and/or intensities used in the analyses were derived from an analysis of design storms for the site. Drainage areas were determined using a planimeter and/or AutoCAD on topographic sheets of the project area. For each drainage area, runoff curve numbers (SCS methods) and/or runoff coefficients (Rational Method) were selected based on ground cover conditions. Times of concentration were calculated by HydroCAD using SCS methods.

4.0 EROSION AND SEDIMENTATION CONTROL MEASURES

The following erosion and sedimentation control measures are to be constructed as part of the proposed construction. **Appendices A and B** to this plan include calculations and plans and details (drawings) for each of these measures, respectively.

4.1 Sediment Trap

The proposed (temporary) sediment trap was designed in accordance with E&SCP&DM Section 6.60.

Temporary sediment traps are subject to several design requirements. Each temporary sediment trap must have a drainage area of no more than 5 acres, must have a basin volume of 3,600 ft^3/acre of disturbed area (measured at the spillway crest), and should have a surface area (measured at the spillway crest) of 0.01 acres/cfs (based on the peak flow from the 10-year storm). Also, each temporary sediment trap must have a minimum spillway weir length (across top of rock embankment) sized to pass the peak runoff from the design storm (or as prescribed in Table 6.60a or E&SCP&DM). Other requirements for temporary sediment traps also meet the criteria of Section 6.60. Each temporary sediment trap was modeled with the HydroCAD computer program and a spreadsheet was used to verify the design requirements.

4.2 Drainage Channels

Drainage channel calculations were conducted using a reformulation of Manning's Equation in a spreadsheet format. The calculations determine the normal depth of flow based on the peak discharge from the design storm (from HydroCAD) and assumed channel dimensions/slope(s). Both temporary and/or permanent channel linings were chosen, as appropriate, based on the calculated velocity and/or shear stress. Temporary channel linings (if specified) were designed based on the peak discharge from a 2-year 24-hour design storm.

4.3 Culverts

There are two culverts which will be used at the site to convey flow beneath roadways. These culverts will be directed to the sediment basin. Culverts were designed either using HydroCAD or a spreadsheet based on an analysis of inlet and outlet control under the influence of the design storm to determine the maximum headwater elevation. Where required, culvert outlets were designed for outlet stabilization based on criteria set forth in E&SCP&DM, Section 6.41.

4.4 Silt Fence

Silt fencing design was based on criteria set forth in E&SCP&DM, Section 6.62 including the limitation of 100 feet of fencing for each ¼ acre of drainage area.

4.5 Vegetative Stabilization

Vegetative stabilization will be in accordance with the seeding schedule on the drawings (**Appendix B**). The seeding schedule was based on Table 6.11k of E&SCP&DM which is applicable to this site.

5.0 SCHEDULE FOR IMPLEMENTATION

All erosion control measures will be placed before any land disturbance or waste placement may begin in that portion of the site which drains to the erosion control measures. Vegetative stabilization of disturbed areas will be in accordance with the following requirements:

- Temporary or permanent ground cover (or other acceptable measure(s)) adequate to restrain erosion on erodible slopes or other areas will be stabilized within fifteen (15) working days or twenty-one (21) calendar days following completion of any phase of grading.

6.0 INSPECTION AND MAINTENANCE

All erosion and sedimentation control measures will be inspected at least once every seven calendar days and within 24 hours after any storm event of greater than 0.5 inches of rain per 24 hour period. A rain gauge will be maintained on the site and a record of the rainfall amounts and dates will be kept properly.

During inspections, any stormwater discharges from the site will be observed for stormwater discharge characteristics to evaluate the effectiveness of the erosion and sedimentation control measures incorporating Best Management Practices (BMPs). If visible sedimentation is leaving the disturbed limits of the site, corrective action will be taken immediately to control the discharge of sediments.

Repairs to erosion and sedimentation control measures will be made as needed and accumulated sediment removed if necessary. All sediments which are removed from erosion and sedimentation control measures will be disposed of in an approved manner at a location to be designated by the Engineer in such a manner that further erosion and sedimentation will not occur.

Appendix A

Erosion & Sedimentation Control Calculations

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EROSION AND SEDIMENTATION CONTROL PLAN
APPENDIX A: EROSION AND SEDIMENTATION CONTROL CALCULATIONS

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1.0 Drainage and E&S Control Calculations - Overview
2.0 Analysis of Design Storms
3.0 Drainage Areas and Curve Numbers
4.0 Stormwater Routing (HydroCAD output)*
- 25-Year 24-Hour Storm

5.0 Drainage Channel Analysis
- DC-1A
- DC-1B
- DC-2A
- DC-2B
- DC-3
- DC-4

6.0 Sediment Trap Analysis
- Sediment Trap No. 1

7.0 Outlet Protection Analysis
- C-1
- C-2

*The design of culverts is included in the HydroCAD output.

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PROJECT Halifax County Transfer Station

SUBJECT Drainage and E&SC Calculations - Overview

JOB NO. HALIFAX-11-5
DATE 1/29/12
COMPUTED BY PKS
CHECKED BY LAQ

Objective

To design stormwater conveyance, detention, and erosion and sedimentation control measures to remove and contain stormwater flow from the design storm. The design of these measures will be based on:

- Design storm information for the site;
- Peak discharge calculations using the Rational Method and/or USDA-NRCS (SCS) Methods; and
- Stormwater routing using USDA-NRCS (SCS) or other methods.

References

Debo, T.N., and Reese, A.J. (1995), Municipal Storm Water Management, Lewis Publishers, Boca Raton, FL.

Federal Highway Administration (2001), Urban Drainage Design Manual, Hydraulic Engineering Circular No. 22, FHWA NHI-01-021, Second Ed., U.S. Dept. of Transportation, Washington, D.C.

Georgia Soil and Water Conservation Commission (2000), Manual for Erosion and Sediment Control in Georgia, Fifth Edition, Athens, GA.

HydroCAD Software Solutions, LLC (2006), HydroCAD Stormwater Modeling System Owner's Manual - Version 8, Chocorua, NH.

Malcom, H. Rooney (1989 & 2003 Supplement), Elements of Urban Stormwater Design, NC State Univ., Raleigh, NC.

North Carolina Division of Land Resources (2006), North Carolina Erosion & Sediment Control Planning & Design Manual, Raleigh, NC.

North Carolina Division of Water Quality (July 2005) Updated Draft Manual of Stormwater Best Management Practices, (Public Comment Version), Raleigh, NC.

Pennsylvania DEP Bureau of Watershed Protection (2000), Erosion and Sediment Pollution Control Program Manual.

USDA-NRCS (1992), Computer Program for Project Formulation Hydrology (TR-20).

USDA-NRCS (1986 & 1999 Update), Urban Hydrology for Small Watersheds (TR-55).

Virginia Department of Conservation and Recreation (1992), Virginia Erosion & Sediment Control Handbook, Third Edition, Richmond, VA.

D&E&SC CALCS OVERVIEW.WPD

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services
14 N. Boylan Avenue, Raleigh, NC 27603
Telephone: (919) 828-0577

Analysis The main design criteria will be to ensure that all stormwater conveyance and detention measures will be able to accommodate the runoff from the design storm. Drainage channels, culverts, etc. were designed based on the peak discharge to each measure. Detention measures were designed based on stormwater routing methods and/or State/local criteria.

Calculations

- Peak Discharge Calculations:

- USDA-NRCS (SCS) Methods:

Use HydroCAD program to determine the peak discharge to each device or structure. HydroCAD is based on the SCS unit hydrograph procedure, which is a principal component of NRCS TR-20. Alternatively spreadsheets can be used to determine flow rates using the procedures detailed in NRCS TR-55.

- Rational Method:

$$Q = CIA \qquad \text{(Malcom Eq. I -1)}$$

where:
Q = peak discharge (cfs)
C = rational runoff coefficient
I = applicable rainfall intensity (in/hr) of storm event (based on time of concentration)
A = drainage area (acres)

- Time of Concentration:

The time of concentration for use in determining the peak discharge in the NRCS and/or Rational methods can be determined by the methods detailed in NRCS TR-55 or other methods. HydroCAD uses the NRCS methods.

- Stormwater Routing:

Stormwater routing was accomplished using the HydroCAD program, which is based on USDA-NRCS (SCS) methods. Unless otherwise specified, the unit hydrograph method was used. The storm type (i.e. Type I 24-hr., Type II 24-hr., etc.) was selected as appropriate for the project location.

PROJECT Halifax County Transfer Station

SUBJECT Analysis of Design Storms

JOB NO. HALIFAX-11-5
DATE 1/29/12
COMPUTED BY PKS
CHECKED BY LAQ

Objective To compile the expected design storm depths and intensities over various return periods. These design storm values will be used in various calculations.

References Rainfall data was obtained from the following references:

Frederick, R.H., V.A. Myers, and E.P. Anciello (1977), "Five to 60-Minute Precipitation Frequency for the Eastern and Central United States," NOAA Technical Memo. NWS HYDRO-35, National Weather Service, NOAA, U.S. Dept. Of Commerce, Silver Spring, MD.

U.S. Weather Bureau (1961), "Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years," U.S. Weather Bureau Technical Paper 40.

DESIGN STORMS.WPD

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Telephone: (919) 828-0577

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services
14 N. Boylan Avenue Tel: 919-828-0577
Raleigh, NC 27603 Fax: 919-828-3899

SHEET: 2/2
JOB #: HALIFAX-11-5
DATE: 1/29/12
BY: PKS
CHKD BY: LAQ

Halifax County Transfer Station
Analysis of Design Storms

LOCATION: **Aurelian Springs, NC**

DURATION	RETURN PERIOD 2-YR P (in)	100-YR P (in)	SOURCE
5 min	0.48	0.81	NOAA HYDRO-35
15 min	1.02	1.81	NOAA HYDRO-35
60 min	1.70	3.50	NOAA HYDRO-35

2 hr to 24 hr Rainfall Events = **USER INPUT** USWB TP-40

DEPTH-DURATION-FREQUENCY TABLE

DURATION	RETURN PERIOD 2-YR (in)	5-YR (in)	10-YR (in)	25-YR (in)	50-YR (in)	100-YR (in)
5 min	0.48	0.55	0.60	0.68	0.75	0.81
10 min	0.80	0.93	1.02	1.17	1.29	1.40
15 min	1.02	1.19	1.32	1.51	1.66	1.81
30 min	1.35	1.65	1.86	2.16	2.40	2.64
60 min	1.70	2.12	2.41	2.84	3.17	3.50
2 hr	2.15	2.75	3.20	3.70	4.20	4.70
3 hr	2.40	3.05	3.55	4.05	4.55	5.05
6 hr	2.80	3.60	4.10	4.90	5.50	6.10
12 hr	3.40	4.20	4.95	5.90	6.50	7.30
24 hr	3.60	4.90	5.80	6.50	7.40	8.20

INTENSITY-DURATION-FREQUENCY TABLE

DURATION	RETURN PERIOD 2-YR (in/hr)	5-YR (in/hr)	10-YR (in/hr)	25-YR (in/hr)	50-YR (in/hr)	100-YR (in/hr)
5 min	5.76	6.58	7.22	8.19	8.96	9.72
10 min	4.79	5.56	6.15	7.02	7.71	8.40
15 min	4.08	4.76	5.27	6.04	6.64	7.24
30 min	2.71	3.29	3.71	4.32	4.80	5.28
60 min	1.70	2.12	2.41	2.84	3.17	3.50
2 hr	1.08	1.38	1.60	1.85	2.10	2.35
3 hr	0.80	1.02	1.18	1.35	1.52	1.68
6 hr	0.47	0.60	0.68	0.82	0.92	1.02
12 hr	0.28	0.35	0.41	0.49	0.54	0.61
24 hr	0.15	0.20	0.24	0.27	0.31	0.34

PROJECT Halifax County Transfer Station

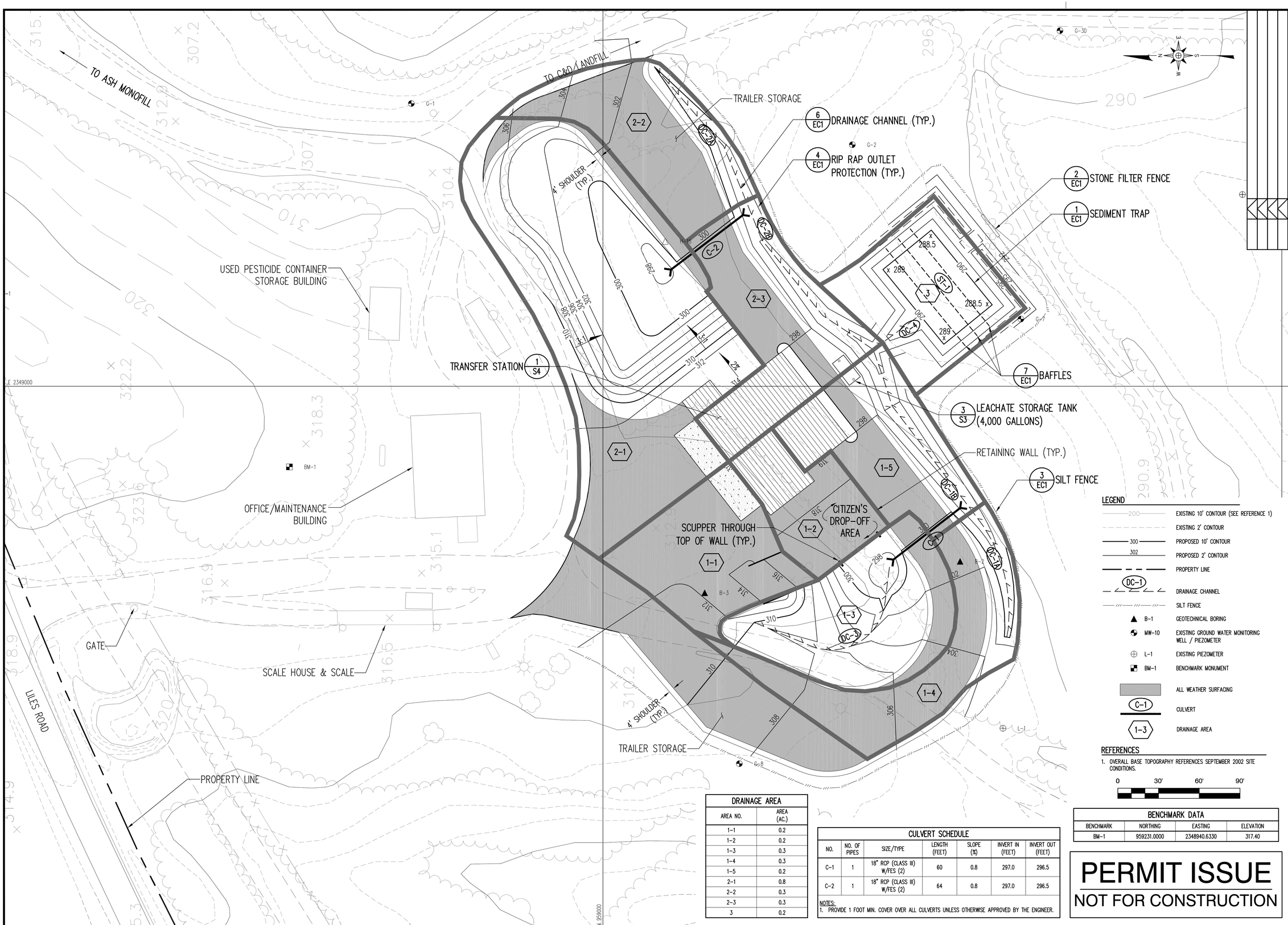
SUBJECT Drainage Areas & Curve Numbers

JOB NO. HALIFAX-11-5
DATE 1/29/12
COMPUTED BY PKS
CHECKED BY LAQ

Objective To breakout drainage areas and associated runoff curve numbers for the drainage and erosion control plan(s). Drainage areas and runoff curve numbers will be used to determine the design flow to each stormwater conveyance and/or detention measure. Drainage areas and runoff curve numbers are tabulated in the HydroCAD output. Areas were measured by planimeter or AutoCAD on the attached plan drawing.

DRAIN AREAS & CURVE NUMBERS.WPD

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services
14 N. Boylan Avenue, Raleigh, NC 27603
Telephone: (919) 828-0577



LEGEND

200	EXISTING 10' CONTOUR (SEE REFERENCE 1)
	EXISTING 2' CONTOUR
300	PROPOSED 10' CONTOUR
302	PROPOSED 2' CONTOUR
	PROPERTY LINE
DC-1	DRAINAGE CHANNEL
	SILT FENCE
B-1	GEOTECHNICAL BORING
MW-10	EXISTING GROUND WATER MONITORING WELL / PIEZOMETER
L-1	EXISTING PIEZOMETER
BM-1	BENCHMARK MONUMENT
	ALL WEATHER SURFACING
C-1	CULVERT
1-3	DRAINAGE AREA

REFERENCES

1. OVERALL BASE TOPOGRAPHY REFERENCES SEPTEMBER 2002 SITE CONDITIONS.

0 30' 60' 90'

DRAINAGE AREA	
AREA NO.	AREA (AC.)
1-1	0.2
1-2	0.2
1-3	0.3
1-4	0.3
1-5	0.2
2-1	0.8
2-2	0.3
2-3	0.3
3	0.2

CULVERT SCHEDULE						
NO.	NO. OF PIPES	SIZE/TYPE	LENGTH (FEET)	SLOPE (%)	INVERT IN (FEET)	INVERT OUT (FEET)
C-1	1	18" RCP (CLASS III) W/FES (2)	60	0.8	297.0	296.5
C-2	1	18" RCP (CLASS III) W/FES (2)	64	0.8	297.0	296.5

NOTES:
1. PROVIDE 1 FOOT MIN. COVER OVER ALL CULVERTS UNLESS OTHERWISE APPROVED BY THE ENGINEER.

BENCHMARK DATA			
BENCHMARK	NORTHING	EASTING	ELEVATION
BM-1	959231.0000	2348940.6330	317.40

PERMIT ISSUE
NOT FOR CONSTRUCTION

RICHARDSON SMITH GARDNER & ASSOCIATES
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ph: 919-828-0577
fax: 919-828-3899
www.rsgengineers.com

REVISION | NO. | DATE

SEAL

PROJECT TITLE: HALIFAX COUNTY TRANSFER STATION EROSION AND SEDIMENTATION CONTROL PLAN

DRAWING TITLE: DRAINAGE AREAS

DESIGNED BY: P.K.S.	DRAWN BY: J.A.L.
CHECKED BY:	PROJECT NO.: HALIFAX 11-5
SCALE: AS SHOWN	DATE: JAN. 2012
FILE NAME: HALI-D0174	
SHEET NO.	DRAWING NO. FIG. 1

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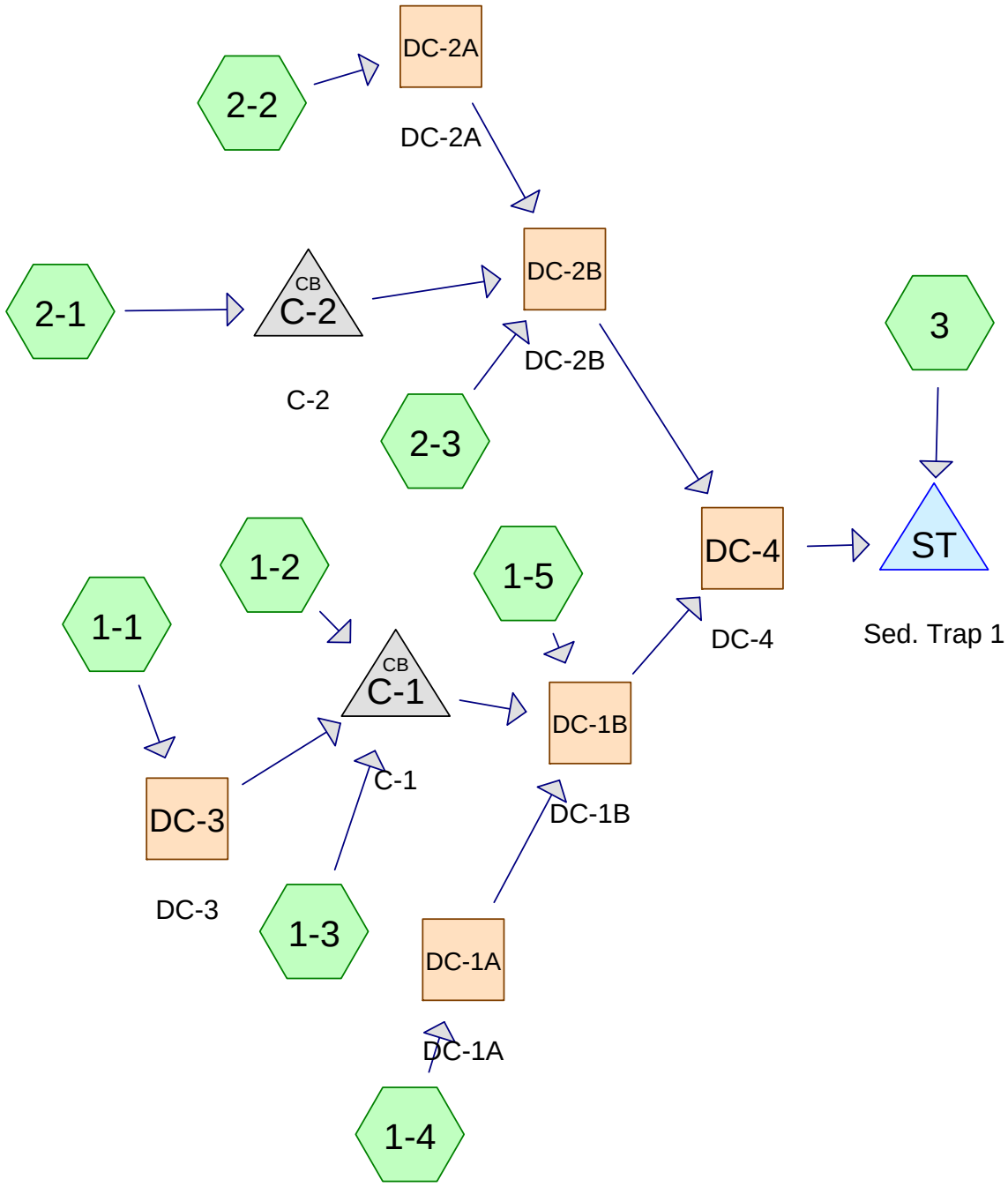


Subcat Reach Pond Link

Drainage Diagram for HC Transfer Station 012912
Prepared by Richardson Smith Gardner & Assocs., Inc. 1/29/2012
HydroCAD® 8.00 s/n 004004 © 2006 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcats)
1.070	74	>75% Grass cover, Good, HSG C (1-3,1-4,1-5,2-1,2-2,2-3,3)
0.920	98	Paved roads w/curbs & sewers (1-1,1-2,1-4,1-5,2-2)
0.680	98	Paved roads w/curbs & sewers & Building (1-3,2-1,2-3)
0.130	98	Water Surface (Max.) (3)
2.800		

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1-1: Runoff Area=0.200 ac Runoff Depth>6.26"
Flow Length=120' Slope=0.0250 '/' Tc=1.2 min CN=98 Runoff=2.14 cfs 0.104 af

Subcatchment 1-2: Runoff Area=0.200 ac Runoff Depth>6.26"
Flow Length=70' Slope=0.0400 '/' Tc=0.7 min CN=98 Runoff=2.18 cfs 0.104 af

Subcatchment 1-3: Runoff Area=0.300 ac Runoff Depth>4.23"
Flow Length=80' Slope=0.1500 '/' Tc=5.0 min CN=80 Runoff=2.29 cfs 0.106 af

Subcatchment 1-4: Runoff Area=0.300 ac Runoff Depth>5.33"
Flow Length=30' Slope=0.0800 '/' Tc=2.9 min CN=90 Runoff=2.88 cfs 0.133 af

Subcatchment 1-5: Runoff Area=0.200 ac Runoff Depth>4.89"
Flow Length=45' Slope=0.0300 '/' Tc=0.5 min CN=86 Runoff=1.95 cfs 0.081 af

Subcatchment 2-1: Runoff Area=0.800 ac Runoff Depth>4.88"
Flow Length=135' Tc=3.7 min CN=86 Runoff=7.09 cfs 0.326 af

Subcatchment 2-2: Runoff Area=0.300 ac Runoff Depth>5.56"
Flow Length=150' Slope=0.0500 '/' Tc=1.1 min CN=92 Runoff=3.10 cfs 0.139 af

Subcatchment 2-3: Runoff Area=0.300 ac Runoff Depth>5.33"
Flow Length=45' Slope=0.0200 '/' Tc=0.6 min CN=90 Runoff=3.08 cfs 0.133 af

Subcatchment 3: Runoff Area=0.200 ac Runoff Depth>5.33"
Flow Length=35' Slope=0.1500 '/' Tc=2.6 min CN=90 Runoff=1.94 cfs 0.089 af

Reach DC-1A: DC-1A Avg. Depth=0.30' Max Vel=1.97 fps Inflow=2.88 cfs 0.133 af
n=0.050 L=105.0' S=0.0286 '/' Capacity=113.54 cfs Outflow=2.83 cfs 0.133 af

Reach DC-1B: DC-1B Avg. Depth=0.60' Max Vel=2.98 fps Inflow=10.36 cfs 0.529 af
n=0.050 L=135.0' S=0.0296 '/' Capacity=115.62 cfs Outflow=10.28 cfs 0.528 af

Reach DC-2A: DC-2A Avg. Depth=0.69' Max Vel=2.14 fps Inflow=3.10 cfs 0.139 af
n=0.050 L=130.0' S=0.0231 '/' Capacity=24.29 cfs Outflow=3.01 cfs 0.139 af

Reach DC-2B: DC-2B Avg. Depth=0.67' Max Vel=3.11 fps Inflow=12.49 cfs 0.598 af
n=0.050 L=140.0' S=0.0286 '/' Capacity=113.54 cfs Outflow=12.40 cfs 0.597 af

Reach DC-3: DC-3 Avg. Depth=0.48' Max Vel=3.09 fps Inflow=2.14 cfs 0.104 af
n=0.050 L=140.0' S=0.0786 '/' Capacity=44.82 cfs Outflow=2.10 cfs 0.104 af

Reach DC-4: DC-4 Avg. Depth=0.83' Max Vel=4.19 fps Inflow=22.65 cfs 1.125 af
n=0.070 L=50.0' S=0.0800 '/' Capacity=135.70 cfs Outflow=22.61 cfs 1.125 af

Pond C-1: C-1 Peak Elev=298.34' Inflow=6.08 cfs 0.314 af
18.0" x 64.0' Culvert Outflow=6.08 cfs 0.314 af

Pond C-2: C-2 Peak Elev=298.50' Inflow=7.09 cfs 0.326 af
18.0" x 64.0' Culvert Outflow=7.09 cfs 0.326 af

Pond ST: Sed. Trap 1 Peak Elev=293.15' Storage=18,260 cf Inflow=24.40 cfs 1.214 af
Primary=15.39 cfs 1.086 af Secondary=0.00 cfs 0.000 af Outflow=15.39 cfs 1.086 af

Total Runoff Area = 2.800 ac Runoff Volume = 1.216 af Average Runoff Depth = 5.21"
38.21% Pervious Area = 1.070 ac 61.79% Impervious Area = 1.730 ac

Subcatchment 1-1:

Runoff = 2.14 cfs @ 11.91 hrs, Volume= 0.104 af, Depth> 6.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Halifax 25-Yr 24-Hr Rainfall=6.50"

Area (ac)	CN	Description
0.200	98	Paved roads w/curbs & sewers
0.200		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	120	0.0250	1.65		**Sheet Flow, Across Pavement** Smooth surfaces n= 0.011 P2= 3.60"

Subcatchment 1-2:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 2.18 cfs @ 11.91 hrs, Volume= 0.104 af, Depth> 6.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Halifax 25-Yr 24-Hr Rainfall=6.50"

Area (ac)	CN	Description
0.200	98	Paved roads w/curbs & sewers
0.200		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	70	0.0400	1.79		**Sheet Flow, Across Pavement** Smooth surfaces n= 0.011 P2= 3.60"

Subcatchment 1-3:

Runoff = 2.29 cfs @ 11.96 hrs, Volume= 0.106 af, Depth> 4.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Halifax 25-Yr 24-Hr Rainfall=6.50"

Area (ac)	CN	Description
0.220	74	>75% Grass cover, Good, HSG C
0.080	98	Paved roads w/curbs & sewers & Building
0.300	80	Weighted Average
0.220		Pervious Area
0.080		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	80	0.1500	0.27		**Sheet Flow, Slope from Upper End** Grass: Dense n= 0.240 P2= 3.60"

Subcatchment 1-4:

Runoff = 2.88 cfs @ 11.93 hrs, Volume= 0.133 af, Depth> 5.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Halifax 25-Yr 24-Hr Rainfall=6.50"

Area (ac)	CN	Description
0.100	74	>75% Grass cover, Good, HSG C
0.200	98	Paved roads w/curbs & sewers
0.300	90	Weighted Average
0.100		Pervious Area
0.200		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	30	0.0800	0.17		**Sheet Flow, Slope Above Channel** Grass: Dense n= 0.240 P2= 3.60"

Subcatchment 1-5:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.95 cfs @ 11.91 hrs, Volume= 0.081 af, Depth> 4.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Halifax 25-Yr 24-Hr Rainfall=6.50"

Area (ac)	CN	Description
0.100	74	>75% Grass cover, Good, HSG C
0.100	98	Paved roads w/curbs & sewers
0.200	86	Weighted Average
0.100		Pervious Area
0.100		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	45	0.0300	1.46		**Sheet Flow, Slope from Retaining Wall** Smooth surfaces n= 0.011 P2= 3.60"

Subcatchment 2-1:

Runoff = 7.09 cfs @ 11.94 hrs, Volume= 0.326 af, Depth> 4.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Halifax 25-Yr 24-Hr Rainfall=6.50"

Area (ac)	CN	Description
0.400	74	>75% Grass cover, Good, HSG C
0.400	98	Paved roads w/curbs & sewers & Building
0.800	86	Weighted Average
0.400		Pervious Area
0.400		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	60	0.3300	0.34		**Sheet Flow, Upper End of Area** Grass: Dense n= 0.240 P2= 3.60"
0.8	75	0.0500	1.57		**Shallow Concentrated Flow, Slope to C2** Short Grass Pasture Kv= 7.0 fps
3.7	135	Total			

Subcatchment 2-2:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 3.10 cfs @ 11.91 hrs, Volume= 0.139 af, Depth> 5.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Halifax 25-Yr 24-Hr Rainfall=6.50"

Area (ac)	CN	Description
0.080	74	>75% Grass cover, Good, HSG C
0.220	98	Paved roads w/curbs & sewers
0.300	92	Weighted Average
0.080		Pervious Area
0.220		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	150	0.0500	2.28		**Sheet Flow, Flow Across Drive** Smooth surfaces n= 0.011 P2= 3.60"

Subcatchment 2-3:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 3.08 cfs @ 11.91 hrs, Volume= 0.133 af, Depth> 5.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Halifax 25-Yr 24-Hr Rainfall=6.50"

Area (ac)	CN	Description
0.100	74	>75% Grass cover, Good, HSG C
0.200	98	Paved roads w/curbs & sewers & Building
0.300	90	Weighted Average
0.100		Pervious Area
0.200		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	45	0.0200	1.24		**Sheet Flow, Slope from Retaining Wall** Smooth surfaces n= 0.011 P2= 3.60"

Subcatchment 3:

Runoff = 1.94 cfs @ 11.93 hrs, Volume= 0.089 af, Depth> 5.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Halifax 25-Yr 24-Hr Rainfall=6.50"

Area (ac)	CN	Description
0.070	74	>75% Grass cover, Good, HSG C
0.130	98	Water Surface (Max.)
0.200	90	Weighted Average
0.070		Pervious Area
0.130		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	35	0.1500	0.22		**Sheet Flow, Upper End of Area** Grass: Dense n= 0.240 P2= 3.60"

Reach DC-1A: DC-1A

Inflow Area = 0.300 ac, Inflow Depth > 5.33" for Halifax 25-Yr 24-Hr event
Inflow = 2.88 cfs @ 11.93 hrs, Volume= 0.133 af
Outflow = 2.83 cfs @ 11.96 hrs, Volume= 0.133 af, Atten= 2%, Lag= 1.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.97 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 0.46 fps, Avg. Travel Time= 3.8 min

Peak Storage= 151 cf @ 11.94 hrs, Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 113.54 cfs

4.00' x 2.00' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 16.00'
Length= 105.0' Slope= 0.0286 '/'
Inlet Invert= 300.00', Outlet Invert= 297.00'

‡

Reach DC-1B: DC-1B

[61] Hint: Submerged 20% of Reach DC-1A bottom
[79] Warning: Submerged Pond C-1 Primary device # 1 INLET by 0.60'

Inflow Area = 1.200 ac, Inflow Depth > 5.29" for Halifax 25-Yr 24-Hr event
Inflow = 10.36 cfs @ 11.92 hrs, Volume= 0.529 af
Outflow = 10.28 cfs @ 11.94 hrs, Volume= 0.528 af, Atten= 1%, Lag= 1.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.98 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 0.69 fps, Avg. Travel Time= 3.2 min

Peak Storage= 466 cf @ 11.93 hrs, Average Depth at Peak Storage= 0.60'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 115.62 cfs

4.00' x 2.00' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 16.00'
Length= 135.0' Slope= 0.0296 '/'
Inlet Invert= 297.00', Outlet Invert= 293.00'

‡

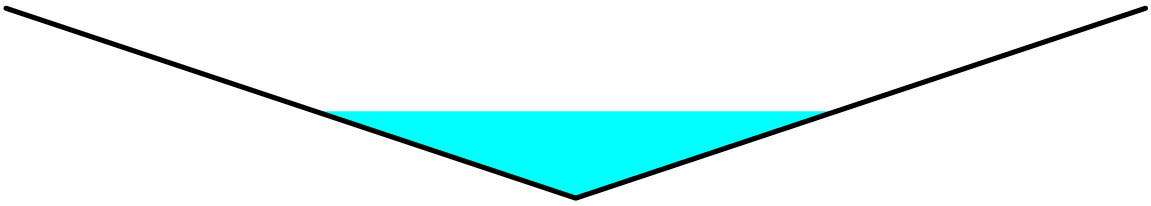
Reach DC-2A: DC-2A

Inflow Area = 0.300 ac, Inflow Depth > 5.56" for Halifax 25-Yr 24-Hr event
Inflow = 3.10 cfs @ 11.91 hrs, Volume= 0.139 af
Outflow = 3.01 cfs @ 11.94 hrs, Volume= 0.139 af, Atten= 3%, Lag= 1.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.14 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.72 fps, Avg. Travel Time= 3.0 min

Peak Storage= 184 cf @ 11.92 hrs, Average Depth at Peak Storage= 0.69'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 24.29 cfs

0.00' x 1.50' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 130.0' Slope= 0.0231 '/'
Inlet Invert= 300.00', Outlet Invert= 297.00'



Reach DC-2B: DC-2B

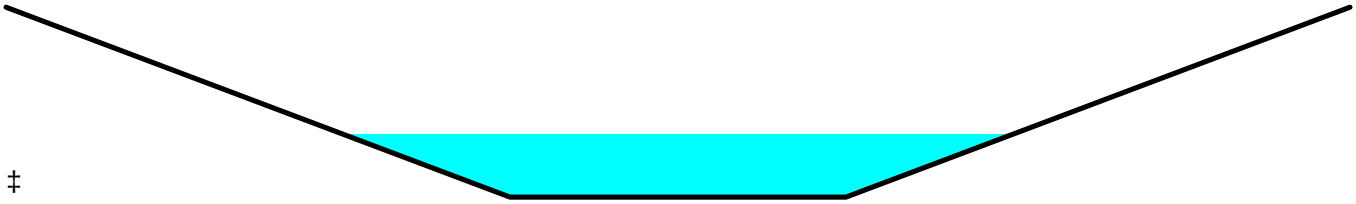
[61] Hint: Submerged 22% of Reach DC-2A bottom
[81] Warning: Exceeded Pond C-2 by 0.01' @ 4.17 hrs

Inflow Area = 1.400 ac, Inflow Depth > 5.12" for Halifax 25-Yr 24-Hr event
Inflow = 12.49 cfs @ 11.93 hrs, Volume= 0.598 af
Outflow = 12.40 cfs @ 11.95 hrs, Volume= 0.597 af, Atten= 1%, Lag= 1.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.11 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 0.74 fps, Avg. Travel Time= 3.2 min

Peak Storage= 559 cf @ 11.94 hrs, Average Depth at Peak Storage= 0.67'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 113.54 cfs

4.00' x 2.00' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 16.00'
Length= 140.0' Slope= 0.0286 '/'
Inlet Invert= 297.00', Outlet Invert= 293.00'



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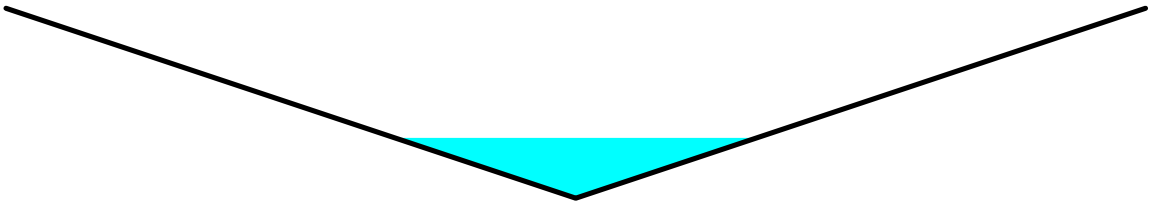
Reach DC-3: DC-3

Inflow Area = 0.200 ac, Inflow Depth > 6.26" for Halifax 25-Yr 24-Hr event
Inflow = 2.14 cfs @ 11.91 hrs, Volume= 0.104 af
Outflow = 2.10 cfs @ 11.93 hrs, Volume= 0.104 af, Atten= 2%, Lag= 1.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.09 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 1.07 fps, Avg. Travel Time= 2.2 min

Peak Storage= 95 cf @ 11.92 hrs, Average Depth at Peak Storage= 0.48'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 44.82 cfs

0.00' x 1.50' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 140.0' Slope= 0.0786 '/'
Inlet Invert= 308.00', Outlet Invert= 297.00'



Reach DC-4: DC-4

[61] Hint: Submerged 21% of Reach DC-1B bottom
[61] Hint: Submerged 21% of Reach DC-2B bottom

Inflow Area =	2.600 ac,	Inflow Depth >	5.19"	for	Halifax 25-Yr 24-Hr event
Inflow =	22.65 cfs @	11.95 hrs,	Volume=	1.125 af	
Outflow =	22.61 cfs @	11.95 hrs,	Volume=	1.125 af,	Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.19 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 0.99 fps, Avg. Travel Time= 0.8 min

Peak Storage= 270 cf @ 11.95 hrs, Average Depth at Peak Storage= 0.83'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 135.70 cfs

4.00' x 2.00' deep channel, n= 0.070
Side Slope Z-value= 3.0 '/' Top Width= 16.00'
Length= 50.0' Slope= 0.0800 '/'
Inlet Invert= 293.00', Outlet Invert= 289.00'

‡

Pond C-1: C-1

[61] Hint: Submerged 12% of Reach DC-3 bottom

Inflow Area =	0.700 ac,	Inflow Depth >	5.39"	for	Halifax 25-Yr 24-Hr event
Inflow =	6.08 cfs @	11.92 hrs,	Volume=	0.314 af	
Outflow =	6.08 cfs @	11.92 hrs,	Volume=	0.314 af,	Atten= 0%, Lag= 0.0 min
Primary =	6.08 cfs @	11.92 hrs,	Volume=	0.314 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 298.34' @ 11.92 hrs
Flood Elev= 299.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	297.00'	**18.0" x 64.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 296.50' S= 0.0078 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=6.07 cfs @ 11.92 hrs HW=298.34' (Free Discharge)
└─**1=Culvert** (Barrel Controls 6.07 cfs @ 4.82 fps)

Pond C-2: C-2

Inflow Area = 0.800 ac, Inflow Depth > 4.88" for Halifax 25-Yr 24-Hr event
Inflow = 7.09 cfs @ 11.94 hrs, Volume= 0.326 af
Outflow = 7.09 cfs @ 11.94 hrs, Volume= 0.326 af, Atten= 0%, Lag= 0.0 min
Primary = 7.09 cfs @ 11.94 hrs, Volume= 0.326 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 298.50' @ 11.94 hrs
Flood Elev= 299.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	297.00'	**18.0" x 64.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 296.50' S= 0.0078 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=7.07 cfs @ 11.94 hrs HW=298.50' (Free Discharge)
└─**1=Culvert** (Barrel Controls 7.07 cfs @ 4.98 fps)

Pond ST: Sed. Trap 1

[62] Warning: Submerged 7% of Reach DC-4 inlet

Inflow Area = 2.800 ac, Inflow Depth > 5.20" for Halifax 25-Yr 24-Hr event
Inflow = 24.40 cfs @ 11.95 hrs, Volume= 1.214 af
Outflow = 15.39 cfs @ 12.02 hrs, Volume= 1.086 af, Atten= 37%, Lag= 4.3 min
Primary = 15.39 cfs @ 12.02 hrs, Volume= 1.086 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 293.15' @ 12.02 hrs Surf.Area= 5,867 sf Storage= 18,260 cf
Flood Elev= 295.00' Surf.Area= 7,676 sf Storage= 30,309 cf

Plug-Flow detention time= 106.8 min calculated for 1.086 af (89% of inflow)
Center-of-Mass det. time= 53.4 min (830.9 - 777.5)

Volume	Invert	Avail.Storage	Storage Description
#1	288.50'	30,309 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
288.50	500	0	0
289.00	2,600	775	775
290.00	3,195	2,898	3,673
292.00	4,814	8,009	11,682
294.00	6,650	11,464	23,146
295.00	7,676	7,163	30,309

Device	Routing	Invert	Outlet Devices
#1	Primary	290.00'	**Rock Dam** Head (feet) 0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 Disch. (cfs) 0.000 0.220 1.000 2.530 5.000 8.590 13.500 19.910
#2	Secondary	293.50'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=15.38 cfs @ 12.02 hrs HW=293.15' (Free Discharge)
└─**1=Rock Dam** (Custom Controls 15.38 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=288.50' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

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Objective To design drainage channels, ditches, etc. to handle stormwater flow from the design storm(s). The main design criteria will be to ensure that all drainage channels, ditches, etc. will be able to accommodate the peak discharge from the design storm without overtopping and without exceeding the allowable shear stress and/or velocity of the selected channel lining.

References

Federal Highway Administration (2001), Urban Drainage Design Manual, Hydraulic Engineering Circular No. 22, FHWA NHI-01-021, Second Ed., U.S. Dept. of Transportation, Washington, D.C.

North Carolina Division of Land Resources (2006), North Carolina Erosion & Sediment Control Planning & Design Manual, Raleigh, NC.

Malcom, H. Rooney (1989 & 2003 Supplement), Elements of Urban Stormwater Design, NC State Univ., Raleigh, NC.

Pennsylvania DEP Bureau of Watershed Protection (2000), Erosion and Sediment Pollution Control Program Manual.

Analysis The following approach is used in the design of drainage channels:

1. Determine the peak discharge from the design storm(s) (from HydroCAD or spreadsheet methods). For permanent linings (Grass, TRM, rip rap, gabions, etc.) use the peak discharge from the 25-Yr 24-Hr storm unless otherwise specified. For grass lined channels, a smaller design storm (2-Yr 24-Hr - unless otherwise specified) is used to evaluate temporary linings.
2. Input other design parameters (bottom width; side slopes; minimum freeboard, min./max. slopes; and channel lining).
3. Based on the design parameters calculate normal depth of flow, velocity, Froude number, and maximum shear stress for both max./min. slopes. Also determine the critical slope and corresponding normal depth.
4. Compare the velocity and/or shear stress to allowable values (the maximum slope values will control). If values are exceeded, revise design parameters as required.
5. Based on normal depth values and required freeboard (generally use the greater of 6 inches or 25% of the flow depth), determine the minimum channel depth and top width for both max./min. slopes (the minimum slope values will control).
6. If the channel has a significant curved reach, evaluate the shear stress and superelevation of the water surface in the bend.

DRAINAGE CHANNEL.WPD

Calculations

- Manning's Equation:

$$Q = \frac{1.49\,AR^{2/3}S^{1/2}}{n} = AV \qquad \text{(HEC-22 Eq. 5-5)}$$

where:
- Q = discharge (cfs)
- n = Manning's roughness coefficient (See Below)
- A = cross sectional area of flow (ft^2)
- R = hydraulic radius (ft) = A/P
- P = wetted perimeter
- S = slope of channel (ft/ft)
- V = average channel velocity (ft/sec)

- Maximum Shear Stress (Tractive Force Method):

$$\tau_d = \gamma d S \qquad \text{(HEC-22 Eq. 5-13)}$$

where:
- τ_d = maximum shear stress on channel lining (lb/ft^2)
- γ = unit weight of water (62.4 lb/ft^3)
- d = maximum depth of flow (ft)
- S = channel slope (ft/ft)

- Froude Number:

$$Fr = \frac{v}{\sqrt{\frac{gA}{T}}}$$

where:
- Fr = Froude number (dimensionless)
- v = flow velocity (ft/sec)
- g = acceleration of gravity (32.2 ft/sec^2)
- A = cross-sectional area of flow (ft^2)
- T = top width of flow (ft)

Note that A/T = the hydraulic depth (D). For $Fr > 1.0$, flow is supercritical; $Fr < 1.0$, flow is subcritical; $Fr = 1.0$, flow is critical.

Critical Slope:

The critical slope (S_c) is the slope at which Fr = 1.0. When the slope is between $0.7S_c$ and $1.3S_c$, unstable flow may occur as small flow disturbances can initiate a change in the flow state. If slopes are within this range, consider additional freeboard.

- Manning's Roughness Coefficient (n):

Grass:

$$n = \frac{R^{1/6}}{\left[K + 19.97\log\left(R^{1.4}S^{0.4}\right)\right]}$$ (HEC-22 Eq. 5-6 - 5-10)

where:
R = hydraulic radius (ft)
K = vegetative coefficient (depending on retardance class)
= 15.8 (Class A)
= 23.0 (Class B)
= 30.2 (Class C)
= 34.6 (Class D)
= 37.7 (Class E)
S = slope of channel (ft/ft)

Rip Rap:

$$n = \frac{y^{1/6}}{21.6\log\left(\frac{y}{d_{50}}\right) + 14}$$ (PA DEP Manual Fig. 3)

where:
y = depth of flow (ft)
d_{50} = median size of rip rap (ft)

- Curved Channels (Where Applicable):

Shear Stress in Bend:

$$\tau_b = K_b \tau_d$$ (HEC-22 Eq. 5-15)

where:
τ_d = bend shear stress (lb/ft^2)
K_b = function of R_c/B (use HEC-22 Chart 21)
τ_d = maximum shear stress on channel lining (lb/ft^2)
R_c = radius to the centerline of the channel (ft)
B = bottom width of channel (ft)

Superelevation at Outside of Bend:

$$\Delta d = 0.5 \frac{V^2 T}{g R_c}$$ (HEC-22 Eq. 5-11 modified)

where:
Δd = superelevation of water surface between the outer channel bank and the centerline of the channel (avg. water surface before bend) (ft)
V = average channel velocity (ft/sec)
T = top width of flow (ft)
g = acceleration of gravity (32.2 ft/sec^2)
R_c = radius to the centerline of the channel (ft)

- Allowable Shear Stress/Velocity:

Grass-Lined Channels:

For grass-lined channels, an allowable velocity approach is applicable for slopes flatter than 10%. For slopes of 10% and steeper appropriate permanent linings should be used. For use in the evaluation of curved channels, the following allowable shear stress values (lb/ft^2) can be assumed based on retardance class:

Class A: 3.70
Class B: 2.10
Class C: 1.00
Class D: 0.60
Class E: 0.35

Rip Rap-Lined Channels:

For rip rap-lined channels, an allowable velocity approach is applicable for slopes flatter than 10% (see attached table). For slopes of 10% or steeper, use the following equation:

$$\tau_{allow} = 4 \times d_{50} \qquad \text{(HEC-22 Eq. 5-17)}$$

where: τ_{allow} = allowable shear stress (lb/ft^2)
d_{50} = median size of rip rap (ft)

Reno Mattress or Gabion-Lined Channels:

For Reno mattress or gabion-lined channels, use allowable velocity for slopes flatter than 10% and allowable shear stress for slopes of 10% or steeper (see attached table).

Riprap Gradation, Filter Blanket Requirements, Maximum Velocities

	Graded Rock Size (in)			Filter Blanket Requirements**		
NSA No.	Max.	d_{50}*	Min.	Size NSA No.	Placement Thickness	V_{max} (ft/sec
R-1	1.5	.75	No. 8	FS-1	N/A	2.5
R-2	3	1.5	1	FS-1	N/A	4.5
R-3	6	3	2	FS-1	3	6.5
R-4	12	6	3	FS-2	4	9.0
R-5	18	9	5	FS-2	6	11.5
R-6	24	12	7	FS-3	8	13.0
R-7	30	15	12	FS-3	10	14.5

* The d_{50} stone size is the size exceeded by 50% of the total weight of the tonnage shipped (i.e. 50% by weight shall consist of pieces larger than the d_{50} stone size").

** This is a general standard. Soil conditions at each site should be analyzed to determine actual filter size. A suitable woven or non-woven geotextile underlayment, used according to manufacturer's recommendations, may be substituted for the filter stone.

Ref: PA DEP Manual Table 9

Maximum Permissible Velocities for Reno Mattress & Gabions

Type	n	Thickness Inches	Rock Fill Gradation (in)	Permissible* Velocity (fps)	Permissible** Shear Stress (lb/ft^2)
Reno Mattress	.025 - .030	6	3 - 6	6.0	8.35
	.025 - .030	6 - 10	3 - 6	12.0	8.35
	.025 - .030	10 - 12	3 - 6	15.0	8.35
	.025 - .030	12 - 18	4 - 6	18.0	8.35
Gabion	.027	>18	5 - 9	22.0	8.35

* Permissible velocities may be increased by the introduction of sand mastic grout. Refer to manufacturer's recommendations/specifications for permissible velocities and for recommendations regarding filters or geotextile fabric underlayment when using Reno mattresses or gabions for channel linings.

**Based on vegetation completely grown.

Ref: PA DEP Manual Table 13

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SHEET:	6/11
JOB #:	HALIFAX-11-5
DATE:	1/29/12
BY:	PKS
CHKD BY:	LAQ

Halifax County Transfer Station
Drainage Channel Analysis (TRM Lined)

Channel No. DC-1A

Design Parameters:

PEAK DISCHARGE, $Q25$ = 2.9 ft^3/s Source: HydroCAD 25-Yr 24-Hr

Bottom Width, B = 4.0 ft

Left Side Slope, z_1 = 3.0 horizontal :1 vertical

Right Side Slope, z_2 = 3.0 horizontal :1 vertical

Minimum Freeboard = 0.5 ft

Maximum Channel Slope, S_{max} = 0.030 ft/ft

Minimum Channel Slope, S_{min} = 0.010 ft/ft

Turf Reinforcement Matting (TRM) Lining:

Grass Retardance = D

K = 34.6

TRM Product Name = Propex - Landlok TRM 435, or equal

τ_{allow} = 5.0 lb/ft^2

Normal Depth

Depth of Flow (Norm. Depth) Y_n ft	Manning's Roughness Coefficient n	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius $R=A/P$ ft	Top Width T ft	Hydraulic Depth $D=A/T$ ft	Average Velocity V_n ft/s	Flow Rate Q ft^3/s	Froude Number F_r (Normal) #	Maximum Shear Stress τ_d lb/ft^2	Factor of Safety τ_{allow}/τ_d	Comment
Maximum Slope:												
0.41	0.093	2.14	6.59	0.33	6.46	0.33	1.31	2.8	0.40	**0.8**	6.5	**O.K.**
Minimum Slope:												
0.59	0.100	3.40	7.73	0.44	7.54	0.45	0.86	2.9	0.23	**0.4**	13.6	**O.K.**

Critical Depth

Depth of Flow (Crit. Depth) Y_c ft	Manning's Roughness Coefficient n	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius $R=A/P$ ft	Top Width T ft	Hydraulic Depth $D=A/T$ ft	Section Factor $Z=AD^{1/2}$ $ft^{2.5}$	Flow Rate Q ft^3/s	Average Velocity V_c ft/s	Froude Number F_r (Critical) #	Uniform-Flow Critical Slope S_c ft/ft	Comment
0.24	0.087	1.13	5.52	0.21	5.44	0.21	0.52	2.9	2.59	1.00	0.188	**Flow is Stable.**

Determination of Minimum Channel Depth & Top Width

Maximum Slope		Minimum Slope	
Minimum Channel Depth ft	Minimum Top Width T ft	Minimum Channel Depth ft	Minimum Top Width T ft
0.91	9.46	**1.09**	**10.54**

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Halifax County Transfer Station
Drainage Channel Analysis (TRM Lined)

Channel No. DC-1B

Design Parameters:

PEAK DISCHARGE, *Q25* = 10.4 ft^3/s Source: HydroCAD 25-Yr 24-Hr

Bottom Width, *B* = 4.0 ft

Left Side Slope, z_1 = 3.0 horizontal :1 vertical

Right Side Slope, z_2 = 3.0 horizontal :1 vertical

Minimum Freeboard = 0.5 ft

Maximum Channel Slope, S_{max} = 0.040 ft/ft

Minimum Channel Slope, S_{min} = 0.010 ft/ft

Turf Reinforcement Matting (TRM) Lining:

Grass Retardance = D

K = 34.6

TRM Product Name = Propex - Landlok TRM 435, or equal

τ_{allow} = 5.0 lb/ft^2

Normal Depth

Depth of Flow (Norm. Depth) Y_n ft	Manning's Roughness Coefficient n	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius $R=A/P$ ft	Top Width T ft	Hydraulic Depth $D=A/T$ ft	Average Velocity V_n ft/s	Flow Rate Q ft^3/s	Froude Number F_r (Normal) #	Maximum Shear Stress τ_d lb/ft^2	Factor of Safety τ_{allow}/τ_d	Comment
Maximum Slope:												
0.63	0.063	3.71	7.98	0.46	7.78	0.48	2.86	10.6	0.73	**1.6**	3.2	**O.K.**
Minimum Slope:												
0.95	0.070	6.51	10.01	0.65	9.70	0.67	1.60	10.4	0.35	**0.6**	8.4	**O.K.**

Critical Depth

Depth of Flow (Crit. Depth) Y_c ft	Manning's Roughness Coefficient n	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius $R=A/P$ ft	Top Width T ft	Hydraulic Depth $D=A/T$ ft	Section Factor $Z=AD^{1/2}$ $ft^{2.5}$	Flow Rate Q ft^3/s	Average Velocity V_c ft/s	Froude Number F_r (Critical) #	Uniform-Flow Critical Slope S_c ft/ft	Comment
0.52	0.060	2.89	7.29	0.40	7.12	0.41	1.84	10.5	3.62	1.00	0.074	**Flow is Stable.**

Determination of Minimum Channel Depth & Top Width

Maximum Slope		Minimum Slope	
Minimum Channel Depth ft	Minimum Top Width T ft	Minimum Channel Depth ft	Minimum Top Width T ft
1.13	10.78	**1.45**	**12.70**

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Halifax County Transfer Station
Drainage Channel Analysis (TRM Lined)

Channel No. DC-2A

Design Parameters:

PEAK DISCHARGE, $Q25$ = 3.1 ft^3/s Source: HydroCAD 25-Yr 24-Hr

Bottom Width, B = 0.0 ft
Left Side Slope, z_1 = 3.0 horizontal :1 vertical
Right Side Slope, z_2 = 3.0 horizontal :1 vertical

Minimum Freeboard = 0.5 ft

Maximum Channel Slope, S_{max} = 0.040 ft/ft
Minimum Channel Slope, S_{min} = 0.010 ft/ft

Turf Reinforcement Matting (TRM) Lining:
Grass Retardance = D
K = 34.6
TRM Product Name = Propex - Landlok TRM 435, or equal
τ_{allow} = 5.0 lb/ft^2

Normal Depth

Depth of Flow (Norm. Depth) Y_n ft	Manning's Roughness Coefficient n	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius $R=A/P$ ft	Top Width T ft	Hydraulic Depth $D=A/T$ ft	Average Velocity V_n ft/s	Flow Rate Q ft^3/s	Froude Number F_r (Normal) #	Maximum Shear Stress τ_d lb/ft^2	Factor of Safety τ_{allow}/τ_d	Comment
Maximum Slope:												
0.74	0.079	1.64	4.68	0.35	4.44	0.37	1.88	3.1	0.54	**1.8**	2.7	**O.K.**
Minimum Slope:												
1.02	0.091	3.12	6.45	0.48	6.12	0.51	1.01	3.2	0.25	**0.6**	7.9	**O.K.**

Critical Depth

Depth of Flow (Crit. Depth) Y_c ft	Manning's Roughness Coefficient n	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius $R=A/P$ ft	Top Width T ft	Hydraulic Depth $D=A/T$ ft	Section Factor $Z=AD^{1/2}$ $ft^{2.5}$	Flow Rate Q ft^3/s	Average Velocity V_c ft/s	Froude Number F_r (Critical) #	Uniform-Flow Critical Slope S_c ft/ft	Comment
0.58	0.070	1.01	3.67	0.28	3.48	0.29	0.54	3.1	3.06	1.00	0.114	**Flow is Stable.**

Determination of Minimum Channel Depth & Top Width

Maximum Slope		Minimum Slope	
Minimum Channel Depth ft	Minimum Top Width T ft	Minimum Channel Depth ft	Minimum Top Width T ft
1.24	7.44	**1.52**	**9.12**

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Halifax County Transfer Station
Drainage Channel Analysis (TRM Lined)

Channel No. DC-2B

Design Parameters:

PEAK DISCHARGE, $Q25$ = 12.5 ft^3/s Source: HydroCAD 25-Yr 24-Hr

Bottom Width, B = 4.0 ft
Left Side Slope, z_1 = 3.0 horizontal :1 vertical
Right Side Slope, z_2 = 3.0 horizontal :1 vertical

Minimum Freeboard = 0.5 ft

Maximum Channel Slope, S_{max} = 0.040 ft/ft
Minimum Channel Slope, S_{min} = 0.010 ft/ft

Turf Reinforcement Matting (TRM) Lining:
Grass Retardance = D
K = 34.6
TRM Product Name = Propex - Landlok TRM 435, or equal
τ_{allow} = 5.0 lb/ft^2

Normal Depth

Depth of Flow (Norm. Depth) Y_n ft	Manning's Roughness Coefficient n	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius $R=A/P$ ft	Top Width T ft	Hydraulic Depth $D=A/T$ ft	Average Velocity V_n ft/s	Flow Rate Q ft^3/s	Froude Number F_r (Normal) #	Maximum Shear Stress τ_d lb/ft^2	Factor of Safety τ_{allow}/τ_d	Comment
Maximum Slope:												
0.67	0.060	4.03	8.24	0.49	8.02	0.50	3.08	12.4	0.77	**1.7**	3.0	**O.K.**
Minimum Slope:												
1.02	0.067	7.20	10.45	0.69	10.12	0.71	1.74	12.5	0.36	**0.6**	7.9	**O.K.**

Critical Depth

Depth of Flow (Crit. Depth) Y_c ft	Manning's Roughness Coefficient n	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius $R=A/P$ ft	Top Width T ft	Hydraulic Depth $D=A/T$ ft	Section Factor $Z=AD^{1/2}$ $ft^{2.5}$	Flow Rate Q ft^3/s	Average Velocity V_c ft/s	Froude Number F_r (Critical) #	Uniform-Flow Critical Slope S_c ft/ft	Comment
0.58	0.058	3.33	7.67	0.43	7.48	0.45	2.22	12.6	3.79	1.00	0.067	**Flow is Stable.**

Determination of Minimum Channel Depth & Top Width

Maximum Slope		Minimum Slope	
Minimum Channel Depth ft	Minimum Top Width T ft	Minimum Channel Depth ft	Minimum Top Width T ft
1.17	11.02	**1.52**	**13.12**

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Halifax County Transfer Station
Drainage Channel Analysis (TRM Lined)

Channel No. DC-3

Design Parameters:

PEAK DISCHARGE, $Q25$ = 2.1 ft^3/s Source: HydroCAD 25-Yr 24-Hr

Bottom Width, B = 0.0 ft
Left Side Slope, z_1 = 3.0 horizontal :1 vertical
Right Side Slope, z_2 = 3.0 horizontal :1 vertical

Minimum Freeboard = 0.5 ft

Maximum Channel Slope, S_{max} = 0.100 ft/ft
Minimum Channel Slope, S_{min} = 0.040 ft/ft

Turf Reinforcement Matting (TRM) Lining:
Grass Retardance = D
K = 34.6
TRM Product Name = Propex - Landlok TRM 435, or equal
τ_{allow} = 5.0 lb/ft^2

Normal Depth

Depth of Flow (Norm. Depth) Y_n ft	Manning's Roughness Coefficient n	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius $R=A/P$ ft	Top Width T ft	Hydraulic Depth $D=A/T$ ft	Average Velocity V_n ft/s	Flow Rate Q ft^3/s	Froude Number F_r (Normal) #	Maximum Shear Stress τ_d lb/ft^2	Factor of Safety τ_{allow}/τ_d	Comment
Maximum Slope:												
0.54	0.080	0.87	3.42	0.26	3.24	0.27	2.38	2.1	0.81	**3.4**	1.5	**O.K.**
Minimum Slope:												
0.66	0.088	1.31	4.17	0.31	3.96	0.33	1.57	2.1	0.48	**1.6**	3.0	**O.K.**

Critical Depth

Depth of Flow (Crit. Depth) Y_c ft	Manning's Roughness Coefficient n	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius $R=A/P$ ft	Top Width T ft	Hydraulic Depth $D=A/T$ ft	Section Factor $Z=AD^{1/2}$ $ft^{2.5}$	Flow Rate Q ft^3/s	Average Velocity V_c ft/s	Froude Number F_r (Critical) #	Uniform-Flow Critical Slope S_c ft/ft	Comment
0.50	0.077	0.75	3.16	0.24	3.00	0.25	0.38	2.1	2.84	1.00	0.147	**Flow is Stable.**

Determination of Minimum Channel Depth & Top Width

Maximum Slope		Minimum Slope	
Minimum Channel Depth ft	Minimum Top Width T ft	Minimum Channel Depth ft	Minimum Top Width T ft
1.04	6.24	**1.16**	**6.96**

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Halifax County Transfer Station
Drainage Channel Analysis (Rip Rap Lined)

Channel No. DC-4

Design Parameters:

PEAK DISCHARGE, $Q25$ = 22.7 ft^3/s Source: HydroCAD 25-Yr 24-Hr

Bottom Width, B = 4.0 ft

Left Side Slope, z_1 = 3.0 horizontal :1 vertical

Right Side Slope, z_2 = 3.0 horizontal :1 vertical

Minimum Freeboard = 0.5 ft

Maximum Channel Slope, S_{max} = 0.090 ft/ft

Minimum Channel Slope, S_{min} = 0.040 ft/ft

Rip Rap Lining:

D_{50} = 1.00 ft

V_{allow} = 13.0 ft/sec

τ_{allow} = 4.0 lb/ft^2

Normal Depth

Depth of Flow (Norm. Depth) Y_n ft	Manning's Roughness Coefficient n	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius $R=A/P$ ft	Top Width T ft	Hydraulic Depth $D=A/T$ ft	Average Velocity V_n ft/s	Flow Rate Q ft^3/s	Froude Number F_r (Normal) #	Maximum Shear Stress τ_d lb/ft^2	Allowable Velocity (V) or Sh. Stress (S) Used?	Factor of Safety V_{allow}/V_n or τ_{allow}/τ_d	Comment
Maximum Slope:													
0.85	0.078	5.57	9.38	0.59	9.10	0.61	4.05	22.5	0.91	**4.8**	V	3.2	**O.K.**
Minimum Slope:													
1.00	0.071	7.00	10.32	0.68	10.00	0.70	3.22	22.5	0.68	**2.5**	V	4.0	**O.K.**

Critical Depth

Depth of Flow (Crit. Depth) Y_c ft	Manning's Roughness Coefficient n	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius $R=A/P$ ft	Top Width T ft	Hydraulic Depth $D=A/T$ ft	Section Factor $Z=AD^{1/2}$ $ft^{2.5}$	Flow Rate Q ft^3/s	Average Velocity V_c ft/s	Froude Number F_r (Critical) #	Uniform-Flow Critical Slope S_c ft/ft	Comment
0.81	0.080	5.21	9.12	0.57	8.86	0.59	3.99	22.7	4.35	1.00	0.116	**Slopes Near Sc - Check Freeboard.**

Determination of Minimum Channel Depth & Top Width

Maximum Slope		Minimum Slope	
Minimum Channel Depth ft	Minimum Top Width T ft	Minimum Channel Depth ft	Minimum Top Width T ft
1.35	12.10	**1.50**	**13.00**

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Objective To design a sediment trap(s) and/or rock dam(s) to satisfy erosion and sediment control requirements and to handle the flow from the design storm.

References Koerner, Robert M. (1999), Designing with Geosynthetics, 4th Ed., Prentice-Hall Inc., Englewood Cliffs, NJ, p. 463.

Malcom, H. Rooney (1989 & 2003 Supplement), Elements of Urban Stormwater Design, NC State Univ., Raleigh, NC.

North Carolina Division of Land Resources (2006), North Carolina Erosion & Sediment Control Planning & Design Manual, Raleigh, NC.

Analysis The following approach is used to properly size and evaluate each sediment trap/rock dam:

1. Design for Wet (If Applicable) and Dry Storage.
2. Perform Spillway Calculations.

Calculations

- Design for Wet (If Applicable) and Dry Storage:

  - Determine required wet (if applicable) and dry storage volumes based on applicable erosion and sedimentation control requirements.

  - If applicable, calculate the desired surface area at the measurement elevation. For some locations:

$$A = 0.01 Q_P$$

where: A = desired surface area (acres)
Q_P = peak discharge from design storm (cfs)
(NC - Use 10-yr 24-hr storm; GA - Use 2-yr 24-hr storm)

- Size Basin:

Rectangular Basin:

$$V = HLW - SH^2L - SH^2W + 2S^2H^3 \qquad \text{(Koerner Eq. 5.17)}$$

SED TRAP-R DAM-GENERAL.WPD

where:
V = volume of basin
H = height at center
W = width at measurement elevation
L = length at measurement elevation
S = side slope ratio (i.e. 2 for 2:1 slopes)

Custom Size (or Refined Rectangular Basin):

- Set up a stage-storage relationship for the proposed basin as shown below. Based on this relationship and the required volume(s) and/or desired surface area, determine the required wet storage (if applicable) and dry storage elevations. Alternatively the elevation(s) can be determined from a graphical stage-storage relationship.

$$S = K_S Z^b \qquad \text{(Malcom Eq. III-7)}$$

where:
S = storage volume (ft^3)
K_S ,b = linear regression constants describing the stage-storage relationship
Z = stage referenced to the bottom elevation included in the analysis (ft)

- Set cleanout elevation.

- Set spillway (weir) elevation.

- Evaluate basin shape. Compare with the recommended length to width ratio. If this ratio is not achieved, the basin should be modified or baffles should be added as required.

- Spillway Calculations:

- Design crest length of spillway to handle flow from the design storm using the following equation. Determine peak flow from stormwater routing program.

$$Q_P = C_W L H^{3/2} \qquad \text{(Malcom Eq. I-6)}$$

where:
Q_P = peak discharge from design storm (cfs)
C_w = weir coefficient (=3.0 for free overfall)
L = length of weir (ft)
H = driving head (ft) (= allowable headwater above crest of weir or calculated value from stormwater routing program)

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CHKD BY:	LAQ

Halifax County Transfer Station
Sediment Trap/Rock Dam Analysis **Trap/Rock Dam No.: ST-1**

DESIGN FOR WET (IF APPLICABLE) AND DRY STORAGE:

Areas Draining Into Basin:

Drainage Area	Area (acres)
Total Drainage Areas	2.8
Total =	2.8 Acres

Basin Requirements:

Wet Storage:

Required Storage Capacity (ft^3/Ac.) =	0	**Enter "0" if Not Applicable.**
Required Storage Capacity (ft^3) =	0	
Required Depth of Wet Storage (ft) =	1.5	**Enter "0" if Not Applicable.**

Dry Storage:

Required Storage Capacity (ft^3/Ac.) =	3,600	**To Measurement Elevation**
Required Storage Capacity (ft^3) =	10,080	
Multipier (X) for Desired Surface Area (Qp x X) =	0.01	**At Measurement Elevation**
Peak Discharge into Basin (Qp) (cfs) =	24.4	**From HydroCAD - 25-Yr, 24-Hr. Storm**
Desired Surface Area (Ac) =	0.24	
Desired Surface Area (ft^2) =	10,629	

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Custom Size - or Refined Rectangular Basin:

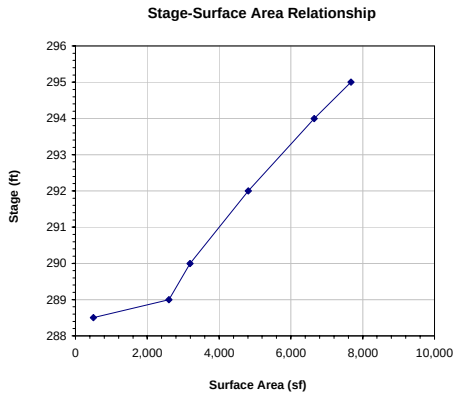
Determine Stage-Storage Function:

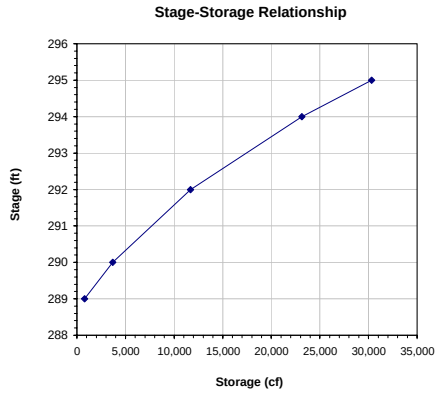
Contour	Area (ft^2)	Area (acres)	Incremental Volume (ft^3)	Cumulative Volume (ft^3)	Stage (ft)	ln S	ln Z	Z est
288.5	500	0.01						
289	2,600	0.06	775	775	0.5	6.65	-0.69	0.50
290	3,195	0.07	2,898	3,673	1.5	8.21	0.41	1.50
292	4,814	0.11	8,009	11,682	3.5	9.37	1.25	3.50
294	6,650	0.15	11,464	23,146	5.5	10.05	1.70	5.50
295	7,676	0.18	7,163	30,309	6.5	10.32	1.87	6.50

Linear Regression Constants:

Ks = 2,057 Storage = 2057 z^1.42
b = 1.42

***CAUTION: CHECK INPUT FOR REGRESSION ANALYSIS!**





Basin Design Elevations: ***Based on Custom Size**

Elev. of Bottom of Basin = 288.5

Wet Storage:

Required Storage Capacity (ft^3) = 0
Min. Elev. of Wet Storage (Permanent Pool) = 290.0
Selected Elev. of Wet Storage (Permanent Pool) = 290.0 **O.K.**
Actual Wet Storage Volume (ft^3) = 3,659 **O.K.**

Dry Storage:

Required Storage Capacity (ft^3) = 13,739 **= Required Dry Storage + Actual Wet Storage**
Min. Measurement Elev. = 292.3
Selected Measurement Elev. = 293.5 **O.K.**
Actual Total Storage Volume (ft^3) = 20,232 **O.K.**

Desired Surface Area (ft^3) = 10,629
Actual Surface Area at Spillway (Weir) (ft^2) = 5,747 **No Good. Increase Surface Area at Permanent Pool If Possible.**

OK as is. Peak flow conservatively based on 25 Yr storm. Also, consider large quantity of impervious surface.

Cleanout:

Cleanout Requirement (% of Wet Storage) = 0 **Enter "0" if Not Applicable**
Cleanout Requirement (% of Total Storage) = 50
Basin Cleanout Volume (ft^3) = 10,116 **Based on 50% of Total Storage Volume**
Basin Cleanout Elevation = 291.6

Spillway (Weir) Elev.:

Spillway (Weir) Elev. - Measurement Elev. (ft) = 0 **Enter "0" if Measurement Elevation is at Weir**
Spillway (Weir) Elevation = 293.5

SHEET:	5/6
JOB #:	HALIFAX-11-5
DATE:	1/29/12
BY:	PKS
CHKD BY:	LAQ

Basin Shape:

Length of Basin (ft) =	92	**Measured at Crest of Weir**
Width of Basin (ft) =	66	**Measured at Crest of Weir**
Desired Length to Width Ratio (X:1) =	2	
Actual Length to Width Ratio (X:1) =	1.4	**No Good. Revise Shape or Add Baffles.** *Baffles Used.*

SPILLWAY CALCULATIONS:

Crest Elev. (ft) =	293.5	
Required Freeboard (ft) =	1.5	
Top of Berm Elev. (ft) =	295.0	
Design Crest Length (ft) =	10	**> Required by NC E&SC Manual**

SUMMARY DATA:

Trap/Rock Dam No.: ST-1

Elev. of Bottom of Basin =	288.5
Cleanout Elev. (ft) =	291.6
Elev. of Wet Storage (Permanent Pool) =	290.0
Elev. of Spillway (Weir) =	293.5
Top of Berm Elev. (ft) =	295.0
Top of Berm Width (ft) =	5

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Raleigh, NC 27603 Fax: 919-828-3899

SHEET: 6/6
JOB #: HALIFAX-11-5
DATE: 1/29/12
BY: PKS
CHKD BY: LAQ

Halifax County Transfer Station
Sediment Trap/Rock Dam Analysis - Filter Flow

Filter Flow (For Use in HydroCAD):

Permeability of Stone (k) (ft/sec) =	0.50	(Approx. Half of typical permeability of No. 57 Stone to account for clogging)
Base of Stone Elevation (ft) =	290	
Length of Stone at Base (ft) =	3	
Crest Elevation (ft) =	293.5	
Length of Stone at Crest (ft) =	10	

Elevation (ft)	Avg. Gradient (ft/ft)	Top Length of Stone (ft^3)	Area of Stone (ft^3)	Filter Flow (cfs)
290.00	0.00	3.00	0.00	0.00
290.50	0.25	4.00	1.75	0.22
291.00	0.50	5.00	4.00	1.00
291.50	0.75	6.00	6.75	2.53
292.00	1.00	7.00	10.00	5.00
292.50	1.25	8.00	13.75	8.59
293.00	1.50	9.00	18.00	13.50
293.50	1.75	10.00	22.75	19.91

Notes: Gradient = Average Head
Filter Flow is based on Darcy's Law (Flow = kiA)

PROJECT Halifax County Transfer Station

SUBJECT Outlet Protection Analysis

JOB NO. HALIFAX-11-5
DATE 1/29/12
COMPUTED BY PKS
CHECKED BY LAQ

Objective To design outlet protection for culverts and/or drainage channels based on the maximum flow from the design storm. Rip rap aprons are applicable when the Froude Number (Fr) is less than or equal to 2.5 (Debo and Reese). For higher Froude Numbers, rip rap outlet basins, baffled outlets, and/or other methods are more appropriate.

Reference Debo, T.N., and Reese, A.J. (1995), Municipal Storm Water Management, Lewis Publishers, Boca Raton, FL, Section 8.11 - pp. 289-290; Section 12.6 - pp. 523-526.

Federal Highway Administration (2000), Hydraulic Design of Energy Dissipators for Culverts and Channels, Hydraulic Engineering Circular No. 14, FHWA EPD-86-110, Metric Ed., U.S. Dept. of Transportation, Washington, D.C.

North Carolina Division of Land Resources (2006), North Carolina Erosion & Sediment Control Planning & Design Manual, Raleigh, NC.

Analysis For each outlet, determine the Froude Number (Fr) based on the pipe Manning's number, diameter, slope, and design discharge. Use the methods described in Section 8.11 of Debo and Reese. Select the method of outlet protection, as appropriate, and perform design calculations.

Rip Rap Aprons:

If Fr $\leq$ 2.5, a rip rap apron may be used. The following design approach is based on Section 12.6 of Debo and Reese and Section 8.06 of the NC Erosion & Sediment Control Planning and Design Manual:

1. Determine the tailwater condition and select the appropriate design chart.

2. Using the appropriate design chart, determine the d_{50} rip-rap size and minimum apron length (La) based on the maximum design flow (Q), flow depth (d), and/or velocity (v) (depending on whether the pipe is flowing full or partially full).

3. Using the same chart, determine apron dimensions.

4. Determine the maximum stone diameter: $d_{max} = 1.5 \times d_{50}$

5. Determine the apron thickness:
   Thickness = $1.5 \times d_{max}$ (No Filter Geotextile)
   Thickness = $1.5 \times d_{50}$ (With Filter Geotextile)

Other Methods:

If Fr > 2.5, consider the use of a rip rap basin, baffled outlet, or other device. Design method according to FHA guidelines using HY8-Energy program (or other documented source).

OUTLET PROTECTION.WPD

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Raleigh, NC 27603 Fax: 919-828-3899

SHEET: 2/3
JOB #: HALIFAX-11-5
DATE: 1/29/12
BY: PKS
CHKD BY: LAQ

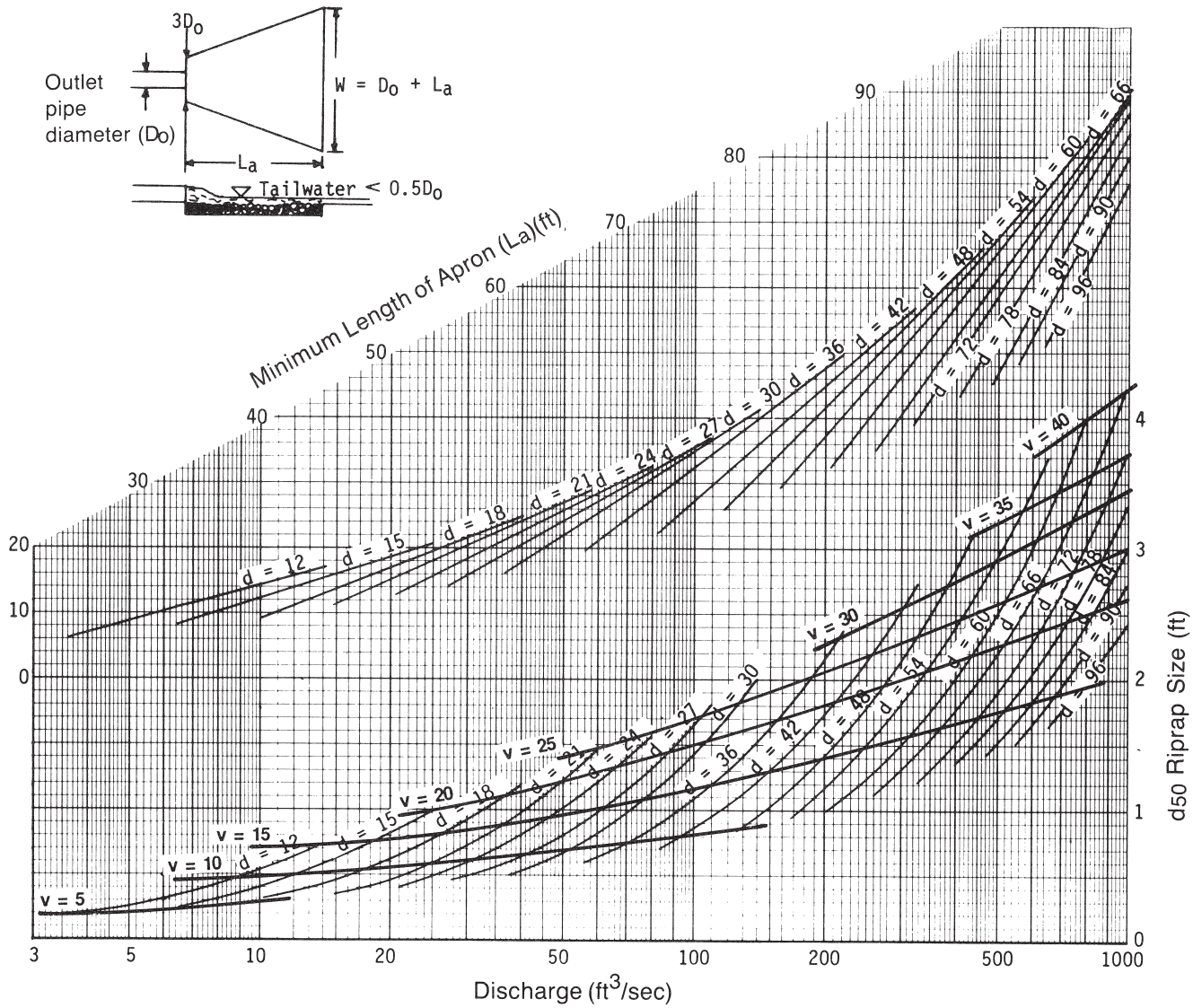
Halifax County Transfer Station
Outlet Protection Analysis - Rip Rap Aprons (Circular Pipe)

Rip Rap Aprons:

	Outlet				
	C-1	**C-2**			
Pipe Type:	Concrete	Concrete			
Manning's Coefficient:	0.012	0.012			
Diameter (D_O) (in) =	18	18			
Slope (%) =	0.8	0.8			
Design Discharge (cfs) =	**6.1**	**7.1**			
Source of Discharge Data:	HydroCAD 25-Yr 24-Hr	HydroCAD 25-Yr 24-Hr			
K =	0.187	0.217			
θ (degrees) =	194	206			
Flow Depth (d) (in) =	**10.1**	**11.0**			
Flow Area (ft^2) =	1.0	1.1			
Flow Velocity (v) (ft/sec) =	**6.0**	**6.2**			
Froude Number =	1.15	1.15			
Rip Rap Aprons Applicable?	**Yes**	**Yes**			
Tailwater Condition (Low or High)*:	Low	Low			
d_{50} (ft)** =	**1.00**	**0.75**			
d_{max} (ft) =	1.50	1.13			
Apron Thickness (X) (ft):	-----	-----			
No Geotextile:	2.25	1.69			
With Geotextile:	**1.50**	**1.13**			
Apron Dimensions (ft):	-----	-----			
Length (La)** =	**10**	**10**			
Width (W) =	**Channel Width**	**Channel Width**			

*Tailwater Conditions: Low: Tw < $0.5D_O$; High: Tw > $0.5D_O$

** Value from Chart.



Curves may not be extrapolated.

Figure 8.06a Design of outlet protection protection from a round pipe flowing full, minimum tailwater condition (T_w < 0.5 diameter).

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Attachment E

Permit Drawings

Halifax County, North Carolina
Transfer Station
Permit Application

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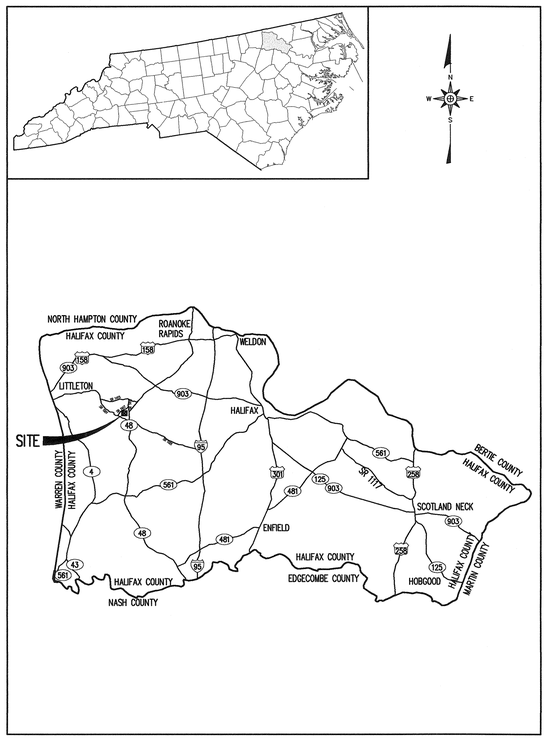
HALIFAX COUNTY, NORTH CAROLINA
DEPARTMENT OF PUBLIC UTILITIES

HALIFAX COUNTY TRANSFER STATION PERMIT DRAWINGS

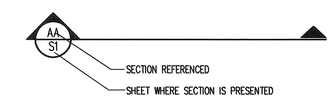
JANUARY 2012



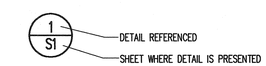
SITE LOCATION MAP
NOT TO SCALE

SHEET NO.	DRAWING NO.	TITLE
1	--	TITLE-COVER SHEET
2	S1	EXISTING CONDITIONS
3	S2	SITE GRADING AND DRAINAGE PLAN
4	S3	FLOOR PLAN AND DETAILS
5	S4	BUILDING ELEVATIONS
6	EC1	EROSION AND SEDIMENTATION CONTROL DETAILS (SHEET 1 OF 2)
7	EC2	EROSION AND SEDIMENTATION CONTROL DETAILS (SHEET 2 OF 2)

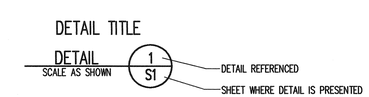
STANDARD SECTION LOCATION CALLOUT (SHEET AND DETAIL)



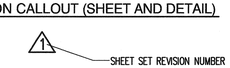
STANDARD DETAIL CALLOUT

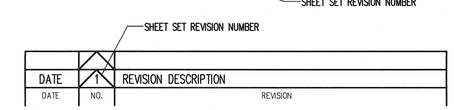


STANDARD DETAIL LABEL AND CALLOUT



STANDARD REVISION CALLOUT (SHEET AND DETAIL)





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NORTH CAROLINA PROFESSIONAL SEAL 021666 ENGINEER PETER K. SCHEER
1/31/12

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FILE NAME
HALI-D0162

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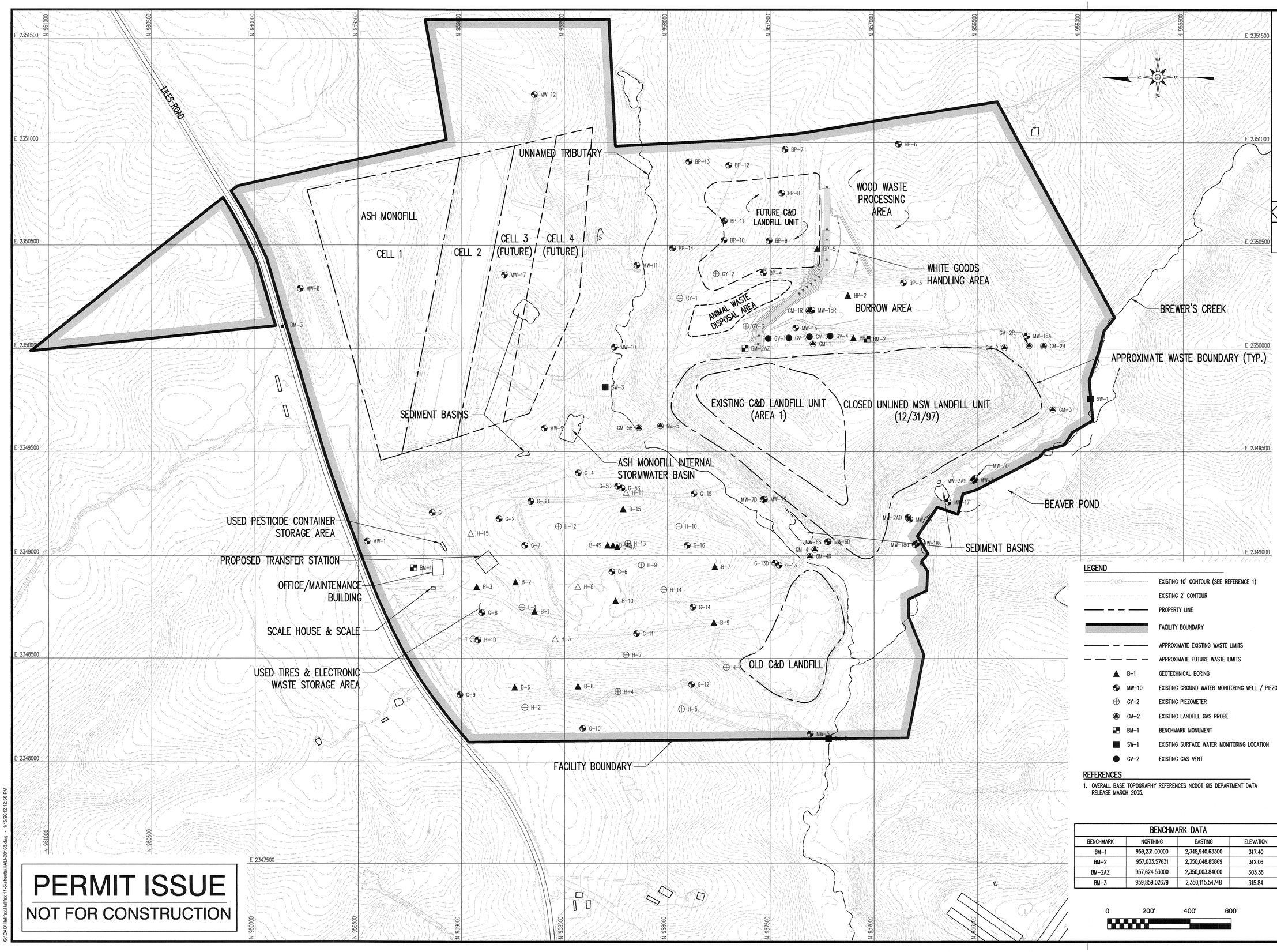

LEGEND

- EXISTING 10' CONTOUR (SEE REFERENCE 1)
- EXISTING 2' CONTOUR
- PROPERTY LINE
- FACILITY BOUNDARY
- APPROXIMATE EXISTING WASTE LIMITS
- APPROXIMATE FUTURE WASTE LIMITS
- B-1 GEOTECHNICAL BORING
- MW-10 EXISTING GROUND WATER MONITORING WELL / PIEZOMETER
- GY-2 EXISTING PIEZOMETER
- GM-2 EXISTING LANDFILL GAS PROBE
- BM-1 BENCHMARK MONUMENT
- SW-1 EXISTING SURFACE WATER MONITORING LOCATION
- GV-2 EXISTING GAS VENT

REFERENCES

1. OVERALL BASE TOPOGRAPHY REFERENCES NCDOT GIS DEPARTMENT DATA RELEASE MARCH 2005.

BENCHMARK DATA

BENCHMARK	NORTHING	EASTING	ELEVATION
BM-1	959,231.00000	2,348,940.63300	317.40
BM-2	957,033.57631	2,350,048.85869	312.06
BM-2AZ	957,624.53000	2,350,003.84000	303.36
BM-3	959,859.02679	2,350,115.54748	315.84

0 200' 400' 600'

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REVISION | NO. | DATE

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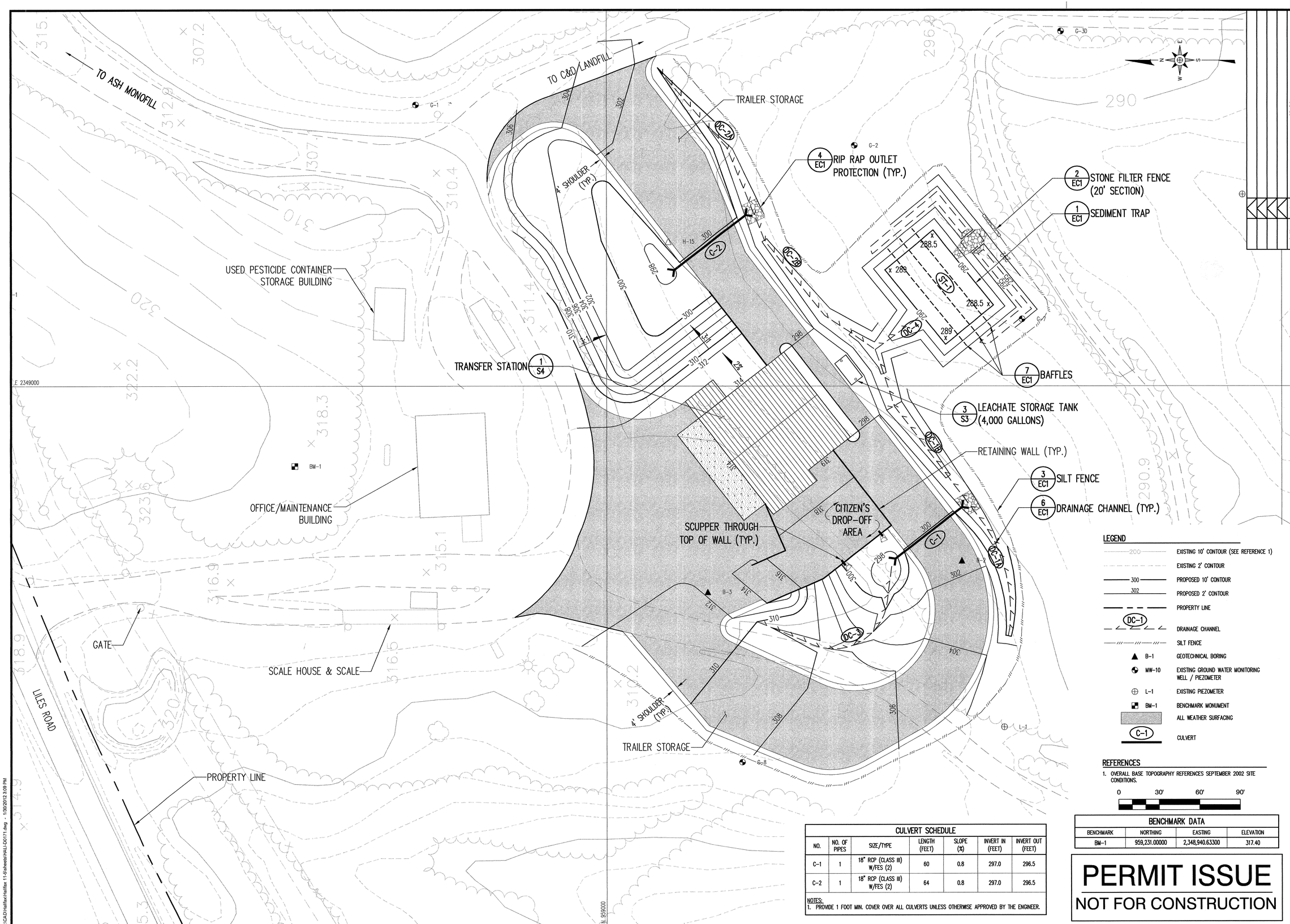
www.rsgengineers.com

SEAL

PROJECT TITLE: HALIFAX COUNTY TRANSFER STATION PERMIT DRAWINGS

DRAWING TITLE: EXISTING CONDITIONS

DESIGNED BY: P.K.S.	DRAWN BY: W.R.B.
CHECKED BY: ZQ	PROJECT NO.: HALIFAX 11-5
SCALE: AS SHOWN	DATE: JAN. 2012
FILE NAME: HALI-D0163	
SHEET NO. 2	DRAWING NO. S1



LEGEND

200	EXISTING 10' CONTOUR (SEE REFERENCE 1)
	EXISTING 2' CONTOUR
300	PROPOSED 10' CONTOUR
302	PROPOSED 2' CONTOUR
	PROPERTY LINE
DC-1	DRAINAGE CHANNEL
	SILT FENCE
B-1	GEOTECHNICAL BORING
MW-10	EXISTING GROUND WATER MONITORING WELL / PIEZOMETER
L-1	EXISTING PIEZOMETER
BM-1	BENCHMARK MONUMENT
	ALL WEATHER SURFACING
C-1	CULVERT

REFERENCES

1. OVERALL BASE TOPOGRAPHY REFERENCES SEPTEMBER 2002 SITE CONDITIONS.

0 30' 60' 90'

CULVERT SCHEDULE

NO.	NO. OF PIPES	SIZE/TYPE	LENGTH (FEET)	SLOPE (%)	INVERT IN (FEET)	INVERT OUT (FEET)
C-1	1	18" RCP (CLASS III) W/FES (2)	60	0.8	297.0	296.5
C-2	1	18" RCP (CLASS III) W/FES (2)	64	0.8	297.0	296.5

NOTES:
1. PROVIDE 1 FOOT MIN. COVER OVER ALL CULVERTS UNLESS OTHERWISE APPROVED BY THE ENGINEER.

BENCHMARK DATA

BENCHMARK	NORTHING	EASTING	ELEVATION
BM-1	959,231.00000	2,348,940.63300	317.40

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REVISION | NO. | DATE

SEAL: NORTH CAROLINA PROFESSIONAL SEAL 022362 ENGINEER PETER K. SMITH 1/31/12

PROJECT TITLE: HALIFAX COUNTY TRANSFER STATION PERMIT DRAWINGS

DRAWING TITLE: SITE GRADING AND DRAINAGE PLAN

DESIGNED BY: P.K.S.	DRAWN BY: W.R.B.
CHECKED BY:	PROJECT NO.: HALIFAX 11-5
SCALE: AS SHOWN	DATE: JAN. 2012
FILE NAME: HALI-D0171	
SHEET NO. 3	DRAWING NO. S2

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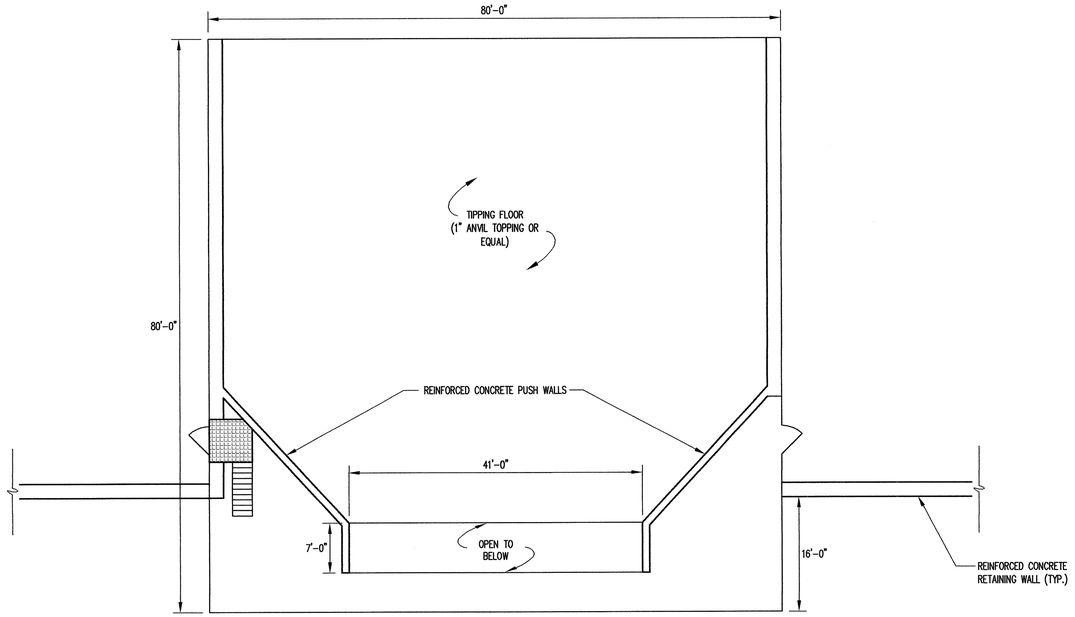
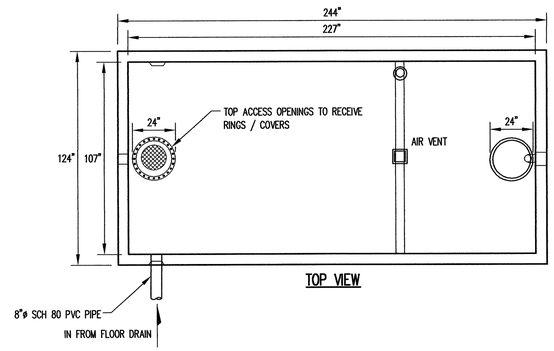
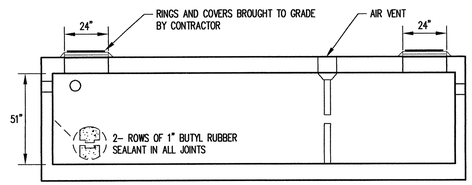


TIPPING FLOOR PLAN

DETAIL 1/S3 NOT TO SCALE



TOP VIEW

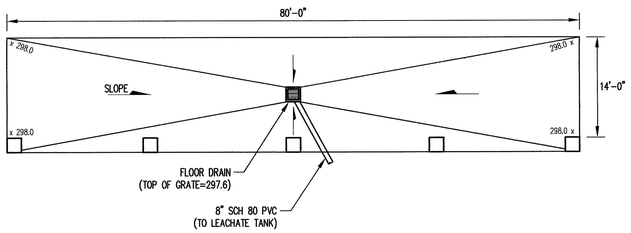


SIDE VIEW

NOTES:
1. TANK SHALL BE CONSTRUCTED USING PRECAST REINFORCED CONCRETE.
2. CONCRETE COMPRESSIVE STRENGTH = 4,500 PSI AT 28 DAYS.
3. TANK SHALL BE TRAFFIC RATED.
4. INLET PIPE(S) SHALL BE SEALED WITH NONSHRINK WATERTIGHT GROUT.

LEACHATE STORAGE TANK

DETAIL 3/S3 NOT TO SCALE



LOADING BAY FLOOR PLAN

DETAIL 2/S3 NOT TO SCALE

PERMIT ISSUE
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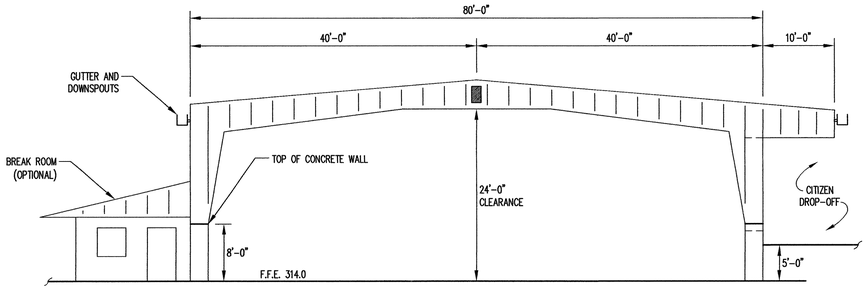
SEAL

SEAL: PROFESSIONAL ENGINEER SEAL 021698 PETER K. SMITH 1/31/12

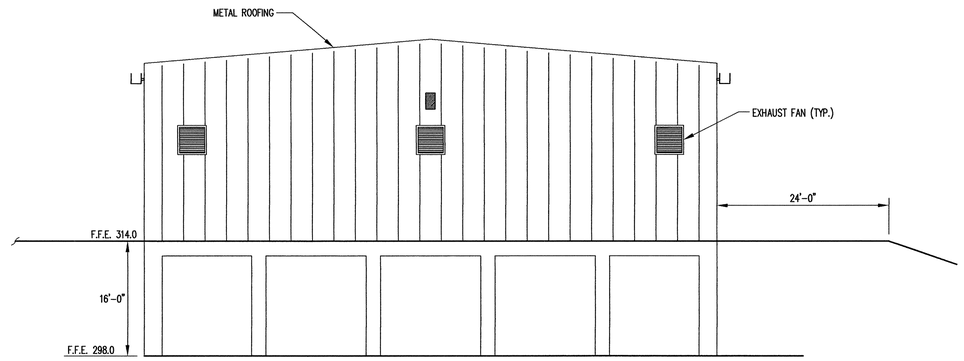
PROJECT TITLE: HALIFAX COUNTY TRANSFER STATION PERMIT DRAWINGS

DRAWING TITLE: FLOOR PLAN AND DETAILS

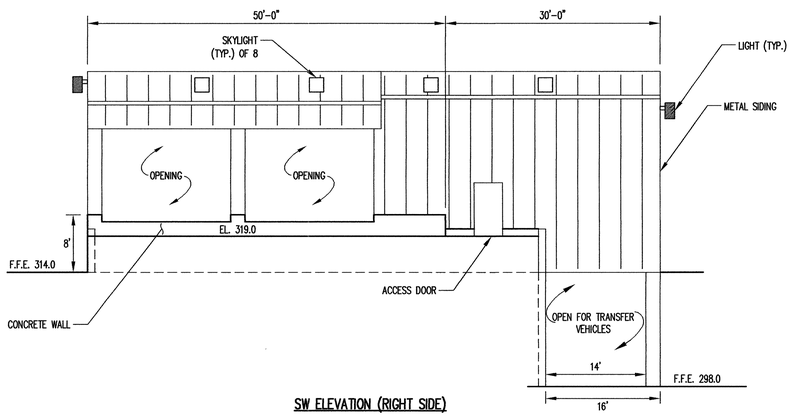
DESIGNED BY: P.K.S.	DRAWN BY: J.A.L.
CHECKED BY:	PROJECT NO.: HALIFAX 11-5
SCALE: AS SHOWN	DATE: JAN. 2012
FILE NAME: HALI-D0172	
SHEET NO. 4	DRAWING NO. S3



NW ELEVATION (FRONT)



SE ELEVATION (REAR)



SW ELEVATION (RIGHT SIDE)

TRANSFER STATION BUILDING ELEVATIONS

DETAIL 1/S4
NOT TO SCALE

PERMIT ISSUE
NOT FOR CONSTRUCTION

NO.	DATE	REVISION

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SEAL

SEAL: NORTH CAROLINA PROFESSIONAL SEAL 021686 ENGINEER PETER K. SMITH 1/31/12

PROJECT TITLE: HALIFAX COUNTY TRANSFER STATION PERMIT DRAWINGS

DRAWING TITLE: BUILDING ELEVATIONS

DESIGNED BY: P.K.S.	DRAWN BY: J.A.L.
CHECKED BY:	PROJECT NO.: HALIFAX 11-5
SCALE: AS SHOWN	DATE: JAN. 2012
FILE NAME HALI-D0173	
SHEET NO. 5	DRAWING NO. S4

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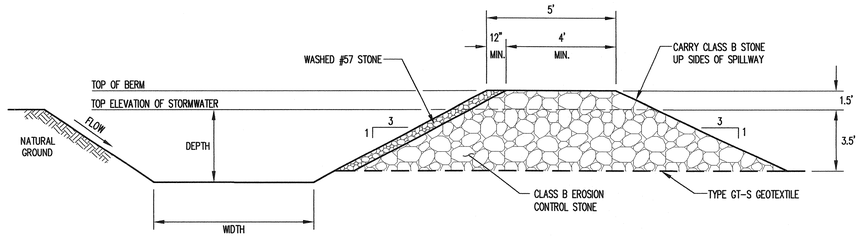
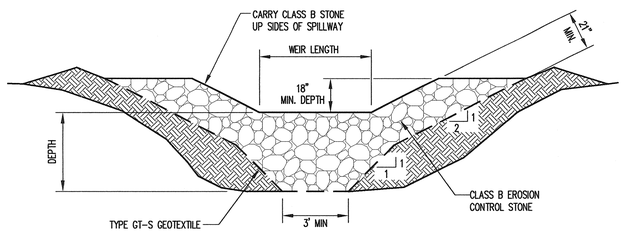


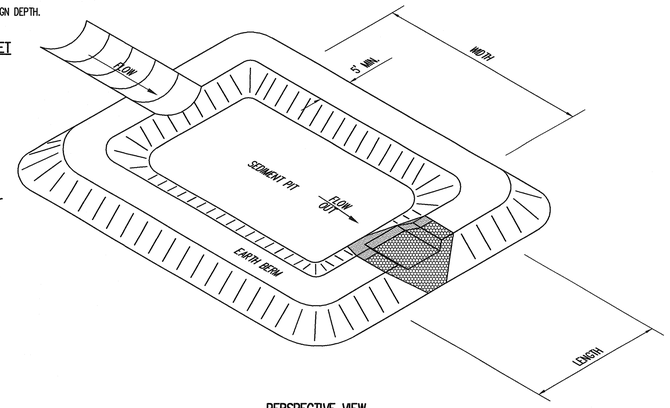
NOTE:
1. CLEAN TRAP WHEN SEDIMENT REACHES ONE-HALF OF THE DESIGN DEPTH.

SECTION THRU TRAP AND OUTLET

TEMPORARY SEDIMENT TRAP SCHEDULE				
TRAP	WIDTH	LENGTH	DEPTH	WEIR LENGTH
1	SEE PLAN VIEW		5	10'



SECTION THRU BERM AND OUTLET



PERSPECTIVE VIEW

SEDIMENT TRAP

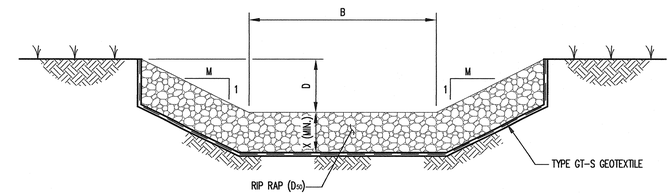
DETAIL 1 / EC1
NOT TO SCALE

SEEDING SCHEDULE		
MATERIAL	SEED TYPE	APPLICATION RATE
LIME	–	4,000 LBS/ACRE
FERTILIZER	–	1,000 LBS/ACRE
SEED		
PERMANENT	KENTUCKY 31 TALL FESCUE PENSACOLA BAHIAGRASS SERICEA LESPEDEZA KOBE LESPEDEZA SEASONAL NURSE CROP	80 LBS/ACRE 50 LBS/ACRE 30 LBS/ACRE 10 LBS/ACRE SEE NOTE 2
TEMPORARY	SEASONAL NURSE CROP	SEE NOTE 2
MULCH	–	4,000–5,000 LBS/ACRE
BINDER	–	150 GALLONS/ACRE

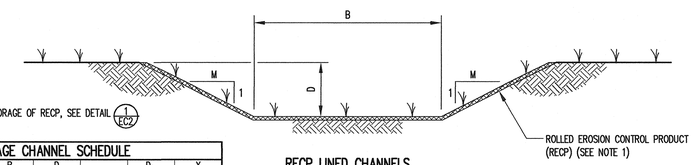
NOTES:
1. APPLICATION RATES AND/OR CHEMICAL ANALYSIS SHALL BE CONFIRMED OR ESTABLISHED BY A SOIL TEST.
2. USE SEASONAL NURSE CROP IN ACCORDANCE WITH SEEDING DATES AS STATED BELOW:
   APRIL 15 – AUGUST 15 — 10 LBS/ACRE GERMAN MILLET OR 15 LBS/ACRE SUDANGRASS
   AUGUST 16 – APRIL 14 — 25 LBS/ACRE RYE (GRAIN)
3. FROM SEPTEMBER 1 – MARCH 1, USE UNSCARIFIED SERICEA SEED.

SEEDING SCHEDULE

DETAIL 5 / EC1
NOT TO SCALE



RIP RAP LINED CHANNELS



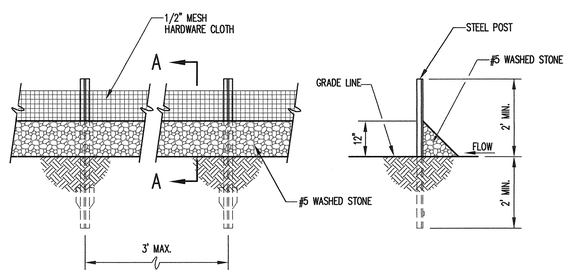
NOTES:
1. FOR ANCHORAGE OF RECP, SEE DETAIL 1 / EC2

RECP LINED CHANNELS

DRAINAGE CHANNEL SCHEDULE						
DRAINAGE CHANNEL NO.	LINING	B (FEET)	D (FEET)	M	D_{50} (INCHES)	X (FEET)
DC-1A & 1B	*TRM	4	1.5 (MIN.)	3	--	--
DC-2A	*TRM	0	1.5 (MIN.)	3	--	--
DC-2B	*TRM	4	1.5 (MIN.)	3	--	--
DC-3	*TRM	0	1.5 (MIN.)	3	--	--
DC-4	RIP RAP	4	2.0 (MIN.)	3	6	1.0
*TRM –TURF REINFORCEMENT MATTING						

DRAINAGE CHANNEL DETAILS

DETAIL 6 / EC1
NOT TO SCALE

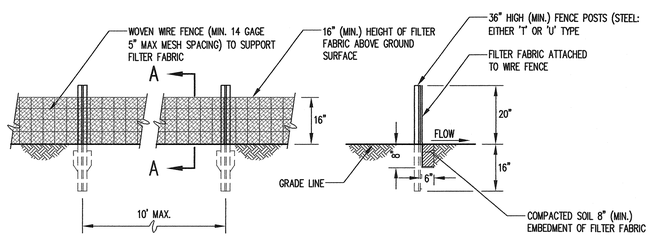


ELEVATION

SECTION A–A

STONE FILTER FENCE

DETAIL 2 / EC1
NOT TO SCALE

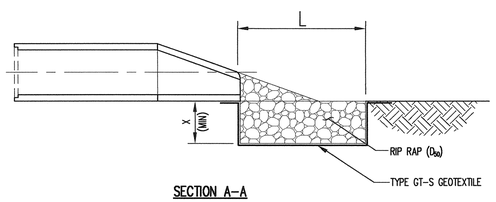


ELEVATION

SECTION A–A

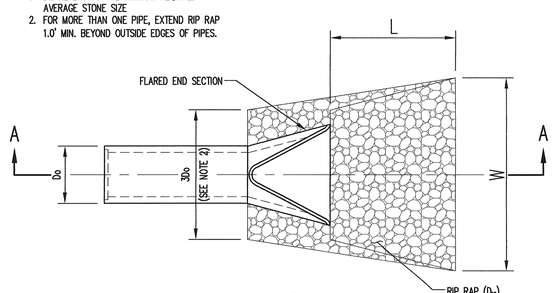
SILT FENCE

DETAIL 3 / EC1
NOT TO SCALE



SECTION A–A

NOTES:
1. D_{50} REFERS TO THE MINIMUM REQUIRED AVERAGE STONE SIZE
2. FOR MORE THAN ONE PIPE, EXTEND RIP RAP 1.0' MIN. BEYOND OUTSIDE EDGES OF PIPES.

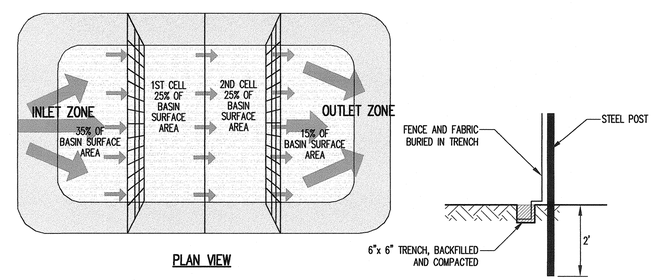


PLAN

RIP RAP OUTLET PROTECTION					
PIPE/OUTLET	D_o	L (FT)	W (FT)	X (IN)	D_{50} (IN)
WALL SCUPPERS (2)	---	8	8	12	6
C-1	18"	10*	12	12	6
C-2	18"	10*	12	12	6
* RIP RAP LENGTH IS EQUAL TO CHANNEL WIDTH AT FLOW DEPTH OF 2 FEET.					

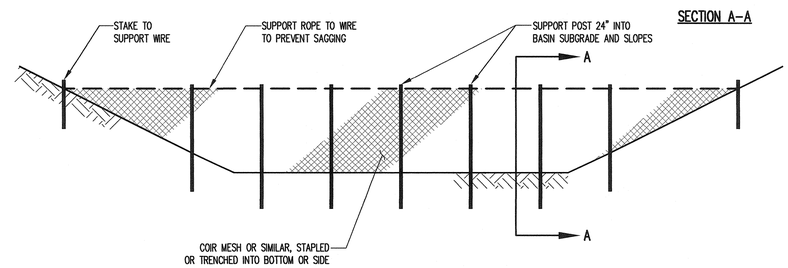
RIP RAP OUTLET PROTECTION

DETAIL 4 / EC1
NOT TO SCALE



PLAN VIEW

SECTION A–A



ELEVATION

BAFFLES

DETAIL 7 / EC1
NOT TO SCALE

NOTES:
1. BAFFLE MATERIAL SHOULD BE SECURED AT THE BOTTOM AND SIDES USING STAPLES OR BY TRENCHING AS FOR SILT FENCE.
2. MOST OF THE SEDIMENT WILL ACCUMULATE IN THE FIRST BAY, WHICH SHOULD BE READILY ACCESSIBLE FOR MAINTENANCE.
3. PROVIDE 3 BAFFLES (USE TWO IF LESS THAN 20 FEET IN LENGTH).
4. BAFFLE SHALL BE 700 g/m² COIR EROSION BLANKET.
5. TOPS OF BAFFLES SHOULD BE 2 INCHES LOWER THAN THE TOP OF THE BERMS.
6. INSPECT BAFFLES FOR REPAIR ONCE A WEEK AND AFTER EACH RAINFALL.

PERMIT ISSUE
NOT FOR CONSTRUCTION

NO.	DATE	REVISION

RICHARDSON SMITH GARDNER & ASSOCIATES
NC LIC. NO. C-0618 (Engineering)
14 N. Boylan Ave.
Raleigh, N.C. 27603
ph: 919-828-0577
fax: 919-828-3899
www.rsgengineers.com

SEAL

PROJECT TITLE: HALIFAX COUNTY TRANSFER STATION PERMIT DRAWINGS

DRAWING TITLE: EROSION AND SEDIMENTATION CONTROL DETAILS (SHEET 1 OF 2)

DESIGNED BY: P.K.S.	DRAWN BY: W.R.B.
CHECKED BY: ZQ	PROJECT NO.: HALIFAX 11-5
SCALE: AS SHOWN	DATE: JAN. 2012
FILE NAME: HALI-D0165	
SHEET NO. 6	DRAWING NO. EC1

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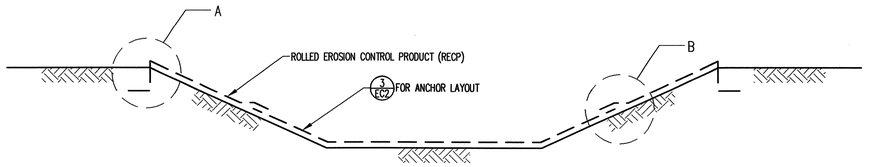
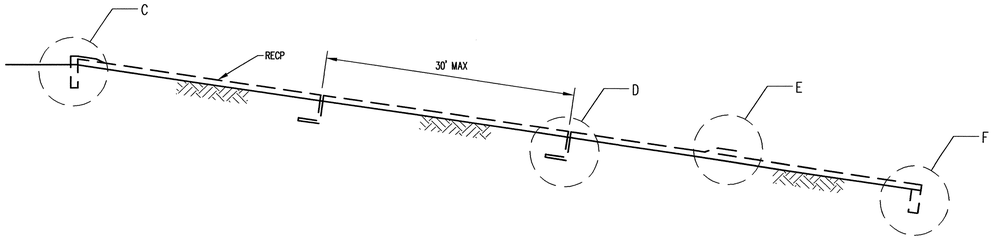
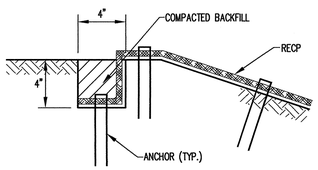


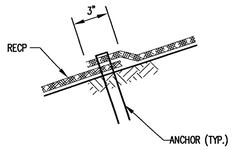
TYPICAL CHANNEL CROSS SECTION



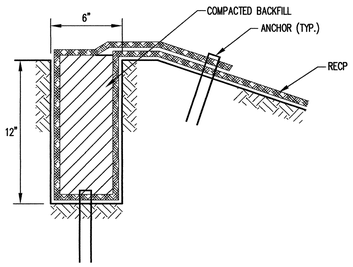
TYPICAL CHANNEL PROFILE



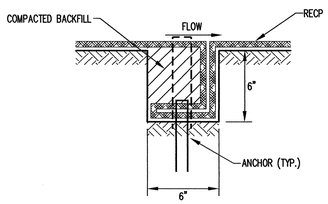
A. LONGITUDINAL ANCHOR TRENCH



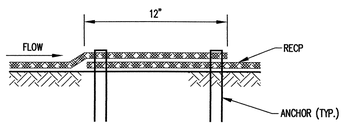
B. OVERLAP AT ADJACENT EDGES



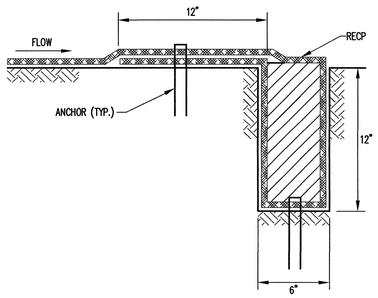
C. UPSTREAM TERMINAL ANCHOR TRENCH



D. INTERMITTENT CHECK SLOT



E. OVERLAP AT ROLL ENDS



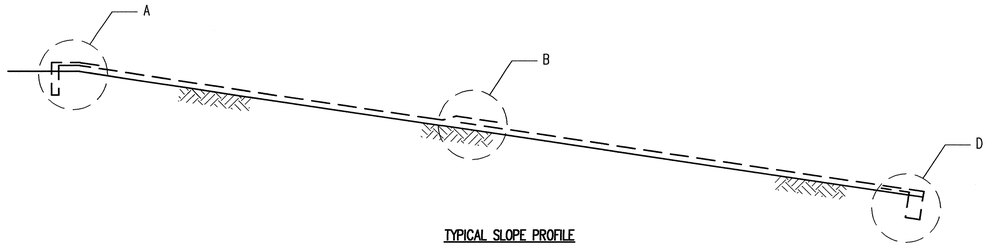
F. DOWNSTREAM TERMINAL ANCHOR TRENCH

NOTES:

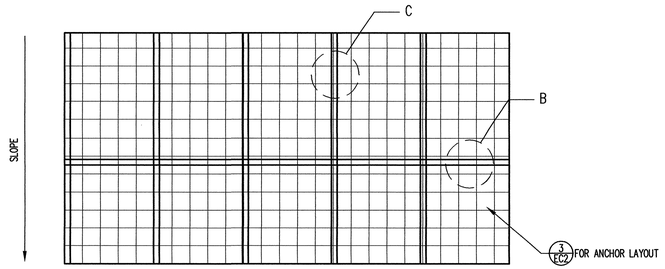
1. PLACE ANCHORS AT ANCHOR TRENCHES, OVERLAPS, AND CHECK SLOTS ON 1 FOOT CENTERS. IF APPLICABLE, STAGGER ANCHOR SPACING BETWEEN MULTIPLE ROWS OF ANCHORS.

INSTALLATION OF ROLLED EROSION CONTROL PRODUCTS (CHANNELS)

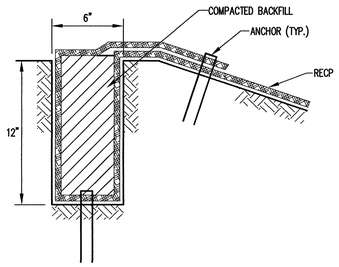
DETAIL 1/EC2
NOT TO SCALE



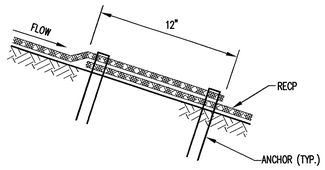
TYPICAL SLOPE PROFILE



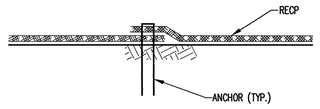
TYPICAL SLOPE PLAN VIEW



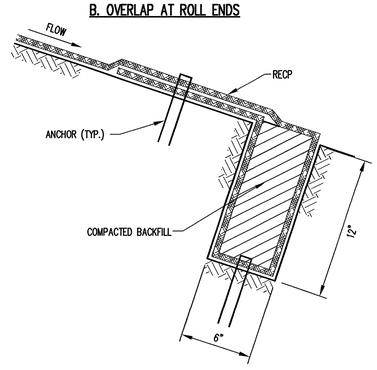
A. UPSLOPE TERMINAL ANCHOR TRENCH



B. OVERLAP AT ROLL ENDS



C. OVERLAP AT ADJACENT EDGES



D. DOWNSLOPE TERMINAL ANCHOR TRENCH

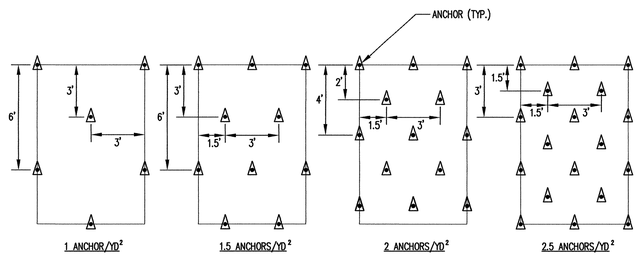
NOTE:

1. PLACE ANCHORS AT ANCHOR TRENCHES, OVERLAPS, AND CHECK SLOTS ON 1 FOOT CENTERS. IF APPLICABLE, STAGGER ANCHOR SPACING BETWEEN MULTIPLE ROWS OF ANCHORS.

INSTALLATION OF ROLLED EROSION CONTROL PRODUCTS (SLOPES)

DETAIL 2/EC2
NOT TO SCALE

ANCHOR SPACING SCHEDULE	
LOCATION	REQUIRED ANCHOR SPACING (ANCHORS/YD^2)
ALL CHANNELS	2.5
1.5H:1V SLOPES	2.0
2H:1V SLOPES	2.0
2.5H:1V SLOPES	1.5
3H:1V SLOPES	1.5
3.5H:1V SLOPES	1.0
4H:1V SLOPES	1.0



ANCHOR LAYOUT

DETAIL 3/EC2
NOT TO SCALE

PERMIT ISSUE
NOT FOR CONSTRUCTION

REVISION | NO. | DATE

RICHARDSON SMITH GARDNER & ASSOCIATES
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SEAL

NORTH CAROLINA PROFESSIONAL SEAL 021066 ENGINEER PETER K. SOTOS 11/13/12

PROJECT TITLE: HALIFAX COUNTY TRANSFER STATION PERMIT DRAWINGS

DRAWING TITLE: EROSION AND SEDIMENTATION CONTROL DETAILS (SHEET 2 OF 2)

DESIGNED BY: P.K.S.	DRAWN BY: W.R.B.
CHECKED BY:	PROJECT NO.: HALIFAX 11-5
SCALE: AS SHOWN	DATE: JAN. 2012
FILE NAME: HALI-D0166	
SHEET NO. 7	DRAWING NO. EC2

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Attachment F

Zoning Documentation

Halifax County, North Carolina
Transfer Station
Permit Application

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Halifax County
Planning & Development Services
PO Box 69 - 15 West Pittsylvania Street, Halifax, NC 27839
(252) 583-1082 Planning & Zoning (252) 583-4891 Building Inspections
(252) 583-2288 E911 Addressing (252) 583-2735 Fax

January 13, 2012

Mr. Edward F. Mussler, P.E.
NC DENR Division of Waste Management
1646 Mail Service Center
Raleigh, NC 27699-1646

RE: Halifax County – Proposed Transfer Station
Demonstration of Consistency with Zoning Ordinances

Dear Mr. Mussler:

In compliance with 15A NCAC 13B.0401(2), this letter is to notify you that the proposed municipal solid waste (MSW) transfer station at the Halifax County Landfill facility meets the applicable zoning requirements of Halifax County as a permitted use in the RA – Residential / Agriculture district.

Should you have any questions or require clarification, please contact me at your earliest convenience.

Sincerely,

Chris D. Rountree, Director
Planning & Development Services

cc: Pieter Scheer, P.E., Richardson Smith Gardner & Associates

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Attachment G

Traffic Requirements

Halifax County, North Carolina
Transfer Station
Permit Application

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Martin/Alexiou/Bryson, P.C.
Transportation Planning
Traffic Engineering, C-3496

MEMORANDUM

To: John Rouse, P.E., NCDOT Division 4 Engineer
From: Andrew Topp, P.E., Martin/Alexiou/Bryson, P.C.
Date: January 6, 2011
Subject: Proposed Halifax Transfer Station Traffic Assessment

Introduction

A bill was passed in the North Carolina General Assembly in 2007 that affects the permitting process for new solid waste facilities. This bill, Senate Bill 1492, contains a subsection (included in Appendix A) that dictates the terms of a traffic study requirement. Halifax County is seeking to build a new transfer station at the County's landfill site along SR 1417 (Liles Road) in Littleton, which requires adherence to this new law. They are seeking the permits necessary to accept 200 tons of waste per day. Before commencing with the full development plans for the site and typical driveway permit process, Halifax County, is seeking certification from NCDOT as is required by this law, summarized below:

> *"obtaining a certification from the Division Engineer of the Department of Transportation that the proposed facility will not have a substantial impact on highway traffic."*

A map illustrating the site's location and surrounding roadways is shown in Figure 1 and a sketch of the proposed site is included in the Figure 2. This memorandum summarizes the trip generation, trip distribution, and traffic assignment for the site traffic, and also provides an assessment of the potential traffic impacts associated with the proposed transfer station as is required to address the above requirements.

Project Background

Halifax County is seeking to add a transfer station to the existing county landfill in Littleton, NC. The transfer station operations are planned to begin in mid-2013. The site is located along the southern side of Liles Road, as shown in Figure 1 at the end of this memorandum. The amount of waste to be collected at this location will be determined based on the actual demand; however, Halifax County seeks a permit to accept up to 200 tons/day.

Traffic Generation

The trip generation for transfer stations consists of three parts; incoming collection trucks delivering waste to the site, outgoing transfer trucks, and then employee and other miscellaneous trips. The *ITE Trip Generation Manual, 8th Edition* does not presently have data to generate traffic specifically for transfer stations. However, based on the known projected tons of waste that will be allowed into and out of the transfer station on any given day, it is possible to determine the maximum number of daily truck trips associated with this tonnage. The site engineer, Richardson Smith Gardner & Associates staff projected traffic trends associated with the proposed transfer station use based on discussions with the County and their experience developing these types of projects. If the maximum 200 tons per day is accepted, the following mix of truck traffic is expected to deliver waste to this site:

- Collection Trucks (10 tons/truck) delivering 160 tons/day or 16 total trucks

- Roll-Off Container Trucks (6 tons/truck) delivering 20 tons/day or 4 total trucks
- Small Loads (1 ton/truck) delivering 20 tons/day or 20 total trucks

The outgoing waste is transported to the landfill using 20 ton trucks which results in 10 trucks per day. A few employee trips and occasional deliveries result in some additional trips during the day. The incoming and outgoing trips are generally uniformly spread throughout the day. To be conservative, a k-factor of 15% was applied to the daily totals to derive the peak hour volumes.

Table 1: Trip Generation

Trip Type	Tonnage	Daily Trips	Peak Hour		
			Enter	Exit	Total
Truck Trips – Incoming Collection Trucks	200	80	6	6	12
Truck Trips – Outgoing Transfer Trucks	200	20	2	2	4
Employee/Misc Trips	N/A	20	2	2	4
Total	**400**	**120**	**10**	**10**	**20**

Traffic Distribution and Assignment

The traffic distribution was derived from the same methodology utilized for the existing traffic volumes. The distribution of trips is assumed is as follows:

- 30% to/from the west via Justice Branch Road (SR 1001)
- 30% to/from the south via Justice Branch Road (SR 1001)
- 10% to/from the north via Fire Tower Road (SR 1418)
- 30% to/from the south via Fire Tower Road (SR 1418) south to NC 48

The site distributions, resulting trip assignment, and other related volume illustrations are contained in Figure 3.

Existing (2011) Conditions

The study area for the proposed transfer station impact analysis consisted of the following intersections:

- Liles Road (SR 1417) at Justice Branch Road (SR 1001)
- Liles Road (SR 1417) at Fire Tower Road (SR 1418)
- Liles Road (SR 1417) at the existing Halifax County Landfill driveway

These intersections were analyzed under the Existing conditions, including existing lane configurations, traffic control, and current estimated turning movement count data as shown in Figure 3.

Count Data

Due to the low AADT reported by NCDOT, the turning movement volumes were derived from the AADT maps using standard engineering practices. Appendix B shows the 2009 NCDOT AADT map for Halifax County. Typically, the peak hour volume is 10% to 12% of the AADT in rural areas. To be conservative, 15% of the AADT was utilized. To determine the directional split, 60% of the peak hour volume was estimated to be traveling to/from NC 48. Volumes along Liles Road was estimated by applying ITE Trip Generation Rates to the number of residences along that road and including the daily traffic currently using the County's landfill which resulted in an AADT of approximately 125 vehicles per day. Turning movements into and out-off the site were based on 50% distribution in each direction. Figure 3 shows the estimated peak hour volumes.

Future (2013) Conditions

Future conditions were assessed for 2013, which is the projected year of opening of the site under the special use permit. A three-percent growth rate was applied uniformly to the existing roadway volumes to account for background growth in traffic, resulting in No-Build (2013) volumes. Site traffic was then distributed to the driveways according to projected travel patterns. The traffic operation summary for this intersection under all scenarios is tabulated in Table 2 below and the analysis results are included in the Appendix.

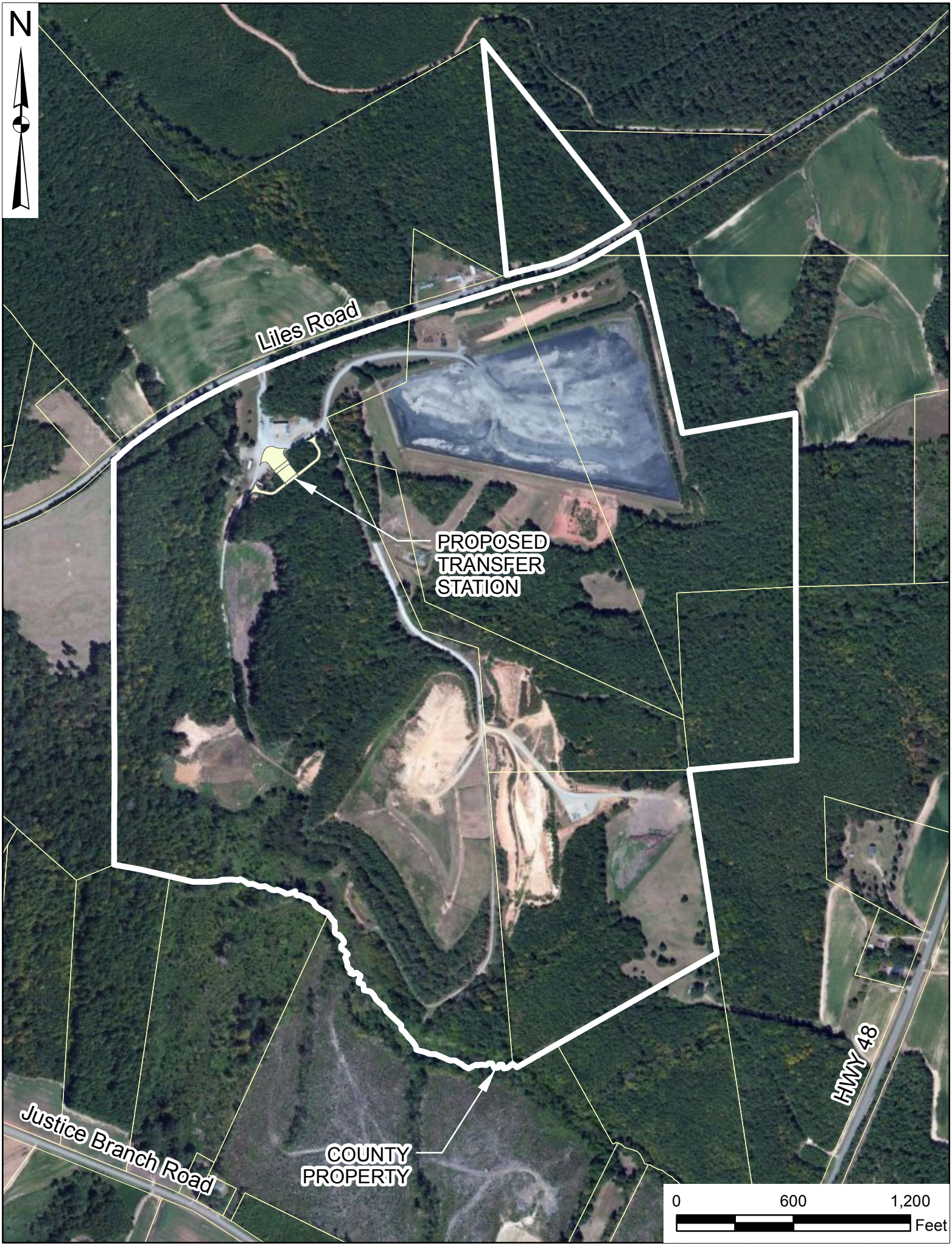
Table 2: Intersection Level of Service Summary

Intersection	Existing Peak Hour	No-Build Peak Hour	Build Peak Hour
Liles Road (SR 1417) and Justice Branch Road (SR 1001)	(WB-A)	(WB-A)	(WB-A)
Liles Road (SR 1417) and Fire Tower Road (SR 1418)	(EB-A)	(EB-A)	(EB-A)
Liles Road (SR 1417) and Site Driveway	(NB-A)	(NB-A)	(NB-A)

Legend: (XB-X) =(stop controlled approach – approach level of service)

The traffic analysis results show that all intersections operate at an acceptable LOS A during all three scenarios. The additional traffic from the site has a negligible impact on the surrounding intersections on Liles Road and the driveway operates at acceptable levels of service during the peak travel time. Although the site's traffic is predominantly heavy vehicles, Liles Road has a sufficient capacity and width to accommodate these trucks. Only very minor queuing exists (95% queue is 3 feet) as vehicles exit the site. This queuing will be contained within the site's driveway area and will not impact the flow of traffic along Liles Road.

Figure 1 Vicinity Map


N
Liles Road
PROPOSED
TRANSFER
STATION
HWY 48
Justice Branch Road
COUNTY
PROPERTY
0
600
1,200
Feet

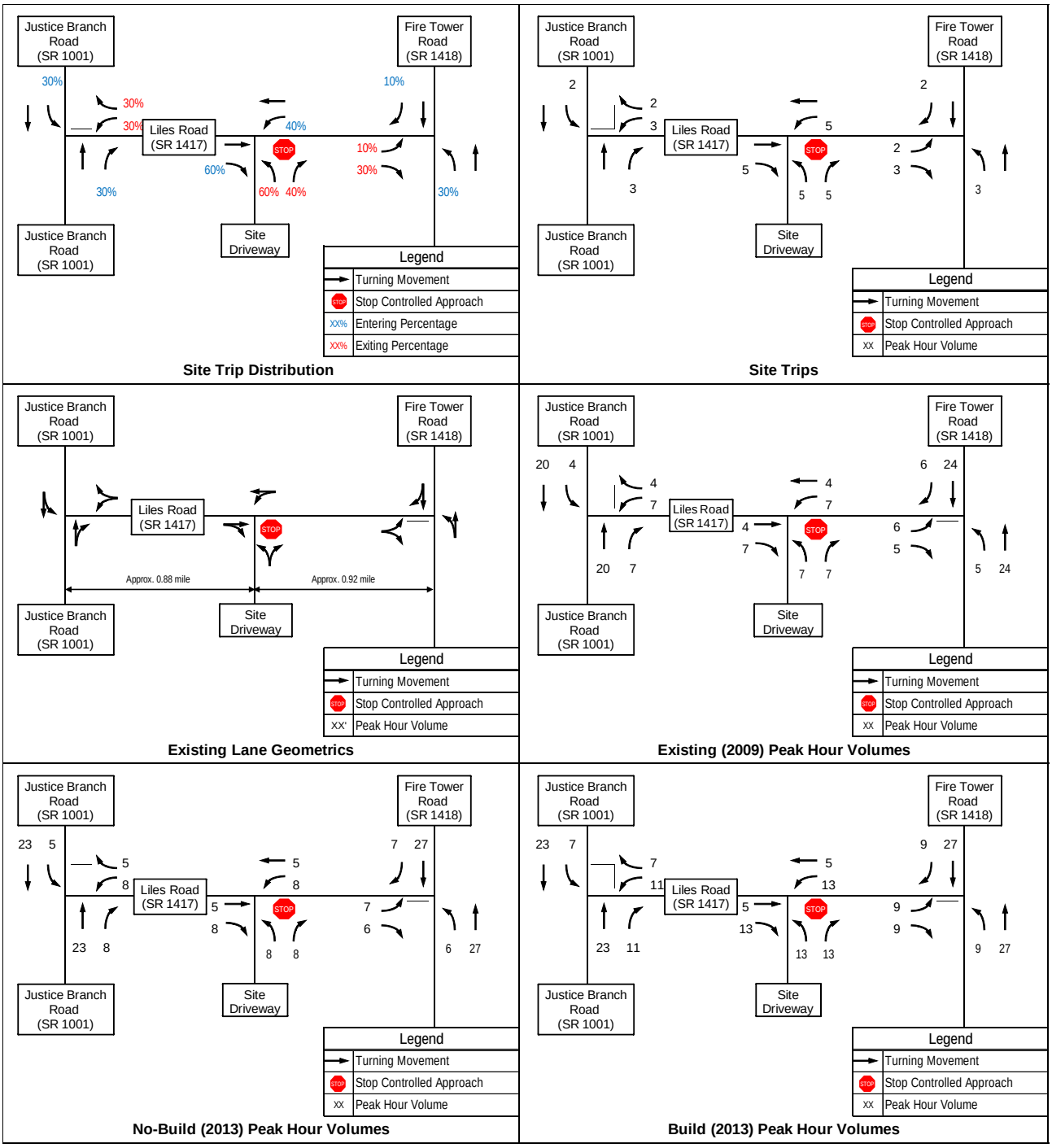


Figure 3 Study Volumes

APPENDIX

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APPENDIX A

Senate Bill 1492

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GENERAL ASSEMBLY OF NORTH CAROLINA
SESSION 2007

SESSION LAW 2007-550
SENATE BILL 1492

"§ 130A-295.5. Traffic study required for certain solid waste management facilities.

(a) An applicant for a permit for a sanitary landfill or for a transfer station shall conduct a traffic study of the impacts of the proposed facility. The Department shall include as a condition of a permit for a sanitary landfill or for a transfer station a requirement that the permit holder mitigate adverse impacts identified by the traffic study. The study shall include all of the following at a minimum:

(1) Identification of routes from the nearest limited access highway used to access the proposed facility.

(2) Daily and hourly traffic volumes that will result along each approach route between the nearest limited access highway and the proposed facility.

(3) A map identifying land uses located along the identified approach routes, including, but not limited to, residential, commercial, industrial development, and agricultural operations. The map shall identify residences, schools, hospitals, nursing homes, and other significant buildings that front the approach routes.

(4) Identification of locations on approach routes where road conditions are inadequate to handle the increased traffic associated with the proposed facility and a description of the mitigation measures proposed by the applicant to address the conditions.

(5) A description of the potential adverse impacts of increased traffic associated with the proposed facility and the mitigation measures proposed by the applicant to address these impacts.

(6) An analysis of the impact of any increase in freight traffic on railroads and waterways.

(b) An applicant for a permit for a sanitary landfill or for a transfer station may satisfy the requirements of subsection (a) of this section by obtaining a certification from the Division Engineer of the Department of Transportation that the proposed facility will not have a substantial impact on highway traffic."

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APPENDIX B

2009 NCDOT AADT Map

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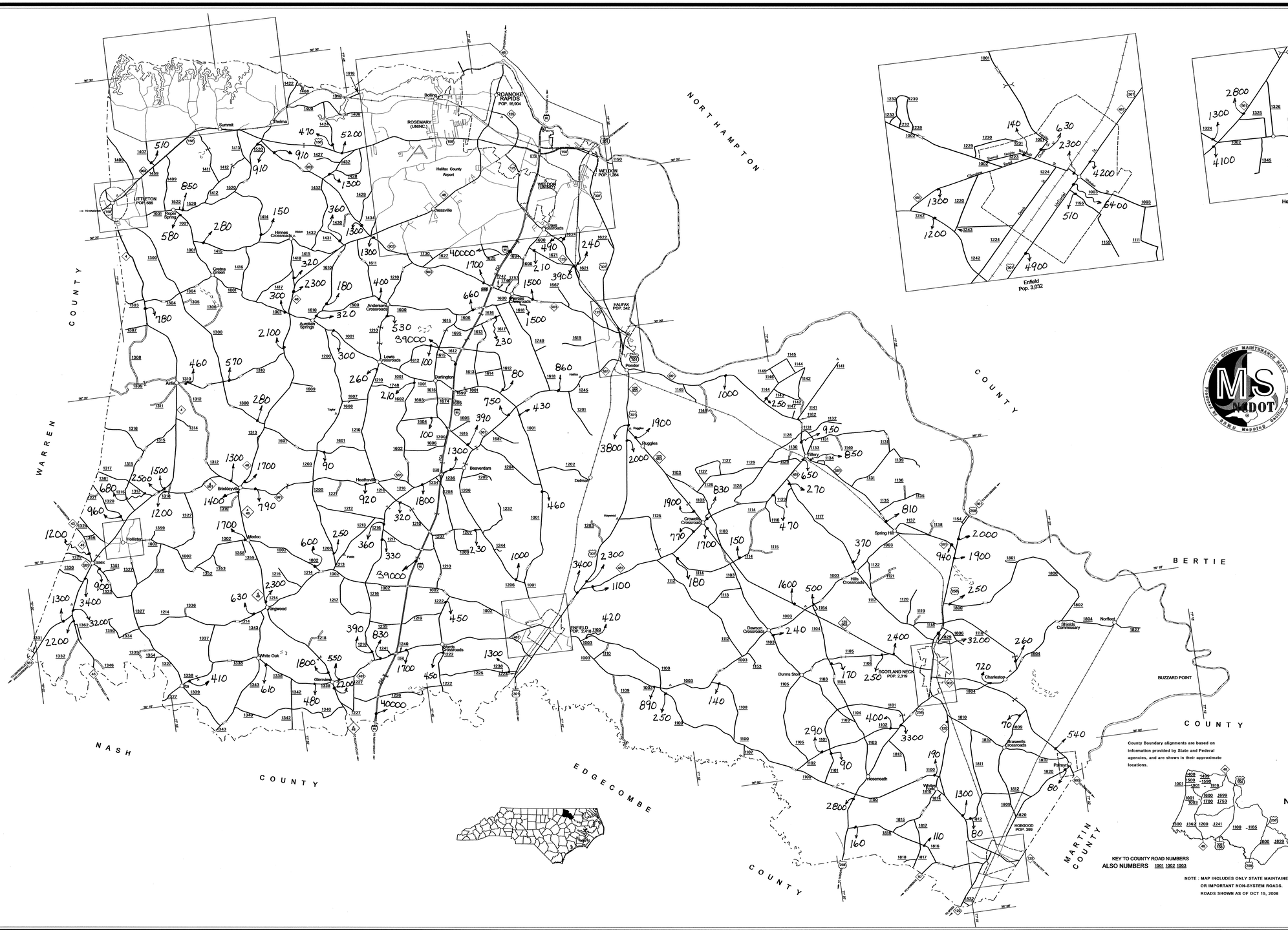

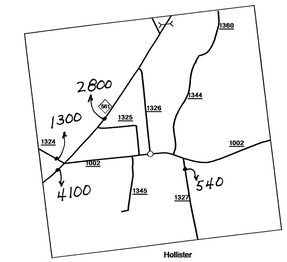

LEGEND

- PRIMITIVE OR UNIMPROVED ROAD
- GRADED AND DRAINED ROAD
- SOIL,GRAVEL OR STONE SURFACED ROAD
- HARD SURFACED ROAD
- 4 LANE UNDIVIDED HIGHWAY
- DIVIDED HIGHWAY
- HIGHWAY WITH FRONTAGE ROADS
- F.C.A. FULL CONTROL ACCESS
- NS NON-SYSTEM ROAD
- PROJECTED LOCATION
- INTERSECTION DISTANCE
- TRAFFIC CIRCLE
- HIGHWAY INTERCHANGE
- DETAILED HIGHWAY INTERCHANGE
- ROAD THROUGH MOUNTAIN PASS
- HIGHWAY BRIDGE
- UNDERPASS
- OVERPASS
- DRAW SPAN ON BRIDGE
- HIGHWAY TUNNEL
- FORD
- 95 INTERSTATE HIGHWAY
- 70 U.S. NUMBERED HIGHWAY
- 43 N.C. NUMBERED HIGHWAY
- U.S. NUMBERED BICYCLE ROUTE
- N.C. NUMBERED BICYCLE ROUTE
- 999 INTERSTATE INTERCHANGE NUMBER
- 999 SECONDARY ROAD NUMBER
- TEL-FLEET-PIPE CABLE
- RAILROAD, ANY NUMBER OF TRACKS USED BY SINGLE OPERATING COMPANY
- RAILROAD,ANY NUMBER OF TRACKS USED BY MORE THAN ONE OPERATION COMPANY ON SAME OR ADJACENT RIGHTS-OF-WAY
- RAILROAD STATION
- GRADE CROSSING
- UNDERPASS
- OVERPASS
- RAILROAD TUNNEL
- INSET AREA
- URB.B. URBAN EXTENSION BOUNDARY LINE
- N.P.B. RESERVATION OR PARK BOUNDARY
- CITY LIMIT
- N.F.B. NATIONAL FOREST BOUNDARY
- S.F.B. STATE FOREST BOUNDARY
- F.G.B. FEDERAL GAMELAND BOUNDARY
- S.G.B. STATE GAMELAND BOUNDARY
- M.R.B. MILITARY RESERVATION BOUNDARY
- COUNTY LINE
- STATE LINE
- INCORPORATED CITY OR VILLAGE, (GENERALIZED)
- FREE OR TOLL FERRY
- CANAL
- NARROW STREAM
- WIDE STREAM
- DAM WITH LOCK
- DAM
- RESERVOIR,POND,OR LAKE
- COMMUNITY AND TOWN CENTER
- COUNTY SEAT
- SCHOOL
- COLLEGE OR UNIVERSITY
- HOSPITAL
- CHURCH
- CHURCH WITH CEMETERY
- CEMETERY
- PATROL STATION
- CORRECTIONAL OR PENAL INSTN.
- HIGHWAY GARAGE OR MAINT. YARD
- HIGHWAY DIV. OR DIST. OFFICE
- WEIGHT STATION
- MONUMENT-SMALL HISTORICAL SITE
- LIGHTHOUSE
- MOUNTAIN PEAK
- REST AREA
- TRIANGULATION STATION
- COAST GUARD STATION
- MILITARY AIRFIELD
- COMMERCIAL OR MUNICIPAL FIELD
- HANGAR ON FIELD
- LANDING STRIP
- MARKED AUXILIARY FIELD

County Boundary alignments are based on information provided by State and Federal agencies, and are shown in their approximate locations.

KEY TO COUNTY ROAD NUMBERS
ALSO NUMBERS 1001 1002 1003

NOTE : MAP INCLUDES ONLY STATE MAINTAINED ROADS OR IMPORTANT NON-SYSTEM ROADS.
ROADS SHOWN AS OF OCT 15, 2008

2009 AADT

ANNUAL AVERAGE DAILY TRAFFIC

HALIFAX COUNTY

NORTH CAROLINA

GENERATED BY THE

TRAFFIC SURVEY GROUP

TRANSPORTATION PLANNING BRANCH

BASE MAPPING PREPARED BY

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STATE ROAD MAINTENANCE UNIT
MAPPING & INFORMATION SECTION

IN COOPERATION WITH THE

U.S.DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

SCALE

1 0 1 2 3 4 MILES

0 0.5 1 MILE

SCALE FOR ENLARGEMENTS

10,000 FOOT GRID BASED ON NORTH CAROLINA PLANE COORDINATE SYSTEM

POLYCONIC PROJECTION

SHEET 1 OF 2

Disclaimer: The IMG Unit's goal is to provide the most accurate information as possible, the magnitude of the data prevents any guarantee of accuracy or completeness. If you find any information that is incorrect, please send your request to the IMG Unit.

COPIES OF THIS MAP ARE AVAILABLE TO THE PUBLIC AT A NOMINAL COST.
ADDRESS:
N.C. DEPARTMENT OF TRANSPORTATION
INFORMATION, MAPPING, AND GRAPHICS
1548 MAIL SERVICE CENTER
RALEIGH, N.C. 27699

REVISED
10/2/01 MEM
1/23/02 MEM
3/25/03 MEM
8/25/03 TRP
4/1/04 TRP
1/07/05 TRP
6/14/06 BDG
1/25/07 BDG
7/23/07 BDG
6/11/08 BDG
6/20/08 BDG
10/15/08 BDG

HALIFAX

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APPENDIX C

INTERSECTION CAPACITY ANALYSIS

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Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	7	4	20	7	4	20
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	8	5	23	8	5	23
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	59	27			31	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	59	27			31	
tC, single (s)	6.9	6.8			4.2	
tC, 2 stage (s)						
tF (s)	4.0	3.8			2.3	
p0 queue free %	99	100			100	
cM capacity (veh/h)	829	915			1514	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	12	31	27
Volume Left	8	0	5
Volume Right	5	8	0
cSH	858	1700	1514
Volume to Capacity	0.01	0.02	0.00
Queue Length 95th (ft)	1	0	0
Control Delay (s)	9.3	0.0	1.2
Lane LOS	A		A
Approach Delay (s)	9.3	0.0	1.2
Approach LOS	A		

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	14.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	6	5	5	24	24	6
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	7	6	6	27	27	7
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	69	31	34			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	69	31	34			
tC, single (s)	6.9	6.8	4.2			
tC, 2 stage (s)						
tF (s)	4.0	3.8	2.3			
p0 queue free %	99	99	100			
cM capacity (veh/h)	816	910	1527			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	12	33	34
Volume Left	7	6	0
Volume Right	6	0	7
cSH	856	1527	1700
Volume to Capacity	0.01	0.00	0.02
Queue Length 95th (ft)	1	0	0
Control Delay (s)	9.3	1.3	0.0
Lane LOS	A	A	
Approach Delay (s)	9.3	1.3	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	15.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	4	7	7	4	7	7
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	5	8	8	5	8	8
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			12		29	9
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			12		29	9
tC, single (s)			4.6		7.3	7.1
tC, 2 stage (s)						
tF (s)			2.7		4.3	4.1
p0 queue free %			99		99	99
cM capacity (veh/h)			1321		803	873

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	12	12	16
Volume Left	0	8	8
Volume Right	8	0	8
cSH	1700	1321	837
Volume to Capacity	0.01	0.01	0.02
Queue Length 95th (ft)	0	0	1
Control Delay (s)	0.0	4.9	9.4
Lane LOS		A	A
Approach Delay (s)	0.0	4.9	9.4
Approach LOS			A

Intersection Summary			
Average Delay	5.2		
Intersection Capacity Utilization	16.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	8	5	23	8	5	23
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	9	6	26	9	6	26
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	68	31			35	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	68	31			35	
tC, single (s)	6.9	6.7			4.2	
tC, 2 stage (s)						
tF (s)	4.0	3.8			2.3	
p0 queue free %	99	99			100	
cM capacity (veh/h)	819	912			1502	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	15	35	32
Volume Left	9	0	6
Volume Right	6	9	0
cSH	853	1700	1502
Volume to Capacity	0.02	0.02	0.00
Queue Length 95th (ft)	1	0	0
Control Delay (s)	9.3	0.0	1.3
Lane LOS	A		A
Approach Delay (s)	9.3	0.0	1.3
Approach LOS	A		

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	15.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	7	6	6	27	27	7
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	8	7	7	31	31	8
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	79	35	39			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	79	35	39			
tC, single (s)	6.9	6.7	4.2			
tC, 2 stage (s)						
tF (s)	4.0	3.8	2.3			
p0 queue free %	99	99	100			
cM capacity (veh/h)	806	907	1509			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	15	38	39
Volume Left	8	7	0
Volume Right	7	0	8
cSH	850	1509	1700
Volume to Capacity	0.02	0.00	0.02
Queue Length 95th (ft)	1	0	0
Control Delay (s)	9.3	1.4	0.0
Lane LOS	A	A	
Approach Delay (s)	9.3	1.4	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	16.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	5	8	8	5	8	8
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	6	9	9	6	9	9
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			15		34	10
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			15		34	10
tC, single (s)			4.6		7.3	7.1
tC, 2 stage (s)						
tF (s)			2.7		4.3	4.1
p0 queue free %			99		99	99
cM capacity (veh/h)			1322		793	867

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	15	15	18
Volume Left	0	9	9
Volume Right	9	0	9
cSH	1700	1322	829
Volume to Capacity	0.01	0.01	0.02
Queue Length 95th (ft)	0	1	2
Control Delay (s)	0.0	4.8	9.4
Lane LOS		A	A
Approach Delay (s)	0.0	4.8	9.4
Approach LOS			A

Intersection Summary			
Average Delay	5.1		
Intersection Capacity Utilization	17.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	11	7	23	11	7	23
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	12	8	26	12	8	26
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	74	32			39	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	74	32			39	
tC, single (s)	7.0	6.8			4.3	
tC, 2 stage (s)						
tF (s)	4.0	3.8			2.4	
p0 queue free %	98	99			99	
cM capacity (veh/h)	797	895			1463	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	20	39	34
Volume Left	12	0	8
Volume Right	8	12	0
cSH	833	1700	1463
Volume to Capacity	0.02	0.02	0.01
Queue Length 95th (ft)	2	0	0
Control Delay (s)	9.4	0.0	1.8
Lane LOS	A		A
Approach Delay (s)	9.4	0.0	1.8
Approach LOS	A		

Intersection Summary			
Average Delay	2.7		
Intersection Capacity Utilization	17.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	9	9	9	27	27	9
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	10	10	10	31	31	10
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	87	36	41			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	87	36	41			
tC, single (s)	7.0	6.8	4.3			
tC, 2 stage (s)						
tF (s)	4.0	3.8	2.4			
p0 queue free %	99	99	99			
cM capacity (veh/h)	782	891	1477			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	20	41	41
Volume Left	10	10	0
Volume Right	10	0	10
cSH	833	1477	1700
Volume to Capacity	0.02	0.01	0.02
Queue Length 95th (ft)	2	1	0
Control Delay (s)	9.4	1.9	0.0
Lane LOS	A	A	
Approach Delay (s)	9.4	1.9	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	2.6		
Intersection Capacity Utilization	18.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	5	13	13	5	13	13
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	6	15	15	6	15	15
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			20		48	13
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			20		48	13
tC, single (s)			4.7		7.2	7.0
tC, 2 stage (s)						
tF (s)			2.7		4.3	4.1
p0 queue free %			99		98	98
cM capacity (veh/h)			1285		779	870

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	20	20	30
Volume Left	0	15	15
Volume Right	15	0	15
cSH	1700	1285	822
Volume to Capacity	0.01	0.01	0.04
Queue Length 95th (ft)	0	1	3
Control Delay (s)	0.0	5.7	9.5
Lane LOS		A	A
Approach Delay (s)	0.0	5.7	9.5
Approach LOS			A

Intersection Summary			
Average Delay	5.7		
Intersection Capacity Utilization	17.6%	ICU Level of Service	A
Analysis Period (min)	15		

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