DES Waste Management Division
29 Hazen Drive; PO Box 95
Concord, NH 03302-0095

Type I-B Modification for Stage V Construction Modifications and Stormwater Improvements & Type II Modification for Stage V Construction North Country Environmental Services Landfill

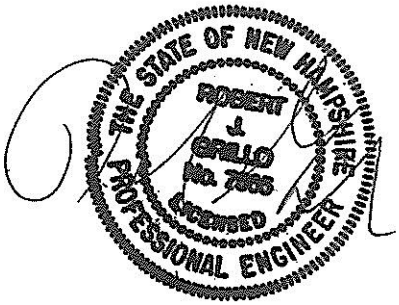
581 Trudeau Road
Bethlehem, NH 03574

NHDES Site #: 198704033
Project Type: SW-LNDFILL

Prepared For:
North Country Environmental Services
220 Avenue B
Williston, VT 05495
Phone Number (802) 651-5454
RP Contact Name: John Gay
RP Contact Email: john.gay@casella.com

Kate O'Shea

Digitally signed by Kate O'Shea
DN: cn=Kate O'Shea, o=CMA Engineers, Inc, ou, email=koshea@cmaengineers.com, c=US
Date: 2015.01.05 16:38:30 -05'00'



Prepared By:
CMA Engineers, Inc.
35 Bow Street
Portsmouth, NH 03801
Phone Number: (603) 431-6196
Contact Name: Robert J. Grillo, P.E.
Contact Email: rgrillo@cmaengineers.com

Date of Report: January 5, 2015

CMA
ENGINEERS, INC.
CIVIL/ENVIRONMENTAL
ENGINEERS

35 Bow Street
Portsmouth, New Hampshire
03801-3819

Phone: 603/431-6196

January 5, 2015

Mr. Paul M. Gildersleeve, P.E.
Solid Waste Management Bureau
New Hampshire Department of Environmental Services
29 Hazen Drive, P.O. Box 95
Concord, New Hampshire 03302-0095

RE: NCES – North Country Environmental Services, Trudeau Rd, Bethlehem, NH
Type I-B Modification for Stage V Construction Modifications and Stormwater Improvements and Type II Modification for Stage V Construction
DES-SW-SP-03-002, WMD Doc Log # 13337, 13390, 13419, 13423, 13477, 13883, 13995 and 14056
CMA #833-C

Dear Mr. Gildersleeve:

On behalf of North Country Environmental Services (NCES), CMA Engineers, Inc. is submitting the enclosed Type I-B Modification for Stage V Construction Modifications and Stormwater Improvements and Type II Modification for Stage V Construction. Please find enclosed one copy of the application for your review. The complete document has also been submitted electronically through the NHDES Onestop database.

This Type I-B permit modification is sought to modify Construction Drawings and Specifications previously approved by the Type I-A Permit Modification on August 15, 2014 for Stage V of the NCES Landfill. The modifications are primarily to the site stormwater system to the northwest of proposed Stage V.

Submitted with this application are revised Design Drawings, revised Closure Plan Drawings, a revised Stormwater Management Report and the project Contract Documents and Specifications. This permit modification application also includes a Type II Permit Modification to approve the Construction Drawings.

Two checks are enclosed to cover the applicable application fees. A check for $12,000 to cover the Type I-B Permit Modification application fee is based on the calculation provided in Env-Sw 310.08 for a lifespan index of 0.8 for between 5 and 10 years of life expectancy. A check for $100 is enclosed for the Type II Permit Modification application fee.

In accordance with Section IX of the Type I Permit Modification Application Form (Section Env-Sw 315.05(i) of the New Hampshire Code of Administrative Rules), complete copies of this application are being transmitted by certified mail to the Town of Bethlehem, the New Hampshire Department of Resources & Economic Development Natural Heritage Bureau and the New

Hampshire Fish and Game Department. Copies of the certified mail receipts will be forwarded to your attention when they return to our office.

If you have any questions, please do not hesitate to contact me at (207) 541-4223.

Very truly yours,
CMA ENGINEERS, INC.

Robert J. Grillo, P.E.
Project Manager

Adam J. Sandahl, P.E.
Project Engineer

RJG/AJS:ams

Enclosures

Solid Waste Management Facility Permit – Type I-B Modification for Stage V Construction Modifications and Stormwater Improvements and Type II Modification for Stage V Construction
NCES Stage V Landfill Expansion Construction Drawings (Full Size)
Type I-B Permit Modification Check ($12,000)
Type II Permit Modification Check ($100)

cc: NHDES Onestop
John Gay, NCES (w/enc)
Kevin Roy, NCES (w/enc)
Bryan Gould, Cleveland, Waters and Bass, P.A. (w/enc)

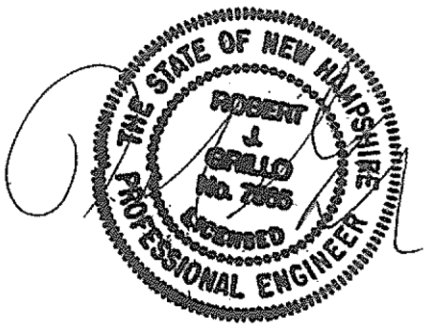
North Country Environmental Services, Inc.
Permit Number: DES-SW-SP-03-002

Solid Waste Management Facility Permit

Type I-B Modification for Stage V Construction Modifications and Stormwater Improvements And Type II Modification for Stage V Construction

Applications to NH Department of Environmental Services:
Type I-B and Type II Modifications to Solid Waste Management Facility Permit

January 2015



Submitted by:

North Country Environmental Services, Inc.
Bethlehem, New Hampshire

Prepared by: CMA Engineers, Inc.

Civil and Environmental Engineers
35 Bow Street
Portsmouth, New Hampshire 03801

North Country Environmental Services, Inc.
Stage V Modifications, Stormwater Improvements and Construction
Type I-B and Type II Permit Modifications

Bethlehem, New Hampshire
January 2015

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Type I-B and Type II Modifications to Solid Waste Management Facility Permit

Check ($100)

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Part IV - Revised Closure Plan Drawings Sheets C2 and C3 (Full Size Bound Separately)

Part V – Stormwater Report

Part VI – Contract Documents and Technical Specifications

Part I

TYPE I-B PERMIT MODIFICATION APPLICATION FORM

INSTRUCTIONS
for obtaining a

Type I Modification To Solid Waste Management Facility Permit

pursuant to
RSA 149-M and New Hampshire Administrative Solid Waste Rule Env-Sw 315

Read these instructions before completing the attached form. For additional assistance contact the NH Department of Environmental Services (DES), Permitting & Design Review Section (P&DRS) at (603) 271-2925 or the below noted mailing address or TDD Access: Relay NH 1-800-735-2964.

Note: All references on this form beginning with "Env-Sw" are citations from the New Hampshire Solid Waste Rules. To obtain a copy of the Rules, contact the DES Public Information & Permitting Office at (603) 271-2975 or above noted TDD Access. The Rules are also available on the Internet at http:\\www.des.nh.gov/rules .

Complete the attached form to obtain either a "type I-A" or "type I-B" permit modification pursuant to Env-Sw 315.02(b) or (c), respectively. **Before completing the form, be certain the proposed facility modification falls within the definition of either a type I-A or type I-B modification.** [If unfamiliar with how to make this determination, refer to the worksheet on the reverse side of this instruction sheet and/or contact the P&DRS for assistance.]

All requested information must be provided as specified. Do **NOT** skip any question, unless instructed to do so. Do **NOT** mark any question "not applicable." If you need more room than provided on the form to answer a particular question and are using a paper copy of the form, attach additional pages as necessary; mark each page clearly to show both the applicant name and the question being answered; and indicate on the form that the additional pages are attached.

Submit **THREE** copies of the completed form, **EACH bearing ORIGINAL signatures**. Applications may be submitted to the department electronically. If an applicant chooses to submit an application electronically, a single paper copy of the application shall also be submitted to the department to the following address:

NH Department of Environmental Services (DES)
Waste Management Division (WMD)
Permitting & Design Review Section (P&DRS)
29 Hazen Drive, PO Box 95
Concord, NH 03302-0095

Include the required fee, as determined from the following table. Make checks or money orders payable to "TREASURER, State of New Hampshire":

Type I-A Modification, without a capacity increase	**$1500**
Type I-A Modification, with a capacity increase	**See Env-Sw 310.07(a)(2) for formula to calculate or contact the P&DRS for assistance, at (603) 271-2925**
Type I-B Modification	**$100**

Your application will be processed by DES in accordance with Env-Sw 304 and Env-Sw 305. If your application is correctly filed (i.e., you submit the right number of copies, each with original signatures, and the required fee), your application will be accepted for processing. Within 60 days of receipt, and earlier whenever possible, you will be notified whether the application is complete (i.e., whether the application provides all information required to support a full technical review and determine whether the proposed modification meets all requirements of the Rules). If incomplete, you will be given instructions for correcting the deficiencies. If complete, you will be notified in writing and the agency will undertake a technical review of the application to determine whether the proposal meets all requirements of the Rules. In addition, for certain type I-A modifications, the agency must also hold a public hearing within the host municipality during the technical review process. Following the close of the technical review process and the hearing, if held, DES will make a final decision to issue or deny the requested modification. You will be notified in writing, as will the host municipality and host solid waste management district.

WORKSHEET FOR DETERMINING MODIFICATION TYPE

STEP 1: In order to correctly use and complete the attached application form, you must first confirm that your proposed facility modification is a "type I" modification (as opposed to being either a "type II" through "type V" modification). If your response to each of the following questions is "FALSE," your proposed facility modification most likely falls within the scope of a "type I" modification:

☐ **True** ☒ **False** The proposed change is required by a condition of my permit which requires me to submit final plans for DES approval based on preliminary plans provided to DES on an earlier date. (Note: If this statement is "TRUE," your proposed modification is most likely a "type II" modification and you need to file your application by completing a "Type II Permit Modification Application Form.")

☐ **True** ☒ **False** The proposed change is one of the following **AND** I am able to certify compliance with each of the statements provided in Section X of this application form:

_ A change in facility operating hours between the hours of 6 AM and 6 PM or within alternative limits specified in my permit, or for a private facility managing only on-site generated waste, within limits allowed by local ordinance.

_ A change in a key above-ground site feature, for instance a facility structure or appurtenance, which will not alter the permitted function(s) of the facility, change the basis of the approved facility design or violate any applicable siting criteria specified in the Rules, and which is merely a change to improve facility operations within the limits specified in my permit.

_ For a facility permitted to collect recyclable materials, a change in the type of select recyclable materials (paper, cardboard, glass, plastic, metal or textiles) to be collected which does not increase the facility's approved storage capacity or require a change in the approved financial assurance plan of record for the facility.

_ For landfills, a change in the type of cover material to be used at the facility, pursuant to Env-Sw 806.03.

_ A name change for the permittee or facility that does not constitute a change in ownership or operational control of the facility.

_ A change in organizational structure, including a change in the individuals/entities holding 10% or more of the permittee's equity or debt and/or a change in officers, directors, partners or key employees, that does not constitute a change in ownership or operational control of the facility.

(Note: If you respond "TRUE" to the above statement, your proposed modification is most likely a "type III" modification and you need to file your application by completing a "Type III Permit Modification Application Form.")

☐ **True** ☒ **False** The proposed change is to transfer my permit or otherwise authorize a change in the ownership or operational control of the facility. (Note: If you respond "TRUE" to this statement, your proposed modification is most likely a "type IV" modification and you need to file your application by completing a "Type IV Permit Modification Application Form.")

☐ **True** ☒ **False** The proposed change is to authorize the destruction or relocation of facility records. (Note: If you respond "TRUE" to this statement, your proposed modification is most likely a "type V" modification and you need to file your application by completing a "Type V Permit Modification Application Form.")

STEP 2: If your response to each of the above is “FALSE,” you may assume that the proposed modification is a type I modification. You must now determine whether the proposed change is a “type I-A” or “type I-B” modification, as defined by Env-Sw 315.02(b) or (c).

A "type I-A" modification is one that will change facility operations in a manner having the potential to adversely affect the state's ability to establish and maintain an integrated system of facilities which: (1) will assist in achieving the waste reduction/recycling goals in RSA 149-M:2; (2) is consistent with the hierarchy in RSA 149-M:3; and (3) will provide a substantial public benefit pursuant to RSA 149-M:11. Therefore, if any of the following statements are TRUE relative to the change you are proposing at your facility, the change falls within the definition of a "type I-A" modification.

☐ **True** ☒ **False** The proposed modification will increase the approved design capacity of the facility.

☐ **True** ☒ **False** The proposed modification will extend the expiration date of the permit.

☐ **True** ☒ **False** The proposed modification will reduce the operating life expectancy of a NH landfill without a comparable reduction in the permitted capacity of the landfill, as by directly or indirectly increasing the quantity of waste which will be received daily at a New Hampshire landfill.

☐ **True** ☒ **False** The proposed modification will expand the permitted service area of the subject facility.

☐ **True** ☒ **False** The proposed modification will change the subject facility service type from a "limited service" area facility (one which can accept waste from only certain sources specified in the permit) to an "unlimited service" area facility (one which can accept waste from any source).

☐ **True** ☒ **False** The proposed modification will change facility operations to include a waste management method less preferred in the RSA 149-M:3 hierarchy. The methods, in order of descending preference as specified in RSA 149-M:3 are: source reduction; recycling and reuse; composting; waste-to-energy technologies (including incineration); incineration without resource recovery; and landfilling.

If you answer "FALSE" to each of the above statements, your proposed modification is most likely a "type I-B" modification, i.e., a modification which is unlikely to have an adverse effect on the state's ability to establish and maintain an integrated system of facilities which (1) will assist in achieving the waste reduction/recycling goals in RSA 149-M:2; (2) is consistent with the hierarchy in RSA 149-M:3; and (3) provides a substantial public benefit pursuant to RSA 149-M:11.

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Waste Management Division

For Office Use Only:
WMD Log #:_____
Date Rec'd.:_____
No. of Copies:_____
Fee: $_____/Check #_____

APPLICATION FORM FOR

TYPE I MODIFICATION TO SOLID WASTE MANAGEMENT FACILITY PERMIT

pursuant to
RSA 149-M and New Hampshire Administrative Solid Waste Rule Env-Sw 315

SECTION I. FACILITY IDENTIFICATION

(1)	Facility name: North Country Environmental Services, Inc.
(2)	Functional classification: ☐ collection/storage/transfer ☐ processing/treatment ☒ landfill
(3)	Mailing address: 581 Trudeau Road, Bethlehem, New Hampshire 03574
(4)	Permit number: DES-SW-SP-03-002
(5)	Location, by street address and municipality: 581 Trudeau Road, Bethlehem, NH 03574

SECTION II. PERMITTEE IDENTIFICATION

(1)	Permittee/applicant name: North Country Environmental Services, Inc.			
(2)	Mailing address: 220 Avenue B, Williston, VT 05495			
(3)	Telephone number: (802) 651-5454			
(4)	If different than above, identify the individual associated with and designated by the permittee/applicant to be the contact individual for matters concerning this application:			
	(a)	Name: John Gay	(b)	Title: Engineering Manager
	(c)	Mailing address: 220 Avenue B, Williston, VT 05495		
	(d)	Telephone number: (802) 651-5454	(e)	E-Mail: John.Gay@casella.com

SECTION III. DESCRIPTION OF PROPOSED MODIFICATION

Describe the proposed modification by answering each of the following questions. Use additional paper as necessary.

(1) Provide a **BRIEF** description of the proposed modification. [Check box if response is provided on separate paper ☒]

(2) Identify whether the proposed modification is a "type I-A" or "type I-B" modification. (If uncertain, use the worksheet provided with the instructions for this form): ☐ Type I-A ☒ Type I-B

(3) Identify, either below or on separate paper, each written permit condition that will require amendment to effect the proposed modification and provide draft language for the same. [Check box if response is provided on separate paper ☐]

The proposed modification revises the Type I-A Permit Modification for the Stage V approved construction drawings, Closure Plan Drawings, specifications and Stormwater Management Report.

(4) Identify, below, each "last approved plan of record" identified in the permit which will be affected by the proposed modification and will therefore require amendment/revision:

Check here if affected	TYPE OF PLAN	DES APPROVAL DATE	WMD LOG # (Find this number on your copy of the approval)
☒	Facility design plans/specifications	August 15, 2014	13337, 13390, 13419, 13423, 13477, 13883, 13995, 14056
☐	Facility operating plan		
☒	Facility closure plan	August 15, 2014	13337, 13390, 13419, 13423, 13477, 13883, 13995, 14056
☐	Facility financial assurance plan		
☐	Other plan (specify):		

(5)	Submit, on separate paper, the proposed amendments/revisions for each document identified pursuant to (4) above, based on the below listed instructions. (Note: The revisions may be presented in the form of replacement pages ready for substitution into the last approved plan of record, each page being clearly marked to show the date of revision. In the event there is no last approved plan of record for any of the following, you must prepare and submit a full plan, including the proposed modification(s), in accordance with the applicable cited Rules.)	
	☒	Facility design plans must be prepared in accordance with Env-Sw 1103.05.
	☐	Facility operating plans must be prepared in accordance with Env-Sw 1105.11.
	☒	Facility closure plans must be prepared in accordance with Env-Sw 1106.04.
	☐	Financial assurance plans must be prepared as specified in Env-Sw 1400 and must include all related draft financial assurance documents required to effect the proposed modification.
(6)	In order for DES to approve the proposed modification, the agency must be able to conclude from the information provided in this application that the proposed modification meets all applicable requirements of the Rules. Therefore, for any aspect of the proposed modification where it may not be self-evident that the proposed change meets all applicable requirements of the Rules, you should explicitly provide such information. Provide your response below and/or use separate paper as necessary. (Check box if response is attached on separate paper ☐)	
	The information provided in this application meets applicable requirements of the Rules.	

SECTION IV. SCHEDULE

Provide a proposed schedule for implementing the modification. Use separate paper if necessary. (Check box if response is attached on separate paper ☐)

Pending approval, the proposed modification will be implemented in spring 2015 and completed in 2016.

SECTION V. STATEMENT OF NEED

Provide a statement of need describing why the proposed change is necessary or desirable. Use separate paper if necessary. (Check box if response is attached on separate paper ☐)

The proposed stormwater modifications will improve site stormwater management by more evenly distrbuting stormwater flow between Detention Pond 4 and the western ponds and also reducing the reach of existing perimeter swales and intermediate draiange benches. Other changes to the plans include clarifiactions and minor modifications as described in Section III of this Application.

SECTION VI. IMPACT EVALUATION

On separate paper, identify all impacts, both positive and adverse, which the proposed modification will have, including each of the below listed considerations.

(1) The effect the modification will have on facility function, capacity, life expectancy, service type and service area.

(2) The effect the modification will have on the environment, public health and safety.

(3) The effect the modification will have on the state's ability to achieve the goals and objectives specified in RSA 149-M:2, namely achieving a 40% minimum weight reduction in the solid waste stream on a per capita basis by the year 2000 and avoiding the disposal of recyclable materials in a lined landfill with a leachate collection system.

(4) The effect the modification will have on establishing and maintaining integrated waste management systems consistent with the hierarchy of waste management methods in RSA 149-M:3 [the methods, in descending order of preference as specified in RSA 149-M:3, are: source reduction; recycling and reusing; composting; waste-to-energy technologies (including incineration), incineration without resource recovery; and landfilling].

(5) Consistency with the state solid waste management plan and the applicable district plan, pursuant to RSA 149-M:12,I(b). If necessary, contact the P&DRS at (603) 271-2925 for plan information.

SECTION VII. PUBLIC BENEFIT DEMONSTRATION

Provide a "demonstration of public benefit" based on the below listed instructions. Check which one of the listed instructions applies to your particular application.

☐	**For a type I-A modification of a standard permit**, provide a "demonstration of public benefit" in accordance with RSA 149-M:11 and in conformance with the provisions of Env-Sw 1005.05. Prepare and submit the demonstration on separate paper.
☐	**For a type I-A modification of an emergency permit or a research and development permit, or a permit-by-notification**, there is a presumption of public benefit, provided that the proposed modification meets all requirements of the Rules. Therefore, you may skip this section and go to Section VIII.
☒	**For a type I-B modification**, there is a presumption of public benefit, provided that the proposed modification meets all requirements of the Rules. Therefore, you may skip this section and go to Section VIII.

SECTION VIII. OTHER PERMITS

Complete the following table to identify and provide the status of all other permits or approvals necessary to effect the proposed modification.

Type of Permit/Approval Required	Date the Application was/will be Submitted	Status/Comments
NHDES Type II Permit Modification	Concurrent with the DES Type I-B Permit Application	
NHDES Alteration of Terrain	Pending NHDES Type II Permit Modification Approval	

SECTION IX. LEGAL NOTICES

Submit proof of having provided certain legal notifications and filings, as follows:

(1) You must send by certified mail, or deliver in hand, a complete copy of this application to the host municipality, host solid waste management district and other affected entities, with a "notice of filing," as specified by Env-Sw 303.

(2) For a type I-A modification, you must send by certified mail, or deliver in hand, a "notice of filing" to each owner of property abutting the facility site, as specified by Env-Sw 303. If the applicant/permittee or the owner of the facility site owns any abutting parcel of land, the "notice of filing" must be sent to the owner(s) of the next parcel(s) not owned by the permittee/applicant or facility site owner.

(3) You must also provide a "notice of filing" to the New Hampshire Department of Justice/Office of the Attorney General (NH DoJ/AGO) if, pursuant to Section X(2) of this form, you are required to submit business and personal disclosure information.

(4) You must attach to this application "proof" that notification has been provided as required by (1) through (3) above. Therefore, attach a copy of the notice(s) of filing and the signature(s) of all required recipients, acknowledging receipt.

SECTION X. CERTIFICATION OF COMPLIANCE/COMPLIANCE REPORT

All applications for permit modification must be submitted with either certification of compliance or a compliance report, as follows:

(1) If you are ABLE to certify that each of the statements numbered (1) - (8) below are true, do so by your signature.

(2) If you are UNABLE to certify that each of the statements numbered (1) - (8) below are true, you must:

- ❒ Prepare and submit a separate Compliance Report as specified by Env-Sw 303.15; and
- ❒ If the proposed modification involves a change in organizational structure, or a change in individuals/entities holding 10% or more of the permittee's debt or equity, or a change in officers, directors, partners or key employees, none of which constitutes a change in operational control of the facility or a change in ownership per Env-Sw 315.02(f), also submit completed "business and personal disclosure forms" for each non-compliant individual and entity involved in the change. Obtain the required forms from the P&DRS at (603) 271-2925. Submit the completed forms, with the notice of filing referenced by Section IX(3) of this form and a copy of the Compliance Report, direct to the New Hampshire Department of Justice/Office of Attorney General, Environmental Protection Bureau, 33 Capitol Street, Concord, NH 03301-6397. [Note: Copies of the completed disclosure forms should NOT be attached to this application when it is submitted to DES or to the host municipality, host solid waste management district and other effected entities, pursuant to Section IX(1) above. Only the NH DoJ/AGO should receive copies of the disclosure forms].

COMPLIANCE STATEMENT

The applicant shall certify that each of the statements listed in (1)-(8) below are true for each of the following individuals and entities:

- ☒ **The applicant, and**
- ☒ **The facility owner, and**
- ☒ **The facility operator, and**
- ☒ **All individuals and entities holding 10% or more of the applicant's debt or equity, and**
- ☒ **All of the applicant's officers, directors, and partners, and**
- ☒ **All individuals and entities having managerial, supervisory or substantial decision making authority and responsibility for the management of the facility operations or the activity(s) for which approval is being sought.**

(1)	No individual or entity listed above has been convicted of or plead guilty or no contest to a felony in any state or federal court during the 5 years before the date of the application.
(2)	No individual or entity listed above has been convicted of or plead guilty or no contest to a misdemeanor for a violation of environmental statutes or rules in any state or federal court during the 5 years before the date of the application.
(3)	No individual or entity listed above has owned or operated any hazardous or solid waste facility which has been the subject of an administrative or judicial enforcement action for a violation of environmental statutes or rules during the 5 years before the date of the application.

(4)	No individual or entity listed above has been the subject of any administrative or judicial enforcement action for a violation of environmental statutes and rules during the 5 years before the date of the application;	
(5)	All hazardous and solid waste facilities owned or operated in New Hampshire by any individual or entity listed above are in compliance with either.	
	(a)	All applicable environmental statutes, rules, and DES permit requirements; or
	(b)	A DES approved schedule for achieving compliance therewith.
(6)	All individuals and entities listed above are in compliance with all civil and criminal penalty provisions of any outstanding consent agreement, settlement, or court order to which DES is a party.	
(7)	All individuals and entities listed above have paid, or are in compliance with the payment schedule for any administrative fine assessed by DES.	
(8)	All individuals and entities listed above are in compliance with all terms and conditions under every administrative order, court order or settlement agreement relating to programs implemented by DES.	

Signature of the permittee/applicant certifying the above statements are true:

Permittee/Applicant Name **(Print Clearly or Type)** JOHN GAY

Permittee/Applicant Signature J. Gay

Date 12/18/14

SECTION XI. PERMITTEE/APPLICANT SIGNATURE REQUIREMENTS

The permittee/applicant must sign the following statement prior to submitting this application. All copies of the application filed with DES must bear the permittee's/applicant's ORIGINAL signature. If the permittee/applicant is not an individual, an individual duly authorized by the permittee/applicant shall sign the application.

To the best of my knowledge and belief, the information and material submitted herewith is correct and complete. I understand that any approval granted by DES based on false and/or incomplete information shall be subject to revocation or suspension, and that administrative, civil or criminal penalties may also apply. I certify that this application is submitted on a complete and accurate form, as provided by DES, without alteration of the text.

Permittee/Applicant Name **(Print Clearly or Type)** JOHN GAY

Permittee/Applicant Signature J. Gay

Date 12/18/14

SECTION XII. PROPERTY OWNER SIGNATURE

If the permittee and property owner are not the same, the property owner must also sign this form as follows. All copies of the application filed with DES must bear the property owner's ORIGINAL signature. If the property owner is not an individual, an individual duly authorized by the property owner shall sign the application.

(1)	I hereby affirm that the permittee/applicant has the legal right to occupy and use the property on which the subject facility is or will be located for the purposes specified in this application.
(2)	I hereby affirm that I shall grant access to the property for closure and post-closure monitoring of the subject facility and site as required by RSA 149-M and the New Hampshire Solid Waste Rules (Env-Sw 100 - 300 and Env-Sw 400 - 2000), as amended.

Property Owner Name **(Print Clearly or Type)** _____

Property Owner Signature _____

Date _____

Section III (1). Brief Description of Proposed Modification

This Type I-B permit modification is sought to modify Construction Drawings and Specifications previously approved by the Type I-A Permit Modification on August 15, 2014 for Stage V of the North Country Environmental Services (NCES) Landfill. This permit modification application also includes a Type II Permit Modification to approve the Construction Drawings.

The modifications are primarily to the site stormwater system to the northwest of proposed Stage V. Submitted with this application are revised Design Drawings, revised Closure Plan Drawings, a revised Stormwater Management Report and the project Contract Documents and Specifications. A summary describing each of the revisions is presented below:

Stormwater Improvements

NCES is proposing stormwater modifications from what was approved by the NHDES in August, including construction of an additional detention pond (Proposed Detention Pond No. 6), expansion of the detention pond previously identified as Detention Pond 6 to include the limits of existing Detention Pond No. 5 (now identified as Proposed Detention Pond No. 5), and eliminating a proposed modification of Pond 4. These modifications are made in part to reduce stormwater flow to Detention Pond No. 4, so that the reach of perimeter and intermediate bench swales is shortened and stormwater flows are more spacially balanced and distributed. The proposed ponds, are located to the west of proposed Stage V.

NCES intends to divert stormwater away from Detention Pond No. 4 by grading intermediate drainage benches to drain to a plunge pool at the southwest corner of the landfill. The plunge pool combines with flow from the southern toe swale and outlets to the western toe swale draining to proposed Detention Pond No. 6. Under this configuration, approximately ½ of the closed landfill will drain to Detention Pond No. 4 and the other half will drain to the new Detention Ponds 5 and 6. The base of the western toe swale is being widened from 2 feet to 3.5 feet to accommodate the additional flow.

The new stormwater ponds are also designed to accommodate possible additional flow generated by future low-emissions tarping, if installed, as depicted on the fill sequence plans submitted as

part of the Stage V permit application. Under the configurations submitted, there would be a maximum of 20 acres of the landfill surface covered by the tarp at any point in time. Installation of low-emissions tarp would require a Type I-B Permit Modification application submission to the NHDES. The tarp would likely be constructed with 30-mil HDPE or LLDPE.

Stormwater will flow from Pond 6 flows to Pond 5 via a 36" HDPE culvert. In addition to the Pond 6 flow, Detention Pond No. 5 accepts stormwater flow from the Stage V perimeter gravel access road and flow from portions of the final Stage V closure surface. Detention Pond 5 outlets through an outlet structure that drains to the existing stormwater treatment swale. The length of the treatment swale has been reduced from 624 to 490 feet by the construction of Detention Pond No. 6. At the reduced length, the stormwater treatment swale will continue to provide adequate treatment. Both Detention Ponds 5 and 6 are equipped with a sedimentation forebay.

With these improvements, the expansion of Detention Pond 4 will not be necessary. The Pond 4 expansion was approved as part of the Type I-A Permit Modification.

Sheet C2 of the Closure Plan drawing set has been updated to depict the revised stormwater improvements including the new stormwater ponds and stormwater swale configuration. Additionally, Detail 1 on Sheet C3 has been modified to depict the 40-mil LLDPE swale liner being installed and extrusion welded to the cap at the time of closure. Previous plans had depicted the swale liner being installed with the swale during landfill cell construction and tying into the cap at the time of closure. Full and reduced size Sheets C2 and C3 are included with this application in Part IV.

A copy of the revised stormwater calculations are included with this application in Part V.

Detention Pond Outlet Structure Modification

The outlet structure for Detention Pond No. 5 is designed with a replaceable orifice plate in the event NCES places low-emissions tarp on the landfill surface. The plate to be installed during Stage V construction would restrict peak off-site flow during heavy rain events, i.e. greater than the 10-year storm. The replacement orifice plate would restrict the increased peak off-site flow

with the low emissions tarp in place, particularly for the two-year storm event. The approved outlet structure had an orifice weir cast into the structure.

The outlet structure outlet pipe has also been increased from a 15" diameter to 30" diameter. The structure itself has been increased from a 3' x 3' concrete structure to a 5' x 5' structure.

Reconfiguration of Stormwater Swales and Culverts

The stormwater swales and culvert configuration has been modified to remove the existing culverts and drain manhole that conveyed stormwater from the western toe swale (abutting Stage IV Phase II) to the Stage V toe swale. Stormwater will now outlet from the western toe swale to Proposed Detention Pond 6 through a 36" reinforced concrete pipe (RCP).

Additionally, the cross culvert under the Stage V gravel access road draining to Detention Pond No. 5 has been increased from 15" to 18".

Landfill Gas System Improvements

NCES will include landfill gas improvements in the project including expansion of the 14" HDPE perimeter gas header around the perimeter of proposed Stage V. The plans also depict an additional 10" gas header loop that ties into an existing gas header over Stage IV Phase I. This loop is being installed to improve vacuum on the north side of the landfill and is not directly related to the construction of Stage V. The condensate trap for this loop will initially be tied into the Stage IV Phase I primary leachate cleanout. The drain will be relocated to the Stage V primary leachate pipe upon construction.

Drawing Sheet Changes

Landfill cross sections, previously depicted on Sheets 8 and 9 have been consolidated to Sheet. 10. The cross sections have been truncated so that they depict primarily the Stage V construction area. *The Sheet 3 – Proposed Overall Site Plan* section lines have been updated to reflect the current cross sections.

Two new sheets have been added to the construction drawing set. *Sheet 5 – 2015 Work Plan* depicts construction to be performed in 2015 (NCES is planning for a two-year construction schedule) and *Sheet 9 – Erosion Control and Site Layout Plan*.

Other Minor Changes

1. The construction plan set has been revised to include updated topography of the landfill surface from aerial photogrammetry performed by Eastern Topographics of Wolfeboro, NH on August 19, 2014. The plans have been updated to show the limits of gravel roads on the landfill surface on that date.

2. Property line bearings and distances have been added to *Sheet 2 - Existing Conditions & Overall Site Plan*.

3. A proposed construction sequence has been added to *Sheet 3 – Proposed Overall Site Plan*. NCES intends to construct Stage V in two phases under one contract. The proposed construction sequence describes work to be completed during the 2015 and 2016 construction seasons.

4. *Sheet 4 – Existing Conditions, Waste Excavation & Demolition Plan* has been updated to remove demolition of the existing flare station which was completed separately in 2013/2014 and is no longer part of this project. The plan has been updated to depict remaining items to be demolished in 2015/2016. The plan has also been updated to depict the Stage IV Phase I LFG header loop including a detail of the loop's condensate trap. Additionally, the plan is modified to depict locations where the existing leachate forcemain will need to be relocated for Stage V construction.

5. Additional notes have been added to *Sheet 6 – Proposed Secondary Liner Grading Plan* to detail the construction sequence of the liner connection of Stage V to Stage IV.

6. *Sheet 7 - Proposed Primary Drainage Stone Grading Plan* has been modified to depict the location of the new 14" HDPE perimeter gas header and details for condensate traps, valves and vertical gas risers.

7. The Stage IV cleanout pipes located over the Stage IV Phase II-B anchor trench will be extended west and exit near Pump Station I (Stage IV Phase II Pump Station). This modification is shown on Sheets 6 and 7 and Sheet 11, Detail 12.

8. The location of the Stage I Overlay Liner leachate piping, installed in the fall of 2014, has been added to the plans. The cleanout pipe for the overlay liner is located near the Stage IV Phase IIB leachate cleanout pipes and will be extended with the other Stage IV Phase II

cleanout pipes to the west side of Stage V near Pump Station I.

9. The 12" gravel layer over the primary leachate piping has been removed. This layer is typically utilized as a filter layer between the ¾" stone around the pipe and primary drainage sand. Since the Stage V design utilizes 18" of 1.5" stone in place of the primary drainage sand, the filter layer is not necessary. The gravel layer was previously depicted on Sheet 11, Detail 11.

10. The landfill details had indicated either 18" of 1.5" Crushed Stone or 18" of 4" Washed Bank Run Stone. NCES is currently processing 1.5" stone on site for use in Stage V construction. References to 4" Washed Bank Run Stone have been removed from the details.

11. The 60-mil HDPE secondary liner rub sheet in the sump has been removed, previously depicted on Sheet 12, Detail 14. GCL will be placed directly over the 12" screened till layer.

12. Cross-pitch of the gravel landfill access road is increased from 2 to 3% to improve roadway drainage.

13. A cleanout has been added to the Stage V primary leachate pipe at the tie in to Stage IV Phase I. The modification is depicted on Sheet 12, Detail 15 and show in plan view on Sheet 7.

14. The discharge location of the Stage V Secondary Leachate forcemain in the Stage IV Phase I pump station has been revised (Sheet 13, Detail 19). The forcemain now discharges to the Stage IV Phase I primary leachate cleanout riser. The detail has also been amended to provide for a sample port and a cleanout. A separate line for the sump pump is being tied into the cleanout.

15. The Stage V Secondary Pump Station Manhole, detailed on Sheet 13, Detail 16 had been modified to provide access through the side of the structure as opposed to through the top. The modification will allow easier and direct access to the Stage V secondary cleanout through the hatch opening.

16. Several details have been modified to indicate a minimum of 18" of stone be installed over primary leachate pipes and the 14" HDPE gas header pipe including:

    a. Sheet 11, Details 10 and 13
    b. Sheet 12, Detail 14
    c. Sheet 14, Detail 22

17. Drainage geocomposite over the primary stone in the sump area (Detail 15 on Sheet 12) has been removed. This was a remnant of when the original landfill design included primary drainage sand with stone only in the sump area. This drainage geocomposite was intended to act as a buffer between the sand and stone.

18. The Interim Stormwater Management Detail (Sheet 16, Detail 37) has been revised to show locations for the primary and secondary stormwater containment walls for clarity.

19. Drainage geocomposite has been removed from the Temporary Gas Collection Tarp details. The Temporary Gas Collection Tarp will only consist of 30-mil HDPE, similar to the Stage IV Phase IIB tarp constructed in 2013.

20. Stone outlet protection is added to all proposed culvert outlets.

21. The Closure Plan drawings have been updated to depict the revised stormwater detention ponds, swale configuration and dropchute. The Closure Plan detail 1 on Sheet C3 has been modified to show the toe swale liner being installed at the time of closure instead of during Stage V construction.

Section VI – Impact Evaluation

Per the Type I Permit Modification form, the following responses are given to the five enumerated considerations.

(1) The effect the modification will have on facility function, capacity, life expectancy, service type, and service area.

The modification request proposes no change to the facility function, service type, and service area.

(2) The effect the modification will have on the environment, public health, and public safety.

The proposed modification will improve stormwater management at the site as stormwater flow will be more evenly distributed between the on-site stormwater ponds. Additionally, the reach of the existing perimeter swales and intermediate drainage benches will be reduced. Other minor modifications described above provide similar or additional environmental protection.

(3) The effect the modification will have on the state's ability to achieve the goals and objectives specified in RSA 149-M:2, namely achieving a 40% minimum weight reduction in the solid waste stream on a per capita basis by the year 2000 and avoiding the disposal of recyclable materials in a lined landfill with a leachate collection system.

The proposed modification will not affect the state's ability to achieve the goals and objectives specified in RSA 149-M:2.

(4) The effect the modification will have on establishing and maintaining integrated waste management systems consistent with the hierarchy of waste management methods in RSA 149:M (the methods, in descending order of preference as specified in RSA 149-M:3, are: source reduction; recycling and reusing; composting; waste-to-energy (including incineration), incineration without energy recovery; and landfilling.

The proposed modification does not impact establishing and maintaining integrated waste management systems consistent with the hierarchy of waste management methods in RSA 149:M.

(5) Consistency with the state solid waste management plan and the applicable district plan, pursuant to RSA 149-M12 I(b).

The proposed modification does not impact the state solid waste management plan and the applicable district plan, pursuant to RSA 149-M12 I(b).

SECTION IX. Legal Notices

Legal Notifications and Filings

Name	Address	City	State	Zip
Town of Bethlehem, NH	2511 Main Street	Bethlehem	NH	03574
NH Fish and Game Department	11 Hazen Drive	Concord	NH	03301
NH Department of Resources and Economic Development	172 Pembroke Rd.	Concord	NH	03302

Note that there is no Solid Waste Management District for Bethlehem; therefore, notification cannot be provided to a chairman.

CMA ENGINEERS, INC.
CIVIL/ENVIRONMENTAL ENGINEERS

35 Bow Street
Portsmouth, New Hampshire
03801-3819

Phone: 603/431-6196
Fax: 603/431-5376

E-mail: info@cmaengineers.com
Web Site: www.cmaengineers.com

January 5, 2015

Town Clerk
Board of Selectmen
Town of Bethlehem, NH
2155 Main Street
Bethlehem, NH 03574

VIA CERTIFIED MAIL RETURN RECEIPT REQUESTED

RE: North Country Environmental Services, Inc. Stage V Landfill (DES-SW-SP-03-002)
New Hampshire Department of Environmental Services
Waste Management Division, Permitting & Design Review Section
Type I-B Permit Modification
CMA #833-C

Dear Town Clerk and Board of Selectmen,

Pursuant to RSA 149-M and the New Hampshire Solid Waste Rules, you are hereby notified that North Country Environmental Services, Inc., (NCES) will be filing an application with the New Hampshire Department of Environmental Services (NHDES) for a Type I-B Permit Modification to the Standard Facility Permit on or about January 5, 2015 for its landfill located at 581 Trudeau Road in Bethlehem, NH. A copy of the complete application is enclosed.

The application, if approved, would allow for the construction of stormwater improvements at the site including a new stormwater detention pond and expansion of an existing pond. These improvements are in addition to what was approved by the NHDES for Stage V in August, 2014. These improvements are made in part to more evenly distribute stormwater flow between on-site detention ponds. Additionally, the reach of perimeter and intermediate bench swales will be shortened and stormwater flows will be more spacially balanced and distributed. The proposed ponds, are located to the west of proposed Stage V. NCES has also included upgrades to the site's landfill gas system to the permit modification including expansion of existing landfill gas piping around the perimeter of Stage V. Other modifications to the construction drawings include minor design changes, construction level notes and details beyond what is required by the NHDES. This work will be constructed concurrently with the Stage V expansion project, which is anticipated to begin in the spring of 2015 and end in 2016.

For additional information regarding these applications you may contact me at CMA Engineers, Inc., 35 Bow Street, Portsmouth, NH 03801, (603) 431-6196.

The permit applicant, facility owner, facility operator and property owner is NCES. NCES's mailing address is P.O. Box 9, Bethlehem, NH 03574. You may also direct inquiries about the applications to Mr. John Gay, Engineering Manager, 220 Avenue B, Williston, VT 05495. You can also contact Mr. Gay at 802-651-5454 or John.Gay@casella.com.

In accordance with Section Env-Sw 303 of the New Hampshire Solid Waste Rules, a copy of the complete application is available for review at the offices of the Town of Bethlehem at 2511 Main

Street, at the NHDES located at 29 Hazen Drive, Concord, NH and at NCES's offices at 581 Trudeau Road, Bethlehem, NH 03574 during normal business hours. The New Hampshire Solid Waste Rules have specific procedures for the review and issuance or denial of applications such as NCES is filing. The procedures involve a series of steps, which are substantively identical to those depicted on the enclosed flow chart for a standard permit application.

If you have any questions regarding the permit application review process, or wish to comment on the subject application, please contact Mr. Wayne Wheeler at NHDES-Waste Management Division, 29 Hazen Drive, P.O. Box 95, Concord, NH, 03302-0095, (603) 271-2925.

Thank you for your cooperation on this project.

Very truly yours,

CMA ENGINEERS, INC.

Robert J. Grillo, P.E.
Project Manager

Enclosure

cc w/o enc: Wayne Wheeler, P.E., NHDES
John Gay, NCES
Kevin Roy, NCES
Bryan Gould, Esquire, Cleveland, Waters and Bass, P.A.

CMA ENGINEERS, INC.
CIVIL/ENVIRONMENTAL ENGINEERS

35 Bow Street
Portsmouth, New Hampshire
03801-3819

Phone: 603/431-6196
Fax: 603/431-5376

E-mail: info@cmaengineers.com
Web Site: www.cmaengineers.com

January 5, 2015

NH Fish and Game Department
Endangered Species Coordinator
11 Hazen Drive
Concord, NH 03301

VIA CERTIFIED MAIL RETURN RECEIPT REQUESTED

RE: North Country Environmental Services, Inc. Stage V Landfill (DES-SW-SP-03-002)
New Hampshire Department of Environmental Services
Waste Management Division, Permitting & Design Review Section
Type I-B Permit Modification
CMA #833-C

Dear Endangered Species Coordinator,

Pursuant to RSA 149-M and the New Hampshire Solid Waste Rules, you are hereby notified that North Country Environmental Services, Inc., (NCES) will be filing an application with the New Hampshire Department of Environmental Services (NHDES) for a Type I-B Permit Modification to the Standard Facility Permit on or about January 5, 2015 for its landfill located at 581 Trudeau Road in Bethlehem, NH. A copy of the complete application is enclosed.

The application, if approved, would allow for the construction of stormwater improvements at the site including a new stormwater detention pond and expansion of an existing pond. These improvements are in addition to what was approved by the NHDES for Stage V in August, 2014. These improvements are made in part to more evenly distribute stormwater flow between on-site detention ponds. Additionally, the reach of perimeter and intermediate bench swales will be shortened and stormwater flows will be more spacially balanced and distributed. The proposed ponds, are located to the west of proposed Stage V. NCES has also included upgrades to the site's landfill gas system to the permit modification including expansion of existing landfill gas piping around the perimeter of Stage V. Other modifications to the construction drawings include minor design changes, construction level notes and details beyond what is required by the NHDES. This work will be constructed concurrently with the Stage V expansion project, which is anticipated to begin in the spring of 2015 and end in 2016.

The New Hampshire Natural Heritage Bureau's DataCheck tool identified no threatened or endangered species in the project area. The U.S. Fish & Wildlife's Information, Planning and Conservation System (IPAC) mapping tool, however, indicated the Canadian Lynx should be considered in an effects analysis of the project, even though the project is not located in designated critical habitat. The proposed facility nonetheless has the potential to affect a threatened species, and out of an abundance of caution, we are notifying you pursuant to NH Solid Waste Rule Env-Sw 303.09. A copy of the permit application is enclosed for review and comment. To assure proper consideration of your comments, if any, please submit written comments direct to the NHDES-WMD, P.O. Box 95, Concord, NH 03302-0095 within the next 30 days.

For additional information regarding these applications you may contact me at CMA Engineers, Inc., 35 Bow Street, Portsmouth, NH 03801, (603) 431-6196.

In accordance with Section Env-Sw 303 of the New Hampshire Solid Waste Rules, a copy of the complete application is available for review at the offices of the Town of Bethlehem at 2511 Main Street, at the NHDES located at 29 Hazen Drive, Concord, NH and at NCES's offices at 581 Trudeau Road, Bethlehem, NH 03574 during normal business hours. The permit applicant, facility owner, facility operator and property owner is NCES. NCES's mailing address is P.O. Box 9, Bethlehem, NH 03574. You may also direct inquiries about the applications to Mr. John Gay, Engineering Manager, 220 Avenue B, Williston, VT 05495. You can also contact Mr. Gay at 802-651-5454 or John.Gay@casella.com.

The New Hampshire Solid Waste Rules have specific procedures for the review and issuance or denial of applications such as NCES is filing. The procedures involve a series of steps, which are substantively identical to those depicted on the enclosed flow chart for a standard permit application.

If you have any questions regarding the permit application review process, or wish to comment on the subject application, please contact Mr. Wayne Wheeler at NHDES-Waste Management Division, 29 Hazen Drive, P.O. Box 95, Concord, NH, 03302-0095, (603) 271-2925.

Thank you for your cooperation on this project.

Very truly yours,

CMA ENGINEERS, INC.

Robert J. Grillo, P.E.
Project Manager

Enclosure

cc w/o enc: Wayne Wheeler, P.E., NHDES
John Gay, NCES
Kevin Roy, NCES
Bryan Gould, Esquire, Cleveland, Waters and Bass, P.A.

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E-mail: info@cmaengineers.com
Web Site: www.cmaengineers.com

January 5, 2015

NH Department of Resources & Economic Development
Natural Heritage Inventory
172 Pembroke Road
P.O. Box 1856
Concord, NH 03302-1856

VIA CERTIFIED MAIL RETURN RECEIPT REQUESTED

RE: North Country Environmental Services, Inc. Stage V Landfill (DES-SW-SP-03-002)
New Hampshire Department of Environmental Services
Waste Management Division, Permitting & Design Review Section
Type I-B Permit Modification
CMA #833-C

Dear Natural Heritage Inventory,

Pursuant to RSA 149-M and the New Hampshire Solid Waste Rules, you are hereby notified that North Country Environmental Services, Inc., (NCES) will be filing an application with the New Hampshire Department of Environmental Services (NHDES) for a Type I-B Permit Modification to the Standard Facility Permit on or about January 5, 2015 for its landfill located at 581 Trudeau Road in Bethlehem, NH. A copy of the complete application is enclosed.

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For additional information regarding these applications you may contact me at CMA Engineers, Inc., 35 Bow Street, Portsmouth, NH 03801, (603) 431-6196.

In accordance with Section Env-Sw 303 of the New Hampshire Solid Waste Rules, a copy of the complete application is available for review at the offices of the Town of Bethlehem at 2511 Main Street, at the NHDES located at 29 Hazen Drive, Concord, NH and at NCES's offices at 581 Trudeau Road, Bethlehem, NH 03574 during normal business hours. The permit applicant, facility owner, facility operator and property owner is NCES. NCES's mailing address is P.O. Box 9, Bethlehem, NH 03574. You may also direct inquiries about the applications to Mr. John Gay, Engineering Manager, 220 Avenue B, Williston, VT 05495. You can also contact Mr. Gay at 802-651-5454 or John.Gay@casella.com.

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Thank you for your cooperation on this project.

Very truly yours,

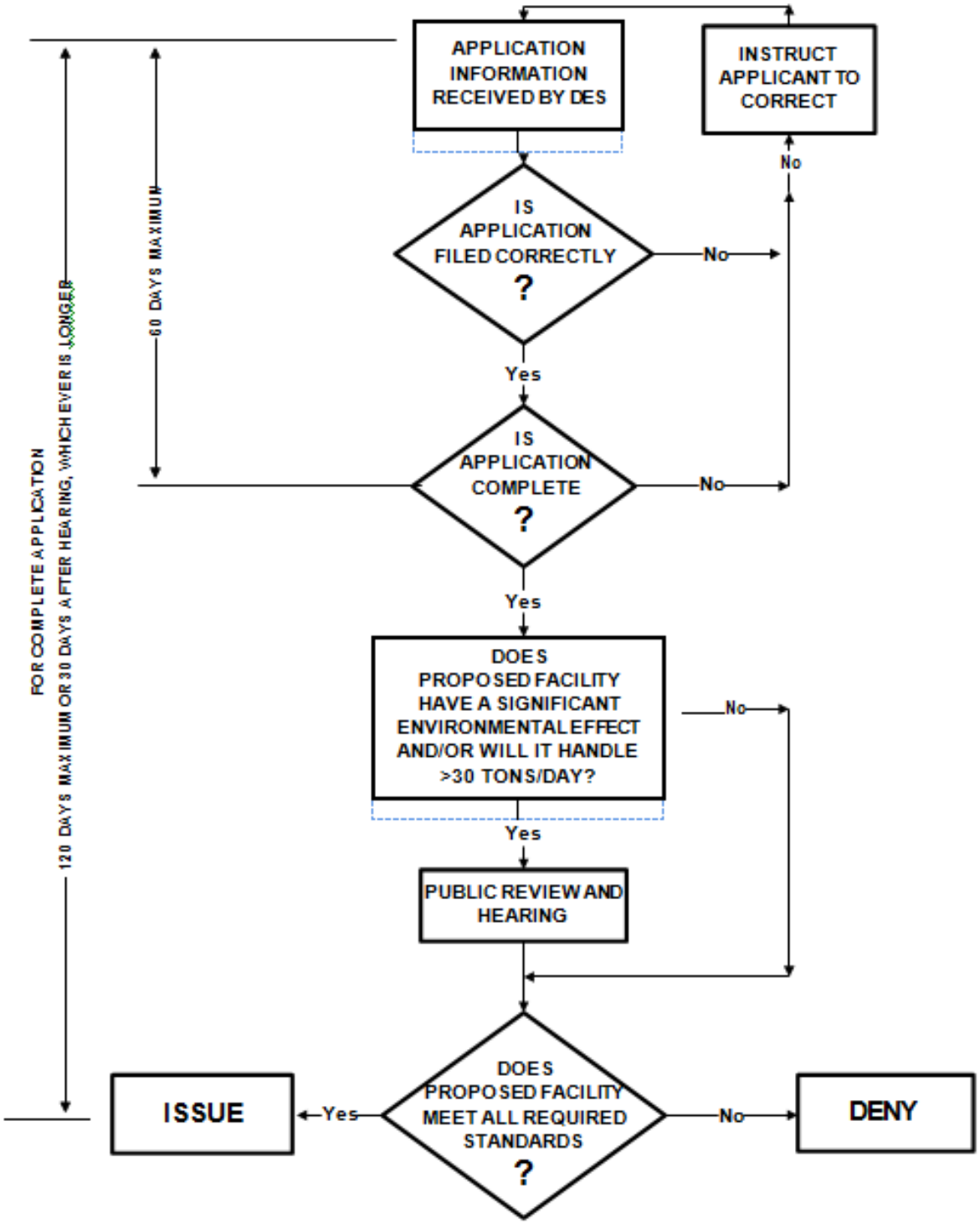
CMA ENGINEERS, INC.

Robert J. Grillo, P.E.
Project Manager

Enclosure

cc w/o enc: Wayne Wheeler, P.E., NHDES
John Gay, NCES
Kevin Roy, NCES
Bryan Gould, Esquire, Cleveland, Waters and Bass, P.A

STANDARD PERMIT APPLICATION PROCESSING PROVISIONS AS PROVIDED IN PARTS Env-Sw 303 - 305 OF THE *NEW HAMPSHIRE SOLID WASTE RULES*



Part II

TYPE II PERMIT MODIFICATION APPLICATION FORM

INSTRUCTIONS
for obtaining a

Type II Modification To Solid Waste Management Facility Permit

pursuant to
RSA 149-M and New Hampshire Administrative Solid Waste Rule Env-Sw 315

Read these instructions before completing the attached form. For additional assistance contact the NH Department of Environmental Services (DES), Permitting & Design Review Section (P&DRS) at (603) 271-2925 or the below noted mailing address or TDD Access: Relay NH 1-800-735-2964.

Note: All references on this form beginning with "Env-Sw" are citations from the New Hampshire Solid Waste Rules. To obtain a copy of the *Rules*, contact the DES Public Information & Permitting Office at (603) 271-2975 or above noted TDD Access. The Rules are also available on the Internet at http:\\www.des.nh.gov .

Use the attached form to obtain a "type II" permit modification. A "type II" permit modification is the regulatory mechanism by which final plans (for construction, operation, closure or financial assurance) are approved and attached to a solid waste facility permit as a condition of the permit.

All requested information must be provided as indicated on the attached form. Do **NOT** skip any question, unless instructed to do so. Do **NOT** mark any question "not applicable." If you need more space than provided on the form to answer a particular question and are using a paper copy of the form, attach additional pages as necessary, mark each page clearly to show both the applicant name and the question being answered, and indicate on the form that the additional pages are attached.

Submit **THREE** copies of the completed form, **EACH bearing ORIGINAL signatures**. Applications may be submitted to the department electronically. If an applicant chooses to submit an application electronically, a single paper copy of the application shall also be submitted to the department to the following address:

NH Department of Environmental Services (DES)
Waste Management Division (WMD)
Permitting & Design Review Section (P&DRS)
29 Hazen Drive, PO Box 95
Concord, NH 03302-0095

Include the required fee (see table below). Make checks or money orders payable to "TREASURER, State of New Hampshire."

Final Design/Construction Plans for a Non-Landfill Facility	**NO FEE**
Final Design/Construction Plans for a Landfill	**Initial Phase: NO FEE** **Subsequent Phases: FEE is calculated based on capacity & life expectancy of phase; refer to Env-Sw 310.08(a) for formula or contact P&DRS for assistance**
Final Operating Plans	**NO FEE**
Final Closure/Capping Plans for a Non-Landfill Facility or an Unlined Landfill	**NO FEE**
Final Closure/Capping Plans for a Lined Landfill	**FEE is calculated based on capping area; refer to Env-Sw 310.08(b) for formula or contact P&DRS for assistance**
Final Financial Assurance Plans	**NO FEE**

Your application will be processed by DES in accordance with Env-Sw 304 and Env-Sw 305.

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Waste Management Division

For Office Use Only:
WMD Log #:_____
Date Rec'd.:_____
No. of Copies:_____ ❒ **Fee: $**_____
Check #_____
❒ **No Fee Required**

APPLICATION FORM FOR

Type II Modification To Solid Waste Management Facility Permit

pursuant to
RSA 149-M and New Hampshire Administrative Solid Waste Rules Env-Sw 315

SECTION I. FACILITY IDENTIFICATION

(1)	Facility name: North Country Environmental Services, Inc.
(2)	Functional Classification: ☐ Collection/Storage/Transfer ☐ Processing/Treatment ☒ Landfill
(3)	Mailing address: 581 Trudeau Road, Bethlehem, NH 03574
(4)	Permit number: DES-SW-SP-03-002
(5)	Location, by street address and municipality: 581 Trudeau Road, Bethlehem, NH 03574

SECTION II. PERMITTEE IDENTIFICATION

(1)	Permittee/applicant name: North Country Environmental Services, Inc.			
(2)	Mailing address: 220 Avenue B, Williston, VT 05495			
(3)	Telephone number: (802) 651-5454			
(4)	If different than above, identify the individual associated with and designated by the permittee/applicant to be the contact individual for matters concerning this application:			
	(a)	Name: John Gay	(b)	Title: Engineering Manager
	(c)	Mailing address: 220 Avenue B, Williston, VT 05495		
	(d)	Telephone number: (802) 651-5454	(e)	E-mail: John.Gay@casella.com

SECTION III. DESCRIPTION OF PROPOSED MODIFICATION

Provide a complete description of the proposed modification by answering each of the following questions. Use additional paper as necessary.

(1) Identify the type of final plans being submitted for approval. (Check one that applies. If more than one applies, submit a separate application for each):

☐	Final design/construction plans for non-landfill facility	☐	Final closure plan for non-landfill facility
☒	Final design/construction plans for landfill:	☐	Final closure/capping plans for lined landfill
	☐ Initial Phase ☒ Subsequent Phase	☐	Final closure/capping plans for unlined landfill
☐	Final operating plan	☐	Final financial assurance plan

(2) Provide a **BRIEF** description of the proposed modification/requested approval:

This Type II Permit Modification Application is to request approval of Construction Plans approved by Type I-A Permit Modification for Stage V on August 15, 2014 and the Type I-B Permit Modification submitted concurrently with this application.

(3) Identify, below, the preliminary plans approved in the permit which provide the basis for the final plans being submitted with this application:

Check one	TYPE OF PRELIMINARY PLAN	DES Approval Date	WMD Log #
☒	Facility design plans/specifications	August 15, 2014	13337, 13390, 13419, 13423, 13477, 13883, 13995 and 14056
☐	Facility operating plan		
☒	Facility closure plan	August 15, 2014	13337, 13390, 13419, 13423, 13477, 13883, 13995 and 14056
☐	Facility financial assurance plan		
☐	Other plan *(specify):*		

(4)	Submit the proposed final plans for which approval is being sought. The plans must be prepared based on the preliminary plans identified in (3) above and according to the below listed instructions. When appropriate, final plans may be presented in the form of replacement pages ready for substitution into the related approved preliminary plans, with each page being clearly marked to show the date of revision. Mark the submitted/attached plans as "Attachment III(4)".	
	☒	Facility design/construction plans must be prepared in accordance with Env-Sw 1103.05
	☐	Facility operating plans must be prepared in accordance with Env-Sw 1105.11
	☐	Facility closure plans must be prepared in accordance with Env-Sw 1106.04
	☐	Financial assurance plans must be prepared as specified in Env-Sw 1400 and must include all related financial assurance documents required to effect the plan

SECTION IV. CERTIFICATION OF COMPLIANCE/COMPLIANCE REPORT

If you are able to certify that each of the following statements is true, do so by your signature. If you are unable to certify that each of the following statements is true, you must prepare and submit a separate Compliance Report as specified by Env-Sw 303.15.

COMPLIANCE STATEMENT

The applicant shall certify that each of the statements listed in (1)-(8) below are true for each of the following individuals and entities:

- ☒ **The applicant, and**
- ☒ **The facility owner, and**
- ☒ **The facility operator, and**
- ☒ **All individuals and entities holding 10% or more of the applicant's debt or equity, and**
- ☒ **All of the applicant's officers, directors, and partners, and**
- ☒ **All individuals and entities having managerial, supervisory or substantial decision making authority and responsibility for the management of facility operations or the activity(s) for which approval is being sought**

(1)	No individual or entity listed above has been convicted of or plead guilty or no contest to a felony in any state or federal court during the 5 years before the date of the application.	
(2)	No individual or entity listed above has been convicted of or plead guilty or no contest to a misdemeanor for a violation of environmental statutes or rules in any state or federal court during the 5 years before the date of the application.	
(3)	No individual or entity listed above has owned or operated any hazardous or solid waste facility which has been the subject of an administrative or judicial enforcement action for a violation of environmental statutes or rules during the 5 years before the date of the application.	
(4)	No individual or entity listed above has been the subject of any administrative or judicial enforcement action for a violation of environmental statutes and rules during the 5 years before the date of the application.	
(5)	All hazardous and solid waste facilities owned or operated in New Hampshire by any individual or entity listed above are in compliance with either.	
	(a)	All applicable environmental statutes, rules, and DES permit requirements; or
	(b)	A DES approved schedule for achieving compliance therewith.
(6)	All individuals and entities listed above are in compliance with all civil and criminal penalty provisions of any outstanding consent agreement, settlement, or court order to which DES is a party.	
(7)	All individuals and entities listed above have paid, or are in compliance with the payment schedule for any administrative fine assessed by DES.	
(8)	All individuals and entities listed above are in compliance with all terms and conditions under every administrative order, court order or settlement agreement relating to programs implemented by DES.	

Signature of the permittee/applicant certifying the above statements are true:

Permittee/Applicant Name **(Print Clearly or Type)** JOHN GAY

Permittee/Applicant Signature J GAY

Date 12/18/14

RECEIVED
DEC - 2014
CMA ENGINEERS

OR

Circle the untrue statement(s) and attach a Compliance Report, pursuant to Env-Sw 303.15

SECTION V. PERMITTEE/ APPLICANT SIGNATURE REQUIREMENTS

The permittee/applicant must sign the following statement prior to submitting this application. All copies of the application filed with DES must bear the permittee's/applicant's ORIGINAL signature. If the permittee/applicant is not an individual, an individual duly authorized by the permittee/applicant shall sign the application.

To the best of my knowledge and belief, the information and material submitted herewith is correct and complete. I understand that any approval granted by DES based on false and/or incomplete information shall be subject to revocation or suspension, and that administrative, civil or criminal penalties may also apply. I certify that this application is submitted on a complete and accurate form, as provided by DES, without alteration of the text.

Permittee/Applicant Name **(Print Clearly or Type)** JOHN GAY

Permittee/Applicant Signature J. Gay

Date 12/18/14

SECTION VI. PROPERTY OWNER SIGNATURE

If the permittee/applicant and property owner are not the same, the property owner must also sign this form as follows. All copies of the application filed with DES must bear an ORIGINAL signature. If the property owner is not an individual, an individual duly authorized by the property owner shall sign the application.

(1)	I hereby affirm that the permittee/applicant has the legal right to occupy and use the property on which the subject facility is or will be located for the purposes specified in this application.
(2)	I hereby affirm that I shall grant access to the property for closure and post-closure monitoring of the subject facility and site as required by RSA 149-M and the New Hampshire Solid Waste Rules, as amended.

Property Owner Name **(Print Clearly or Type)** _____

Property Owner Signature _____

Date _____

Part III

DESIGN DRAWINGS

(Full Size Bound Separately)

NORTH COUNTRY ENVIRONMENTAL SERVICES, INC.
STAGE V LANDFILL EXPANSION

Bethlehem, New Hampshire

Construction Drawings

January 2015

Sheet Index

1. Cover Sheet
2. Existing Conditions & Overall Site Plan
3. Proposed Overall Site Plan
4. Existing Conditions, Waste Excavation, & Demolition Plan
5. 2015 Work Plan
6. Proposed Secondary Liner Grading Plan
7. Proposed Primary Drainage Stone Grading Plan
8. Proposed Detention Pond 5 & 6 Grading Plan
9. Erosion Control and Site Layout Plan
10. Landfill Cross Sections
11. Details - Landfill
12. Details - Sump Modification & Construction
13. Details - Riser Modification & Construction
14. Details - Site Work
15. Details - Erosion Control
16. Details - Temporary Environmental Controls

Locus Plan

Prepared By:

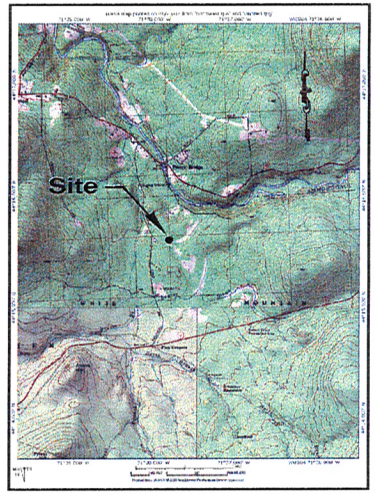
CMA ENGINEERS
CIVIL/ENVIRONMENTAL ENGINEERS

Portsmouth, NH 603/431-6196 • Manchester, NH 603/627-0708 • Portland, ME 207/541-4223

Website: www.cmaengineers.com
E-mail: info@cmaengineers.com

Prepared For:

north country ENVIRONMENTAL SERVICES
Bethlehem, New Hampshire 03574



Project Location

Drawing file: M:\CADD\PROJECTS\833-Tyrell\833-Cover1406.dwg 1/01/2015 12:39pm

Plan References:

The horizontal and vertical locations of all underground/buried features including, but not limited to leachate collection pipes, liner location, forcemain, culverts, tanks, sumps, and utilities were obtained from the following plans:

A. "Record Drawings, 1987 Construction Sanco Landfill Expansion, Phase I Construction" prepared for Sanco, Inc. by Kimball Chase Company, Inc. of Portsmouth, New Hampshire dated March 25, 1988. (Stage I Phase I)

B. "Record Drawings 1988/1989 Construction" prepared for Consumat Sanco, Inc. by Goldberg–Zoino & Associates, Inc. dated March 1990. (Stage I Phase II and Stage I Phase III)

C. "Phase IV – Record Drawings" prepared for Consumat Sanco, Inc. by Goldberg–Zoino & Associates, Inc. dated January 1993. (Stage I Phase IV)

D. "Stage II Phase II Record Drawings" prepared for North Country Environmental Services, Inc. by Sanborn, Head & Associates of Concord, New Hampshire dated March 1999. (Stage II Phase II)

E. "Stage III Construction Record Drawings" prepared for North Country Environmental Services, Inc. by Sanborn, Head & Associates of Concord, New Hampshire dated December 2000. (Stage III)

F. "Record Drawings, Stage III Gas System Modifications" prepared for North Country Environmental Services, Inc. by Sanborn, Head & Associates of Concord, New Hampshire dated July 2005.

G. "Stage IV Phase I Construction Drawings" prepared for North Country Environmental Services, Inc. by Sanborn, Head & Associates, Inc. of Concord, New Hampshire dated July 2005 and revised April 2006. (Stage IV Phase I)

H. "Interim Stage IV Phase I Construction Record Drawings" prepared for North Country Environmental Services, Inc. by Sanborn, Head & Associates of Concord, New Hampshire dated August 2006. (Stage IV Phase I)

I. "2007 Landfill Gas Improvements Record Drawings" prepared for North Country Environmental Services, Inc. by CMA Engineers, Inc. of Portsmouth, New Hampshire dated April 2008.

J. "Stage IV Phase I Overlay Liner Construction Record Drawings" prepared for North Country Environmental Services, Inc. by CMA Engineers, Inc. of Portsmouth, New Hampshire dated August 2008.

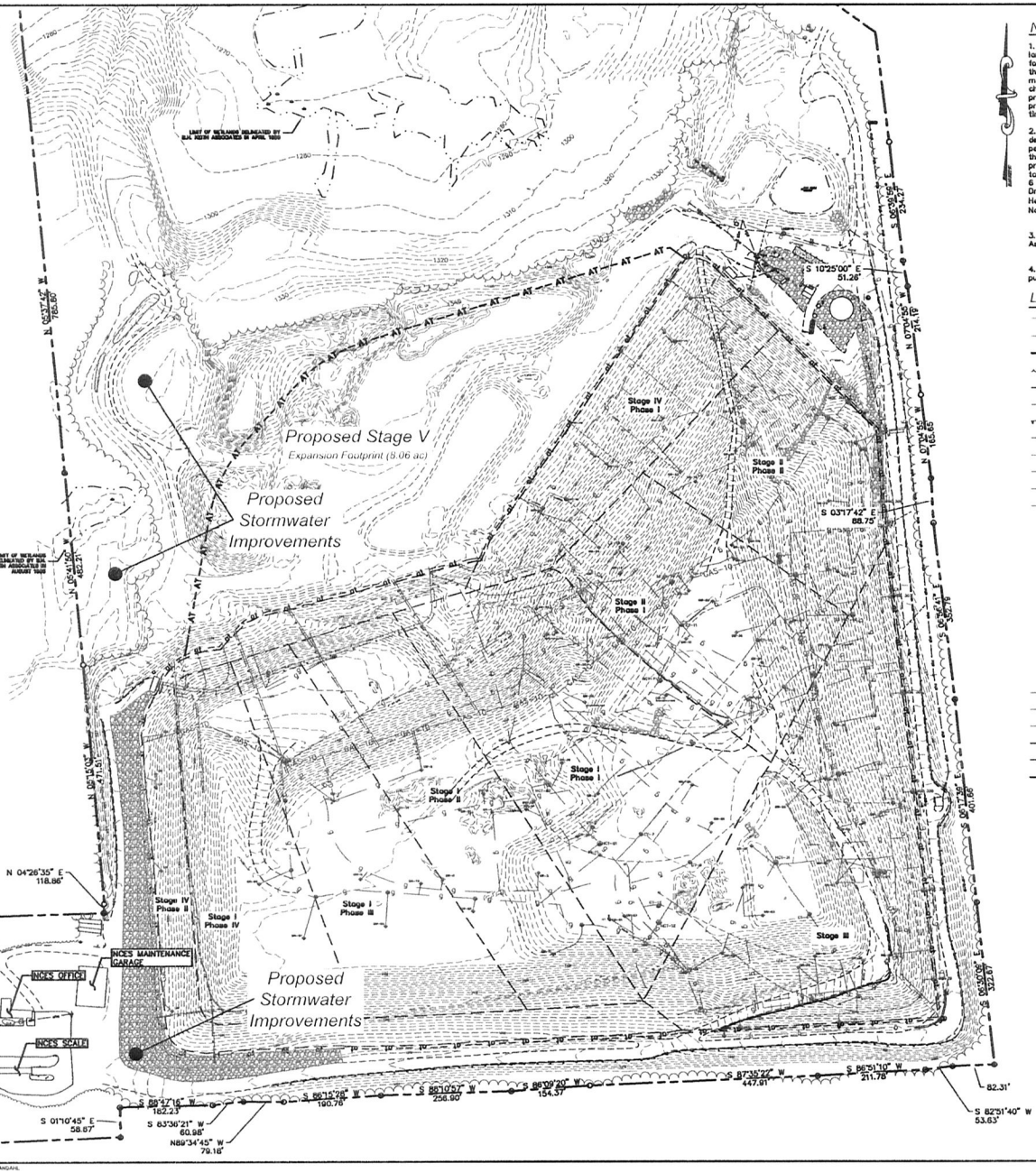
K. "Leachate Management Improvements Record Drawings" prepared for North Country Environmental Services, Inc. by CMA Engineers, Inc. of Portsmouth, New Hampshire dated February 2009.

L. "Stage IV Phase II–A Construction Record Drawings" prepared for North Country Environmental Services, Inc. by CMA Engineers, Inc. of Portsmouth, New Hampshire dated February 2012.

M. "Property Boundary Plan" by Horizons Engineering of Littleton, New Hampshire dated April 2012.

N. Boundary line information taken from Horizons Engineering, Inc. plan titled "A Minor Lot Line Adjustment Plan for North Country Environmental Services, Inc. Between Tax Map 419 Lots 21 & 22" dated February 2012.

O. "Stage IV Phase II–B Construction Record Drawings" prepared for North Country Environmental Services, Inc. by CMA Engineers, Inc. of Portsmouth, New Hampshire dated November 2013.



Notes:

1. This facility is an active landfill. Grades within the landfill footprint will change as filling progresses. The footprint of proposed Stage V is located in the vicinity of the common borrow pit containing virgin and stockpiled materials. Grades within the common borrow pit will change due to material use and stockpiles will be relocated prior to landfill construction. Proposed grades outside the proposed anchor trench will change based on topography at time of construction.

2. Existing topography shown within the treeline is developed from the August 19, 2014 aerial photogrammetry performed by Eastern Topographics. Topography north of the treeline is taken from the Stage IV Design Drawings prepared by SHA and dated March 2002. Existing topography shown in the area of Proposed Detention Pond 6 is approximate and based on Sheet 1A of the Record Drawings for Stage I of the landfill prepared by Sanborn, Head and Associates, Inc. dated December 1998 (Revised November 1999).

3. Existing limit of wetlands were delineated by B.H Keith Associates in August 1995 and April 1999.

4. Proposed features on this plan are for reference purposes only. See following sheets for additional detail.

Legend:

- Existing 2' Contour
- Existing 10' Contour
- Existing Property Line
- Existing Tree Line
- Existing Limit of Wetland
- Existing Edge of Gravel
- Existing Retaining Wall
- Existing Edge of Pond
- Existing Primary Leachate Pipe
- Existing Secondary Leachate Pipe
- Existing Leachate Force Main
- Existing Overhead Electric
- MW 403U Existing Monitoring Well
- Existing Secondary Leachate Collection System Manhole/Pump Station
- Existing Primary Leachate Collection System Manhole/Pump Station
- Existing Leak Detection Manhole
- P2 TH Existing Valves
- GP-14 Existing Gas Probe
- SVP-17 Existing Soil Vapor Probe
- GW-8 Existing Gas Extraction Well and Wellhead
- GV-14 Existing Gas Vent
- Existing Gas Line
- Existing Underground Electric
- Existing Fence
- AT Existing Anchor Trench
- Existing Limit of Waste
- AT Proposed Anchor Trench

1	Issued for NHDES Type I Perm. Modification	JAN. 2015

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LOCATIONS:
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DATE JAN. 2015	DESIGNED RJG/BWS/AJS		
PROJECT NO. E33	DRAWN BY BWS/AJS		
FILE NAME E33P14-1 Dwg.	REVIEWED BY RJG		

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Existing Conditions & Overall Site Plan

Drawing no. 2

of sheets 2 of 10

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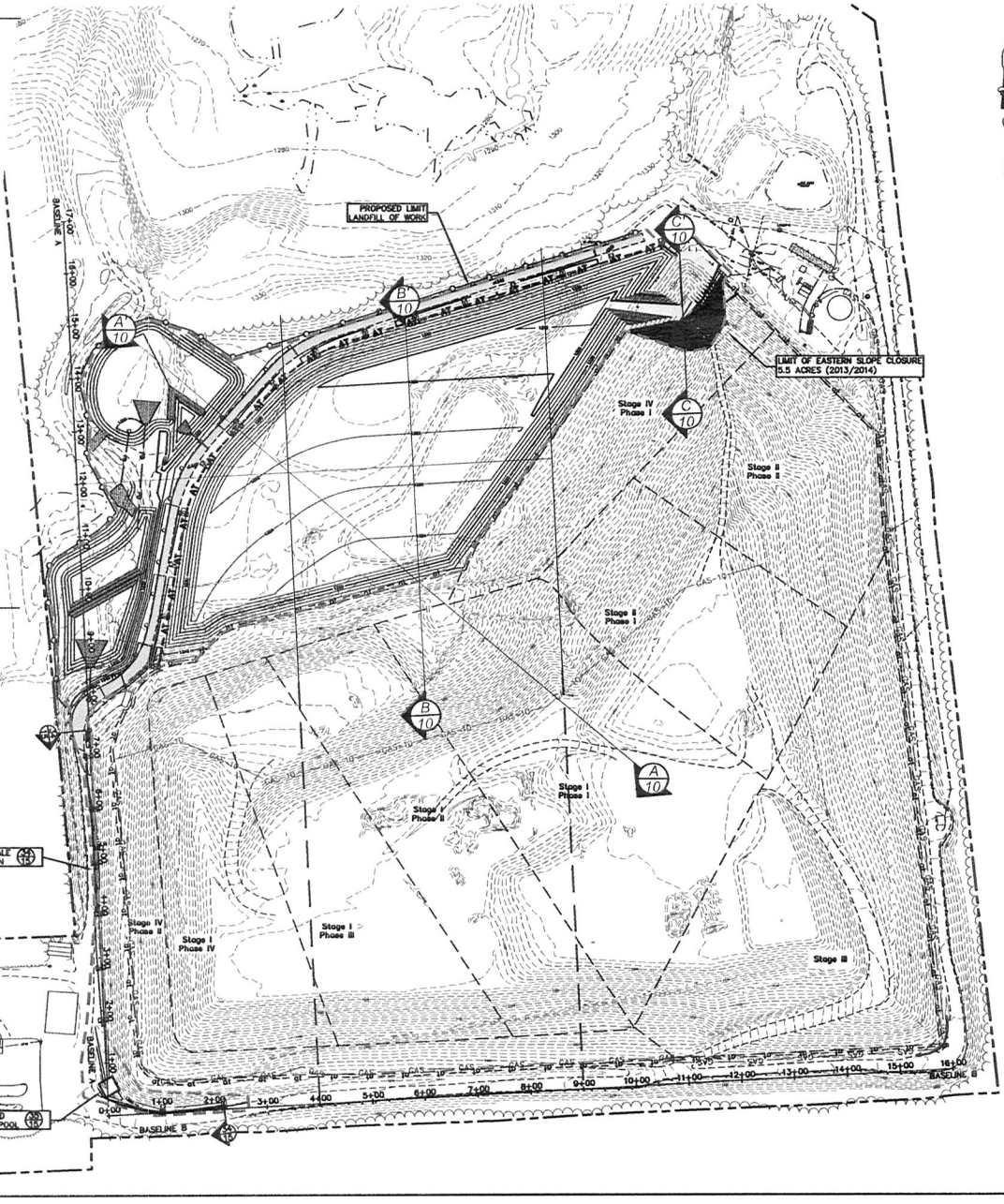
2015 Construction Sequence Notes

1. Establish vertical and horizontal control.
2. Install and maintain sedimentation and erosion controls as specified and as shown on Sheet 9.
3. Install new gas header condensate loop over Stage VI Phase I (See Sheet 4).
4. Decommission existing monitoring wells, gas header pipe, culverts and overhead electric per specifications.
5. Clear and grub and remove existing topsoil from limits of work to area designated by owner.
7. Install temporary forcemain as depicted on Sheet 4.
8. Complete excavation to proposed Stage V subgrade elevation and stockpile excavated soils at location determined by Owner (not more than 1 mile one-way). Construct silt fence perimeter around stockpiles.
9. Excavate and relocate waste (area designated by owner not more than 1 mile one-way) in Stage IV Phase I to access Stage IV Phase I sump area.
10. Construct secondary stormwater containment wall after primary liner demo in waste excavation area (weld flap to existing Stage IV Phase I liner.
11. Construct perimeter berm.
12. Construct stormwater improvements including Detention Ponds 5 and 6, expansion of the western swale and plunge pool.
13. Construct gas header modifications in waste relocation area and install temporary LFG collectors and temporary gas collection tarp.
14. Install 12" screened till layer to the limit shown on Sheet 5.
15. Install GCL layer where secondary leachate piping is to be installed (base areas only) and in sump area.
16. Install 60-mil HDPE secondary liner to the limit shown on Sheet 5 and weld to existing Stage IV secondary liner.
17. Install secondary drainage geocomposite layer to limit of secondary stormwater containment wall and the limit shown on Sheet 5.
18. Install secondary leachate piping to the limit shown on Sheet 5 – including second layer of drainage geocomposite, secondary pump station manhole and tie in secondary forcemain to Stage IV Phase I Side Riser Building.
19. Install 3/4" stone and gravel layers over secondary leachate piping.
20. Install 12" drainage sand layer to limit of secondary stormwater containment wall and the limit shown on Sheet 5.
21. Install GCL layer where primary leachate piping is to be installed (base areas only).
22. Install 60-mil HDPE primary liner to limit of secondary stormwater containment wall and the limit shown on Sheet 5.
23. Remove secondary stormwater containment wall and connect Stage V secondary drainage geocomposite to Stage IV Phase I secondary drainage geocomposite.
24. Construct primary stormwater containment wall.
25. Weld Stage V primary liner to Stage IV primary liner.
26. Install primary drainage geocomposite to limit of primary stormwater containment wall and the limit shown on Sheet 5.
27. Install phase separation berm.
28. Install sump in northeast corner of Phase II cell to pump accumulated stormwater.
29. Install primary leachate piping, including second layer of drainage geocomposite, to the limit shown on Sheet 5 and connect Stage V leachate collection pipe to Stage IV Phase I sump riser.
30. Install 3/4" stone over primary leachate piping.
29 Install 3" HDPE forcemain, 14" HDPE gas header pipe, condensate trap, valve and riser to Phase I Project limit. Provide end caps for future Phase II tie in.
30. Install 18" stone layer over primary drainage geocomposite to the limit shown on Sheet 5.
31. Loam and seed disturbed areas outside of anchor trench.
32. Site cleanup and demobilization.

2016 Construction Sequence Notes

1. Establish vertical and horizontal control.
2. Install and maintain sedimentation and erosion controls as specified and as shown on Sheet 9.
3. Pump any accumulated stormwater from the Stage V excavation area and discharge to existing sediment forebay of Detention Ponds 4, 5 or 6.
4. Inspect 2015 construction work and make repairs as necessary.
5. Demolish existing Geokon Unit.
6. Install 12" screened till layer.
7. Install GCL layer where secondary leachate piping is to be installed (base areas only).
8. Install 60-mil HDPE secondary liner and weld to existing Stage IV secondary liner.
9. Install secondary drainage geocomposite layer
10. Install secondary leachate piping including second layer of drainage geocomposite.
11. Install 3/4" stone and gravel layers over secondary leachate piping.
12. Install 12" drainage sand layer.
13. Install GCL layer where primary leachate piping is to be installed (base areas only).
14. Install 60-mil HDPE primary liner and weld to existing Phase IV primary liner.
15. Install primary drainage geocomposite and tie into existing Stage IV drainage geocomposite.
16. Install primary leachate piping.
17. Install perimeter 3" leachate forcemain and 14" HDPE LFG header pipe, condensate trap, valves and risers.
18. Demolish existing leachate forcemain and associated structures.
19. Install 18" stone layer over primary drainage geocomposite.
20. Loam and seed disturbed areas.
21. Site cleanup and demobilization.



Notes:

1. Existing topography shown within the treeline is developed from the August 19, 2014 aerial photogrammetry performed by Eastern Topographics. The topography has been modified to depict approximate post-stockpile surface grades on this plan. Topography north of the treeline is taken from the Stage IV Design Drawings prepared by SHA and dated March 2002. Existing topography shown in the area of Proposed Detention Pond 5 is approximate and based on Sheet 1A of the Record Drawings for Stage I of the landfill prepared by Sanborn, Head and Associates, Inc. dated December 1996 (Revised November 1999).
2. Existing limit of wetlands were delineated by B.H Keith Associates in August 1995 and April 1999.
3. Proposed features on this plan are for reference purposes only. See following sheets for additional detail.
4. Proposed topography shown within the proposed Stage V landfill expansion on this plan are top of secondary liner.
5. Construction baselines and section alignments shown on this sheet are used for landfill cross sections on Sheet 10.

Legend:

- Existing 2' Contour
- Existing 10' Contour
- Existing Property Line
- Existing Tree Line
- Existing Limit of Wetland
- Existing Guardrail
- Existing Edge of Gravel
- Existing Retaining Wall
- Existing Edge of Pond
- Existing Primary Leachate Pipe
- Existing Secondary Leachate Pipe
- Existing Leachate Force Main
- Existing Overhead Electric
- MW 403U Existing Monitoring Well
- Existing Secondary Leachate Collection System Manhole/Pump Station
- Existing Primary Leachate Collection System Manhole/Pump Station
- Existing Leak Detection Manhole
- Existing Valves
- PZ TR
- GP-14 Existing Gas Probe
- SVP-17 Existing Soil Vapor Probe
- GW-8 Existing Gas Extraction Well and Wellhead
- GV-14 Existing Gas Vent
- Existing Gas Line
- Existing Underground Electric
- Existing Fence
- Existing Anchor Trench
- Existing Limit of Waste
- Proposed Anchor Trench
- Proposed Limit of Work
- Proposed 10' Contour
- Proposed 2' Contour
- Proposed Gravel Road
- Proposed Drainage Pipe
- Proposed Waste Excavation
- Proposed Silt Fence
- Proposed Stone Check Dam

1	Revised to NHDES Tier I Permit Modification	JAN 2015	RJG

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Portsmouth Office: 112 Bow Street, Portsmouth, New Hampshire 03801, (603) 433-2100
www.cmaengineers.com info@cmaengineers.com

DATE JAN 2015	DESIGNED RJG & BKS & AJS	DRAWN BY BKS & AJS	
PROJECT NO. 833		APPROVED RJG	
FILE NO. 833-01-01-01			SCALE 1" = 100'

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Proposed Overall Site Plan

drawing no. 3
sheet 1 of 16

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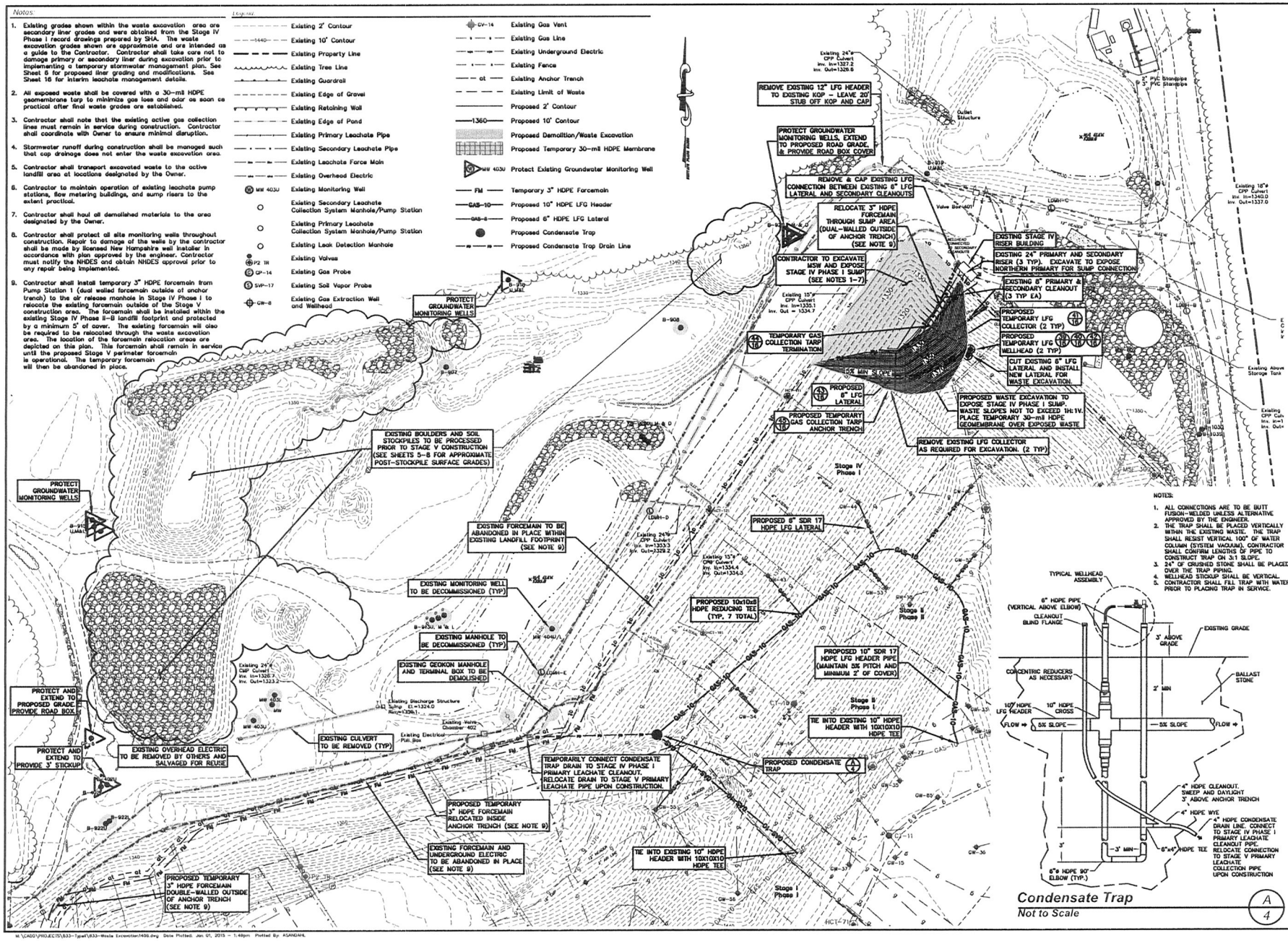
Notes:

1. Existing grades shown within the waste excavation area are secondary liner grades and were obtained from the Stage IV Phase I record drawings prepared by SHA. The waste excavation grades shown are approximate and are intended as a guide to the Contractor. Contractor shall take care not to damage primary or secondary liner during excavation prior to implementing a temporary stormwater management plan. See Sheet 6 for proposed liner grading and modifications. See Sheet 16 for interim leachate management details.
2. All exposed waste shall be covered with a 30-mil HDPE geomembrane tarp to minimize gas loss and odor as soon as practical after final waste grades are established.
3. Contractor shall note that the existing active gas collection lines must remain in service during construction. Contractor shall coordinate with Owner to ensure minimal disruption.
4. Stormwater runoff during construction shall be managed such that cap drainage does not enter the waste excavation area.
5. Contractor shall transport excavated waste to the active landfill area at locations designated by the Owner.
6. Contractor to maintain operation of existing leachate pump stations, flow metering buildings, and sump risers to the extent practical.
7. Contractor shall haul all demolished materials to the area designated by the Owner.
8. Contractor shall protect all site monitoring wells throughout construction. Repair to damage of the wells by the contractor shall be made by licensed New Hampshire well installer in accordance with plan approved by the engineer. Contractor must notify the NHDES and obtain NHDES approval prior to any repair being implemented.
9. Contractor shall install temporary 3" HDPE forcemain from Pump Station 1 (dual walled forcemain outside of anchor trench) to the air release manhole in Stage IV Phase I to relocate the existing forcemain outside of the Stage V construction area. The forcemain shall be installed within the existing Stage IV Phase II-B landfill footprint and protected by a minimum 5' of cover. The existing forcemain will also be required to be relocated through the waste excavation area. The location of the forcemain relocation areas are depicted on this plan. This forcemain shall remain in service until the proposed Stage V perimeter forcemain is operational. The temporary forcemain will then be abandoned in place.

Legend:

- Existing 2' Contour
- Existing 10' Contour
- Existing Property Line
- Existing Tree Line
- Existing Guardrail
- Existing Edge of Gravel
- Existing Retaining Wall
- Existing Edge of Pond
- Existing Primary Leachate Pipe
- Existing Secondary Leachate Pipe
- Existing Leachate Force Main
- Existing Overhead Electric
- MW 403U Existing Monitoring Well
- Existing Secondary Leachate Collection System Manhole/Pump Station
- Existing Primary Leachate Collection System Manhole/Pump Station
- Existing Leak Detection Manhole
- P2 TR Existing Valves
- GP-14 Existing Gas Probe
- SVP-17 Existing Soil Vapor Probe
- GW-8 Existing Gas Extraction Well and Wellhead
- GV-14 Existing Gas Vent
- Existing Gas Line
- Existing Underground Electric
- Existing Fence
- at Existing Anchor Trench
- Existing Limit of Waste
- Proposed 2' Contour
- 1360 Proposed 10' Contour
- Proposed Demolition/Waste Excavation
- Proposed Temporary 30-mil HDPE Membrane
- MW 403U Protect Existing Groundwater Monitoring Well
- FM Temporary 3" HDPE Forcemain
- GAS-10 Proposed 10" HDPE LFG Header
- GAS-6 Proposed 6" HDPE LFG Lateral
- Proposed Condensate Trap
- Proposed Condensate Trap Drain Line



NOTES:

1. ALL CONNECTIONS ARE TO BE BUTT FUSION-WELDED UNLESS ALTERNATIVE APPROVED BY THE ENGINEER.
2. THE TRAP SHALL BE PLACED VERTICALLY WITHIN THE EXISTING WASTE. THE TRAP SHALL RESIST VERTICAL 100" OF WATER COLUMN (SYSTEM VACUUM). CONTRACTOR SHALL CONFIRM LENGTHS OF PIPE TO CONSTRUCT TRAP ON 3:1 SLOPE.
3. 24" OF CRUSHED STONE SHALL BE PLACED OVER THE TRAP PIPING.
4. WELLHEAD STICKUP SHALL BE VERTICAL.
5. CONTRACTOR SHALL FILL TRAP WITH WATER PRIOR TO PLACING TRAP IN SERVICE.

Condensate Trap

Not to Scale

A/4

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CIVIL/ENVIRONMENTAL ENGINEERS

No.	Revisions/UNDES Tier I Permit Modification	Date	By
1		JAN 2015	RJG

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Existing Conditions, Waste Excavation & Demolition Plan

Drawing no. 4

Sheet 4 of 16

Date JAN 2015 | Designed by RJG/EWS/AJS | Drawn by EWS/AJS | Approved by RJG | Scale 1" = 50'

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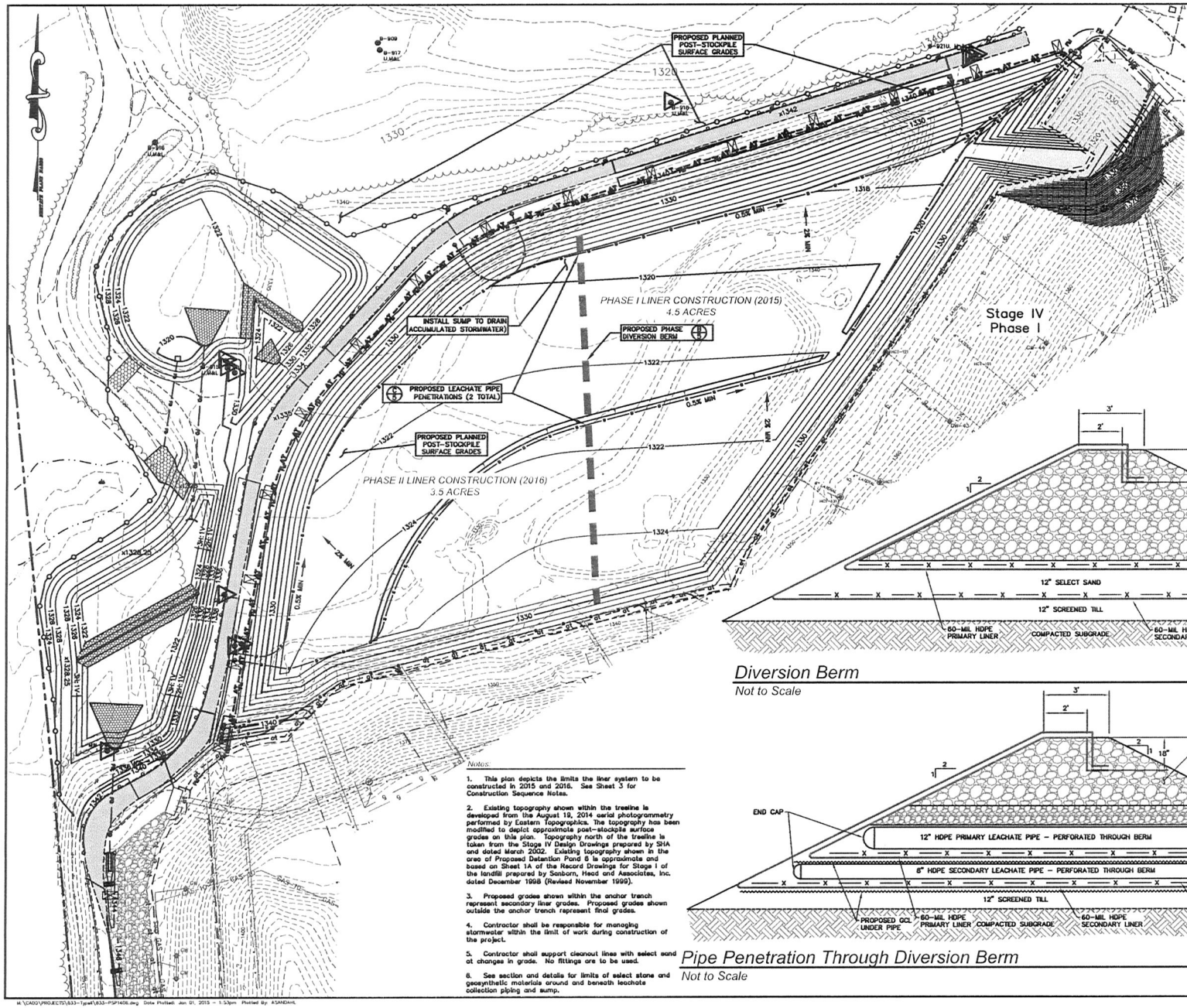
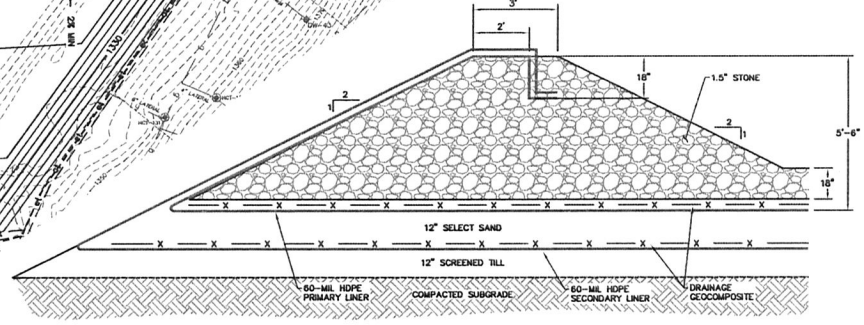
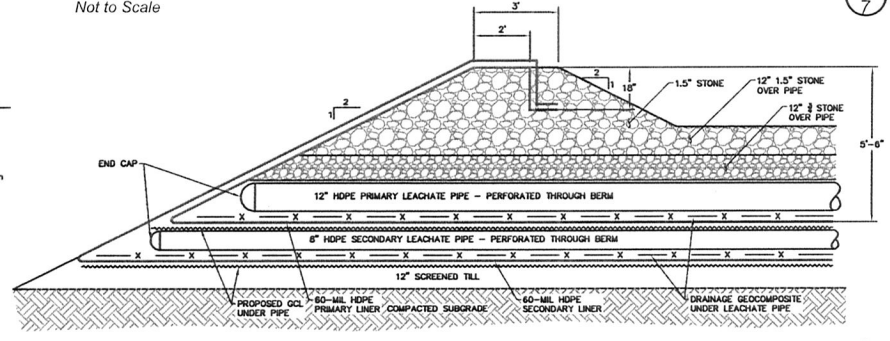




Diversion Berm

Not to Scale

B/7



Pipe Penetration Through Diversion Berm

Not to Scale

C/7

Notes:

1. This plan depicts the limits the liner system to be constructed in 2015 and 2016. See Sheet 3 for Construction Sequence Notes.
2. Existing topography shown within the treeline is developed from the August 19, 2014 aerial photogrammetry performed by Eastern Topographics. The topography has been modified to depict approximate post-stockpile surface grades on this plan. Topography north of the treeline is taken from the Stage IV Design Drawings prepared by SHA and dated March 2002. Existing topography shown in the area of Proposed Detention Pond 8 is approximate and based on Sheet 1A of the Record Drawings for Stage I of the landfill prepared by Sanborn, Head and Associates, Inc. dated December 1998 (Revised November 1999).
3. Proposed grades shown within the anchor trench represent secondary liner grades. Proposed grades shown outside the anchor trench represent final grades.
4. Contractor shall be responsible for managing stormwater within the limit of work during construction of the project.
5. Contractor shall support cleanout lines with select sand at changes in grade. No fittings are to be used.
6. See section and details for limits of select stone and geosynthetic materials around and beneath leachate collection piping and sump.

Issued for/Rev.	Date	By
1 Issued for NHDES Typ.II Permit Modification	JAN 2015	RJG

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STATE OF NEW HAMPSHIRE
RICHARD J. GUERIN
No. 9346
PROFESSIONAL ENGINEER

Designed by: KJB/BMS/AJS
Drawn by: BMS/AJS
Approved by: RJG
Date: JAN 2015
Project No.: 633
Filename: 1633-PSP1406.dwg

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings
2015 Work Plan

drawing no. 5
sheet 5 of 16

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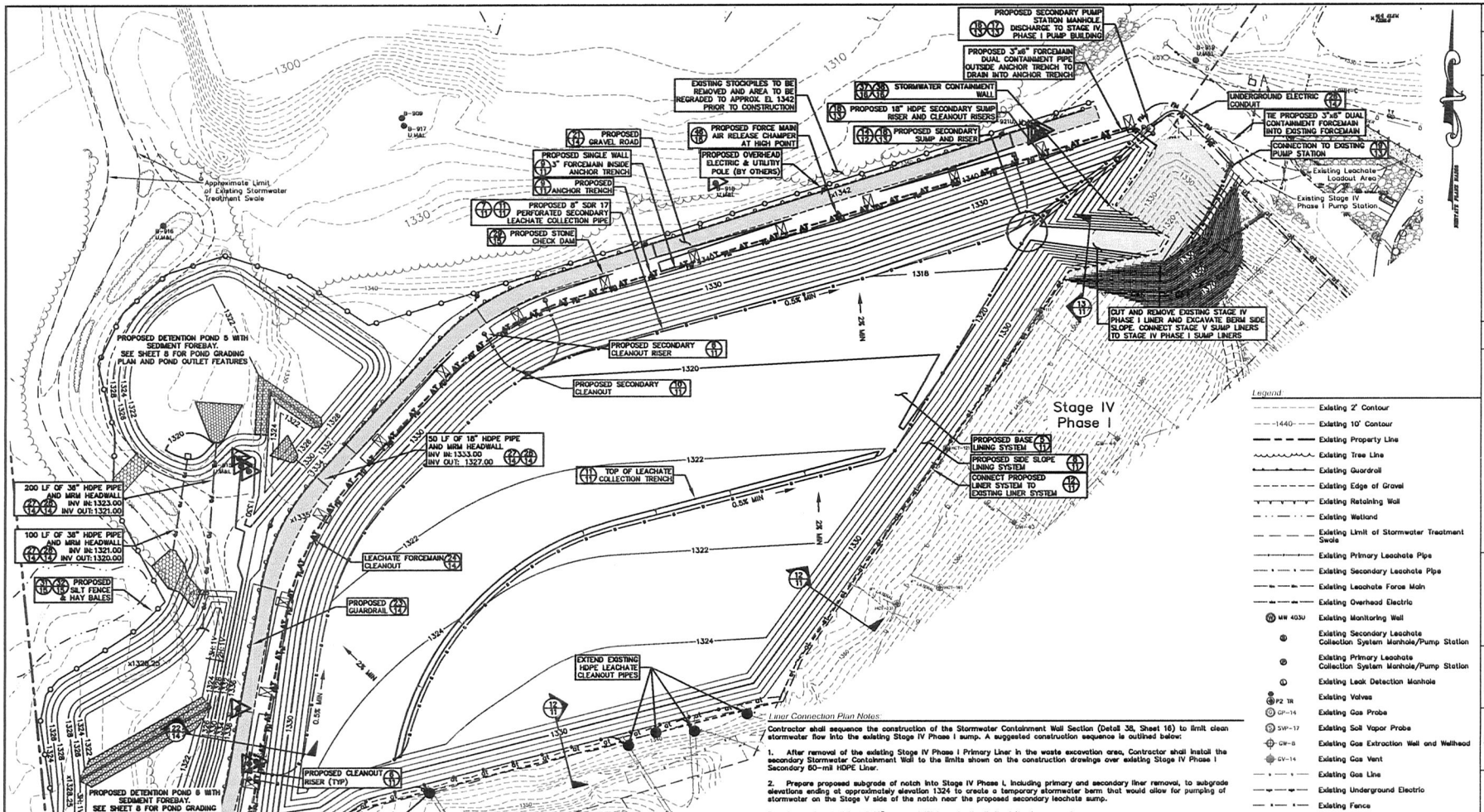

Legend:

- Existing 2' Contour
- Existing 10' Contour
- Existing Property Line
- Existing Tree Line
- Existing Guardrail
- Existing Edge of Gravel
- Existing Retaining Wall
- Existing Wetland
- Existing Limit of Stormwater Treatment Swale
- Existing Primary Leachate Pipe
- Existing Secondary Leachate Pipe
- Existing Leachate Force Main
- Existing Overhead Electric
- MW 403U Existing Monitoring Well
- Existing Secondary Leachate Collection System Manhole/Pump Station
- Existing Primary Leachate Collection System Manhole/Pump Station
- Existing Leak Detection Manhole
- PZ TR Existing Valves
- GP-14 Existing Gas Probe
- SVP-17 Existing Soil Vapor Probe
- GW-8 Existing Gas Extraction Well and Wellhead
- GV-14 Existing Gas Vent
- Existing Gas Line
- Existing Underground Electric
- Existing Fence
- Existing Anchor Trench
- Existing Limit of Waste
- Proposed Secondary Liner 2' Contour
- 1330 Proposed Secondary Liner 10' Contour
- Proposed Anchor Trench
- Proposed Limit of Waste
- Proposed Secondary Leachate Pipe
- Proposed Primary Leachate Pipe
- Proposed Connection to Existing Liner
- PD Proposed Drainage Pipe
- Proposed Guardrail
- Proposed Silt Fence
- Proposed Gravel Road
- Proposed Stone Check Dam
- Interim Stormwater Management
- Proposed Well Protection

Notes:

1. Existing topography shown within the treeline is developed from the August 19, 2014 aerial photogrammetry performed by Eastern Topographics. The topography has been modified to depict approximate post-stockpile surface grades on this plan. Topography north of the treeline is taken from the Stage IV Design Drawings prepared by SHA and dated March 2002. Existing topography shown in the area of Proposed Detention Pond 6 is approximate and based on Sheet 1A of the Record Drawings for Stage I of the landfill prepared by Sanborn, Head and Associates, Inc. dated December 1998 (Revised November 1999).

2. Proposed grades shown within the anchor trench represent secondary liner grades. Proposed grades shown outside the anchor trench represent final grades.

3. Contractor shall be responsible for managing stormwater within the limit of work during construction of the project.

4. Contractor shall support cleanout lines with select sand at changes in grade. No fittings are to be used.

5. See section and details for limits of select stone and geosynthetic materials around and beneath leachate collection piping and sump.

Liner Connection Plan Notes:

Contractor shall sequence the construction of the Stormwater Containment Wall Section (Detail 3B, Sheet 16) to limit clean stormwater flow into the existing Stage IV Phase I sump. A suggested construction sequence is outlined below:

1. After removal of the existing Stage IV Phase I Primary Liner in the waste excavation area, Contractor shall install the secondary Stormwater Containment Wall to the limits shown on the construction drawings over existing Stage IV Phase I Secondary 60-mil HDPE Liner.

2. Prepare proposed subgrade of notch into Stage IV Phase I, including primary and secondary liner removal, to subgrade elevations ending at approximately elevation 1324 to create a temporary stormwater berm that would allow for pumping of stormwater on the Stage V side of the notch near the proposed secondary leachate sump.

3. Contractor shall install 12" screened till layer to the limit of the temporary berm.

4. Immediately prior to the installation of 60-mil HDPE secondary liner in this area, weather permitting, the contractor shall remove the temporary berm and install remainder of the 12" screened till layer to the limits of the cut Stage IV Phase I liner.

5. Liner Contractor shall install the Stage V 60-mil HDPE secondary liner and weld to the Stage IV Phase I secondary liner.

6. Contractor shall install secondary drainage geocomposite leaving enough new composite flapped over the containment wall to tie into Stage IV Phase I at a later date.

7. Contractor shall install 8" SDR 17 HDPE Secondary Leachate Piping.

8. Contractor shall install 12" Drainage Sand Layer over secondary drainage geocomposite to limit of secondary stormwater containment wall.

9. Contractor shall install 60-mil HDPE primary liner to limit of secondary stormwater containment wall.

10. Contractor shall remove the secondary stormwater containment wall, tie the Stage V secondary drainage composite to existing Stage IV Phase I secondary drainage geocomposite and fill remaining 12" Drainage Sand Layer.

11. Contractor shall install the Primary Stormwater Containment Wall to the limits shown on the construction drawings. Steps 10 and 11 shall be completed during dry weather over 1 to 3 days.

12. Liner Contractor shall install Stage V 60-mil primary liner and weld to the existing Stage IV Phase I primary liner.

13. Contractor shall install primary drainage geocomposite leaving enough new composite flapped over the containment wall to tie into Stage IV Phase I at a later date.

14. Contractor shall install 12" SDR 17 HDPE leachate pipe to limits shown, leaving out a section of pipe of sufficient length at the location of the primary leachate containment wall for connection to Stage IV Phase I at a later date.

15. Contractor shall install 18" 1.5" stone layer over Primary Drainage Geocomposite.

No.	Revision	Date	By
1	Issued for PDES Type I Permit Modification	JAN 2015	RJG

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info@cmaengineers.com www.cmaengineers.com

Date: JAN 2015
Designed by: RJG/BWS/AJS
Drawn by: BWS/AJS
Approved by: RJG
Scale: 1" = 100'

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Proposed Secondary Liner Grading Plan

Drawing no. 6
Sheet 6 of 15

M:\CADD\PROJECTS\633-Tjpa4\633-PSP1406.dwg Date Plotted: Jan 01, 2015 - 2:21pm Plotted By: ASANDAHL

Notes:

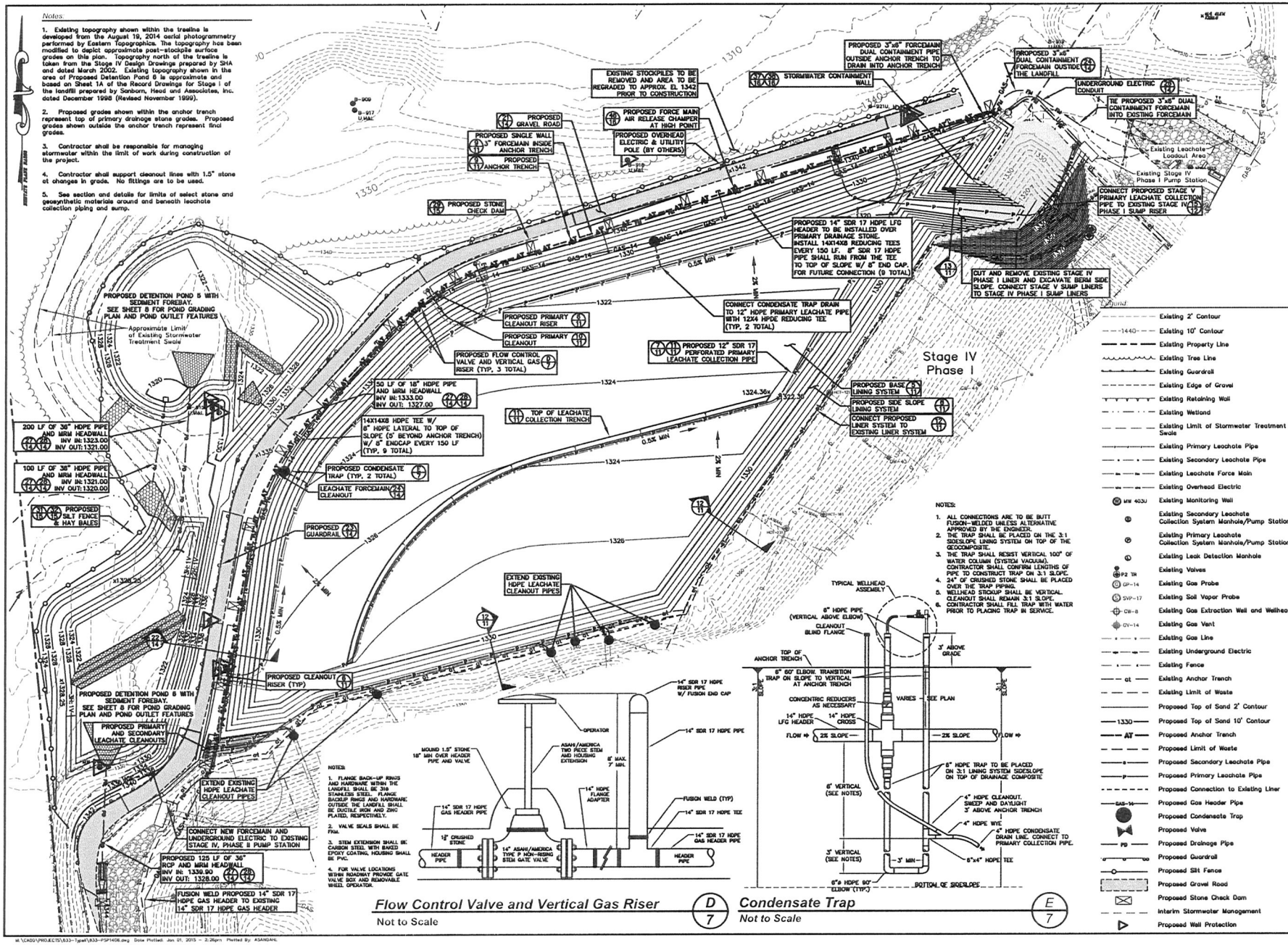
1. Existing topography shown within the treeline is developed from the August 19, 2014 aerial photogrammetry performed by Eastern Topographics. The topography has been modified to depict approximate post-stockpile surface grades on this plan. Topography north of the treeline is taken from the Stage IV Design Drawings prepared by SHA and dated March 2002. Existing topography shown in the area of Proposed Detention Pond 6 is approximate and based on Sheet 1A of the Record Drawings for Stage I of the landfill prepared by Sanborn, Head and Associates, Inc. dated December 1998 (Revised November 1999).

2. Proposed grades shown within the anchor trench represent top of primary drainage stone grades. Proposed grades shown outside the anchor trench represent final grades.

3. Contractor shall be responsible for managing stormwater within the limit of work during construction of the project.

4. Contractor shall support cleanout lines with 1.5" stone at changes in grade. No fittings are to be used.

5. See section and details for limits of select stone and geosynthetic materials around and beneath leachate collection piping and sump.



NOTES:

1. FLANGE BACK-UP RINGS AND HARDWARE WITHIN THE LANDFILL SHALL BE 316 STAINLESS STEEL. FLANGE BACKUP RINGS AND HARDWARE OUTSIDE THE LANDFILL SHALL BE DUCTILE IRON AND ZINC PLATED, RESPECTIVELY.
2. VALVE SEALS SHALL BE FKM.
3. STEM EXTENSION SHALL BE CARBON STEEL WITH BAKED EPOXY COATING. HOUSING SHALL BE PVC.
4. FOR VALVE LOCATIONS WITHIN ROADWAY PROVIDE GATE VALVE BOX AND REMOVABLE WHEEL OPERATOR.

Flow Control Valve and Vertical Gas Riser

Not to Scale

D / 7

NOTES:

1. ALL CONNECTIONS ARE TO BE BUTT FUSION-WELDED UNLESS ALTERNATIVE APPROVED BY THE ENGINEER.
2. THE TRAP SHALL BE PLACED ON THE 3:1 SIDESLOPE LINING SYSTEM ON TOP OF THE GEOCOMPOSITE.
3. THE TRAP SHALL RESIST VERTICAL 100" OF WATER COLUMN (SYSTEM VACUUM). CONTRACTOR SHALL CONFIRM LENGTHS OF PIPE TO CONSTRUCT TRAP ON 3:1 SLOPE.
4. 24" OF CRUSHED STONE SHALL BE PLACED OVER THE TRAP PIPING.
5. WELLHEAD STICKUP SHALL BE VERTICAL. CLEANOUT SHALL REMAIN 3:1 SLOPE.
6. CONTRACTOR SHALL FILL TRAP WITH WATER PRIOR TO PLACING TRAP IN SERVICE.

Condensate Trap

Not to Scale

E / 7

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THE STATE OF NEW HAMPSHIRE REGISTERED PROFESSIONAL ENGINEER

date	JAN 2015
project no.	E25
file name	11-PSP-4D-Rev.
designed by	RJG & BWS/AJS
drawn by	BWS/AJS
approved by	RJG
scale	1" = 50' (H) 1" = 5' (V)

1	Issued for NHDES Type I Permit Modification	JAN 2015	RJG

North Country Environmental Services
Bethlehem, NH

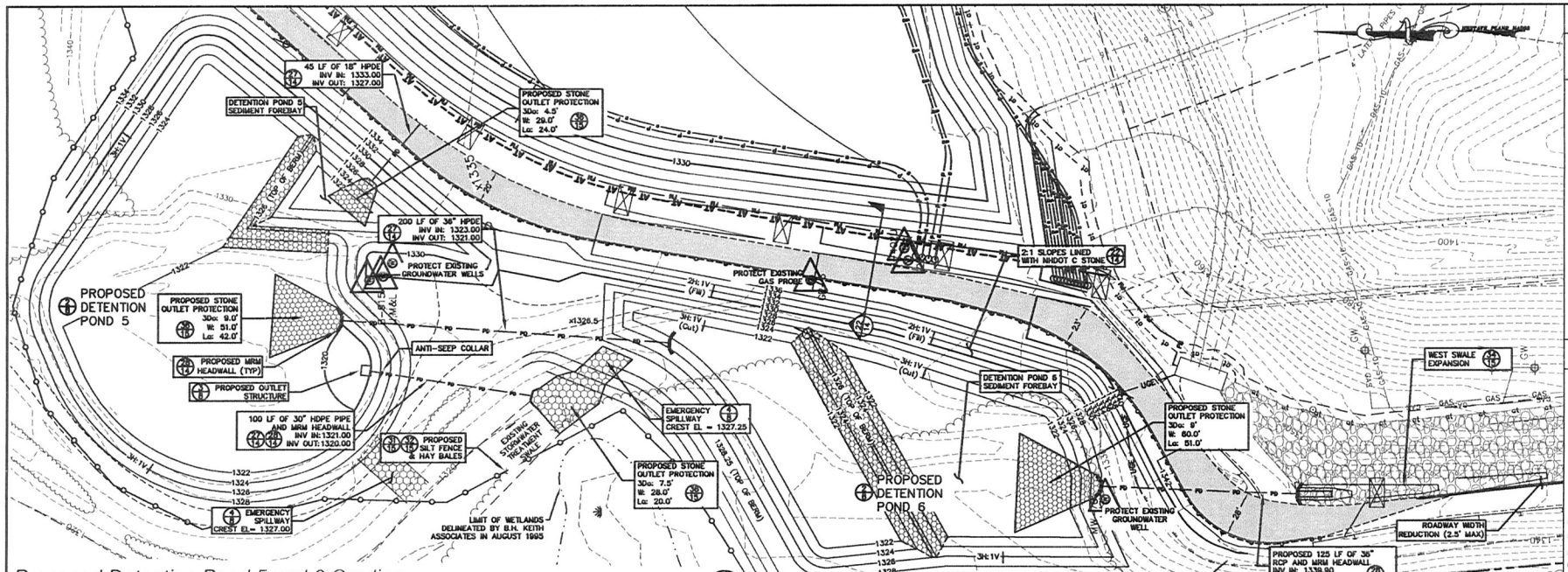
Stage V Landfill Expansion
Construction Drawings

Proposed Primary Drainage Stone Grading Plan

drawing no. 7

sheet 7 of 75

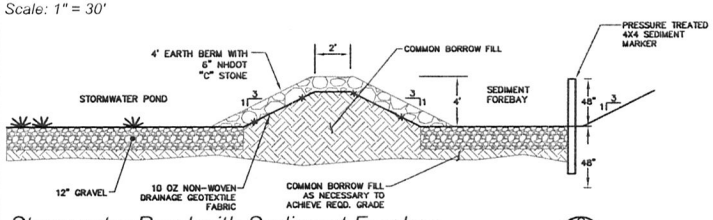
M:\CADD\PROJECTS\E33-Type4\E33-PSP140E.dwg Date Plotted: Jan 01, 2015 - 2:26pm Plotted By: ASANDAHL



Proposed Detention Pond 5 and 6 Grading

Scale: 1" = 30'

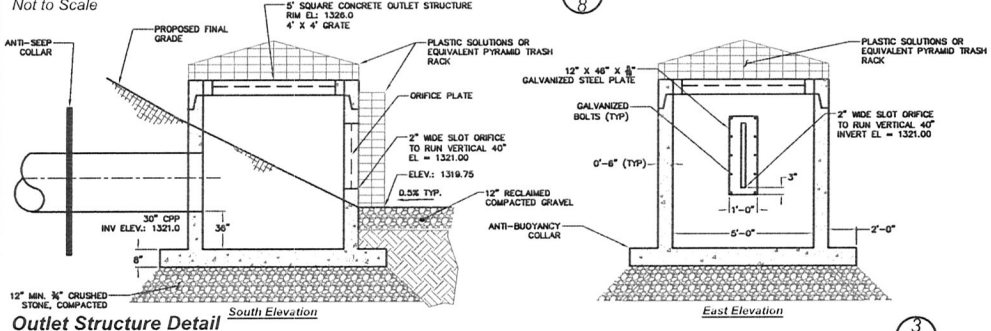
1/8



Stormwater Pond with Sediment Forebay

Not to Scale

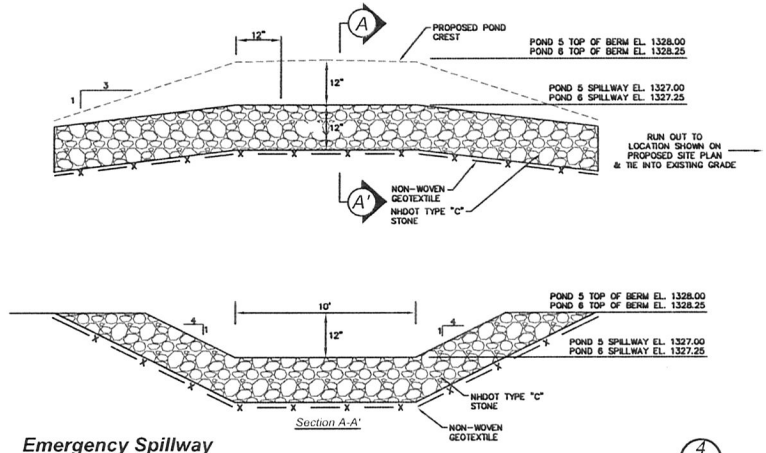
2/8



Outlet Structure Detail

Not to Scale

3/8



Emergency Spillway

Not to Scale

4/8

CMA ENGINEERS
CIVIL/ENVIRONMENTAL ENGINEERS

JAN. 2012 R.J.C.

designed by R.J.C./B.W.S./A.J.S.
drawn by B.W.S./A.J.S.
approved by R.J.C.
date JAN. 2012
project no. 833
file name 11-pgs-4-5.dwg
scale 1" = 30'

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Proposed Detention Pond 5 & 6 Grading Plan

drawing no. 8
sheet 8 of 15

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Erosion Control Notes:

1. Prior to construction and thereafter erosion control measures are to be implemented as noted. The smallest practical area of land should be exposed at any one time during development. When land is exposed during development, the exposure should be kept to the shortest practical period of time. Land should not be left exposed during the winter months.

2. Hay bale barriers shall be installed and maintained along limits of work where shown. Additional hay bales shall be added as required by the Engineer. Hay bales will be staked and maintained prior to and during construction until disturbed areas are covered with crushed gravel or have a healthy stand of grass.

3. All disturbed areas and side slopes which are finish graded with no further construction to take place shall be seeded and mulched within 72 hours. All seed, lime and fertilizer programs shall conform to all applicable sections of the specifications.

4. Any disturbed areas which are to be left temporarily, or longer than two weeks and which will be regraded later during construction, shall be machine hay mulched and seeded at the rate of 2 tons per acre. The smallest practical area shall be disturbed during construction, but in no case shall exceed 5-acres at any one time before disturbed areas are stabilized.

5. Avoid use of undisturbed areas whenever possible during construction. Construction traffic shall travel the roadbeds of existing and future roads.

6. Silt fence shall be installed & maintained where shown and additional silt fence added as required by the Engineer prior to any on-site grading or disturbance of existing surface materials. It should be maintained during and after development to remove sediment from runoff water and from land undergoing development. Where possible natural drainage ways should be utilized and left open to remove clean excess surface water. The silt fence is to be maintained and cleaned until all slopes have a healthy stand of grass.

7. Erosion control devices shall be inspected weekly and after every 0.5-in of rainfall.

8. All disturbed areas shall have a minimum of 4 inches of loam placed, before being seeded and mulched unless otherwise shown. Erosion control matting shall be placed on all slopes steeper than 3:1 and within grass lined swales as shown.

9. After all disturbed areas have been stabilized, the temporary erosion control measures are to be removed and accumulated sediment disposed of in an on site location designated by the Owner.

10. Baled hay and mulch shall be mowings of acceptable herbaceous growth, free from noxious weeds or woody stems, and shall be dry.

11. Silt fences shall be minimum of 36 inches high with the bottom of the fabric keyed into the ground (see detail). Posts shall be of wood or steel.

12. The erosion control devices shown on the Drawings and as specified in the specifications represent the minimum required for erosion control. The Contractor shall add to these devices any and all measures as required by the Engineer to effectively prevent migration of sediment from the work area.

13. All slopes and disturbed areas to be seeded shall comply with the NHDES Section 644 WF Seed Type 45.

14. Lime shall conform to NHDOT specifications, Div. 600, sec. 642 "Limestone". Limestone shall be applied by either the dry or hydraulic method as described in NHDOT Div 600, sec. 644.2.5. The amount of limestone applied should be based on evaluation of soil tests conducted by the contractor. The minimum rate of 2 tons per acre or 100 lbs per sq. ft. shall be applied if required.

15. Fertilizer to be used must be the equivalent of a 15-15-15 mixture and shall be reviewed by the Engineer. Fertilizer shall conform to NHDOT specifications Div. 600, Sec. 643 "Fertilizer for Grasses." Kinds and amounts of fertilizer should be based on evaluation of soil tests conducted by the contractor. The minimum amounts applied shall be as follows:

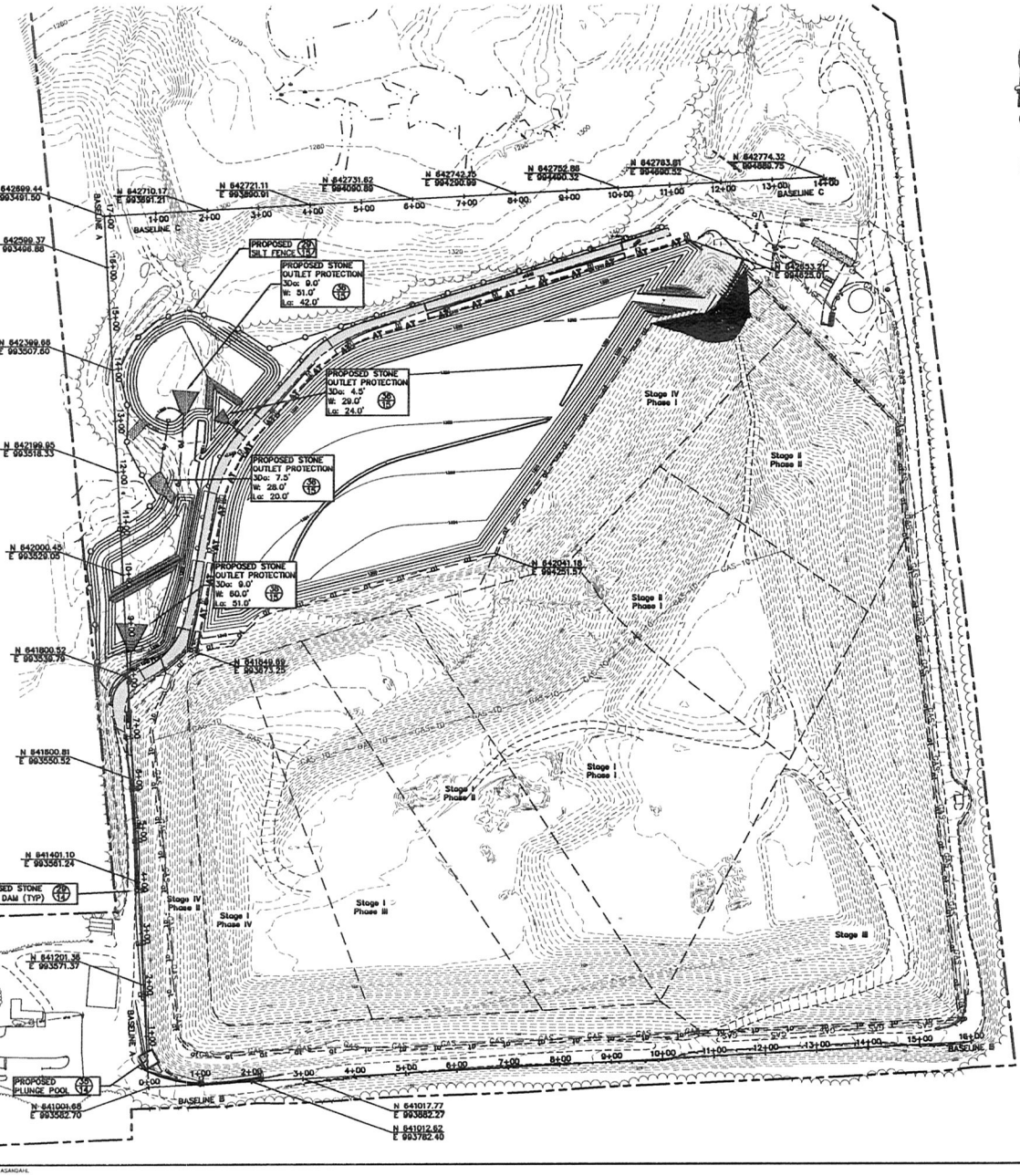
Nitrogen (N) 150 lbs per acre or 1.1 lbs per 1000 s.f.
Phosphate (P O) 100 lbs per acre or 2.2 lbs per 1000 s.f.
Potash (K O) 100 lbs per acre or 2.2 lbs per 1000 s.f.

(Note: This is the equivalent of 500 lbs per acre of 10-20-20 fertilizer or 1000 lbs per acre of 5-10-10)

16. All proposed swales must be stabilized prior to directing runoff to them.

17. All roadways to be stabilized within 72 hours of achieving finished grade.

18. All areas shall be stabilized within 45 days of initial disturbance. An area shall be considered stable if one of the following has occurred:
- Base course gravels have been installed in areas to be paved;
- A minimum of 85% vegetated growth has been established;
- A minimum of 3-in of non-erosive material such as stone or rip rap has been installed; or
- Erosion control blankets have been properly installed.



Winter Construction Notes:

Winter Construction notes prepared in accordance with Rule Env-Wq 1505.05

1. All proposed vegetated areas which do not exhibit a minimum of 85% vegetative growth by November 30th, or which are disturbed after November 30th, shall be stabilized by seeding and installing bonded fiber matrix and soil stabilizer at a rate of 3,000 lb/acre and 10 gallons/acre respectively for stabilization over winter. The seeding and mulching shall not occur over accumulated snow or on frozen ground and shall be completed in advance of thaw or spring melt events;

2. All ditches or swales which do not exhibit a minimum of 85% vegetative growth by November 30th, shall be stabilized temporarily with stone or erosion control blankets appropriate for the design flow conditions; and

3. After November 30th, incomplete road or parking surfaces, where work has stopped for the winter season, shall be protected with a minimum of 3 inches of crushed gravel per NHDOT Item 304.3.

Legend:

- Existing 2' Contour
- Existing 10' Contour
- Existing Property Line
- Existing Tree Line
- Existing Limit of Wetland
- Existing Guardrail
- Existing Edge of Gravel
- Existing Retaining Wall
- Existing Edge of Pond
- Existing Primary Leachate Pipe
- Existing Secondary Leachate Pipe
- Existing Leachate Force Main
- Existing Overhead Electric
- MW 403U — Existing Monitoring Well
- Existing Secondary Leachate Collection System Manhole/Pump Station
- Existing Primary Leachate Collection System Manhole/Pump Station
- Existing Leak Detection Manhole
- PZ TR — Existing Valves
- GP-14 — Existing Gas Probe
- SVP-17 — Existing Soil Vapor Probe
- GW-8 — Existing Gas Extraction Well and Wellhead
- GV-14 — Existing Gas Vent
- Existing Gas Line
- Existing Underground Electric
- Existing Fence
- Existing Anchor Trench
- Existing Limit of Waste
- Proposed Anchor Trench
- Proposed Limit of Work
- 1440 — Proposed 10' Contour
- Proposed 2' Contour
- Proposed Gravel Road
- PD — Proposed Drainage Pipe
- Proposed Waste Excavation
- Proposed Stone Check Dam
- Proposed Silt Fence

	JAN. 2013	RJG
Issued for NHDES Type I Permit Modification		

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Date	JAN. 2013
Project No.	833
Reviewed by	RJG
Drawn by	BWS/AJS
Approved by	RJG
Scale	1" = 100'

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

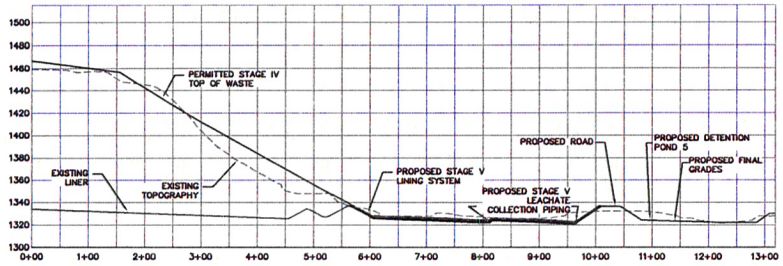
Erosion Control and
Site Layout Plan

Drawing No. 9

Sheet 9 of 16

Notes:

1. Section Lines are shown on Sheet 3



Section A-A'
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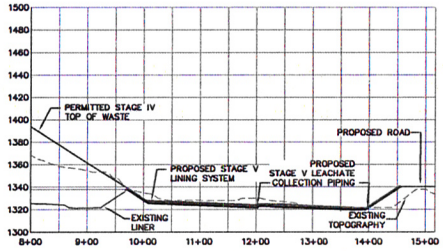
Vertical: 1" = 50'



Section B-B'
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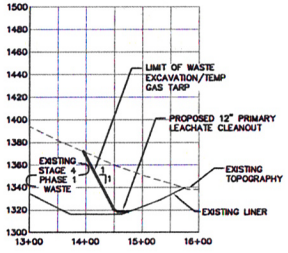
Vertical: 1" = 50'



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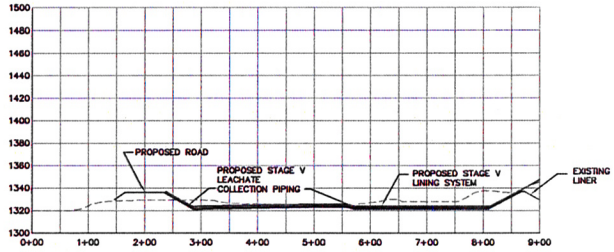
Vertical: 1" = 50'



Baseline A Station 12+00
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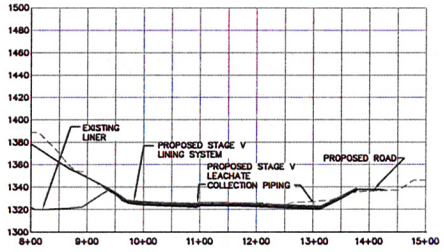
Vertical: 1" = 50'



Baseline B Station 4+00
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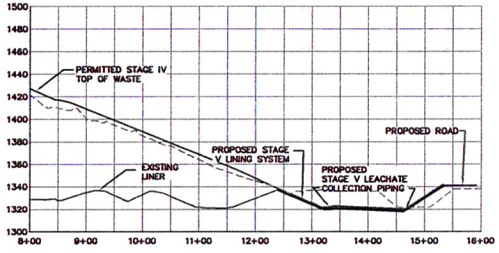
Vertical: 1" = 50'



Baseline B Station 9+00
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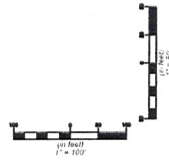
Vertical: 1" = 50'



1	Issued for NHDES Type I Permit Modification	JAN. 2015	RJG
No.	revision	date	By

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date JAN. 2015
project no. 833
file name
CTY-Xsections1408-A19.dwg
designed by RJG/BWS/AJS
drawn by BWS/AJS
approved by RJG
scale NONE

North Country Environmental Services
Bethlehem, NH

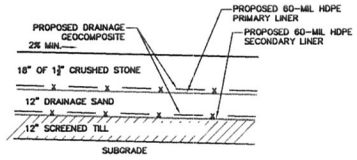
Stage V Landfill Expansion
Construction Drawings

Landfill Cross Sections

drawing no.
10

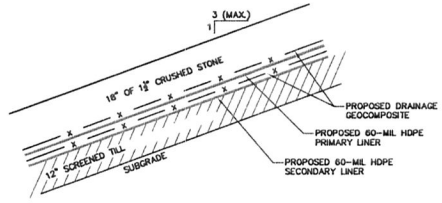
sheet 10 of 15

M:\CADD\PROJECTS\833-Tgpak\833-XSections1408-A19.dwg Date Plotted: Jan 01, 2015 – 2:34pm Plotted By: ASANDAHL



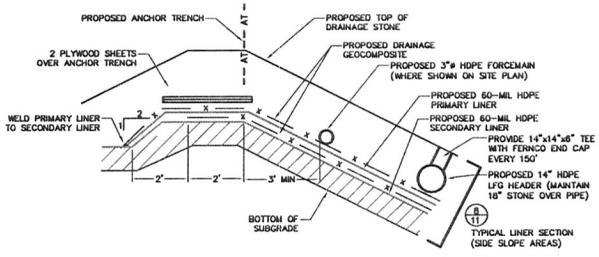
Typical Liner Section (Base Areas)

Not to Scale (5/6) (5/7)



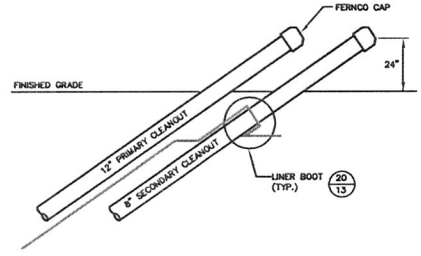
Typical Liner Section (Side Slope Areas)

Not to Scale (8/6) (8/7) (8/14)



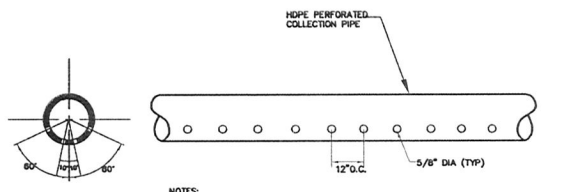
Typical Anchor Trench

Not to Scale (9/6) (9/7) (9/14)



Primary & Secondary Cleanout Riser

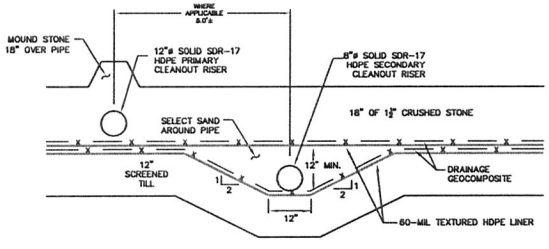
Not to Scale (6/6) (6/7)



NOTES:
1. PRIMARY LEACHATE COLLECTION PIPE INSIDE LANDFILL SHALL BE 12" DIA. HDPE SDR 17
2. SECONDARY LEAK DETECTION PIPE INSIDE LANDFILL SHALL BE 8" DIA. HDPE SDR 17
3. PRIMARY & SECONDARY PIPES ARE NON-PERFORATED WHEN PASSING THROUGH FLAPS, PHASE SEPARATION, AND INTERMEDIATE BERMS. SEE APPROPRIATE SECTIONS AND DETAILS.
4. PRIMARY AND SECONDARY CLEANOUT/VENT PIPES ARE NON-PERFORATED.

Perforated Collection Pipe

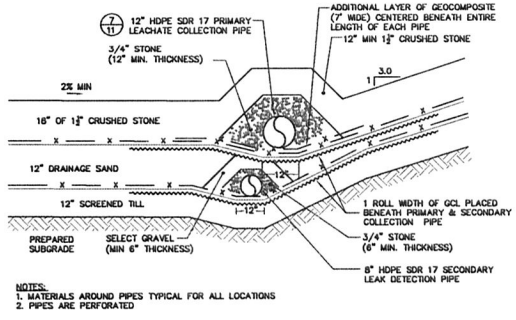
Not to Scale (7/6) (7/7)



NOTES:
1. SEE BOOT REQUIREMENTS FOR SECONDARY CLEANOUT AT ANCHOR TRENCH THIS SHEET.
2. CLEANOUTS SHALL EXTEND 24" ABOVE FINISHED GRADE AND PROVIDED WITH FERNCO CAP.

Primary & Secondary Cleanout Cross Section

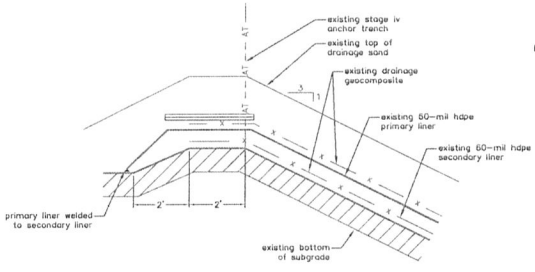
Not to Scale (10/6) (10/7)



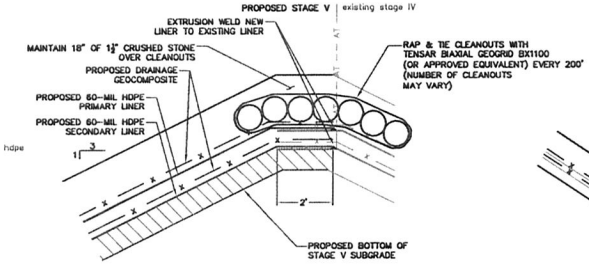
NOTES:
1. MATERIALS AROUND PIPES TYPICAL FOR ALL LOCATIONS
2. PIPES ARE PERFORATED

Leachate Collection Pipe

Not to Scale (11/6) (11/7)



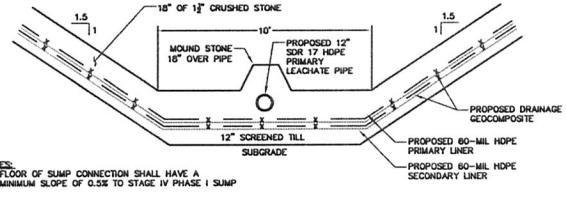
EXISTING



PROPOSED

Liner Connection to Stage IV

Not to Scale (12/6) (12/7)



NOTES:
1. FLOOR OF SUMP CONNECTION SHALL HAVE A MINIMUM SLOPE OF 0.5% TO STAGE IV PHASE I SUMP

Connection to Stage IV Phase I Sump

Not to Scale (13/6) (13/7)

CMA ENGINEERS
CIVIL ENVIRONMENTAL ENGINEERS
15 Bow Drive, Bedford, NH 03110
603-472-5191
Large Place
55 Jackson Street, Portsmouth, NH 03801
603-431-1127
Fax 603-433-7779
info@cmaengineers.com www.cmaengineers.com

Issued for NHDES Type II Permit Modification	JAN 2015	RJG

DATE JAN 2015 | DESIGNED 5.AS.BWS.AJS | DRAWN BWS.AJS | REVIEWED RJG

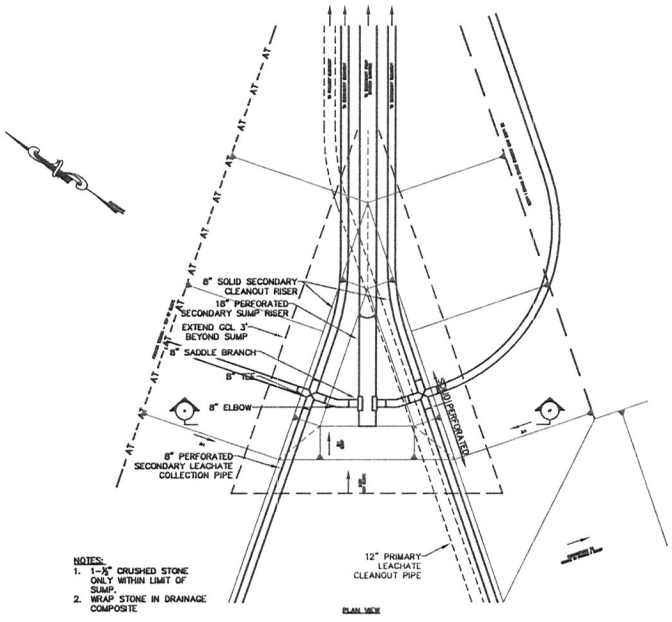
North Country Environmental Services
Bethlehem, NH

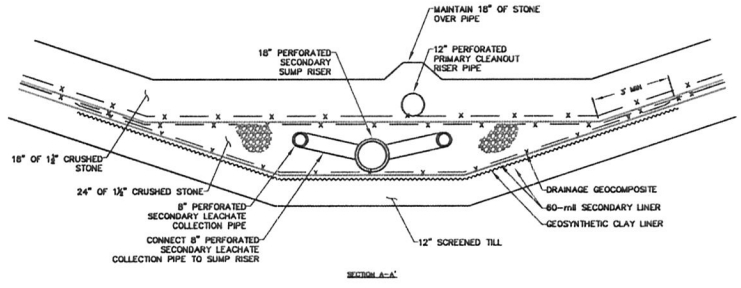
Stage V Landfill Expansion
Construction Drawings

Details - Landfill

Drawing no. 11

M:\CADD\PROJECTS\633-Type4\633-Details1408.dwg Date Plotted: Jan 01, 2015 – 2:40pm Plotted By: ASANGARI

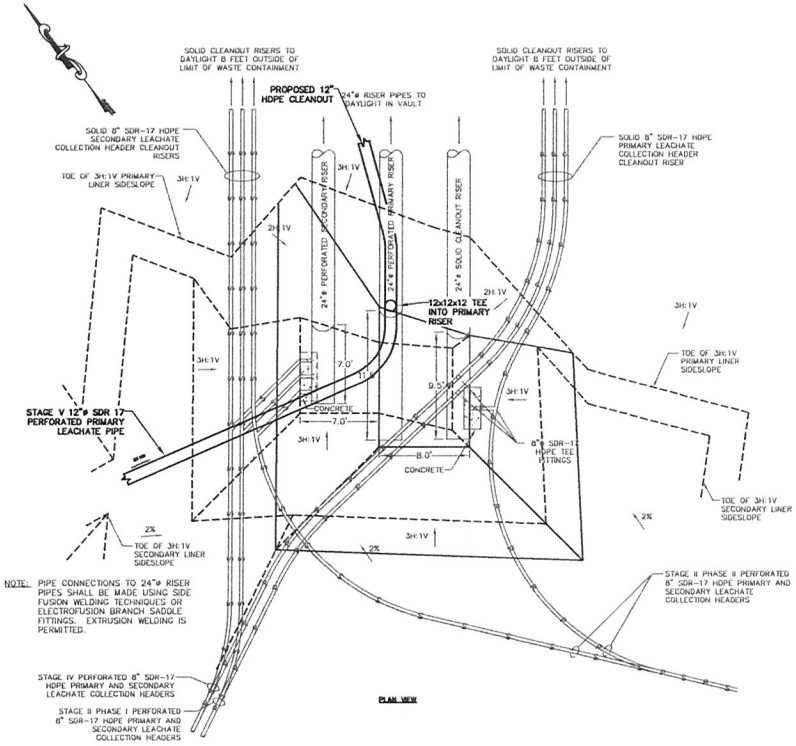


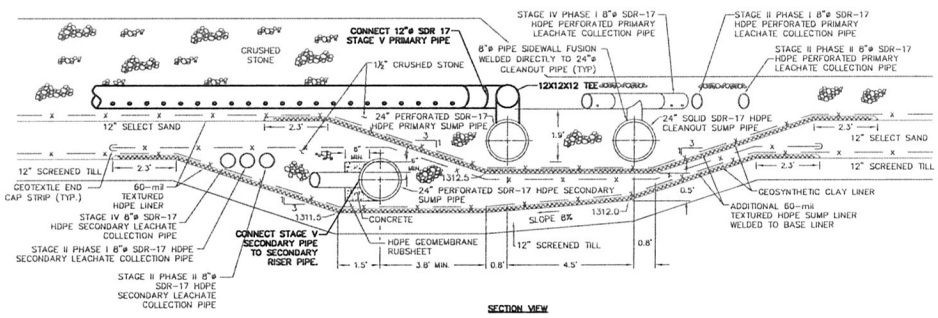


Stage V Secondary Sump

Not to Scale

14
6





Connection to Stage IV, Phase I Sump

Not to Scale

15
7

JAN 2012	R.J.G.

ISSUED FOR NHDES Type I Permit Modification

CMA ENGINEERS
Civil Environmental Engineers

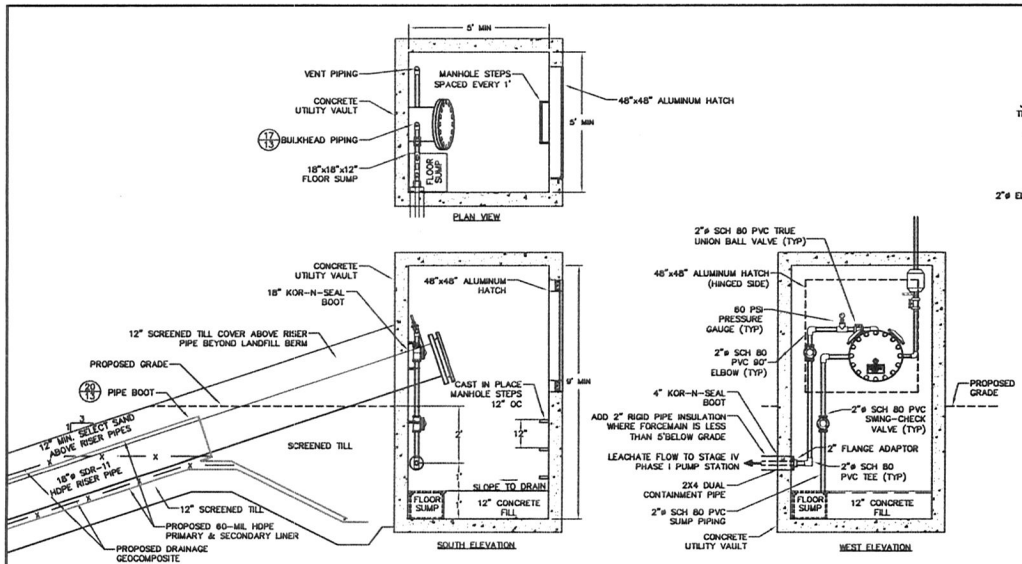
North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Details
Sump Modification & Construction

Drawing No. 12

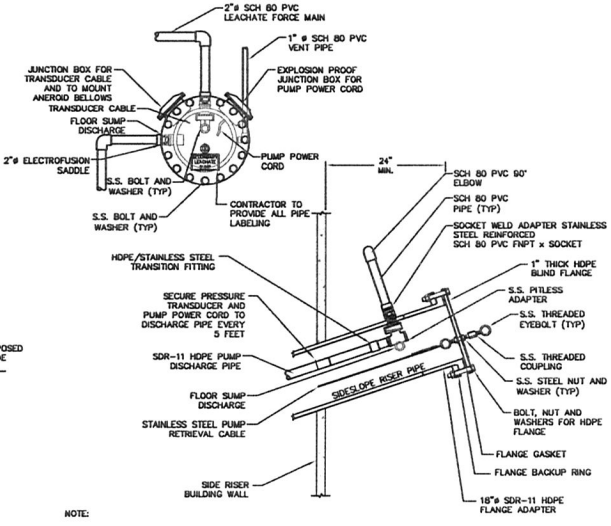
M:\CADD\PROJECTS\833-Type8\833-Details1408.dwg Date Plotted: Jan 01, 2015 – 2:34pm Plotted By: ASANDAHL



Secondary Pump Station Manhole

Not to Scale

16/6



NOTE:

1. CONTRACTOR SHALL PROVIDE AN ENGRAVED STAINLESS STEEL LABEL ON THE TOP OF EACH RISER THAT SHOWS THE TOTAL LENGTH OF THE SIDE RISER PIPE ALONG THE INVERT.

EQUIPMENT LIST

PITLESS ADAPTER – MODEL NW STAINLESS STEEL DISCHARGE ADAPTER, EPG COMPANIES, INC., MAPLE GROVE, MN, (800)443-7526.

FLANGE BACKUP RING – DUCTILE IRON FLANGE BACKUP RING WITH POWDERCOAT EPOXY COATING.

BOLTS FOR FLANGE (16 PER FLANGE)– GRADE 8 PLAIN STEEL HEX-HEAD CAP SCREWS, 1-1/8"-7 STANDARD THREAD, 8-1/2" LONG.

HEX NUTS FOR FLANGE (16 PER FLANGE)–PLAIN STEEL HEX FULL NUT, 1-1/8"-7.

WASHERS FOR FLANGE (32 PER FLANGE)– PLAIN STEEL SAE STANDARD FLAT WASHER, 1-1/8" SCREW SIZE, 2-1/4" O.D., 9/64" THICK.

FLANGE GASKETS – 1/8-INCH THICK VITON FULL FACE FLANGE GASKET.

PUMP CORD JUNCTION BOX – EXPLOSION PROOF JUNCTION BOX, 4" x 4" MINIMUM INTERIOR DIMENSIONS.

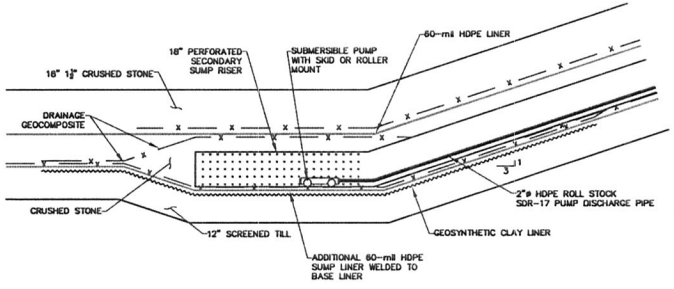
PROVIDE PASS-THROUGH SINGLE TIER TERMINAL BLOCKS FOR PUMP POWER AND TRANSDUCER CONDUCTORS. PROVIDE LABELS FOR EACH TERMINAL.

EXTEND PRESSURE TRANSDUCER CABLE VENT TUBE TO ANEROID BELLOWS MOUNTED IN THE TRANSDUCER CABLE JUNCTION BOX ON THE WALL OF THE SIDESLOPE RISER PIPE.

Bulkhead Piping Detail

Not to Scale

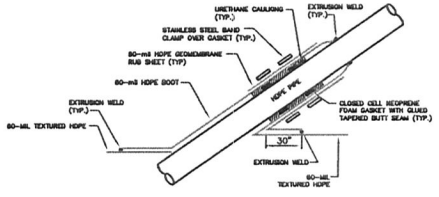
17/6



Proposed Secondary Sump Riser to Manhole Pump Station

Not to Scale

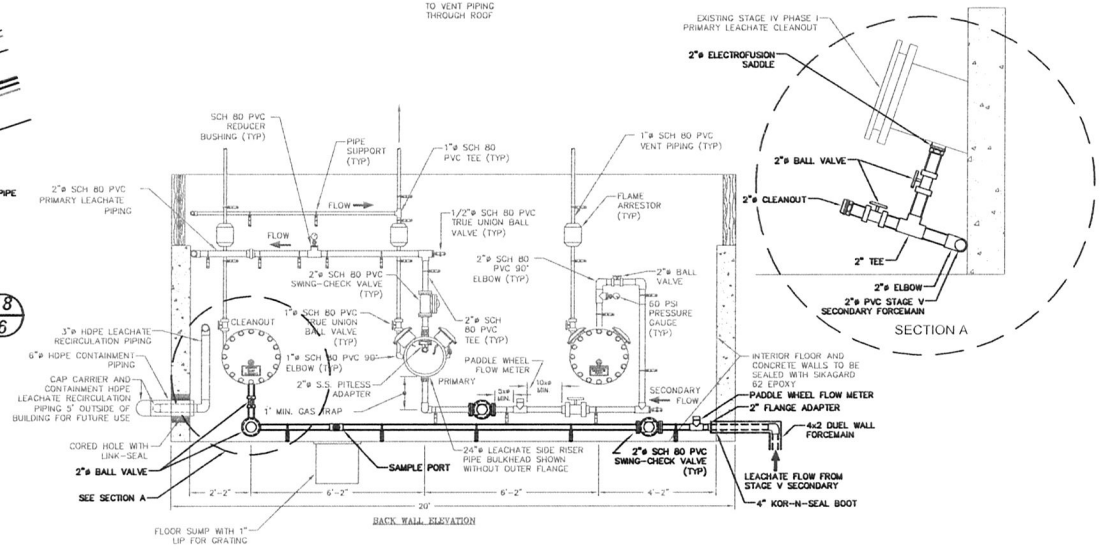
18/6



Typical Boot Detail

Not to Scale

20/11 20/13



Proposed Alterations To Stage IV Side Riser Building Piping

Not to Scale

19/6

CMA ENGINEERS
CIVIL ENVIRONMENTAL ENGINEERS

DATE	DESCRIPTION	BY	CK
JAN 2015	Issued for NHDES Type I Permit Modification	RJC	

DATE: JAN 2015
DESIGNED: EJS
DRAWN: BMS/AJS
CHECKED: RJC
APPROVED: RJC

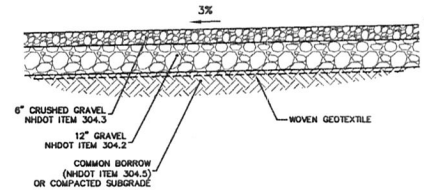
North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Details
Riser Modification & Construction

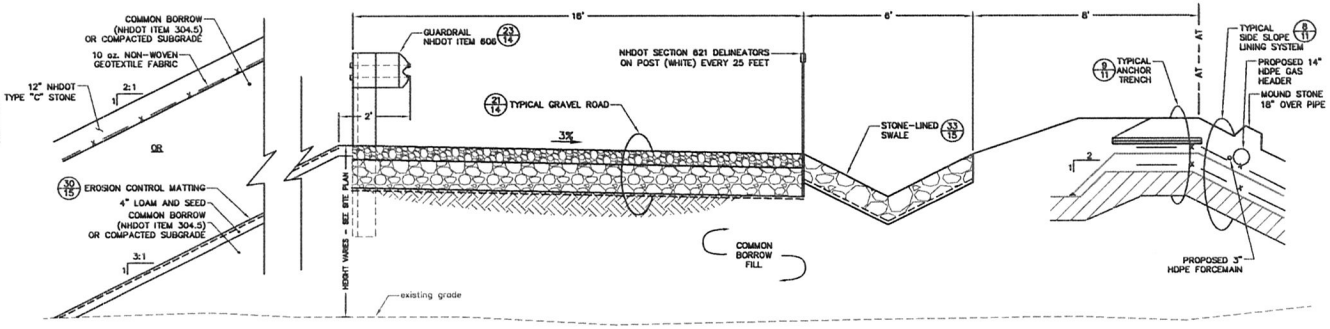
drawing no. 13

M:\CADD\PROJECTS\833-Type4\833-Details1406.dwg Date Plotted: Jan 01, 2015 – 2:56pm Plotted By: ASANGAIL



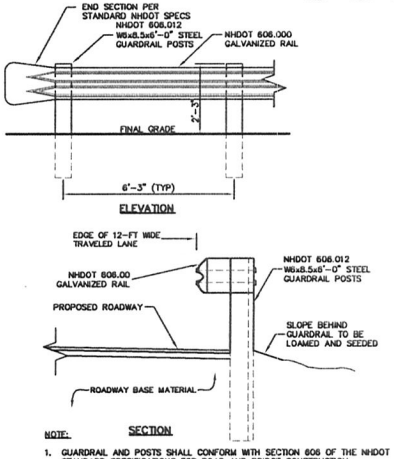
Typical Gravel Road Section (21/6) (21/7) (21/14)

Not to Scale



Landfill Berm & Roadway (22/6) (22/7) (22/8)

Not to Scale

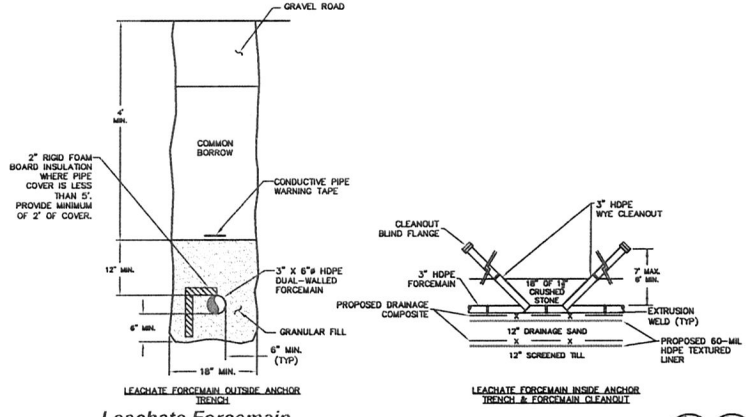


NOTE:

1. GUARDRAIL AND POSTS SHALL CONFORM WITH SECTION 606 OF THE NHDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION.

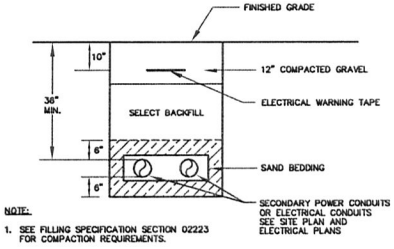
Typical Guardrail Detail (23/6) (23/7) (23/14)

Not to Scale



Leachate Forcemain (24/6) (24/7)

Not to Scale

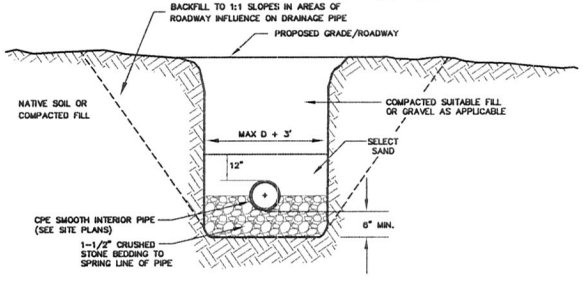


NOTE:

1. SEE FILLING SPECIFICATION SECTION 02223 FOR COMPACTION REQUIREMENTS.

Underground Electric Conduit Detail (26/6) (26/7)

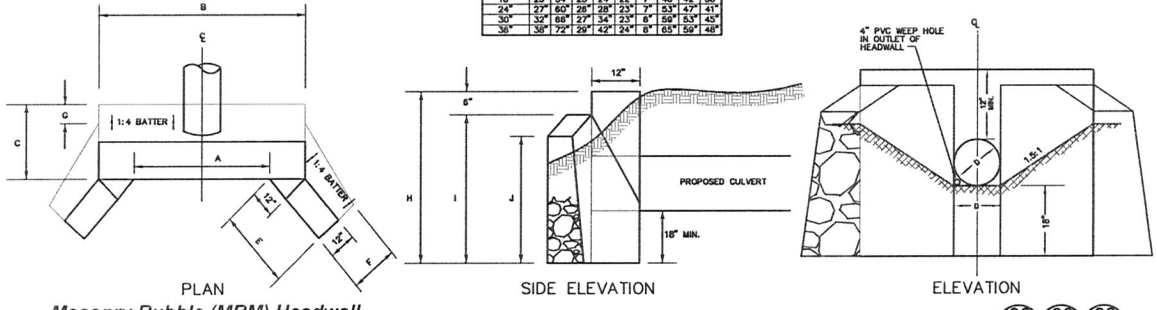
Not to Scale



Typical Drainage Pipe Trench (27/6) (27/7) (27/8)

Not to Scale

DIAMETER D	A	B	C	E	F	G	H	I	J
15"	23"	54"	24"	20"	22"	7"	43"	36"	36"
18"	25"	54"	25"	24"	22"	7"	48"	42"	38"
24"	27"	60"	26"	28"	23"	7"	53"	47"	41"
30"	32"	66"	27"	34"	23"	8"	59"	53"	45"
36"	38"	72"	29"	42"	24"	8"	65"	59"	48"



Masonry Rubble (MRM) Headwall (28/6) (28/7) (28/8)

Not to Scale

CMA ENGINEERS
CIVIL ENVIRONMENTAL LANDUSE

Large Plots
22 Bow Street
Concord, NH 03301
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1 Tree Farm
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info@cmaengineers.com
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STATE OF NEW HAMPSHIRE
ALAN BINSALE
No. 9811
LICENSED PROFESSIONAL ENGINEER

DATE	JAN 2016
PROJECT NO.	833
DRAWN BY	BMS
CHECKED BY	ASB
APPROVED BY	ASB
SCALE	

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Details - Site Work

Drawing No.
14

Issued for NHDES Type I Permit Modification

1	JAN 2016	ASB

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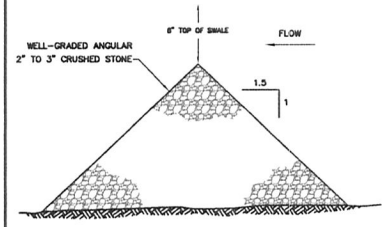


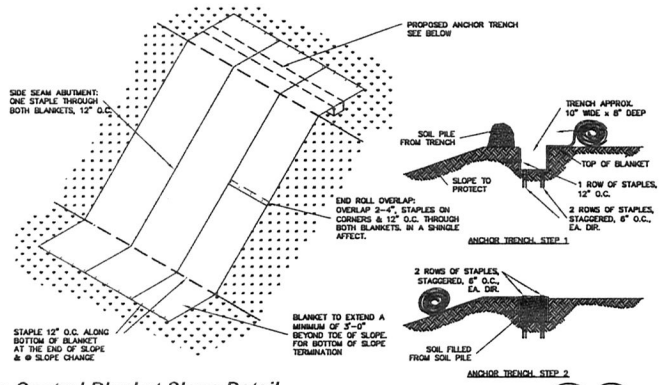
NOTES:

1. PLACE CRUSHED STONE TO WITHIN 6" OF TOP OF DRAINAGE WAY.
2. FOR ACTIVE DRAINAGE OUTFLOW CHECK DAMS SHALL BE PLACED IN SERIES ALONG FLOW LINE TO RETAIN SEDIMENTS.

Stone Check Dam

29/6 29/7 29/9

Not to Scale



Erosion Control Blanket Slope Detail

30/9 30/14

Not to Scale

Erosion Control Notes

1. Prior to construction and thereafter erosion control measures are to be implemented as noted. The smallest practical area of land should be exposed at any one time during development. When land is exposed during development, the exposure should be kept to the shortest practical period of time. Land should not be left exposed during the winter months.

2. Hay bale barriers shall be installed and maintained along limits of work where shown. Additional hay bales shall be added as required by the Engineer. Hay bales will be staked and maintained prior to and during construction until disturbed areas are covered with crushed gravel or have a healthy stand of grass.

3. All disturbed areas and side slopes which are finish graded with no further construction to take place shall be seeded and mulched within 72 hours. All seed, lime and fertilizer programs shall conform to all applicable sections of the specifications.

4. Any disturbed areas which are to be left temporarily, or longer than two weeks and which will be regraded later during construction, shall be machine hay mulched and seeded at the rate of 2 tons per acre. The smallest practical area shall be disturbed during construction, but in no case shall exceed 5-acres at any one time before disturbed areas are stabilized.

5. Avoid use of undisturbed areas whenever possible during construction. Construction traffic shall travel the roadbeds of existing and future roads.

6. Silt fence shall be installed & maintained where shown and additional silt fence added as required by the Engineer prior to any on-site grading or disturbance of existing surface material. It should be maintained during and after development to remove sediment from runoff water and from land undergoing development. Where possible natural drainage ways should be utilized and left open to remove clean excess surface water. The silt fence is to be maintained and cleaned until all slopes have a healthy stand of grass.

7. Erosion control devices shall be inspected weekly and after every 0.5-in of rainfall.

8. All disturbed areas shall have a minimum of 4 inches of loam placed, before being seeded and mulched unless otherwise shown. Erosion control matting shall be placed on all slopes steeper than 3:1 and within grass lined swales as shown.

9. After all disturbed areas have been stabilized, the temporary erosion control measures are to be removed and accumulated sediment disposed of in an on site location designated by the Owner.

10. Baled hay and mulch shall be mowings of acceptable herbaceous growth, free from noxious weeds or woody stems, and shall be dry.

11. Silt fences shall be minimum of 36 inches high with the bottom of the fabric keyed into the ground (see detail). Posts shall be of wood or steel.

12. The erosion control devices shown on the Drawings and as specified in the specifications represent the minimum required for erosion control. The Contractor shall add to these devices any and all measures as required by the Engineer to effectively prevent migration of sediment from the work area.

13. All slopes and disturbed areas to be seeded shall comply with the NHDES Section 644 WF Seed Type 45.

14. Lime shall conform to NHDOT specifications, Div. 600, sec. 642 "Limestone". Limestone shall be applied by either the dry or hydraulic method as described in NHDOT Div 600, sec. 644.2.5. The amount of limestone applied should be based on evaluation of soil tests conducted by the contractor. The minimum rate of 2 tons per acre or 100 lbs per sq. ft. shall be applied if required.

15. Fertilizer to be used must be the equivalent of a 15-15-15 mixture and shall be reviewed by the Engineer. Fertilizer shall conform to NHDOT specifications Div. 600, Sec. 643 "Fertilizer for Grasses." Kinds and amounts of fertilizer should be based on evaluation of soil tests conducted by the contractor. The minimum amounts applied shall be as follows:

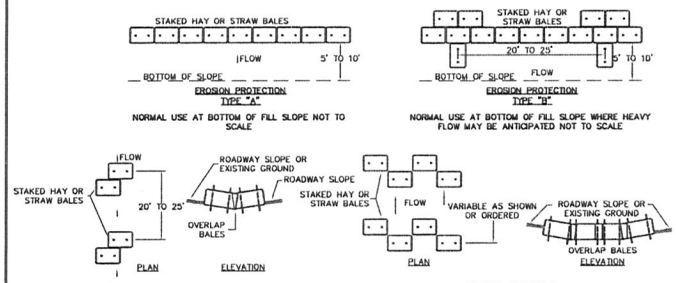
Nitrogen (N) 150 lbs per acre or 1.1 lbs per 1000 s.f.
Phosphate (P O) 100 lbs per acre or 2.2 lbs per 1000 s.f.
Potash (K O) 100 lbs per acre or 2.2 lbs per 1000 s.f.

(Note: This is the equivalent of 500 lbs per acre of 10-20-20 fertilizer or 1000 lbs per acre of 5-10-10)

16. All proposed swales must be stabilized prior to directing runoff to them.

17. All roadways to be stabilized within 72 hours of achieving finished grade.

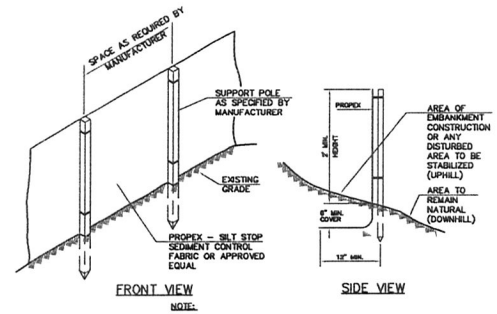
18. All areas shall be stabilized within 45 days of initial disturbance. An area shall be considered stable if one of the following has occurred:
- Base course gravels have been installed in areas to be paved;
- A minimum of 85% vegetated growth has been established;
- A minimum of 3-in of non-erosive material such as stone or rip rap has been installed; or
- Erosion control blankets have been properly installed.



Hay Bales

31/6 31/7 31/8 31/9

Not to Scale



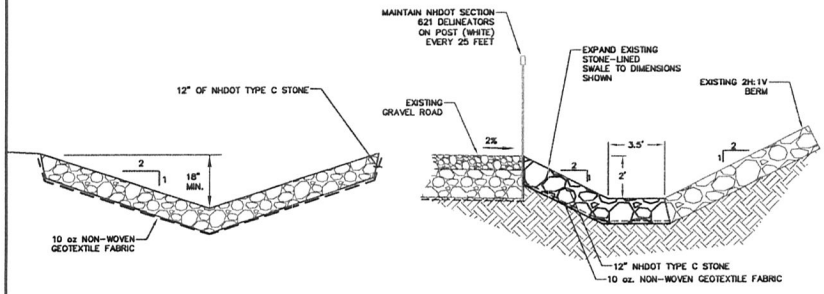
NOTE:

1. AT A MINIMUM, SILT FENCE IS TO BE INSTALLED TO PROTECT WETLAND AREAS, WATERWAYS, EXISTING AND PROPOSED DRAINAGE FEATURES, SLOPES, LAWNS AND PLANTINGS ADJACENT TO THE WORK.

Silt Fence

32/6 32/7 32/8 31/9

Not to Scale



Stone-Lined Swale

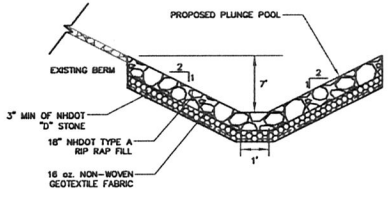
33/14

Not to Scale

West Swale Expansion Section

34/6 34/7 34/8

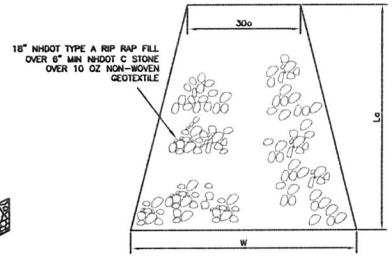
Not to Scale



Plunge Pool Detail

35/3 35/9

Not to Scale



NOTE:

1) STONE TO BE A MINIMUM OF 24" DEEP.

2) CONTRACTOR RESPONSIBLE FOR REMOVING DEBRIS OR SEDIMENT WHICH ENTERS STONE PRIOR TO STABILIZATION.

3) SEE DRAWINGS FOR REQUIRED DIMENSIONS.

Typical Culvert Outlet Protection

36/8 36/9

Not to Scale

No.	Issued for NHDES Type I Permit Modification	JAN 2015	RJG
1			

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STATE OF NEW HAMPSHIRE
RICHARD J. GUERIN
No. 9404
PROFESSIONAL ENGINEER

DESIGNED BY RJG/BMS/AJS
DRAWN BY BMS/AJS
REVIEWED BY RJG
DATE JAN 2015
PROJECT NO. 8211
FILE NO. 14-1014
FILENAME 14-1014.DWG
SCALE NONE

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

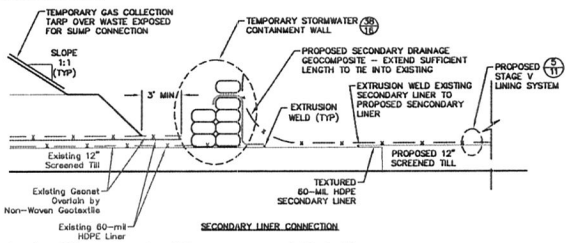
Details - Erosion Control

DRAWING NO. 15

SHEET 15 OF 16

M:\CADD\PROJECTS\833-Type4\833-Details1408.dwg Date Plotted: Jan 01, 2015 – 3:07pm Plotted By: ASANDAHL

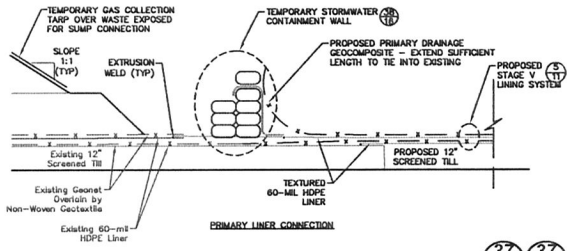
NOTE: CONTRACTOR SHALL TAKE ALL MEASURES AND PRECAUTIONS NECESSARY TO PROPERLY CONTROL THE TEMPORARY STORMWATER MANAGEMENT SYSTEM AND CONTAINMENT BERM REQUIRED FOR THE CONNECTION TO THE EXISTING STAGE IV PHASE I PRIMARY AND SECONDARY LINER SYSTEMS AND CONSTRUCTION OF THE NEW STAGE V SUMP. CONTRACTOR SHALL PREVENT ANY STORMWATER FROM ESCAPING FROM THE CONTAINMENT AREA TO THE LEACHATE COLLECTION SYSTEM. CONTRACTOR SHALL OPERATE AND MAINTAIN THE CONTAINMENT SYSTEM AND PUMPS 24 HOURS PER DAY FOR THE DURATION THAT THE CONTAINMENT SYSTEM IS OPERATIONAL, AND TO HAVE ON-SITE BACK UP PUMPS AND BACK-UP GAS/DIESEL POWERED GENERATORS IN THE EVENT EXISTING ELECTRICAL CONNECTIONS OR GENERATOR CEASE TO FUNCTION.

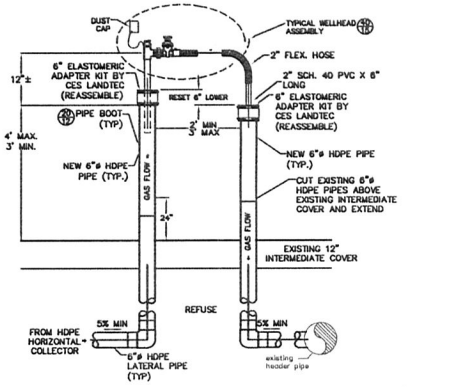


Interim Stormwater Management Detail

Not to Scale

37/6 37/7

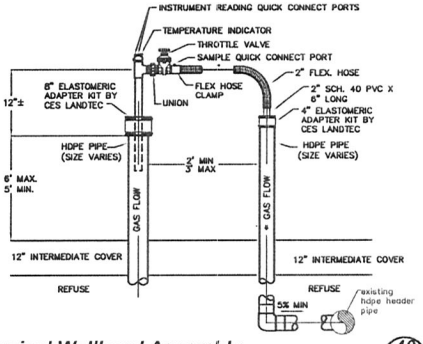




Horizontal Gas Collection Wellhead

Not to Scale

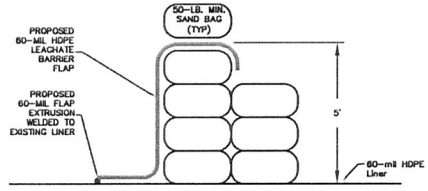
39/4



Typical Wellhead Assembly

Not to Scale

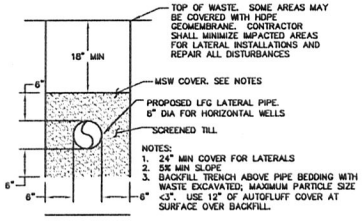
40/4 40/16



Typical Stormwater Containment Wall Section

Not to Scale

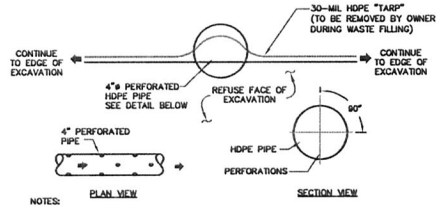
38/6 38/7



Landfill Gas Lateral

Not to Scale

43/4



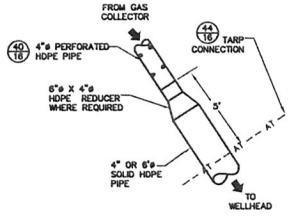
NOTES:

1. HOLES SHALL BE 1/2"ø DRILLED HOLES SPACED 12" APART IN 4 ROWS ALONG THE LENGTH OF THE PIPE. ROWS SHALL BE LOCATED 90° APART OFFSET 6" ALONG THE AXIS OF THE PIPE.

Temporary Horizontal Collector

Not to Scale

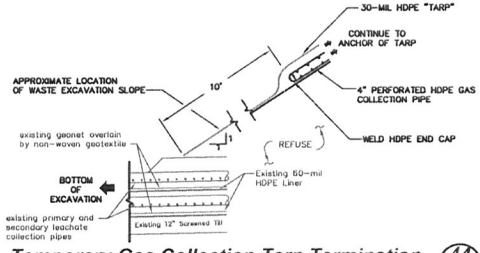
41/4 41/16



Gas Collector Connection

Not to Scale

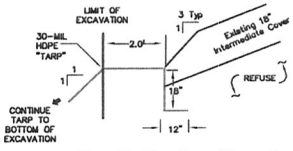
42/4 42/16



Temporary Gas Collection Tarp Termination

Not to Scale

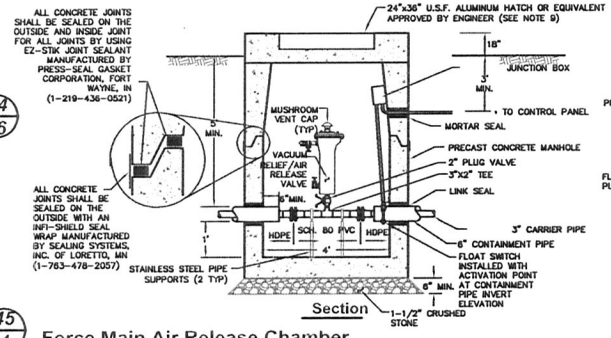
44/4 44/16

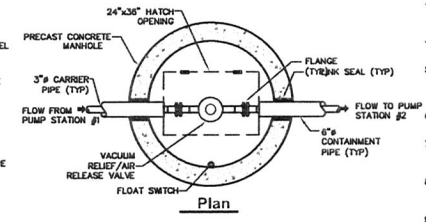


Temporary Gas Collection Tarp Anchor Trench

Not to Scale

45/4





Force Main Air Release Chamber

Not to Scale

46/6 46/7

GENERAL LEAK DETECTION AND AIR RELEASE CHAMBER NOTES:

1. ASSUME CLASS 1 DIVISION 1 GROUP D ATMOSPHERE IN ALL BELOW-GRADE STRUCTURES, INCLUDING MANHOLES AND VALVE BOXES.
2. TWO COATS OF SIKAGARD 62 SHALL BE APPLIED TO THE FLOOR AND WALLS OF ALL THE MANHOLES INCLUDING ACROSS ALL BARREL SECTION JOINT SURFACES. CONCRETE SURFACE TO BE COATED SHALL BE DRY, FREE OF SURFACE VOIDS, HONEYCOMBED CONCRETE, CRACKS, MORTAR SMEARS, DIRT, AND FORM RELEASE AGENTS. SURFACE DEFECTS SUCH AS CRACKS, HOLES, OR CAVITIES SHALL BE FILLED AND FINISHED FLUSH WITH A PORTLAND CEMENT GROUT OR CONCRETE. VOIDS IN SURFACES ARE TO BE FILLED TO CREATE A SMOOTH, SLIGHTLY POROUS SURFACE. CLEAN ALL SURFACES TO REMOVE DIRT, MUD, DEBRIS, DUST, LAITANCE, ETC.
3. DRAIN PIPE PERFORATIONS SHALL BE ¼"ø HOLES SPACED 120° RADIALLY AND 6" ALONG AXIS OF PIPE.
4. FLOAT SWITCH CIRCUITS SHALL BE INTRINSICALLY SAFE.
5. PIPE SUPPORT NOT SHOWN. CONTRACTOR SHALL PROVIDE SUPPORTS AND RESTRAINTS AS REQUIRED TO SECURE THE PIPE SYSTEM IN THE MANHOLES.
6. PROVIDE FULL-FACE VITON GASKET FOR ALL FLANGE CONNECTIONS.
7. CONTAINMENT PIPES ARE TO BE LEFT OPEN-ENDED IN MANHOLES UNLESS OTHERWISE NOTED.
8. FORCE MAIN PIPING SHALL BE SDR-17 CARRIER PIPE WITHIN SDR-17 CONTAINMENT PIPE UNLESS OTHERWISE NOTED.
9. ALUMINUM HATCH SHALL BE U.S.F. FABRICATION TYPE WAPS (FLOODTIGHT/GASTIGHT) WITH STAPLE FOR PADLOCK. HATCH SHALL BE CAST INTO CHAMBER COVER.

Issue	Date	Initials
1	Issued for NHDES Tank Permit Modification	JAN 2015	RJG

CMA ENGINEERS
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designed by RJG/BWS/AJS
drawn by BWS/AJS
approved by RJG
date JAN 2015
project no. 833
scale NONE

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Details
Temporary Environmental Controls

drawing no. 16

sheet 16 of 16

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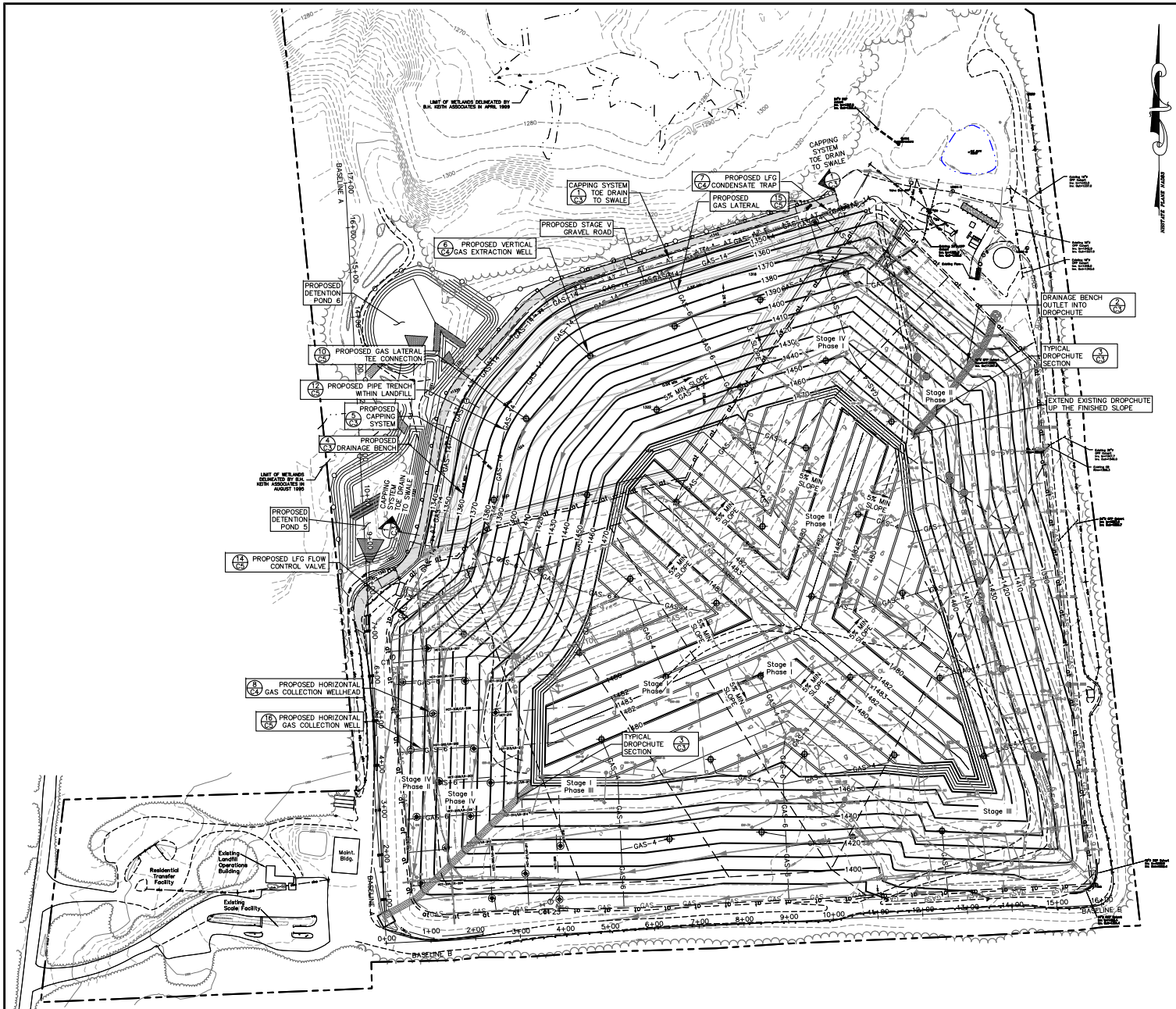
Part IV

REVISED CLOSURE PLAN DRAWINGS SHEETS C2 AND C3



Notes:

1. Existing topography shown is from the October 9, 2013 aerial survey performed by Eastern Topographics.
2. Existing topography within the Stage V footprint is not shown for clarity. Proposed Stage V top of drainage sand for reference.
3. Proposed capping grades shown are final top of cap grades. Top of waste grades are 3.83' lower than shown.
4. All proposed landfill capping system drainage benches shall be spaced every 100' on center horizontally at a minimum slope of 2%.
5. Final closure grades shall have a maximum slope of 3:1 and a minimum slope of 5%.
6. Final closure grades shall have a maximum elevation of 1483' above mean sea level.

Legend:

- Existing 2' Contour
- Existing 10' Contour
- Existing Property Line
- Existing Tree Line
- Existing Guardrail
- Existing Edge of Gravel
- Existing Retaining Wall
- Existing Edge of Pond
- Existing Primary Leachate Pipe
- Existing Secondary Leachate Pipe
- Existing Leachate Force Main
- Existing Overhead Electric
- MW 403U — Existing Monitoring Well
- P2 TR — Existing Valves
- GP-14 — Existing Gas Probe
- SVP-17 — Existing Soil Vapor Probe
- GW-8 — Existing Gas Extraction Well and Wellhead
- GV-14 — Existing Gas Vent
- Existing Gas Line
- Existing Underground Electric
- Existing Fence
- Existing Anchor Trench
- Existing Limit of Waste
- 1330 — Proposed Stage V 10' Primary Sand Contour
- 1330 — Proposed Stage V 10' Closure Contour
- AT — Proposed Anchor Trench
- Proposed Limit of Waste
- Proposed Drainage Bench Centerline
- Proposed Horizontal LFG Well Head
- Proposed Horizontal LFG Collector
- GW-8 — Proposed Vertical Well & Well Head
- GAS-4 — Proposed LFG Pipe (Number denotes diameter)

no.	revision	date	by
1	Issued to NHDES with Type I-A Permit Modification	FEB 2014	RJG
2	Issued for NHDES Review - Supplemental Submittal	3/7/14	RJG
3	Issued for NHDES Review- May 22, 2014 Comments	6/19/14	RJG
4	Issued for NHDES Review - July 18, 2014 Comments	7/28/14	RJG
5	Issued to NHDES with Type I-B Permit Modification	JAN 2015	RJG

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THE STATE OF NEW HAMPSHIRE RICHARD J. GUERTIN 9404 PROFESSIONAL ENGINEER

designed by: RJG/BWS
drawn by: BWS/LBK
approved by: RJG
date: February 2014
project no: 833
file name: 833-Closure Plan1411.dwg
scale: 0 50 100 (in feet) 1" = 100'

North Country Environmental Services
Bethlehem, NH
Stage V Landfill Expansion
Type I-A Permit Modification
Final Grading Plan

drawing no. C2

sheet: 2 of 5

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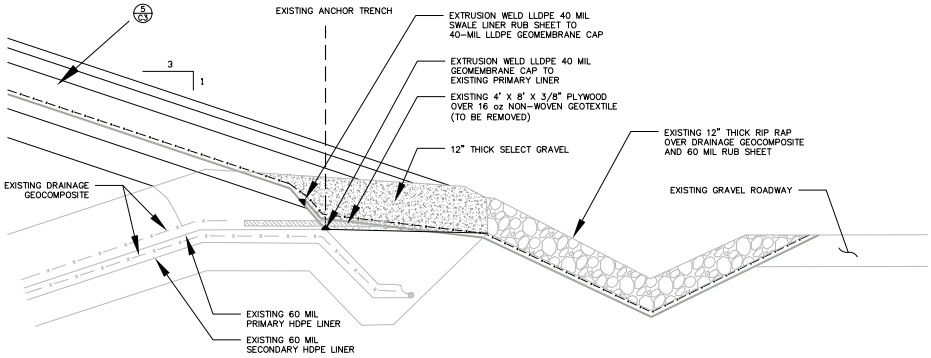
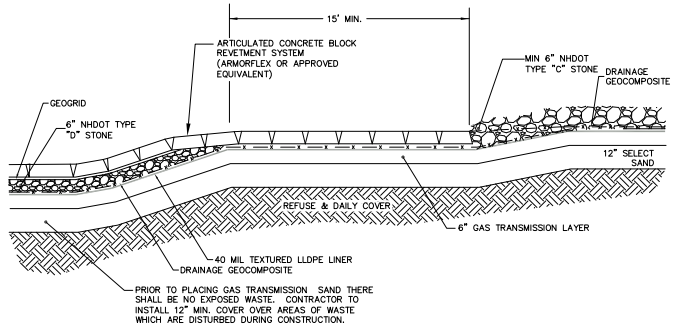


Capping System Toe Drain to Swale

Not to Scale

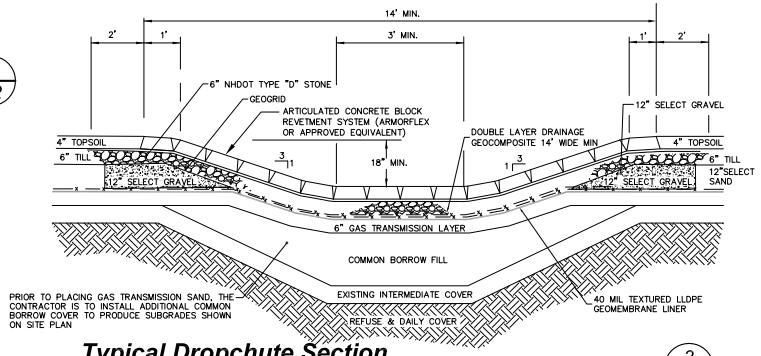
1 / C2



Drainage Bench Outlet Into Dropchute

Not to Scale

2 / C2



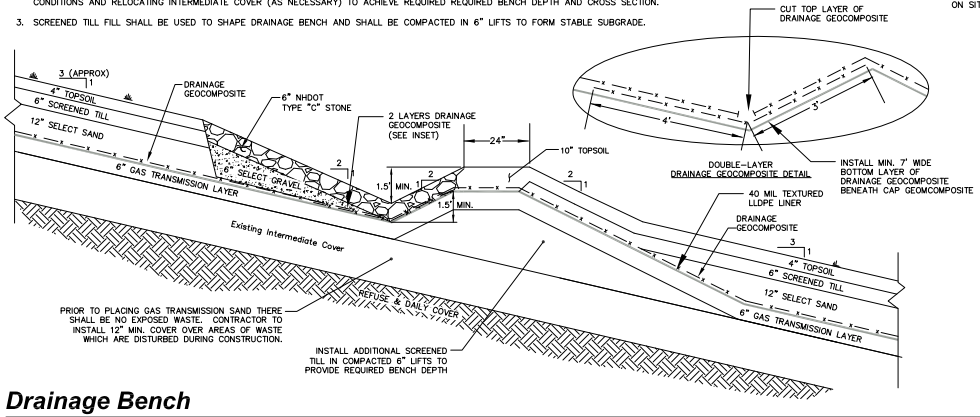
Typical Dropchute Section

Not to Scale

3 / C2

NOTES:

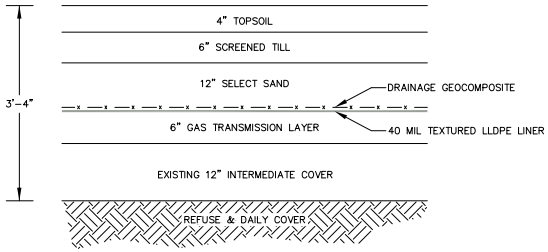
1. DRAINAGE BENCHES SHALL BE NEWLY CONSTRUCTED AT THE SPACING SHOWN ON THE PLANS AT A MINIMUM 2% SLOPE.
2. EXISTING INTERMEDIATE COVER THICKNESS AT SWALES ARE APPROXIMATE AND NOT VERIFIED. CONTRACTOR IS RESPONSIBLE FOR VERIFYING EXISTING CONDITIONS AND RELOCATING INTERMEDIATE COVER (AS NECESSARY) TO ACHIEVE REQUIRED REQUIRED BENCH DEPTH AND CROSS SECTION.
3. SCREENED TILL FILL SHALL BE USED TO SHAPE DRAINAGE BENCH AND SHALL BE COMPACTED IN 6" LIFTS TO FORM STABLE SUBGRADE.



Drainage Bench

Not to Scale

4 / C2



Capping System Section

Not to Scale

5 / C2

no.	revision	date	by
1	Issued for NHDES Comments	2/7/13	RJG
2	Issued for NHDES Review - Supplemental Submittal	3/7/14	RJG
3	Issued for NHDES Review- May 22, 2014 Comments	6/19/14	RJG
4	Issued to NHDES with Type I-B Permit Modification	JAN 2015	RJG

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designed by: RJG/BWS
drawn by: BWS
approved by: ATR
date: February 2014
project no: 833
file name: 833-Closure Details1411.dwg
scale:

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Type I-A Permit Modification

Closure Details

drawing no. C3

sheet: 3 of 5

Drawing file: M:\CADD\PROJECTS\833-Tyrell\Revised Closure Plans\833-Closure Details1411.dwg 1/01/2015 4:02pm

Part V

STORMWATER MANAGEMENT REPORT

NHDES SOLID WASTE TYPE I-B PERMIT MODIFICATION
STORMWATER MANAGEMENT REPORT
North Country Environmental Services, Inc.
Solid Waste Landfill
Stage V Landfill Expansion
Bethlehem, New Hampshire

February 2014 (Revised January 2015)

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Stage V Closure Drawings (Bound Separately)

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B. Hydrologic Soil Plans
C. Extreme Precipitation Tables
D. Pre & Post-Development Flow Summary Tables
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   ii. 10-Year Storm
   iii. 25-Year Storm
   iv. 50-Year Storm
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   i. Drainage Diagram
   ii. 25-Year, 24 Hour Storm Calculations
F. Post-Development Drainage Analysis
   i. Drainage Diagram
   ii. 25-Year, 24 Hour Storm Calculations
G. Natural Heritage Bureau Data Base Check
H. FEMA Flood Plain Map

PROJECT DESCRIPTION

This Stormwater Management Report is revised to incorporate modifications to site stormwater features including the construction of an additional stormwater pond on the west side of the site (Detention Pond No. 6) and modification and expansion of existing Detention Pond No. 5. With these improvements, the expansion of Detention Pond 4 will not be necessary. The Pond 4 expansion was approved as part of the Type I-A Permit Modification.

NCES is submitting a Type I-B Permit Modification to incorporate these modifications to the approved Design Drawings including changes to the site stormwater design. Concurrently, NCES is submitting a Type II Permit Modification to approve the Construction Drawings. NCES anticipates applying for a new Alteration of Terrain permit for Stage V construction upon the approval of the Type II permit modification.

Background

The North Country Environmental Services (NCES) landfill site is located off Trudeau Road in Bethlehem, NH, southeast from the center of town. The site is situated south of Rt. 302 and the Ammonoosuc River and east of Trudeau Road. The land to the south is undeveloped National Forest.

The landfill is operated under permits issued by NHDES-WMD including a Solid Waste Facility Management Permit (DES-SW-SP-03-002) and a Groundwater Release Detection Permit (GWP-198704033-B-006). The facility also operates and manages stormwater run-off in accordance with its NPDES-Multi Sector General Permit for industrial activities.

To date, the NCES landfill has been developed in four stages with the most recent expansion being Stage IV, Phase IIB, which was substantially completed in November 2013. The proposed Stage V expansion was approved by the NHDES in August 2014 and is an 8.06 acre horizontal expansion to the northwest of the existing landfill.

NCES is proposing additional stormwater improvements from what was approved by the NHDES in August, including construction of an additional 0.75 acre detention pond (Proposed Detention Pond No. 6) and expansion of the detention pond previously identified as Detention Pond 6 to include the limits of existing Detention Pond No. 5 (now identified as Proposed Detention Pond No. 5 (1.03 acres)). These modifications are made in part to reduce stormwater flow to Detention Pond No. 4, so that the reach of perimeter and intermediate bench swales is shortened and stormwater flows are more spacially balanced and distributed. The proposed ponds are located to the west of proposed Stage V. With these improvements, the expansion of Detention Pond No. 4 will not be necessary. The expansion of Detention Pond No. 4 was approved in August 2014 and would have increased its area from 0.86 acres to 1.14 acres. Detention Pond No. 3 will be demolished with the construction of Stage V.

The new stormwater configuration is designed to accommodate additional flow generated by future low-emissions tarping, if installed, as depicted on the fill sequence plans submitted as part of the Stage V permit application.

Other stormwater features include drainage swales and culverts to convey runoff to the stormwater ponds. The outlet structure for Detention Pond No. 5 is designed with a replaceable orifice plate in the event NCES places low-emissions tarp on the landfill surface. The plate to be installed during Stage V construction would restrict peak off-site flow during heavy rain events, i.e. greater than the 10-year storm. The replacement orifice plate would restrict the increased peak off-site flow with the low emissions tarp in place, particularly for the two-year storm event. The approved outlet structure had an orifice weir cast into the structure.

Emergency overflow spillways will be installed on Detention Ponds No. 5 and 6 that will discharge to the stormwater treatment swale.

Treatment of impervious surfaces continues to be achieved through the northwestern stormwater treatment swale. The total length of the stormwater treatment swale will be reduced from 624 feet to 490 feet with the construction of Detention Pond 6. The stormwater treatment swale will continue to provide appropriate treatment at the reduced

length. Detention Ponds Nos. 5 and 6 are equipped with sedimentation forebays to provide additional treatment.

Under the new stormwater configuration, approximately half of the area of the fully closed landfill (Stages I through V) will drain to the northeastern dropchute and half will drain to a plunge pool at the southwest corner of the landfill. NCES Operations will reconfigure intermediate bench swales so that southern and western landfill faces will drain to this southwestern plunge pool. From this southwest point, stormwater flow will be along the western toe swale to Detention Pond No. 6. To accommodate additional flow in this swale it is proposed to be widened at the base from 2 feet to 3.5 feet. Northern and eastern faces will continue to drain to the northeastern dropchute.

The intent of this report is to present the final design of the stormwater management system and erosion control practices for the overall Stage V landfill expansion. The expansion is anticipated to be constructed in two phases. Phase I will take place over the 2015 construction season and include all site work and stormwater improvements and 4.5 acres of the liner system. Phase II construction will finalize the remaining 3.5 acres of the liner system during the 2016 construction season.

Design Summary

The proposed construction has been designed so that no runoff outside the landfill area enters the landfill, erosion and sediment transport due to surface runoff is controlled, and the 25-year, 24-hour peak post-development stormwater flow does not exceed the pre-development condition. Precipitation falling into the active phase of the landfill will be collected as leachate until it can be shed as clean runoff from the intermediate or final cover systems. Precipitation falling onto inactive and closed portions of the landfill will be discharged as stormwater to the detention ponds prior to treatment through the treatment swale.

To meet the requirements of RSA 485-A:17, Env-Wq 1504.08, and Env-Sw 805.09, the pre- and post-development (following closure of Stage V) peak stormwater runoff flows

were calculated for the 25-year, Type II, 24-hour storm event. Pre- and post-development flows for the 2-year, 10-year, and 50-year 24 hour storm events were also

analyzed for the anticipated Alteration of Terrain permit application and are reported in this application. The 100-year storms were also analyzed for confirmation of the detention pond sizing and the existing outlet structure design. The method used for all analyses was SCS TR55: Urban Hydrology for Small Watersheds, performed with Autodesk's Storm and Sanitary Analysis® modeling software. Pre- and post-development drainage analysis results are presented in Appendix E and F, respectively.

Precipitation values for each 24-hour storm event are obtained from the Extreme Precipitation Estimates published by the Northeast Regional Climate Center (see Appendix C). Utilization of these tables to model storm events was at the request of NHDES-Alteration of Terrain Program for all projects starting in 2013. The results of the analyses are summarized in the following sections while all drainage analysis output reports are presented in Appendices E and F.

The pre-development analysis depicts pre-landfill conditions with data obtained from available USGS mapping and NRCS Soil Survey Data. The post development conditions depicted in this application represent the final closure conditions of the operating landfill, following the full development of Stage V. It is anticipated that Stage V will reach final waste grades in 2022. However, the actual closure date will depend on tonnage and compaction rates. The post-development conditions represent the worst case scenario for peak flows.

The majority of stormwater flow leaving the site flows to the north and northwest and infiltrates to groundwater or eventually discharges into the Ammonoosuc River. Prior to development of the landfill, the soils on the site were classified by the National Resources Conservation Service (NRCS) to include Adams loamy sand, Waumbeck loamy sand, Monadnock and Hermon soils, Croghan loamy fine sand, and Kinsman sand

(See Appendix B). The soils are predominantly in hydrologic Group B. A portion of the area beneath the existing landfill is Group C.

All work associated with the Stage V landfill expansion will be completed over existing developed or disturbed areas including the soil borrow areas and existing Detention Pond No 3. Because there are no new areas of disturbance, a High Intensity Soil Survey was not completed for the project. The total of new impervious area associated with Stage V construction is 8.63 acres, which includes the 8.06 acre landfill expansion. The remaining 0.57 acres includes the gravel perimeter road.

As required by the AoT regulations, maximum sheet flow length of 100 feet was assumed for all drainage areas. A curve number for the capping system and stabilized intermediate cover conditions was conservatively assumed as CN=74, regardless of the pre-existing soil zone as the landfill capping system is not connected to existing soils. For the stone lined slopes (i.e. berms), a curve number of 62 has been utilized as we have assumed that potential maximum soil moisture retention in the clean borrow materials beneath the subgrade is over 6 inches.

Wetlands on the site were previously delineated by B.H. Keith Associates, Inc. of Freedom, NH. There are no proposed disturbances to delineated wetlands for the proposed closure construction. A search of NH Natural Heritage Bureau database was performed using the online data check tool. Search results indicate there are no rare species or exemplary natural communities within the limits of the proposed Stage V work or on the NCES property. See Appendix G for a copy of the NH Natural Heritage Bureau database search results.

The project is not located within a flood plain and a copy of the FEMA Flood Insurance Rate Map for the landfill is provided in Appendix H.

A portion of the proposed construction project area is located within the Designated River Corridor. The corridor is depicted on the post-development drainage plans. Upon approval of the Stage V Type II permit modification, a copy of the associated Alteration of Terrain permit application will be transmitted to the Local Rivers Advisory Committee.

A summary of peak off-site flows for the pre-development and post-development conditions at the site is presented below:

	Pre-Development (cfs)			
Design Storm	2-yr	10-yr	25-yr	50-yr
Out North	0.91	12.66	34.13	61.58
Out Southwest	None			
Total	**0.91**	**12.66**	**34.13**	**61.58**

	Post-Development (cfs)			
Design Storm	2-yr	10-yr	25-yr	50-yr
Out North	0.28	2.62	9.51	19.57
Out Southwest	0.46	1.91	3.56	5.24
Total	**0.74**	**4.53**	**13.07**	**24.81**

The point of analysis is north and upstream of the NCES facility and identified in the calculations as "Out North". All post development peak off-site flows to this point are reduced from the pre-development condition.

There is a small southern portion of the site which includes runoff of the southern landfill berm, identified as drainage area C1, which discharges to "Out Southwest" in the post development condition. Runoff from this area is managed by stormwater devices to the west in the vicinity of the scales and office which was permitted previously AoT-0394. These berms, access roads, and other landfill appurtenances which make up drainage area C1 were constructed in previous construction projects. There are no proposed changes in this area with the Stage V construction and no new stormwater is directed to the drainage area. The predevelopment model does not model an outfall for this area. Existing stormwater management features in the area of the facility which currently manage stormwater from drainage area C1 have performed adequately to date.

PRE-DEVELOPMENT CONDITIONS

Prior to development as a landfill site, the property consisted of wooded areas with a borrow pit operation on its eastern portion. A topographic survey of the site prior to development does not exist, but based on the United States Geological Survey (USGS) mapping, the ground surface slopes to the north and northwest to a natural drainage course that flows to the north and then east into the Ammonoosuc River.

The pre-development conditions includes wooded areas in good condition, over Hydrologic Group A, B, and C soils and a borrow pit over Group B Soil comprising a watershed area of 112.17 acres. Three pre-development sub-areas (A1, A2 & B1) have been evaluated for peak flow off the site prior to development. Areas A1 and A2 discharge to the northwest and north (northwest outfall) in a defined drainage way (see USGS mapping). Drainage Area B1 discharges to the northwest toward a wetland area that then in the north in a defined channel (northeast outfall). Flows from basins A and B combine prior to leaving the property in an existing drainage course that flows east to the Ammonoosuc River (north outfall). The letter designations correspond to the post-development drainage areas that discharge to the same drainage course. The pre-development drainage diagram, including the time of concentration flow paths, are provided along with the pre-development drainage analysis calculations in Appendix E.

POST-DEVELOPMENT CONDITIONS

The post-development condition assumes the Stage V landfill expansion is constructed, filled to the maximum permitted capacity and closed with the final capping system.

Throughout the development of the previous four stages of the landfill, detention ponds have been constructed and eliminated as needed to manage stormwater while continuing landfill operations. Currently, stormwater is managed at the facility by Detention Ponds 3 and 4 and a grass-lined treatment swale. The Stage V post-development condition will eliminate Detention Pond No. 3 and construct new Detention Ponds 6 on the west side of the site. Detention Pond 5 is partially constructed and will be expanded to the limits of the detention pond depicted in the approved construction drawings (formerly Detention Pond No. 6). Construction of proposed Detention Pond No. 6 will require reducing the length of the existing treatment swale from 624 to 490 feet. Detention Pond No. 5 will outlet to the existing treatment swale. Stormwater treatment in the post-development condition will continue to be provided by the treatment swale.

NCES intends to divert stormwater away from Detention Pond No. 4 by grading intermediate drainage benches to drain to a proposed plunge pool at the southwest corner of the landfill. The plunge pool combines with flow from the southern toe swale and outlets to the western toe swale draining to proposed Detention Pond No. 6. Under this configuration, approximately ½ of the closed landfill will drain to Detention Pond No. 4 and the other half will drain to the new Detention Ponds 5 and 6. The base of the western toe swale is being widened from 2 feet to 3.5 feet to accommodate the additional flow.

Previous Post-Development Condition stormwater models had assumed larger drainage bench reaches draining to the northeastern dropchute, as long as 3,300 feet. The revised model has a maximum drainage bench reach of approximately 1,500 feet.

The new drainage bench configuration will significantly increase stormwater flow through the western toe swale, which will need to be widened by 18". Stormwater will cross under the perimeter access road via a 36" reinforced concrete pipe culvert to Detention Pond No. 6.

Detention Pond No. 4 was constructed as a two stage pond with an oversized sediment forebay. This pond receives flow from the northern and eastern portions of the landfill and discharges to the north via an outlet structure, grass lined treatment swale and level spreader through an existing wooded buffer. Due to the reconfiguration of the stormwater swales, Pond 4 will not need to be expanded as approved in the Type I-A Permit Modification for Stage V.

Detention Pond No. 5 will be constructed adjacent to and to the northwest of proposed Stage V. Pond 5 will receive flow from subbasins A3, A4 and A5 in the northern Stage V cap area in addition to flow from Detention Pond No. 6. Pond 6 will have an outlet control structure and discharge the existing stormwater treatment swale and is also equipped with a sediment forebay and an overflow channel that will discharge to the existing stormwater treatment swale.

Detention Pond No. 6 will constructed to the west of existing Stage IV Phase II as a two stage pond with an oversized sediment forebay. This pond receives flow from the southern and western portions of the landfill and discharges to Detention Pond No. 6 via a 36" culvert. Pond 6 is also equipped with an overflow channel that will discharge to the existing stormwater treatment swale.

The detention ponds are designed to significantly reduce the post-development peak flows to below the pre-development peak flows, thereby mitigating any potential for downstream flooding as a result of run-off from the site. The detention ponds also provide some treatment for the removal of suspended solids entrained in the run-off.

Three post-development drainage areas, Drainage Area A, B, & C including 31 sub-drainage areas were created for analysis based on their slopes, ground cover, soil type,

and discharge locations. The post-development drainage diagram is included in Appendix F.

Drainage Area A includes all areas that drain to the northwest outfall design point, which includes drainage areas on the west of the landfill and a southern portion of the landfill. These areas are designated as A1 through A15. Stormwater in this area is managed by Detention Ponds 5 and 6 and the grass-lined treatment swale. Flow from Drainage Area A converges with flow from Drainage Area B north of the landfill prior to leaving the property and reaching the Ammonoosuc River.

Drainage Area B includes all areas that drain to the northeast outfall design point, which includes the majority of the landfill footprint, including the Stage V expansion, and portions of the facility to the north and east of the landfill. These areas are designated as B1 through B15. Detention Pond 4 manages all Drainage Area B upgradient stormwater runoff.

Drainage Area C includes only a small area along southern portion of the facility that discharges towards the west. This area includes the grass stabilized earth berms wrapping around the south and eastern portion of the landfill. The Stage V expansion does not change the drainage characteristics or runoff from this area, which currently flows to the west. Stormwater management for the transfer station west of this area was designed and permitted under AoT-0394.

The post-development drainage diagram, including the time of concentration flow paths, are provided along with the pre-development drainage analysis calculations in Appendix F. The peak 10-, 25- and 50-year, 24-hour post-development off-site flow is reduced by the proposed stormwater management system to a flow rate below the pre-development peak off-site flow rate. The total volume of stormwater run-off is greater than the pre-development volume, but it will be released slowly from the detention ponds to mitigate impacts on downgradient features and structures.

A summary of the pre- and post-development peak discharge flows for the different discharge areas are shown in Appendix D.

The calculations used to determine the post-development drainage area flows are shown in Appendix F. Drainage swales were configured based on estimated flows generated

from each of the drainage areas. The maximum capacity, estimated flow depth, and velocities determined for the swales, drainage benches, and culvert design are also included in the drainage calculations.

The following is a summary of the post-development drainage areas and their peak individual discharge rates for the 25-year 24-hour storm:

Drainage Area A1: 3.66 cfs (32.51 Acres)
Drainage ***Area A1*** is predominantly made up of undeveloped woods, but also small portions of the landfill facility including the grass-lined treatment swale, Pond 5 and Pond 6. There is a relatively small wetland also in this area just west of the upgradient portion of the treatment swale. Stormwater sheet flows through woods and converges with runoff from drainage area B to the north outfall design point, downgradient of the bluff north of the facility.

Drainage Area A2: 0.00 cfs (4.87 Acres)
Drainage ***Area A2*** is predominantly made up of undeveloped woods with soils in the A hydrologic soil group. Stormwater sheet flows to a wet area in the northwest corner of the basin, then flows through subbasin A1 in a natural drainage way. Because the of drainage characteristics of this basin, stormwater infiltrates into the ground and only runs off in larger storm events.

Drainage Area A3: 5.82 cfs (2.37 Acres)
Drainage ***Area A3*** includes a small northwestern portion of the landfill cap, Pond 5 and a portion of the Stage V gravel access road. Stormwater sheet flows from the landfill cap to the perimeter swale, through a proposed 18" CPP culvert, which discharges to Pond 5. Drainage ***Area A3*** assumes 0.42 acres of impervious gravel road.

Drainage Area A4: 3.70 cfs (1.41 Acres)
Drainage ***Area A4*** includes a small northwestern portion of the landfill cap. Stormwater sheet flows from the landfill cap to a 600 foot drainage bench that discharges to the northern toe swale.

Drainage Area A5: 3.22 cfs (1.20 Acres)
Drainage ***Area A5*** includes a small northwestern portion of the landfill cap and a small area of gravel road at the toe of slope. Stormwater sheet flows from the landfill cap to a 400 foot drainage bench that discharges to the northern toe swale. Drainage ***Area A5*** includes 0.04 acres of impervious gravel road.

Drainage Area A6: 6.24 cfs (2.59 Acres)
Drainage ***Area A6*** includes a western portion of the landfill cap, rip-rap-liner berm and a small area of gravel road at the toe of slope. Stormwater sheet flows

from the landfill cap to a 1,000 foot drainage bench that discharges to the southwestern plunge pool and western toe swale. Drainage ***Area A6*** assumes 0.08 acres of impervious gravel road.

Drainage Area A7: 6.16 cfs (2.34 Acres)
Drainage ***Area A7*** includes a western portion of the landfill cap. Stormwater sheet flows from the landfill cap to a 1,100 foot drainage bench that discharges to the southwestern plunge pool and western toe swale.

Drainage Area A8: 10.37 cfs (4.98 Acres)
Drainage ***Area A8*** includes a western portion of the landfill cap. Stormwater sheet flows from the landfill cap to a 900 foot drainage bench that discharges to the southwestern plunge pool and western toe swale.

Drainage Area A9: 1.84 cfs (0.81 Acres)
Drainage ***Area A9*** includes a western portion of the landfill cap, rip-rap lined berm and a small section of gravel road. Stormwater sheet flows from the landfill cap to the western toe swale. Drainage ***Area A9*** assumes 0.30 acres of impervious gravel road.

Drainage Area A10: 0.66 cfs (0.25 Acres)
Drainage ***Area A10*** includes a southwestern portion of the landfill cap. Stormwater sheet flows from the landfill cap to a 200 foot drainage bench that discharges to the southwestern plunge pool and western toe swale.

Drainage Area A11: 0.75 cfs (0.32 Acres)
Drainage ***Area A11*** includes a southwestern portion of the landfill cap. Stormwater sheet flows from the landfill cap to a 200 foot drainage bench that discharges to the southwestern plunge pool and western toe swale.

Drainage Area A12: 12.65 cfs (5.78 Acres)
Drainage ***Area A12*** includes a southern portion of the landfill cap. Stormwater sheet flows from the landfill cap to a 1,200 foot drainage bench that discharges to the southwestern plunge pool and western toe swale.

Drainage Area A13: 7.86 cfs (2.99 Acres)
Drainage ***Area A13*** includes a southern portion of the landfill cap. Stormwater sheet flows from the landfill cap to a 1,500 foot drainage bench that discharges to the southwestern plunge pool and western toe swale.

Drainage Area A14: 5.20cfs (2.20 Acres)

Drainage ***Area A14*** includes a southern portion of the landfill cap and rip-rap-lined berm. Stormwater sheet flows from the landfill cap to a 1,100 foot drainage bench that discharges to the southern toe swale.

Drainage Area A15: 6.11 cfs (3.16 Acres)

Drainage ***Area A15*** includes a southern portion of the landfill cap, rip-rap-lined berm and gravel access road. Stormwater sheet flows from the landfill cap to the southern toe swale.

Drainage Area B1: 6.90 cfs (15.54 Acres)

Drainage ***Area B1*** is includes a large wooded portion to the north of the landfill. This area also includes some wetlands and some gravel drive area between the landfill and Detention Pond 4. Stormwater from this subarea sheet flows to the wetlands, which discharges down the bluff to the northeast outfall design point and converges with flow from Drainage Area A at the north outfall design point.

Drainage Area B2: 3.26 cfs (2.55 Acres)

Drainage ***Area B2*** is the area that flows directly to Detention Pond #4. This area includes runoff of the gravel drive, proposed flare station, and leachate management area. ***Area B2*** assumes 0.36 acres is impervious gravel road.

Drainage Area B3: 6.00 cfs (2.23 Acres)

Drainage ***Area B3*** includes a northern portion of the landfill cap and gravel access road. Stormwater sheet flows from the landfill cap to the northern toe swale. Drainage ***Area B3*** assumes 0.11 acres is impervious gravel road.

Drainage Area B4: 5.86 cfs (2.23 Acres)

Drainage ***Area B4*** includes a northern portion of the landfill cap. Stormwater sheet flows from the landfill cap to a 1,200 foot drainage bench that discharges to the northeastern dropchute.

Drainage Area B5: 5.79 cfs (2.20 Acres)

Drainage ***Area B5*** includes a northern portion of the landfill cap. Stormwater sheet flows from the landfill cap to a 1,100 foot drainage bench that discharges to the northeastern dropchute.

Drainage Area B6: 0.66 cfs (0.25 Acres)

Drainage ***Area B6*** includes a northern portion of the landfill cap. Stormwater sheet flows from the landfill cap to a 200 foot drainage bench that discharges to the northeastern dropchute.

Drainage Area B7: 9.63 cfs (4.60 Acres)

Drainage ***Area B7*** includes a center portion of the landfill cap. Stormwater sheet flows from the landfill cap to a 900 foot drainage bench that discharges to the northeastern dropchute.

Drainage Area B8: 7.17 cfs (3.31 Acres)

Drainage ***Area B8*** includes an eastern portion of the landfill cap. Stormwater sheet flows from the landfill cap to a 500 foot drainage bench that discharges to the northeastern dropchute.

Drainage Area B9: 5.38 cfs (2.37 Acres)

Drainage ***Area B9*** includes an eastern portion of the landfill cap. Stormwater sheet flows from the landfill cap to a 1,100 foot drainage bench that discharges to the northeastern dropchute.

Drainage Area B10: 7.10 cfs (2.70 Acres)

Drainage ***Area B10*** includes an eastern portion of the landfill cap. Stormwater sheet flows from the landfill cap to a 1,200 foot drainage bench that discharges to the Detention Pond 4 via an 18" CPP.

Drainage Area B11: 0.71 cfs (0.29 Acres)

Drainage ***Area B11*** includes an eastern portion of the landfill cap. Stormwater sheet flows from the landfill cap to the eastern toe swale. Drainage ***Area B11*** includes 0.14 acres of impervious gravel road.

Drainage Area B12: 1.05 cfs (0.44 Acres)

Drainage ***Area B12*** includes an eastern portion of the landfill cap. Stormwater sheet flows from the landfill cap to the eastern toe swale. Drainage ***Area B12*** includes 0.20 acres of impervious gravel road.

Drainage Area B13: 4.50 cfs (1.52 Acres)

Drainage ***Area B13*** includes an eastern portion of the landfill cap. Stormwater sheet flows from the landfill cap to the eastern toe swale. Drainage ***Area B13*** includes 0.37 acres of impervious gravel road.

Drainage Area B14: 0.78 cfs (0.64 Acres)

Drainage ***Area B14*** is a small strip of land located east of the landfill and mechanically stabilized earth (MSE) wall. This area is a well vegetated grass and brush area and sheet flows to a swale which discharges to an existing 18" CPP culvert. Stormwater from the eastern portion of the landfill cap is routed this through this drainage area to ultimately reach Detention Pond 4.

Drainage Area B15: 0.93 cfs (0.76 Acres)

Drainage ***Area B15***, similar to Area 14, is a small strip of land located east of the landfill and mechanically stabilized earth (MSE) wall and south of Area B14. This area is a well vegetated grass and brush area and sheet flows to a swale which discharges to an existing 18" CPP culvert. Stormwater from the eastern portion of the landfill cap is routed this through this drainage area to ultimately reach Detention Pond 4.

Drainage Area C1: 3.04 cfs (2.76 Acres)

Drainage ***Area C1*** includes the earth berm that wraps around the southern and south eastern portion of the landfill. Stormwater in this area runs along the southern property line to the west towards the scale and operations area. Drainage ***Area C1*** includes 0.32 acres of impervious gravel road. This area is unaffected by the Stage V development and is unchanged in the post-development condition from today.

STORMWATER CONTROL PRACTICES

Detention Ponds

Stormwater runoff hydrographs for the drainage areas were generated using Autodesk's Storm and Sanitary Analysis® modeling software. Design runoff hydrographs were based on the 25-year, Type II, 24-hour storm and calculated using the SCS unit hydrograph method. The detention pond calculations and hydrographs are included in Appendix F. Calculations for the 2-, 10-, 25-, 50-, and 100-year storm were also completed to estimate the pond and existing outlet structure performance. The detention pond analyses were completed with a starting water elevation equal to the lowest invert out elevation. A summary of the pond performance during the post development conditions is described below.

Detention Pond No. 4

Approximately one-half closed landfill area and eastern portion of the leachate management and LFG management facilities will discharge into Detention Pond No. 4 (Drainage Areas B2 – B15). The detention pond will reduce the 25-year/24-hour storm peak flow of 53.76 cfs to 0.83 cfs. Treatment of the discharge is provided by the existing 80 foot long grass-lined treatment swale and the forested buffer strip downgradient of the existing level spreader. The detention pond maintains 1 foot of freeboard to the emergency spillway crest for the 100-year/24-hour storm. The detention pond grading

includes an access roadway for maintenance of the pond and removal of accumulated sediment.

The proposed stormwater improvements, including the addition of Detention Ponds 5 and 6, will not require the expansion of this pond, as approved in the Type I-A Permit Modification for Stage V.

Detention Pond No. 5

Proposed Detention Pond No. 5 will consist of expanding the existing partially constructed Detention Pond No. 5 to the limits of the previously proposed Detention Pond No 6, as approved by the Stage V Type I-A Permit Modification by the NHDES in August.

Detention Pond 5 will manage stormwater from subbasins A3, A4, A5 and proposed Detention Pond No. 6. Stormwater will discharge through a multi-stage release outlet structure to the existing stormwater treatment swale. The detention pond maintains 1 foot of freeboard to the emergency spillway crest for the 100-year/24-hour storm. The detention pond grading includes an access roadway for maintenance of the pond and removal of accumulated sediment. Detention Pond No. 5 reduces peak flows from 24.88 cfs to 2.18 cfs.

The existing Detention Pond 5 was partially constructed in 2005-2006 in anticipation of the Stage IV landfill expansion and currently has no designed outlet structure other than a spillway.

Detention Pond No. 6

Approximately one-half closed landfill area will discharge into Detention Pond 6 (Drainage Areas A6 – A15). The detention pond will reduce the 25-year/24-hour storm peak flow of 50.40 cfs to 12.21 cfs. The detention pond maintains 1 foot of freeboard to the emergency spillway crest for the 100-year/24-hour storm. The sediment forebay of Detention Pond No. 6 will be allowed to pond up to 4 feet to use as dust suppression water by NCES operations. Flow from Pond 6 outlets to Detention Pond No. 5.

Sediment will be removed from the pond via the adjacent landfill access road and egress into the pond over the 3:1 slopes.

STORMWATER TREATMENT PRACTICES

The proposed construction activities do not include installation of any impervious paved roadways. All existing and proposed landfill access roadways on the site are constructed with a crushed stone course. For purposes of assessing water quality flows and volumes, we have included the gravel roadways as impervious areas. The proposed project will continue to utilize the existing treatment swale and detention pond with wooded buffer for treatment of storm water discharges off-site.

NCES is an operating landfill facility that is monitored by a series of groundwater monitoring wells in accordance with its Groundwater Release Detection Permit GWP-198704033-B-006. Groundwater flow direction on the site is toward the north where a number of release detection wells are located. The facility is also permitted under the USEPA Multi-Sector General Permit for Industrial Activities, and is managed in accordance with the Storm Water Pollution Prevention Plan (SWPPP) developed for the site. In accordance with Env-Wq 1502.26 the landfill is considered a High Load Area.

Accordingly, this facility meets the intent of Env-Wq 1507.04 (e) for areas that where groundwater recharge is prohibited and are not proposing to intentionally infiltrate or recharge ground water from surface water runoff. Such action could introduce groundwater mounding in areas that will affect the ground water monitoring network required for the facility's groundwater release detection permit.

Existing Treatment Swale

The existing grass-lined stormwater treatment swale will be reduced from 624 feet to 490 feet. However, stormwater which it currently manages will be diverted to the new Detention Pond 6. The treatment swale will also manage stormwater which runs off directly into it and any discharge from Pond 5.

Treatment is accomplished through sedimentation and potentially other factors such as vegetative filtration and uptake, infiltration, adsorption, biological uptake and microbial breakdown due to the high residence time. The treatment swale was installed over 15-years ago during the development of the landfill. The existing swale has a base width of 12 feet and is 624 feet long, which is longer than the 100 foot length required by NHDES. There is no evidence of flow concentration within the bottom of the swale and the length.

Vegetated Buffer

Stormwater run-off from the majority of the landfill capping system and eastern portions of the facility (Drainage Area B) is directed to Detention Pond 4. Detention Pond 4 discharges to a wooded buffer via an existing 35-foot long stone level spreader. Detention Pond 4 reduces the 2-year 24-hour Post Development peak flow to 0.18 cfs.

EROSION CONTROL DURING CONSTRUCTION

The proposed construction of the Stage V landfill expansion will include the installation of temporary erosion control devices until the site is fully stabilized. The erosion control devices include: silt fencing, stone check dams, erosion control matting, outlet protection and utilization of existing stabilized channels for discharge. The proposed erosion control plan and notes and erosion control and stormwater details are included in the Design Drawings, which are included as part of this application (bound separately).

A Notice of Intent (NOI) for coverage under the Construction General Permit will be prepared and submitted prior to all construction activities associated with Stage V. A copy of the document will be kept at the on-site construction trailer for the duration of the project and all inspections will be performed by qualified personnel.

CONCLUSIONS

Peak stormwater run-off flow rates for the proposed Stage V expansion conditions are decreased from the pre-development conditions due to the establishment of the stormwater runoff collection, management, and treatment system.

An analysis of the 100-year/24-hr storm event demonstrated that the proposed stormwater management system will be able to sufficiently accommodate surface water runoff. The detention ponds and outlet structures are sized to manage the 100-year/24-hour storm. The 100-year/24-hr storm event will not cause flooding on the site or permanent damage to stormwater management system components.

The proposed drainage system and erosion control measures depicted on the Design Drawings and described herein will provide adequate erosion and sedimentation control during construction, operation and post-closure maintenance of the landfill

Stormwater Management Report

Appendix A

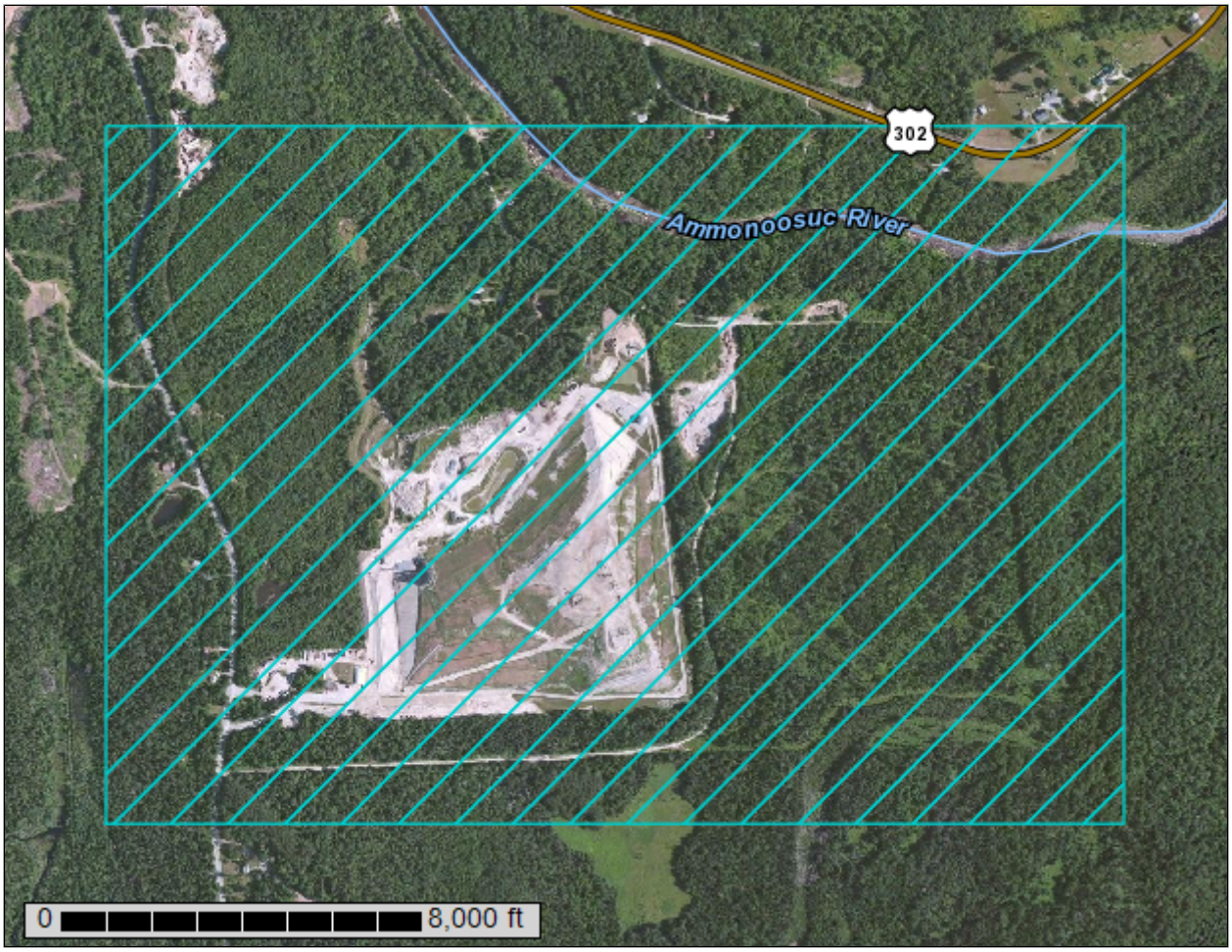
NRCS Soil Survey

United States Department of Agriculture

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Grafton County, New Hampshire, and White Mountain National Forest



December 10, 2013

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://soils.usda.gov/sqi/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/state_offices/).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:9,360 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 450 900 1800 2700

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Grafton County, New Hampshire
Survey Area Data: Version 15, Aug 27, 2012

Soil Survey Area: White Mountain National Forest
Survey Area Data: Not available

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Aug 19, 2010—Jul 16, 2011

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

Map Unit Legend

Grafton County, New Hampshire (NH009)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
22A	Colton loamy sand, 0 to 3 percent slopes	0.9	0.2%
22C	Colton loamy sand, 8 to 15 percent slopes	0.3	0.1%
22E	Colton loamy sand, 15 to 60 percent slopes	14.6	3.3%
36A	Adams loamy sand, 0 to 3 percent slopes	1.9	0.4%
36B	Adams loamy sand, 3 to 8 percent slopes	11.6	2.6%
36C	Adams loamy sand, 8 to 15 percent slopes	33.0	7.4%
36E	Adams loamy sand, 15 to 60 percent slopes	27.2	6.1%
57B	Becket fine sandy loam, 3 to 8 percent slopes, very stony	2.8	0.6%
57C	Becket fine sandy loam, 8 to 15 percent slopes, very stony	0.1	0.0%
59B	Waumbek loamy sand, 3 to 8 percent slopes, very stony	35.8	8.1%
102	Sunday loamy sand	7.5	1.7%
255B	Monadnock and Hermon soils, 3 to 8 percent, very stony	2.1	0.5%
255C	Monadnock and Hermon soils, 8 to 15 percent, very stony	49.6	11.2%
255D	Monadnock and Hermon soils, 15 to 25 percent slopes, very stony	64.5	14.5%
255E	Monadnock and Hermon soils, 25 to 35 percent slopes, very stony	50.6	11.4%
298	Pits, gravel	11.3	2.5%
395	Chocorua mucky peat	4.6	1.0%
613	Croghan loamy fine sand	12.4	2.8%
614	Kinsman sand	26.5	6.0%
W	Water	7.1	1.6%
Subtotals for Soil Survey Area		**364.3**	**82.0%**
Totals for Area of Interest		**444.2**	**100.0%**

White Mountain National Forest (NH605)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
No soil data available for this soil survey area.			

White Mountain National Forest (NH605)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
Subtotals for Soil Survey Area		**—**	**—**
Totals for Area of Interest		**444.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Grafton County, New Hampshire

22A—Colton loamy sand, 0 to 3 percent slopes

Map Unit Setting

Elevation: 10 to 2,200 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 46 degrees F
Frost-free period: 70 to 160 days

Map Unit Composition

Colton and similar soils: 85 percent
Minor components: 15 percent

Description of Colton

Setting

Parent material: Stratified sandy and gravelly outwash derived from granite and gneiss

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.1 inches)

Interpretive groups

Farmland classification: Farmland of local importance
Land capability (nonirrigated): 3s
Hydrologic Soil Group: A

Typical profile

0 to 11 inches: Loamy sand
11 to 22 inches: Gravelly loamy sand
22 to 65 inches: Very gravelly loamy sand

Minor Components

Adams

Percent of map unit: 8 percent

Croghan

Percent of map unit: 7 percent

22C—Colton loamy sand, 8 to 15 percent slopes

Map Unit Setting

Elevation: 10 to 2,200 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 46 degrees F
Frost-free period: 70 to 160 days

Map Unit Composition

Colton and similar soils: 85 percent
Minor components: 15 percent

Description of Colton

Setting

Parent material: Stratified sandy and gravelly outwash derived from granite and gneiss

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.1 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 4e
Hydrologic Soil Group: A

Typical profile

0 to 11 inches: Loamy sand
11 to 22 inches: Gravelly loamy sand
22 to 65 inches: Very gravelly loamy sand

Minor Components

Adams

Percent of map unit: 8 percent

Croghan

Percent of map unit: 7 percent

22E—Colton loamy sand, 15 to 60 percent slopes

Map Unit Setting

Elevation: 10 to 2,100 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 46 degrees F
Frost-free period: 80 to 160 days

Map Unit Composition

Colton and similar soils: 75 percent
Minor components: 25 percent

Description of Colton

Setting

Parent material: Stratified sandy and gravelly outwash derived from granite and gneiss

Properties and qualities

Slope: 15 to 60 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.1 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 7e
Hydrologic Soil Group: A

Typical profile

0 to 11 inches: Loamy sand
11 to 22 inches: Gravelly loamy sand
22 to 65 inches: Very gravelly loamy sand

Minor Components

Croghan

Percent of map unit: 10 percent

Not named

Percent of map unit: 5 percent

Kinsman

Percent of map unit: 3 percent
Landform: Ravines

Lyme
Percent of map unit: 3 percent
Landform: Ravines

Pillsbury
Percent of map unit: 2 percent
Landform: Recessionial moraines

Rock outcrop
Percent of map unit: 2 percent

36A—Adams loamy sand, 0 to 3 percent slopes

Map Unit Setting
Elevation: 10 to 2,200 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 46 degrees F
Frost-free period: 70 to 160 days

Map Unit Composition
Adams and similar soils: 85 percent
Minor components: 15 percent

Description of Adams

Setting
Parent material: Sandy outwash derived mainly from granite, gneiss and schist

Properties and qualities
Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.3 inches)

Interpretive groups
Farmland classification: Farmland of local importance
Land capability (nonirrigated): 3s
Hydrologic Soil Group: A

Typical profile
0 to 6 inches: Loamy sand
6 to 26 inches: Sand
26 to 65 inches: Sand

Minor Components

Colton
Percent of map unit: 3 percent

Croghan
Percent of map unit: 3 percent

Groveton
Percent of map unit: 3 percent

Kinsman
Percent of map unit: 3 percent
Landform: Outwash terraces

Not named
Percent of map unit: 3 percent

36B—Adams loamy sand, 3 to 8 percent slopes

Map Unit Setting
Elevation: 10 to 2,200 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 46 degrees F
Frost-free period: 70 to 160 days

Map Unit Composition
Adams and similar soils: 85 percent
Minor components: 15 percent

Description of Adams

Setting
Parent material: Sandy outwash derived mainly from granite, gneiss and schist

Properties and qualities
Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.3 inches)

Interpretive groups
Farmland classification: Farmland of local importance
Land capability (nonirrigated): 3s
Hydrologic Soil Group: A

Typical profile

0 to 6 inches: Loamy sand
6 to 26 inches: Sand
26 to 65 inches: Sand

Minor Components

Colton

Percent of map unit: 3 percent

Croghan

Percent of map unit: 3 percent

Groveton

Percent of map unit: 3 percent

Kinsman

Percent of map unit: 3 percent
Landform: Outwash terraces

Not named

Percent of map unit: 3 percent

36C—Adams loamy sand, 8 to 15 percent slopes

Map Unit Setting

Elevation: 10 to 2,200 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 46 degrees F
Frost-free period: 70 to 160 days

Map Unit Composition

Adams and similar soils: 85 percent
Minor components: 15 percent

Description of Adams

Setting

Parent material: Sandy outwash derived mainly from granite, gneiss and schist

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.3 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 4e
Hydrologic Soil Group: A

Typical profile

0 to 6 inches: Loamy sand
6 to 26 inches: Sand
26 to 65 inches: Sand

Minor Components

Colton

Percent of map unit: 3 percent

Croghan

Percent of map unit: 3 percent

Groveton

Percent of map unit: 3 percent

Kinsman

Percent of map unit: 3 percent
Landform: Outwash terraces

Not named

Percent of map unit: 3 percent

36E—Adams loamy sand, 15 to 60 percent slopes

Map Unit Setting

Elevation: 150 to 2,200 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 46 degrees F
Frost-free period: 70 to 160 days

Map Unit Composition

Adams and similar soils: 85 percent
Minor components: 15 percent

Description of Adams

Setting

Parent material: Sandy outwash derived mainly from granite, gneiss and schist

Properties and qualities

Slope: 15 to 60 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.3 inches)

Interpretive groups
Farmland classification: Not prime farmland
Land capability (nonirrigated): 7e
Hydrologic Soil Group: A

Typical profile
0 to 6 inches: Loamy sand
6 to 26 inches: Sand
26 to 65 inches: Sand

Minor Components

Not named
Percent of map unit: 5 percent

Croghan
Percent of map unit: 4 percent

Kinsman
Percent of map unit: 3 percent
Landform: Depressions

Pillsbury
Percent of map unit: 3 percent
Landform: Ravines

57B—Becket fine sandy loam, 3 to 8 percent slopes, very stony

Map Unit Composition
Becket and similar soils: 85 percent
Minor components: 15 percent

Description of Becket

Setting
Parent material: Basal melt-out till derived from granite and gneiss and/or basal melt-out till derived from schist

Properties and qualities
Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: About 24 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.7 inches)

Interpretive groups

Farmland classification: Farmland of local importance
Land capability (nonirrigated): 6s
Hydrologic Soil Group: C

Typical profile

0 to 7 inches: Fine sandy loam
7 to 22 inches: Fine sandy loam
22 to 65 inches: Gravelly loamy fine sand

Minor Components

Not named

Percent of map unit: 5 percent

Pillsbury

Percent of map unit: 5 percent
Landform: Depressions

Skerry

Percent of map unit: 5 percent

57C—Becket fine sandy loam, 8 to 15 percent slopes, very stony

Map Unit Composition

Becket and similar soils: 85 percent
Minor components: 15 percent

Description of Becket

Setting

Parent material: Basal melt-out till derived from granite and gneiss and/or basal melt-out till derived from schist

Properties and qualities

Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: About 24 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.7 inches)

Interpretive groups

Farmland classification: Farmland of local importance
Land capability (nonirrigated): 6s
Hydrologic Soil Group: C

Typical profile

0 to 7 inches: Fine sandy loam
7 to 22 inches: Fine sandy loam

22 to 65 inches: Gravelly loamy fine sand

Minor Components

Not named
Percent of map unit: 5 percent

Pillsbury
Percent of map unit: 5 percent
Landform: Depressions

Skerry
Percent of map unit: 5 percent

59B—Waumbek loamy sand, 3 to 8 percent slopes, very stony

Map Unit Setting
Elevation: 10 to 2,800 feet
Mean annual precipitation: 34 to 48 inches
Mean annual air temperature: 37 to 46 degrees F
Frost-free period: 100 to 160 days

Map Unit Composition
Waumbek and similar soils: 85 percent
Minor components: 15 percent

Description of Waumbek

Properties and qualities
Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 6.00 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.0 inches)

Interpretive groups
Farmland classification: Not prime farmland
Land capability (nonirrigated): 6s
Hydrologic Soil Group: B

Typical profile
0 to 4 inches: Slightly decomposed plant material
4 to 9 inches: Loamy sand
9 to 25 inches: Very cobbly loamy sand
25 to 65 inches: Very cobbly loamy sand

Minor Components

Hermon
Percent of map unit: 5 percent

Lyme
Percent of map unit: 5 percent
Landform: Depressions

Moosilauke
Percent of map unit: 5 percent
Landform: Depressions

102—Sunday loamy sand

Map Unit Setting
Elevation: 10 to 1,750 feet
Mean annual precipitation: 34 to 48 inches
Mean annual air temperature: 37 to 46 degrees F
Frost-free period: 80 to 160 days

Map Unit Composition
Sunday and similar soils: 90 percent
Minor components: 10 percent

Description of Sunday

Properties and qualities
Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water capacity: Low (about 4.2 inches)

Interpretive groups
Farmland classification: Farmland of local importance
Land capability (nonirrigated): 3s
Hydrologic Soil Group: A

Typical profile
0 to 9 inches: Loamy sand
9 to 65 inches: Sand

Minor Components

Not named
Percent of map unit: 4 percent

Ondawa

Percent of map unit: 3 percent

Podunk

Percent of map unit: 3 percent

255B—Monadnock and Hermon soils, 3 to 8 percent, very stony

Map Unit Setting

Elevation: 10 to 2,800 feet
Mean annual precipitation: 34 to 48 inches
Mean annual air temperature: 37 to 46 degrees F
Frost-free period: 100 to 160 days

Map Unit Composition

Monadnock and similar soils: 45 percent
Hermon and similar soils: 40 percent
Minor components: 15 percent

Description of Monadnock

Setting

Parent material: Till

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.3 inches)

Interpretive groups

Farmland classification: Farmland of local importance
Land capability (nonirrigated): 6s
Hydrologic Soil Group: B

Typical profile

0 to 6 inches: Fine sandy loam
6 to 23 inches: Very fine sandy loam
23 to 65 inches: Loamy sand

Description of Hermon

Setting

Parent material: Till

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (2.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.5 inches)

Interpretive groups

Farmland classification: Farmland of local importance
Land capability (nonirrigated): 6s
Hydrologic Soil Group: A

Typical profile

0 to 5 inches: Fine sandy loam
5 to 7 inches: Fine sandy loam
7 to 22 inches: Gravelly fine sandy loam
22 to 65 inches: Very gravelly loamy sand

Minor Components

Waumbek

Percent of map unit: 8 percent

Lyme

Percent of map unit: 7 percent
Landform: Depressions

255C—Monadnock and Hermon soils, 8 to 15 percent, very stony

Map Unit Setting

Elevation: 10 to 2,800 feet
Mean annual precipitation: 34 to 48 inches
Mean annual air temperature: 37 to 46 degrees F
Frost-free period: 100 to 160 days

Map Unit Composition

Monadnock and similar soils: 45 percent
Hermon and similar soils: 40 percent
Minor components: 15 percent

Description of Monadnock

Setting

Parent material: Till

Properties and qualities

Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.3 inches)

Interpretive groups

Farmland classification: Farmland of local importance
Land capability (nonirrigated): 6s
Hydrologic Soil Group: B

Typical profile

0 to 6 inches: Fine sandy loam
6 to 23 inches: Very fine sandy loam
23 to 65 inches: Loamy sand

Description of Hermon

Setting

Parent material: Till

Properties and qualities

Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (2.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.5 inches)

Interpretive groups

Farmland classification: Farmland of local importance
Land capability (nonirrigated): 6s
Hydrologic Soil Group: A

Typical profile

0 to 5 inches: Fine sandy loam
5 to 7 inches: Fine sandy loam
7 to 22 inches: Gravelly fine sandy loam
22 to 65 inches: Very gravelly loamy sand

Minor Components

Waumbek

Percent of map unit: 8 percent

Lyme

Percent of map unit: 7 percent
Landform: Depressions

255D—Monadnock and Hermon soils, 15 to 25 percent slopes, very stony

Map Unit Setting

Elevation: 10 to 2,800 feet
Mean annual precipitation: 34 to 48 inches
Mean annual air temperature: 37 to 46 degrees F
Frost-free period: 100 to 160 days

Map Unit Composition

Monadnock and similar soils: 45 percent
Hermon and similar soils: 40 percent
Minor components: 15 percent

Description of Monadnock

Setting

Parent material: Till

Properties and qualities

Slope: 15 to 25 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.3 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 6s
Hydrologic Soil Group: B

Typical profile

0 to 6 inches: Fine sandy loam
6 to 23 inches: Very fine sandy loam
23 to 65 inches: Loamy sand

Description of Hermon

Setting

Parent material: Till

Properties and qualities

Slope: 15 to 25 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained

Capacity of the most limiting layer to transmit water (Ksat): High to very high (2.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.5 inches)

Interpretive groups
Farmland classification: Not prime farmland
Land capability (nonirrigated): 6s
Hydrologic Soil Group: A

Typical profile
0 to 5 inches: Fine sandy loam
5 to 7 inches: Fine sandy loam
7 to 22 inches: Gravelly fine sandy loam
22 to 65 inches: Very gravelly loamy sand

Minor Components

Waumbek
Percent of map unit: 8 percent

Lyme
Percent of map unit: 7 percent
Landform: Depressions

255E—Monadnock and Hermon soils, 25 to 35 percent slopes, very stony

Map Unit Setting
Elevation: 10 to 2,800 feet
Mean annual precipitation: 34 to 48 inches
Mean annual air temperature: 37 to 46 degrees F
Frost-free period: 100 to 160 days

Map Unit Composition
Monadnock and similar soils: 45 percent
Hermon and similar soils: 40 percent
Minor components: 15 percent

Description of Monadnock

Setting
Parent material: Till

Properties and qualities
Slope: 25 to 35 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.3 inches)

Interpretive groups
Farmland classification: Not prime farmland
Land capability (nonirrigated): 7s
Hydrologic Soil Group: B

Typical profile
0 to 6 inches: Fine sandy loam
6 to 23 inches: Very fine sandy loam
23 to 65 inches: Loamy sand

Description of Hermon

Setting
Parent material: Till

Properties and qualities
Slope: 25 to 35 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (2.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.5 inches)

Interpretive groups
Farmland classification: Not prime farmland
Land capability (nonirrigated): 7s
Hydrologic Soil Group: A

Typical profile
0 to 5 inches: Fine sandy loam
5 to 7 inches: Fine sandy loam
7 to 22 inches: Gravelly fine sandy loam
22 to 65 inches: Very gravelly loamy sand

Minor Components

Waumbek
Percent of map unit: 8 percent

Lyme
Percent of map unit: 7 percent
Landform: Depressions

298—Pits, gravel

Map Unit Composition

Pits: 100 percent

395—Chocorua mucky peat

Map Unit Setting

Elevation: 10 to 2,800 feet
Mean annual precipitation: 28 to 48 inches
Mean annual air temperature: 37 to 46 degrees F
Frost-free period: 60 to 160 days

Map Unit Composition

Chocorua and similar soils: 85 percent
Minor components: 15 percent

Description of Chocorua

Setting

Landform: Bogs
Parent material: Organic material over outwash

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water capacity: Very high (about 15.8 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 8w
Hydrologic Soil Group: D

Typical profile

0 to 5 inches: Mucky peat
5 to 26 inches: Mucky peat
26 to 65 inches: Sand

Minor Components

Not named

Percent of map unit: 5 percent

Landform: Swamps

Greenwood
Percent of map unit: 4 percent
Landform: Bogs

Searsport
Percent of map unit: 4 percent
Landform: Swamps

Water
Percent of map unit: 2 percent

613—Croghan loamy fine sand

Map Unit Setting
Elevation: 10 to 2,800 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 46 degrees F
Frost-free period: 70 to 160 days

Map Unit Composition
Croghan and similar soils: 85 percent
Minor components: 15 percent

Description of Croghan

Setting
Parent material: Sandy outwash derived mainly from granite, gneiss and schist

Properties and qualities
Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.2 inches)

Interpretive groups
Farmland classification: Farmland of statewide importance
Land capability (nonirrigated): 2w
Hydrologic Soil Group: B

Typical profile
0 to 11 inches: Loamy fine sand
11 to 28 inches: Loamy fine sand
28 to 65 inches: Sand

Minor Components

Adams
Percent of map unit: 4 percent

Colton
Percent of map unit: 4 percent

Kinsman
Percent of map unit: 4 percent
Landform: Outwash terraces

Searsport
Percent of map unit: 3 percent
Landform: Bogs

614—Kinsman sand

Map Unit Setting
Elevation: 10 to 2,800 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 46 degrees F
Frost-free period: 80 to 160 days

Map Unit Composition
Kinsman and similar soils: 90 percent
Minor components: 10 percent

Description of Kinsman

Setting
Landform: Outwash terraces
Parent material: Outwash

Properties and qualities
Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.5 inches)

Interpretive groups
Farmland classification: Farmland of local importance
Land capability (nonirrigated): 4w
Hydrologic Soil Group: C

Typical profile
0 to 8 inches: Sand

8 to 24 inches: Sand
24 to 65 inches: Gravelly sand

Minor Components

Croghan
Percent of map unit: 4 percent

Chocorua
Percent of map unit: 3 percent
Landform: Bogs

Searsport
Percent of map unit: 3 percent
Landform: Swamps

W—Water

Map Unit Composition
Water: 100 percent

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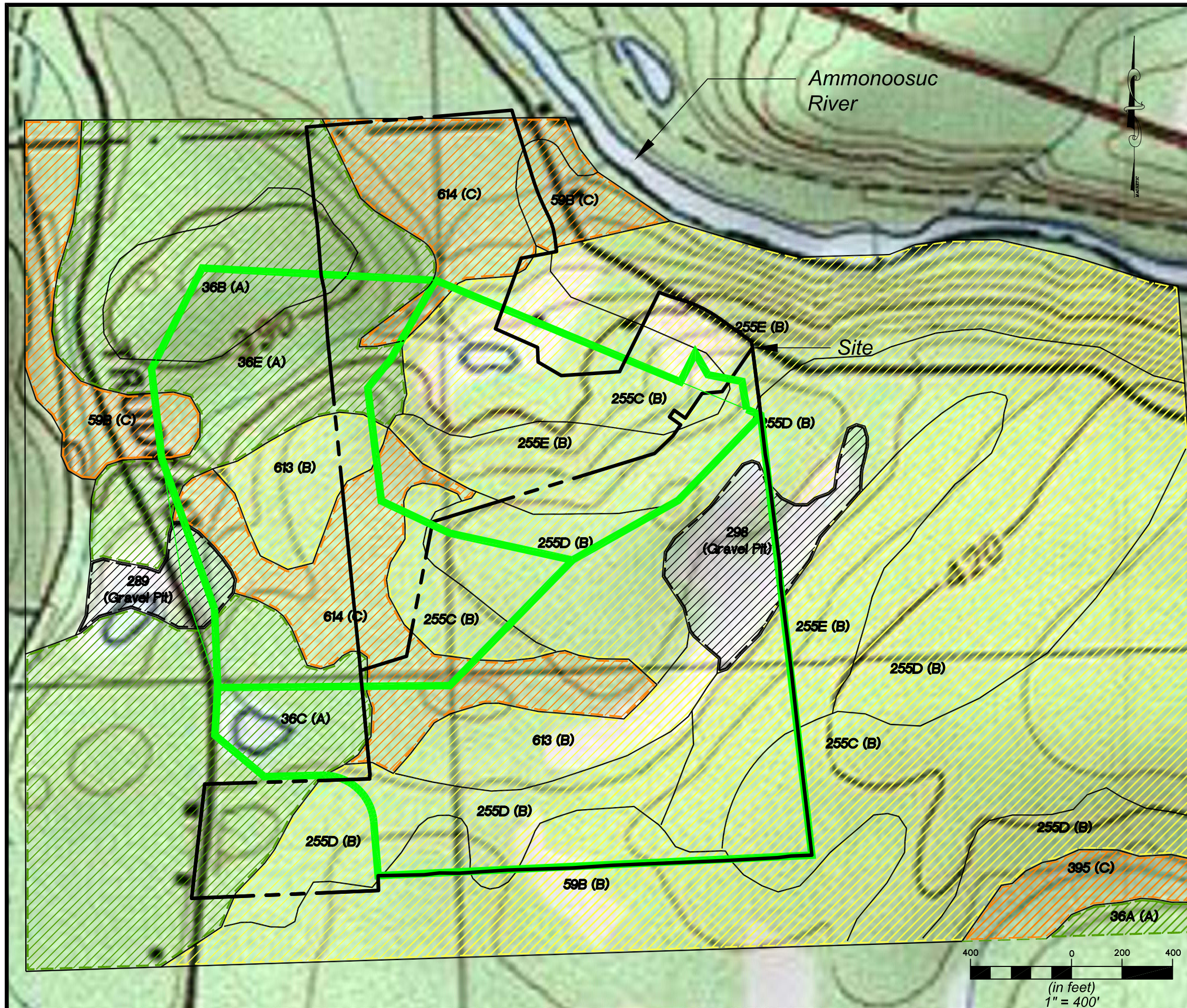
Stormwater Management Report

Appendix B

Hydrologic Soil Plans



Legend

A1	Subbasin
	Impervious Area
	Type "A" Soils
	Type "B" Soils
	Type "C" Soils
	Existing Gravel Pit
	Landfill Boundary

Soil Type Legend

255C (B) — Soil Type; Hydrologic Soil Group

22A, 22C, 22E	Colton loamy sand
36A, 36B, 36C, 36E	Adams loamy sand
57B, 57C	Becket fine sand loam
59B	Waumbek loamy sand
102	Sunday loam sand
255B, 255C, 255D	Monadnock and Hermon soils
298	Pits, gravel
395	Chocoura mucky peat
613	Croghan loamy fine sand
614	Kinsman sand
	Soil Type Division Line

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North Country Environmental Services
Stage V Landfill Expansion
Type I-B Permit Modification
Bethlehem, New Hampshire

Pre-Development Color-Coded Soil Plan

Appendix B

Stormwater Management Report

Appendix C

Extreme Precipitation Tables

Extreme Precipitation Tables

Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Smoothing	Yes
State	New Hampshire
Location	
Longitude	71.626 degrees West
Latitude	44.260 degrees North
Elevation	1,365 feet
Date/Time	Mon, 18 Nov 2013 11:17:21 -0500

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.26	0.40	0.49	0.65	0.81	1.00	**1yr**	0.70	0.95	1.14	1.39	1.69	2.04	2.33	**1yr**	1.81	2.24	2.60	3.25	3.75	**1yr**
2yr	0.30	0.46	0.58	0.76	0.96	1.19	**2yr**	0.83	1.11	1.35	1.64	1.98	2.37	2.69	**2yr**	2.09	2.59	3.04	3.72	4.28	**2yr**
5yr	0.35	0.55	0.69	0.93	1.18	1.48	**5yr**	1.02	1.37	1.69	2.05	2.45	2.90	3.33	**5yr**	2.57	3.20	3.70	4.50	5.14	**5yr**
10yr	0.39	0.62	0.78	1.07	1.39	1.75	**10yr**	1.20	1.60	2.00	2.42	2.88	3.39	3.91	**10yr**	3.00	3.76	4.31	5.19	5.91	**10yr**
25yr	0.46	0.74	0.94	1.30	1.72	2.18	**25yr**	1.49	1.98	2.50	3.01	3.57	4.17	4.84	**25yr**	3.69	4.66	5.27	6.28	7.10	**25yr**
50yr	0.52	0.84	1.08	1.50	2.03	2.58	**50yr**	1.75	2.32	2.96	3.56	4.20	4.87	5.70	**50yr**	4.31	5.48	6.14	7.26	8.16	**50yr**
100yr	0.59	0.95	1.23	1.75	2.39	3.06	**100yr**	2.06	2.72	3.51	4.21	4.94	5.70	6.70	**100yr**	5.05	6.45	7.15	8.38	9.38	**100yr**
200yr	0.67	1.10	1.42	2.04	2.82	3.61	**200yr**	2.43	3.20	4.15	4.97	5.81	6.67	7.89	**200yr**	5.90	7.59	8.34	9.69	10.79	**200yr**
500yr	0.81	1.33	1.73	2.51	3.51	4.52	**500yr**	3.03	3.97	5.19	6.20	7.20	8.22	9.81	**500yr**	7.28	9.43	10.23	11.75	13.00	**500yr**

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.22	0.34	0.41	0.56	0.68	0.79	**1yr**	0.59	0.78	0.92	1.20	1.54	1.84	2.15	**1yr**	1.63	2.07	2.33	2.63	3.07	**1yr**
2yr	0.29	0.44	0.55	0.74	0.91	1.10	**2yr**	0.79	1.07	1.26	1.63	2.05	2.30	2.63	**2yr**	2.04	2.53	2.96	3.64	4.19	**2yr**
5yr	0.32	0.50	0.62	0.85	1.08	1.28	**5yr**	0.94	1.25	1.46	1.89	2.49	2.72	3.10	**5yr**	2.40	2.98	3.49	4.26	4.86	**5yr**
10yr	0.35	0.54	0.67	0.94	1.21	1.43	**10yr**	1.05	1.40	1.63	2.10	2.64	3.05	3.52	**10yr**	2.70	3.39	3.94	4.80	5.41	**10yr**
25yr	0.40	0.60	0.75	1.07	1.41	1.65	**25yr**	1.22	1.61	1.86	2.41	3.01	3.54	4.15	**25yr**	3.13	3.99	4.65	5.59	6.24	**25yr**
50yr	0.42	0.65	0.80	1.15	1.55	1.83	**50yr**	1.34	1.79	2.04	2.64	3.32	3.94	4.70	**50yr**	3.49	4.52	5.24	6.26	6.95	**50yr**
100yr	0.46	0.70	0.87	1.26	1.73	2.01	**100yr**	1.49	1.97	2.25	2.90	3.66	4.40	5.31	**100yr**	3.89	5.10	5.94	7.05	7.72	**100yr**
200yr	0.50	0.75	0.95	1.38	1.92	2.22	**200yr**	1.66	2.17	2.48	3.19	4.01	4.90	5.99	**200yr**	4.33	5.76	6.71	7.89	8.42	**200yr**
500yr	0.56	0.83	1.07	1.56	2.22	2.53	**500yr**	1.92	2.48	2.79	3.58	4.51	5.64	7.03	**500yr**	4.99	6.76	7.88	9.18	9.67	**500yr**

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.28	0.43	0.53	0.71	0.88	1.08	**1yr**	0.76	1.05	1.26	1.67	2.03	2.19	2.51	**1yr**	1.93	2.41	2.77	3.45	4.00	**1yr**
2yr	0.32	0.49	0.61	0.82	1.02	1.21	**2yr**	0.88	1.18	1.37	1.80	2.26	2.46	2.78	**2yr**	2.18	2.67	3.12	3.82	4.39	**2yr**
5yr	0.39	0.60	0.74	1.02	1.29	1.52	**5yr**	1.12	1.49	1.73	2.26	2.77	3.07	3.54	**5yr**	2.72	3.40	3.94	4.75	5.40	**5yr**
10yr	0.46	0.70	0.87	1.22	1.57	1.85	**10yr**	1.36	1.81	2.05	2.73	3.43	3.68	4.28	**10yr**	3.26	4.11	4.70	5.62	6.32	**10yr**
25yr	0.58	0.88	1.09	1.56	2.05	2.39	**25yr**	1.77	2.33	2.62	3.51	4.43	4.71	5.50	**25yr**	4.17	5.29	5.96	7.05	7.81	**25yr**
50yr	0.69	1.04	1.30	1.87	2.52	2.90	**50yr**	2.17	2.84	3.17	4.26	5.40	5.66	6.66	**50yr**	5.01	6.40	7.14	8.33	9.18	**50yr**
100yr	0.82	1.24	1.55	2.25	3.08	3.54	**100yr**	2.66	3.46	3.81	5.19	6.60	6.83	8.07	**100yr**	6.05	7.76	8.56	9.90	10.80	**100yr**
200yr	0.98	1.48	1.87	2.71	3.77	4.31	**200yr**	3.26	4.22	4.62	6.33	8.08	8.25	9.81	**200yr**	7.30	9.43	10.26	11.75	12.85	**200yr**
500yr	1.25	1.86	2.40	3.49	4.96	5.61	**500yr**	4.28	5.48	5.94	8.23	10.60	10.61	12.66	**500yr**	9.39	12.18	13.05	14.78	15.95	**500yr**

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Northeast Regional Climate Center

Stormwater Management Report

Appendix D

Pre & Post-Development Flow Summary Tables

i. 2-Year Storm
ii. 10-Year Storm
iii. 25-Year Storm
iv. 50-Year Storm

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PROJECT: NCES - Stage V

PROJECT NO: 833
DATE: November 12, 2014
CALC. BY:

Table 1: Pre-Development vs Post Development Peak Flow Summary Table for 2-year 24-hour Storm

Discharge Area	Sub-basin	Area	Peak Runoff	Offsite Discharge	Sub-basin	Area	Peak Runoff	Pond Flow In	Pond Flow Out	Offsite Discharge	Comments
		(acre)	(cfs)			(acre)	(cfs)	(cfs)	(cfs)	(cfs)	
North	A1	49.60	0.78	0.91	A1	31.68	0.03			0.28	Pond 5 manages stormwater from drainage areas A3, A4 & A5 and Detention Pond No. 6. Detention Pond No. 6 manages stormwater from drainage areas A5 - A15. There is no discharge from Ponds 5 and 6 in the 2-year analysis.
	A2	38.68	0.07		A2	4.87	0.00				
	Subtotal	88.28			A3	3.44	1.58	Pond 5			
					A4	1.41	1.03				
					A5	1.20	0.91	3.03	0.00		
					A6	2.59	1.62	Pond 6			
					A7	2.34	1.72				
					A8	4.98	2.90				
					A9	0.81	0.45				
					A10	0.25	0.18				
					A11	0.32	0.21	12.61	0.00		
					A12	5.78	3.57				
					A13	2.99	2.19				
					A14	2.20	1.33				
					A15	3.16	1.45				
					Subtotal	68.02					
					B1	15.30	0.11				Pond 4 manages stormwater from drainage areas B2 - B15.
					B2	2.55	0.42	Pond 4			
					B3	2.23	1.72				
					B4	2.23	1.63				
					B5	2.20	1.61				
					B6	0.25	0.18				
					B7	4.60	2.70				
	B1	23.89	0.17		B8	3.31	2.02				
					B9	2.37	1.53	13.93	0.18		
					B10	2.70	1.98				
					B11	0.29	0.19				
					B12	0.44	0.27				
					B13	1.52	1.41				
					B14	0.64	0.07				
					B15	0.76	0.09				
					Subtotal	41.39					
Southwest	None			None	C1	2.76	0.46			0.46	Runoff from C1 flows to the east and is managed by the stormwater devices in the vicinity of the scale house, office, and facility entrance.
	Total	**112.17**		**0.91**	**Total**	**112.17**				**0.74**	

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PROJECT: NCES - Stage V
PROJECT NO: 833
DATE: November 12, 2014
CALC. BY: AJS

Table 2: Pre-Development vs Post Development Peak Flow Summary Table for 10-year 24-hour Storm

Discharge Area	Sub-basin	Area	Peak Runoff	Offsite Discharge	Sub-basin	Area	Peak Runoff	Pond Flow In	Pond Flow Out	Offsite Discharge	Comments
		(acre)	(cfs)			(acre)	(cfs)	(cfs)	(cfs)	(cfs)	
					A1	31.68	0.63				Pond 5 manage stormwater from drainage areas A3, A4 & A5 and Detention Pond No. 6. Detention Pond No. 6 manages stormwater from drainage areas A5 - A15.
	A1	49.60	9.36		A2	4.87	0.00				
	A2	38.68	1.27		A3	3.44	4.34	Pond 5			
	Subtotal	88.28			A4	1.41	2.45				
					A5	1.20	2.14	10.37	0.94		
					A6	2.59	4.03				
					A7	2.34	4.08				
					A8	4.98	6.89				
					A9	0.81	1.17				
					A10	0.25	0.43	Pond 6			
					A11	0.32	0.50	32.58	2.17		
					A12	5.78	8.40				
					A13	2.99	5.20				
					A14	2.20	3.34				
					A15	3.16	3.89				
					Subtotal	68.02					
North				12.66	B1	15.30	2.43			2.62	Pond 4 manages stormwater from drainage areas B2 - B15.
					B2	2.55	1.83				
					B3	2.23	4.00				
					B4	2.23	3.88				
					B5	2.20	3.83				
					B6	0.25	0.43				
					B7	4.60	6.39				
	B1	23.89	3.74		B8	3.31	4.77	Pond 4			
					B9	2.37	3.58	35.1	0.57		
					B10	2.70	4.70				
					B11	0.29	0.46				
					B12	0.44	0.68				
					B13	1.52	3.07				
					B14	0.64	0.43				
					B15	0.76	0.51				
					Subtotal	41.39					
Southwest	None			None	C1	2.76	1.91			1.91	Runoff from C1 flows to the east and is managed by the stormwater devices in the vicinity of the scale house, office, and facility entrance.
	Total	**112.17**		**12.66**	**Total**	**112.17**				**4.53**	

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PROJECT NO: 833
DATE: November 12, 2014
CALC. BY: AJS

Table 3: Pre-Development vs Post Development Peak Flow Summary Table for 25-year 24-hour Storm

Discharge Area	Sub-basin	Area	Peak Runoff	Offsite Discharge	Sub-basin	Area	Peak Runoff	Pond Flow In	Pond Flow Out	Offsite Discharge	Comments
		(acre)	(cfs)			(acre)	(cfs)	(cfs)	(cfs)	(cfs)	
					A1	31.68	3.62				Pond 5 manages stormwater from drainage areas A3, A4 & A5 and Detention Pond No 6. Detention Pond No. 6 manages stormwater from drainage areas A5 - A15.
	A1	49.60	21.89		A2	4.87	0.00				
	A2	38.68	6.06		A3	3.44	7.04	Pond 5			
	Subtotal	88.28			A4	1.41	3.70				
					A5	1.20	3.22	24.88	2.18		
					A6	2.59	6.24				
					A7	2.34	6.16				
					A8	4.98	10.37				
					A9	0.81	1.84				
					A10	0.25	0.66	Pond 6			
					A11	0.32	0.75	50.40	12.21		
					A12	5.78	12.65				
					A13	2.99	7.86				
					A14	2.20	5.20				
					A15	3.16	6.11				
					Subtotal	68.02					
North				34.13	B1	15.30	6.80			9.51	Pond 4 manages stormwater from drainage areas B2 - B15.
					B2	2.55	3.26				
					B3	2.23	6.00				
					B4	2.23	5.86				
					B5	2.20	5.79				
					B6	0.25	0.66				
					B7	4.60	9.63				
	B1	23.89	10.52		B8	3.31	7.17	Pond 4			
					B9	2.37	5.38	53.76	0.83		
					B10	2.70	7.10				
					B11	0.29	0.71				
					B12	0.44	1.05				
					B13	1.52	4.50				
					B14	0.64	0.78				
					B15	0.76	0.93				
					Subtotal	41.39					
Southwest	None			None	C1	2.76	3.56			3.56	Runoff from C1 flows to the east and is managed by the stormwater devices in the vicinity of the scale house, office, and facility entrance.
	Total	**112.17**		**34.13**	**Total**	**112.17**				**13.07**	

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PROJECT: NCES - Stage V
PROJECT NO: 833
DATE: November 12, 2014
CALC. BY: AJS

Table 4: Pre-Development vs Post Development Peak Flow Summary Table for 50-year 24-hour Storm

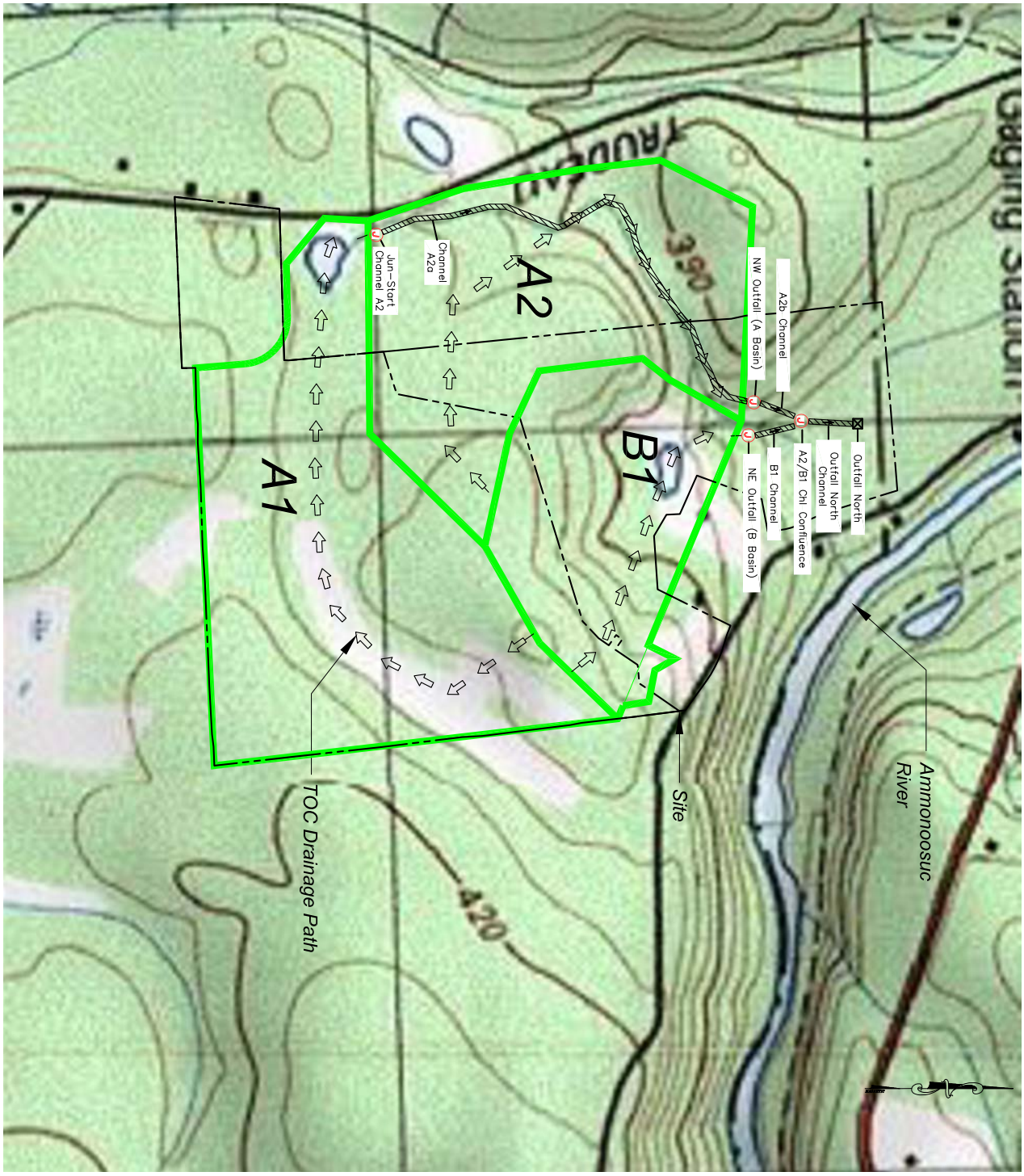
Discharge Area	Sub-basin	Area	Peak Runoff	Offsite Discharge	Sub-basin	Area	Peak Runoff	Pond Flow In	Pond Flow Out	Offsite Discharge	Comments
		(acre)	(cfs)			(acre)	(cfs)	(cfs)	(cfs)	(cfs)	
					A1	31.68	8.85				Pond 5 manages stormwater from drainage areas A3, A4 & A5 and Detention Pond No. 6. Detention Pond manages stormwater from drainage areas A5 - A15.
	A1	49.60	36.27		A2	4.87	0.02				
	A2	38.68	13.37		A3	3.44	9.71	Pond 5			
	Subtotal	88.28			A4	1.41	4.89				
					A5	1.20	4.24	49.64	3.10		
					A6	2.59	8.37				
					A7	2.34	8.14				
					A8	4.98	13.71				
					A9	0.81	2.49				
					A10	0.25	0.87	Pond 6			
					A11	0.32	0.99	67.58	32.43		
					A12	5.78	16.70				
					A13	2.99	10.39				
					A14	2.20	7.00				
					A15	3.16	8.26				
					Subtotal	68.02					
North				61.58	B1	15.30	12.01			19.57	Pond 4 manages stormwater from drainage areas B2 - B15.
					B2	2.55	4.71				
					B3	2.23	7.90				
					B4	2.23	7.74				
					B5	2.20	7.65				
					B6	0.25	0.87				
					B7	4.60	12.73				
	B1	23.89	18.62		B8	3.31	9.47	Pond 4			
					B9	2.37	7.09	71.83	1.00		
					B10	2.70	9.39				
					B11	0.29	0.95				
					B12	0.44	1.41				
					B13	1.52	5.84				
					B14	0.64	1.18				
					B15	0.76	1.40				
					Subtotal	41.39					
Southwest	None			None	C1	2.76	5.24			5.24	Runoff from C1 flows to the east and is managed by the stormwater devices in the vicinity of the scale house, office, and facility entrance.
	Total	**112.17**		**61.58**	**Total**	**112.17**				**24.81**	

Stormwater Management Report

Appendix E

Pre-Development Drainage Analysis

i. Drainage Diagram
ii. 25-Year, 24-Hour Storm Calculations



Legend

- Junction
- Outfall
- Subbasin
- Conveyance
- Time of Concentration Flow Direction

North Country Environmental Services Bethlehem, New Hampshire	date: February 2014	designed by: BWS/PAC	
	project no: 833	drawn by: PAC	
Stage V Landfill Expansion	file name: AoT Pre	approved by: BWS/PAC	
Stormwater Analysis Pre Development Conditions	scale: 200 0 100 200 1 inch = 200 ft.		

drawing no. Appendix E
sheet: - of -

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55 So. Commercial Street, Manchester, NH, 603/627-0708
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no.	revision	date	by
1	Issued for NHDES Review	2/7/14	BWS
2	Issued for NHDES Review	JAN 2015	RJG

F:\CADD\PROJECTS\833-NCES Stage V\dwg\AOT\833-AOT-Pre.dwg 2/5/2014 1:17:12 PM EST

Project Description

File Name ..... Stage V-Pre Development.SPF

Project Options

Flow Units ..... CFS
Elevation Type ..... Elevation
Hydrology Method ..... SCS TR-20
Time of Concentration (TOC) Method ..... SCS TR-55
Link Routing Method ..... Hydrodynamic
Enable Overflow Ponding at Nodes ..... YES
Skip Steady State Analysis Time Periods ..... YES

Analysis Options

Start Analysis On ..... Oct 04, 2010 00:00:00
End Analysis On ..... Oct 05, 2010 00:00:00
Start Reporting On ..... Oct 04, 2010 00:00:00
Antecedent Dry Days ..... 0 days
Runoff (Dry Weather) Time Step ..... 0 01:00:00 days hh:mm:ss
Runoff (Wet Weather) Time Step ..... 0 00:05:00 days hh:mm:ss
Reporting Time Step ..... 0 00:05:00 days hh:mm:ss
Routing Time Step ..... 30 seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	3
Nodes	5
Junctions	4
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	4
Channels	4
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Gage-1	Time Series	25 Year - Extreme	Cumulative	inches	New Hampshire	Grafton	25	4.17	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	A1	49.60	57.70	4.17	0.73	36.16	21.89	0 00:33:42
2	A2	38.68	49.91	4.17	0.38	14.82	6.06	0 00:30:19
3	B1	23.89	55.06	4.17	0.60	14.38	10.52	0 00:21:44

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	A2 Channel Start	Junction	1329.00	1340.00	1329.00	1340.00	0.00	21.58	1329.57	0.00	10.43	0 00:00	0.00	0.00
2	A2/B1 Chl Confluence	Junction	1230.00	1250.00	1230.00	1250.00	0.00	34.14	1230.53	0.00	19.47	0 00:00	0.00	0.00
3	NE Outfall (B basin)	Junction	1240.00	1260.00	1240.00	1260.00	0.00	10.48	1240.26	0.00	19.74	0 00:00	0.00	0.00
4	NW Outfall (A Basin)	Junction	1240.00	1260.00	1240.00	1260.00	0.00	27.38	1240.45	0.00	19.55	0 00:00	0.00	0.00
5	Outfall 3 - North	Outfall	1214.00					34.13	1214.52					

Subbasin Hydrology

Subbasin : A1

Input Data

Area (ac) 49.60
Weighted Curve Number 57.70
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	4.27	A	30.00
Woods, Good	34.96	B	55.00
Newly graded area	5.32	B	86.00
Woods, Good	5.05	C	70.00
Composite Area & Weighted CN	49.60		57.70

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	6	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.37	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	16.08	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	800	0.00	0.00
Slope (%) :	4	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	1.00	0.00	0.00
Computed Flow Time (min) :	13.33	0.00	0.00

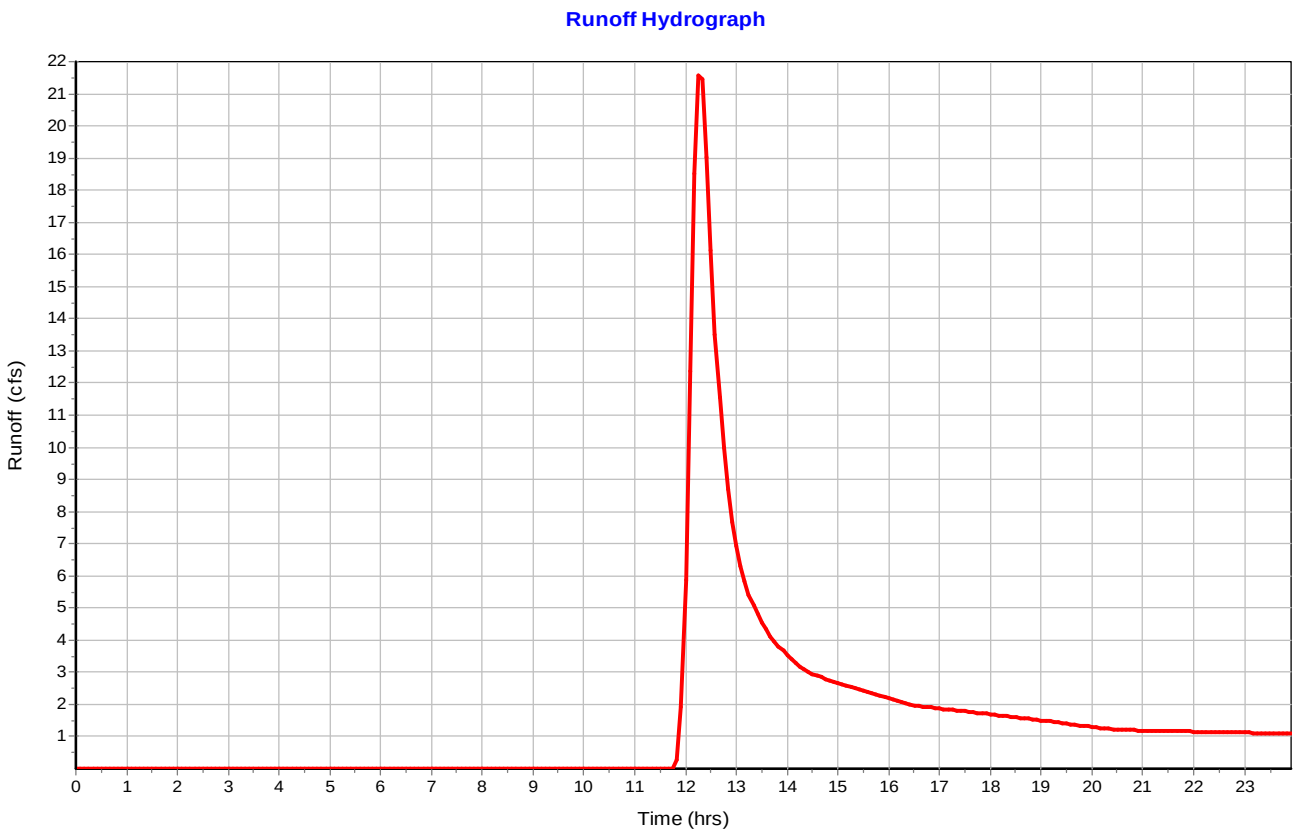
Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.035	0.00	0.00
Flow Length (ft) :	1700	0.00	0.00
Channel Slope (%) :	1.5	0.00	0.00
Cross Section Area (ft²) :	24	0.00	0.00
Wetted Perimeter (ft) :	16.9	0.00	0.00
Velocity (ft/sec) :	6.59	0.00	0.00
Computed Flow Time (min) :	4.30	0.00	0.00

Total TOC (min) 33.71

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 0.73
Peak Runoff (cfs) 21.89
Weighted Curve Number 57.70
Time of Concentration (days hh:mm:ss) 0 00:33:43

Subbasin : A1


Runoff Hydrograph
Runoff (cfs)
Time (hrs)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

Subbasin : A2

Input Data

Area (ac) 38.68
Weighted Curve Number 49.91
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	16.00	A	30.00
Woods, Good	10.55	B	55.00
Newly graded area	1.31	B	86.00
Woods, Good	10.82	C	70.00
Composite Area & Weighted CN	38.68		49.91

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	6	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.37	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	16.08	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	700	0.00	0.00
Slope (%) :	4	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	1.00	0.00	0.00
Computed Flow Time (min) :	11.67	0.00	0.00

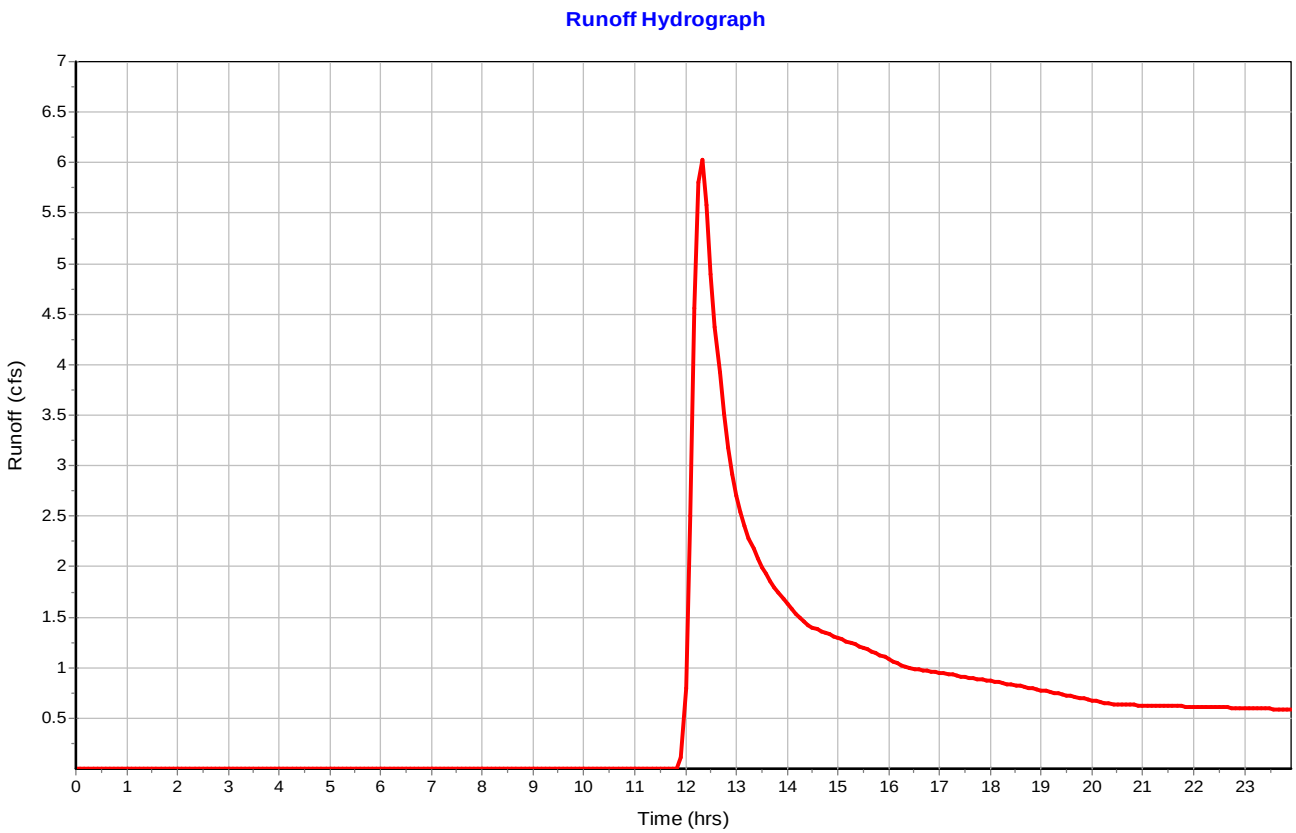
Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.035	0.00	0.00
Flow Length (ft) :	1900	0.00	0.00
Channel Slope (%) :	5.2	0.00	0.00
Cross Section Area (ft^2) :	24	0.00	0.00
Wetted Perimeter (ft) :	16.9	0.00	0.00
Velocity (ft/sec) :	12.27	0.00	0.00
Computed Flow Time (min) :	2.58	0.00	0.00

Total TOC (min) 30.33

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 0.38
Peak Runoff (cfs) 6.06
Weighted Curve Number 49.91
Time of Concentration (days hh:mm:ss) 0 00:30:20

Subbasin : A2


Runoff Hydrograph
Runoff (cfs)
Time (hrs)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

Subbasin : B1

Input Data

Area (ac) 23.89
Weighted Curve Number 55.06
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.65	A	30.00
Woods, Good	22.06	B	55.00
Woods, Good	1.18	C	70.00
Composite Area & Weighted CN	23.89		55.06

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	6	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.37	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	16.08	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	400	0.00	0.00
Slope (%) :	10	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	1.58	0.00	0.00
Computed Flow Time (min) :	4.22	0.00	0.00

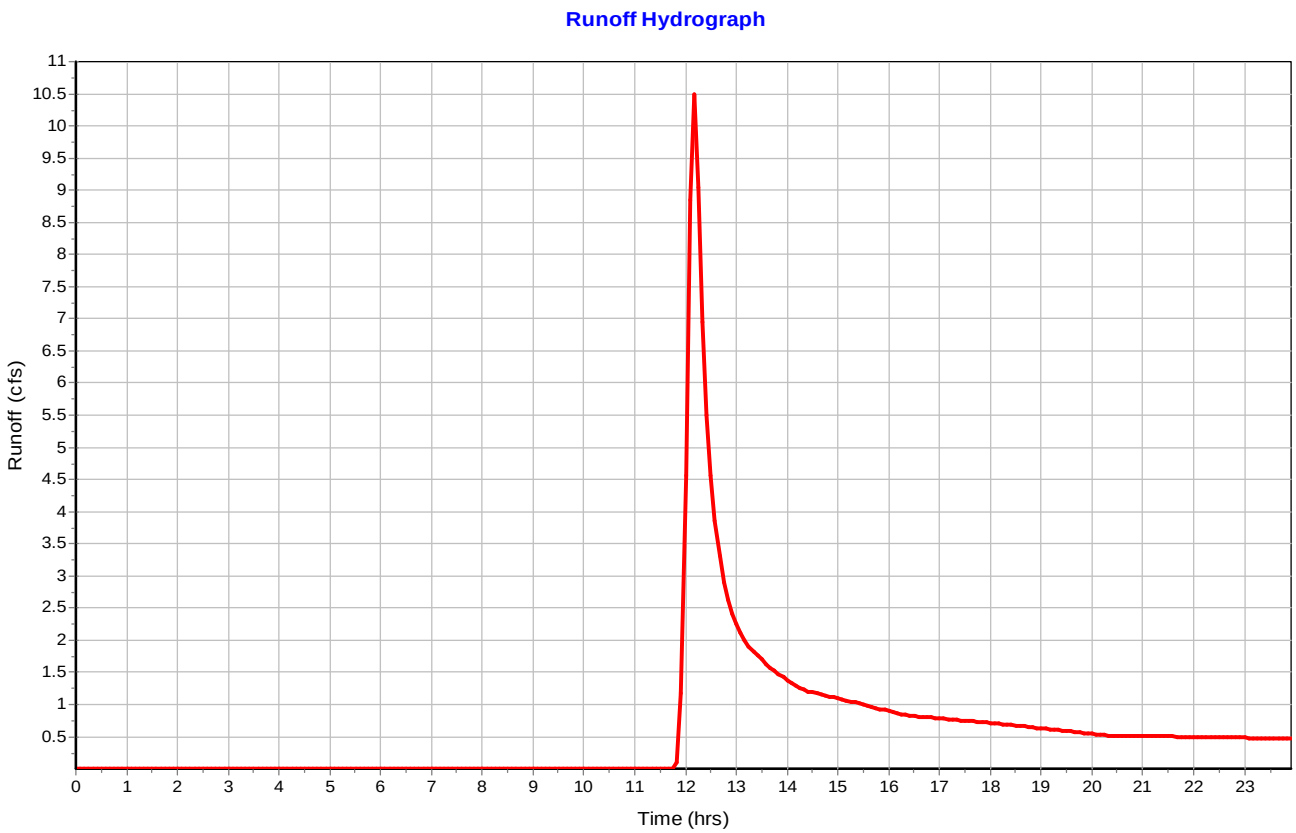
Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.05	0.00	0.00
Flow Length (ft) :	860	0.00	0.00
Channel Slope (%) :	7	0.00	0.00
Cross Section Area (ft^2) :	24	0.00	0.00
Wetted Perimeter (ft) :	16.9	0.00	0.00
Velocity (ft/sec) :	9.96	0.00	0.00
Computed Flow Time (min) :	1.44	0.00	0.00

Total TOC (min) 21.74

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 0.60
Peak Runoff (cfs) 10.52
Weighted Curve Number 55.06
Time of Concentration (days hh:mm:ss) 0 00:21:44

Subbasin : B1

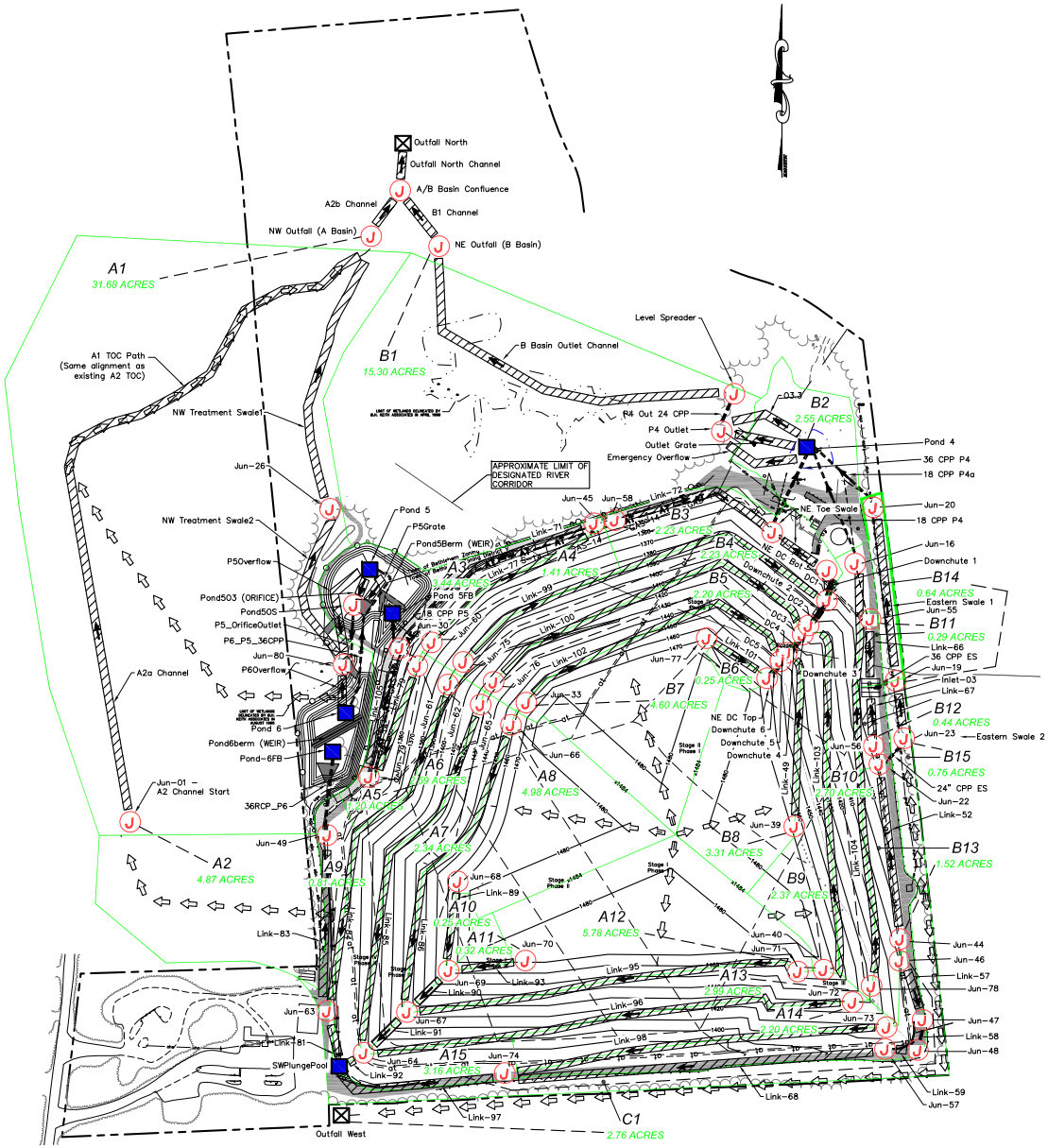

Runoff Hydrograph
Runoff (cfs)
Time (hrs)
11
10.5
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

Stormwater Management Report

Appendix F

Post-Development Drainage Analysis

i. Drainage Diagram
ii. 25-Year, 24-Hour Storm Calculations



Legend

- Junction
- Storage Node
- Conveyance
- Outfall
- Drop Inlet
- Subbasin
- Subbasin Discharge Line
- Impervious Area
- Time of Concentration
- Culvert
- Flow Direction

Impervious Area Summary

Gravel Area (Impervious) = 3.49 Acres

Total Drainage Area = 112.17 Acres

no.	revision	date	by
1	Issued for NHDES Review	2/7/14	BWS
2	Issued for NHDES Review	JAN 2015	RJG

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designed by: BWS/PAC
drawn by: PAC/BWS
approved by: BWS/RJG
date: JAN 2015
project no: 833
file name: AOT-Post
scale: 1 inch = 150 ft.

North Country Environmental Services
Bethlehem, New Hampshire

Stage V Landfill Expansion

Stormwater Analysis
Post Development Conditions

drawing no.
Appendix F

sheet: - of -

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Project Description

File Name	833-Post Development.SPF
Description	833-NCES Stage V

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-20
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	Oct 04, 2010	00:00:00
End Analysis On	Oct 05, 2010	00:00:00
Start Reporting On	Oct 04, 2010	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	31
Nodes	67
Junctions	57
Outfalls	2
Flow Diversions	0
Inlets	2
Storage Nodes	6
Links	76
Channels	48
Pipes	11
Pumps	0
Orifices	12
Weirs	5
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Gage-1	Time Series	25 Year - Extreme	Cumulative	inches	New Hampshire	Grafton	25	4.17	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	A1	31.68	48.37	4.17	0.33	10.33	3.62	0 00:29:44
2	A10	0.25	74.00	4.17	1.72	0.43	0.66	0 00:06:00
3	A11	0.32	74.00	4.17	1.72	0.55	0.75	0 00:10:51
4	A12	5.78	74.00	4.17	1.72	9.95	12.65	0 00:13:44
5	A13	2.99	74.00	4.17	1.72	5.15	7.86	0 00:06:00
6	A14	2.20	71.75	4.17	1.56	3.44	5.20	0 00:06:00
7	A15	3.16	70.62	4.17	1.49	4.70	6.11	0 00:12:16
8	A2	4.87	33.28	4.17	0.00	0.00	0.00	0 00:25:48
9	A3	3.44	68.96	4.17	1.38	4.73	7.04	0 00:06:00
10	A4	1.41	74.00	4.17	1.72	2.43	3.70	0 00:06:00
11	A5	1.20	74.37	4.17	1.75	2.10	3.22	0 00:06:00
12	A6	2.59	72.13	4.17	1.59	4.12	6.24	0 00:06:00
13	A7	2.34	74.00	4.17	1.72	4.03	6.16	0 00:06:00
14	A8	4.98	74.00	4.17	1.72	8.58	10.37	0 00:15:44
15	A9	0.81	70.85	4.17	1.50	1.22	1.84	0 00:06:00
16	B1	15.30	55.13	4.17	0.61	9.26	6.80	0 00:21:44
17	B10	2.70	74.00	4.17	1.72	4.65	7.10	0 00:06:00
18	B11	0.29	72.59	4.17	1.62	0.47	0.71	0 00:06:00
19	B12	0.44	71.91	4.17	1.57	0.69	1.05	0 00:06:00
20	B13	1.52	76.68	4.17	1.92	2.92	4.50	0 00:06:00
21	B14	0.64	61.00	4.17	0.90	0.58	0.78	0 00:06:00
22	B15	0.76	61.00	4.17	0.90	0.68	0.93	0 00:06:00
23	B2	2.55	64.39	4.17	1.09	2.78	3.26	0 00:14:26
24	B3	2.23	74.54	4.17	1.76	3.93	6.00	0 00:06:00
25	B4	2.23	74.00	4.17	1.72	3.84	5.86	0 00:06:00
26	B5	2.20	74.00	4.17	1.72	3.79	5.79	0 00:06:00
27	B6	0.25	74.00	4.17	1.72	0.43	0.66	0 00:06:00
28	B7	4.60	74.00	4.17	1.72	7.92	9.63	0 00:15:33
29	B8	3.31	74.00	4.17	1.72	5.70	7.17	0 00:14:09
30	B9	2.37	74.00	4.17	1.72	4.08	5.38	0 00:12:09
31	C1	2.76	63.78	4.17	1.06	2.92	3.70	0 00:11:11

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	A/B Basin Confluence	Junction	1230.00	1250.00	1230.00	1250.00	0.00	9.51	1230.25	0.00	19.75	0 00:00	0.00	0.00
2	DC1	Junction	1356.00	1362.00	1356.00	1362.00	0.00	31.60	1356.83	0.00	5.17	0 00:00	0.00	0.00
3	DC2	Junction	1381.00	1387.00	1381.00	1387.00	0.00	26.22	1381.66	0.00	5.34	0 00:00	0.00	0.00
4	DC3	Junction	1387.00	1393.00	1387.00	1393.00	0.00	21.12	1387.80	0.00	5.20	0 00:00	0.00	0.00
5	DC4	Junction	1408.00	1414.00	1408.00	1414.00	0.00	16.47	1408.70	0.00	5.30	0 00:00	0.00	0.00
6	DC5	Junction	1420.00	1426.00	1420.00	1426.00	0.00	9.66	1420.95	0.00	5.05	0 00:00	0.00	0.00
7	Jun-01 - A2 Channel Start	Junction	1329.00	1350.00	1329.00	1350.00	0.00	0.00	1329.00	0.00	21.00	0 00:00	0.00	0.00
8	Jun-16	Junction	1348.00	1352.00	1348.00	1352.00	0.00	6.68	1348.74	0.00	3.26	0 00:00	0.00	0.00
9	Jun-19	Junction	1346.00	1370.00	1346.00	1370.00	0.00	7.50	1346.82	0.00	23.18	0 00:00	0.00	0.00
10	Jun-20	Junction	1340.00	1360.00	1340.00	1360.00	0.00	7.44	1340.82	0.00	19.18	0 00:00	0.00	0.00
11	Jun-22	Junction	1367.40	1390.00	1367.40	1390.00	0.00	4.27	1367.84	0.00	22.16	0 00:00	0.00	0.00
12	Jun-23	Junction	1356.70	1390.00	1356.70	1390.00	0.00	5.15	1357.31	0.00	32.69	0 00:00	0.00	0.00
13	Jun-26	Junction	1318.00	1330.00	1318.00	1330.00	0.00	2.18	1318.25	0.00	11.75	0 00:00	0.00	0.00
14	Jun-30	Junction	1333.00	1340.00	1333.00	1340.00	0.00	12.78	1334.17	0.00	5.83	0 00:00	0.00	0.00
15	Jun-33	Junction	1455.00	1459.00	1455.00	1459.00	0.00	9.39	1455.95	0.00	3.05	0 00:00	0.00	0.00
16	Jun-34	Junction	1475.00	1479.00	1475.00	1479.00	0.00	0.00	1475.00	0.00	4.00	0 00:00	0.00	0.00
17	Jun-39	Junction	1464.00	1468.00	1464.00	1468.00	0.00	6.82	1464.70	0.00	3.30	0 00:00	0.00	0.00
18	Jun-40	Junction	1465.00	1469.00	1465.00	1469.00	0.00	5.28	1465.67	0.00	3.33	0 00:00	0.00	0.00
19	Jun-44	Junction	1398.00	1402.00	1398.00	1402.00	0.00	4.39	1398.44	0.00	5.56	0 00:00	0.00	0.00
20	Jun-45	Junction	1340.50	1344.50	1340.50	1344.50	0.00	3.48	1341.34	0.00	3.16	0 00:00	0.00	0.00
21	Jun-46	Junction	1398.00	1402.00	1398.00	1402.00	0.00	5.94	1398.52	0.00	3.48	0 00:00	0.00	0.00
22	Jun-47	Junction	1393.50	1397.50	1393.50	1397.50	0.00	5.89	1394.14	0.00	3.36	0 00:00	0.00	0.00
23	Jun-48	Junction	1391.40	1395.40	1391.40	1395.40	0.00	5.91	1392.07	0.00	3.33	0 00:00	0.00	0.00
24	Jun-49	Junction	1339.50	1343.50	1339.50	1343.50	0.00	50.38	1340.99	0.00	2.51	0 00:00	0.00	0.00
25	Jun-55	Junction	1360.00	1364.00	1360.00	1364.00	0.00	0.68	1360.28	0.00	3.72	0 00:00	0.00	0.00
26	Jun-56	Junction	1367.00	1371.00	1367.00	1371.00	0.00	1.01	1367.17	0.00	3.83	0 00:00	0.00	0.00
27	Jun-57	Junction	1391.00	1397.00	1391.00	1397.00	0.00	5.89	1391.67	0.00	5.33	0 00:00	0.00	0.00
28	Jun-58	Junction	1340.50	1344.50	1340.50	1344.50	0.00	5.83	1341.58	0.00	2.92	0 00:00	0.00	0.00
29	Jun-60	Junction	1353.00	1357.00	1353.00	1357.00	0.00	3.58	1353.75	0.00	3.25	0 00:00	0.00	0.00
30	Jun-61	Junction	1353.00	1357.00	1353.00	1357.00	0.00	3.12	1353.63	0.00	3.37	0 00:00	0.00	0.00
31	Jun-62	Junction	1388.00	1392.00	1388.00	1392.00	0.00	6.03	1388.83	0.00	3.17	0 00:00	0.00	0.00
32	Jun-63	Junction	1354.50	1358.50	1354.50	1358.50	0.00	50.49	1355.83	0.00	2.67	0 00:00	0.00	0.00
33	Jun-64	Junction	1375.00	1379.00	1375.00	1379.00	0.00	34.59	1375.85	0.00	3.15	0 00:00	0.00	0.00
34	Jun-65	Junction	1422.00	1426.00	1422.00	1426.00	0.00	5.97	1422.79	0.00	3.21	0 00:00	0.00	0.00
35	Jun-66	Junction	1455.00	1459.00	1455.00	1459.00	0.00	10.21	1455.98	0.00	3.02	0 00:00	0.00	0.00
36	Jun-67	Junction	1418.00	1422.00	1418.00	1422.00	0.00	23.08	1418.98	0.00	3.02	0 00:00	0.00	0.00
37	Jun-68	Junction	1464.00	1468.00	1464.00	1468.00	0.00	0.64	1464.34	0.00	3.66	0 00:00	0.00	0.00
38	Jun-69	Junction	1455.00	1459.00	1455.00	1459.00	0.00	1.34	1455.34	0.00	3.66	0 00:00	0.00	0.00
39	Jun-70	Junction	1468.00	1472.00	1468.00	1472.00	0.00	0.75	1468.33	0.00	3.67	0 00:00	0.00	0.00
40	Jun-71	Junction	1465.00	1472.00	1465.00	1472.00	0.00	12.11	1465.82	0.00	6.18	0 00:00	0.00	0.00
41	Jun-72	Junction	1440.00	1444.00	1440.00	1444.00	0.00	7.62	1440.86	0.00	3.14	0 00:00	0.00	0.00
42	Jun-73	Junction	1415.00	1419.00	1415.00	1419.00	0.00	4.99	1415.73	0.00	3.27	0 00:00	0.00	0.00
43	Jun-74	Junction	1369.00	1375.00	1369.00	1375.00	0.00	9.90	1369.73	0.00	5.27	0 00:00	0.00	0.00
44	Jun-75	Junction	1388.00	1392.00	1388.00	1392.00	0.00	5.68	1388.84	0.00	3.16	0 00:00	0.00	0.00
45	Jun-76	Junction	1422.00	1426.00	1422.00	1426.00	0.00	5.60	1422.81	0.00	3.19	0 00:00	0.00	0.00
46	Jun-77	Junction	1465.00	1469.00	1465.00	1469.00	0.00	0.64	1465.37	0.00	3.63	0 00:00	0.00	0.00
47	Jun-78	Junction	1440.00	1444.00	1440.00	1444.00	0.00	6.89	1440.75	0.00	3.25	0 00:00	0.00	0.00
48	Jun-79	Junction	1338.00	1344.00	1338.00	1344.00	0.00	9.74	1339.17	0.00	4.83	0 00:00	0.00	0.00
49	Jun-80	Junction	1320.50	1324.00	1320.50	1324.00	0.00	2.18	1321.00	0.00	7.50	0 00:00	0.00	0.00
50	Level Spreader	Junction	1326.00	1335.00	1326.00	1335.00	0.00	0.83	1326.88	0.00	8.12	0 00:00	0.00	0.00
51	NE DC Bot	Junction	1350.00	1370.00	1350.00	1370.00	0.00	31.60	1350.81	0.00	19.19	0 00:00	0.00	0.00
52	NE DC Top	Junction	1460.00	1480.00	1460.00	1480.00	0.00	0.63	1460.37	0.00	19.63	0 00:00	0.00	0.00
53	NE Outfall (B Basin)	Junction	1240.00	1260.00	1240.00	1260.00	0.00	6.88	1240.21	0.00	19.79	0 00:00	0.00	0.00
54	NE Toe Swale	Junction	1336.80	1344.00	1336.80	1344.00	0.00	36.90	1338.39	0.00	5.61	0 00:00	0.00	0.00
55	NW Outfall (A Basin)	Junction	1240.00	1260.00	1240.00	1260.00	0.00	2.18	1240.11	0.00	19.89	0 00:00	0.00	0.00
56	P4 Outlet	Junction	1327.20	1350.00	1327.20	1350.00	0.00	0.83	1327.48	0.00	22.52	0 00:00	0.00	0.00
57	Pond5OS	Junction	1321.00	1325.00	1321.00	1325.00	0.00	2.18	1321.50	0.00	3.50	0 00:00	0.00	0.00
58	Outfall North	Outfall	1214.00					9.51	1214.25					
59	Outfall West	Outfall	1356.00					3.56	1356.00					
60	Jun-51	Storage Node	1353.00	1362.00	1353.00		0.00	44.09	1359.23				0.00	0.00
61	Pond 4	Storage Node	1327.00	1337.00	0.00		0.00	53.77	1331.44				0.00	0.00
62	Pond 5FB	Storage Node	1322.00	1332.00	0.00		0.00	12.76	1326.11				0.00	0.00
63	Pond5	Storage Node	1320.00	1330.00	0.00		0.00	14.12	1323.38				0.00	0.00
64	Pond6	Storage Node	1322.00	1330.00	0.00		0.00	33.99	1323.94				0.00	0.00
65	Pond-6FB	Storage Node	1322.00	1330.00	0.00		0.00	50.40	1326.17				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)
1	18 CPP P4	Pipe	Jun-16	Pond 4	199.00	1348.00	1343.00	2.5100	18.000	0.0150	6.66	14.43	0.46	8.01	0.71	0.48	0.00
2	18 CPP P4a	Pipe	Jun-20	Pond 4	81.00	1340.00	1337.00	3.7000	18.000	0.0120	7.43	21.90	0.34	11.19	0.59	0.40	0.00
3	18 CPP P5	Pipe	Jun-30	Pond 5FB	45.00	1333.00	1327.00	13.3300	18.000	0.0150	12.76	33.24	0.38	17.57	0.64	0.43	0.00
4	24 CPP ES	Pipe	Jun-22	Jun-23	62.00	1367.40	1356.70	17.2600	24.000	0.0120	4.27	101.81	0.04	16.09	0.27	0.14	0.00
5	36 CPP ES	Pipe	Inlet-03	Jun-19	42.55	1347.70	1346.00	4.0000	18.000	0.0120	1.64	22.75	0.07	7.50	0.27	0.18	0.00
6	36 CPP P4	Pipe	NE Toe Swale	Pond 4	140.00	1336.80	1335.60	0.8600	36.000	0.0120	36.88	66.90	0.55	9.69	1.53	0.53	0.00
7	Link-113	Pipe	Jun-49	Pond-6FB	125.00	1339.90	1328.00	9.5200	36.000	0.0150	50.40	178.36	0.28	21.70	1.08	0.36	0.00
8	Link-58	Pipe	Jun-47	Jun-48	111.61	1393.50	1391.40	1.8800	24.000	0.0150	5.91	26.89	0.22	6.87	0.62	0.32	0.00
9	P4 Out 24 CPP	Pipe	P4 Outlet	Level Spreader	62.00	1327.20	1326.60	0.9700	24.000	0.0150	0.83	19.29	0.04	3.07	0.28	0.14	0.00
10	P5_OrificeOutlet	Pipe	Pond5OS	Jun-80	100.00	1321.00	1320.00	1.0000	30.000	0.0150	2.18	25.14	0.09	3.14	0.50	0.20	0.00
11	P6_P5_36CPP	Pipe	Pond6	Pond5	200.00	1323.00	1321.00	1.0000	36.000	0.0150	12.21	57.81	0.21	6.48	0.93	0.31	0.00
12	A2a Channel	Channel	Jun-01 - A2 Channel Start	NW Outfall (A Basin)	1721.32	1329.00	1240.00	5.1700	24.000	0.0500	0.00	231.82	0.00	0.00	0.00	0.00	0.00
13	A2b Channel	Channel	NW Outfall (A Basin)	A/B Basin Confluence	146.91	1240.00	1230.00	6.8100	24.000	0.0320	2.18	415.60	0.01	2.57	0.10	0.05	0.00
14	B Basin Outlet Channel	Channel	Level Spreader	NE Outfall (B Basin)	1070.00	1326.00	1240.00	8.0400	24.000	0.0500	0.83	289.02	0.00	1.42	0.07	0.04	0.00
15	B1 Channel	Channel	NE Outfall (B Basin)	A/B Basin Confluence	155.26	1240.00	1230.00	6.4400	24.000	0.0320	6.85	404.27	0.02	3.90	0.20	0.10	0.00
16	Downchute 1	Channel	DC1	NE DC Bot	18.00	1356.00	1350.00	33.3300	18.000	0.0320	31.60	281.36	0.11	13.80	0.49	0.34	0.00
17	Downchute 2	Channel	DC3	DC2	16.77	1387.00	1381.00	35.7800	18.000	0.0320	21.12	291.49	0.07	12.56	0.39	0.27	0.00
18	Downchute 3	Channel	DC5	DC4	33.00	1420.00	1408.00	36.3600	18.000	0.0320	9.66	293.87	0.03	9.91	0.26	0.17	0.00
19	Downchute 4	Channel	NE DC Top	DC5	120.00	1460.00	1420.00	33.3300	18.000	0.0320	0.63	281.36	0.00	3.68	0.05	0.04	0.00
20	Eastern Swale 1	Channel	Jun-19	Jun-20	512.57	1346.00	1340.00	1.1700	72.000	0.0320	7.44	976.78	0.01	3.13	0.81	0.14	0.00
21	Eastern Swale 2	Channel	Jun-23	Jun-19	512.57	1356.70	1346.00	2.0900	72.000	0.0320	5.10	1304.40	0.00	3.54	0.60	0.10	0.00
22	Link-100	Channel	Jun-76	DC3	1050.04	1422.00	1387.00	3.3300	18.000	0.0320	5.44	29.24	0.19	4.76	0.79	0.53	0.00
23	Link-101	Channel	Jun-77	NE DC Top	175.63	1465.00	1460.00	2.8500	18.000	0.0320	0.63	27.02	0.02	2.38	0.36	0.24	0.00
24	Link-102	Channel	Jun-33	DC5	879.72	1455.00	1420.00	3.9800	18.000	0.0320	9.34	31.94	0.29	5.37	0.94	0.63	0.00
25	Link-103	Channel	Jun-40	DC2	1054.30	1465.00	1381.00	7.9700	18.000	0.0320	5.10	45.20	0.11	6.09	0.65	0.44	0.00
26	Link-104	Channel	Jun-78	Jun-16	1232.26	1440.00	1348.00	7.4700	18.000	0.0320	6.68	43.76	0.15	6.58	0.73	0.49	0.00
27	Link-105	Channel	Jun-79	Jun-30	363.81	1338.00	1333.00	1.3700	18.000	0.0320	9.69	18.77	0.52	3.64	1.17	0.78	0.00
28	Link-46	Channel	DC2	DC1	77.25	1381.00	1356.00	32.3600	18.000	0.0320	26.22	277.23	0.09	12.93	0.46	0.31	0.00
29	Link-48	Channel	DC4	DC3	65.04	1408.00	1387.00	32.2900	18.000	0.0320	16.44	276.91	0.06	11.23	0.36	0.24	0.00
30	Link-49	Channel	Jun-39	DC4	529.28	1464.00	1408.00	10.5800	18.000	0.0320	6.84	52.09	0.13	7.08	0.70	0.47	0.00
31	Link-52	Channel	Jun-44	Jun-22	535.45	1398.00	1367.40	5.7100	72.000	0.0320	4.27	2158.23	0.00	4.80	0.43	0.07	0.00
32	Link-57	Channel	Jun-46	Jun-47	174.79	1398.00	1393.50	2.5700	24.000	0.0320	5.89	95.07	0.06	3.79	0.51	0.26	0.00
33	Link-59	Channel	Jun-48	Jun-57	41.95	1391.40	1391.00	0.9500	24.000	0.0320	5.89	57.86	0.10	2.65	0.65	0.33	0.00
34	Link-66	Channel	Jun-55	Inlet-03	209.08	1360.00	1359.30	0.3300	24.000	0.0320	0.67	34.29	0.02	1.02	0.27	0.13	0.00
35	Link-67	Channel	Jun-56	Inlet-03	205.23	1367.00	1359.30	3.7500	24.000	0.0320	1.00	114.77	0.01	2.51	0.17	0.09	0.00
36	Link-68	Channel	Jun-57	Jun-74	1004.88	1391.00	1369.00	2.1900	24.000	0.0320	5.71	87.67	0.07	3.80	0.52	0.26	0.00
37	Link-71	Channel	Jun-45	Jun-30	699.64	1340.50	1333.00	1.0700	18.000	0.0320	3.41	16.58	0.21	2.77	0.81	0.55	0.00
38	Link-72	Channel	Jun-58	NE Toe Swale	489.39	1340.50	1336.80	0.7600	18.000	0.0320	5.64	13.92	0.40	2.66	1.06	0.71	0.00
39	Link-77	Channel	Jun-60	Jun-45	614.48	1353.00	1340.50	2.0300	18.000	0.0320	3.48	22.84	0.15	3.42	0.73	0.49	0.00
40	Link-79	Channel	Jun-61	Jun-79	382.14	1353.00	1338.00	3.9300	18.000	0.0320	3.06	31.73	0.10	4.03	0.61	0.42	0.00
41	Link-81	Channel	Jun-51	Jun-63	161.13	1358.00	1354.50	2.1700	24.000	0.0320	44.01	116.28	0.38	5.98	1.22	0.62	0.00
42	Link-83	Channel	Jun-63	Jun-49	489.80	1354.50	1339.50	3.0600	24.000	0.0320	50.38	138.06	0.36	7.06	1.20	0.61	0.00
43	Link-84	Channel	Jun-62	Jun-63	1016.99	1388.00	1355.00	3.2400	18.000	0.0320	5.91	28.85	0.20	4.80	0.82	0.55	0.00
44	Link-85	Channel	Jun-65	Jun-64	1103.49	1422.00	1375.00	4.2600	18.000	0.0320	5.80	33.05	0.18	5.27	0.77	0.52	0.00
45	Link-86	Channel	Jun-66	Jun-67	935.29	1455.00	1418.00	3.9600	18.000	0.0320	10.10	31.85	0.32	5.47	0.97	0.65	0.00
46	Link-89	Channel	Jun-68	Jun-69	224.51	1464.00	1455.00	4.0100	18.000	0.0320	0.62	32.06	0.02	2.72	0.34	0.23	0.00
47	Link-90	Channel	Jun-69	Jun-67	168.03	1455.00	1418.00	22.0200	18.000	0.0320	1.33	228.68	0.01	4.29	0.09	0.06	0.00
48	Link-91	Channel	Jun-67	Jun-64	160.93	1418.00	1375.00	26.7200	18.000	0.0320	23.10	251.91	0.09	11.64	0.45	0.30	0.00
49	Link-92	Channel	Jun-64	Jun-51	63.92	1375.00	1358.00	26.6000	18.000	0.0320	34.59	251.32	0.14	13.07	0.55	0.38	0.00
50	Link-93	Channel	Jun-70	Jun-69	189.99	1468.00	1455.00	6.8400	18.000	0.0320	0.74	41.89	0.02	3.41	0.33	0.22	0.00
51	Link-95	Channel	Jun-71	Jun-67	1153.79	1465.00	1418.00	4.0700	18.000	0.0320	12.03	47.59	0.25	5.87	0.81	0.54	0.00
52	Link-96	Channel	Jun-72	Jun-64	1432.79	1440.00	1375.00	4.5400	18.000	0.0320	7.39	34.11	0.22	5.91	0.84	0.56	0.00
53	Link-97	Channel	Jun-74	Jun-51	517.64	1369.00	1358.00	2.1300	24.000	0.0320	9.80	86.38	0.11	4.14	0.70	0.35	0.00
54	Link-98	Channel	Jun-73	Jun-74	1049.76	1415.00	1369.00	4.3800	18.000	0.0320	4.92	33.52	0.15	5.11	0.72	0.48	0.00
55	Link-99	Channel	Jun-75	DC1	1183.31	1388.00	1356.00	2.7000	18.000	0.0320	5.49	26.33	0.21	4.58	0.82	0.55	0.00
56	NE Toe Swale	Channel	NE DC Bot	NE Toe Swale	230.00	1350.00	1336.80	5.7400	30.000	0.0320	31.59	233.48	0.14	8.09	0.79	0.32	0.00
57	NW Treatment Swale1	Channel	Jun-26	NW Outfall (A Basin)	662.50	1318.00	1240.00	11.7700	24.000	0.0500	2.18	349.81	0.01	2.31	0.11	0.06	0.00
58	NW Treatment Swale2	Channel	Jun-80	Jun-26	490.00	1320.50	1318.00	0.5100	24.000	0.0600	2.18	78.37	0.03	0.68	0.25	0.13	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)
59	Outfall North Channel	Channel	A/B Basin Confluence	Outfall North	252.20	1230.00	1214.00	6.3400	24.000	0.0320	9.51	401.22	0.02	4.37	0.25	0.12	0.00
60	O1.2	Orifice	Pond 4	P4 Outlet		1327.00	1327.20		1.500		0.11						
61	O1.1	Orifice	Pond 4	P4 Outlet		1327.00	1327.20		1.500		0.11						
62	O1.3	Orifice	Pond 4	P4 Outlet		1327.00	1327.20		1.500		0.11						
63	O2.1	Orifice	Pond 4	P4 Outlet		1327.00	1327.20		1.500		0.09						
64	O2.2	Orifice	Pond 4	P4 Outlet		1327.00	1327.20		1.500		0.09						
65	O2.3	Orifice	Pond 4	P4 Outlet		1327.00	1327.20		1.500		0.09						
66	O3.1	Orifice	Pond 4	P4 Outlet		1327.00	1327.20		1.500		0.07						
67	O3.2	Orifice	Pond 4	P4 Outlet		1327.00	1327.20		1.500		0.07						
68	O3.3	Orifice	Pond 4	P4 Outlet		1327.00	1327.20		1.500		0.07						
69	Outlet Grate	Orifice	Pond 4	P4 Outlet		1327.00	1327.20		9.000		0.00						
70	P5Grate	Orifice	Pond5	Pond5OS		1320.00	1321.00		48.000		0.00						
71	Pond5O3	Orifice	Pond5	Pond5OS		1320.00	1321.00		30.000		2.18						
72	Emergency Overflow	Weir	Pond 4	P4 Outlet		1327.00	1327.20				0.00						
73	P5Overflow	Weir	Pond5	Jun-80		1320.00	1320.50				0.00						
74	P6Overflow	Weir	Pond6	Jun-80		1322.00	1320.50				0.00						
75	Pond5Berm	Weir	Pond 5FB	Pond5		1322.00	1320.00				12.76						
76	Pond6berm	Weir	Pond-6FB	Pond6		1322.00	1322.00				33.99						

Inlet Summary

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Initial Water Elevation (ft)	Ponded Area (ft^2)	Peak Flow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Allowable Spread (ft)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)
1	Inlet-03	NEENAH FOUNDRY	R-3550-2	On Sag	1	1347.70	1359.30	1347.70	10.00	0.00	N/A	N/A	N/A	7.00	0.00	1359.30
2	Inlet-09	NEENAH FOUNDRY	R-3550-2	On Sag	1	0.00	6.00	0.00	10.00	0.00	N/A	N/A	N/A	7.00	0.00	6.00

Subbasin Hydrology

Subbasin : A1

Input Data

Area (ac) 31.68
Weighted Curve Number 48.37
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.26	B	85.00
Woods, Good	15.50	A	30.00
Woods, Good	6.00	B	55.00
Woods, Good	8.62	C	70.00
Borrow Pit	1.30	B	86.00
Composite Area & Weighted CN	31.68		48.37

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	6	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.37	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	16.08	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	700	0.00	0.00
Slope (%) :	4	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	1.00	0.00	0.00
Computed Flow Time (min) :	11.67	0.00	0.00

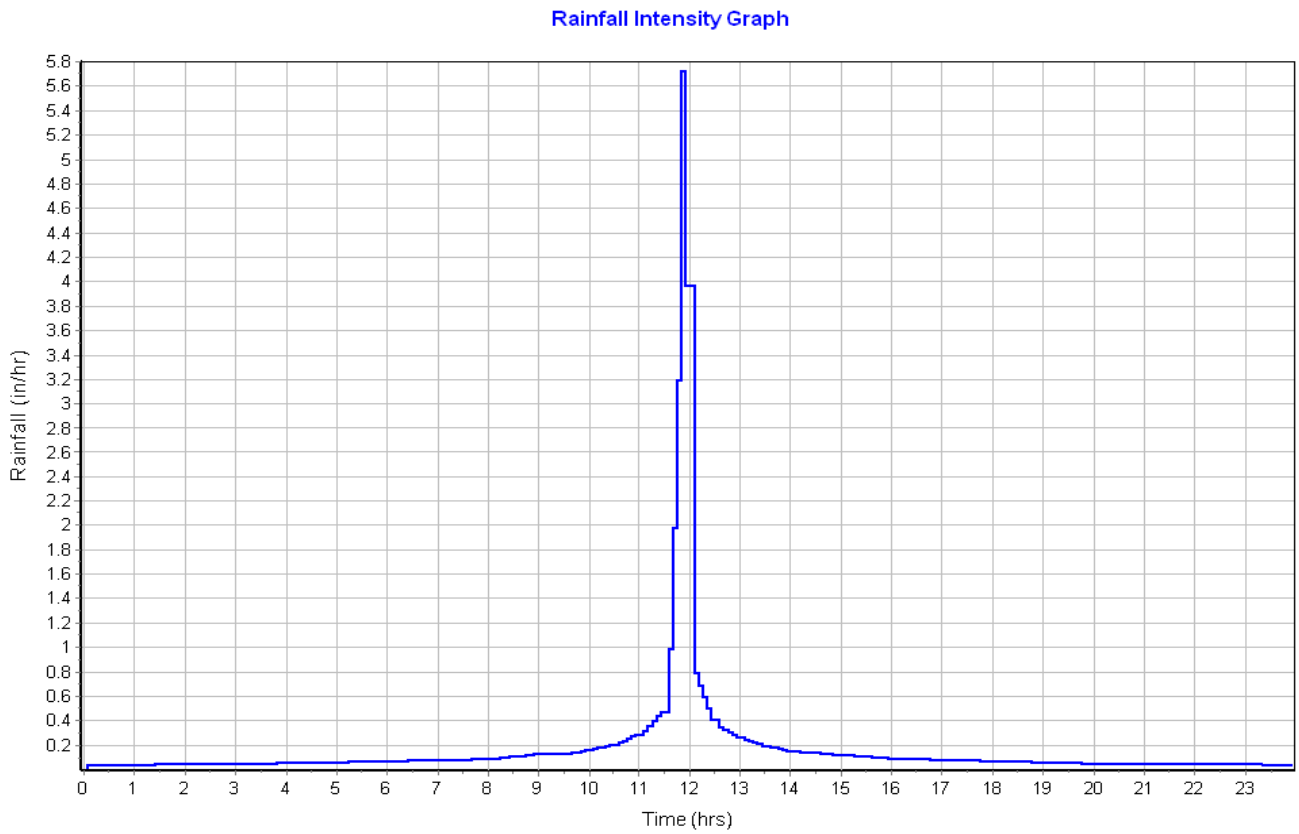
Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.035	0.00	0.00
Flow Length (ft) :	1470	0.00	0.00
Channel Slope (%) :	5.2	0.00	0.00
Cross Section Area (ft²) :	24	0.00	0.00
Wetted Perimeter (ft) :	16.9	0.00	0.00
Velocity (ft/sec) :	12.27	0.00	0.00
Computed Flow Time (min) :	2.00	0.00	0.00

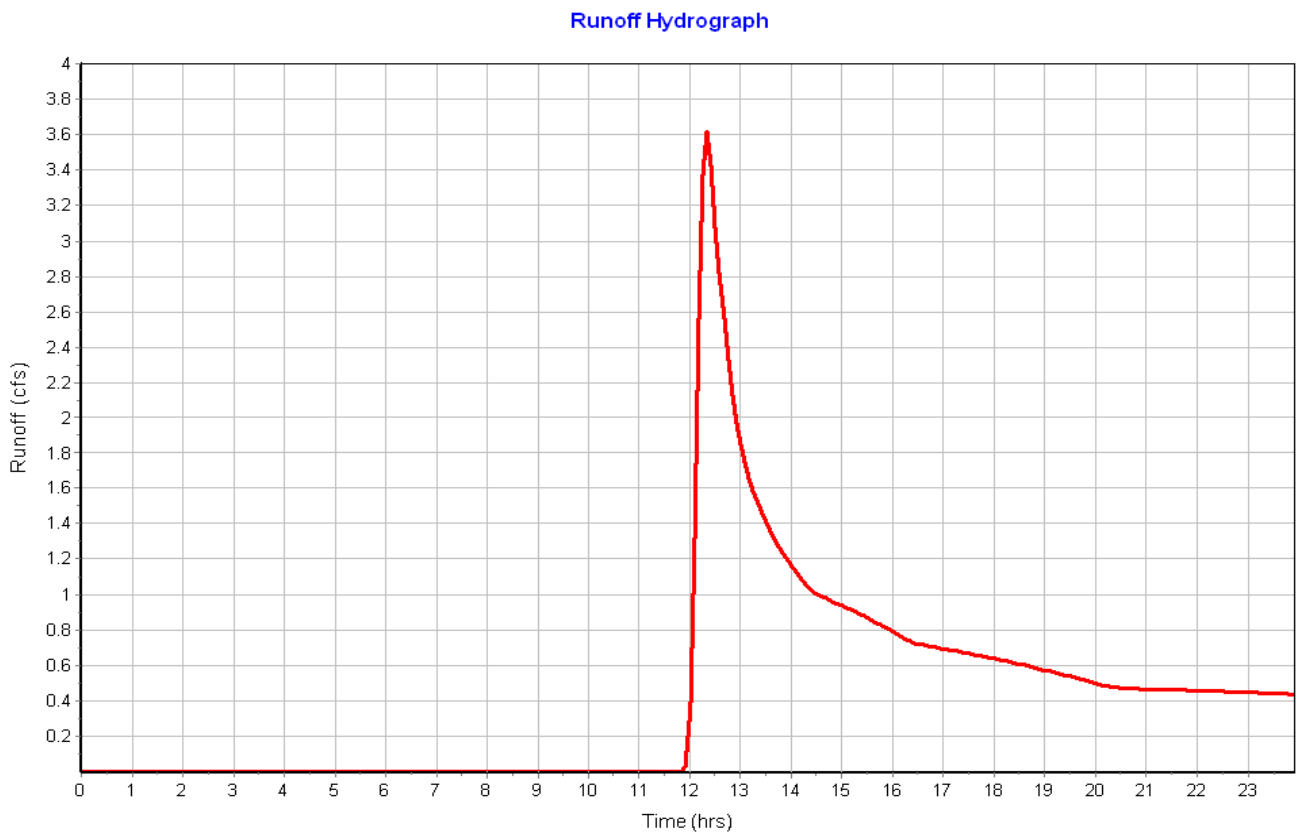
Total TOC (min) 29.74

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 0.33
Peak Runoff (cfs) 3.62
Weighted Curve Number 48.37
Time of Concentration (days hh:mm:ss) 0 00:29:44

Subbasin : A1


Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)


Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : A10

Input Data

Area (ac) 0.25
Weighted Curve Number 74.00
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Landfill Soil Cap	0.25	B	74.00
Liner	0.00	B	100.00
Composite Area & Weighted CN	0.25		74.00

Time of Concentration

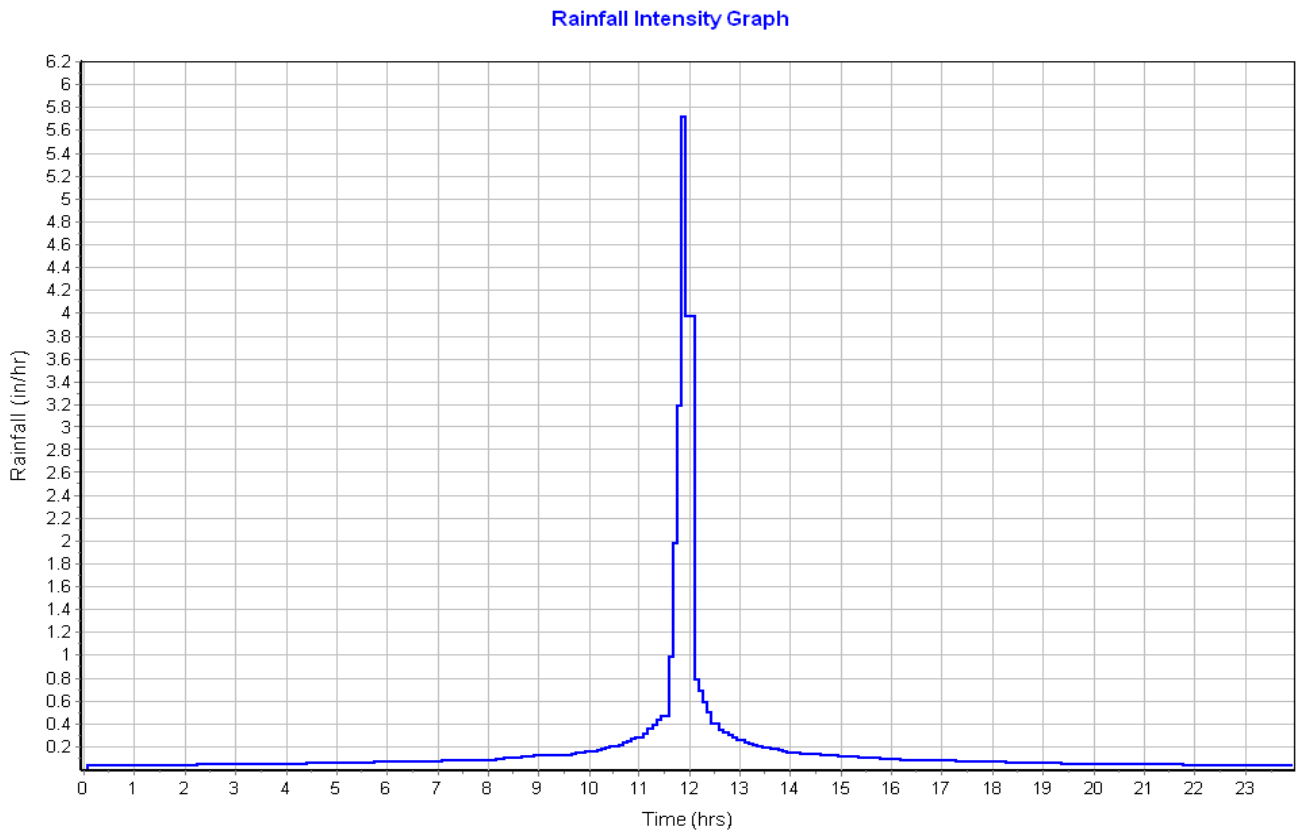
Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	60	0.00	0.00
Slope (%) :	33	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.70	0.00	0.00
Velocity (ft/sec) :	0.30	0.00	0.00
Computed Flow Time (min) :	3.36	0.00	0.00

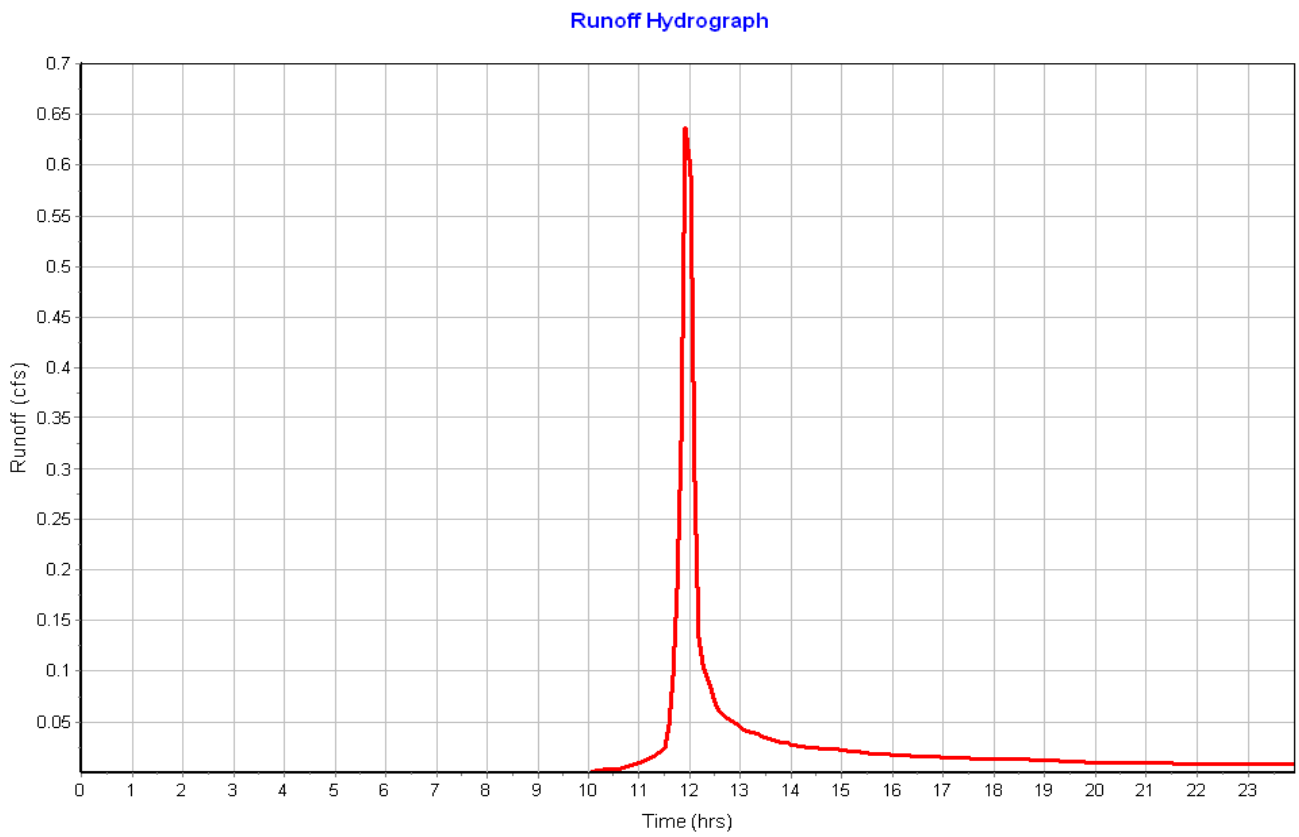
Total TOC (min) 3.36

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.72
Peak Runoff (cfs) 0.66
Weighted Curve Number 74.00
Time of Concentration (days hh:mm:ss) 0 00:03:22

Subbasin : A10





Subbasin : A11

Input Data

Area (ac) 0.32
Weighted Curve Number 74.00
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Landfill Soil Cap	0.32	B	74.00
Liner	0.00	B	100.00
Composite Area & Weighted CN	0.32		74.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.70	0.00	0.00
Velocity (ft/sec) :	0.15	0.00	0.00
Computed Flow Time (min) :	10.77	0.00	0.00

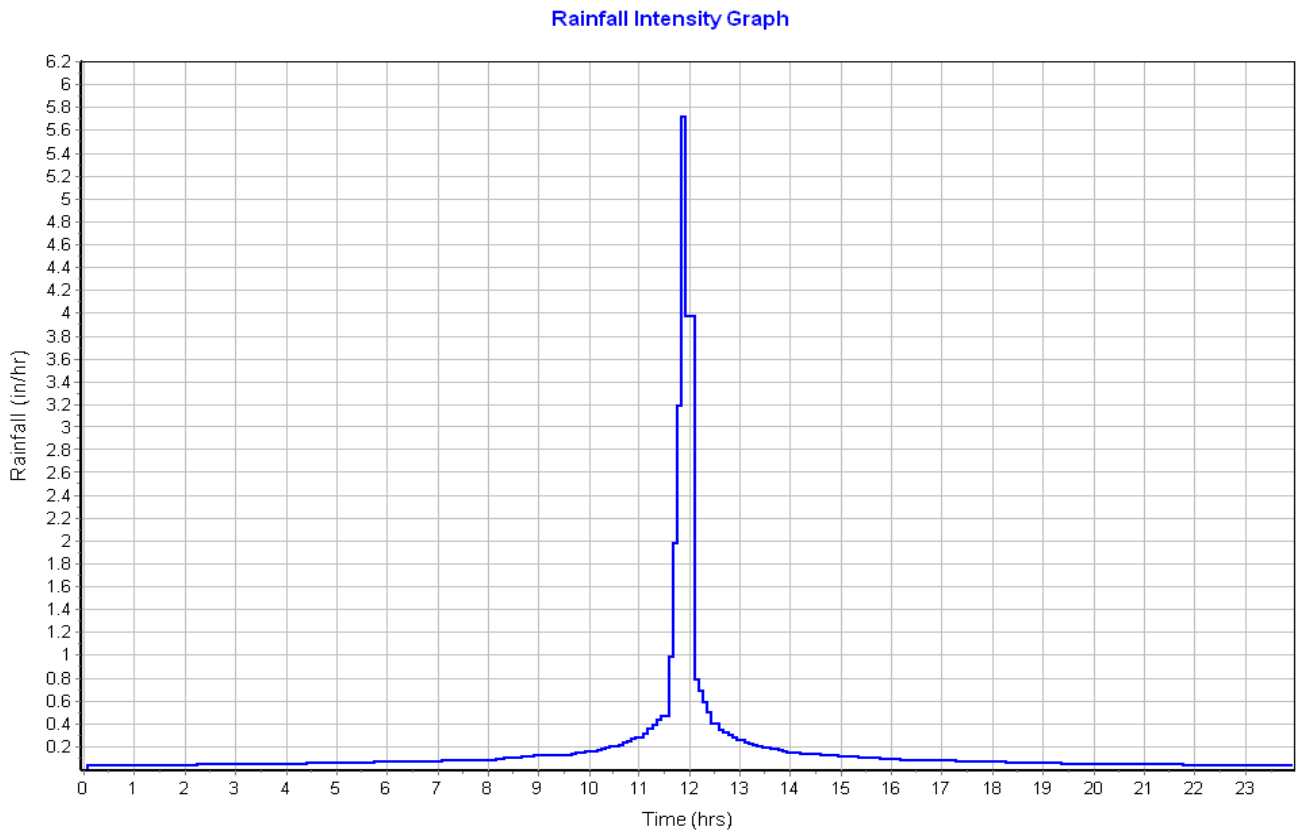
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	20	0.00	0.00
Slope (%) :	33	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	4.02	0.00	0.00
Computed Flow Time (min) :	0.08	0.00	0.00

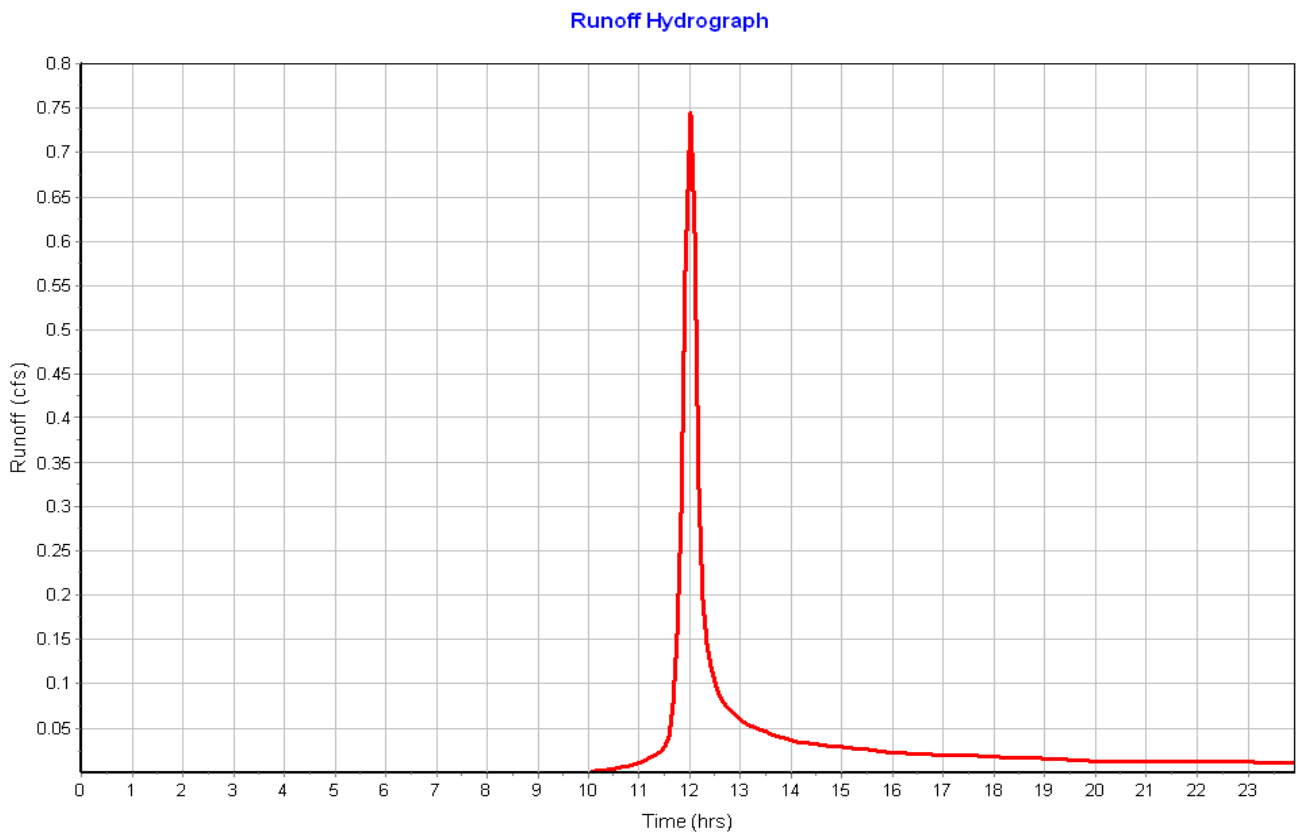
Total TOC (min) 10.85

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.72
Peak Runoff (cfs) 0.75
Weighted Curve Number 74.00
Time of Concentration (days hh:mm:ss) 0 00:10:51

Subbasin : A11





Subbasin : A12

Input Data

Area (ac) 5.78
Weighted Curve Number 74.00
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Landfill Soil Cap	5.78	B	74.00
Liner	0.00	B	100.00
Composite Area & Weighted CN	5.78		74.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.70	0.00	0.00
Velocity (ft/sec) :	0.15	0.00	0.00
Computed Flow Time (min) :	10.77	0.00	0.00

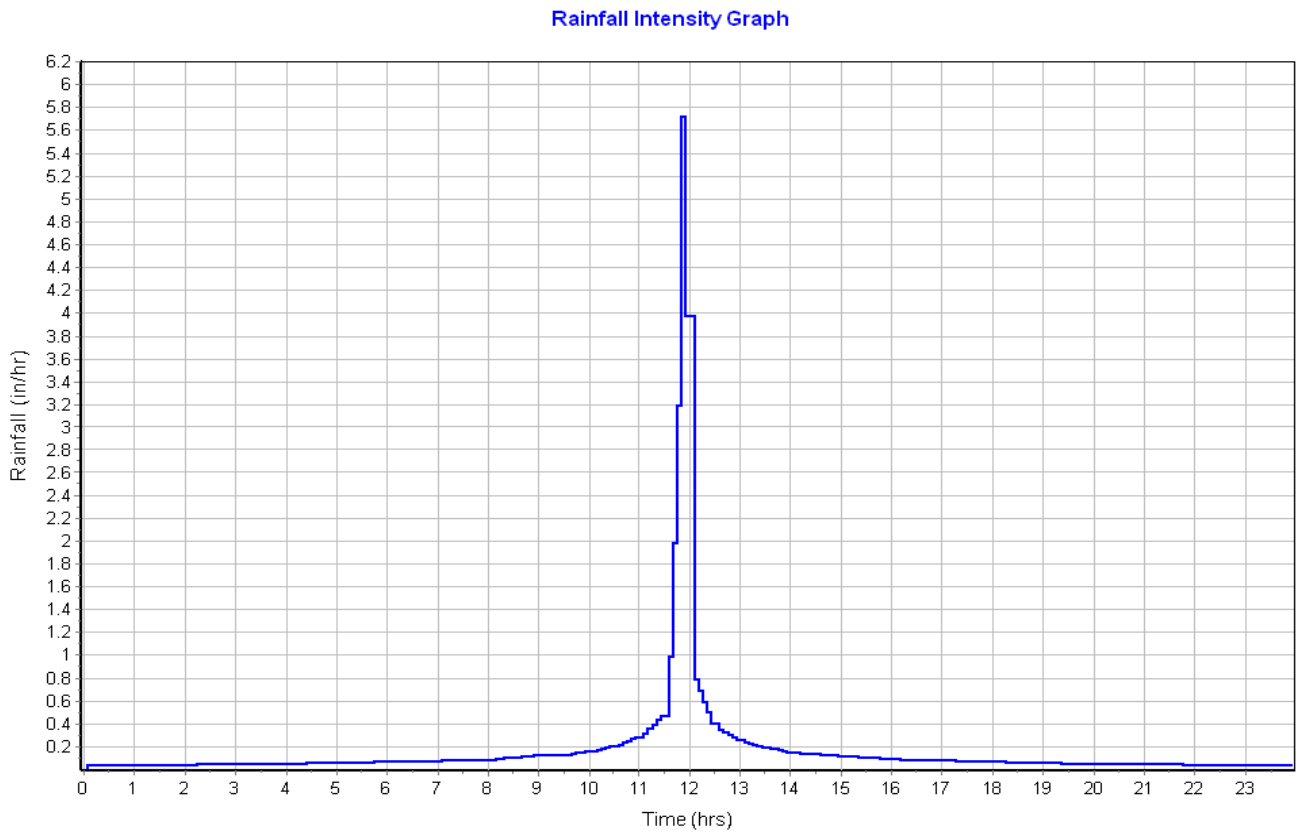
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	280	0.00	0.00
Slope (%) :	5	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.57	0.00	0.00
Computed Flow Time (min) :	2.97	0.00	0.00

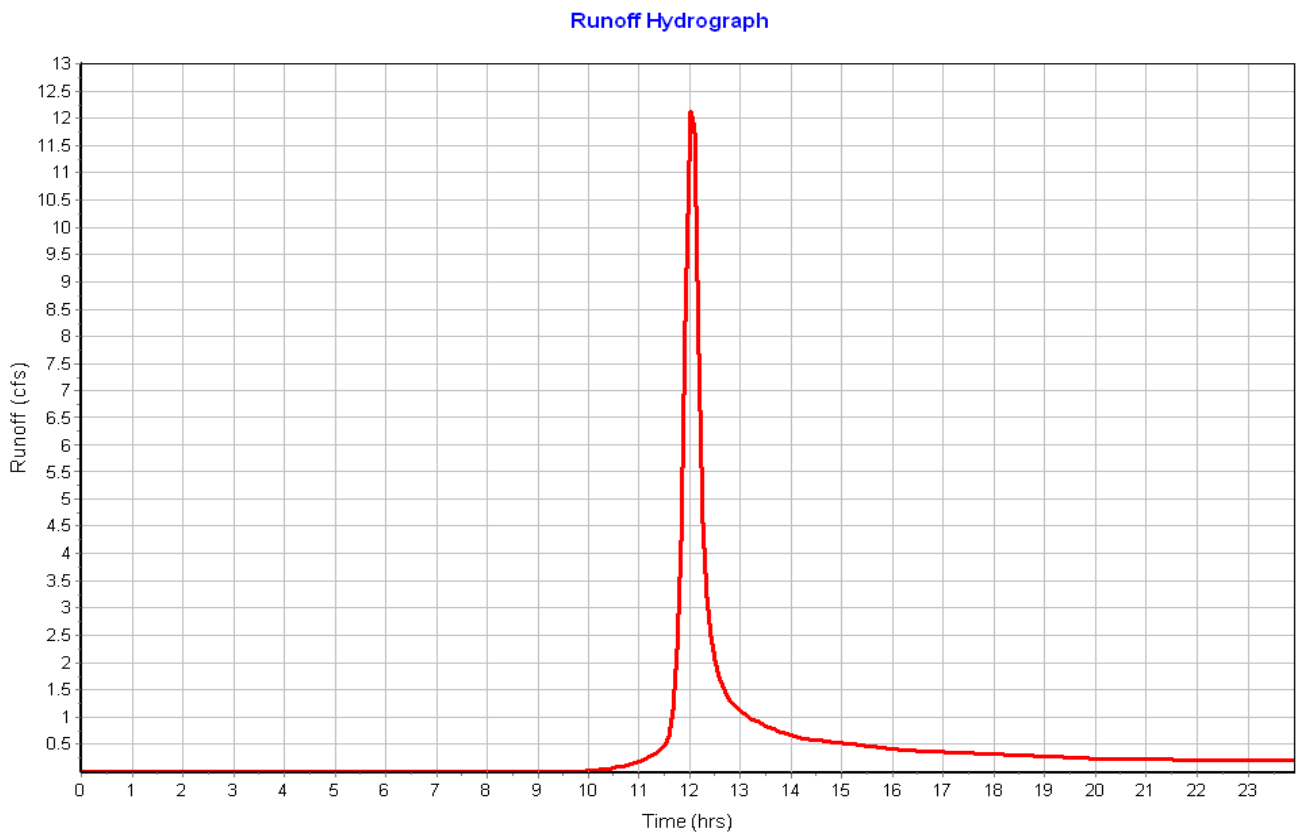
Total TOC (min) 13.74

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.72
Peak Runoff (cfs) 12.65
Weighted Curve Number 74.00
Time of Concentration (days hh:mm:ss) 0 00:13:44

Subbasin : A12





Subbasin : A13

Input Data

Area (ac) 2.99
Weighted Curve Number 74.00
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Landfill Soil Cap	2.99	B	74.00
Liner	0.00	B	100.00
Composite Area & Weighted CN	2.99		74.00

Time of Concentration

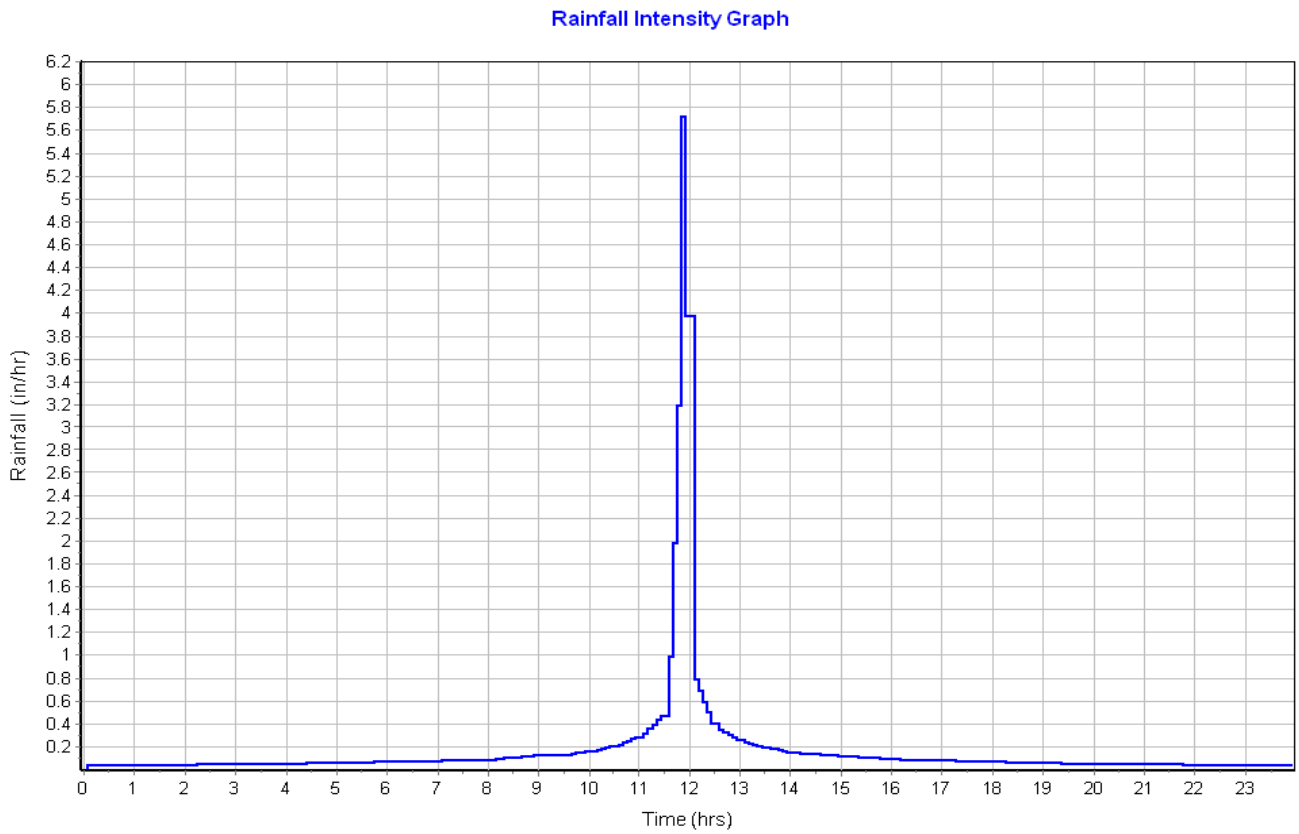
Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	90	0.00	0.00
Slope (%) :	33	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.70	0.00	0.00
Velocity (ft/sec) :	0.32	0.00	0.00
Computed Flow Time (min) :	4.65	0.00	0.00

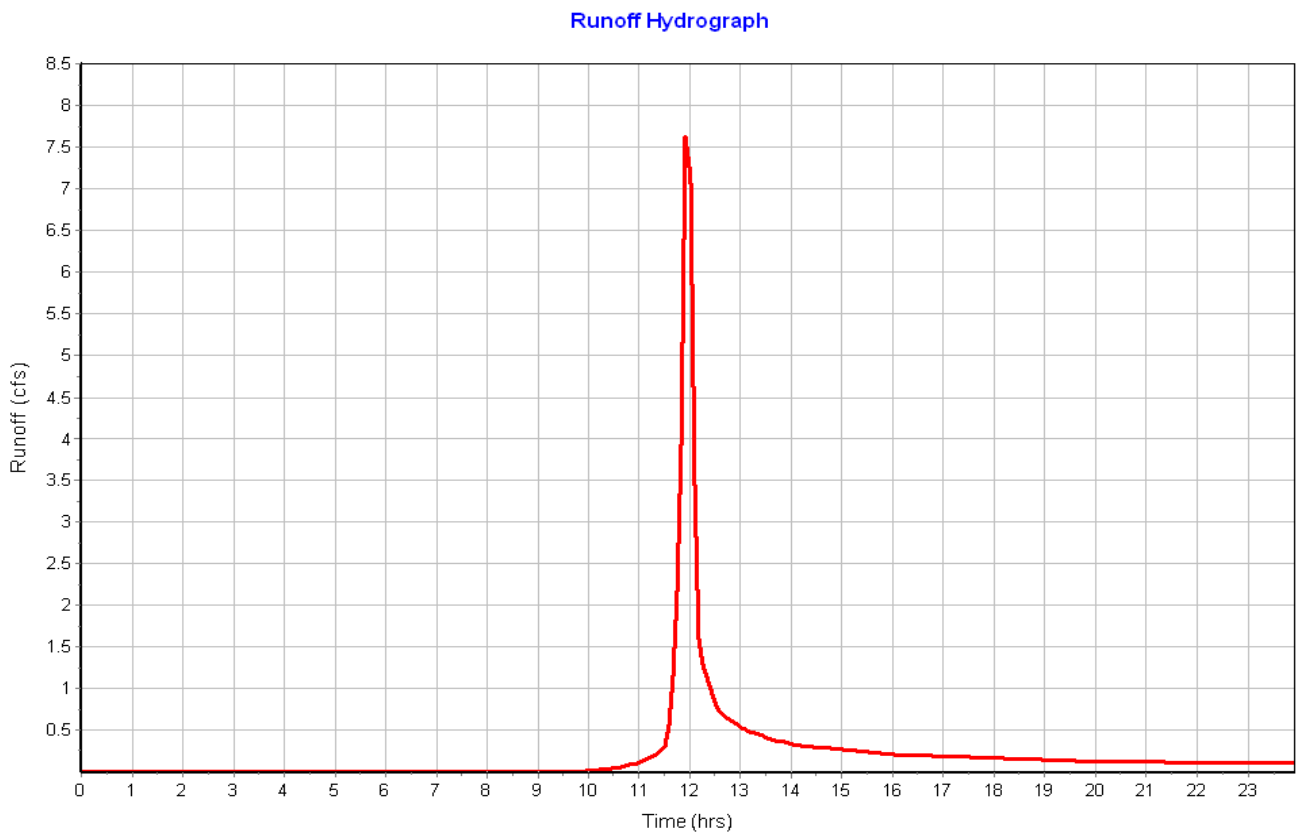
Total TOC (min) 4.65

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.72
Peak Runoff (cfs) 7.86
Weighted Curve Number 74.00
Time of Concentration (days hh:mm:ss) 0 00:04:39

Subbasin : A13





Subbasin : A14

Input Data

Area (ac) 2.20
Weighted Curve Number 71.75
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Rip-rap lines slope / >75% Grass	0.38	B	61.00
Landfill Soil Cap	1.82	B	74.00
Liner	0.00	B	100.00
Composite Area & Weighted CN	2.20		71.75

Time of Concentration

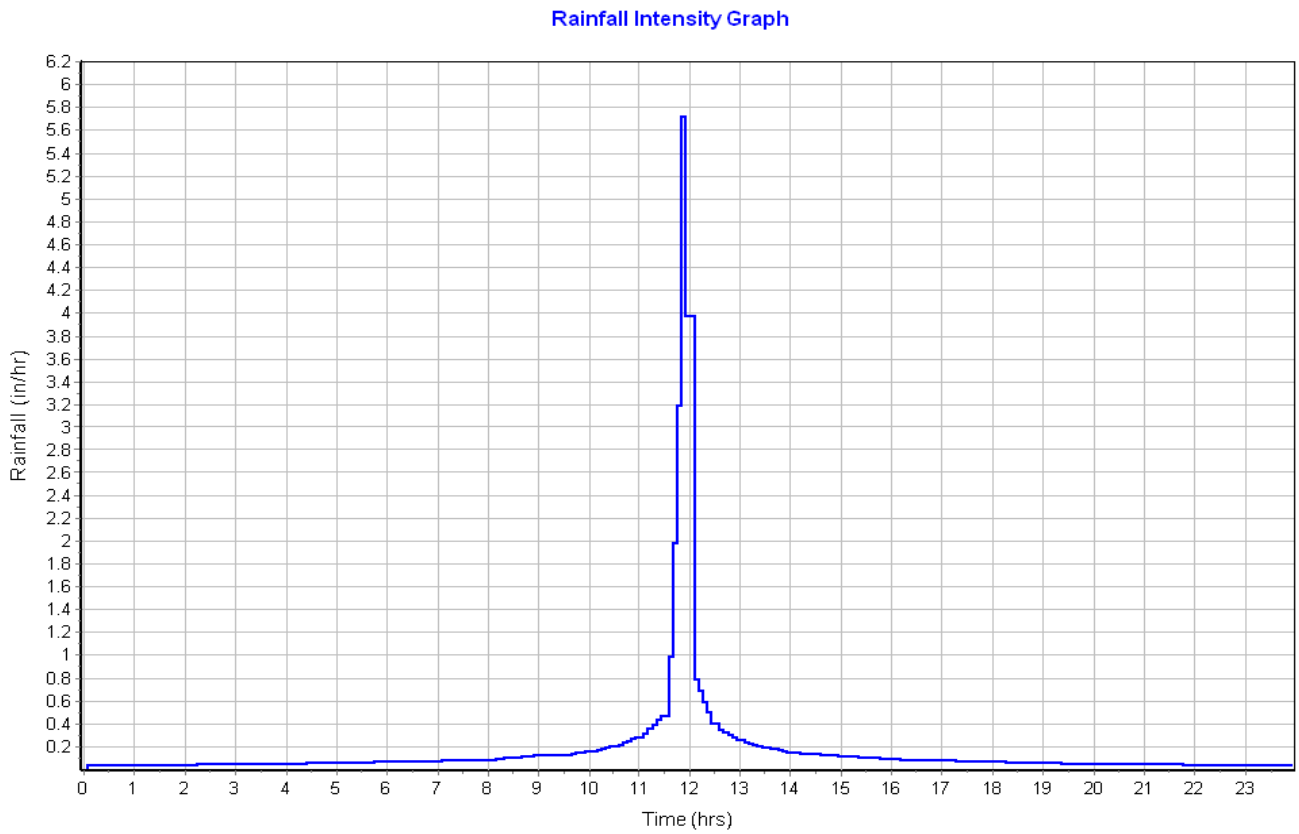
Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	90	0.00	0.00
Slope (%) :	33	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.70	0.00	0.00
Velocity (ft/sec) :	0.32	0.00	0.00
Computed Flow Time (min) :	4.65	0.00	0.00

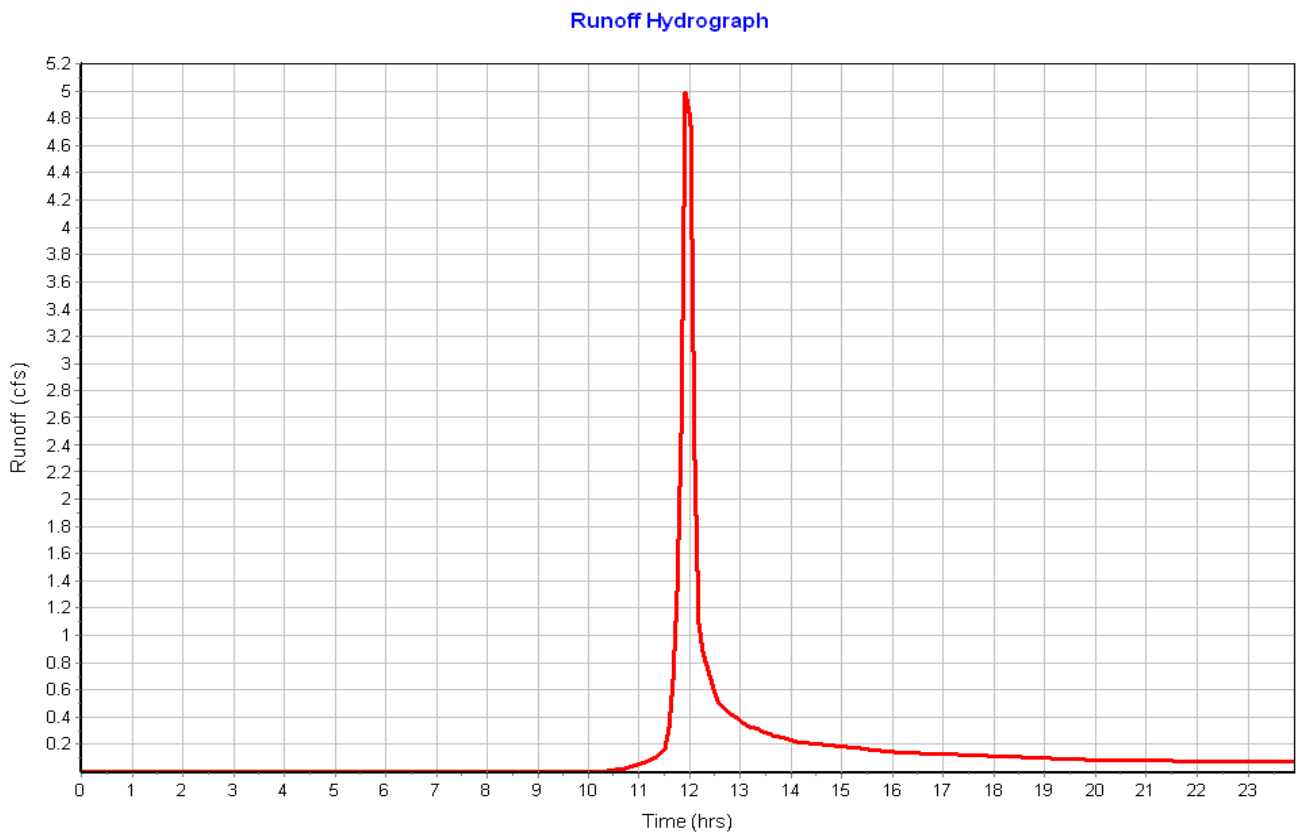
Total TOC (min) 4.65

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.56
Peak Runoff (cfs) 5.20
Weighted Curve Number 71.75
Time of Concentration (days hh:mm:ss) 0 00:04:39

Subbasin : A14





Subbasin : A15

Input Data

Area (ac) 3.16
Weighted Curve Number 70.62
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Landfill Soil Cap	0.77	B	74.00
Gravel roads	0.85	B	85.00
Rip-rap lines slope / >75% Grass	1.54	B	61.00
Liner	0.00	B	100.00
Composite Area & Weighted CN	3.16		70.62

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	90	0.00	0.00
Slope (%) :	50	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.37	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	6.33	0.00	0.00

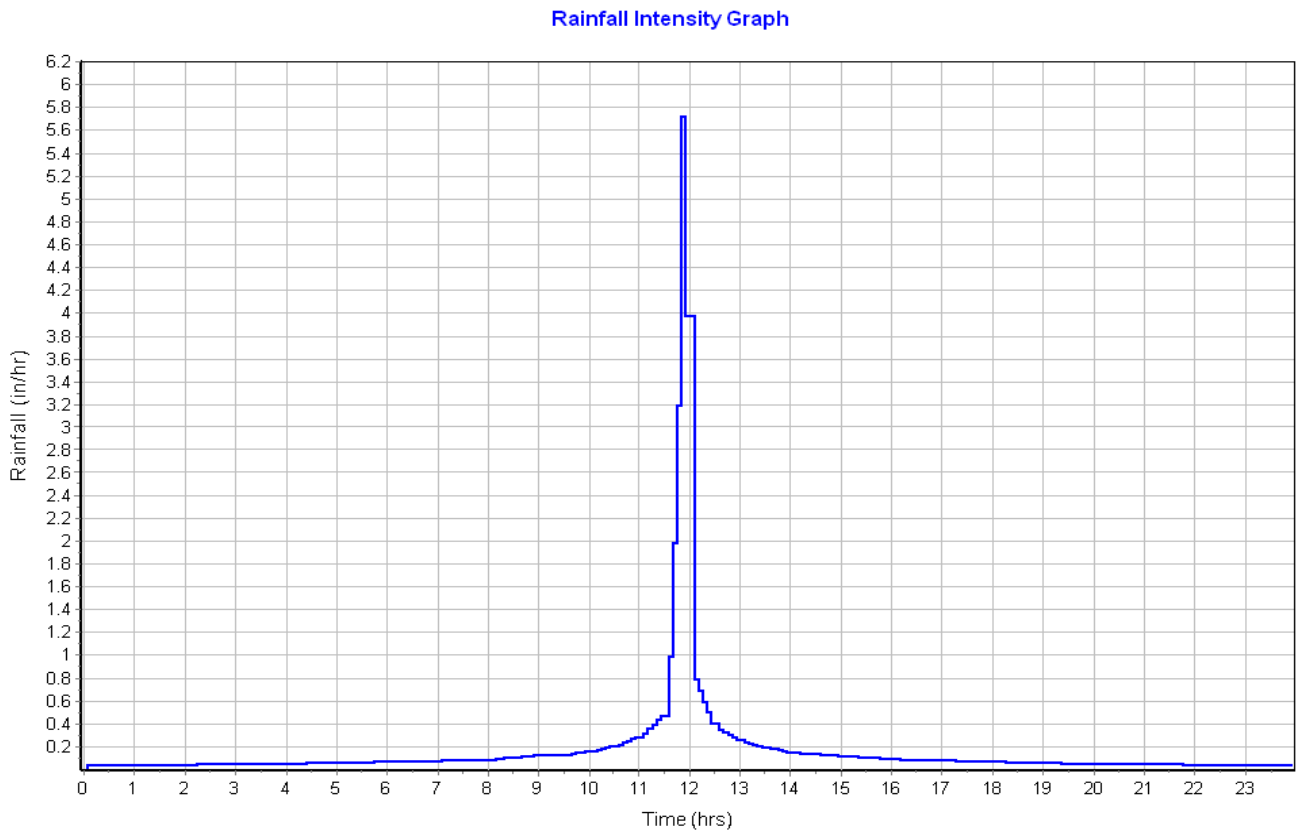
Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.035	0.00	0.00
Flow Length (ft) :	2400	0.00	0.00
Channel Slope (%) :	2.2	0.00	0.00
Cross Section Area (ft²) :	12	0.00	0.00
Wetted Perimeter (ft) :	10.9	0.00	0.00
Velocity (ft/sec) :	6.73	0.00	0.00
Computed Flow Time (min) :	5.94	0.00	0.00

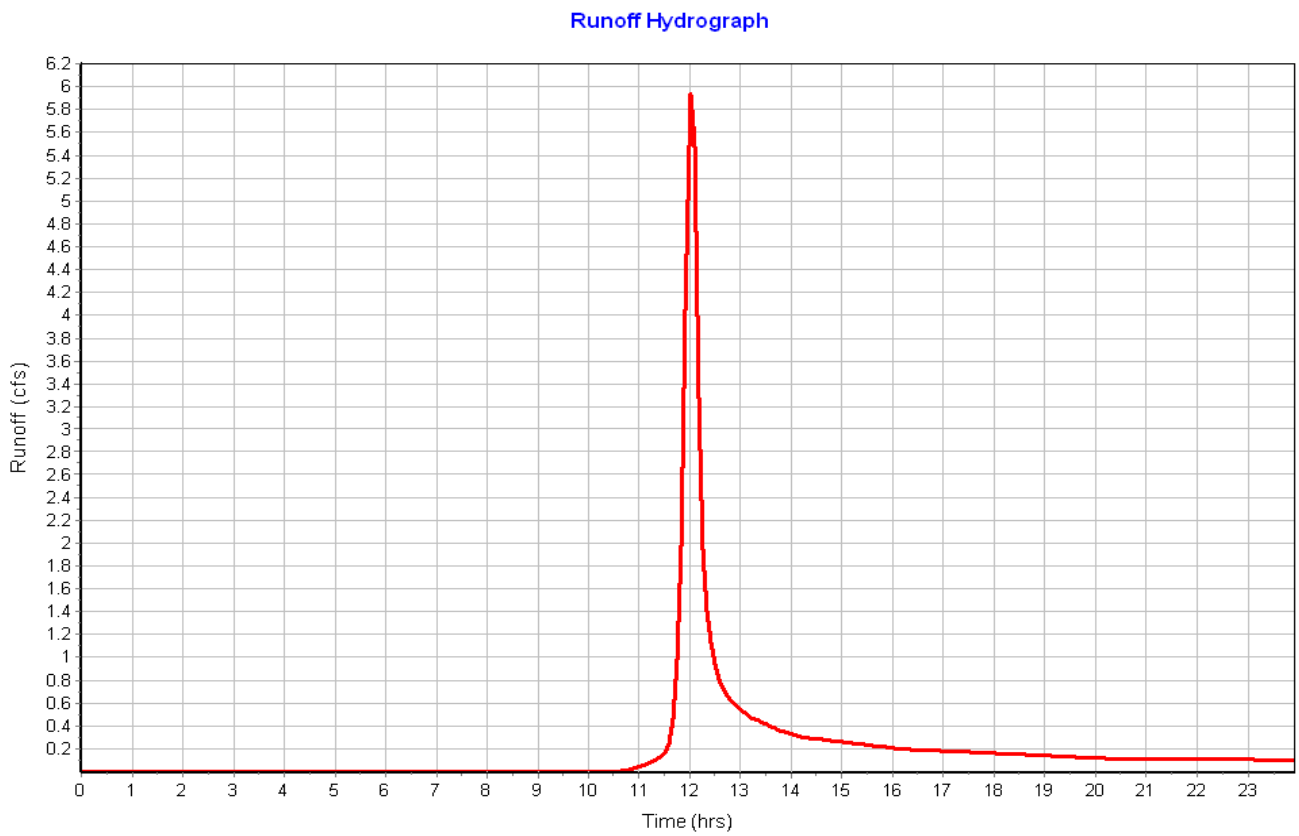
Total TOC (min) 12.27

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.49
Peak Runoff (cfs) 6.11
Weighted Curve Number 70.62
Time of Concentration (days hh:mm:ss) 0 00:12:16

Subbasin : A15





Subbasin : A2

Input Data

Area (ac) 4.87
Weighted Curve Number 33.28
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	4.31	A	30.00
Woods, Good	0.43	B	55.00
Woods, Good	0.13	C	70.00
Composite Area & Weighted CN	4.87		33.28

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	6	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.37	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	16.08	0.00	0.00

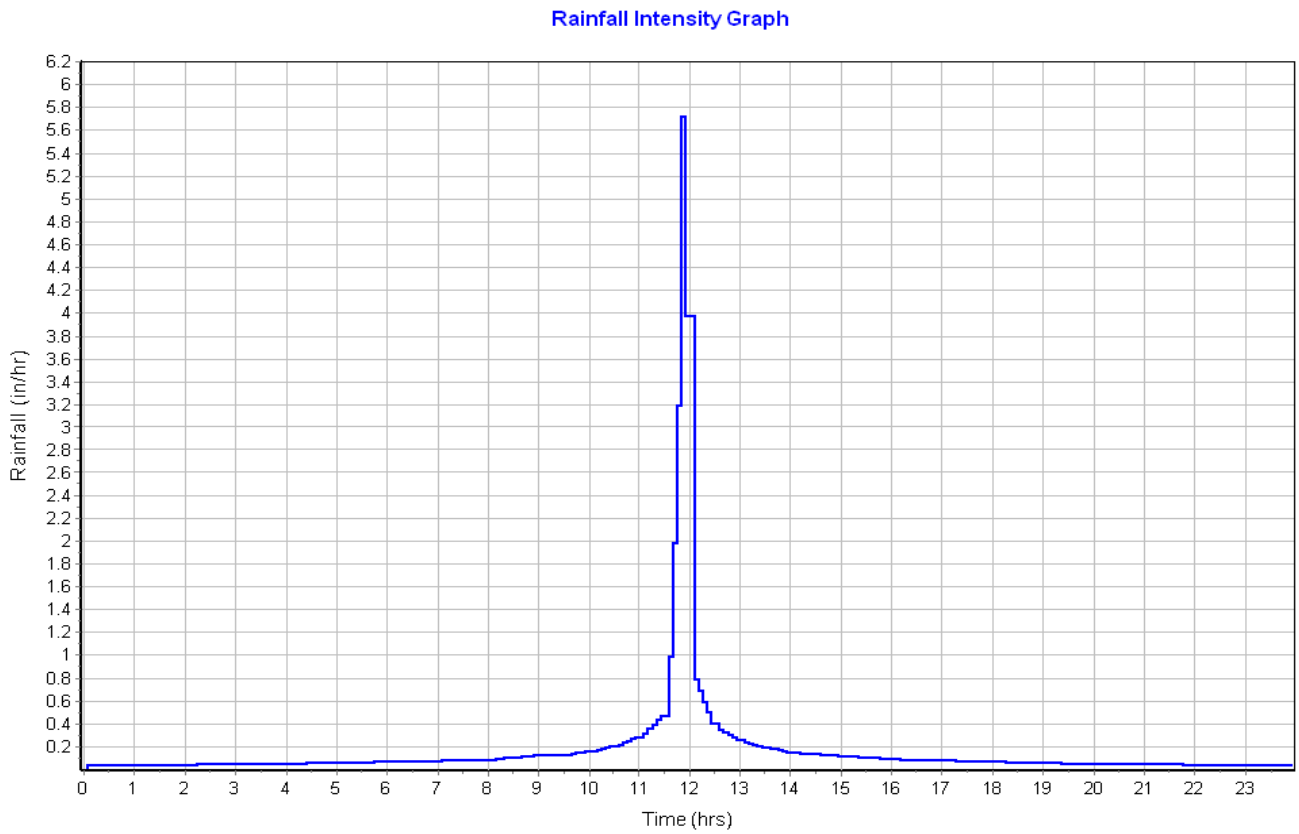
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	583	0.00	0.00
Slope (%) :	4	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	1.00	0.00	0.00
Computed Flow Time (min) :	9.72	0.00	0.00

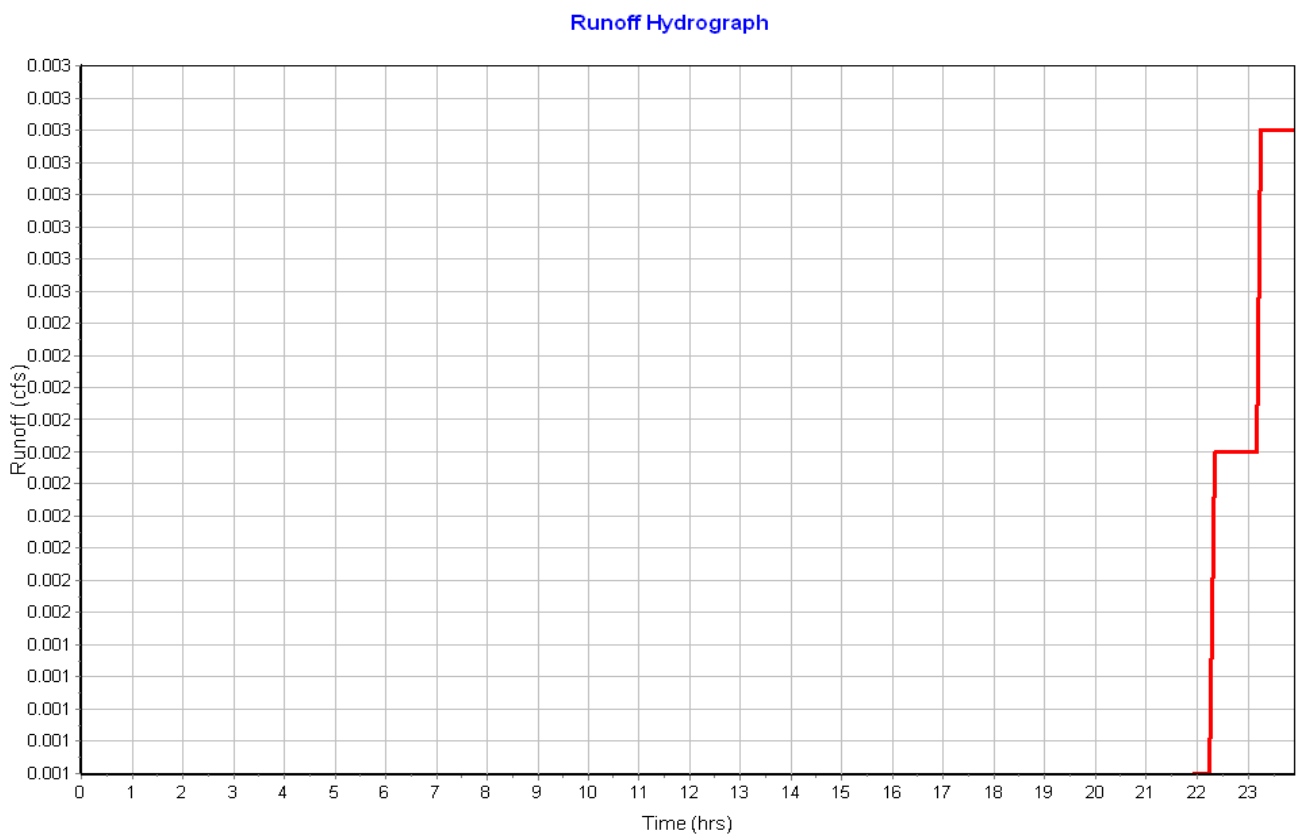
Total TOC (min) 25.80

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 0.00
Peak Runoff (cfs) 0.00
Weighted Curve Number 33.28
Time of Concentration (days hh:mm:ss) 0 00:25:48

Subbasin : A2


Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)


Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : A3

Input Data

Area (ac) 3.44
Weighted Curve Number 68.96
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Landfill Soil Cap	1.33	B	74.00
Gravel roads	0.42	B	85.00
> 75% grass cover, Good	1.69	B	61.00
Rip-rap lines slope / >75% Grass	0.00	B	65.00
Liner	0.00	B	100.00
Composite Area & Weighted CN	3.44		68.96

Time of Concentration

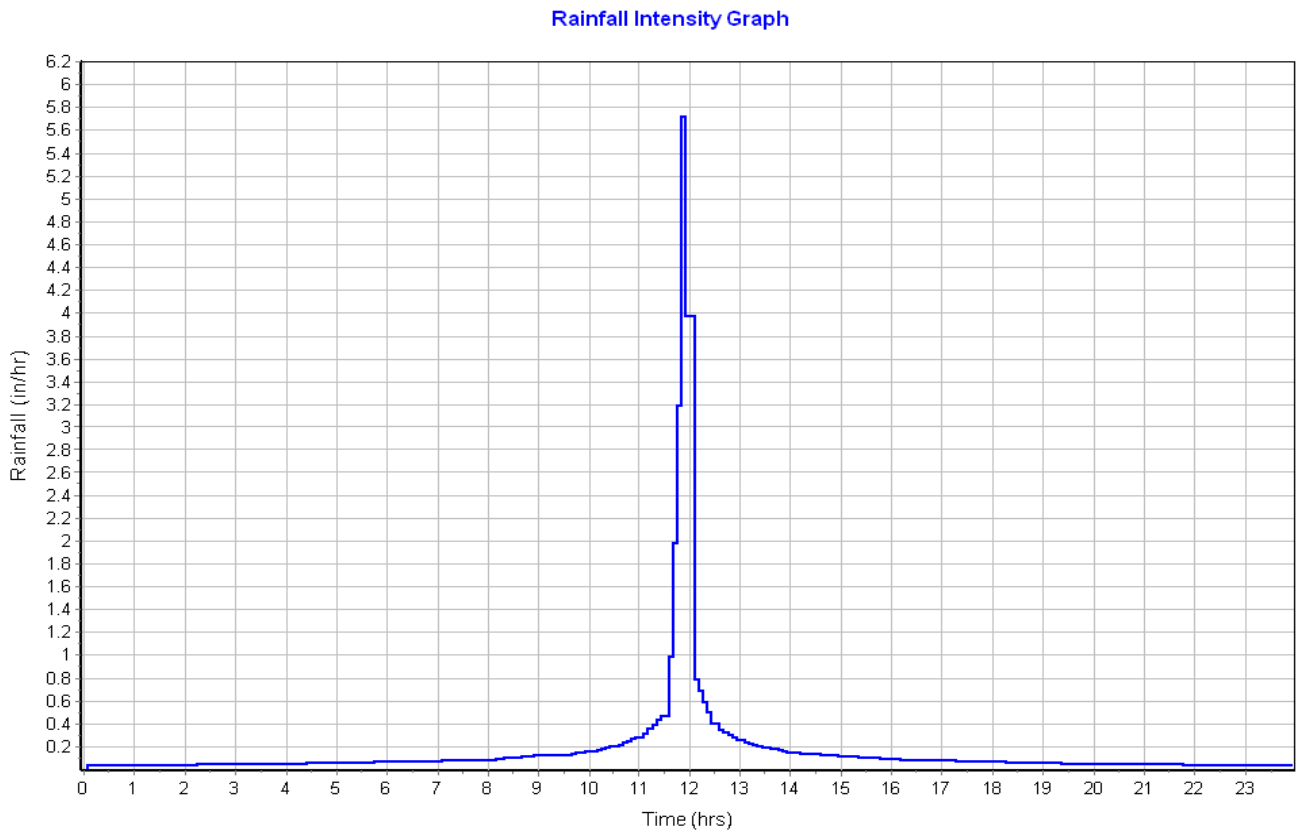
Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	70	0.00	0.00
Slope (%) :	33	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.37	0.00	0.00
Velocity (ft/sec) :	0.29	0.00	0.00
Computed Flow Time (min) :	4.06	0.00	0.00

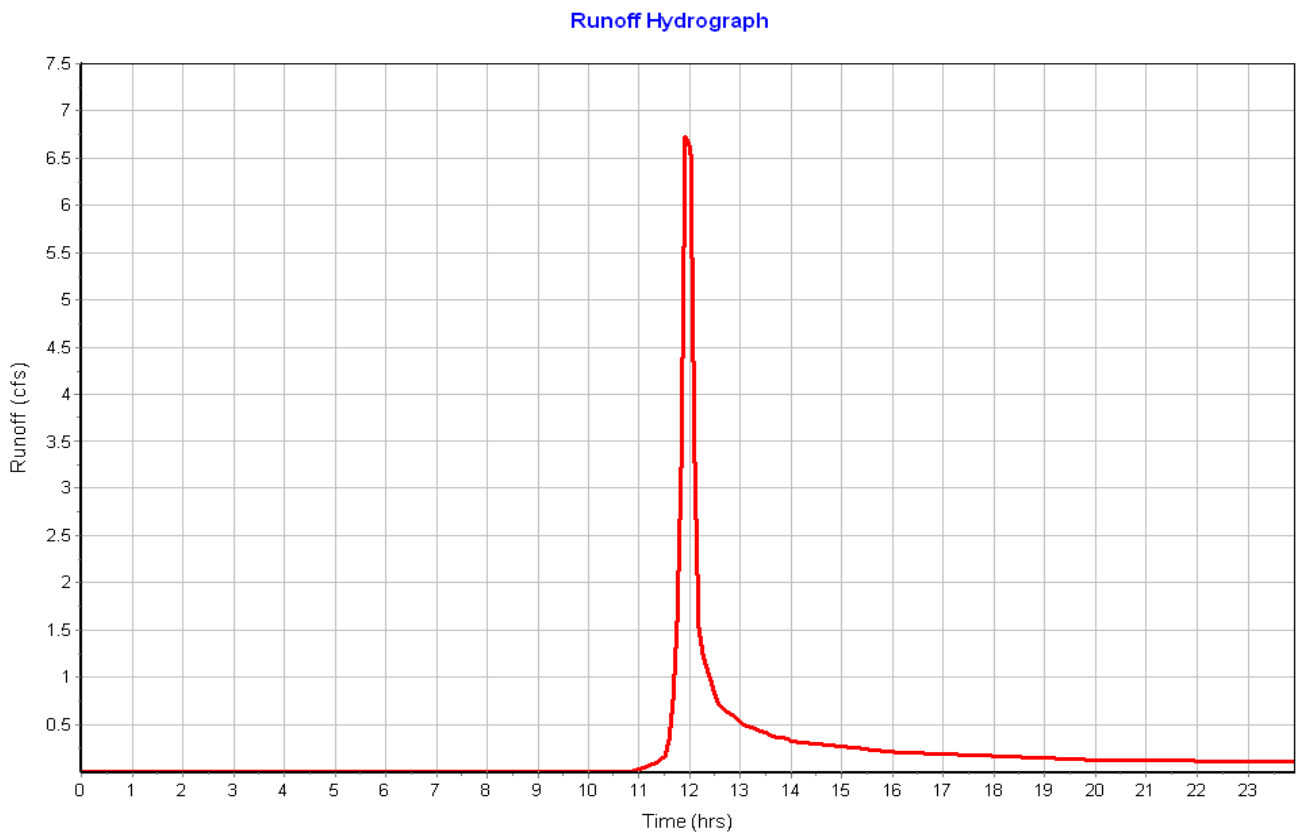
Total TOC (min) 4.06

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.38
Peak Runoff (cfs) 7.04
Weighted Curve Number 68.96
Time of Concentration (days hh:mm:ss) 0 00:04:04

Subbasin : A3


Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)


Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : A4

Input Data

Area (ac) 1.41
Weighted Curve Number 74.00
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Landfill Soil Cap	1.41	B	74.00
Gravel roads	0.00	B	85.00
> 75% grass cover, Good	0.00	B	61.00
Liner	0.00	B	100.00
Composite Area & Weighted CN	1.41		74.00

Time of Concentration

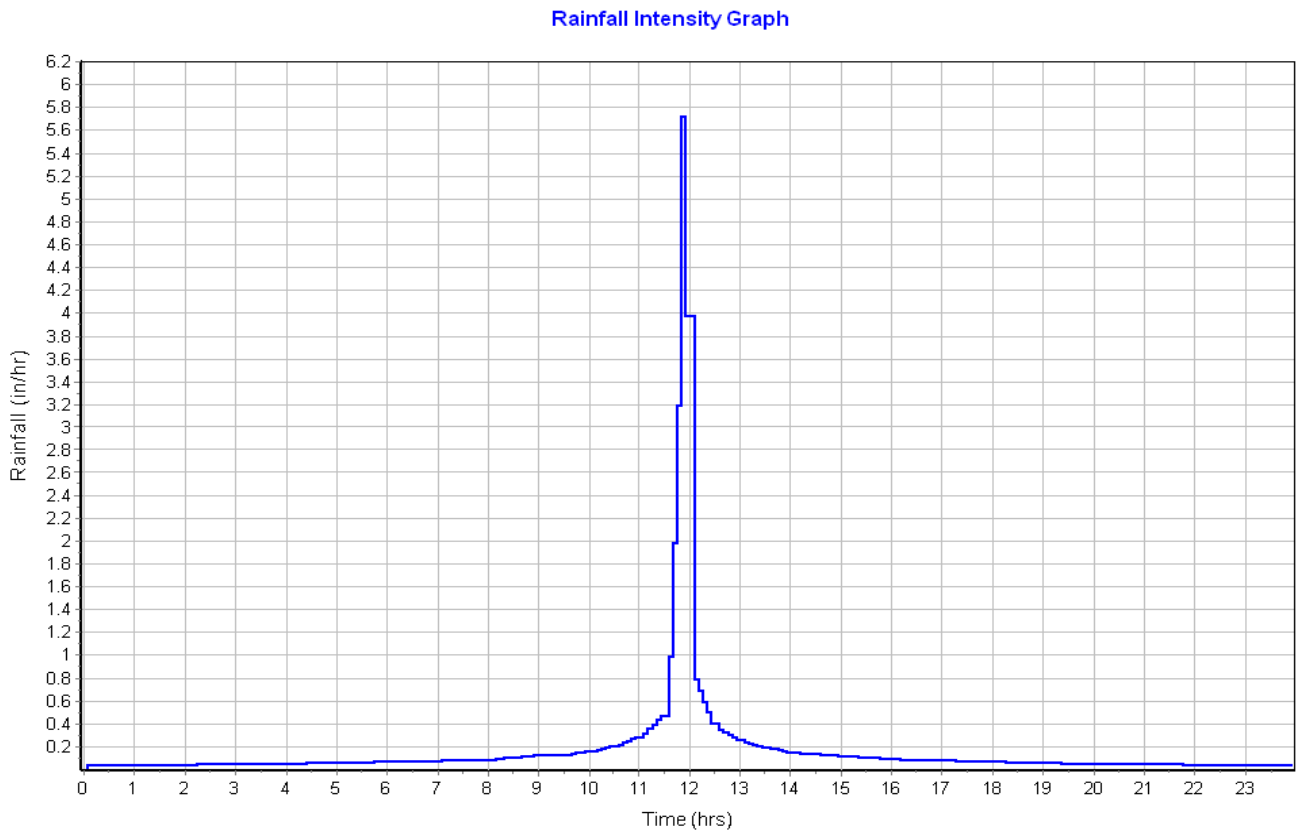
Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	90	0.00	0.00
Slope (%) :	33	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.37	0.00	0.00
Velocity (ft/sec) :	0.30	0.00	0.00
Computed Flow Time (min) :	4.97	0.00	0.00

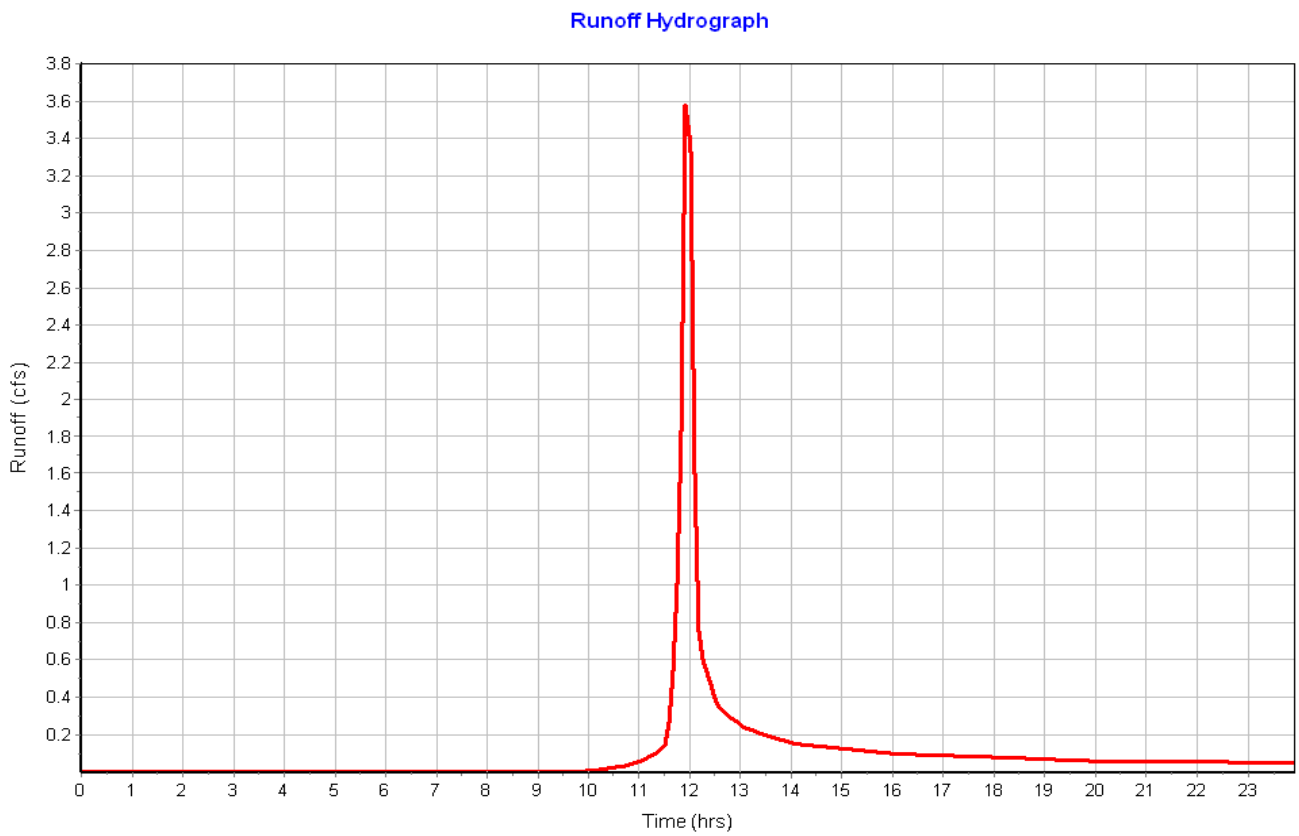
Total TOC (min) 4.97

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.72
Peak Runoff (cfs) 3.70
Weighted Curve Number 74.00
Time of Concentration (days hh:mm:ss) 0 00:04:58

Subbasin : A4


Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)


Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : A5

Input Data

Area (ac) 1.20
Weighted Curve Number 74.37
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Landfill Soil Cap	1.16	B	74.00
Gravel roads	0.04	B	85.00
Composite Area & Weighted CN	1.20		74.37

Time of Concentration

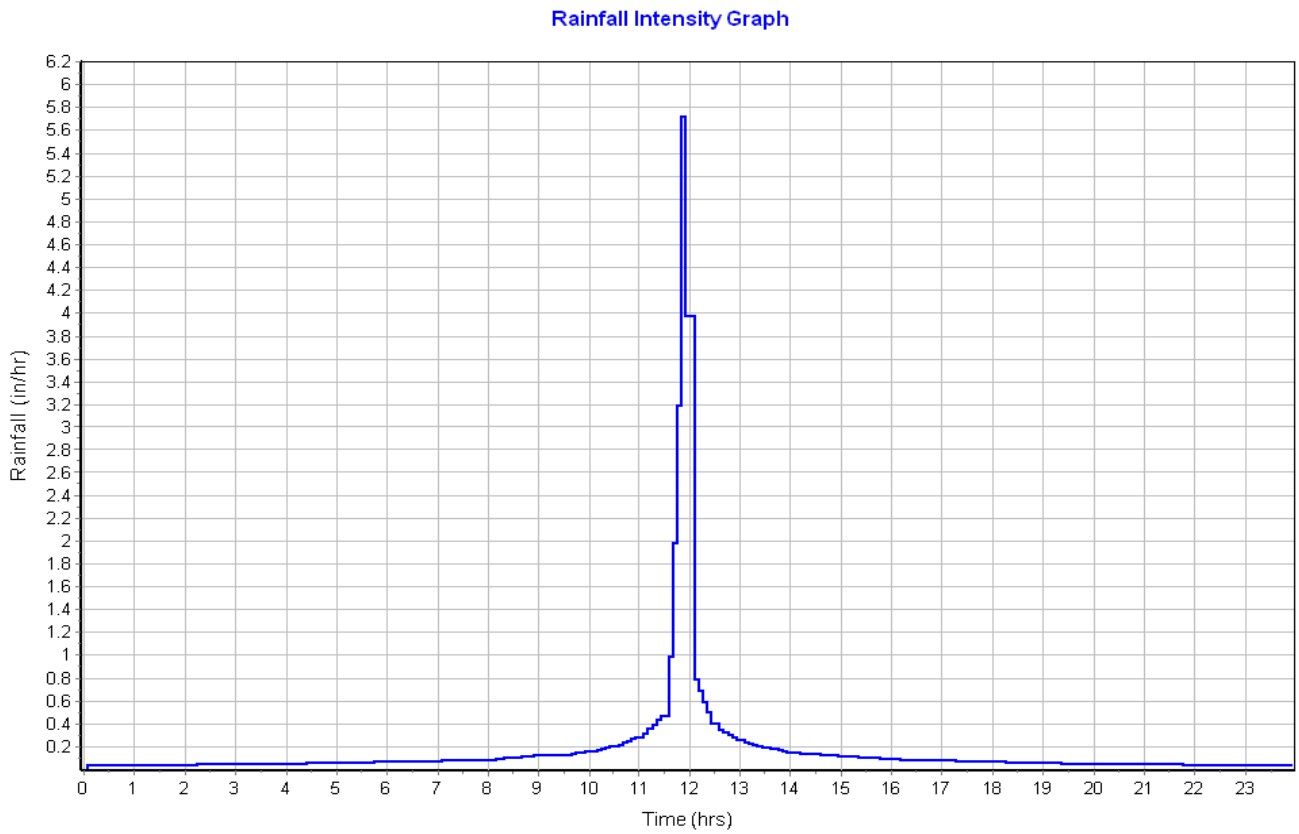
Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	90	0.00	0.00
Slope (%) :	33	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.70	0.00	0.00
Velocity (ft/sec) :	0.32	0.00	0.00
Computed Flow Time (min) :	4.65	0.00	0.00

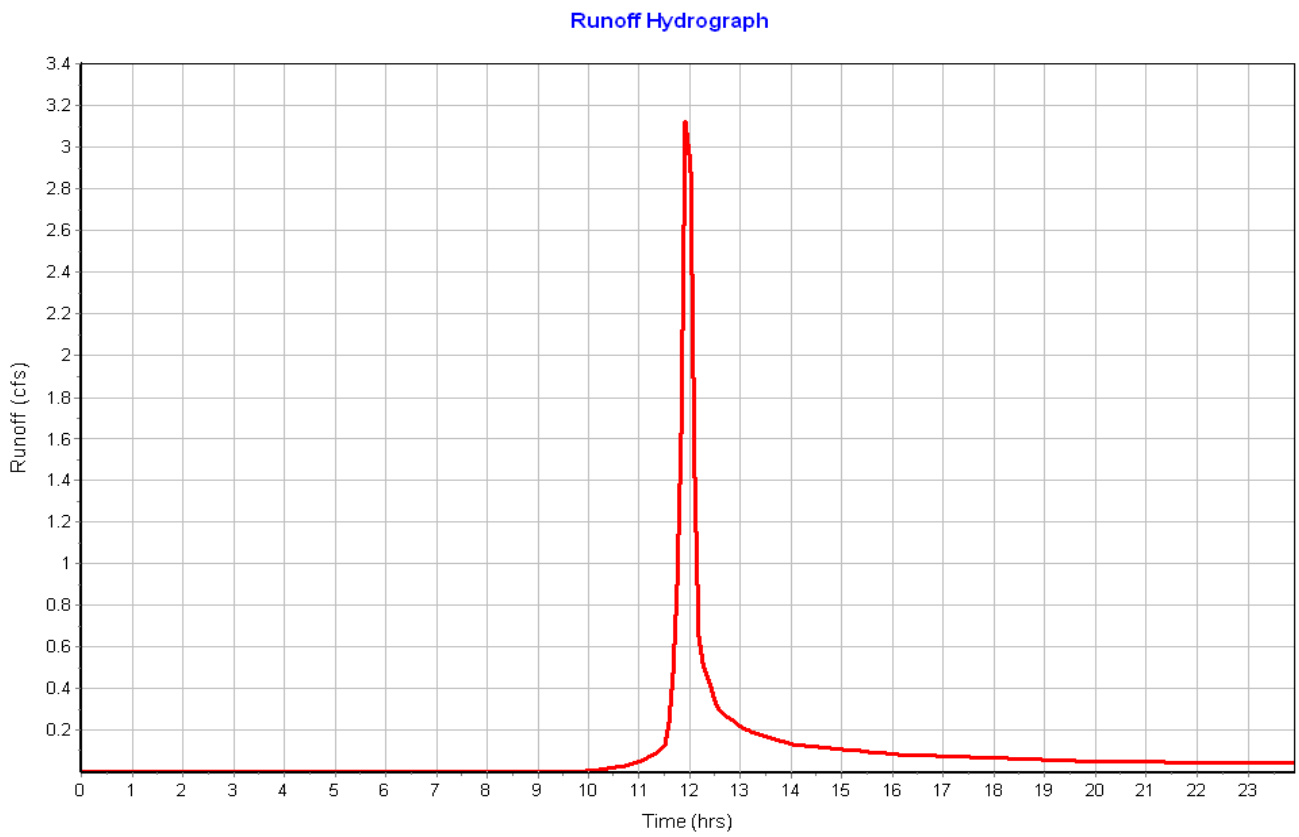
Total TOC (min) 4.65

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.75
Peak Runoff (cfs) 3.22
Weighted Curve Number 74.37
Time of Concentration (days hh:mm:ss) 0 00:04:39

Subbasin : A5


Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)


Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : A6

Input Data

Area (ac) 2.59
Weighted Curve Number 72.13
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Landfill Soil Cap	2.07	B	74.00
Rip-rap lines slope / >75% Grass	0.44	B	61.00
Liner	0.00	B	100.00
Gravel roads	0.08	B	85.00
Composite Area & Weighted CN	2.59		72.13

Time of Concentration

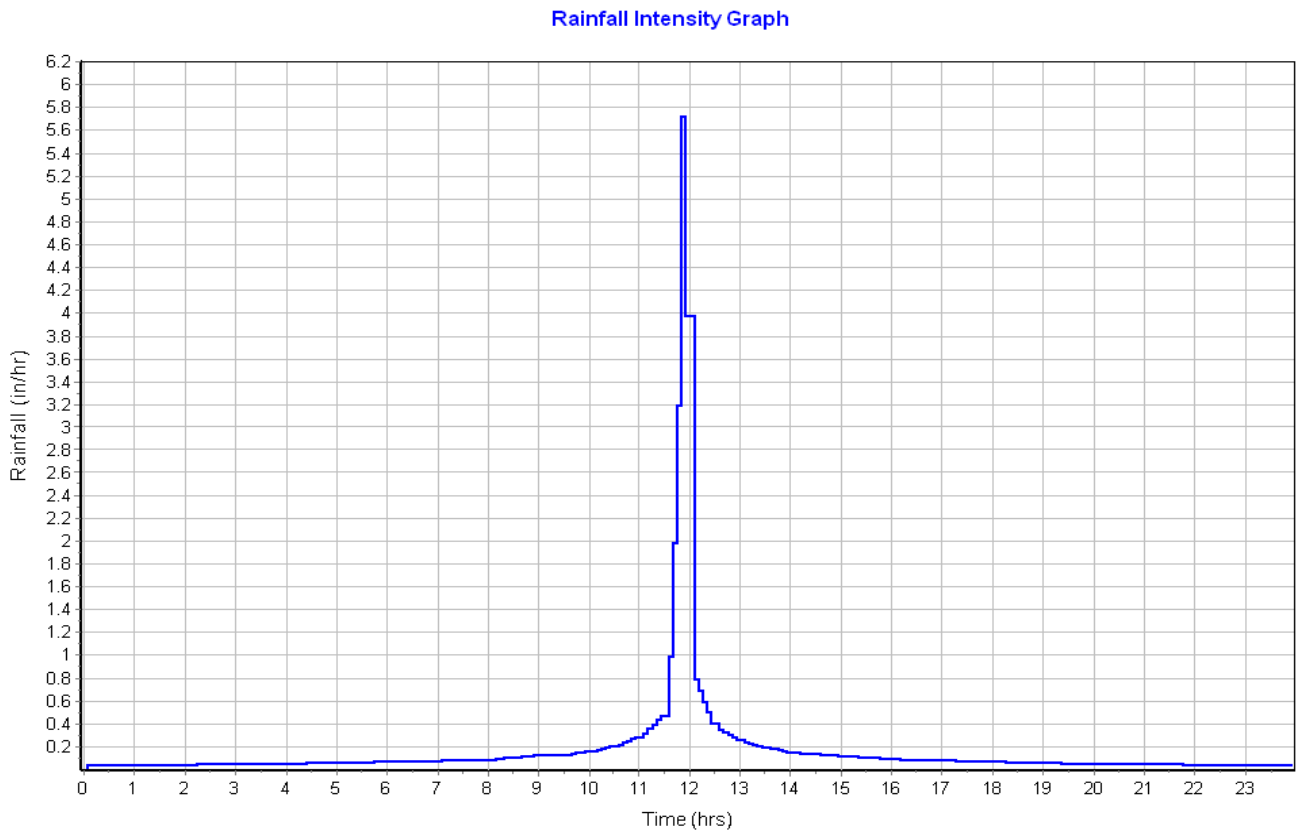
Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	90	0.00	0.00
Slope (%) :	33	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.70	0.00	0.00
Velocity (ft/sec) :	0.32	0.00	0.00
Computed Flow Time (min) :	4.65	0.00	0.00

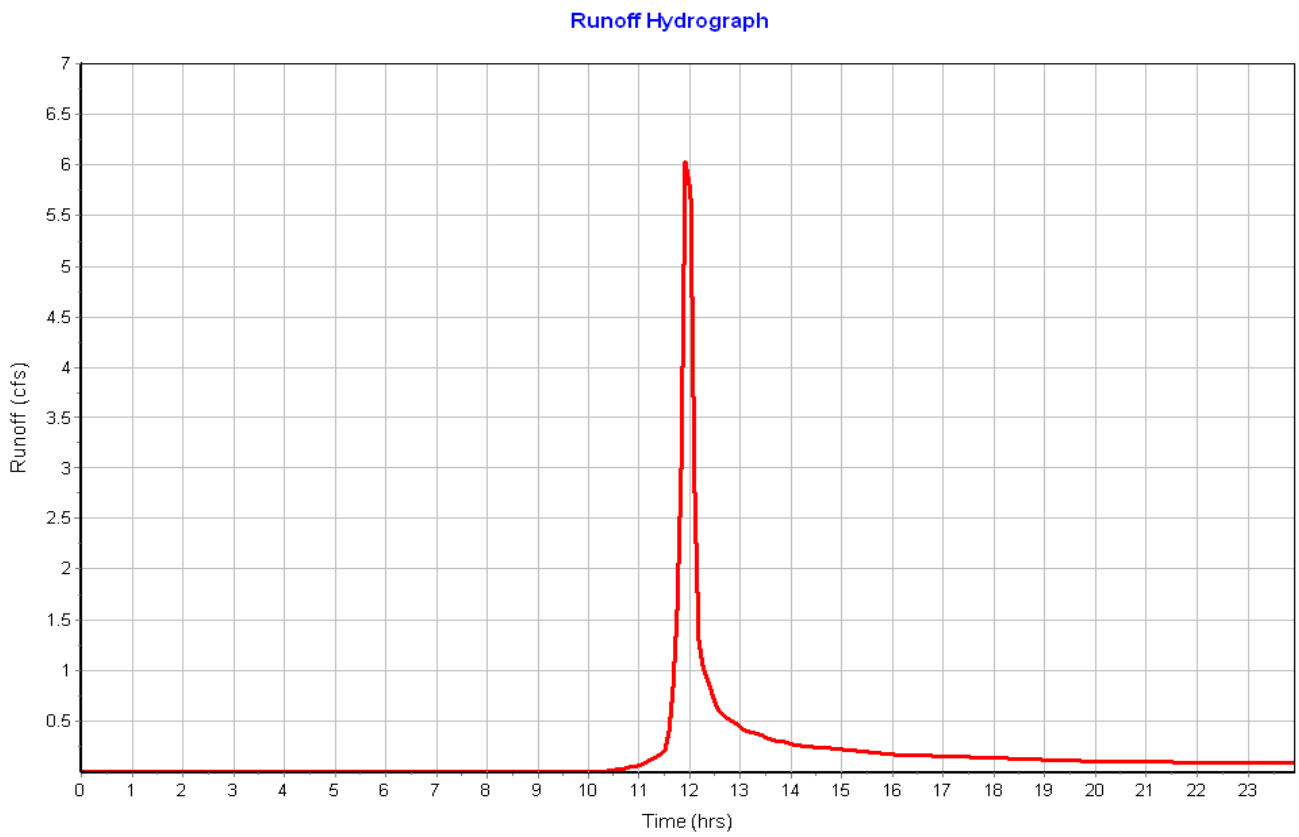
Total TOC (min) 4.65

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.59
Peak Runoff (cfs) 6.24
Weighted Curve Number 72.13
Time of Concentration (days hh:mm:ss) 0 00:04:39

Subbasin : A6


Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)


Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : A7

Input Data

Area (ac) 2.34
Weighted Curve Number 74.00
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Landfill Soil Cap	2.34	B	74.00
Liner	0.00	B	100.00
Composite Area & Weighted CN	2.34		74.00

Time of Concentration

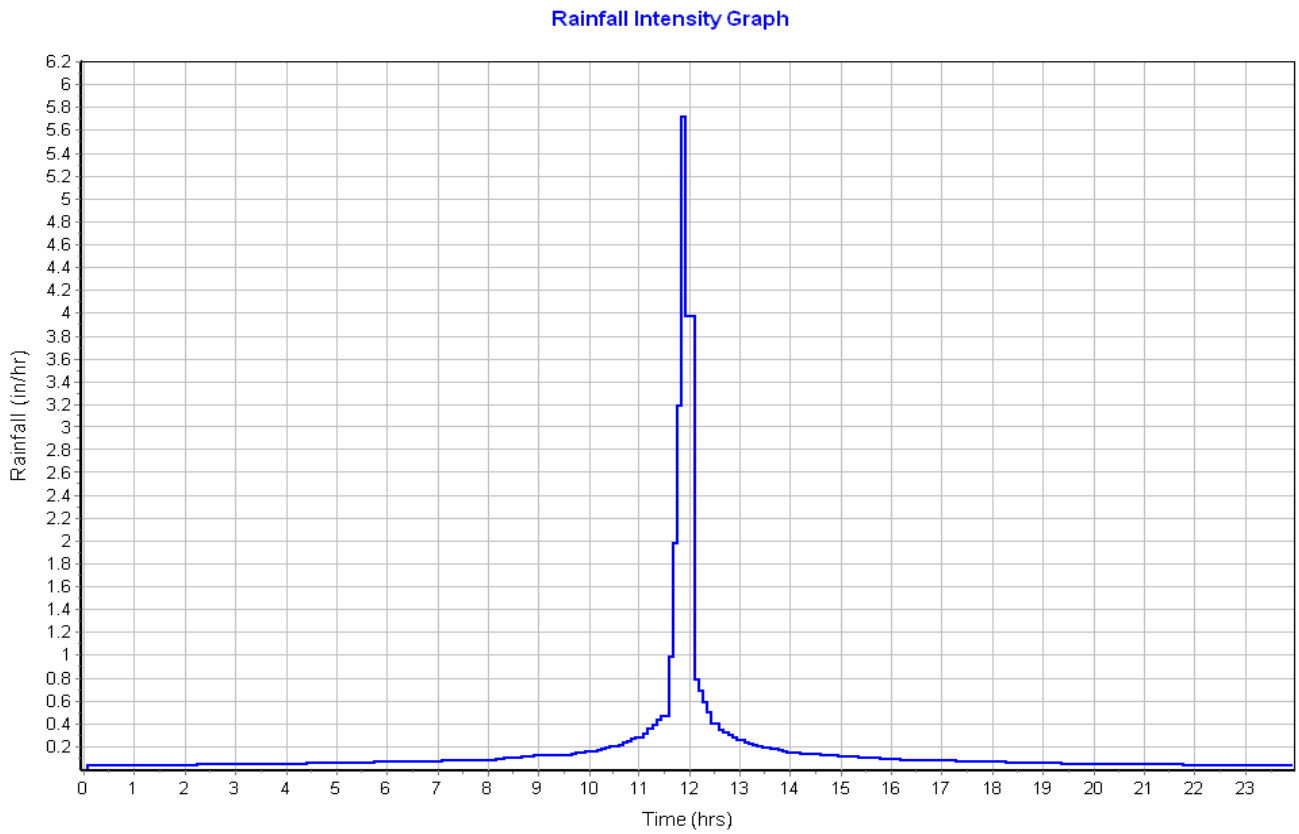
Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	90	0.00	0.00
Slope (%) :	33	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.70	0.00	0.00
Velocity (ft/sec) :	0.32	0.00	0.00
Computed Flow Time (min) :	4.65	0.00	0.00

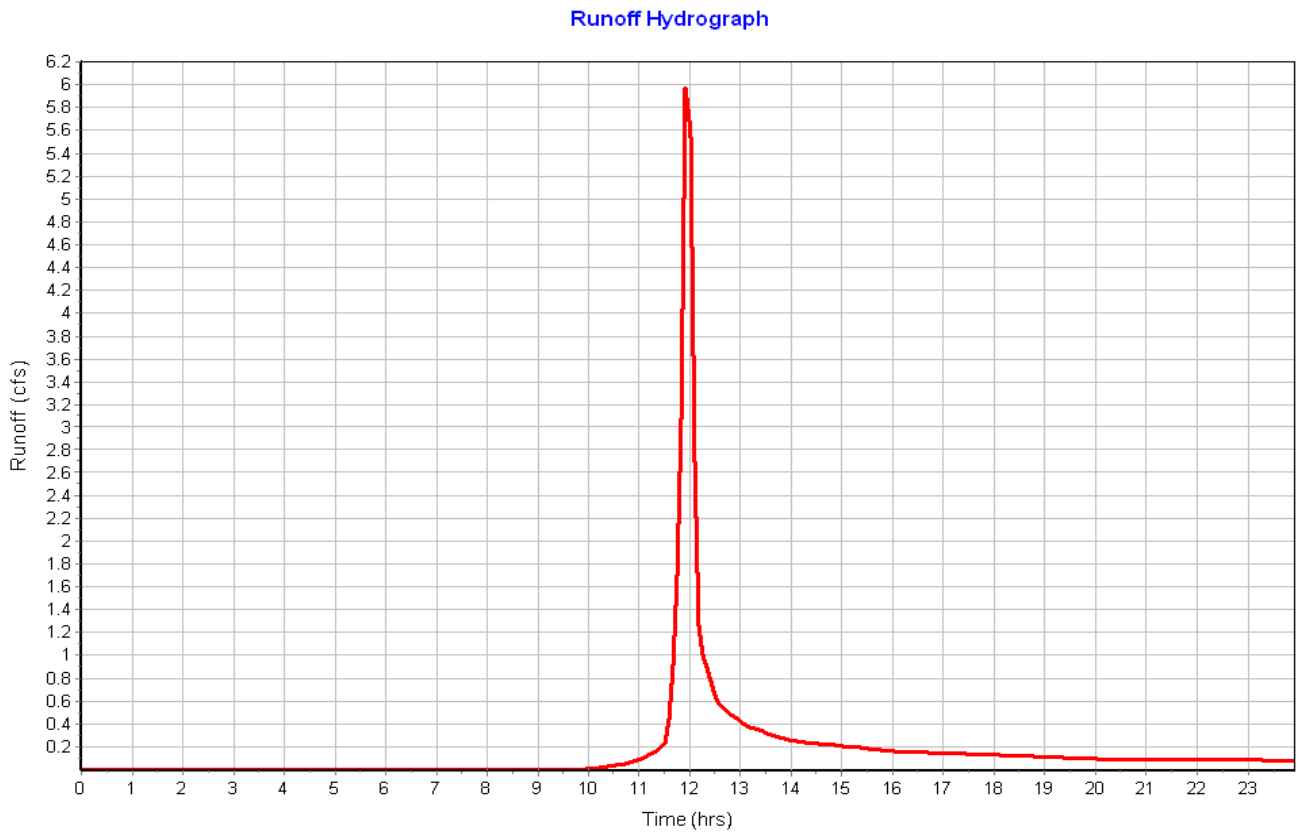
Total TOC (min) 4.65

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.72
Peak Runoff (cfs) 6.16
Weighted Curve Number 74.00
Time of Concentration (days hh:mm:ss) 0 00:04:39

Subbasin : A7


Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)


Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : A8

Input Data

Area (ac) 4.98
Weighted Curve Number 74.00
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Landfill Soil Cap	4.98	B	74.00
Liner	0.00	B	100.00
Composite Area & Weighted CN	4.98		74.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.24	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.37	0.00	0.00
Velocity (ft/sec) :	0.15	0.00	0.00
Computed Flow Time (min) :	11.49	0.00	0.00

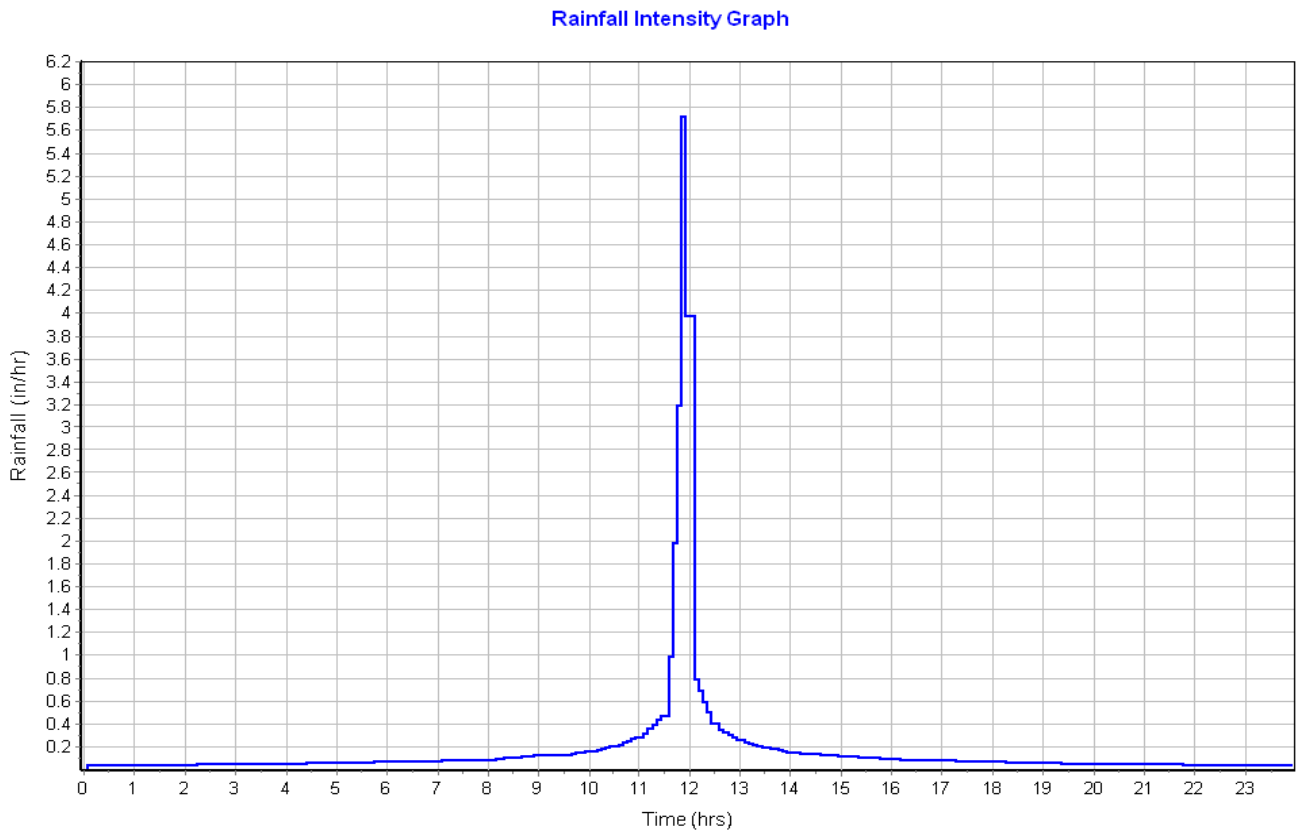
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	400	0.00	0.00
Slope (%) :	5	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.57	0.00	0.00
Computed Flow Time (min) :	4.25	0.00	0.00

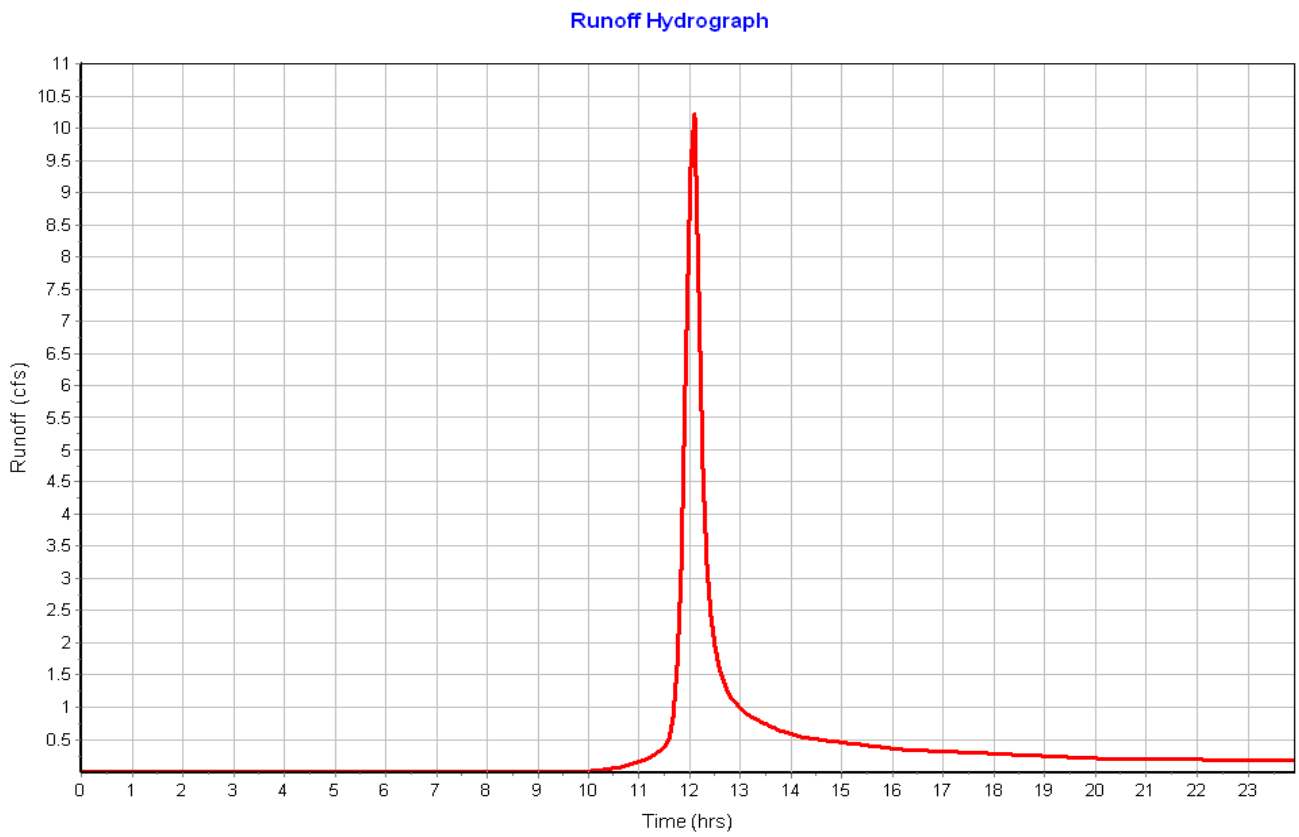
Total TOC (min) 15.74

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.72
Peak Runoff (cfs) 10.37
Weighted Curve Number 74.00
Time of Concentration (days hh:mm:ss) 0 00:15:44

Subbasin : A8


Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)


Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : A9

Input Data

Area (ac) 0.81
Weighted Curve Number 70.85
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Landfill Soil Cap	0.06	B	74.00
Rip-rap lines slope / >75% Grass	0.45	B	61.00
Gravel roads	0.30	B	85.00
Liner	0.00	B	100.00
Composite Area & Weighted CN	0.81		70.85

Time of Concentration

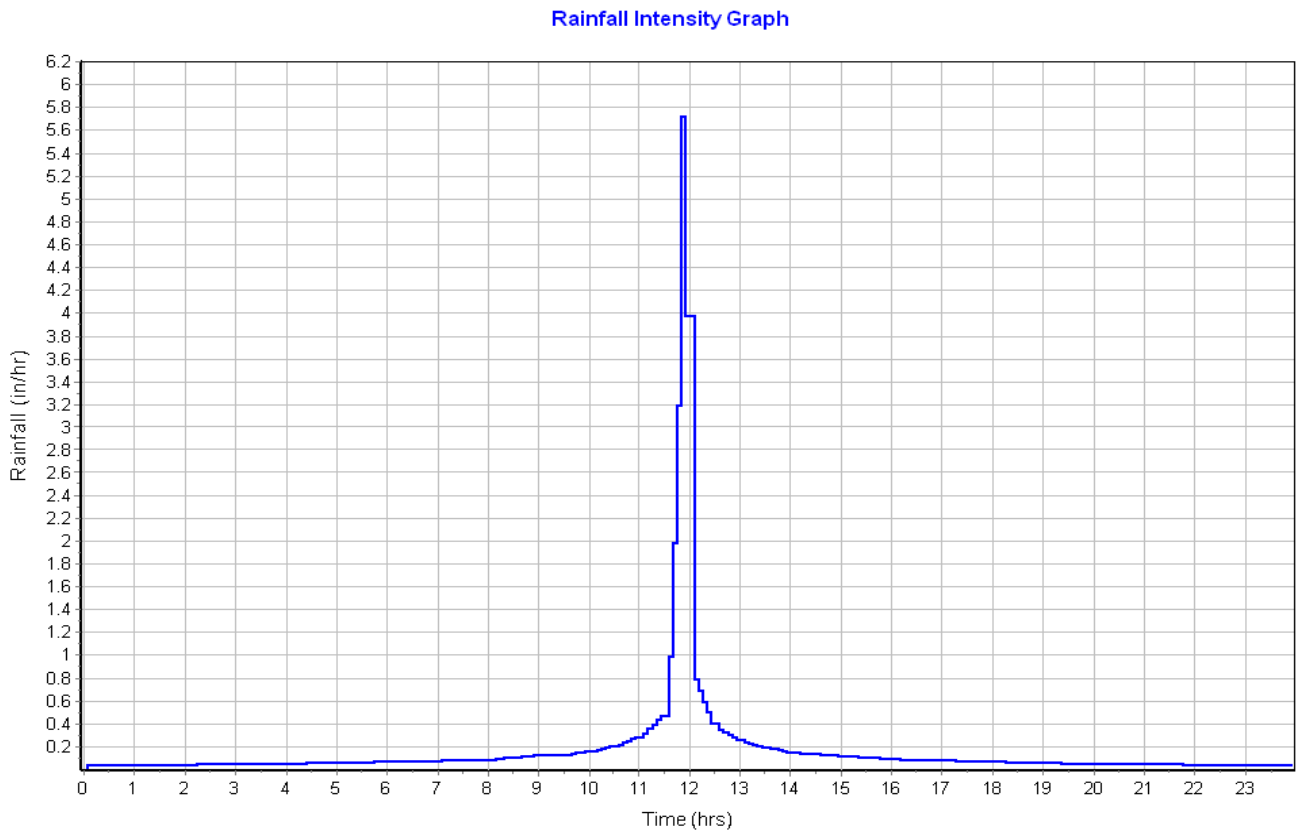
Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	90	0.00	0.00
Slope (%) :	50	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.70	0.00	0.00
Velocity (ft/sec) :	0.25	0.00	0.00
Computed Flow Time (min) :	5.93	0.00	0.00

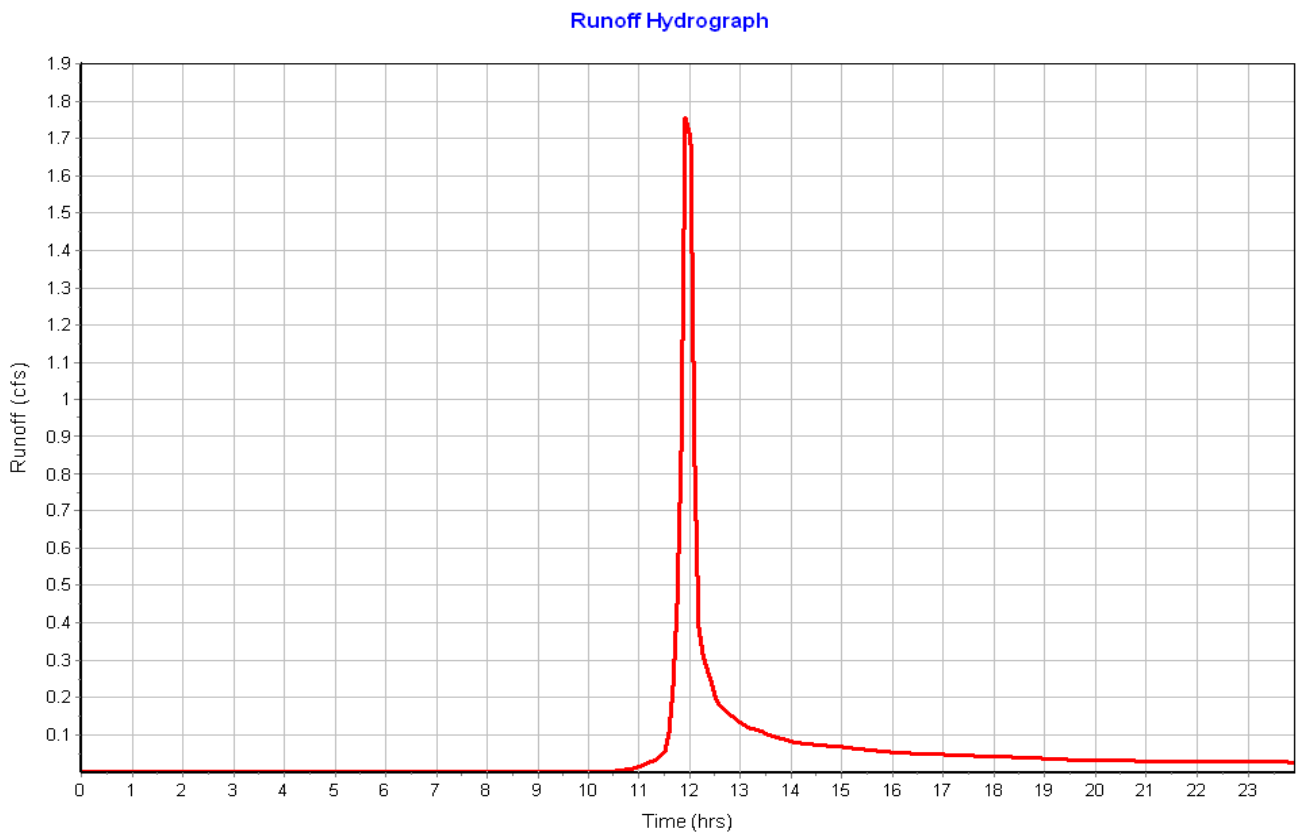
Total TOC (min) 5.93

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.50
Peak Runoff (cfs) 1.84
Weighted Curve Number 70.85
Time of Concentration (days hh:mm:ss) 0 00:05:56

Subbasin : A9


Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)


Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : B1

Input Data

Area (ac) 15.30
Weighted Curve Number 55.13
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.04	B	85.00
Woods, Good	0.65	A	30.00
Woods, Good	13.46	B	55.00
Woods, Good	1.15	C	70.00
Composite Area & Weighted CN	15.30		55.13

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	6	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.37	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	16.08	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	400	0.00	0.00
Slope (%) :	10	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	1.58	0.00	0.00
Computed Flow Time (min) :	4.22	0.00	0.00

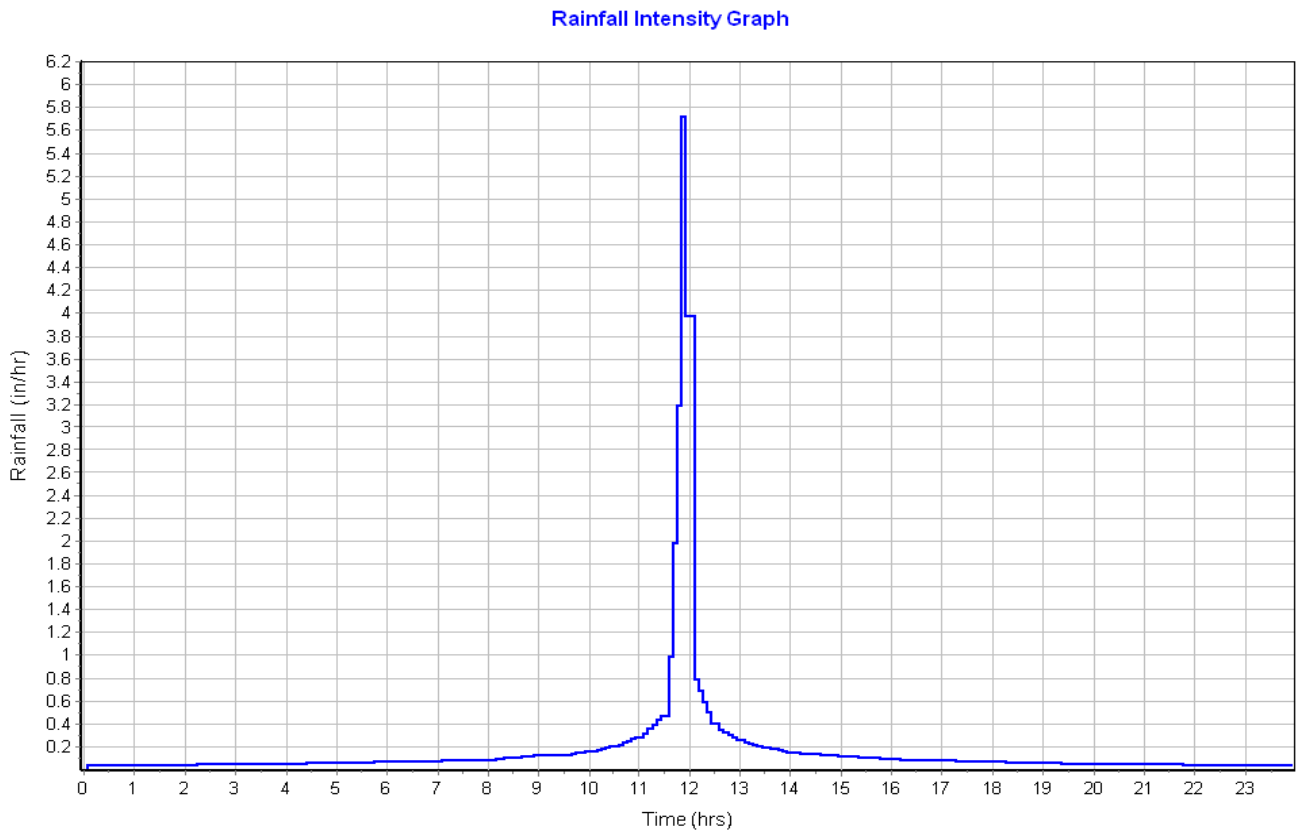
Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.05	0.00	0.00
Flow Length (ft) :	860	0.00	0.00
Channel Slope (%) :	7	0.00	0.00
Cross Section Area (ft^2) :	24	0.00	0.00
Wetted Perimeter (ft) :	16.9	0.00	0.00
Velocity (ft/sec) :	9.96	0.00	0.00
Computed Flow Time (min) :	1.44	0.00	0.00

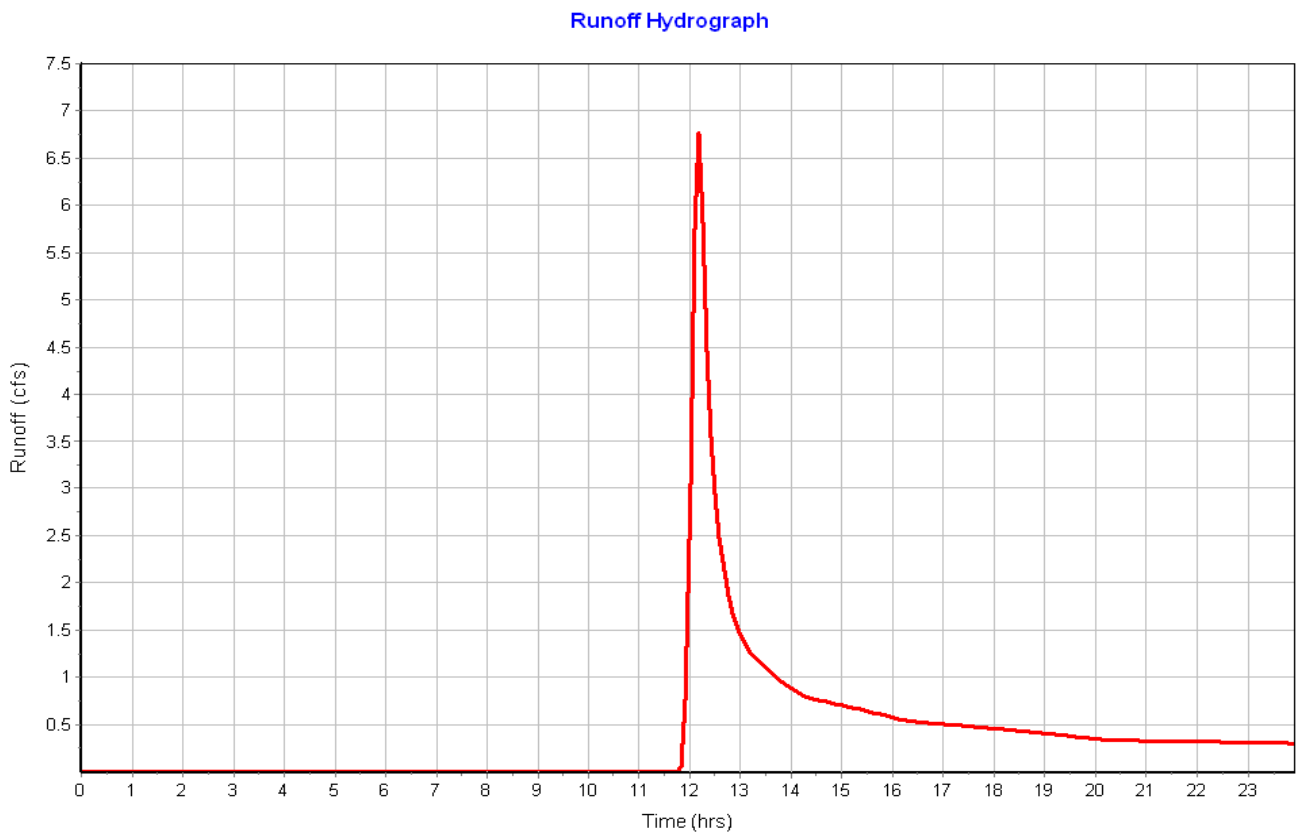
Total TOC (min) 21.74

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 0.61
Peak Runoff (cfs) 6.80
Weighted Curve Number 55.13
Time of Concentration (days hh:mm:ss) 0 00:21:44

Subbasin : B1


Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)


Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : B10

Input Data

Area (ac) 2.70
Weighted Curve Number 74.00
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Landfill Soil Cap	2.70	B	74.00
Gravel roads	0.00	B	85.00
> 75% grass cover, Good	0.00	B	61.00
Composite Area & Weighted CN	2.70		74.00

Time of Concentration

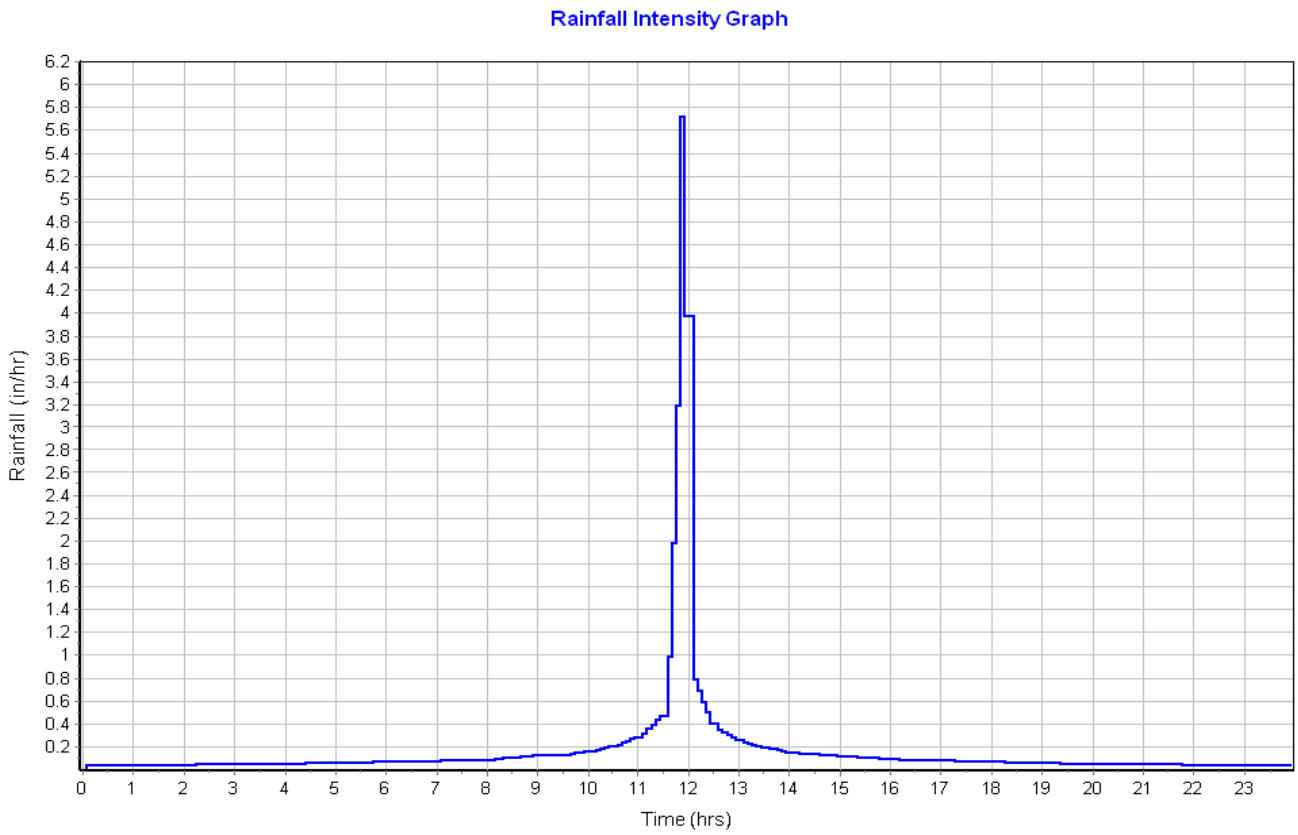
Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	90	0.00	0.00
Slope (%) :	33	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.37	0.00	0.00
Velocity (ft/sec) :	0.30	0.00	0.00
Computed Flow Time (min) :	4.97	0.00	0.00

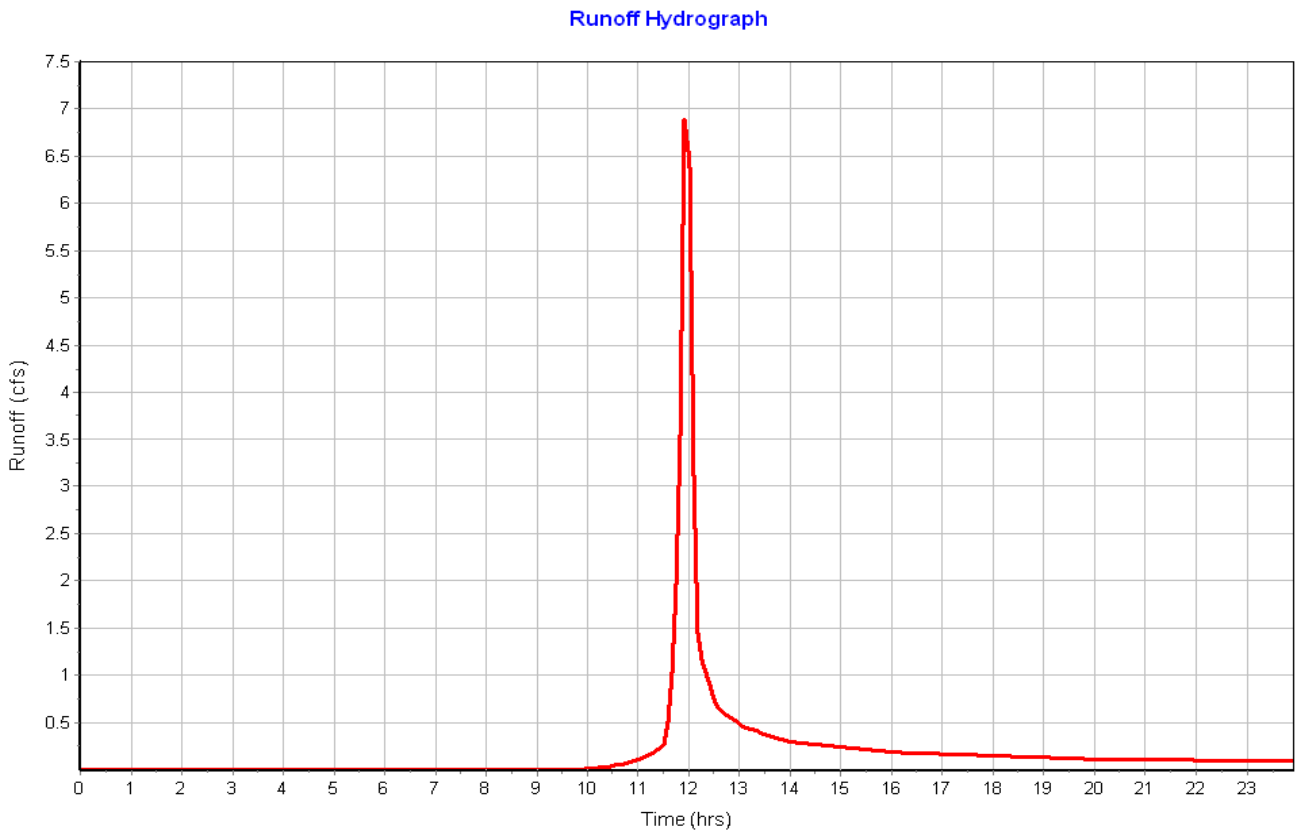
Total TOC (min) 4.97

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.72
Peak Runoff (cfs) 7.10
Weighted Curve Number 74.00
Time of Concentration (days hh:mm:ss) 0 00:04:58

Subbasin : B10





Subbasin : B11

Input Data

Area (ac) 0.29
Weighted Curve Number 72.59
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Rip-rap lines slope / >75% Grass	0.15	B	61.00
Gravel roads	0.14	B	85.00
Composite Area & Weighted CN	0.29		72.59

Time of Concentration

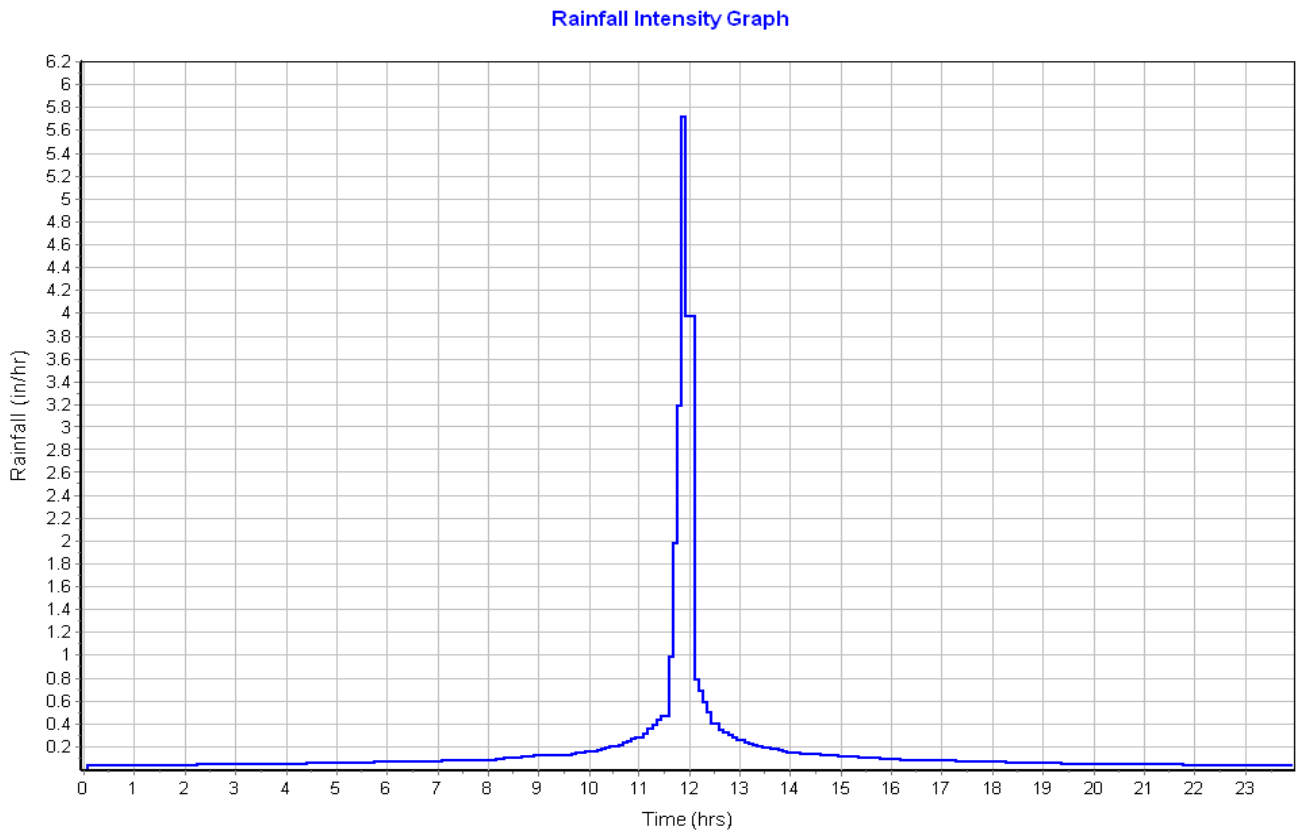
Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	65	0.00	0.00
Slope (%) :	33	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.37	0.00	0.00
Velocity (ft/sec) :	0.28	0.00	0.00
Computed Flow Time (min) :	3.83	0.00	0.00

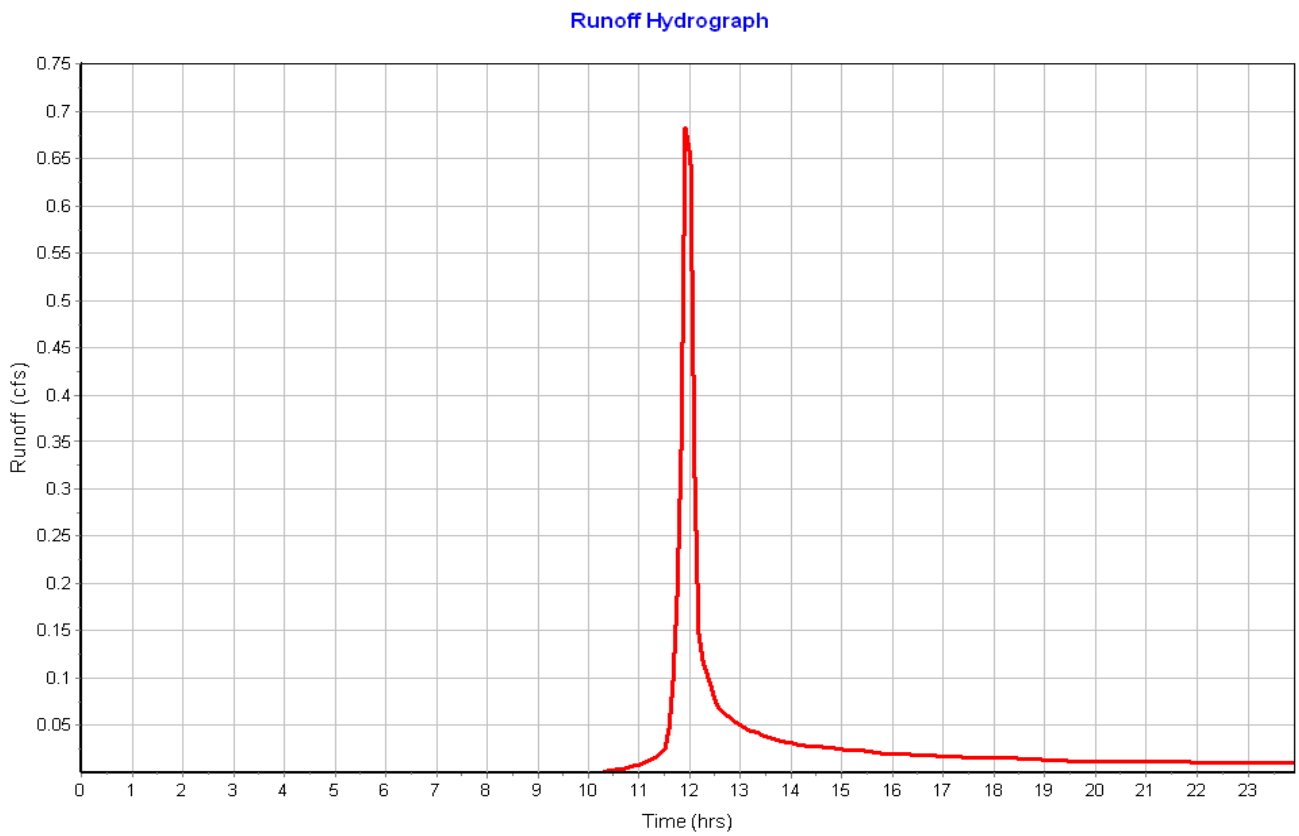
Total TOC (min) 3.83

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.62
Peak Runoff (cfs) 0.71
Weighted Curve Number 72.59
Time of Concentration (days hh:mm:ss) 0 00:03:50

Subbasin : B11





Subbasin : B12

Input Data

Area (ac) 0.44
Weighted Curve Number 71.91
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Rip-rap lines slope / >75% Grass	0.24	B	61.00
Gravel roads	0.20	B	85.00
> 75% grass cover, Good	0.00	B	61.00
Composite Area & Weighted CN	0.44		71.91

Time of Concentration

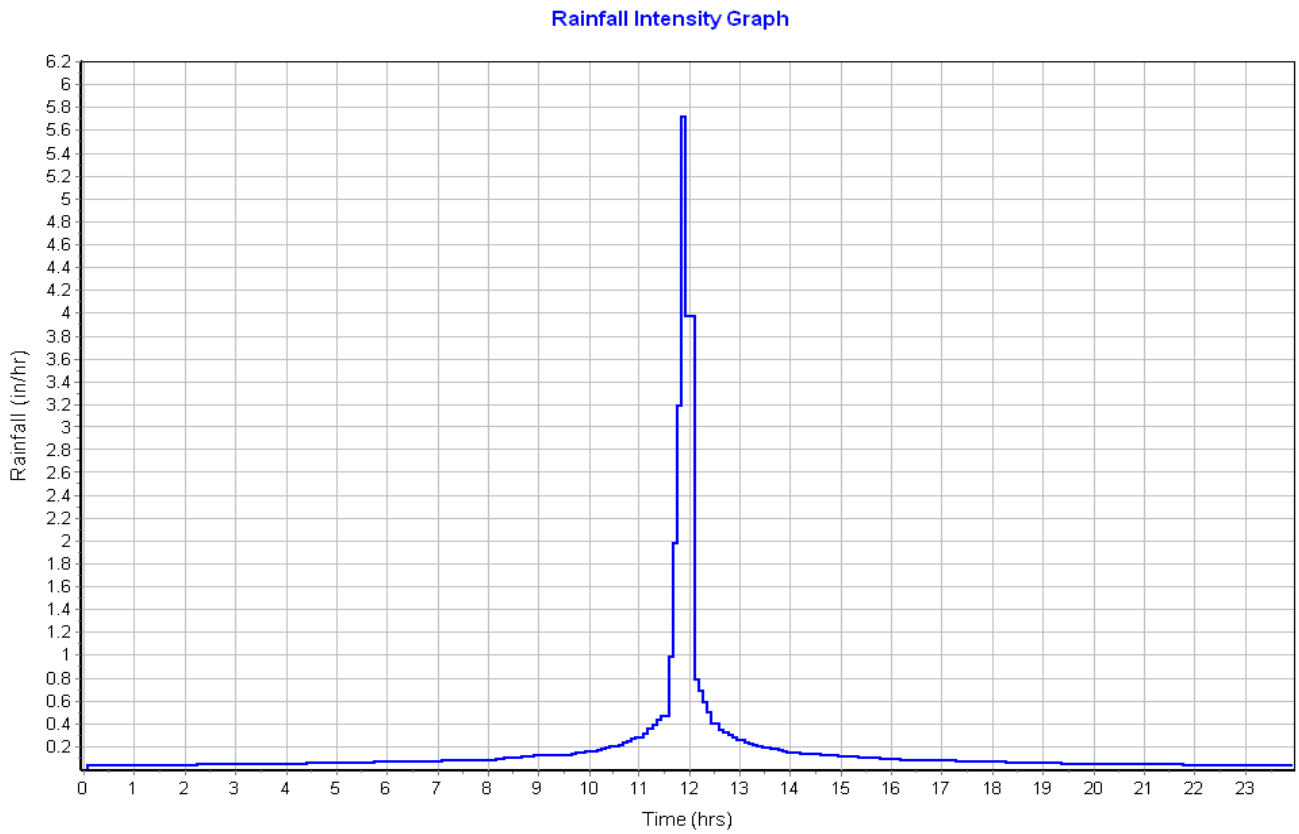
Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	60	0.00	0.00
Slope (%) :	33	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.37	0.00	0.00
Velocity (ft/sec) :	0.28	0.00	0.00
Computed Flow Time (min) :	3.59	0.00	0.00

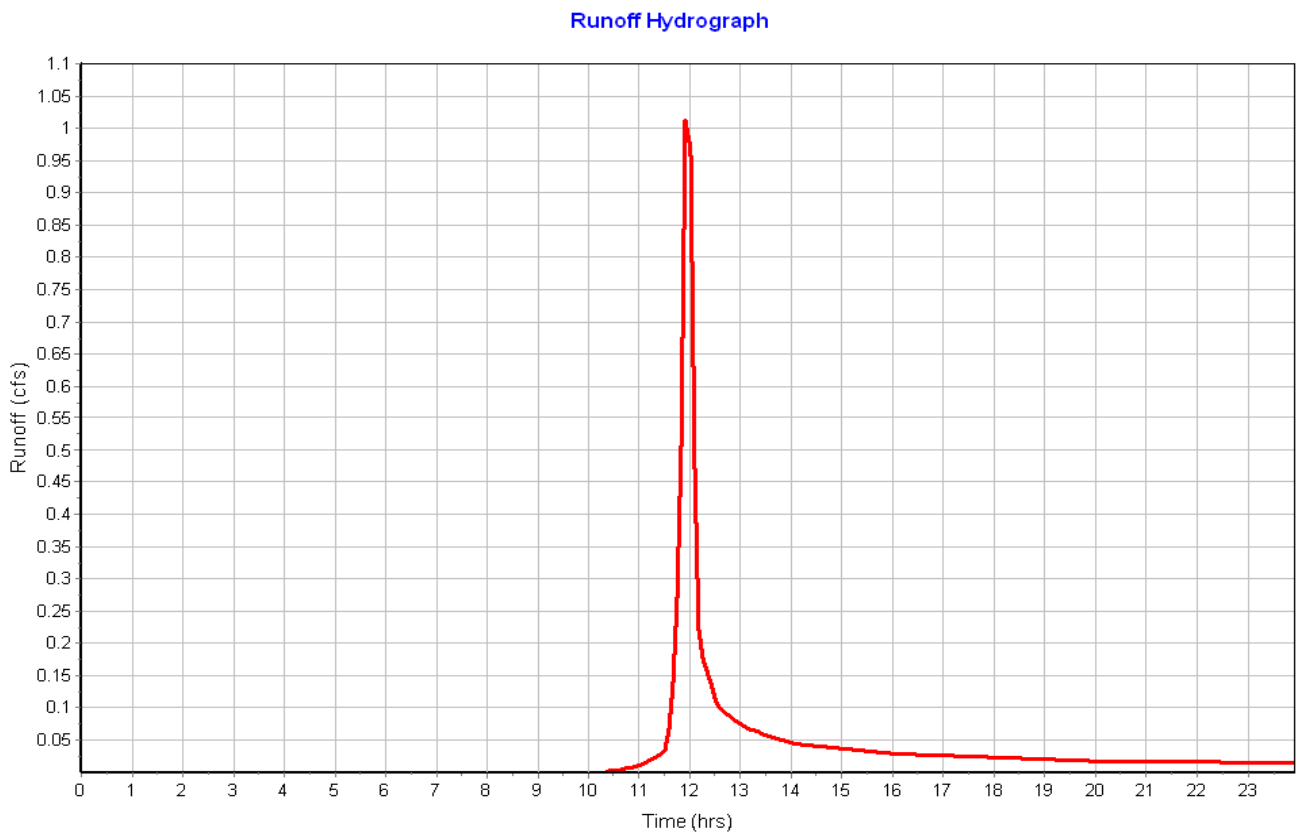
Total TOC (min) 3.59

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.57
Peak Runoff (cfs) 1.05
Weighted Curve Number 71.91
Time of Concentration (days hh:mm:ss) 0 00:03:35

Subbasin : B12





Subbasin : B13

Input Data

Area (ac) 1.52
Weighted Curve Number 76.68
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Landfill Soil Cap	1.15	B	74.00
Gravel roads	0.37	B	85.00
> 75% grass cover, Good	0.00	B	61.00
Composite Area & Weighted CN	1.52		76.68

Time of Concentration

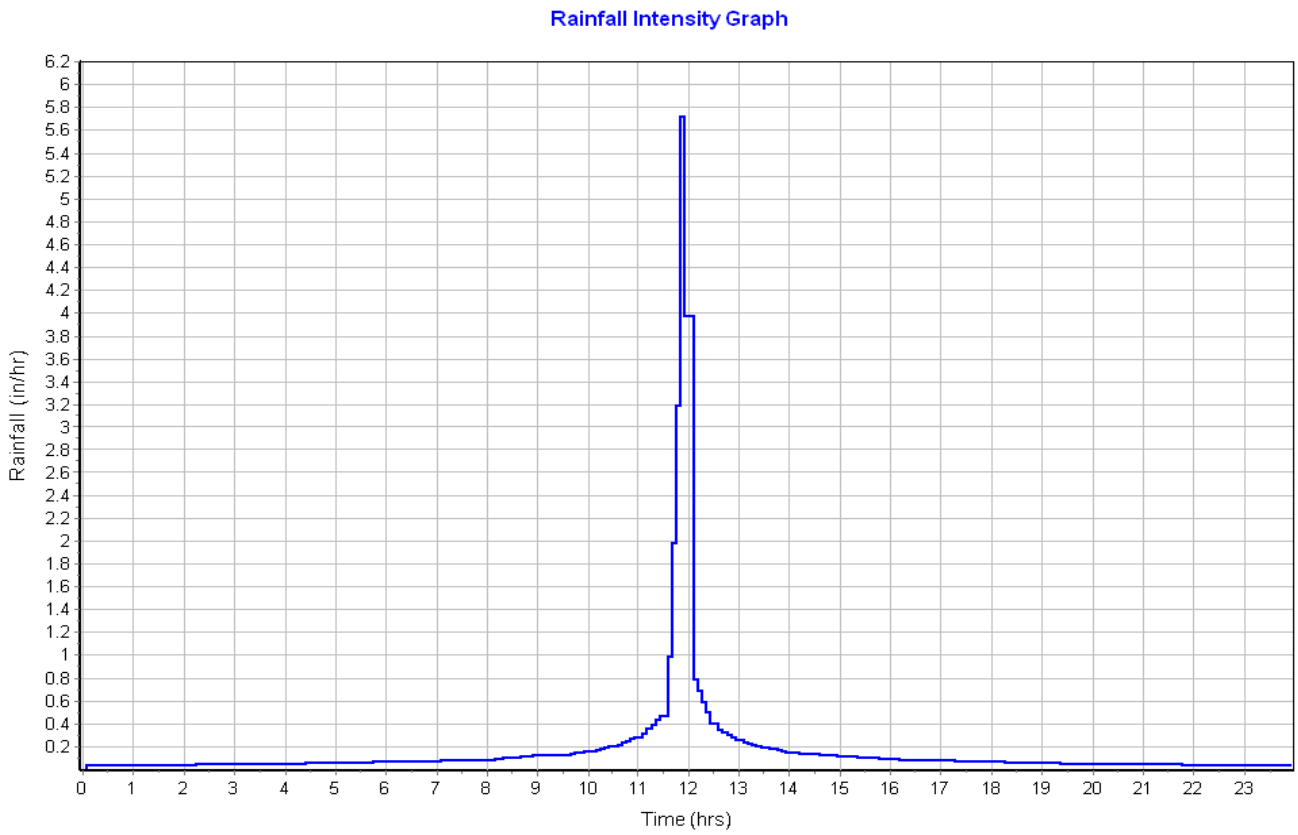
Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	55	0.00	0.00
Slope (%) :	33	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.37	0.00	0.00
Velocity (ft/sec) :	0.27	0.00	0.00
Computed Flow Time (min) :	3.35	0.00	0.00

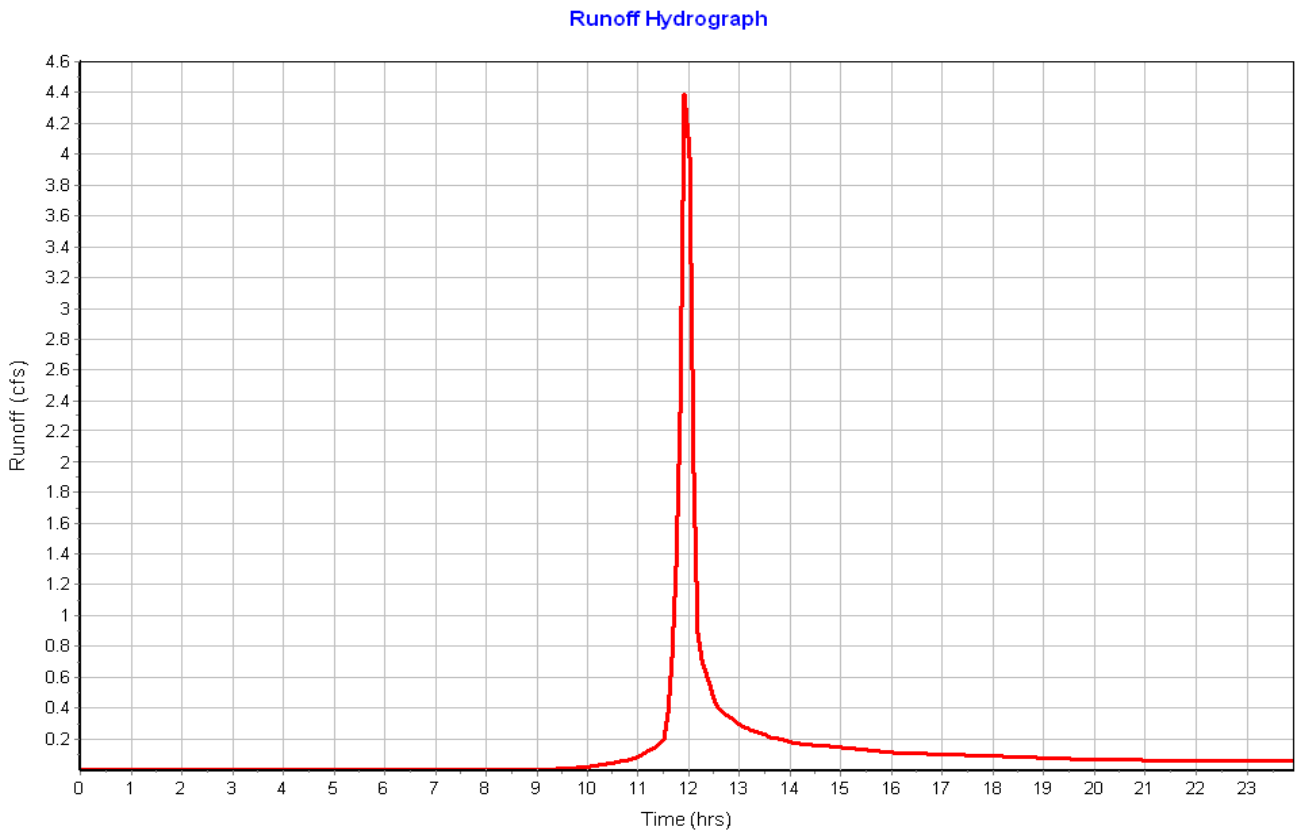
Total TOC (min) 3.35

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.92
Peak Runoff (cfs) 4.50
Weighted Curve Number 76.68
Time of Concentration (days hh:mm:ss) 0 00:03:21

Subbasin : B13





Subbasin : B14

Input Data

Area (ac) 0.64
Weighted Curve Number 61.00
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
> 75% grass cover, Good	0.64	B	61.00
Composite Area & Weighted CN	0.64		61.00

Time of Concentration

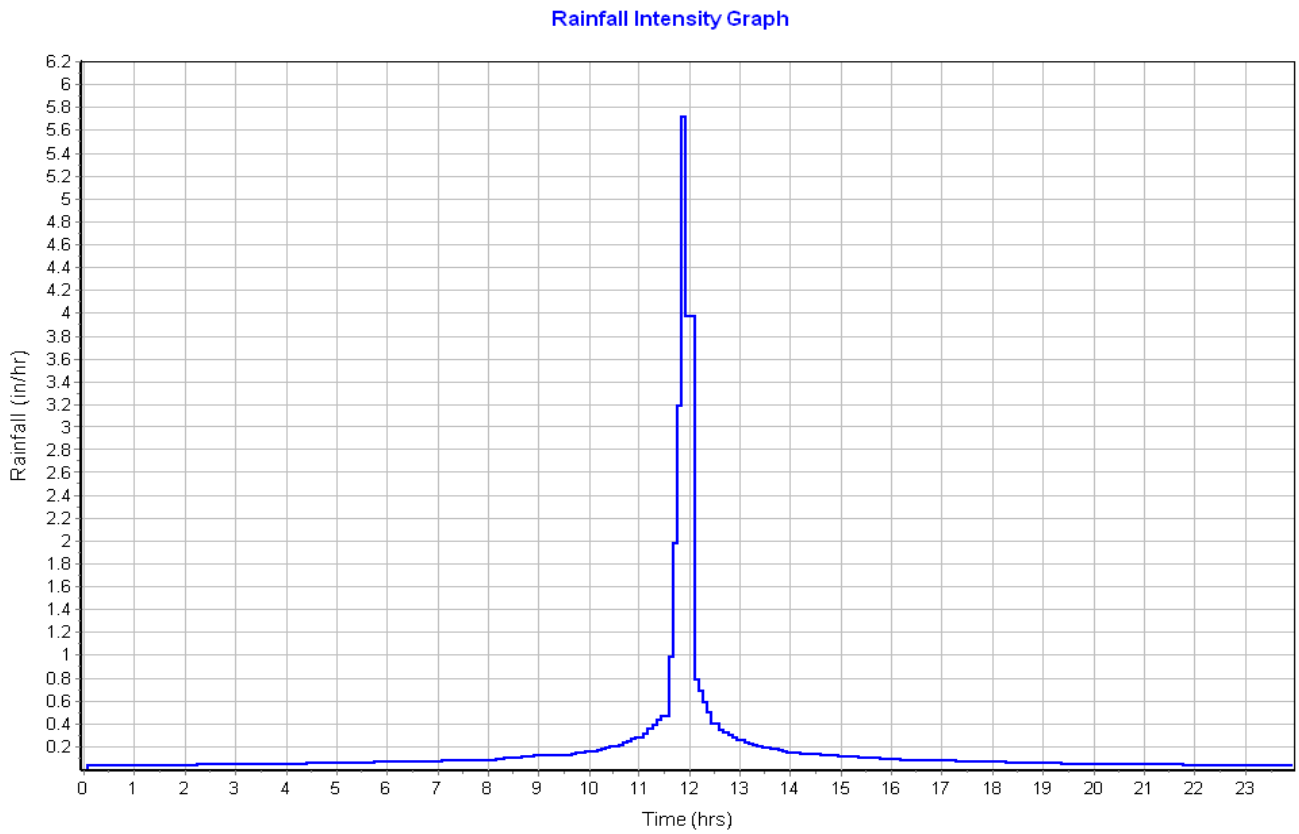
Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.03	0.00	0.00
Flow Length (ft) :	507	0.00	0.00
Channel Slope (%) :	1.2	0.00	0.00
Cross Section Area (ft²) :	4.5	0.00	0.00
Wetted Perimeter (ft) :	6.7	0.00	0.00
Velocity (ft/sec) :	4.17	0.00	0.00
Computed Flow Time (min) :	2.03	0.00	0.00

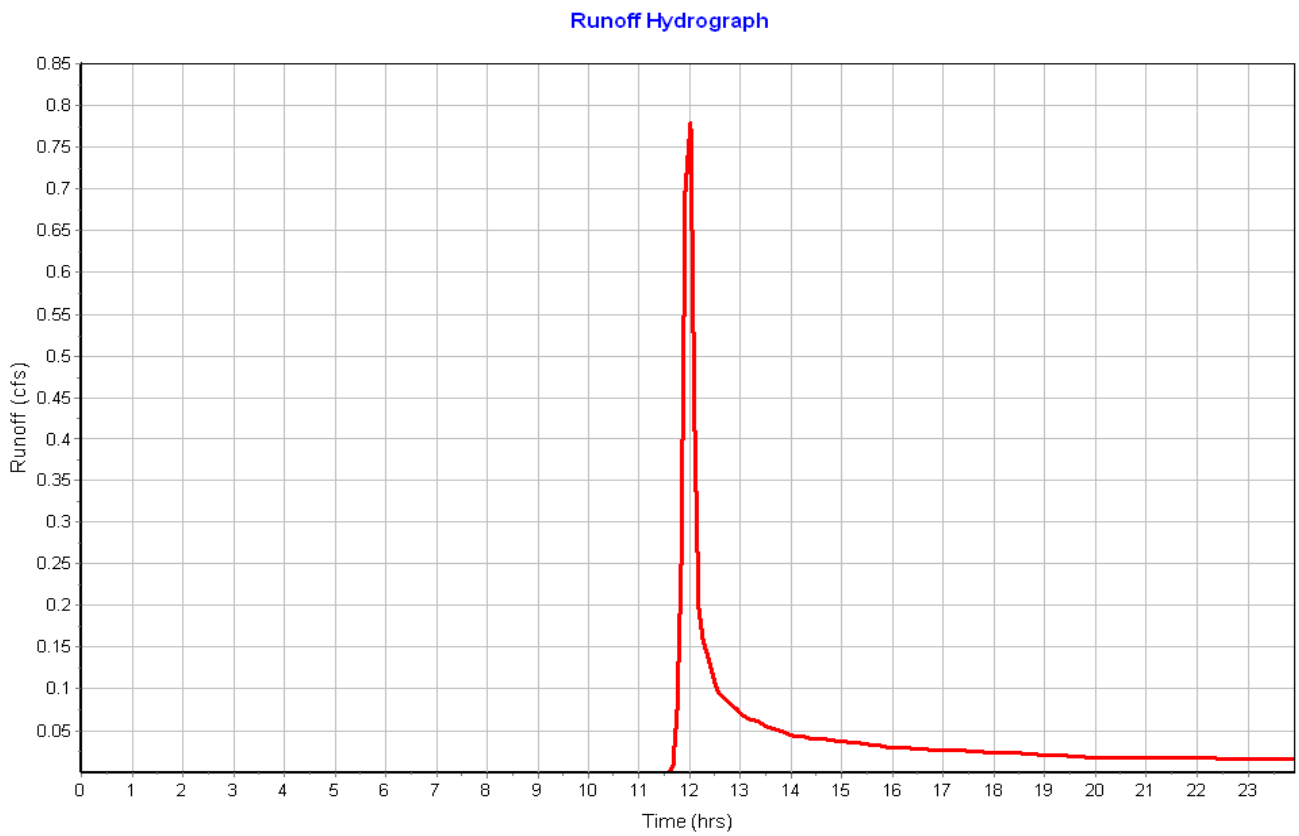
Total TOC (min) 2.03

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 0.90
Peak Runoff (cfs) 0.78
Weighted Curve Number 61.00
Time of Concentration (days hh:mm:ss) 0 00:02:02

Subbasin : B14





Subbasin : B15

Input Data

Area (ac) 0.76
Weighted Curve Number 61.00
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
> 75% grass cover, Good	0.76	B	61.00
Composite Area & Weighted CN	0.76		61.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	25	0.00	0.00
Slope (%) :	33	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.37	0.00	0.00
Velocity (ft/sec) :	0.23	0.00	0.00
Computed Flow Time (min) :	1.78	0.00	0.00

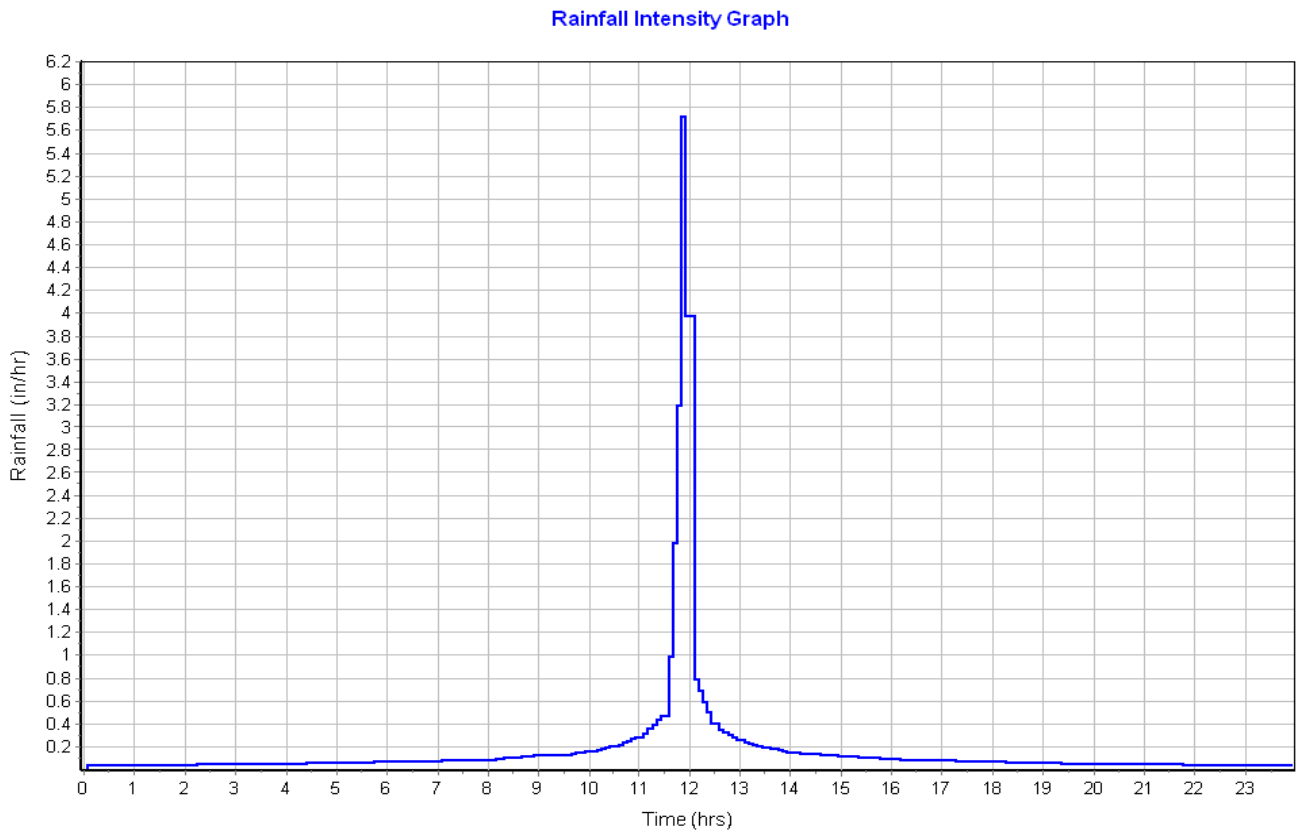
Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.03	0.00	0.00
Flow Length (ft) :	545	0.00	0.00
Channel Slope (%) :	6.2	0.00	0.00
Cross Section Area (ft^2) :	12	0.00	0.00
Wetted Perimeter (ft) :	10.9	0.00	0.00
Velocity (ft/sec) :	13.19	0.00	0.00
Computed Flow Time (min) :	0.69	0.00	0.00

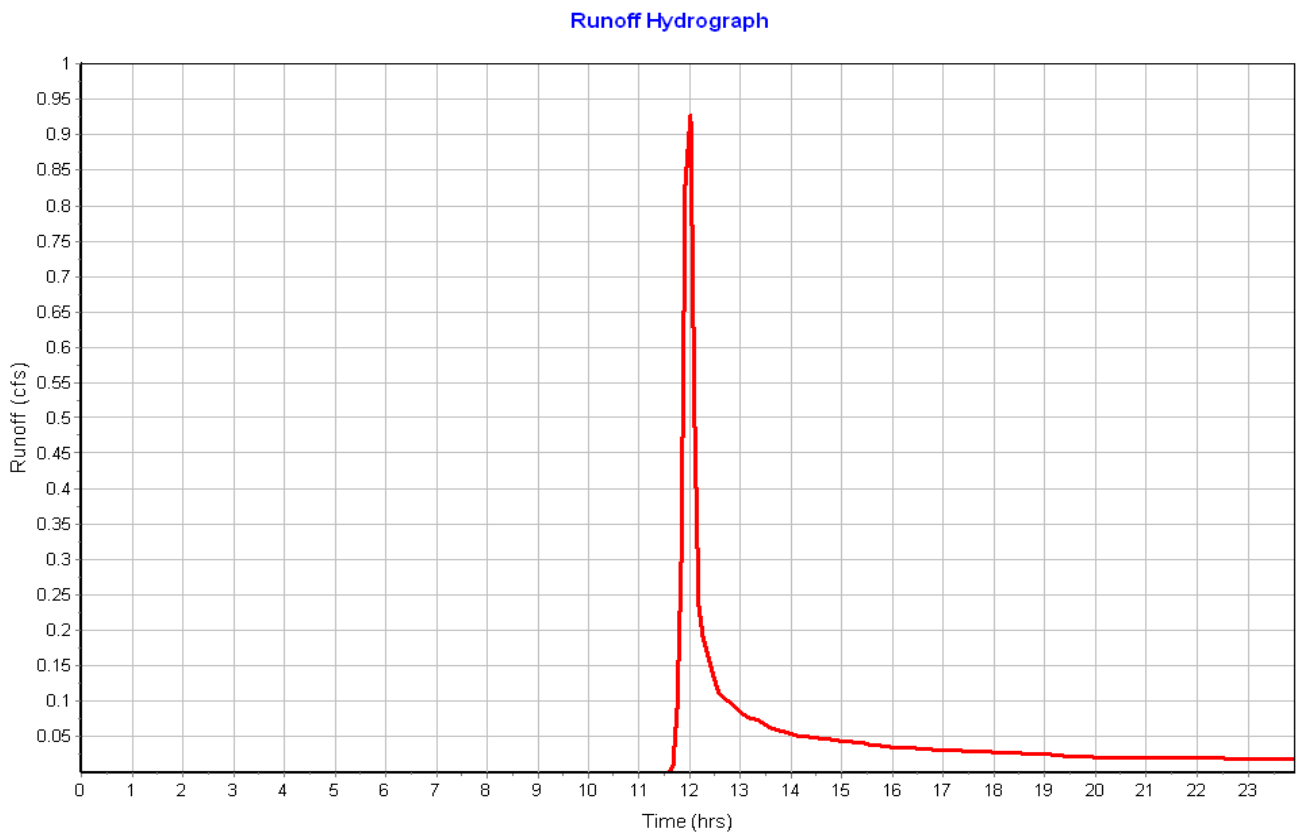
Total TOC (min) 2.47

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 0.90
Peak Runoff (cfs) 0.93
Weighted Curve Number 61.00
Time of Concentration (days hh:mm:ss) 0 00:02:28

Subbasin : B15





Subbasin : B2

Input Data

Area (ac) 2.55
Weighted Curve Number 64.39
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.36	B	85.00
> 75% grass cover, Good	2.19	B	61.00
Composite Area & Weighted CN	2.55		64.39

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	3.4	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.37	0.00	0.00
Velocity (ft/sec) :	0.12	0.00	0.00
Computed Flow Time (min) :	13.41	0.00	0.00

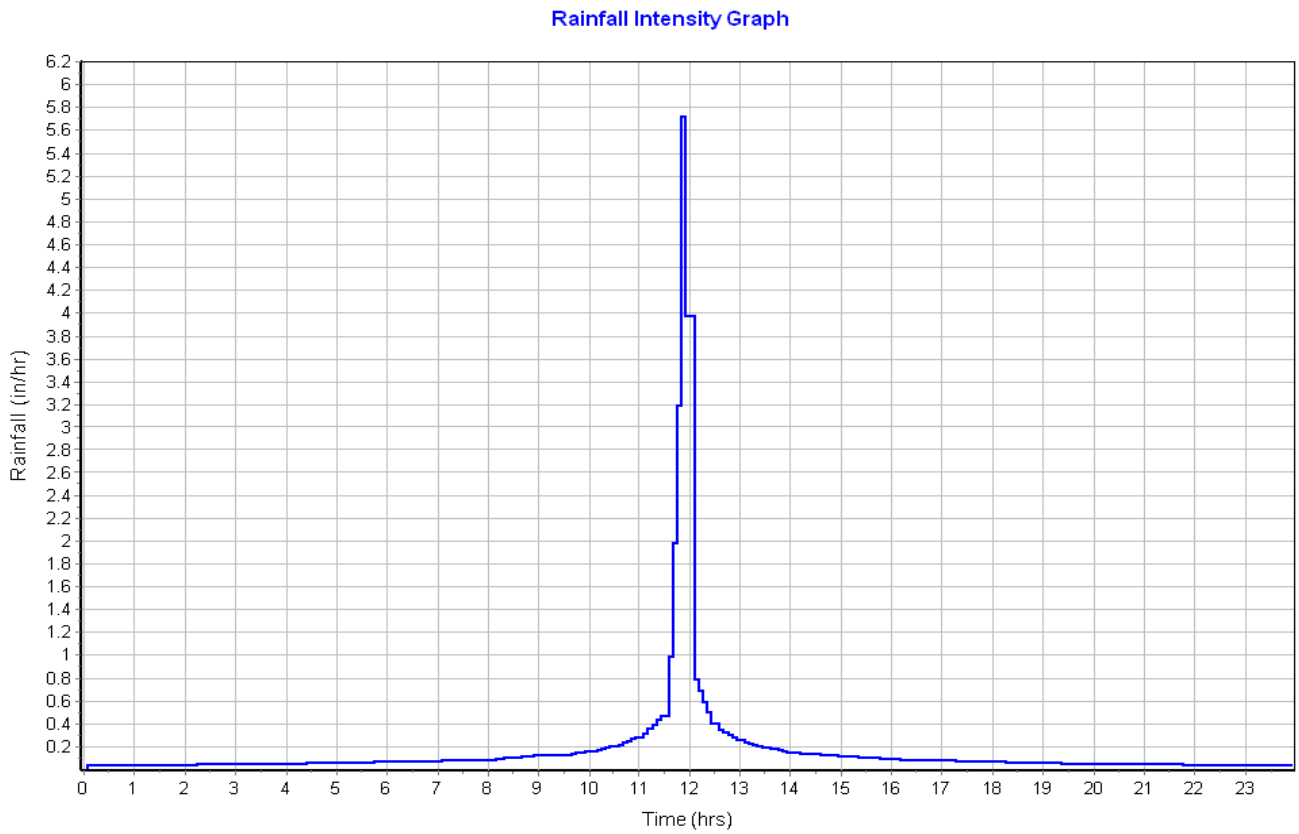
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	80	0.00	0.00
Slope (%) :	3.4	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.29	0.00	0.00
Computed Flow Time (min) :	1.03	0.00	0.00

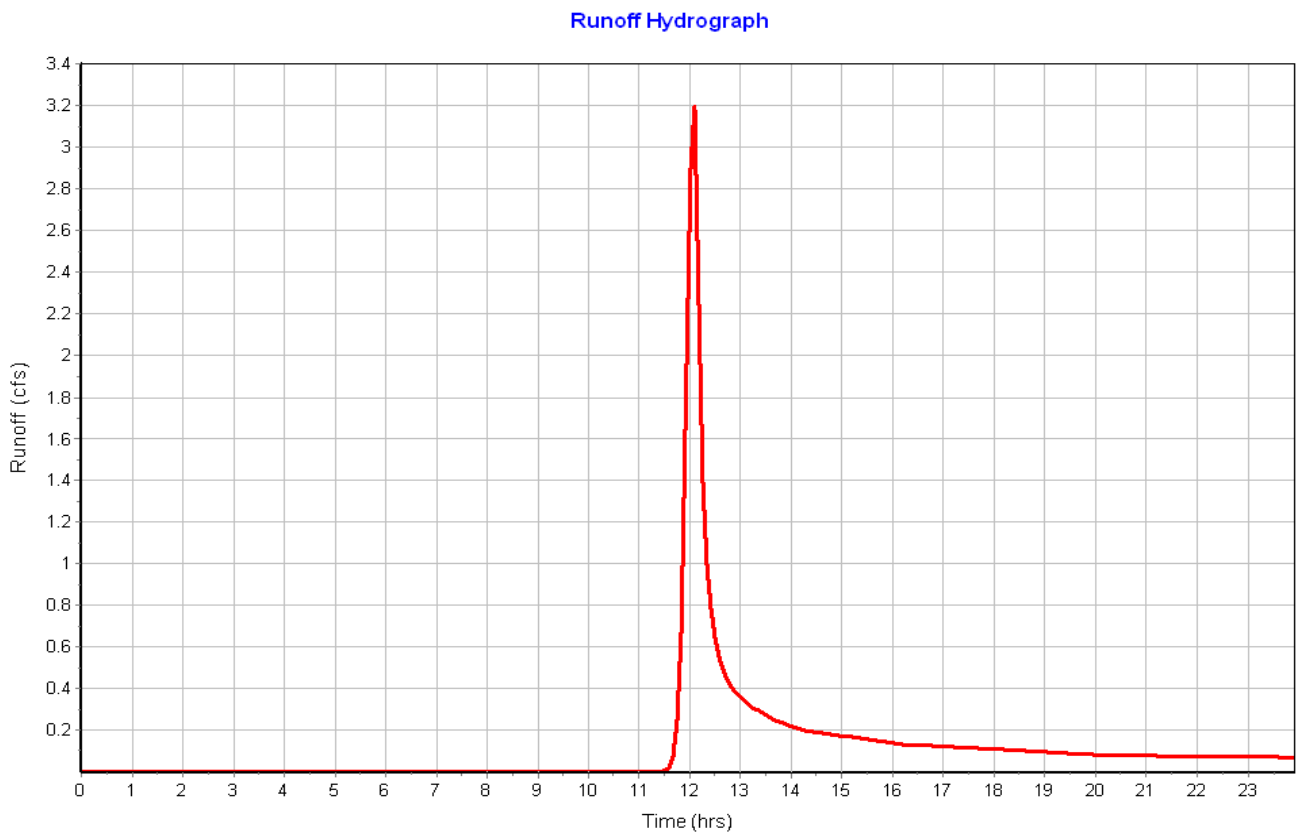
Total TOC (min) 14.44

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.09
Peak Runoff (cfs) 3.26
Weighted Curve Number 64.39
Time of Concentration (days hh:mm:ss) 0 00:14:26

Subbasin : B2


Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)


Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : B3

Input Data

Area (ac) 2.23
Weighted Curve Number 74.54
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Landfill Soil Cap	2.12	B	74.00
Gravel roads	0.11	B	85.00
Liner	0.00	B	100.00
Composite Area & Weighted CN	2.23		74.54

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	33	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.70	0.00	0.00
Velocity (ft/sec) :	0.33	0.00	0.00
Computed Flow Time (min) :	5.06	0.00	0.00

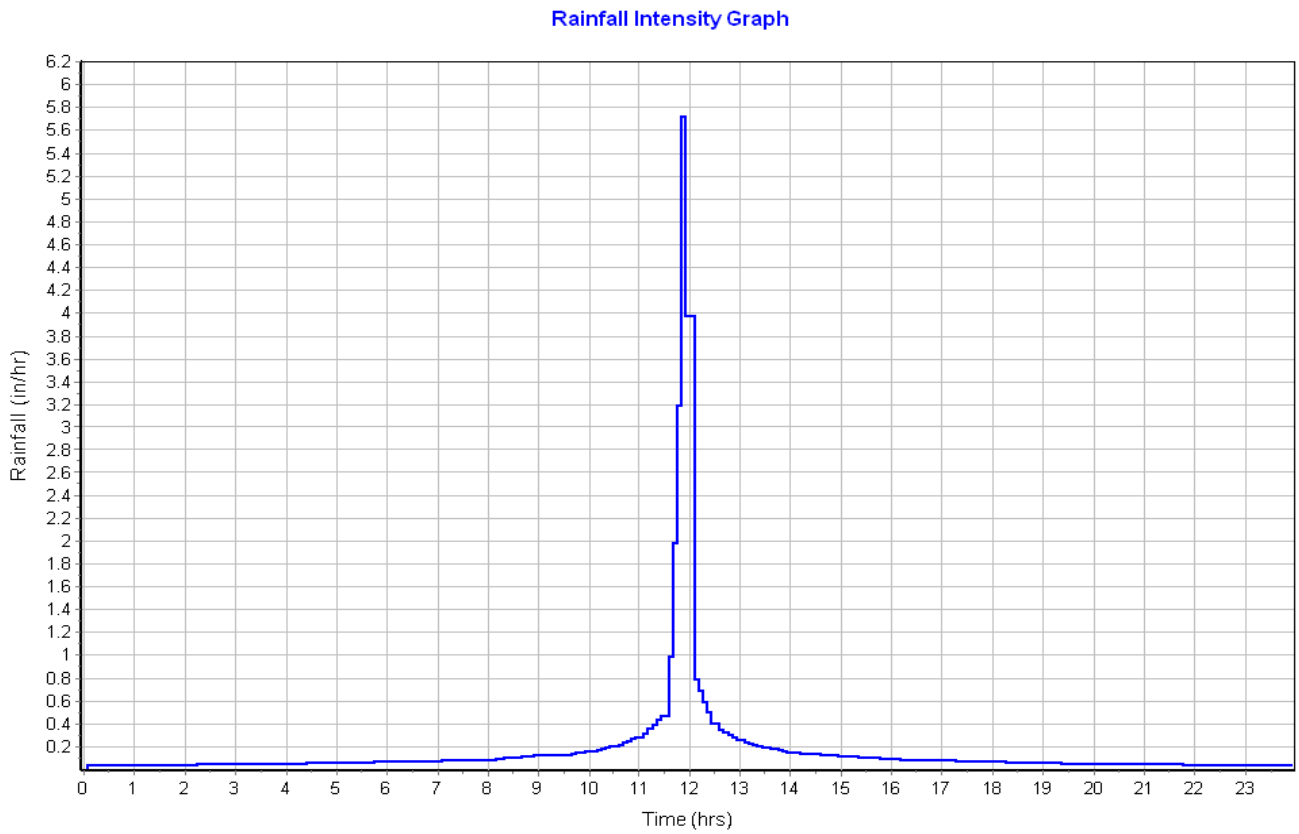
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	30	0.00	0.00
Slope (%) :	33	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	4.02	0.00	0.00
Computed Flow Time (min) :	0.12	0.00	0.00

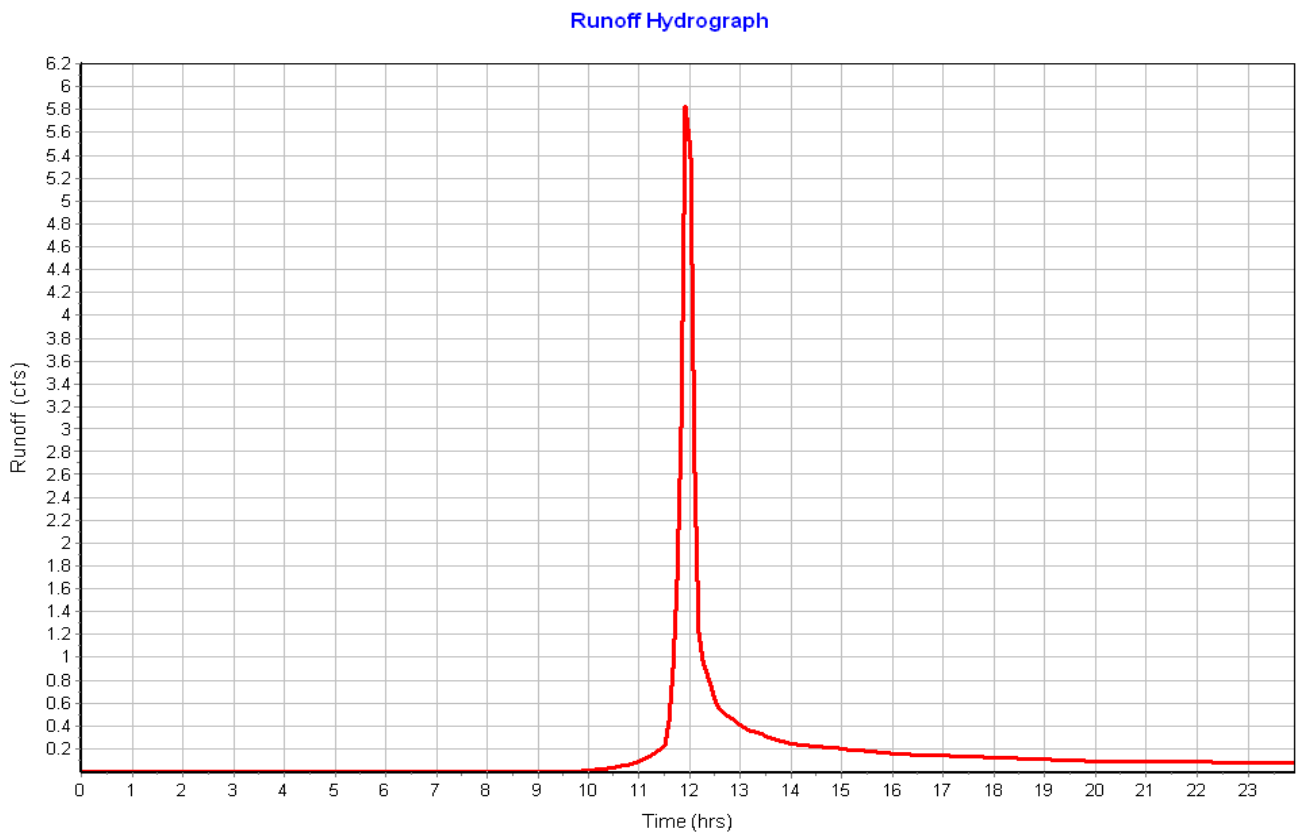
Total TOC (min) 5.19

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.76
Peak Runoff (cfs) 6.00
Weighted Curve Number 74.54
Time of Concentration (days hh:mm:ss) 0 00:05:11

Subbasin : B3


Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)


Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : B4

Input Data

Area (ac) 2.23
Weighted Curve Number 74.00
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Landfill Soil Cap	2.23	B	74.00
Composite Area & Weighted CN	2.23		74.00

Time of Concentration

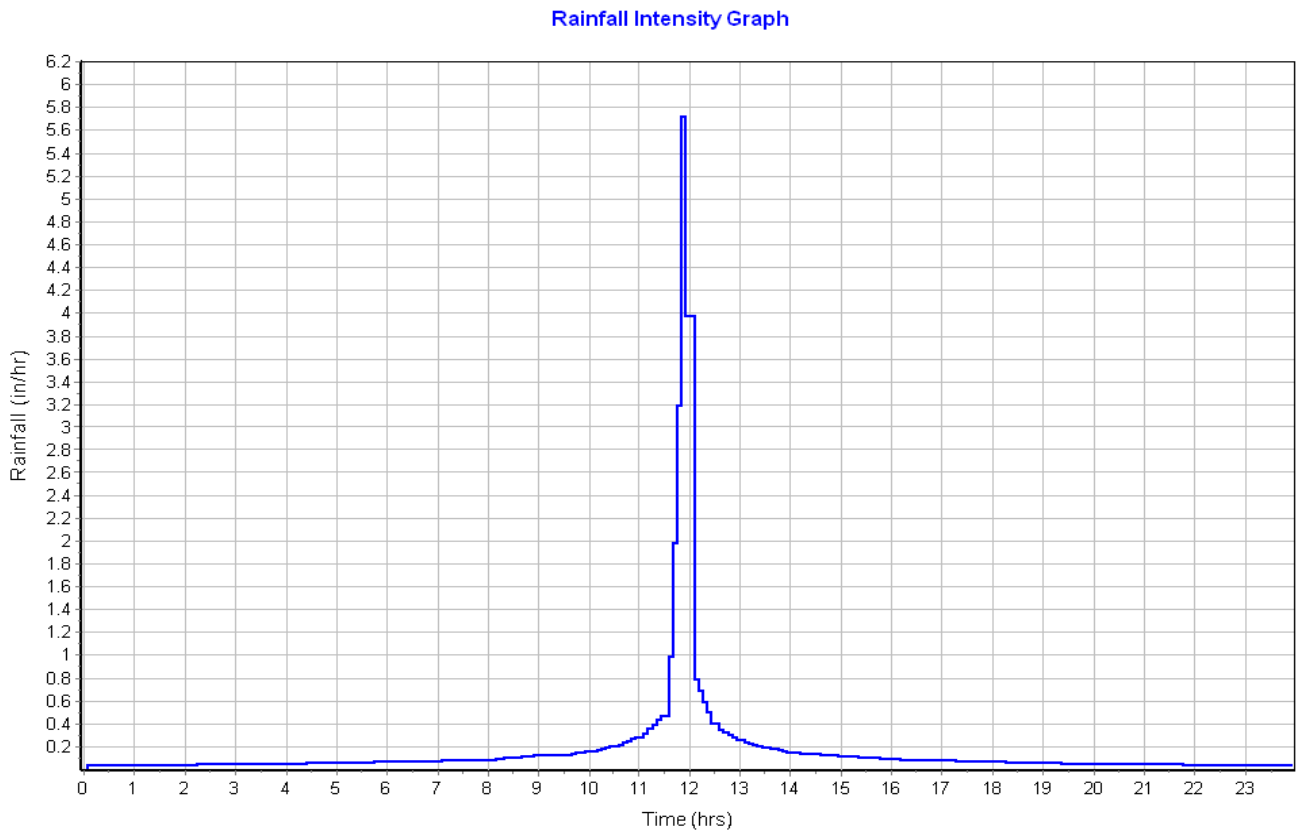
Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	90	0.00	0.00
Slope (%) :	33	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.70	0.00	0.00
Velocity (ft/sec) :	0.32	0.00	0.00
Computed Flow Time (min) :	4.65	0.00	0.00

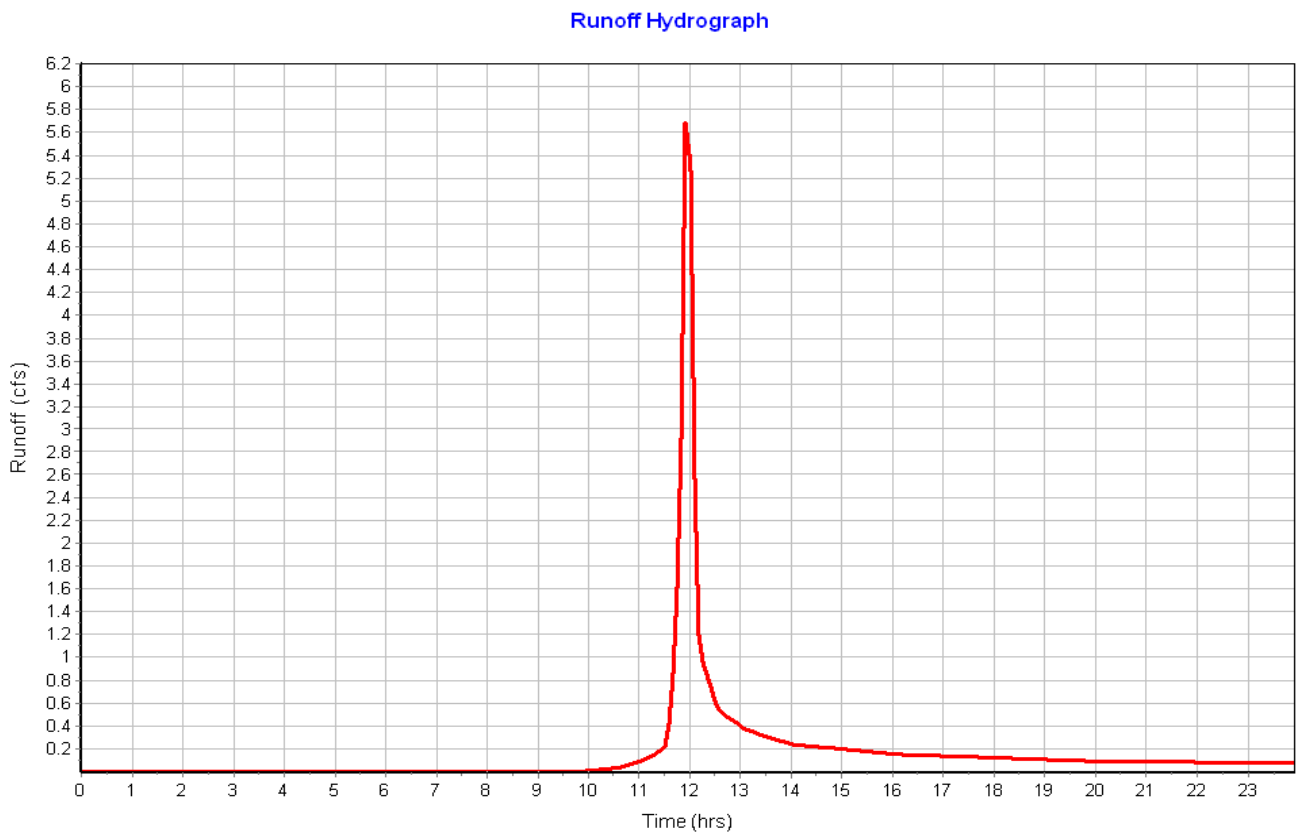
Total TOC (min) 4.65

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.72
Peak Runoff (cfs) 5.86
Weighted Curve Number 74.00
Time of Concentration (days hh:mm:ss) 0 00:04:39

Subbasin : B4


Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)


Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : B5

Input Data

Area (ac) 2.20
Weighted Curve Number 74.00
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Landfill Soil Cap	2.20	B	74.00
Composite Area & Weighted CN	2.20		74.00

Time of Concentration

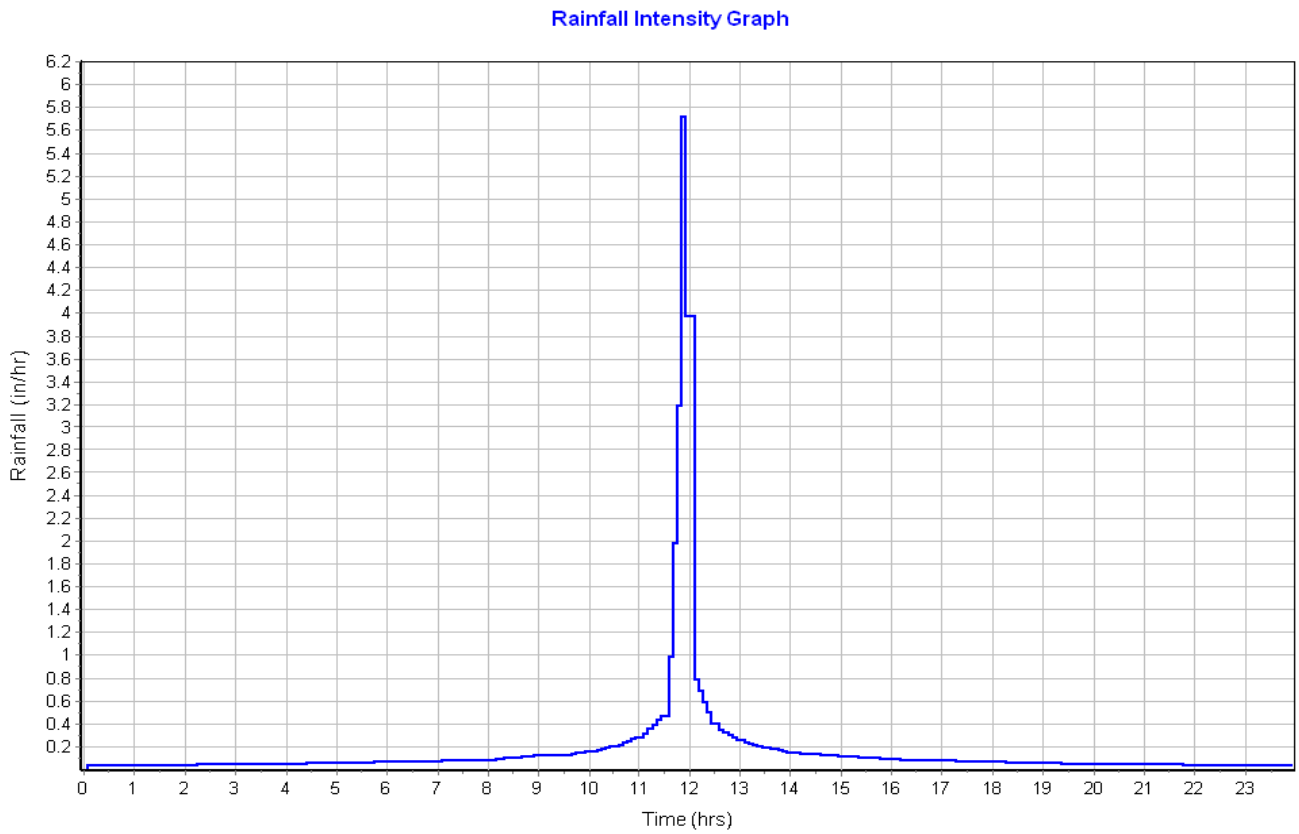
Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	90	0.00	0.00
Slope (%) :	33	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.70	0.00	0.00
Velocity (ft/sec) :	0.32	0.00	0.00
Computed Flow Time (min) :	4.65	0.00	0.00

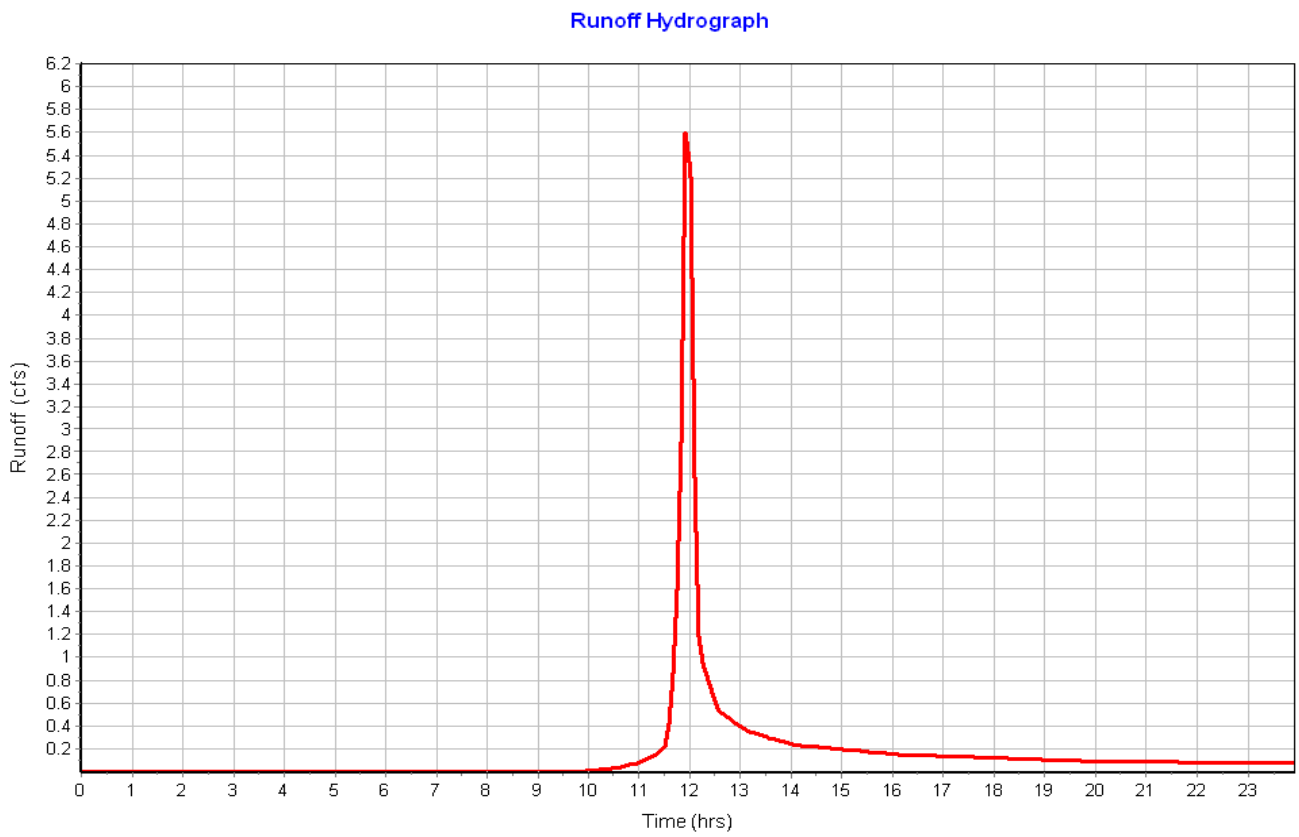
Total TOC (min) 4.65

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.72
Peak Runoff (cfs) 5.79
Weighted Curve Number 74.00
Time of Concentration (days hh:mm:ss) 0 00:04:39

Subbasin : B5


Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)


Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : B6

Input Data

Area (ac) 0.25
Weighted Curve Number 74.00
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Landfill Soil Cap	0.25	B	74.00
Composite Area & Weighted CN	0.25		74.00

Time of Concentration

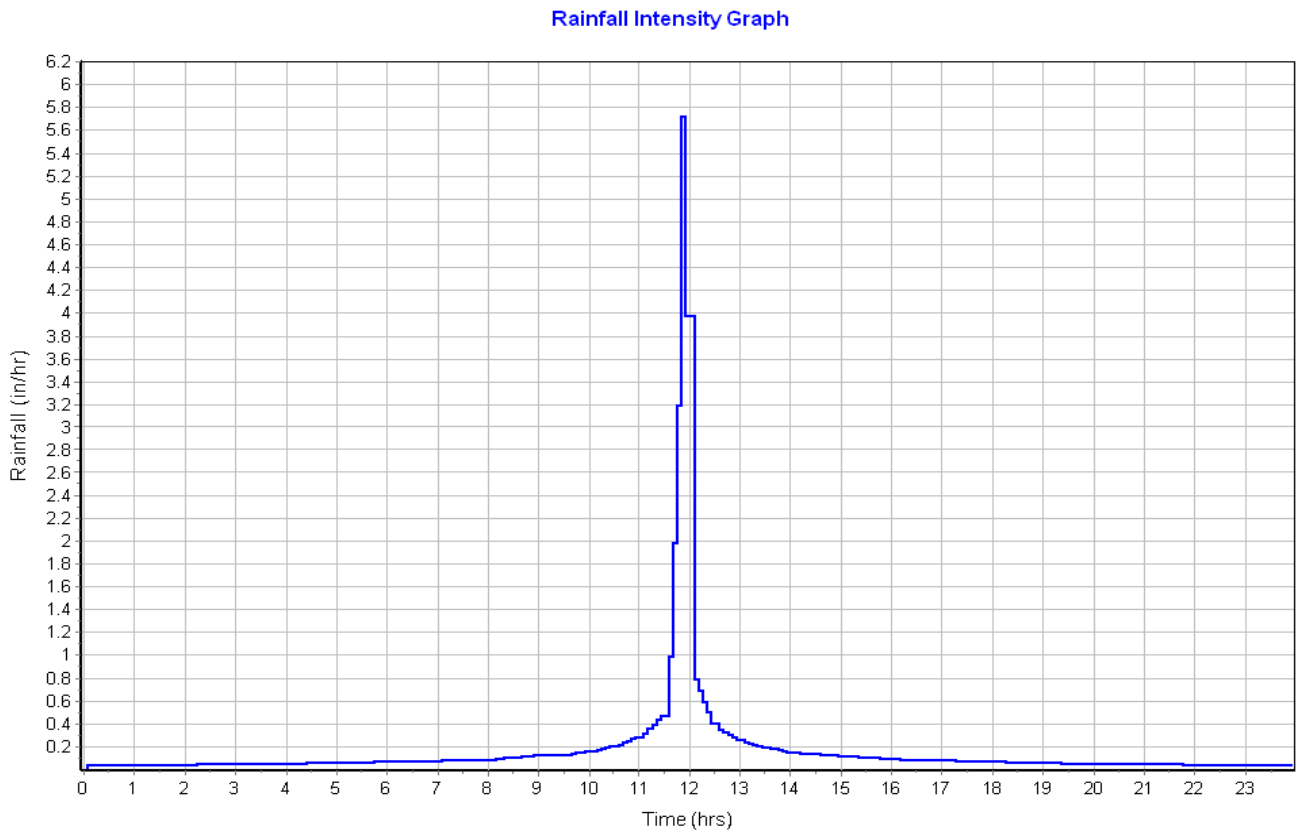
Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	75	0.00	0.00
Slope (%) :	33	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.70	0.00	0.00
Velocity (ft/sec) :	0.31	0.00	0.00
Computed Flow Time (min) :	4.02	0.00	0.00

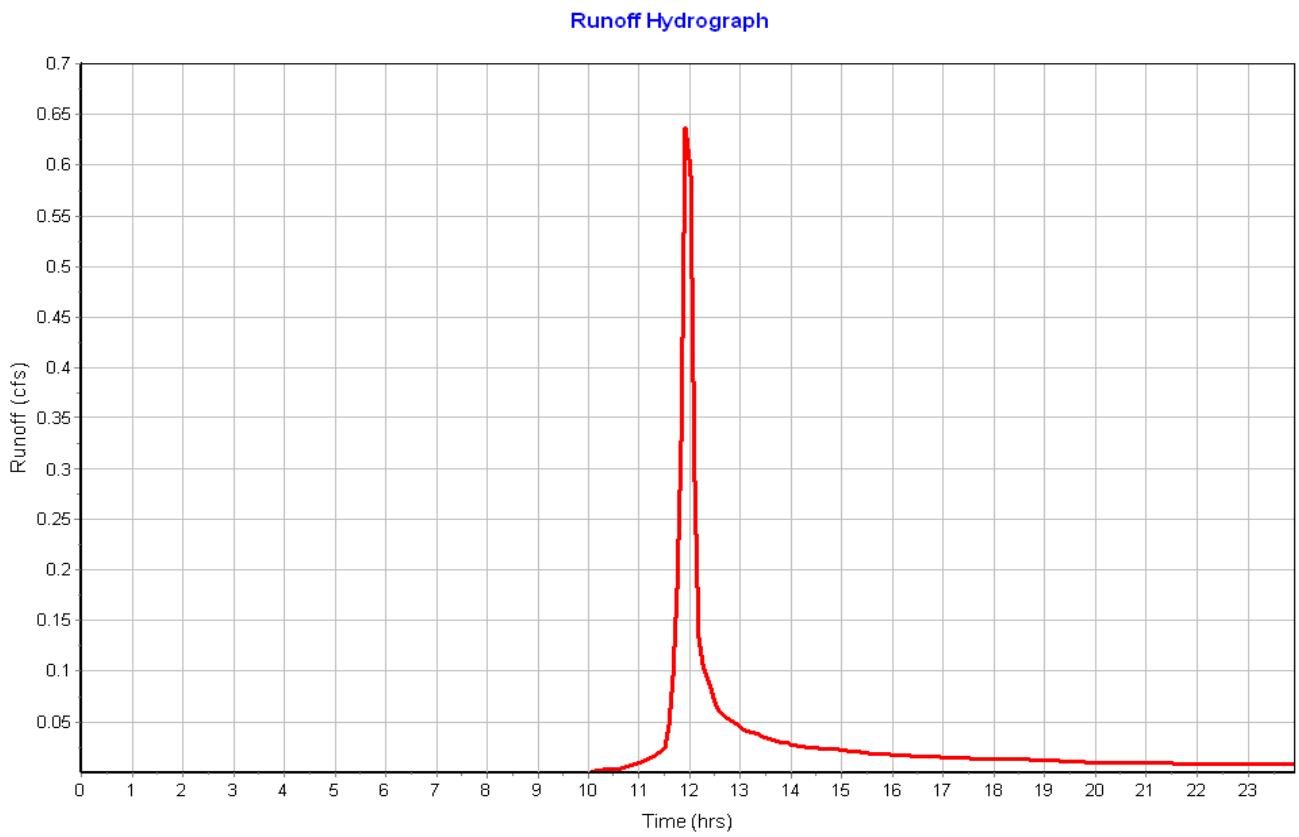
Total TOC (min) 4.02

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.72
Peak Runoff (cfs) 0.66
Weighted Curve Number 74.00
Time of Concentration (days hh:mm:ss) 0 00:04:01

Subbasin : B6


Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)


Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : B7

Input Data

Area (ac) 4.60
Weighted Curve Number 74.00
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Landfill Soil Cap	4.60	B	74.00
Composite Area & Weighted CN	4.60		74.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.70	0.00	0.00
Velocity (ft/sec) :	0.15	0.00	0.00
Computed Flow Time (min) :	10.77	0.00	0.00

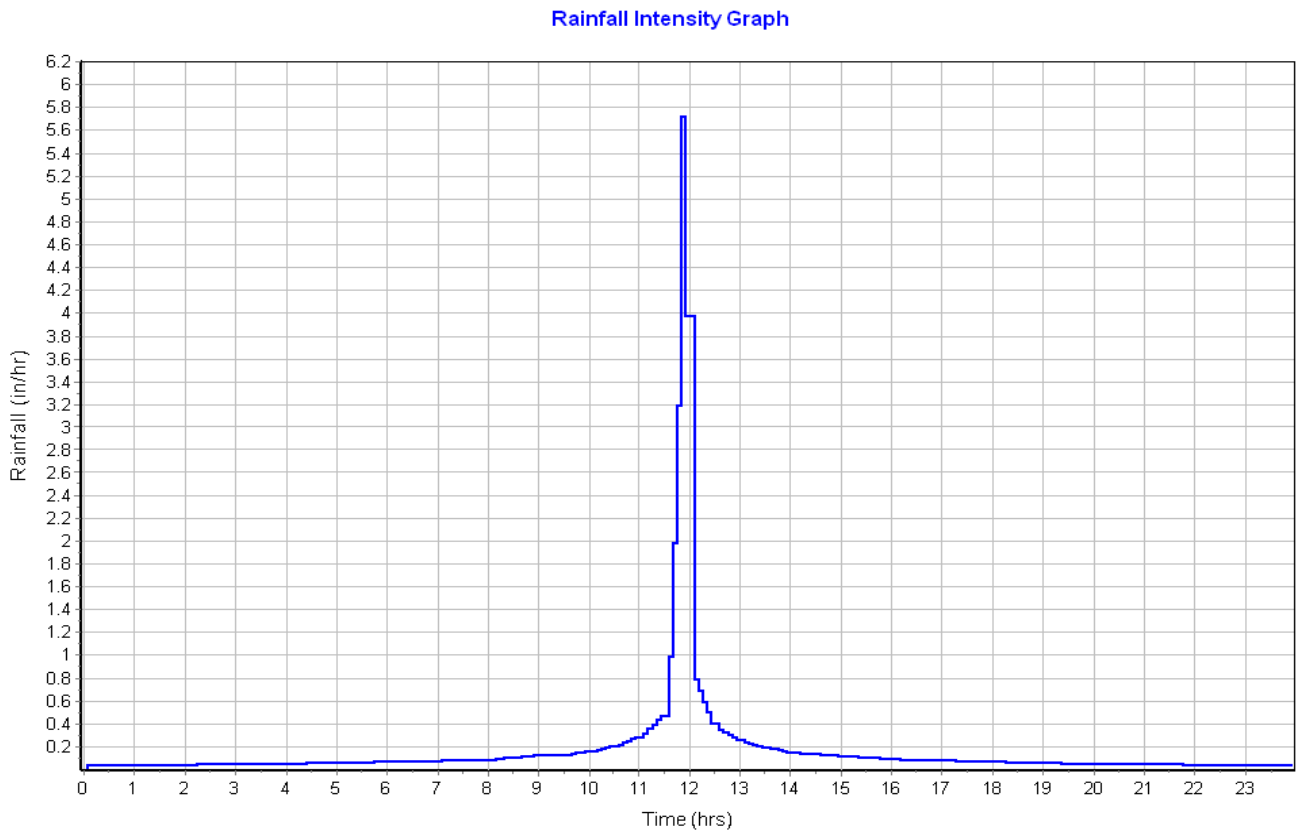
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	450	0.00	0.00
Slope (%) :	5	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.57	0.00	0.00
Computed Flow Time (min) :	4.78	0.00	0.00

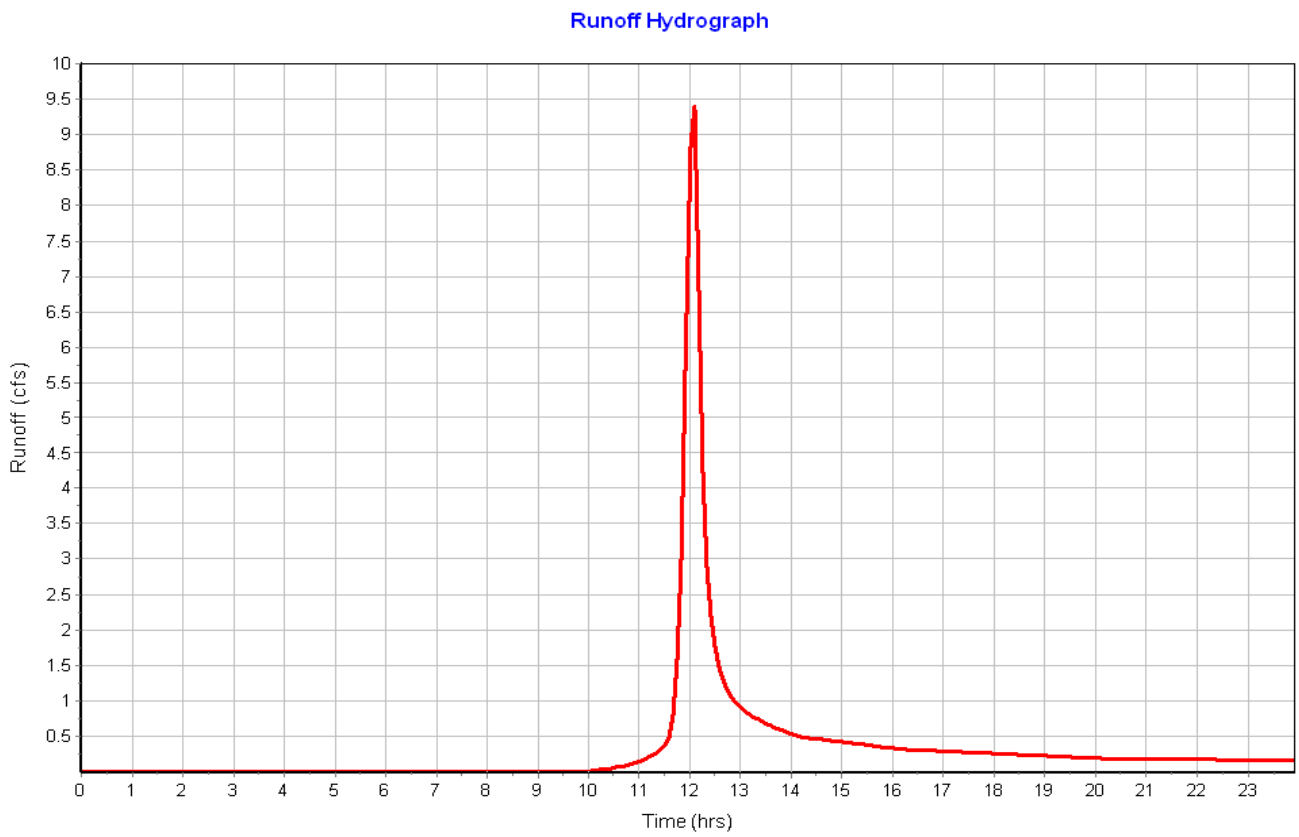
Total TOC (min) 15.55

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.72
Peak Runoff (cfs) 9.63
Weighted Curve Number 74.00
Time of Concentration (days hh:mm:ss) 0 00:15:33

Subbasin : B7


Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)


Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : B8

Input Data

Area (ac) 3.31
Weighted Curve Number 74.00
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Landfill Soil Cap	3.31	B	74.00
Liner	0.00	B	100.00
Composite Area & Weighted CN	3.31		74.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.37	0.00	0.00
Velocity (ft/sec) :	0.15	0.00	0.00
Computed Flow Time (min) :	11.49	0.00	0.00

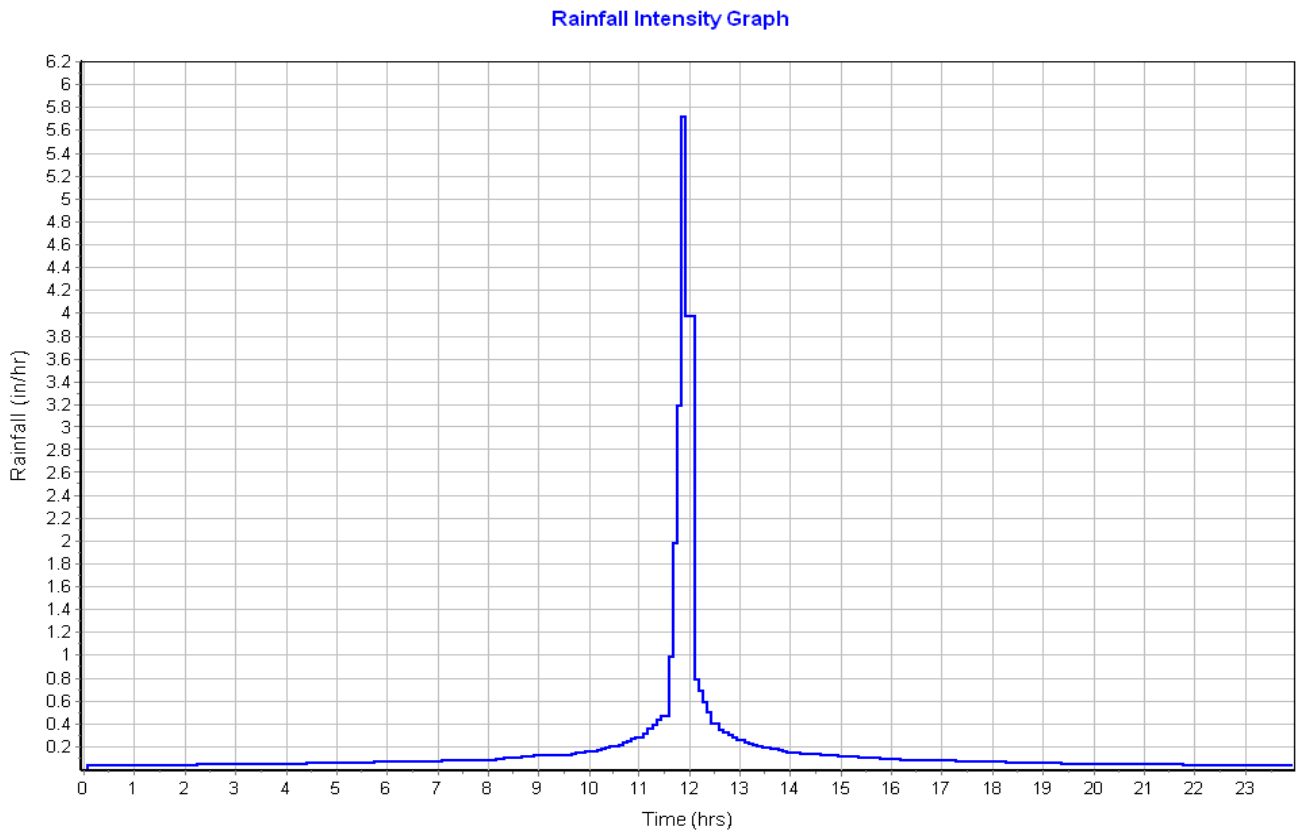
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	250	0.00	0.00
Slope (%) :	5	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.57	0.00	0.00
Computed Flow Time (min) :	2.65	0.00	0.00

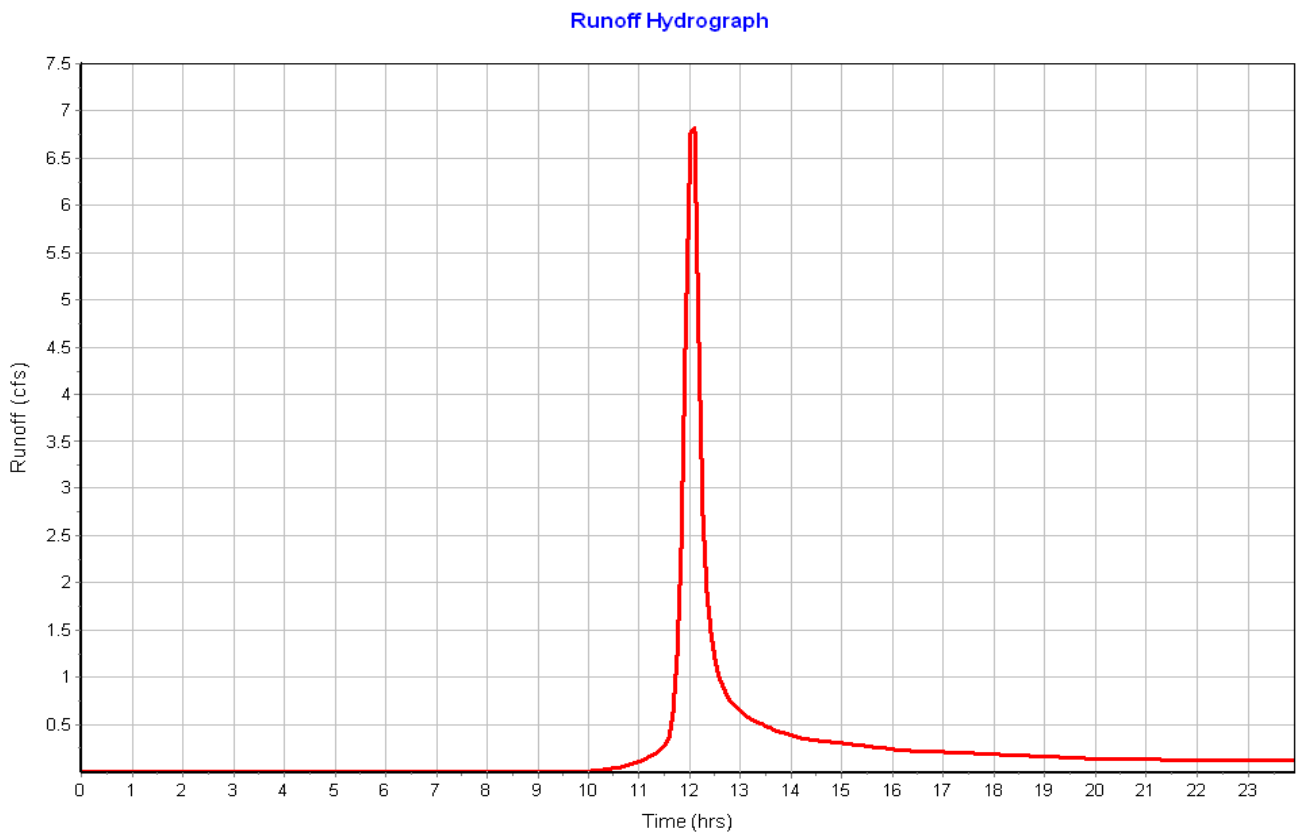
Total TOC (min) 14.15

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.72
Peak Runoff (cfs) 7.17
Weighted Curve Number 74.00
Time of Concentration (days hh:mm:ss) 0 00:14:09

Subbasin : B8


Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)


Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : B9

Input Data

Area (ac) 2.37
Weighted Curve Number 74.00
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Landfill Soil Cap	2.37	B	74.00
Liner	0.00	B	100.00
Composite Area & Weighted CN	2.37		74.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.37	0.00	0.00
Velocity (ft/sec) :	0.15	0.00	0.00
Computed Flow Time (min) :	11.49	0.00	0.00

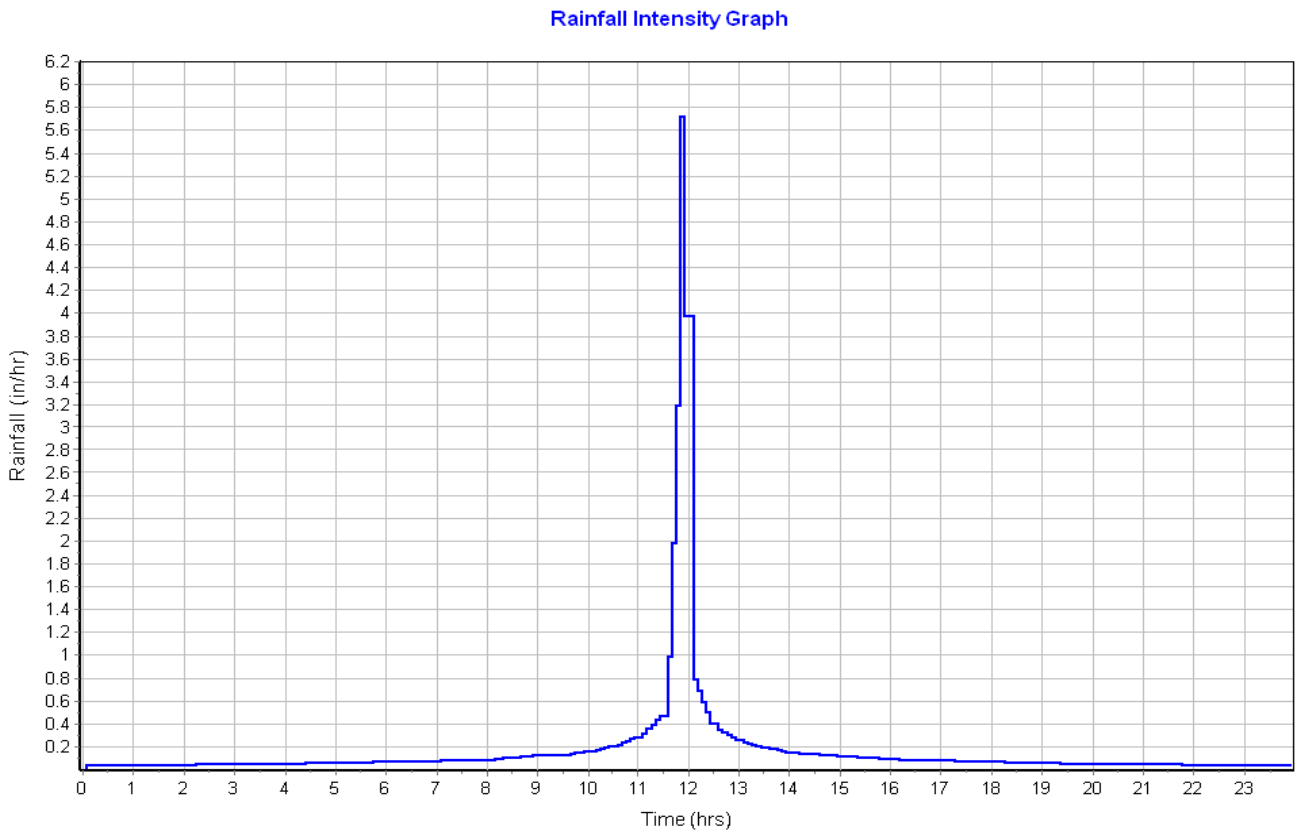
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	160	0.00	0.00
Slope (%) :	33	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	4.02	0.00	0.00
Computed Flow Time (min) :	0.66	0.00	0.00

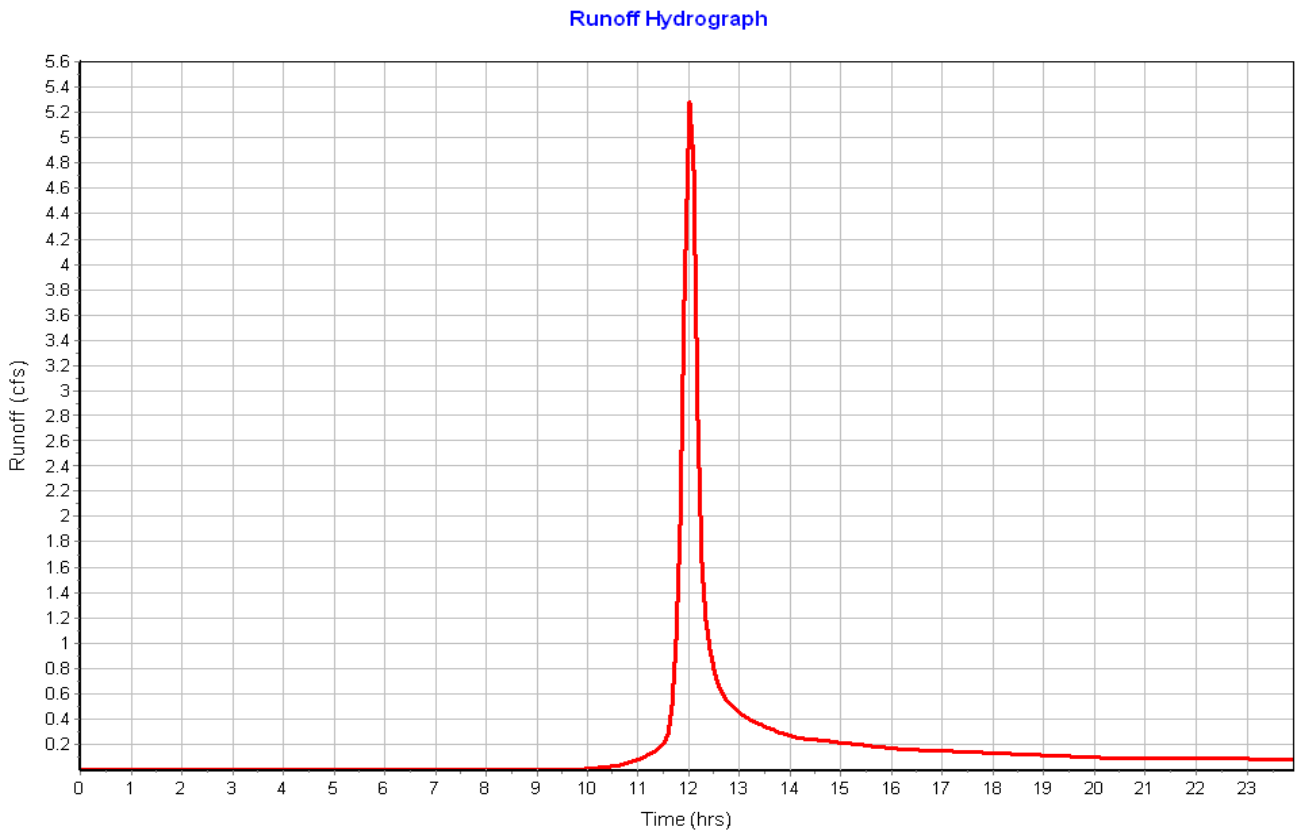
Total TOC (min) 12.16

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.72
Peak Runoff (cfs) 5.38
Weighted Curve Number 74.00
Time of Concentration (days hh:mm:ss) 0 00:12:10

Subbasin : B9


Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)


Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Subbasin : C1

Input Data

Area (ac) 2.76
Weighted Curve Number 63.78
Rain Gage ID Gage-1

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.32	B	85.00
> 75% grass cover, Good	2.44	B	61.00
Composite Area & Weighted CN	2.76		63.78

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	60	0.00	0.00
Slope (%) :	33	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.37	0.00	0.00
Velocity (ft/sec) :	0.28	0.00	0.00
Computed Flow Time (min) :	3.59	0.00	0.00

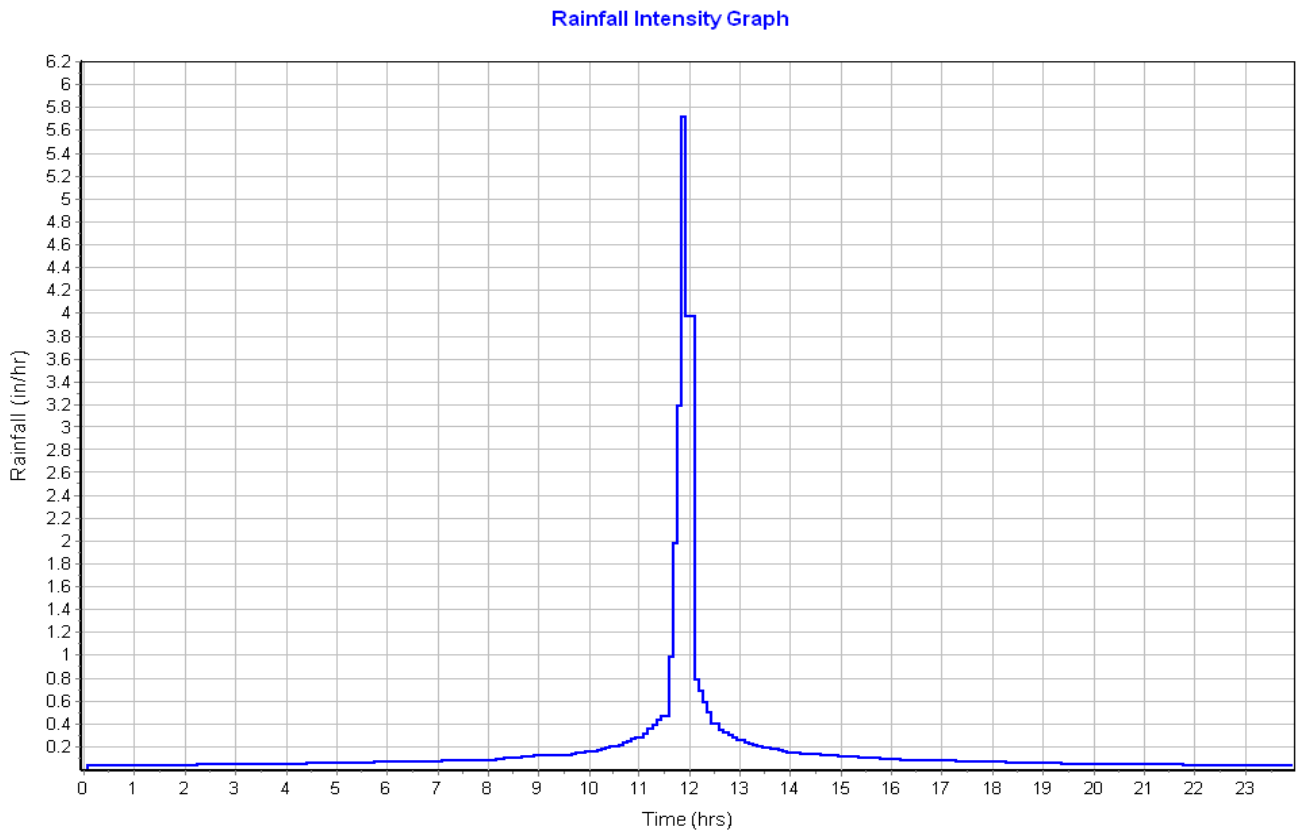
Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.035	0.00	0.00
Flow Length (ft) :	2170	0.00	0.00
Channel Slope (%) :	1.1	0.00	0.00
Cross Section Area (ft²) :	12	0.00	0.00
Wetted Perimeter (ft) :	10.9	0.00	0.00
Velocity (ft/sec) :	4.76	0.00	0.00
Computed Flow Time (min) :	7.60	0.00	0.00

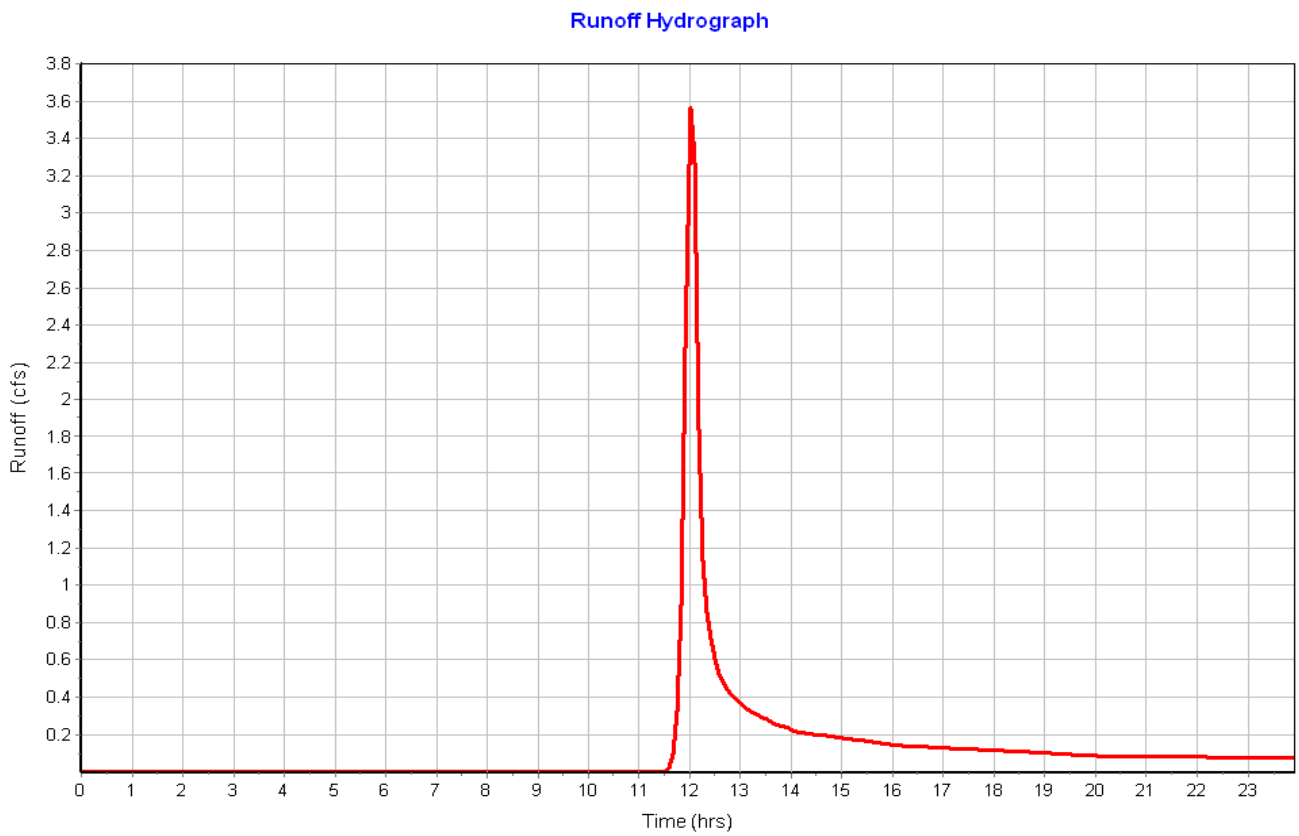
Total TOC (min) 11.19

Subbasin Runoff Results

Total Rainfall (in) 4.17
Total Runoff (in) 1.06
Peak Runoff (cfs) 3.70
Weighted Curve Number 63.78
Time of Concentration (days hh:mm:ss) 0 00:11:11

Subbasin : C1


Rainfall Intensity Graph
Rainfall (in/hr)
Time (hrs)


Runoff Hydrograph
Runoff (cfs)
Time (hrs)

Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	A/B Basin Confluence	1230.00	1250.00	20.00	1230.00	0.00	1250.00	0.00	0.00	0.00
2	DC1	1356.00	1362.00	6.00	1356.00	0.00	1362.00	0.00	0.00	0.00
3	DC2	1381.00	1387.00	6.00	1381.00	0.00	1387.00	0.00	0.00	0.00
4	DC3	1387.00	1393.00	6.00	1387.00	0.00	1393.00	0.00	0.00	0.00
5	DC4	1408.00	1414.00	6.00	1408.00	0.00	1414.00	0.00	0.00	0.00
6	DC5	1420.00	1426.00	6.00	1420.00	0.00	1426.00	0.00	0.00	0.00
7	Jun-01 - A2 Channel Start	1329.00	1350.00	21.00	1329.00	0.00	1350.00	0.00	0.00	0.00
8	Jun-16	1348.00	1352.00	4.00	1348.00	0.00	1352.00	0.00	0.00	0.00
9	Jun-19	1346.00	1370.00	24.00	1346.00	0.00	1370.00	0.00	0.00	0.00
10	Jun-20	1340.00	1360.00	20.00	1340.00	0.00	1360.00	0.00	0.00	0.00
11	Jun-22	1367.40	1390.00	22.60	1367.40	0.00	1390.00	0.00	0.00	0.00
12	Jun-23	1356.70	1390.00	33.30	1356.70	0.00	1390.00	0.00	0.00	0.00
13	Jun-26	1318.00	1330.00	12.00	1318.00	0.00	1330.00	0.00	0.00	0.00
14	Jun-30	1333.00	1340.00	7.00	1333.00	0.00	1340.00	0.00	0.00	0.00
15	Jun-33	1455.00	1459.00	4.00	1455.00	0.00	1459.00	0.00	0.00	0.00
16	Jun-34	1475.00	1479.00	4.00	1475.00	0.00	1479.00	0.00	0.00	0.00
17	Jun-39	1464.00	1468.00	4.00	1464.00	0.00	1468.00	0.00	0.00	0.00
18	Jun-40	1465.00	1469.00	4.00	1465.00	0.00	1469.00	0.00	0.00	0.00
19	Jun-44	1398.00	1402.00	4.00	1398.00	0.00	1402.00	0.00	0.00	0.00
20	Jun-45	1340.50	1344.50	4.00	1340.50	0.00	1344.50	0.00	0.00	0.00
21	Jun-46	1398.00	1402.00	4.00	1398.00	0.00	1402.00	0.00	0.00	0.00
22	Jun-47	1393.50	1397.50	4.00	1393.50	0.00	1397.50	0.00	0.00	0.00
23	Jun-48	1391.40	1395.40	4.00	1391.40	0.00	1395.40	0.00	0.00	0.00
24	Jun-49	1339.50	1343.50	4.00	1339.50	0.00	1343.50	0.00	0.00	0.00
25	Jun-55	1360.00	1364.00	4.00	1360.00	0.00	1364.00	0.00	0.00	0.00
26	Jun-56	1367.00	1371.00	4.00	1367.00	0.00	1371.00	0.00	0.00	0.00
27	Jun-57	1391.00	1397.00	6.00	1391.00	0.00	1397.00	0.00	0.00	0.00
28	Jun-58	1340.50	1344.50	4.00	1340.50	0.00	1344.50	0.00	0.00	0.00
29	Jun-60	1353.00	1357.00	4.00	1353.00	0.00	1357.00	0.00	0.00	0.00
30	Jun-61	1353.00	1357.00	4.00	1353.00	0.00	1357.00	0.00	0.00	0.00
31	Jun-62	1388.00	1392.00	4.00	1388.00	0.00	1392.00	0.00	0.00	0.00
32	Jun-63	1354.50	1358.50	4.00	1354.50	0.00	1358.50	0.00	0.00	0.00
33	Jun-64	1375.00	1379.00	4.00	1375.00	0.00	1379.00	0.00	0.00	0.00
34	Jun-65	1422.00	1426.00	4.00	1422.00	0.00	1426.00	0.00	0.00	0.00
35	Jun-66	1455.00	1459.00	4.00	1455.00	0.00	1459.00	0.00	0.00	0.00
36	Jun-67	1418.00	1422.00	4.00	1418.00	0.00	1422.00	0.00	0.00	0.00
37	Jun-68	1464.00	1468.00	4.00	1464.00	0.00	1468.00	0.00	0.00	0.00
38	Jun-69	1455.00	1459.00	4.00	1455.00	0.00	1459.00	0.00	0.00	0.00
39	Jun-70	1468.00	1472.00	4.00	1468.00	0.00	1472.00	0.00	0.00	0.00
40	Jun-71	1465.00	1472.00	7.00	1465.00	0.00	1472.00	0.00	0.00	0.00
41	Jun-72	1440.00	1444.00	4.00	1440.00	0.00	1444.00	0.00	0.00	0.00
42	Jun-73	1415.00	1419.00	4.00	1415.00	0.00	1419.00	0.00	0.00	0.00
43	Jun-74	1369.00	1375.00	6.00	1369.00	0.00	1375.00	0.00	0.00	0.00
44	Jun-75	1388.00	1392.00	4.00	1388.00	0.00	1392.00	0.00	0.00	0.00
45	Jun-76	1422.00	1426.00	4.00	1422.00	0.00	1426.00	0.00	0.00	0.00
46	Jun-77	1465.00	1469.00	4.00	1465.00	0.00	1469.00	0.00	0.00	0.00
47	Jun-78	1440.00	1444.00	4.00	1440.00	0.00	1444.00	0.00	0.00	0.00
48	Jun-79	1338.00	1344.00	6.00	1338.00	0.00	1344.00	0.00	0.00	0.00
49	Jun-80	1320.50	1324.00	3.50	1320.50	0.00	1324.00	0.00	0.00	0.00
50	Level Spreader	1326.00	1335.00	9.00	1326.00	0.00	1335.00	0.00	0.00	0.00
51	NE DC Bot	1350.00	1370.00	20.00	1350.00	0.00	1370.00	0.00	0.00	0.00
52	NE DC Top	1460.00	1480.00	20.00	1460.00	0.00	1480.00	0.00	0.00	0.00
53	NE Outfall (B Basin)	1240.00	1260.00	20.00	1240.00	0.00	1260.00	0.00	0.00	0.00
54	NE Toe Swale	1336.80	1344.00	7.20	1336.80	0.00	1344.00	0.00	0.00	0.00
55	NW Outfall (A Basin)	1240.00	1260.00	20.00	1240.00	0.00	1260.00	0.00	0.00	0.00
56	P4 Outlet	1327.20	1350.00	22.80	1327.20	0.00	1350.00	0.00	0.00	0.00
57	Pond5OS	1321.00	1325.00	4.00	1321.00	0.00	1325.00	0.00	0.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	A/B Basin Confluence	9.51	3.61	1230.25	0.25	0.00	19.75	1230.08	0.08	0 12:19	0 00:00	0.00	0.00
2	DC1	31.60	0.00	1356.83	0.83	0.00	5.17	1356.13	0.13	0 12:06	0 00:00	0.00	0.00
3	DC2	26.22	0.00	1381.66	0.66	0.00	5.34	1381.11	0.11	0 12:07	0 00:00	0.00	0.00
4	DC3	21.12	0.00	1387.80	0.80	0.00	5.20	1387.13	0.13	0 12:06	0 00:00	0.00	0.00
5	DC4	16.47	0.00	1408.70	0.70	0.00	5.30	1408.12	0.12	0 12:10	0 00:00	0.00	0.00
6	DC5	9.66	0.00	1420.95	0.95	0.00	5.05	1420.16	0.16	0 12:11	0 00:00	0.00	0.00
7	Jun-01 - A2 Channel Start	0.00	0.00	1329.00	0.00	0.00	21.00	1329.00	0.00	0 23:20	0 00:00	0.00	0.00
8	Jun-16	6.68	0.00	1348.74	0.74	0.00	3.26	1348.12	0.12	0 12:05	0 00:00	0.00	0.00
9	Jun-19	7.50	0.78	1346.82	0.82	0.00	23.18	1346.09	0.09	0 12:05	0 00:00	0.00	0.00
10	Jun-20	7.44	0.00	1340.82	0.82	0.00	19.18	1340.09	0.09	0 12:07	0 00:00	0.00	0.00
11	Jun-22	4.27	0.00	1367.84	0.44	0.00	22.16	1367.44	0.04	0 12:02	0 00:00	0.00	0.00
12	Jun-23	5.15	0.93	1357.31	0.61	0.00	32.69	1356.76	0.06	0 12:02	0 00:00	0.00	0.00
13	Jun-26	2.18	0.00	1318.25	0.25	0.00	11.75	1318.11	0.11	0 16:22	0 00:00	0.00	0.00
14	Jun-30	12.78	0.00	1334.17	1.17	0.00	5.83	1333.18	0.18	0 12:03	0 00:00	0.00	0.00
15	Jun-33	9.39	9.39	1455.95	0.95	0.00	3.05	1455.16	0.16	0 12:10	0 00:00	0.00	0.00
16	Jun-34	0.00	0.00	1475.00	0.00	0.00	4.00	1475.00	0.00	0 00:00	0 00:00	0.00	0.00
17	Jun-39	6.82	6.82	1464.70	0.70	0.00	3.30	1464.12	0.12	0 12:10	0 00:00	0.00	0.00
18	Jun-40	5.28	5.28	1465.67	0.67	0.00	3.33	1465.11	0.11	0 12:05	0 00:00	0.00	0.00
19	Jun-44	4.39	4.39	1398.44	0.44	0.00	5.56	1398.04	0.04	0 12:00	0 00:00	0.00	0.00
20	Jun-45	3.48	0.00	1341.34	0.84	0.00	3.16	1340.63	0.13	0 12:05	0 00:00	0.00	0.00
21	Jun-46	5.94	5.94	1398.52	0.52	0.00	3.48	1398.05	0.05	0 12:05	0 00:00	0.00	0.00
22	Jun-47	5.89	0.00	1394.14	0.64	0.00	3.36	1393.57	0.07	0 12:05	0 00:00	0.00	0.00
23	Jun-48	5.91	0.00	1392.07	0.67	0.00	3.33	1391.47	0.07	0 12:06	0 00:00	0.00	0.00
24	Jun-49	50.38	0.00	1340.99	1.49	0.00	2.51	1340.03	0.53	0 12:08	0 00:00	0.00	0.00
25	Jun-55	0.68	0.68	1360.28	0.28	0.00	3.72	1360.02	0.02	0 12:00	0 00:00	0.00	0.00
26	Jun-56	1.01	1.01	1367.17	0.17	0.00	3.83	1367.01	0.01	0 12:00	0 00:00	0.00	0.00
27	Jun-57	5.89	0.00	1391.67	0.67	0.00	5.33	1391.06	0.06	0 12:06	0 00:00	0.00	0.00
28	Jun-58	5.83	5.83	1341.58	1.08	0.00	2.92	1340.67	0.17	0 12:00	0 00:00	0.00	0.00
29	Jun-60	3.58	3.58	1353.75	0.75	0.00	3.25	1353.12	0.12	0 12:00	0 00:00	0.00	0.00
30	Jun-61	3.12	3.12	1353.63	0.63	0.00	3.37	1353.10	0.10	0 12:00	0 00:00	0.00	0.00
31	Jun-62	6.03	6.03	1388.83	0.83	0.00	3.17	1388.13	0.13	0 12:00	0 00:00	0.00	0.00
32	Jun-63	50.49	1.75	1355.83	1.33	0.00	2.67	1355.13	0.63	0 12:06	0 00:00	0.00	0.00
33	Jun-64	34.59	0.00	1375.85	0.85	0.00	3.15	1375.13	0.13	0 12:06	0 00:00	0.00	0.00
34	Jun-65	5.97	5.97	1422.79	0.79	0.00	3.21	1422.12	0.12	0 12:00	0 00:00	0.00	0.00
35	Jun-66	10.21	10.21	1455.98	0.98	0.00	3.02	1455.17	0.17	0 12:10	0 00:00	0.00	0.00
36	Jun-67	23.08	0.00	1418.98	0.98	0.00	3.02	1418.17	0.17	0 12:11	0 00:00	0.00	0.00
37	Jun-68	0.64	0.64	1464.34	0.34	0.00	3.66	1464.05	0.05	0 12:00	0 00:00	0.00	0.00
38	Jun-69	1.34	0.00	1455.34	0.34	0.00	3.66	1455.05	0.05	0 12:02	0 00:00	0.00	0.00
39	Jun-70	0.75	0.75	1468.33	0.33	0.00	3.67	1468.05	0.05	0 12:05	0 00:00	0.00	0.00
40	Jun-71	12.11	12.11	1465.82	0.82	0.00	6.18	1465.09	0.09	0 12:05	0 00:00	0.00	0.00
41	Jun-72	7.62	7.62	1440.86	0.86	0.00	3.14	1440.13	0.13	0 12:00	0 00:00	0.00	0.00
42	Jun-73	4.99	4.99	1415.73	0.73	0.00	3.27	1415.11	0.11	0 12:00	0 00:00	0.00	0.00
43	Jun-74	9.90	0.00	1369.73	0.73	0.00	5.27	1369.11	0.11	0 12:06	0 00:00	0.00	0.00
44	Jun-75	5.68	5.68	1388.84	0.84	0.00	3.16	1388.13	0.13	0 12:00	0 00:00	0.00	0.00
45	Jun-76	5.60	5.60	1422.81	0.81	0.00	3.19	1422.13	0.13	0 12:00	0 00:00	0.00	0.00
46	Jun-77	0.64	0.64	1465.37	0.37	0.00	3.63	1465.06	0.06	0 12:00	0 00:00	0.00	0.00
47	Jun-78	6.89	6.89	1440.75	0.75	0.00	3.25	1440.12	0.12	0 12:00	0 00:00	0.00	0.00
48	Jun-79	9.74	6.72	1339.17	1.17	0.00	4.83	1338.19	0.19	0 12:01	0 00:00	0.00	0.00
49	Jun-80	2.18	0.00	1321.00	0.50	0.00	7.50	1320.72	0.22	0 16:15	0 00:00	0.00	0.00
50	Level Spreader	0.83	0.00	1326.88	0.88	0.00	8.12	1326.74	0.74	0 19:59	0 00:00	0.00	0.00
51	NE DC Bot	31.60	0.00	1350.81	0.81	0.00	19.19	1350.07	0.07	0 12:07	0 00:00	0.00	0.00
52	NE DC Top	0.63	0.00	1460.37	0.37	0.00	19.63	1460.06	0.06	0 12:01	0 00:00	0.00	0.00
53	NE Outfall (B Basin)	6.88	6.77	1240.21	0.21	0.00	19.79	1240.04	0.04	0 12:15	0 00:00	0.00	0.00
54	NE Toe Swale	36.90	0.00	1338.39	1.59	0.00	5.61	1336.98	0.18	0 12:07	0 00:00	0.00	0.00
55	NW Outfall (A Basin)	2.18	0.00	1240.11	0.11	0.00	19.89	1240.05	0.05	0 16:25	0 00:00	0.00	0.00
56	P4 Outlet	0.83	0.00	1327.48	0.28	0.00	22.52	1327.34	0.14	0 19:59	0 00:00	0.00	0.00
57	Pond5OS	2.18	0.00	1321.50	0.50	0.00	3.50	1321.22	0.22	0 16:14	0 00:00	0.00	0.00

Channel Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1	A2a Channel	1721.32	1329.00	0.00	1240.00	0.00	89.00	5.1700	Trapezoidal	2.000	20.000	0.0500	0.5000	0.5000	0.0000	0.00	No
2	A2b Channel	146.91	1240.00	0.00	1230.00	0.00	10.00	6.8100	Trapezoidal	2.000	20.000	0.0320	0.5000	0.5000	0.0000	0.00	No
3	B Basin Outlet Channel	1070.00	1326.00	0.00	1240.00	0.00	86.00	8.0400	Trapezoidal	2.000	20.000	0.0500	0.5000	0.5000	0.0000	0.00	No
4	B1 Channel	155.26	1240.00	0.00	1230.00	0.00	10.00	6.4400	Trapezoidal	2.000	20.000	0.0320	0.5000	0.5000	0.0000	0.00	No
5	Downchute 1	18.00	1356.00	0.00	1350.00	0.00	6.00	33.3300	Trapezoidal	1.500	12.000	0.0320	0.5000	0.5000	0.0000	0.00	No
6	Downchute 2	16.77	1387.00	0.00	1381.00	0.00	6.00	35.7800	Trapezoidal	1.500	12.000	0.0320	0.5000	0.5000	0.0000	0.00	No
7	Downchute 3	33.00	1420.00	0.00	1408.00	0.00	12.00	36.3600	Trapezoidal	1.500	12.000	0.0320	0.5000	0.5000	0.0000	0.00	No
8	Downchute 4	120.00	1460.00	0.00	1420.00	0.00	40.00	33.3300	Trapezoidal	1.500	12.000	0.0320	0.5000	0.5000	0.0000	0.00	No
9	Eastern Swale 1	512.57	1346.00	0.00	1340.00	0.00	6.00	1.1700	Trapezoidal	6.000	31.000	0.0320	0.5000	0.5000	0.0000	0.00	No
10	Eastern Swale 2	512.57	1356.70	0.00	1346.00	0.00	10.70	2.0900	Trapezoidal	6.000	31.000	0.0320	0.5000	0.5000	0.0000	0.00	No
11	Link-100	1050.04	1422.00	0.00	1387.00	0.00	35.00	3.3300	Triangular	1.500	6.000	0.0320	0.5000	0.5000	0.0000	0.00	No
12	Link-101	175.63	1465.00	0.00	1460.00	0.00	5.00	2.8500	Triangular	1.500	6.000	0.0320	0.5000	0.5000	0.0000	0.00	No
13	Link-102	879.72	1455.00	0.00	1420.00	0.00	35.00	3.9800	Triangular	1.500	6.000	0.0320	0.5000	0.5000	0.0000	0.00	No
14	Link-103	1054.30	1465.00	0.00	1381.00	0.00	84.00	7.9700	Triangular	1.500	6.000	0.0320	0.5000	0.5000	0.0000	0.00	No
15	Link-104	1232.26	1440.00	0.00	1348.00	0.00	92.00	7.4700	Triangular	1.500	6.000	0.0320	0.5000	0.5000	0.0000	0.00	No
16	Link-105	363.81	1338.00	0.00	1333.00	0.00	5.00	1.3700	Triangular	1.500	6.000	0.0320	0.5000	0.5000	0.0000	0.00	No
17	Link-46	77.25	1381.00	0.00	1356.00	0.00	25.00	32.3600	Trapezoidal	1.500	12.000	0.0320	0.5000	0.5000	0.0000	0.00	No
18	Link-48	65.04	1408.00	0.00	1387.00	0.00	21.00	32.2900	Trapezoidal	1.500	12.000	0.0320	0.5000	0.5000	0.0000	0.00	No
19	Link-49	529.28	1464.00	0.00	1408.00	0.00	56.00	10.5800	Triangular	1.500	6.000	0.0320	0.5000	0.5000	0.0000	0.00	No
20	Link-52	535.45	1398.00	0.00	1367.40	0.00	30.60	5.7100	Trapezoidal	6.000	31.000	0.0320	0.5000	0.5000	0.0000	0.00	No
21	Link-57	174.79	1398.00	0.00	1393.50	0.00	4.50	2.5700	Trapezoidal	2.000	10.000	0.0320	0.5000	0.5000	0.0000	0.00	No
22	Link-59	41.95	1391.40	0.00	1391.00	0.00	0.40	0.9500	Trapezoidal	2.000	10.000	0.0320	0.5000	0.5000	0.0000	0.00	No
23	Link-66	209.08	1360.00	0.00	1359.30	11.60	0.70	0.3300	Trapezoidal	2.000	10.000	0.0320	0.5000	0.5000	0.0000	0.00	No
24	Link-67	205.23	1367.00	0.00	1359.30	11.60	7.70	3.7500	Trapezoidal	2.000	10.000	0.0320	0.5000	0.5000	0.0000	0.00	No
25	Link-68	1004.88	1391.00	0.00	1369.00	0.00	22.00	2.1900	Trapezoidal	2.000	10.000	0.0320	0.5000	0.5000	0.0000	0.00	No
26	Link-71	699.64	1340.50	0.00	1333.00	0.00	7.50	1.0700	Triangular	1.500	6.000	0.0320	0.5000	0.5000	0.0000	0.00	No
27	Link-72	489.39	1340.50	0.00	1336.80	0.00	3.70	0.7600	Triangular	1.500	6.000	0.0320	0.5000	0.5000	0.0000	0.00	No
28	Link-77	614.48	1353.00	0.00	1340.50	0.00	12.50	2.0300	Triangular	1.500	6.000	0.0320	0.5000	0.5000	0.0000	0.00	No
29	Link-79	382.14	1353.00	0.00	1338.00	0.00	15.00	3.9300	Triangular	1.500	6.000	0.0320	0.5000	0.5000	0.0000	0.00	No
30	Link-81	161.13	1358.00	5.00	1354.50	0.00	3.50	2.1700	Trapezoidal	2.000	11.500	0.0320	0.5000	0.5000	0.0000	0.00	No
31	Link-83	489.80	1354.50	0.00	1339.50	0.00	15.00	3.0600	Trapezoidal	2.000	11.500	0.0320	0.5000	0.5000	0.0000	0.00	No
32	Link-84	1016.99	1388.00	0.00	1355.00	0.50	33.00	3.2400	Triangular	1.500	6.000	0.0320	0.5000	0.5000	0.0000	0.00	No
33	Link-85	1103.49	1422.00	0.00	1375.00	0.00	47.00	4.2600	Triangular	1.500	6.000	0.0320	0.5000	0.5000	0.0000	0.00	No
34	Link-86	935.29	1455.00	0.00	1418.00	0.00	37.00	3.9600	Triangular	1.500	6.000	0.0320	0.5000	0.5000	0.0000	0.00	No
35	Link-89	224.51	1464.00	0.00	1455.00	0.00	9.00	4.0100	Triangular	1.500	6.000	0.0320	0.5000	0.5000	0.0000	0.00	No
36	Link-90	168.03	1455.00	0.00	1418.00	0.00	37.00	22.0200	Trapezoidal	1.500	12.000	0.0320	0.5000	0.5000	0.0000	0.00	No
37	Link-91	160.93	1418.00	0.00	1375.00	0.00	43.00	26.7200	Trapezoidal	1.500	12.000	0.0320	0.5000	0.5000	0.0000	0.00	No
38	Link-92	63.92	1375.00	0.00	1358.00	5.00	17.00	26.6000	Trapezoidal	1.500	12.000	0.0320	0.5000	0.5000	0.0000	0.00	No
39	Link-93	189.99	1468.00	0.00	1455.00	0.00	13.00	6.8400	Triangular	1.500	6.000	0.0320	0.5000	0.5000	0.0000	0.00	No
40	Link-95	1153.79	1465.00	0.00	1418.00	0.00	47.00	4.0700	Trapezoidal	1.500	7.000	0.0320	0.5000	0.5000	0.0000	0.00	No
41	Link-96	1432.79	1440.00	0.00	1375.00	0.00	65.00	4.5400	Triangular	1.500	6.000	0.0320	0.5000	0.5000	0.0000	0.00	No
42	Link-97	517.64	1369.00	0.00	1358.00	5.00	11.00	2.1300	Trapezoidal	2.000	10.000	0.0320	0.5000	0.5000	0.0000	0.00	No
43	Link-98	1049.76	1415.00	0.00	1369.00	0.00	46.00	4.3800	Triangular	1.500	6.000	0.0320	0.5000	0.5000	0.0000	0.00	No
44	Link-99	1183.31	1388.00	0.00	1356.00	0.00	32.00	2.7000	Triangular	1.500	6.000	0.0320	0.5000	0.5000	0.0000	0.00	No
45	NE Toe Swale	230.00	1350.00	0.00	1336.80	0.00	13.20	5.7400	Trapezoidal	2.500	9.000	0.0320	0.5000	0.5000	0.0000	0.00	No
46	NW Treatment Swale1	662.50	1318.00	0.00	1240.00	0.00	78.00	11.7700	Trapezoidal	2.000	20.000	0.0500	0.5000	0.5000	0.0000	0.00	No
47	NW Treatment Swale2	490.00	1320.50	0.00	1318.00	0.00	2.50	0.5100	User-Defined	2.000	22.000	0.0600	0.5000	0.5000	0.0000	0.00	No
48	Outfall North Channel	252.20	1230.00	0.00	1214.00	0.00	16.00	6.3400	Trapezoidal	2.000	20.000	0.0320	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	A2a Channel	0.00	1 00:00	231.82	0.00	0.00		0.00	0.00	0.00		
2	A2b Channel	2.18	0 16:26	415.60	0.01	2.57	0.95	0.10	0.05	0.00		
3	B Basin Outlet Channel	0.83	0 20:07	289.02	0.00	1.42	12.56	0.07	0.04	0.00		
4	B1 Channel	6.85	0 12:15	404.27	0.02	3.90	0.66	0.20	0.10	0.00		
5	Downchute 1	31.60	0 12:07	281.36	0.11	13.80	0.02	0.49	0.34	0.00		
6	Downchute 2	21.12	0 12:07	291.49	0.07	12.56	0.02	0.39	0.27	0.00		
7	Downchute 3	9.66	0 12:11	293.87	0.03	9.91	0.06	0.26	0.17	0.00		
8	Downchute 4	0.63	0 12:02	281.36	0.00	3.68	0.54	0.05	0.04	0.00		
9	Eastern Swale 1	7.44	0 12:07	976.78	0.01	3.13	2.73	0.81	0.14	0.00		
10	Eastern Swale 2	5.10	0 12:06	1304.40	0.00	3.54	2.41	0.60	0.10	0.00		
11	Link-100	5.44	0 12:06	29.24	0.19	4.76	3.68	0.79	0.53	0.00		
12	Link-101	0.63	0 12:01	27.02	0.02	2.38	1.23	0.36	0.24	0.00		
13	Link-102	9.34	0 12:11	31.94	0.29	5.37	2.73	0.94	0.63	0.00		
14	Link-103	5.10	0 12:07	45.20	0.11	6.09	2.89	0.65	0.44	0.00		
15	Link-104	6.68	0 12:05	43.76	0.15	6.58	3.12	0.73	0.49	0.00		
16	Link-105	9.69	0 12:03	18.77	0.52	3.64	1.67	1.17	0.78	0.00		
17	Link-46	26.22	0 12:07	277.23	0.09	12.93	0.10	0.46	0.31	0.00		
18	Link-48	16.44	0 12:10	276.91	0.06	11.23	0.10	0.36	0.24	0.00		
19	Link-49	6.84	0 12:10	52.09	0.13	7.08	1.25	0.70	0.47	0.00		
20	Link-52	4.27	0 12:02	2158.23	0.00	4.80	1.86	0.43	0.07	0.00		
21	Link-57	5.89	0 12:05	95.07	0.06	3.79	0.77	0.51	0.26	0.00		
22	Link-59	5.89	0 12:06	57.86	0.10	2.65	0.26	0.65	0.33	0.00		
23	Link-66	0.67	0 12:05	34.29	0.02	1.02	3.42	0.27	0.13	0.00		
24	Link-67	1.00	0 12:01	114.77	0.01	2.51	1.36	0.17	0.09	0.00		
25	Link-68	5.71	0 12:12	87.67	0.07	3.80	4.41	0.52	0.26	0.00		
26	Link-71	3.41	0 12:08	16.58	0.21	2.77	4.21	0.81	0.55	0.00		
27	Link-72	5.64	0 12:05	13.92	0.40	2.66	3.07	1.06	0.71	0.00		
28	Link-77	3.48	0 12:05	22.84	0.15	3.42	2.99	0.73	0.49	0.00		
29	Link-79	3.06	0 12:02	31.73	0.10	4.03	1.58	0.61	0.42	0.00		
30	Link-81	44.01	0 12:08	116.28	0.38	5.98	0.45	1.22	0.62	0.00		
31	Link-83	50.38	0 12:08	138.06	0.36	7.06	1.16	1.20	0.61	0.00		
32	Link-84	5.91	0 12:06	28.85	0.20	4.80	3.53	0.82	0.55	0.00		
33	Link-85	5.80	0 12:06	33.05	0.18	5.27	3.49	0.77	0.52	0.00		
34	Link-86	10.10	0 12:11	31.85	0.32	5.47	2.85	0.97	0.65	0.00		
35	Link-89	0.62	0 12:02	32.06	0.02	2.72	1.38	0.34	0.23	0.00		
36	Link-90	1.33	0 12:06	228.68	0.01	4.29	0.65	0.09	0.06	0.00		
37	Link-91	23.10	0 12:11	251.91	0.09	11.64	0.23	0.45	0.30	0.00		
38	Link-92	34.59	0 12:07	251.32	0.14	13.07	0.08	0.55	0.38	0.00		
39	Link-93	0.74	0 12:05	41.89	0.02	3.41	0.93	0.33	0.22	0.00		
40	Link-95	12.03	0 12:10	47.59	0.25	5.87	3.28	0.81	0.54	0.00		
41	Link-96	7.39	0 12:06	34.11	0.22	5.91	4.04	0.84	0.56	0.00		
42	Link-97	9.80	0 12:09	86.38	0.11	4.14	2.08	0.70	0.35	0.00		
43	Link-98	4.92	0 12:06	33.52	0.15	5.11	3.42	0.72	0.48	0.00		
44	Link-99	5.49	0 12:06	26.33	0.21	4.58	4.31	0.82	0.55	0.00		
45	NE Toe Swale	31.59	0 12:07	233.48	0.14	8.09	0.47	0.79	0.32	0.00		
46	NW Treatment Swale1	2.18	0 16:25	349.81	0.01	2.31	4.78	0.11	0.06	0.00		
47	NW Treatment Swale2	2.18	0 16:22	78.37	0.03	0.68	12.01	0.25	0.13	0.00		
48	Outfall North Channel	9.51	0 12:20	401.22	0.02	4.37	0.96	0.25	0.12	0.00		

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1	18 CPP P4	199.00	1348.00	0.00	1343.00	16.00	5.00	2.5100	CIRCULAR	18.000	18.000	0.0150	0.5000	0.5000	0.0000	0.00	No
2	18 CPP P4a	81.00	1340.00	0.00	1337.00	10.00	3.00	3.7000	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No
3	18 CPP P5	45.00	1333.00	0.00	1327.00	5.00	6.00	13.3300	CIRCULAR	18.000	18.000	0.0150	0.5000	0.5000	0.0000	0.00	No
4	24 CPP ES	62.00	1367.40	0.00	1356.70	0.00	10.70	17.2600	CIRCULAR	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No
5	36 CPP ES	42.55	1347.70	0.00	1346.00	0.00	1.70	4.0000	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No
6	36 CPP P4	140.00	1336.80	0.00	1335.60	8.60	1.20	0.8600	CIRCULAR	36.000	36.000	0.0120	0.5000	0.5000	0.0000	0.00	No
7	Link-113	125.00	1339.90	0.40	1328.00	6.00	11.90	9.5200	CIRCULAR	36.000	36.000	0.0150	0.5000	0.5000	0.0000	0.00	No
8	Link-58	111.61	1393.50	0.00	1391.40	0.00	2.10	1.8800	CIRCULAR	24.000	24.000	0.0150	0.5000	0.5000	0.0000	0.00	No
9	P4 Out 24 CPP	62.00	1327.20	0.00	1326.60	0.60	0.60	0.9700	CIRCULAR	24.000	24.000	0.0150	0.5000	0.5000	0.0000	0.00	No
10	P5_OrificeOutlet	100.00	1321.00	0.00	1320.00	-0.50	1.00	1.0000	CIRCULAR	30.000	30.000	0.0150	0.5000	0.5000	0.0000	0.00	No
11	P6_P5_36CPP	200.00	1323.00	1.00	1321.00	1.00	2.00	1.0000	CIRCULAR	36.000	36.000	0.0150	0.5000	0.5000	0.0000	0.00	No

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	18 CPP P4	6.66	0 12:06	14.43	0.46	8.01	0.41	0.71	0.48	0.00		Calculated
2	18 CPP P4a	7.43	0 12:07	21.90	0.34	11.19	0.12	0.59	0.40	0.00		Calculated
3	18 CPP P5	12.76	0 12:06	33.24	0.38	17.57	0.04	0.64	0.43	0.00		Calculated
4	24 CPP ES	4.27	0 12:02	101.81	0.04	16.09	0.06	0.27	0.14	0.00		Calculated
5	36 CPP ES	1.64	0 12:03	22.75	0.07	7.50	0.09	0.27	0.18	0.00		Calculated
6	36 CPP P4	36.88	0 12:07	66.90	0.55	9.69	0.24	1.53	0.53	0.00		Calculated
7	Link-113	50.40	0 12:09	178.36	0.28	21.70	0.10	1.08	0.36	0.00		Calculated
8	Link-58	5.91	0 12:06	26.89	0.22	6.87	0.27	0.62	0.32	0.00		Calculated
9	P4 Out 24 CPP	0.83	0 19:59	19.29	0.04	3.07	0.34	0.28	0.14	0.00		Calculated
10	P5_OrificeOutlet	2.18	0 16:15	25.14	0.09	3.14	0.53	0.50	0.20	0.00		Calculated
11	P6_P5_36CPP	12.21	0 12:33	57.81	0.21	6.48	0.51	0.93	0.31	0.00		Calculated

Inlet Input

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Inlet Depth (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Ponded Area (ft²)	Grate Clogging Factor (%)
1	Inlet-03	NEENAH FOUNDRY	R-3550-2	On Sag	1	1347.70	1359.30	11.60	1347.70	0.00	10.00	0.00
2	Inlet-09	NEENAH FOUNDRY	R-3550-2	On Sag	1	0.00	6.00	6.00	0.00	0.00	10.00	0.00

Roadway & Gutter Input

SN	Element ID	Roadway Longitudinal Slope (ft/ft)	Roadway Cross Slope (ft/ft)	Roadway Manning's Roughness	Gutter Cross Slope (ft/ft)	Gutter Width (ft)	Gutter Depression (in)	Allowable Spread (ft)
1	Inlet-03	N/A	0.0200	0.0160	0.0620	2.00	0.0656	7.00
2	Inlet-09	N/A	0.0200	0.0160	0.0620	2.00	0.0657	7.00

Inlet Results

SN	Element ID	Peak Flow (cfs)	Peak Lateral Inflow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)	Max Gutter Water Depth during Peak Flow (ft)	Time of Max Depth Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Inlet-03	0.00	0.00	N/A	N/A	N/A	0.00	1359.30	0.00	0 00:00	0.00	0.00
2	Inlet-09	0.00	0.00	N/A	N/A	N/A	0.00	6.00	0.00	0 00:00	0.00	0.00

Storage Nodes

Storage Node : Jun-51

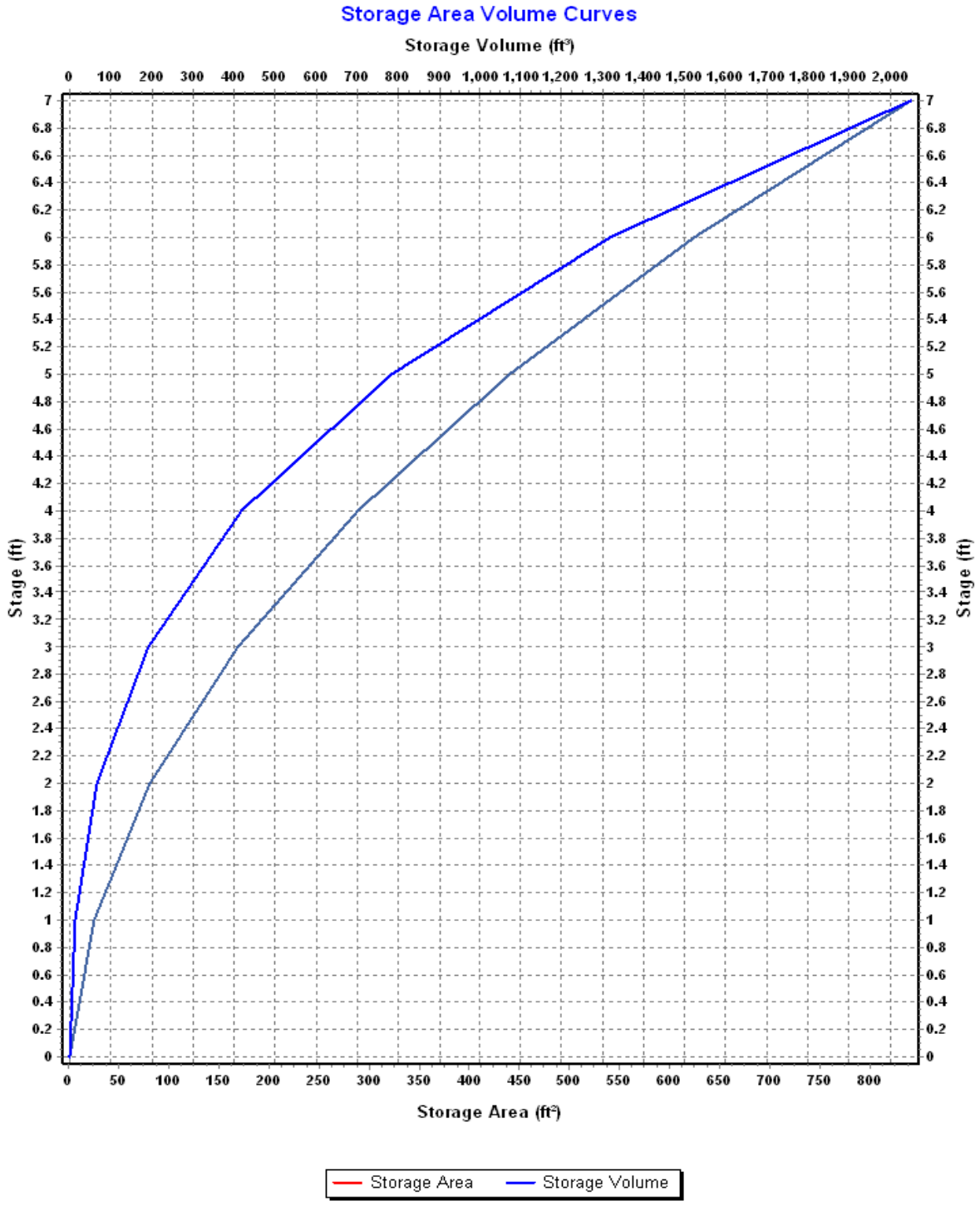
Input Data

Invert Elevation (ft)	1353.00
Max (Rim) Elevation (ft)	1362.00
Max (Rim) Offset (ft)	9.00
Initial Water Elevation (ft)	1353.00
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : SW Plunge Pool

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	1	0.000
1	25	13.00
2	81	66.00
3	169	191.00
4	289	420.00
5	441	785.00
6	625	1318.00
7	841	2051.00


Storage Area Volume Curves
Storage Volume (ft³)
0 100 200 300 400 500 600 700 800 900 1,000 1,100 1,200 1,300 1,400 1,500 1,600 1,700 1,800 1,900 2,000
Stage (ft)
0 0.2 0.4 0.6 0.8 1 1.2 1.4 1.6 1.8 2 2.2 2.4 2.6 2.8 3 3.2 3.4 3.6 3.8 4 4.2 4.4 4.6 4.8 5 5.2 5.4 5.6 5.8 6 6.2 6.4 6.6 6.8 7
0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800
Storage Area (ft²)
Storage Area
Storage Volume

Storage Node : Jun-51 (continued)

Output Summary Results

Peak Inflow (cfs)	44.09
Peak Lateral Inflow (cfs)	0.00
Peak Outflow (cfs)	44.02
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	1359.23
Max HGL Depth Attained (ft)	6.23
Average HGL Elevation Attained (ft)	1355.90
Average HGL Depth Attained (ft)	2.9
Time of Max HGL Occurrence (days hh:mm)	0 12:08
Total Exfiltration Volume (1000-ft³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Storage Node : Pond 4

Input Data

Invert Elevation (ft) 1327.00
Max (Rim) Elevation (ft) 1337.00
Max (Rim) Offset (ft) 10.00
Initial Water Elevation (ft) 0.00
Initial Water Depth (ft) ..... -1327.00
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

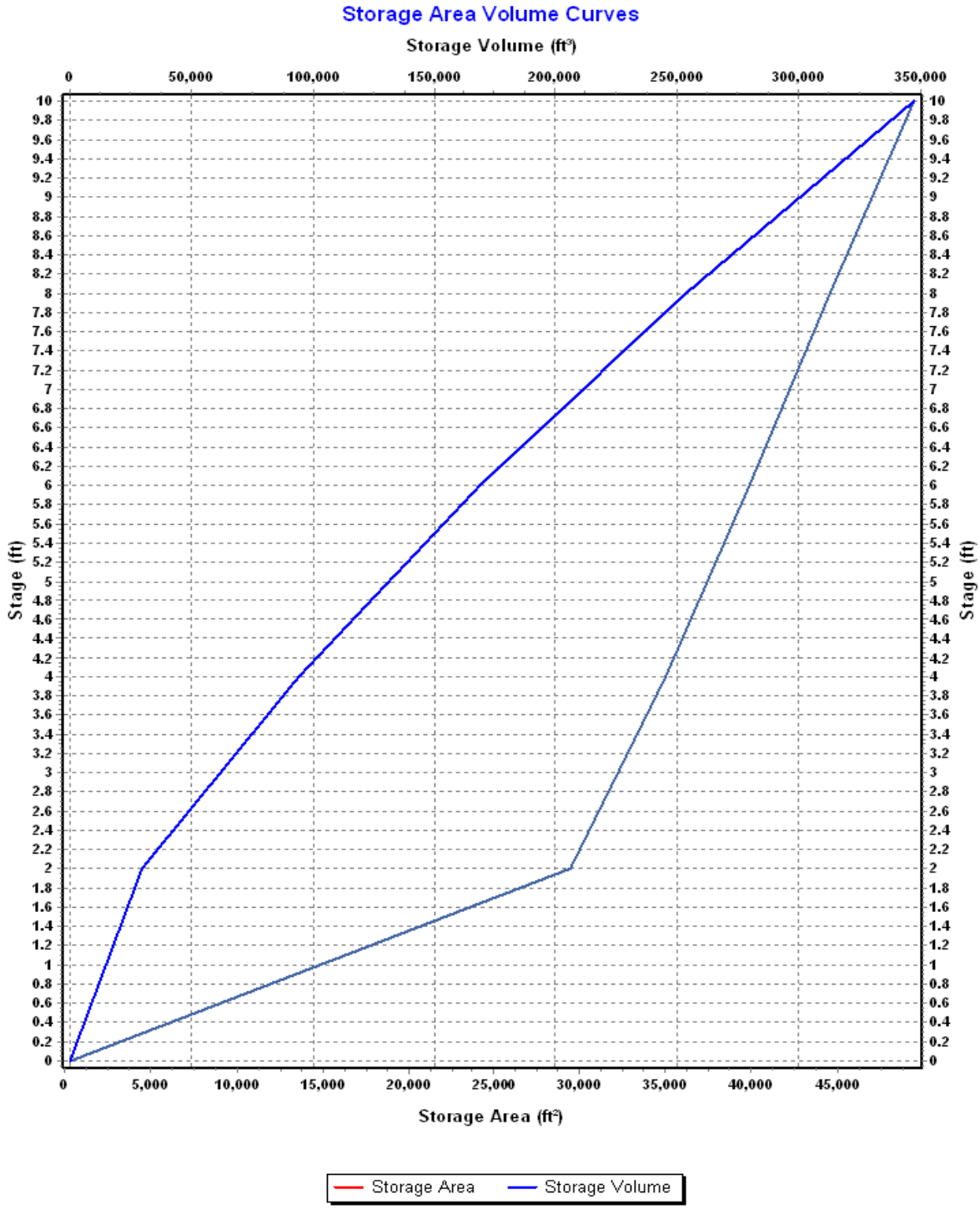
Infiltration/Exfiltration

Exfiltration Rate (in/hr) 0.3000

Storage Area Volume Curves

Storage Curve : Pond 4 - Proposed

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	300	0.000
2	29450	29750.00
4	34965	94165.00
6	39857	168987.00
8	44578	253422.00
10	49464	347464.00


Storage Area Volume Curves
Storage Volume (ft³)
0
50,000
100,000
150,000
200,000
250,000
300,000
350,000
Stage (ft)
Storage Area (ft²)
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000
40,000
45,000
Storage Area
Storage Volume

Storage Node : Pond 4 (continued)

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Emergency Overflow	Trapezoidal	No	1335.00	8.00	90.00	1.00	3.33

Outflow Orifices

SN	Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	01.2	Side	CIRCULAR	No	1.50			1328.00	0.61
2	O1.1	Side	CIRCULAR	No	1.50			1328.00	0.61
3	O1.3	Side	CIRCULAR	No	1.50			1328.00	0.61
4	O2.1	Side	CIRCULAR	No	1.50			1329.00	0.61
5	O2.2	Side	CIRCULAR	No	1.50			1329.00	0.61
6	O2.3	Side	CIRCULAR	No	1.50			1329.00	0.61
7	O3.1	Side	CIRCULAR	No	1.50			1330.00	0.61
8	O3.2	Side	CIRCULAR	No	1.50			1330.00	0.61
9	O3.3	Side	CIRCULAR	No	1.50			1330.00	0.61
10	Outlet Grate	Bottom	Rectangular	No		9.00	9.00	1333.00	0.63

Output Summary Results

Peak Inflow (cfs)	53.77
Peak Lateral Inflow (cfs)	3.19
Peak Outflow (cfs)	0.83
Peak Exfiltration Flow Rate (cfm)	15.04
Max HGL Elevation Attained (ft)	1331.44
Max HGL Depth Attained (ft)	4.44
Average HGL Elevation Attained (ft)	1329.14
Average HGL Depth Attained (ft)	2.14
Time of Max HGL Occurrence (days hh:mm)	0 19:59
Total Exfiltration Volume (1000-ft³)	10.933
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Storage Node : Pond 5FB

Input Data

Invert Elevation (ft) 1322.00
Max (Rim) Elevation (ft) 1332.00
Max (Rim) Offset (ft) 10.00
Initial Water Elevation (ft) 0.00
Initial Water Depth (ft) ..... -1322.00
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

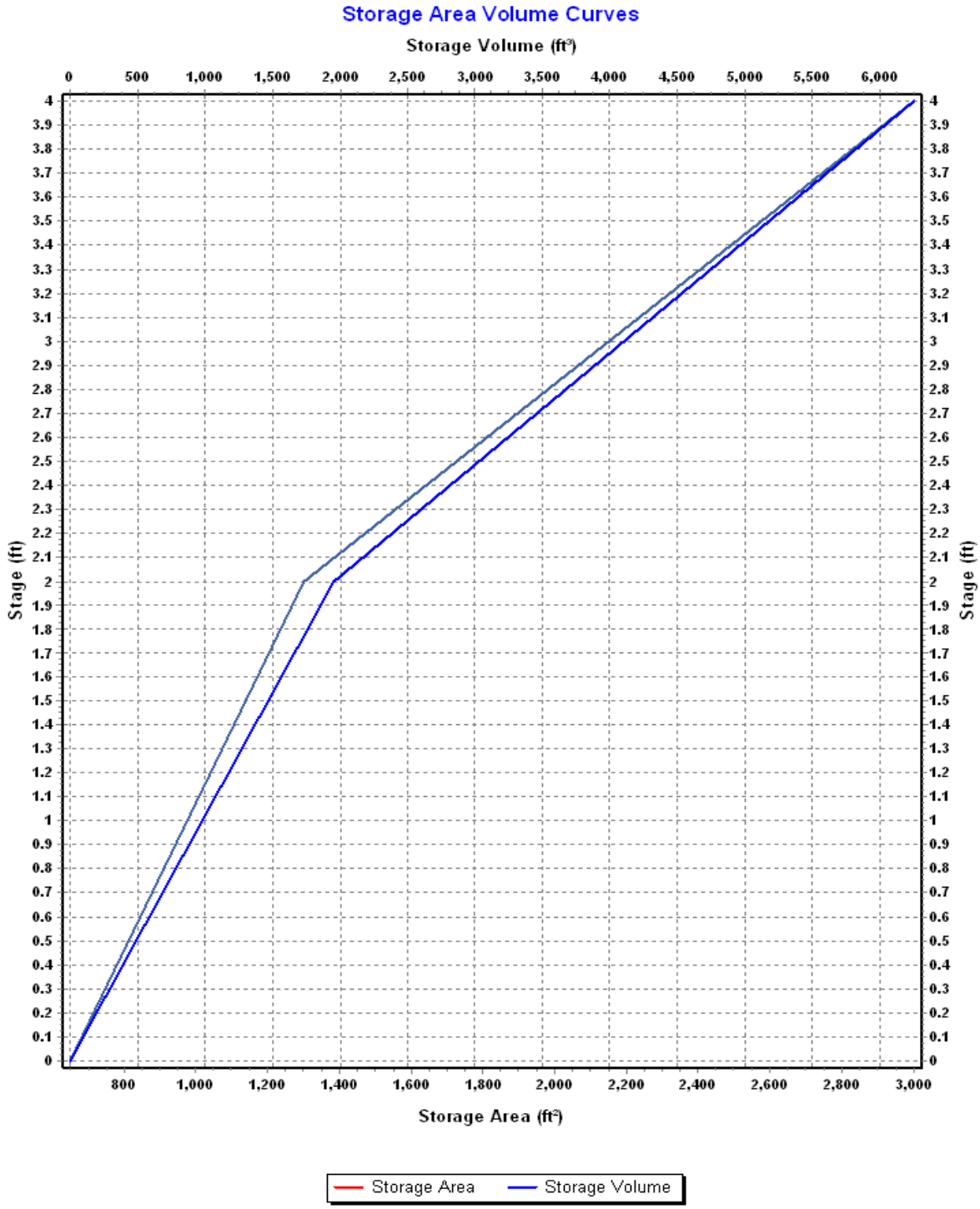
Infiltration/Exfiltration

Exfiltration Rate (in/hr) 0.3000

Storage Area Volume Curves

Storage Curve : Pond 5 FB

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	650	0.000
2	1300	1950.00
4	3000	6250.00


Storage Area Volume Curves
Storage Volume (ft³)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
5,000
5,500
6,000
Stage (ft)
4
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
800
1,000
1,200
1,400
1,600
1,800
2,000
2,200
2,400
2,600
2,800
3,000
Storage Area (ft²)
Storage Area
Storage Volume

Storage Node : Pond 5FB (continued)

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Pond5Berm	Trapezoidal	No	1326.00	4.00	110.00	2.00	3.33

Output Summary Results

Peak Inflow (cfs)	12.76
Peak Lateral Inflow (cfs)	0.00
Peak Outflow (cfs)	12.76
Peak Exfiltration Flow Rate (cfm)	1.32
Max HGL Elevation Attained (ft)	1326.11
Max HGL Depth Attained (ft)	4.11
Average HGL Elevation Attained (ft)	1324.04
Average HGL Depth Attained (ft)	2.04
Time of Max HGL Occurrence (days hh:mm)	0 12:06
Total Exfiltration Volume (1000-ft³)	0.966
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Storage Node : Pond5

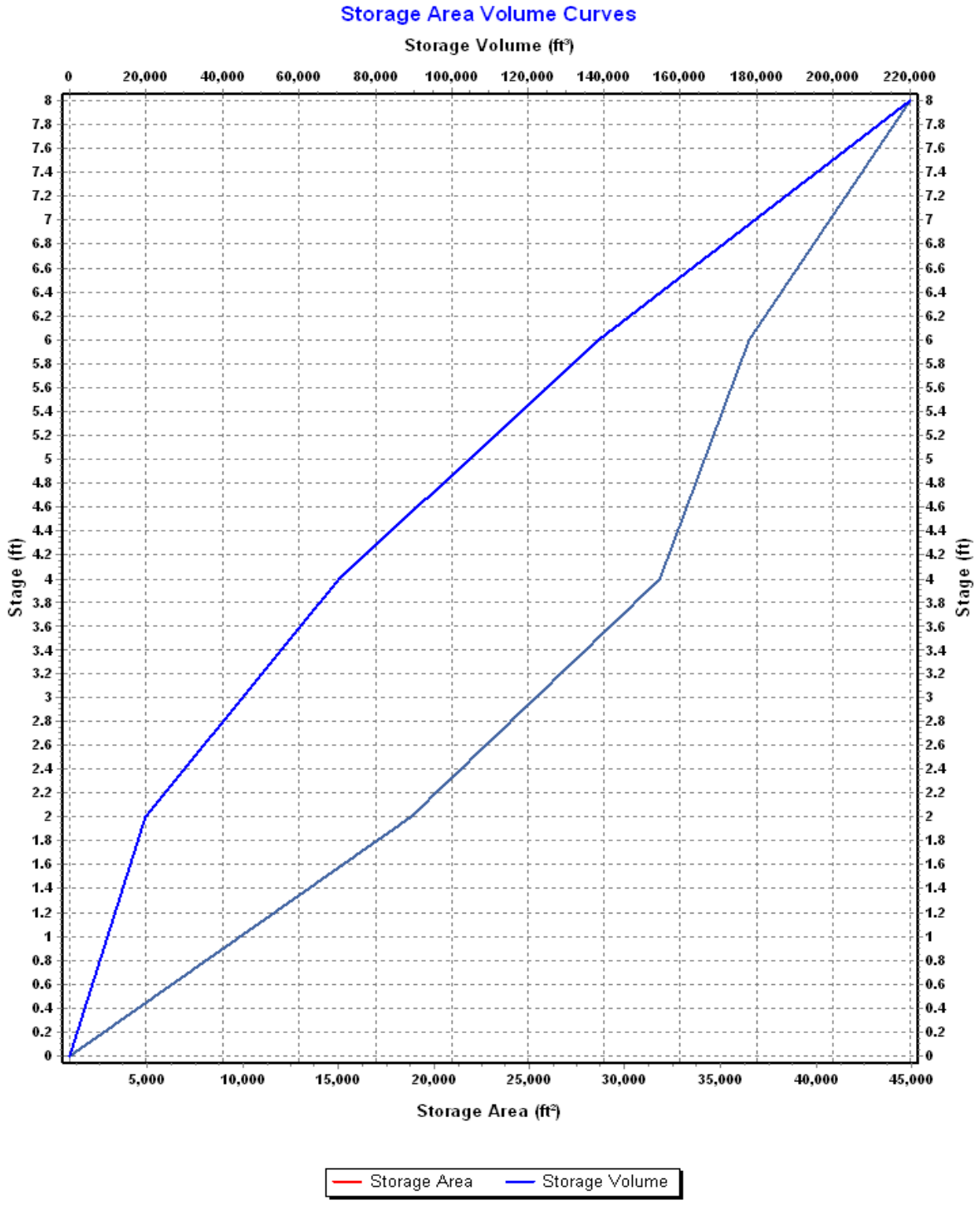
Input Data

Invert Elevation (ft) 1320.00
Max (Rim) Elevation (ft) 1330.00
Max (Rim) Offset (ft) 10.00
Initial Water Elevation (ft) 0.00
Initial Water Depth (ft) ..... -1320.00
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : Pond 5

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	980	0.000
2	18800	19780.00
4	31800	70380.00
6	36500	138680.00
8	44900	220080.00


Storage Area Volume Curves
Storage Volume (ft³)
0
20,000
40,000
60,000
80,000
100,000
120,000
140,000
160,000
180,000
200,000
220,000
Stage (ft)
8
7.8
7.6
7.4
7.2
7
6.8
6.6
6.4
6.2
6
5.8
5.6
5.4
5.2
5
4.8
4.6
4.4
4.2
4
3.8
3.6
3.4
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000
40,000
45,000
Storage Area (ft²)
Storage Area
Storage Volume

Storage Node : Pond5 (continued)

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	P5Overflow	Trapezoidal	No	1327.00	7.00	12.00	1.00	3.33

Outflow Orifices

SN	Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	P5Grate	Bottom	Rectangular	No		48.00	48.00	1326.00	0.63
2	Pond5O3	Side	Rectangular	No		30.00	2.00	1321.00	0.63

Output Summary Results

Peak Inflow (cfs)	14.12
Peak Lateral Inflow (cfs)	0.00
Peak Outflow (cfs)	2.18
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	1323.38
Max HGL Depth Attained (ft)	3.38
Average HGL Elevation Attained (ft)	1321.51
Average HGL Depth Attained (ft)	1.51
Time of Max HGL Occurrence (days hh:mm)	0 16:14
Total Exfiltration Volume (1000-ft³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Storage Node : Pond6

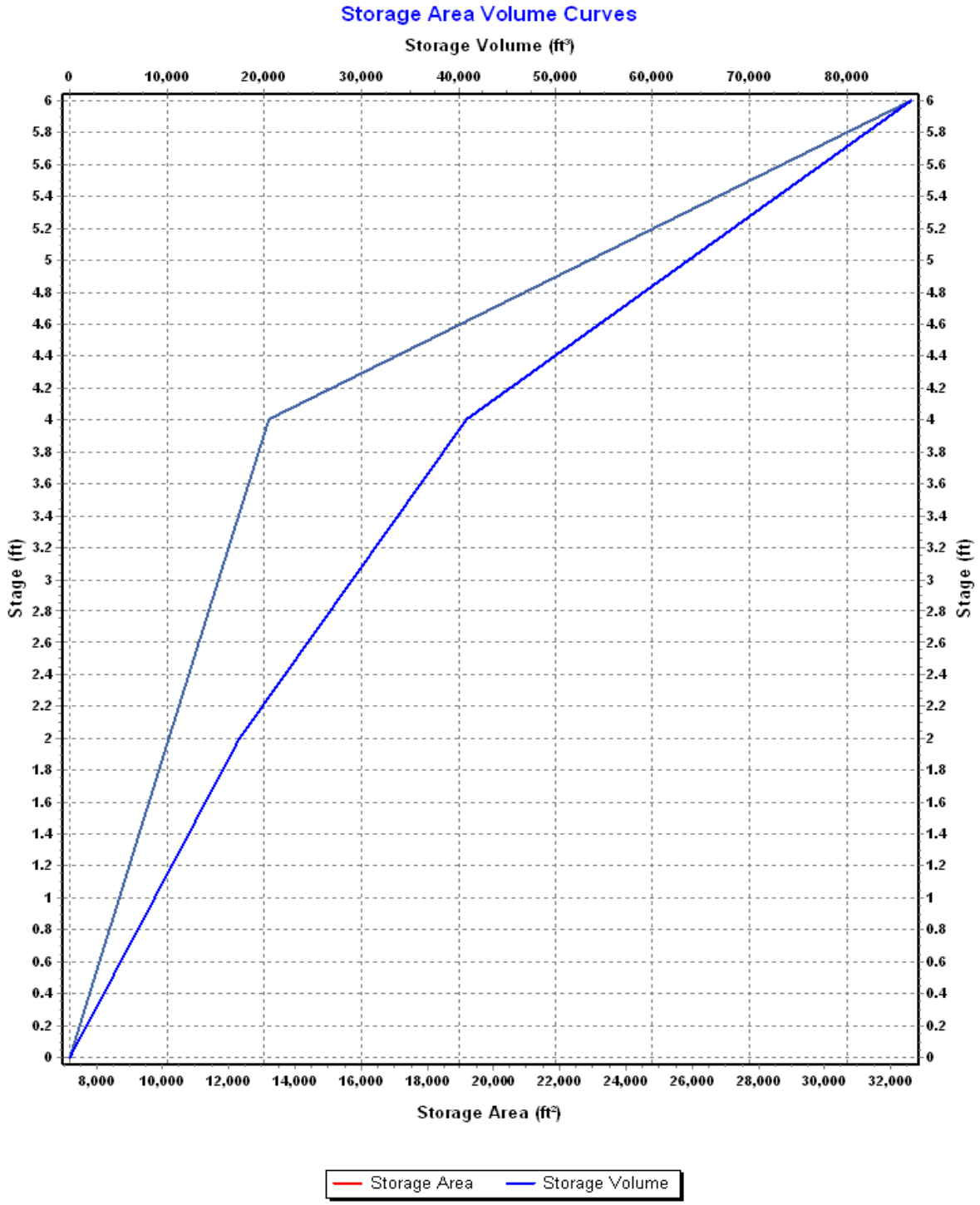
Input Data

Invert Elevation (ft) 1322.00
Max (Rim) Elevation (ft) 1330.00
Max (Rim) Offset (ft) 8.00
Initial Water Elevation (ft) 0.00
Initial Water Depth (ft) ..... -1322.00
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : Pond 6

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	7200	0.000
2	10200	17400.00
4	13200	40800.00
6	32600	86600.00


Storage Area Volume Curves
Storage Volume (ft³)
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
80,000
Stage (ft)
6
5.8
5.6
5.4
5.2
5
4.8
4.6
4.4
4.2
4
3.8
3.6
3.4
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
8,000
10,000
12,000
14,000
16,000
18,000
20,000
22,000
24,000
26,000
28,000
30,000
32,000
Storage Area (ft²)
Storage Area
Storage Volume

Storage Node : Pond6 (continued)

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	P6Overflow	Trapezoidal	No	1327.25	5.25	10.00	1.00	3.33

Output Summary Results

Peak Inflow (cfs)	33.99
Peak Lateral Inflow (cfs)	0.00
Peak Outflow (cfs)	12.21
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	1323.94
Max HGL Depth Attained (ft)	1.94
Average HGL Elevation Attained (ft)	1322.66
Average HGL Depth Attained (ft)	0.66
Time of Max HGL Occurrence (days hh:mm)	0 12:33
Total Exfiltration Volume (1000-ft³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Storage Node : Pond-6FB

Input Data

Invert Elevation (ft) 1322.00
Max (Rim) Elevation (ft) 1330.00
Max (Rim) Offset (ft) 8.00
Initial Water Elevation (ft) 0.00
Initial Water Depth (ft) ..... -1322.00
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

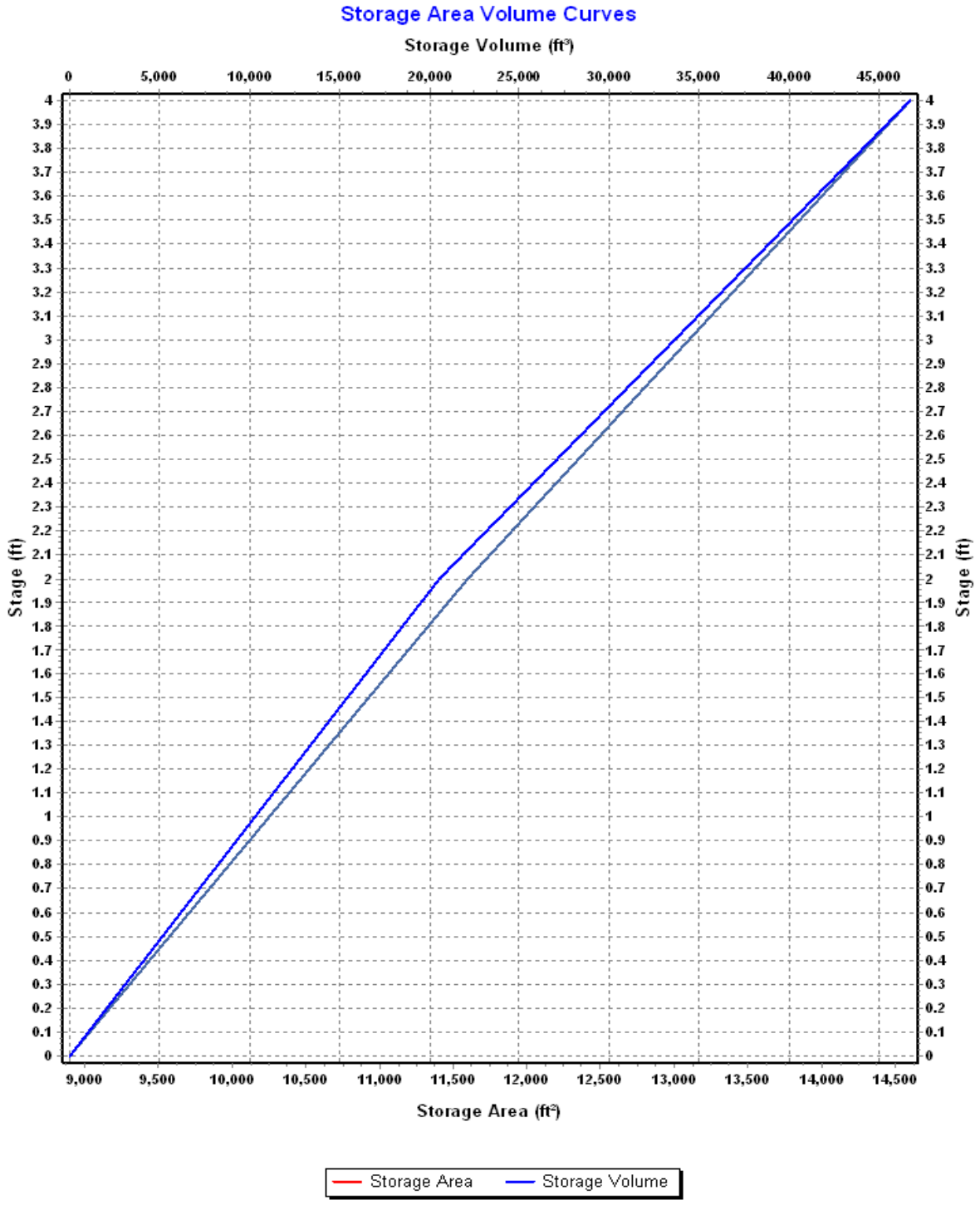
Infiltration/Exfiltration

Exfiltration Rate (in/hr) 0.3000

Storage Area Volume Curves

Storage Curve : Pond 6 FB

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	8900	0.000
2	11600	20500.00
4	14600	46700.00


Storage Area Volume Curves
Storage Volume (ft³)
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000
40,000
45,000
Stage (ft)
4
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
9,000
9,500
10,000
10,500
11,000
11,500
12,000
12,500
13,000
13,500
14,000
14,500
Storage Area (ft²)
Storage Area
Storage Volume

Storage Node : Pond-6FB (continued)

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Pond6berm	Trapezoidal	No	1326.00	4.00	150.00	2.00	3.33

Output Summary Results

Peak Inflow (cfs)	50.40
Peak Lateral Inflow (cfs)	0.00
Peak Outflow (cfs)	33.99
Peak Exfiltration Flow Rate (cfm)	6.30
Max HGL Elevation Attained (ft)	1326.17
Max HGL Depth Attained (ft)	4.17
Average HGL Elevation Attained (ft)	1324.00
Average HGL Depth Attained (ft)	2
Time of Max HGL Occurrence (days hh:mm)	0 12:17
Total Exfiltration Volume (1000-ft³)	4.631
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Stormwater Management Report

Appendix G

NH Natural Heritage Bureau Database Check

Memo

NH Natural Heritage Bureau
NHB Datacheck Results Letter

To: Adam Sandahl, CMA Engineers, Inc
35 Bow Street
Portsmouth, NH 03867

From: Melissa Coppola, NH Natural Heritage Bureau
Date: 2/4/2014 (valid for one year from this date)
Re: Review by NH Natural Heritage Bureau
NHB File ID: NHB14-0403 Town: Bethlehem Location: Tax Maps: Map 419 Lot 22
Description: This project is the 8.3 acre Stage V expansion of the NCES Landfill in Bethlehem, NH

As requested, I have searched our database for records of rare species and exemplary natural communities, with the following results.

Comments: Please send site plans that specify where the new expansion area is located. Send requested information to: melissa.coppola@dred.nh.gov

Natural Community	State[1]	Federal	Notes
Lowland spruce - fir forest	--	--	Threats are primarily logging and development.
Medium level fen system	--	--	Level fens are stagnant, and as such are characterized by low nutrient levels, relatively high acidity levels, and accumulations of peat. The primary threats to this community are changes to its hydrology (especially that which causes pooling), increased nutrient input from stormwater runoff, and sedimentation from nearby disturbance.
Red spruce swamp	--	--	Threats to this community include changes to the wetland's hydrology either through damming or increasing drainage. Significant increases in nutrients and pollutants from stormwater runoff could also have a deleterious effect on the wetland.

[1]Codes: "E" = Endangered, "T" = Threatened, "SC" = Special Concern, "--" = an exemplary natural community, or a rare species tracked by NH Natural Heritage that has not yet been added to the official state list. An asterisk (*) indicates that the most recent report for that occurrence was more than 20 years ago.

A negative result (no record in our database) does not mean that a sensitive species is not present. Our data can only tell you of known occurrences, based on information gathered by qualified biologists and reported to our office. However, many areas have never been surveyed, or have only been surveyed for certain species. An on-site survey would provide better information on what species and communities are indeed present.

Department of Resources and Economic Development
Division of Forests and Lands
(603) 271-2214 fax: 271-6488

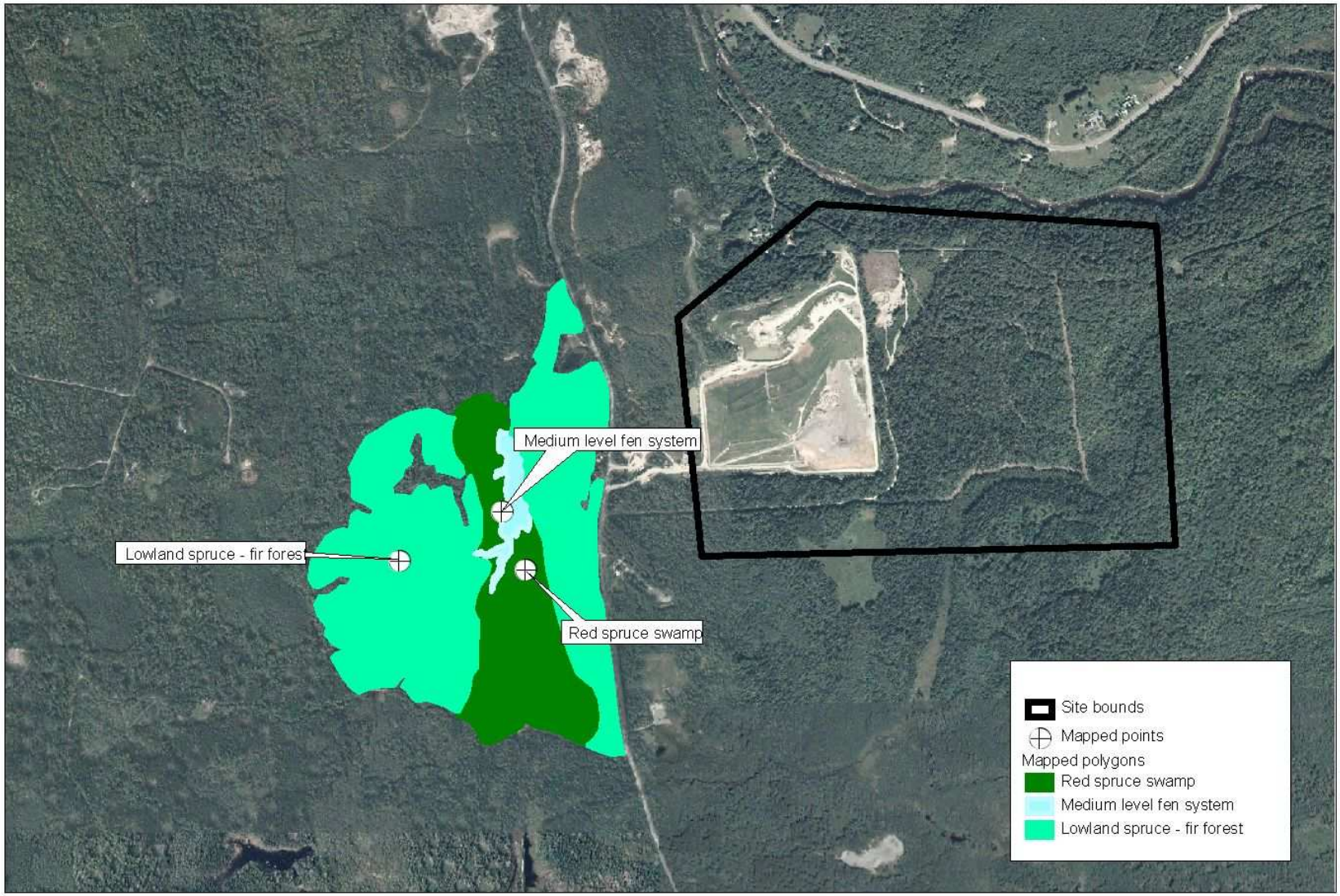
DRED/NHB
PO Box 1856
Concord NH 03302-1856

NHB14-0403

NH NATURAL HERITAGE BUREAU

Known locations of rare species and exemplary natural communities

Note: Mapped locations are not always exact. Occurrences that are not in the vicinity of the project are not shown.



*Historical record

1:15000

Valid for one year from this date: 04 Feb 2014

New Hampshire Natural Heritage Bureau - Community Record

Lowland spruce - fir forest

Legal Status		Conservation Status	
Federal:	Not listed	Global:	Not ranked (need more information)
State:	Not listed	State:	Rare or uncommon

Description at this Location

Conservation Rank: Good quality, condition and landscape context ('B' on a scale of A-D).

Comments on Rank: THE SIZE AND CONTINUITY OF THE SITE, THE PRESENCE OF A MIX OF CONDITIONS SUITABLE FOR VACCINIUM VITIS-IDAEA, AND NESTING HABITAT FOR BLACK-BACKED WOODPECKER, ALONG WITH THE LACK OF EXEMPLARY OLD-GROWTH LOWLAND SPRUCE-FIR ELSEWHERE IN THE REGION, COMBINE TO INDICATE THAT THIS OCCURRRENCE SHOULD BE CONSIDERED EXEMPLARY.

Detailed Description: The dominant trees are *Picea rubens*, *Abies balsamea*, and *Picea mariana*. The forest tends to be close canopied with little understory.

General Area: 1996: Part of a spruce-fir basin swamp, lowland spruce-fir forest, and boreal/transitional acidic fen complex. On a 15-degree slope with active seepage.

General Comments:

Management Comments:

Location

Survey Site Name: Cleveland Mountain

Managed By: White Mountain National Forest

County:	Grafton	USGS quad(s):	Bethlehem W (4407136)
Town(s):	Bethlehem	Lat, Long:	441524N, 0713828W
Size:	98.2 acres	Elevation:	1338 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: From I-93 take Rte. 302 east. Turn right on Trudeau Rd. shortly before Pierce Bridge. The site is west of the road ca. one mile south of Rte. 302.

Dates documented

First reported:	1996-08-20	Last reported:	1996-08-20

New Hampshire Natural Heritage Bureau - System Record

Medium level fen system

Legal Status		Conservation Status	
Federal:	Not listed	Global:	Not ranked (need more information)
State:	Not listed	State:	Rare or uncommon

Description at this Location

Conservation Rank: Good quality, condition and landscape context ('B' on a scale of A-D).
Comments on Rank: Size rank reflects moderate size relative to montane fens.

Detailed Description: 1996: The dominant trees in the community are *Larix laricina* (eastern larch), *Picea mariana* (black spruce), *Abies balsamea* (balsam fir), and *Fraxinus nigra* (black ash). Species composition is similar to that of an exemplary fen ca. 1.5 miles to the west.
General Area: 1996: Associated with old, stagnant beaver flowage.
General Comments:
Management Comments:

Location

Survey Site Name: Cleveland Mountain
Managed By: White Mountain National Forest

County:	Grafton	USGS quad(s):	Bethlehem W (4407136)
Town(s):	Bethlehem	Lat, Long:	441528N, 0713815W
Size:	4.8 acres	Elevation:	1328 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: Off of Rte. 3 (north side) and west of Trudeau Road opposite Ammonoosuc Ranger Station road.

Dates documented

First reported:	1996-08-20	Last reported:	1996-08-20

New Hampshire Natural Heritage Bureau - Community Record

Red spruce swamp

Legal Status		Conservation Status	
Federal:	Not listed	Global:	Not ranked (need more information)
State:	Not listed	State:	Rare or uncommon

Description at this Location

Conservation Rank: Good quality, condition and landscape context ('B' on a scale of A-D).

Comments on Rank:

Detailed Description: 1996. Observed in passing. 1992: Both *Picea mariana* and *Picea rubens* are present with *Larix laricina* scattered throughout and abundant in spots. A very unusual low elevation station for *Vaccinium vitis-idaea* is found here (it is usually restricted to high elevation in NH). Fairly shallow peat accumulation over saturated sand characterize the soil at the site at wetter locations, although peat depth likely varies and soils should be sampled more thoroughly. Cutting of the stand has occurred before. Natural blowdown gaps are evident, with abundant spruce and fir regeneration. Thickets have few plants in shrub or herb layer other than thick moss carpets. Blowdown and harvested areas have continuous moss layer and abundant shrubs; most common of these include: *Nemopanthus mucronata*, *Vaccinium angustifolium*, *Kalmia angustifolia*. Herb spp. include: *Gaultheria hispidula*, *Smilacina trifolia*, *Carex trisperma*, and *Eriophorum spissum*. Towards the north end, the swamp grades into a small open bog area. Several sedges dominate here including *Carex brunnescens*, as well as various other plants typical of streamside marshes and fens.

General Area: 1992: Site harbors a boreal swamp association with dense spruce and larch thickets and small openings with heath shrubs and abundant moss carpets.

General Comments:

Management Comments:

Location

Survey Site Name: Trudeau Road Conifer Swamp

Managed By: White Mountain National Forest

County:	Grafton	USGS quad(s):	Bethlehem W (4407136)
Town(s):	Bethlehem	Lat, Long:	441523N, 0713812W
Size:	42.3 acres	Elevation:	1330 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: From I-93 take Rte. 302 east. Turn right on Trudeau Rd. shortly before Pierce Bridge. The site is west of the road ca. one mile south of Rte. 302.

Dates documented

First reported:	1992-06-26	Last reported:	1996-08-20

New Hampshire Natural Heritage Bureau

DRED - Division of Forests & Lands
PO Box 1856 -- 172 Pembroke Road, Concord, NH 03302-1856
(603) 271-2214

To: Adam Sandahl, CMA Civil/Environmental Engineers

From: Melissa Coppola, NHB-Environmental Information Specialist

Date: February 5, 2014

Subject: NHB14-0403

This memo is a follow-up to NHB14-0403 which had indicated three exemplary natural communities near the transfer station facility. The Natural Heritage Bureau (NHB) requested further information about the project to determine if there is a potential for impacts.

Based on the information provided (site plans and previous correspondence with CMA Engineers regarding this project as a whole), NHB does not expect impacts to the exemplary natural communities located west of the site. Critical to this determination are the following details outlined by CMA Engineers in previous correspondence along with the current site plans (2012 and 2013):

- Stormwater run-off from the newly disturbed areas will be transmitted to a stone and grass lined treatment swale prior to discharging to the existing wooded areas (not into the exemplary natural communities across the road from the project)

- The stormwater will flow toward the northwest corner of the site and infiltrate or continue flowing to the north in the wooded area.

- The proposed improvement project will not discharge stormwater to the west of Trudeau Road.

If these statements are no longer true of project, the dismissal of concerns would not apply. Should you have any further questions, contact me at 603-271-2215 ext. 323 or at Melissa.Coppola@dred.nh.gov

U.S. Fish and Wildlife Service

Natural Resources of Concern

Project Type:

Landfill

Endangered Species Act Species List (USFWS Endangered Species Program).

There are a total of 1 threatened, endangered, or candidate species on your species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fishes may appear on the species list because a project could cause downstream effects on the species. Critical habitats listed under the **Has Critical Habitat** column may or may not lie within your project area. See the **Critical habitats within your project area** section below for critical habitat that lies within your project area. Please contact the designated FWS office if you have questions.

Species that should be considered in an effects analysis for your project:

Mammals	Status		Has Critical Habitat	Contact
Canada Lynx (*Lynx canadensis*) Population: (Contiguous U.S. DPS)	Threatened	species info	Final designated critical habitat	New England Ecological Services Field Office

Critical habitats within your project area:

There are no critical habitats within your project area.

FWS National Wildlife Refuges (USFWS National Wildlife Refuges Program).

There are no refuges found within the vicinity of your project.

FWS Migratory Birds (USFWS Migratory Bird Program).

Most species of birds, including eagles and other raptors, are protected under the Migratory Bird Treaty Act (16 U.S.C. 703). Bald eagles and golden eagles receive additional protection under the Bald and Golden Eagle Protection Act (16 U.S.C. 668). The Service's Birds of Conservation Concern (2008) report identifies species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become listed under the Endangered Species Act as amended (16 U.S.C 1531 et seq.).

U.S. Fish and Wildlife Service

Natural Resources of Concern

Migratory bird information is not available for your project location.

NWI Wetlands (USFWS National Wetlands Inventory).

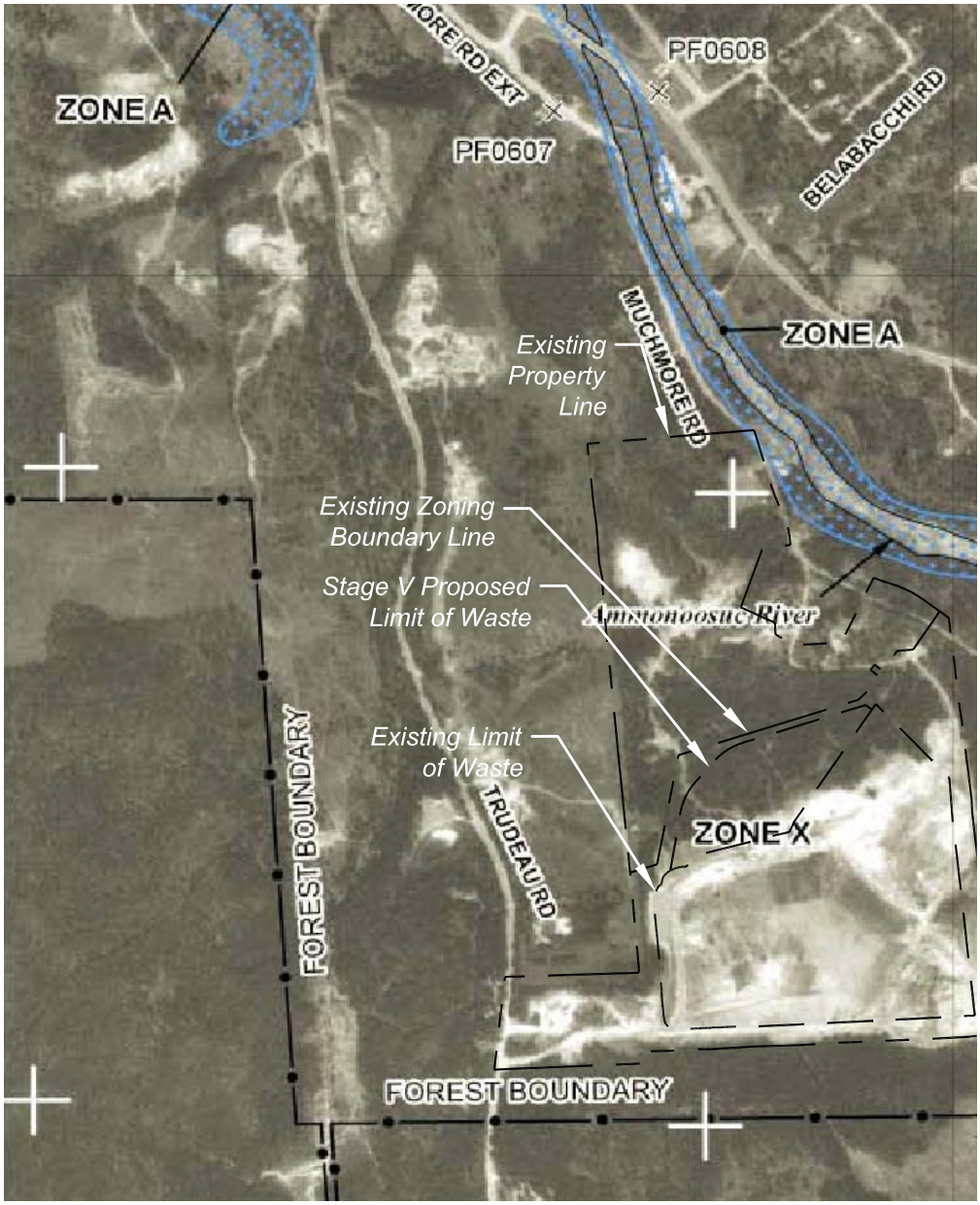
The U.S. Fish and Wildlife Service is the principal Federal agency that provides information on the extent and status of wetlands in the U.S., via the National Wetlands Inventory Program (NWI). In addition to impacts to wetlands within your immediate project area, wetlands outside of your project area may need to be considered in any evaluation of project impacts, due to the hydrologic nature of wetlands (for example, project activities may affect local hydrology within, and outside of, your immediate project area). It may be helpful to refer to the USFWS National Wetland Inventory website. The designated FWS office can also assist you. Impacts to wetlands and other aquatic habitats from your project may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal Statutes. Project Proponents should discuss the relationship of these requirements to their project with the Regulatory Program of the appropriate U.S. Army Corps of Engineers District.

There are no wetlands found within the vicinity of your project.

Stormwater Management Report

Appendix H

FEMA Flood Plain Map



CMA ENGINEERS
CIVIL/ENVIRONMENTAL ENGINEERS

35 Bow Street
Portsmouth, New Hampshire
03801-3819
Phone: 603/431-6196
Fax: 603/431-5376

Langer Place
55 S. Commercial St
Manchester, NH 03101
Phone: 603/627-0708
Fax: 603/627-0746

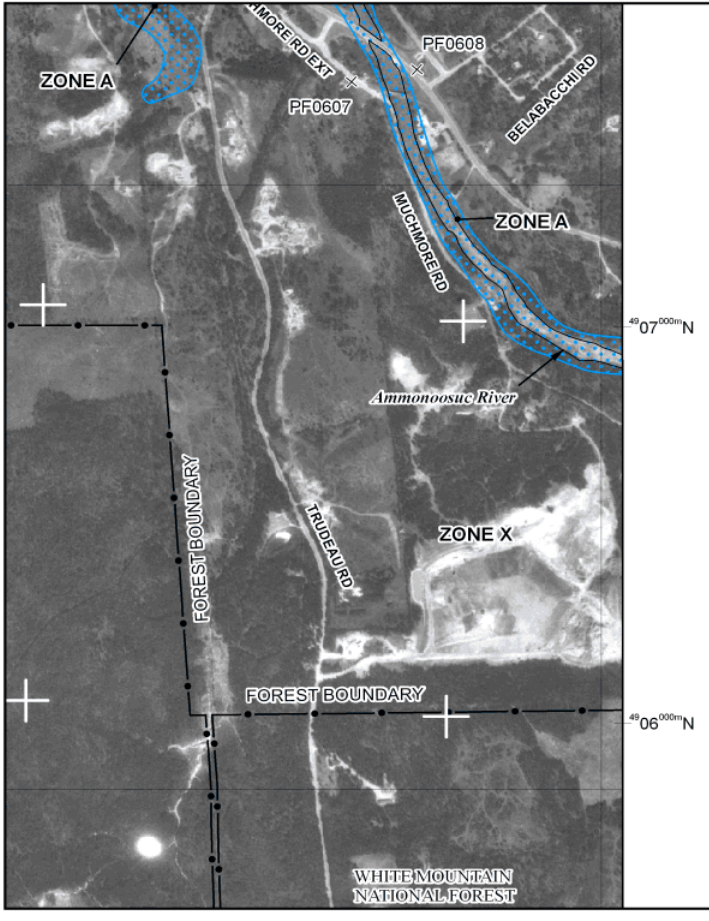
10 Free Street
Portland, Maine
04101-4865
Phone: 207/541-4223
Fax: 207/541-4225

E-mail: info@cmaengineers.com

NCES - Bethlehem, NH
Stage V Landfill Expansion
Type I-A Permit Modification

FEMA 100 Year Flood Plain

Appendix H



MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0145E

FIRM

FLOOD INSURANCE RATE MAP

GRAFTON COUNTY, NEW HAMPSHIRE
(ALL JURISDICTIONS)

PANEL 145 OF 1185

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BETHLEHEM, TOWN OF	330045	0145	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
33009C0145E

EFFECTIVE DATE
FEBRUARY 20, 2008

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Part VI

CONTRACT DOCUMENTS AND SPECIFICATIONS

North Country Environmental Services, Inc.
Permit Number: DES-SW-SP-03-002 (Stage V)

Stage V Landfill Expansion

CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS

January 2015

Prepared for:

North Country Environmental Services, Inc.
Bethlehem, New Hampshire

Prepared by:

CMA Engineers, Inc
Civil and Environmental Engineers
35 Bow Street
Portsmouth, New Hampshire 03801

North Country Environmental Services, Inc.

Stage V Landfill Expansion

CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS

January 2015

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01051	Grades, Lines and Levels
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01300	Submittals
01400	Quality Assurance/Quality Control (QA/QC)
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02222	Excavation
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02273	Drainage Geocomposite
02274	Woven Geotextile Fabric
02275	Non-Woven Geotextile Filter Fabric
02276	HDPE Liner
02279	Geosynthetic Clay Liner
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13001 Site Safety and Contingency Work Plan Outline

DIVISION 16 – ELECTRICAL

16402 Electrical Work

Appendix A – Boring Logs

SECTION I

INVITATION TO BID

INVITATION TO BID

North Country Environmental Services, Inc.
Stage V Landfill Expansion

Sealed proposals for the Stage V Landfill Expansion at the North Country Environmental Services, Inc. (NCES) facility in Bethlehem, New Hampshire will be received at the offices of CMA Engineers, Inc., 35 Bow Street Portsmouth, New Hampshire 03801 until Thursday, February 5, 2015 at 2:00 p.m. Bids received after the specified time will not be accepted.

The landfill expansion project includes among other things, expansion of the existing 60 mil HDPE primary and secondary liner systems; berm construction, installation of leachate forcemain piping, construction of a gravel road; waste excavation and relocation; installation of leachate collection piping; installation of gas header piping; and installation of drainage geocomposite, geosynthetic clay liner, select sand, screened till and stone; construction of stormwater ponds, piping and stormwater structures and temporary stormwater management. The work also includes general site work including excavation, stockpiling and filling, demolition, erosion control, loaming and seeding and general site restoration.

The Bidder is required to provide separate pricing for procurement and installation of 60-mil HDPE liner and drainage geocomposite in the event the Owner chooses to procure these materials separately. The Owner may remove the Bidder's procurement of the 60-mil HDPE liner and drainage geocomposite from the project without penalty to the Owner.

Stone fill required for this project will be processed on-site by the Owner for installation by the Contractor in accordance with the Contract Documents. Contractor shall be responsible for loading and transport of materials to the work area. Stone Fill includes:

- ¾" Stone
- 1.5" Stone
- NHDOT Type C Stone
- NHDOT Type A Rip-Rap fill
- Roadway Gravels

The Contractor is required to provide unit pricing for each of the above items in the event of a material shortage.

Screened Till Fill and Select Sand are available for procurement and processing at the adjacent lot. Bidders are encouraged to contact the property owner to obtain alternate pricing and Bid Alternates are provided on the enclosed Bid Proposal Form for these items. Contact information for the property owner will be made available at the pre-bid conference. The quantity and quality of the materials on the property are not known, but there is believed to be sufficient quantity to complete a significant portion of the project.

This construction project will proceed in two phases. The first phase is to be substantially completed within 180 calendar days of the start date of the Notice to Proceed. The second phase is to be completed by August 28, 2016. It is anticipated that the Notice to Proceed will be issued, and work will commence by April 27, 2015.

A mandatory pre-bid conference will be held at the site on Friday, January16, 2015 at 10:00 a.m. Bids will be due no later than 2:00 p.m. on Thursday, February 5, 2015.

The successful bidder will be required to furnish a Performance Bond and a Payment Bond each in the amount of 100% of the Contract Price.

The Owner reserves the right to waive any informalities in any or all proposals, to reject any or all proposals, or accept any proposal submitted for the project, as deemed by the Owner to be in its best interests based upon qualifications, experience, demonstrated ability to perform, cost, and other factors deemed by the Owner to bear on the successful outcome of the Contract.

John Gay, Engineering Manager

SECTION II

SPECIAL CONDITIONS

SPECIAL CONDITIONS

I. COMMENCEMENT OF WORK

The Contractor shall be prepared to commence work no later than the date indicated in the Notice to Proceed.

Due to waste disposal capacity needs and funding mechanisms, this construction project will proceed in two phases to be completed in 2015 and 2016, respectively. In 2015 NCES intends to complete construction of 4.5 acres of lined landfill area in Stage V (Phase I) to provide disposal capacity needed in early 2016. The remaining 3.6 acres of lined landfill construction will be completed in 2016 (Phase II). A construction sequence outlining each element of the Phase I and Phase II work is presented on the Construction Drawings.

It is the intent of this contract to complete only the Phase I portion of the work in 2015. No payment will be made in 2015 on any Phase II work completed in 2015. Phase I of the construction contract is to be substantially completed within 180 calendar days of the start date of the Notice to Proceed. The Phase II is to be substantially completed by August 28, 2016. Final completion of the project will occur 30 calendar days after the Phase II substantial completion date.

II. SCHEDULE

The following preliminary anticipated schedule has been established in order to ensure that work will be completed in the allotted contract time. This schedule will be confirmed at the time of execution of the contract and will be utilized as the basis for the Contractor's detailed construction schedule.

- Award of Contract: March 20, 2015
- Execution of Contract: March 27, 2015
- Start of Contract Time/Work: April 27, 2015
- Phase I Substantial Completion: October 24, 2015
- Phase II Substantial Completion: August 28, 2016
- Final Completion: September 27, 2016

The dates indicated are subject to change.

Hours of construction shall be limited to Monday through Saturday, 7:00 am to 6:00 pm. Work outside this time frame will not be allowed under normal circumstances. Work outside this time frame will only be allowed with approval by the Owner and Engineer. Holiday, Sunday and work after dark will no be permitted.

III. ORDERING OF MATERIALS

The Contractor shall provide certification to the Engineer within three (3) weeks of Notice to Award that the following materials have been ordered:

- Geosynthetics
- HDPE Pipe

Prior to ordering the above materials, all required submittals must be made, in accordance with the Contract Documents. The Contractor shall also provide to the Engineer, firm delivery dates of the above materials.

IV. ORDER OF WORK

A preliminary construction schedule showing the sequence and duration of the components of work and expected payment schedule shall be submitted by the Contractor prior to the start of work. Such a schedule shall demonstrate how work will be sequenced and how substantial completion dates will be reached within the specified contract time. Additional detail shall be added, if necessary, during the first week of construction after review by the Engineer. The detailed construction schedule will also show submittal dates required for shop drawings, product data and samples, and product delivery dates.

Review by the Engineer of this schedule shall have no effect on the Contractor's responsibility to perform the work within the contract time. No permission for deviation granted shall excuse the delay of Substantial Completion, unless specifically addressed by Change Order.

The Contractor’s schedule shall provide allowances for inclement weather and winter conditions typical for northern New Hampshire.

V. CONSTRUCTION SEQUENCE

The progress of the work shall be scheduled and sequenced to coordinate required aspects of the work, maintain erosion control, maintain and minimize impact on existing landfill operations, and to complete the work within the time specified. The work shall, in general, proceed according to the construction sequence indicated on the Construction Drawings. Contractor shall sequence work such that landfill liner systems are complete to permit NCES to certify the construction and request operational approval from NHDES.

VI. COORDINATION OF WORK WITH OTHER CONTRACTORS

The NCES Landfill currently operates as a solid waste facility accepting commercial and residential waste. The Contractor shall fully coordinate his work with the NCES operating crew and shall not interfere with day to day operations of the landfill.

The landfill is open Monday through Friday 7:00am - 3:00pm and 7:00am - 12:00pm on Saturday.

VII. COORDINATION OF WORK WITH SUBCONTRACTORS

The Contractor is to fully coordinate the work of all subcontractors having a direct contract with the Contractor for performance of work associated with this Contract, including without limitation, surveyors, material supplies, and equipment suppliers.

The Contractor must coordinate schedules, delivery dates, staging area, trades and all other work according to these Specifications and the Construction Schedule.

VIII. QUALIFICATIONS OF CONTRACTOR

In submitting bid proposals, a Contractor represents that he/she has the requisite experience and capabilities to perform all aspects of the work, in full accordance with the design and specifications, and within the required project schedule, and has specific experience on similar projects in New England.

IX. ON-SITE MATERIALS

The base bid schedule items include the Contractor using the following materials from on-site sources, as described below:

A) Stone Fill: Stone fill required for this project will be processed on-site by the Owner for installation by the Contractor in accordance with the Contract Documents. Contractor shall be responsible for loading and transport of materials to the work area. Stone Fill includes:

- ¾" Stone
- 1.5" Stone
- NHDOT Type C Stone
- NHDOT Type A Rip-Rap fill
- Roadway Gravels

The Contractor is required to provide unit pricing for each of the above items in the event of a material shortage.

B) 60-mil HDPE Textured Liner and Drainage Geocomposite: NCES may choose to procure 60-mil HDPE liner and drainage geocomposite for either or both phases of this project. The Owner may remove the Contractor's procurement of these materials from the project without penalty to the Owner. Contractor shall be responsible for installation and testing in accordance with the Contract Documents for both phases of the project.

X. AS-BUILT AND SURVEY CONTROL

The Contractor shall control the layout and construction of all phases of the work. The Contractor shall review layout procedures with the Engineer. Engineer's review shall not relieve Contractor's responsibility for adequacy and sufficiency of survey. Survey control shall be overseen by a NH licensed land surveyor or NH licensed Professional Engineer.

During Construction, the Contractor shall supply to the Engineer verification of the horizontal and vertical layout of all leachate piping, HDPE geomembrane liner anchor trench, stormwater swales, and culverts. The thicknesses of placed materials can be verified through depth measurements separate from the topographic survey.

The Contractor shall perform an as-built survey of the completed work, including a topographic survey of the completed site work, locations of all leachate piping and forcemain, stormwater piping (including all inverts), drainage structures, HDPE primary and secondary, geomembrane panels and repair locations. The survey shall be tied to the on-site

control points. The scale of the drawings shall be no smaller than 1” = 40’. Survey shall be performed under the direction of and the drawings stamped by a NH licensed land surveyor or licensed Professional Engineer, and shall be supplied to Owner in AutoCad 2009 or newer format. Additional requirements are included in Sections 01720 and 01051.

XI. LIMITS OF WORK AND STAGING AREAS

The Contractor must confine his operations to the limits of the work areas shown on the plans and defined in the specifications. Machinery shall be operated with care to prevent damage to adjacent property and injury to people. The Contractor will be required to restore all areas damaged by his operations to equal or better conditions at no extra cost to the Owner. The restoration will be subject to the approval of the Owner.

XII. SAMPLES AND TESTING

Contractor shall plan his operations to allow adequate time for laboratory tests of geosynthetic materials, processed soil materials, laboratory testing of excavated soil and to permit taking of field density tests during compaction. No materials will be placed without review by the Engineer. All material testing will be completed by the Engineer and paid for by the Owner.

XIII. MATERIAL CERTIFICATIONS

The Contractor shall submit four (4) copies of a Certificate of Compliance for all materials used in the Work. The certificates shall be in a form acceptable to the Engineer.

XIV. CONTRACTOR'S EMERGENCY SERVICE

The Contractor shall, at its own cost and expense, make proper arrangements, satisfactory to the Owner, to service emergencies or complaints which may occur at night, over the weekend, when the job is shut down, during the course of work, and/or during the one year correction period. The arrangements shall include provisions to receive complaints from residents received by the Owner and response back to the Owner and Engineer for corrective action as appropriate.

The Contractor shall take measures to control nuisance conditions including but not limited to dust, noise, and odor. Use of calcium chloride for dust control shall be prohibited.

If the Contractor does not meet the obligations to service emergencies or complaints, Owner may, without the obligation to do so, and without waiving the Contractor’s default, make such arrangements, and the cost, as well as all damages, shall be charged to the Contractor.

Contractor shall take all measures and precautions necessary to properly control the temporary stormwater management system and containment berm required for the connection to the existing Stage IV Phase I primary and secondary liner systems and construction of the new Stage V sump. Contractor shall prevent any stormwater from escaping from the containment area to the leachate collection system. Contractor shall operate and maintain the containment system and pumps 24 hours per day for the duration that the containment system is operational, and have on-site back up pumps and back-up gas/diesel powered generators in

the event existing electrical connections or generator cease to function. In accordance with Article 5 of the Construction Agreement, liquidated damages of $1,000/day will be levied for each day that the Contractor fails to properly control or remedy the release of stormwater from the containment area to the leachate collection system.

XV. REGULAR PROJECT MEETINGS

The Engineer will conduct regular Project Meetings at the job site approximately every other week with the Contractor throughout the construction period to enable orderly review of the progress of the Work and provide for a systematic discussion of problems. Meeting shall be held at the Owner's operations office on-site.

The persons designated by the Contractor to participate in these meetings shall have the authority required to commit the Contractor to solutions agreed upon at Project Meetings, and be able to discuss historical and projected work in detail.

XVI. SITE SECURITY

In addition to the Contractor's responsibilities noted in General Conditions, the Contractor shall be responsible for the security and maintenance of all Work prior to acceptance of the work by the Owner, including repair of damage which may occur prior to acceptance.

XVII. DEFINITIONS

New Hampshire Department of Transportation "Standard Specifications for Road and Bridge Construction" (latest edition) shall be referred to as NHDOT Specifications herein.

The Owner of the project is North Country Environmental Services, Inc. (NCES).

XVIII. SCALE HOUSE OPERATIONS AND LANDFILL ACCESS

Contractor shall maintain access to the adjacent scale house station and to the landfill at all times, so as not to disrupt regular operations of the facility, and coordinate action with facility personnel. Contractor's superintendent will be provided with gate access card for secure access during periods when facility is closed. Contractor shall secure access gate if materials are being delivered after facility is closed.

XIX. SUBSURFACE INFORMATION

Bidders are notified that the subsurface information presented herein was gathered for general design purposes and may or may not represent actual field conditions, especially between boring locations. The information cannot be construed as a representation of actual subsurface conditions. Actual conditions will vary. Copies of the boring logs are included in Appendix A.

XXI. APPLICABLE PERMITS

NCES is constructing this project in accordance with several permits issued or to be issued by the NH Department of Environmental Services, including an Alteration of Terrain permit

under NH RSA 485-A and a Solid Waste Facility Permit (under NHRSA 149-M). Copies of the Alteration of Terrain permit and NHDES Construction Approval will be made available to the selected Contractor. The Contractor's work shall comply with all conditions of these permits.

The project will also be completed in accordance with a US EPA National Pollutant Discharge Elimination System (NPDES) Permit for stormwater discharge associated with the construction activities. A stormwater pollution prevention plan (SWPPP) will be developed for the project by NCES, and will be provided to the Contractor for their use. The construction and maintenance related requirements associated with the SWPPP and General Permit are included in the Contract Documents.

The Contractor will be responsible for submitting a Notice of Intent for coverage under the NPDES General Permit and coordinating with NCES to comply with applicable provisions of these permits.

END OF SECTION

SECTION III

INSTRUCTIONS TO BIDDER

INSTRUCTIONS TO BIDDERS

1. BID OPENING of this project is scheduled for Thursday, February 5, 2015 at 2:00 p.m. at the offices of CMA Engineers, Inc., 35 Bow Street, Portsmouth, NH 03801. Construction is intended to start on April 27, 2015, and will occur in two phases. Phase I must be substantially complete within 180 calendar days. Phase II must be complete by August 28, 2016. Bidders should therefore note that the prices contained in the proposal will be considered valid for the duration of the construction project.

   Due to waste disposal capacity needs and funding mechanisms, this construction project will proceed in two phases to be completed in 2015 and 2016, respectively. In 2015 NCES intends to complete construction of 4.5 acres of lined landfill area in Stage V (Phase I) to provide disposal capacity needed in early 2016. The remaining 3.6 acres of lined landfill construction will be completed in 2016 (Phase II). A construction sequence outlining each element of the Phase I and Phase II work is presented on the Construction Drawings.

   It is the intent of this contract to complete only the Phase I portion of the work in 2015. No payment will be made in 2015 on any Phase II work completed in 2015. Phase I of the construction contract is to be substantially completed within 180 calendar days of the start date of the Notice to Proceed. The Phase II is to be substantially completed by August 28, 2016. Final completion of the project will occur 30 calendar days after the Phase II substantial completion date.

2. ESTIMATES OF QUANTITIES: The quantities listed herein for unit price items shall be considered as approximate. The bidders are encouraged to make their own quantity estimates in bid preparation. The lump sum bid items are based on the Plans and Specifications as presented herein and are irrespective of quantities of work. Bid prices for supplemental units shall reasonably reflect the costs included in the Lump Sum Items.

   Unit and Lump Sum prices in the Bid Proposal **shall not be unbalanced**. Unbalanced bids may be cause for rejection.

3. CONTRACT DOCUMENTS AND SITE OF WORK: Before submitting a proposal, the bidder shall examine carefully the Contract Documents and the site of the proposed work. He shall satisfy himself as to the character, quality and quantities of work to be performed and materials to be furnished. The submission of a proposal by a bidder shall be conclusive evidence that the Bidder has complied with these requirements. Claims for additional compensation due to variation between conditions actually encountered in construction and as indicated by the plans, except for payment under the specific payment items included herein, will not be allowed.

4. PREPARATION OF PROPOSAL: The bidder must submit his proposal on the Bid Proposal form included herein. The blank spaces for each item in the proposal forms shall be correctly filled in, by writing in words and numerals, in ink. The bidder must submit a price for each item in the proposal. In case of conflict between words and numerals, **the words shall govern**. The proposal shall be executed with ink in the complete and correct name of the individual, firm or corporation making the proposal and signed by the person or

persons authorized to bind the individual, firm or corporation. Bids by corporations shall have the corporate seal affixed.

The bidder shall properly acknowledge all addenda in the spaces provided therefore on the proposal form and acknowledge submission of all required bid documents as shown on the proposal form.

5. ADDENDA: Bidders desiring further information or interpretation of the plans, specifications or other Contract Documents must make a request for such information in writing to the Engineer, no later than seventy two (72) hours before the bid opening. Answers to such requests will be given in writing to all bidders, in addendum form, and all addenda will be bound with, and made a part of the Contract Documents. No other explanation or interpretation will be considered official or binding. The Engineer will not be responsible for any other interpretations of the plans, specifications or Contract Documents. Should a bidder find discrepancies in or omissions from the plans, specifications or other Contract Documents, or should he be in doubt as to their meaning, he should at once notify the Engineer in order that a written addendum may be sent to all bidders. Any addenda issued prior to forty eight (48) hours of the opening of bids will be emailed, mailed, or delivered to each Contractor who has obtained an official Bid Set from CMA Engineers. The proposal as submitted by the Contractor will be so constructed as to include any addenda, if such are issued by the Engineer prior to forty eight (48) hours of the opening of bids.

   The Owner reserves the right to postpone the bid opening date or time, without prior notice, as it deems to be in its best interests.

6. REJECTION OF PROPOSALS: Proposals containing any omission, alteration of form, additions or conditions not called for, incomplete bids or proposals otherwise regular which are not accompanied by acceptable proposal guaranty will be considered irregular and may be rejected. In case of any ambiguity or lack of clarity in stating the prices in the proposal, the Owner reserves the right to consider the most advantageous construction thereof, or to reject the proposal. Unreasonable or unbalanced bid prices may be cause to reject any proposal.

7. DELIVERY OF PROPOSAL: Each completed proposal sent by mail shall be placed in an envelope sealed and clearly identified on the outside as a proposal for Stage V Landfill Expansion and include the name and address of the bidder. When sent by mail, the sealed proposal, marked as indicated above, should be enclosed in an additional envelope. Electronic submittal of the completed Bid Proposal form sent to rgrillo@cmaengineers.com followed by hard copy sent by mail is also acceptable. Email should indicate in the subject line Bid Proposal for Stage V Landfill Expansion. Proposals will not be considered unless received at the place and on or before the time designated in the Invitation to Bid.

8. WITHDRAWAL OF PROPOSALS: Any bidder, upon his written request, will be given permission to withdraw his proposal no later than the time set for the opening thereof.

9. QUALIFICATION OF BIDDER: The qualifications, experience, and demonstrated ability to complete the work on time and as specified are of importance to the Owner and will be

given significant consideration in the selection of a bidder. Before being awarded the contract the bidder may be required to submit such evidence as the Owner may require to establish his financial responsibility, experience and possession of such equipment as may be needed to prosecute the work in an expeditious, safe and satisfactory manner.

10. DISQUALIFICATION OF BIDDERS: The following are some of the causes which may be considered as sufficient for the disqualification of a bidder and the rejection of his proposal:
    - More than one proposal for the same work from an individual, firm, partnership or corporation.
    - Evidence of collusion among bidders.
    - Poor performance in the execution of work under previous contracts.
    - For being in arrears on existing contracts, or having defaulted on a previous contract.

    The Owner reserves the right to waive any informalities in any or all proposals, to reject any or all proposals, or accept any proposal submitted for the project, as deemed by the Owner to be in its best interest based upon qualifications, experience, demonstrated ability to perform, cost, or other factors deemed by the Owner to bear on the successful outcome of the Contract.

11. CONSIDERATION OF PROPOSALS: For the purpose of award, after the proposals are opened and read, the summation of the products of the approximate quantities shown in the proposal by the lump sum or unit bid prices will be considered the amount of the bid.

    The information provided by bidders and proposed to subcontractors shall be evaluated to determine compliance with the requirements of the project and other comparative favorability to the Owner. The Owner reserves the right to reject any and all proposals and waive technicalities as may be considered to be in the best interest of the Owner.

12. SUBMISSION OF POST BID INFORMATION: Upon request by the Engineer, selected bidders shall within three (3) calendar days thereafter submit the following:

    (1) A designation of the work to be performed by the bidder with his own forces.

    (2) A list of the names of the subcontractors or other persons or organizations (including those who are to furnish materials or equipment fabricated to a special design) proposed for such portions of the work. The bidder will be required to establish to the satisfaction of the Owner the reliability and responsibility of the proposed subcontractors to furnish and perform such portions of the work.

    Prior to the award of Contract, the Owner will notify the bidder in writing if the Owner, after due investigation, has reasonable and substantial objection to any person or organization on such list. If the Owner has a reasonable and substantial objection to any person or organization on such list, and refuses in writing to accept such person or organization, the bidder may, at his option, withdraw his bid without forfeiture of bid security, notwithstanding anything to the contrary contained herein. If the bidder submits an acceptable substitute with an increase in his bid price to cover the difference in cost occasioned by such substitution, the Owner may, at its discretion, accept the increased bid price or may disqualify the bidder. Subcontractors and other persons and organizations proposed by the

bidder and accepted by the Owner must be used on the work for which they were proposed and accepted and shall not be changed except with the written approval of the Engineer.

(3) A proposed work schedule demonstrating the Bidder's plan to complete the work in the required time frame.

13. AWARD OF CONTRACT: Only one Contract will be awarded for all the work called for in the plans and specifications.

14. EXECUTION OF CONTRACT AND BONDS: The Contract will include all Contract Documents. Within seven (7) days after the Pre Construction Meeting, the successful bidder shall execute the Contract in triplicate, and furnish the Owner with Insurance certificates, Performance and Payment Bonds each in the full amount of the Contract price executed by a surety company acceptable to the Owner. The Bonds are to be furnished as a guaranty of the faithful performance of the work and for protection of the claimants for labor and materials.

15. FAILURE TO EXECUTE CONTRACT AND BONDS: Should the bidder to whom the Contract is awarded refuse or neglect to execute the Contract and furnish the required bonds within seven (7) days after notice of award of the Contract, at the option of the Owner, the bidder's proposal shall be treated as withdrawn.

END OF SECTION

SECTION IV

BID FORMS AND BID FORM ATTACHMENTS

EXHIBIT A

BID PROPOSAL

Bidder: _____

Project: Stage V Landfill Expansion

Owner: North Country Environmental Services, Inc.

The undersigned, hereafter referred to as the BIDDER has examined the Contract Documents prepared in connection herewith by CMA Engineers, Inc., the ENGINEER. In addition, he has examined the site and is familiar with all the conditions surrounding the Work contemplated. He hereby submits the following:

BIDDER agrees to perform all the work described in the CONTRACT DOCUMENTS for the following unit prices or lump sums:

_____

Signature Date

PART I - PHASE I (2015) BID PROPOSAL

No.	Item	Unit	Est Qty	LUMP SUM OR UNIT PRICE (FIGURES)	TOTAL PRICE (FIGURES)
1	General Conditions	L.S.	1		
2	Excavation and Filling	L.S.	1		
3	Erosion Control & Site Stabilization	L.S.	1		
4	Demolition	L.S.	1		
5	Roadway, Site Work and Stormwater Ponds	L.S.	1		
6	Waste Excavation & Odor Control	L.S.	1		
7	Temporary Stormwater Management	L.S.	1		
8	Screened Till Fill	L.S.	1		
9	Secondary 60-mil HDPE Textured Liner	S.F	199,000		
10	Installation of Secondary 60-mil HDPE Textured Liner	S.F	199,000		
11	Secondary Bi-Planar 250-mil Drainage Geocomposite	S.F.	199,000		
12	Installation of Secondary Bi-Planar 250-mil Drainage Geocomposite	S.F.	199,000		
13	Secondary Leachate Collection System	L.S.	1		
14	Select Sand	L.S.	1		
15	Primary 60-mil HDPE Textured Liner	S.F	199,000		
16	Installation of Primary 60-mil HDPE Textured Liner	S.F	199,000		
17	Primary Bi-Planar 300-mil Drainage Geocomposite	S.F	199,000		
18	Installation of Primary Bi-Planar 300-mil Drainage Geocomposite	S.F	199,000		
19	Primary Leachate Collection System	L.S.	1		
20	Forcemain	L.S.	1		
21	Stormwater Management and Stabilization	L.S.	1		
22	Landfill Gas Improvements	L.S.	1		

PHASE I SUBTOTAL (FIGURES):

(Written) _____ Dollars and

_____ Cents

PART II - PHASE II (2016) BID PROPOSAL

No.	Item	Unit	Est Qty	LUMP SUM OR UNIT PRICE (FIGURES)	TOTAL PRICE (FIGURES)
1	General Conditions	L.S.	1		
2	Excavation and Filling	L.S.	N/A		N/A
3	Erosion Control & Site Stabilization	L.S.	1		
4	Demolition	L.S.	1		
5	Roadway, Site Work and Stormwater Ponds	L.S.	N/A		N/A
6	Waste Excavation & Odor Control	L.S.	N/A		N/A
7	Temporary Stormwater Management	L.S.	1		
8	Screened Till Fill	L.S.	1		
9	Secondary 60-mil HDPE Textured Liner	S.F	159,000		
10	Installation of Secondary 60-mil HDPE Textured Liner	S.F	159,000		
11	Secondary Bi-Planar 250-mil Drainage Geocomposite	S.F.	159,000		
12	Installation of Secondary Bi-Planar 250-mil Drainage Geocomposite	S.F.	159,000		
13	Secondary Leachate Collection System	L.S.	1		
14	Select Sand	L.S.	1		
15	Primary 60-mil HDPE Textured Liner	S.F	159,000		
16	Installation of Primary 60-mil HDPE Textured Liner	S.F	159,000		
17	Primary Bi-Planar 300-mil Drainage Geocomposite	S.F	159,000		
18	Installation of Primary Bi-Planar 300-mil Drainage Geocomposite	S.F	159,000		
19	Primary Leachate Collection System	L.S.	1		
20	Forcemain	L.S.	1		
21	Stormwater Management and Stabilization	L.S.	1		
22	Landfill Gas Improvements	L.S.	1		

PHASE II SUBTOTAL: (FIGURES)

(Written) _____ Dollars and

_____ Cents

TOTAL (PHASE I + PHASE II):

(Written) _____ Dollars and

_____ Cents

PART III - SUPPLEMENTAL UNIT PRICES

Should certain additional work be required, or should quantities of certain classes of work be increased or decreased from those on which the Contract Sum is based, by order or approval of the Engineer, the undersigned agrees that the following supplemental unit prices may be used as the basis of payment to him/her or credit to the Owner for such addition, increase, or decrease in the work as determined solely by the Owner.

Supplemental prices shall cover all costs, complete in place, and the prices given shall balance with the respective amount per unit to be paid to the Contractor under applicable items of Parts I & II – Base Bid, or refunded to the Owner (in the case of deductions or decreases). No additional adjustments will be allowed for overhead, profit, insurance, or indirect expenses of the Contractor beyond the prices as listed. Owner has the right to reject any or all supplemental unit prices when in Owner's opinion the price appears not to be balanced with Owner's assessment of balanced prices in comparison to other bidders. These prices shall apply to both Phase I (2015) and Phase II (2016) work.

PART II - SUPPLEMENTAL UNIT PRICE ITEMS

No.	Item	Unit	Est Qty	LUMP SUM OR UNIT PRICE (FIGURES)	TOTAL PRICE (FIGURES)
23	3/4" Stone	Ton	N/A		-
24	1.5" Stone	Ton	N/A		-
25	NHDOT Type C Stone	Ton	N/A		-
26	NHDOT Type A Rip-Rap Fill	Ton	N/A		-
27	Crushed Gravel (NHDOT Item 304.3)	Ton	N/A		-
28	Gravel (NHDOT Item 304.2)	Ton	NA		-
29	Screened Till Fill (Procured and Processed at Adjacent Property)	Ton	NA		-
30	Select Sand (Procured and Processed at Adjacent Property)	Ton	N/A		-
31	Addition or Reduction of Common Excavation	Ton	N/A		-

EXHIBIT A

BID PROPOSAL CONTINUED

The Bidder agrees to **add** or **deduct** work required by the Owner or Engineer for the above mentioned Lump Sum, Unit, or Supplemental Unit prices (as applicable).

The undersigned, as Contractor herein referred to as singular and masculine declares as follows:

(1) The only parties interested in the BID as Principals are named herein;

(2) This BID is made without collusion with any other person, firm, or corporation;

(3) The Bidder has carefully examined the site of the proposed work and is fully informed and is satisfied as to the conditions there existing, the character and requirements of the proposed Work, and the difficulties attendant upon its execution. The Bidder has carefully read and examined the Drawings, the proposed AGREEMENT and the Specifications and other Contract Documents therein referred to and knows and understands the terms and provisions thereof;

(4) The Bidder understands the information relative to subsurface and other conditions, natural phenomena, existing pipes and other structures (surface and/or subsurface) has been furnished only for his information and convenience without any warranty or guarantee, expressed or implied, that the subsurface and/or other conditions, natural phenomena, existing pipes and other structures (surface or subsurface) actually encountered will be the same as those shown on the Drawings or in any other Contract Documents and he agrees that he shall not use or be entitled to use such information made available to him through the Contract Documents or otherwise obtained by him in his own examination of the site, as a basis of or ground for any claim against the Owner or Engineer arising from or by reasons of any variance which may exist between the aforesaid information made available to, or otherwise obtained by, him and the subsurface and/or other conditions, natural phenomena, existing pipes and other structures (surface and/or subsurface) actually encountered during the construction work, and he has made due allowance therefore in the BID;

(5) He understands that all reports of investigations and tests of subsurface physical conditions at the site and other information affecting the performance of the Work which have been relied upon by the Engineer in preparation of the Drawings and Specifications are not guaranteed as to accuracy or completeness and are not part of the Contract Documents.

(6) And he understands that the quantities of work tabulated in this Proposal and indicated on the Drawings and in the Specifications and other Contract Documents are approximate and are subject to increase or decrease as deemed necessary by the Engineer, and as allowed for under the Contract Documents.

The undersigned agrees that for extra work, if any, authorized in writing by the Engineer to be performed by him in accordance with the terms and provisions of the Agreement, he will accept compensation as stipulated in the Contract Documents in full payment for such extra work, and agrees that for reductions in work as directed by the Engineer, he will accept reduced compensation as stipulated in the Contract Documents.

If this Bid Proposal is accepted by the Owner, the undersigned agrees to substantially complete the work in accordance with the schedule for substantial completion of work per the Special Conditions, provided to be done under the Contract, and accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete any element of the work on time, except as otherwise expressly provided in the AGREEMENT.

The Bidder hereby agrees that, once opened, he will not withdraw this Bid within 60 days of Bid opening, and that if the Owner shall accept this Bid, the Bidder will duly execute the Contract and provide BONDS as provided in paragraph 14 of Instructions to Bidders.

Respectfully Submitted:

Company Name: _____

_____	_____
Name (Printed)	Address
_____	_____
Title	Address
_____	_____
Signature	Date

(SEAL if Proposal is by a Corporation)

_____

Attest

ADDENDA

The BIDDER acknowledges receipt of the following Addenda*

No. _____Dated

No. _____Dated

No. _____Dated

No. _____Dated

No. _____Dated

No. _____Dated

** to be filled in as appropriate*

APPLICATION FOR PAYMENT NO. _____	CONTRACT: Stage V Landfill Expansion PAGE 1 of 1

OWNER: NCES	CONTRACTOR:	PERIOD OF ESTIMATE

CONTRACT CHANGE ORDER SUMMARY				ESTIMATE	
No.	Approval Date	Amount		1. Original Contract Amount	
		Additions	Deductions	2. Change Orders	
				3. Supplemental Unit Price Work	
				4. Revised Contract Amount (1+2+3)	
				5. Work Completed to Date*	
				6. Stored Materials to Date*	
				7. Subtotal (5+6)	
				8. Retainage	
				9. Previous Payments	
TOTALS:				Amount Due (7-8-9)	
NET CHANGE:				*Detailed Breakdown Attached	

CONTRACT TIME						
Original Time		days	ON SCHEDULE			
Revised		days		YES	Starting Date:	
Remaining		days		NO	Completion Date:	

CONTRACTOR'S Certification:

The undersigned CONTRACTOR certifies that: (1) all previous progress payments received from OWNER on account of Work done under the Contract referred to above have been applied to discharge in full all obligations of CONTRACTOR incurred in connection with Work covered by prior Applications for Payment numbered 1 through inclusive; (2) title to all Work, materials, and equipment incorporated in said Work or otherwise listed in or covered by this Application for Payment will pass to OWNER at time of payment free and clear of all liens, claims, security interest, and encumbrances (except such as are covered by Bond acceptable to OWNER indemnifying OWNER against any such lien, claim, security interest, or encumbrance); and (3) all Work covered by this Application for Payment is in accordance with the Contract Documents and not defective as that term is defined in the Contract Documents.

Dated _____, 2015 Contractor:

By _____
(Authorized Signature)

Payment of the above AMOUNT DUE THIS APPLICATION is recommended.

Dated _____, 2015 Engineer: CMA Engineers, Inc,

By _____
(Authorized Signature)

CERTIFICATE OF SUBSTANTIAL COMPLETION

OWNER's Project No. __NCES-15-Stage V____ ENGINEER's Project No. __833___

Project: ____Stage V Landfill Expansion_____

CONTRACTOR
Contract for:__Stage V Landfill Expansion_____

Contract Date: _____

This Certificate of Partial Substantial Completion applies to all Work under the Contract Documents or to the following specified parts thereof:

Specifically excluded from coverage under this document, is:

To: _____
OWNER

And To: _____
CONTRACTOR

The Work to which this Certificate applies has been inspected by authorized representatives of OWNER, CONTRACTOR and ENGINEER, and that Work is hereby declared to be partially substantially complete in accordance with the Contract Documents on

_____
DATE OF SUBSTANTIAL COMPLETION

A tentative list of items to be completed or corrected is attached hereto. This list may not be all-inclusive, and the failure to include an item in it does not alter the responsibility of CONTRACTOR to complete all the Work in accordance with the Contract Documents. The items in the tentative list shall be completed or corrected by CONTRACTOR within _____ calendar days of the above date of Substantial Completion.

The responsibilities between OWNER and CONTRACTOR for security, operation, safety, maintenance, heat, utilities, insurance and warranties shall be as follows:

RESPONSIBILITIES:
OWNER:_____
_____
_____
_____

CONTRACTOR: _____
_____
_____
_____

The following documents are attached to and made a part of this Certificate:
_____
_____
_____

This certificate does not constitute an acceptance of Work not in accordance with the Contract Documents nor is it a release of CONTRACTOR's obligation to complete the Work in accordance with the Contract Documents.

Executed by ENGINEER on _____, 2015

__CMA ENGINEERS, INC._____
ENGINEER

By: _____

CONTRACTOR accepts this Certificate of Substantial Completion on _____, 2015

_____
CONTRACTOR

By _____

OWNER accepts this Certificate of Substantial Completion on _____, 2015

_____
OWNER

By: _____

EXHIBIT D

MATERIAL WARRANTY
FOR GEOMEMBRANE

WARRANTY NO:

EFFECTIVE DATE:

The MANUFACTURER shall be defined as _____

The OWNER shall be defined as the North Country Environmental Services, Inc.

The MANUFACTURER warrants to the OWNER the HDPE material to conform at the time of sale to the Contract specifications, to be free from defects in materials, and to be able to withstand normal weathering and use from the date of acceptance by the OWNER for a period of 10 year(s) for HDPE Liner under normal uses and services for which it is designed and manufactured, in any customary weather which may be encountered and which is not customarily considered to be in the nature of an Act of God, casualty or catastrophe, such as but not limited to earthquake, flood, piercing hail, or tornado. Normal use and service excludes the exposure of the liner to chemicals in concentrations other than those presented by municipal solid waste residue leachate or mechanical abuse by machinery, equipment, or people.

Should defects or premature loss of use within the scope of the above Material Warranty occur, the MANUFACTURER shall, at its option, supply repair or replacement material on a pro-rata basis at the then current price in such manner as to charge the OWNER only for that portion of the warranted 10-year life that has elapsed since the purchase of the material. To enable the MANUFACTURER's technical staff to properly determine the cause of any alleged defect and to take appropriate steps to supply repair or replacement material for timely corrective measures, if such defect is within the warranty, any claim for alleged breach of warranty must be made in writing, by certified mail, to the MANUFACTURER within 90 days after the alleged defect was first discovered by a responsible representative of the OWNER, or the defect and all warranties with respect to such defect will be deemed to have been waived by the OWNER. In the event repairs or replacements are to be effected, the lined area must be uncovered for the MANUFACTURER and must be in a clean, dry, unencumbered condition. This includes but is not limited to water, dirt, sludge, residuals, or liquid of any kind.

The MANUFACTURER's liability under this Material Warranty shall in no event exceed the amount of the sale price of the material sold to the OWNER for the particular installation in which any defect or premature loss of use is alleged to have occurred, and under no circumstances shall the MANUFACTURER have any liability for consequential damages arising from loss of production or product owing to the failure of the material or installation, and no allowance will be made for repairs, replacements, or alterations made by the OWNER unless with the MANUFACTURER's written consent or unless MANUFACTURER shall have defaulted in its obligations under the Material Warranty. The MANUFACTURER neither assumes nor authorizes any person (other than an officer of the MANUFACTURER) to assume for it any other or additional liability in connection with the MANUFACTURER's liner.

The parties agree that the liner is not being purchased for personal, family, or household purposes and that neither the Magnuson-Moss Warranty Act, nor any similar state consumer warranty statute shall apply to the sale hereunder or in any way supersede or modify the provisions of this Material Warranty.

THE LAWS OF THE STATE OF NEW HAMPSHIRE SHALL GOVERN THE RIGHTS AND DUTIES OF THE PARTIES UNDER THIS WARRANTY. VENUE FOR ALL LEGAL PROCEEDINGS INVOLVING THIS MATERIAL WARRANTY OR ANY MATTER CONTAINED WITHIN SHALL BE IN GRAFTON COUNTY, NEW HAMPSHIRE.

The Material Warranty is extended to the OWNER and is not transferable or assignable to a private owner without the written consent of the MANUFACTURER, which shall not be unreasonably withheld. No rights shall be created by, nor shall any rights against the MANUFACTURER survive, any such transfer or assignment without such consent.

PURCHASER/(OWNER): North Country Environmental Services, Inc.

LOCATION OF INSTALLATION: Bethlehem, New Hampshire

DESCRIPTION OF INTENDED USE:

MANUFACTURER: (address)

_____

_____

_____ _____

Manufacturer (Corporate) Officer* Date

* *Attach authorization to act on behalf of the Manufacturer (Corporation).*

EXHIBIT E

WORKMANSHIP WARRANTY
FOR GEOMEMBRANE

WARRANTY NO:

EFFECTIVE DATE:

The INSTALLER shall be defined as _____

The OWNER shall be defined as the North Country Environmental Services, Inc.

The INSTALLER hereby warrants to the OWNER that the HDPE linings to be installed by the INSTALLER under this warranty shall be installed free from defects in the INSTALLER's workmanship. The warranty set forth in the preceding sentence (the "Workmanship Warranty") shall commence on the date that the OWNER accepts the installation of the linings, and shall apply until and shall expire on the last day of a period of 2 year(s) from said date, and shall be subject to the following conditions:

1. The Workmanship Warranty shall extend the proper installation of the linings. The Workmanship Warranty shall not apply to any alleged defect in installation that is occasioned by fire, Acts of God or acts of any person or entity other than the INSTALLER, or its agent, including without limitation abuse, negligence, misuse, improper treatment, vandalism or by falling objects, abnormal environmental conditions, improper site preparation, subgrade settlement or by any event beyond the reasonable control of the INSTALLER.

2. The Workmanship Warranty shall not be effective with respect to any alleged defect unless the INSTALLER receives the OWNER's written claim therefore within the warranty period and within 90 days after the date of discovery of such defect by a responsible representative of the OWNER. The INSTALLER shall have the right to verify by its own representative the nature and extent to the defects complained of.

3. The extent of the INSTALLER's liability for breach of the Workmanship Warranty shall be limited to timely repairing or replacing the defective installation workmanship, utilizing such workmanship as should result in providing the pro-rated performance remaining under the original period of the Workmanship Warranty for the defective workmanship. In the event that it is necessary for the INSTALLER to repair or replace any defective workmanship with respect to the liners, which shall not be encumbered by any overlying material or liquid, the OWNER shall cooperate in all respects with the INSTALLER or its agent on any defective workmanship with respect to the installation of the linings unless the INSTALLER shall be in default of its obligations under this Workmanship Warranty.

4. The Workmanship Warranty is extended to the OWNER and is not transferable and not assignable to any private owner without the written consent of the INSTALLER, which shall not be unreasonably withheld. No rights against the INSTALLER survive any such transfer or assignment without such consent.

5. No terms or conditions other than those stated herein and no agreement or understanding, oral or written, and no course of conduct or performance in any way purporting to modify the Workmanship Warranty or to waive the INSTALLER's rights hereunder shall be binding on the INSTALLER, unless the same shall be clearly described in a written memorandum that expressly refers to the Workmanship Warranty and expressly having such effect upon the Workmanship Warranty and is separately signed by a duly-authorized officer of the INSTALLER. Moreover, additional liabilities of or limitations upon the rights and remedies of the INSTALLER contained in such documents as purchase orders, order acknowledgments or change orders which may subsequently be exchanged between the parties shall have no force or effect upon the Workmanship Warranty. All proposals, negotiations and representations, if any, made prior to the date hereof or with reference hereto are merged herein.

6. THE LAWS OF THE STATE OF NEW HAMPSHIRE SHALL GOVERN THE RIGHTS AND DUTIES OF THE PARTIES UNDER THIS WARRANTY. VENUE FOR ALL LEGAL PROCEEDINGS INVOLVING THIS MATERIAL WARRANTY OR ANY MATTER CONTAINED WITHIN SHALL BE IN GRAFTON COUNTY, NEW HAMPSHIRE.

PURCHASER/(OWNER): North Country Environmental Services, Inc.

LOCATION OF INSTALLATION: Bethlehem, NH

DESCRIPTION OF INTENDED USE:

INSTALLER: (address)

_____

_____

_____ _____

Installer (Corporate) Officer* Date

**Attach authorization to act on behalf of the Installer (Corporation).*

SECTION V

CONSTRUCTION AGREEMENT AND FORMS

CONSTRUCTION AGREEMENT

THIS AGREEMENT is entered into as of this _____ day of _____, 2015, by and between _____, with an office in _____ (hereinafter referred to as "Contractor"), and North Country Environmental Services, Inc., a subsidiary of Casella Waste Systems, Inc., with an office in Montpelier, VT (hereinafter referred to as "Owner").

RECITALS

WHEREAS, Owner desires to engage Contractor to provide various services and materials in connection with the Work (as defined herein) pursuant to the terms and conditions of this Agreement for Construction of Stage V Landfill Expansion at the North Country Environmental Services, Inc. Landfill, (hereinafter referred to as the "Site"); and

WHEREAS, Contractor desires to render those services and provide such materials as described herein and has the experience, staff and resources to properly perform the Work.

NOW, THEREFORE, as consideration for the covenants, promises and representations contained herein, other good and valuable consideration and intending to be legally bound hereby, Owner and Contractor agree as follows:

1. General Terms and Conditions

I. The Work, Consideration, Definitions, the Agreement Price and Agreement Time

Contractor agrees to provide all necessary and required labor, materials, services and equipment to perform the Work in accordance with the terms of this Agreement and Owner shall pay to Contractor the Agreement Price (as defined herein) of $_____ as adequate and complete consideration for proper performance of such Work.

A. The Work: Contractor shall undertake construction of Stage V Landfill Expansion and associated work at the Site including providing all necessary and required labor, materials, tools, equipment, incidentals, excavation, dewatering, shoring, sheeting, bracing, traffic control, safety devices and services necessary and all related work pursuant to the Contract Documents including the Technical Specifications and the Contract Drawings (herein referred to as the "Work").

B. Terms Defined: The following terms, as they may occur in the Contract Documents, shall mutually be understood by Owner and Contractor to have the following meanings:

"Authorized Representative" shall mean a duly authorized representative of Owner or his designee (designated in writing) who has the authority to execute a Change Order on behalf of Owner.

"Bid and Contract Documents" or "Bid Package" shall mean bid documents entitled: Stage V Landfill Expansion Bid Documents which were prepared by Owner and were previously sent to, received, reviewed and accepted by Contractor. The Bid and Contract Documents consist of the following:

Section Number	Title
I	Invitation to Bid
II	Special Conditions
III	Instructions to Bidders
IV	Bid Forms and Bid Form Attachments
V	Construction Agreement and Forms
VI	Performance and Payment Bonds
VII	Technical Specifications
VIII	Contract Drawings

"Bid Forms" shall mean Section IV of the Bid and Contract Documents and attachments thereto.

"Bid Package" shall mean the Bid and Contract Documents as defined herein.

"Change Order" shall mean Owner's written form issued after execution of this Agreement by an Authorized Representative of Owner to Contractor authorizing an addition, deletion, or revision to the Work as contained in the Contract Documents, and/or an adjustment in the Agreement Price or Agreement Time. The form of Change Order to be used is attached hereto in Section V of the Contract Documents.

"Construction Quality Assurance (CQA) Consultant" shall mean representatives of CMA Engineers, Inc. who shall observe and document construction quality assurance activities and issue the project certification report (if applicable).

"Contract Documents" shall mean this Agreement and the documents attached thereto as referenced below:

Section Number	Title
I	Invitation to Bid
II	Special Conditions
III	Instructions to Bidders
IV	Bid Forms and Bid Form Attachments
V	Construction Agreement and Forms
VI	Performance and Payment Bonds
VII	Technical Specifications
VIII	Contract Drawings

"Contract Drawings" shall mean that portion of the Contract Documents which contains graphic illustrations with written representations thereon reflecting the character and scope of the Work (including plan sheets, details and sections). The set of Contract Drawings for the Work are entitled, "Stage V Landfill Expansion Construction Drawings" which were prepared by Engineer. No Work shall be performed and no materials shall be ordered, fabricated or installed unless and until Owner issues a Notice to Proceed to Contractor. References in the Contract Documents to "Construction Drawings" shall mean Contract Drawings.

"Contractor" shall mean _____, the party entering into this Agreement with Owner who shall perform the Work.

"Date of Completion" shall be the date of Substantial Completion of the Work as defined in this Agreement.

"Day" unless otherwise expressly defined in this Agreement, shall mean a calendar day beginning at midnight and continuing for twenty-four (24) hours until midnight of the following day. All days shall be considered consecutive unless otherwise indicated.

"Engineer" shall mean CMA Engineers, Inc., the design engineer for the Work.

"Extra Work" shall mean an item of the Work not provided for in this Agreement as awarded but authorized by a Field or Change Order.

"Field Order" shall mean a written order issued by Owner which orders minor changes in the Work but which does not involve a change in the Agreement Price or the Agreement Time.

"Final Acceptance" shall be accomplished when the Work has passed Final Inspection, Substantial Completion (as defined herein) has occurred and Contractor receives a written Notice of Final Acceptance from Owner.

"Final Inspection" shall mean the last inspection of the Work by Owner.

"Final Payment" shall mean payment of the Agreement Price to Contractor by Owner for proper performance of the Work less amounts previously paid by Owner to Contractor less amounts not due to

Contractor because of a change in the Scope of the Work less amounts withheld or applied by Owner pursuant to the terms and conditions of this Agreement or applicable law. Final Payment shall not be made to Contractor until and unless a Notice of Final Acceptance of the Work is sent by Owner and is received by Contractor.

"Notice to Proceed" shall mean a written notice sent by Owner to the Contractor indicating the date on which it is to commence performance of the Work.

"Owner" shall mean North Country Environmental Services, Inc., a subsidiary of Casella Waste Systems, Inc., the party for whom the Work is to be performed.

"Payment Forms" shall mean application for payment forms (i.e. invoices), copies of which are attached hereto in Section VII of the Contract Documents, which must be completed by Contractor and submitted to Owner before payment may be made to Contractor hereunder.

"Site" shall be the location where the Work will be performed which is the North Country Environmental Services, Inc. Landfill as indicated previously in the Recitals to the Agreement and shall include all surface and subsurface conditions.

"Subcontractor" shall mean all materialmen, suppliers, vendors, agents and their respective employees and any other individual or entity, at any tier, providing goods and/or services to or on behalf of Contractor regarding performance of the Work.

"Substantial Completion" shall be the date, as determined by Owner, when the Work is sufficiently completed in accordance with the Contract Documents so that the Work can be utilized for the purpose for which it was intended by Owner.

"Superintendent" shall mean Contractor's employee who shall be in attendance at the Site; and who shall be a competent, full-time representative of Contractor; and who shall be the manager of Contractor's Work; and who shall meet all qualifications set forth in the CQA Plan (if included herein) and who shall have the authority to make decisions regarding the Work and sign Change Orders on behalf of Contractor.

"Facilities" shall mean all above ground and below ground pipelines, conduits, ducts, cables, wire, manholes, vaults, utilities, tanks, tunnels, attachments and any encasements containing such items which have been installed to furnish any services, facilities, utilities or materials including, but not limited to, the following: electricity; gases; water; steam; liquid petroleum products; telephone or other communications; cable television; sewage and drainage removal; traffic or other control systems.

C. Agreement Time: Work shall commence within ten (10) days after the date referenced in a Notice to Proceed for commencement of the Work, and Substantial Completion shall occur within 200 calendar days of the Notice to Proceed, and shall be completed and ready for final completion within an additional 30 calendar days.

D. Agreement Price: Owner shall pay compensation to Contractor which shall be the (fixed unit price) (a price guaranteed not to exceed the ceiling price) of _____ dollars ($_____) (herein referred to as the "Agreement Price").

2. Form and Intent of Contract Documents

For purposes of the Contract Documents, it shall be presumed that all materials, labor, equipment and services necessary and/or required to perform the Work or to fulfill the intent of the Contract Documents shall be performed, furnished and installed by Contractor regardless of whether they are expressly indicated in the Contract Documents. All Work shall be performed by Contractor unless expressly reflected in the Contract Documents as being performed by Owner or others.

3. Time Is of the Essence

In the performance and completion of the Work by Contractor, time shall be of the essence of this Agreement.

4. Payment

A. At the end of each month, Contractor shall submit itemized Payment Forms to Owner at the Site based upon the percentage of Work properly completed in accordance with the task breakdown on the Schedule and supported by receipts or vouchers showing payments for materials and labor, payments to Subcontractors and such other documentation as Owner may require in order to document Contractor's right to payment.

i. The percentage of Work properly completed in accordance with the Contract Documents shall be calculated on the basis of materials placed or installed (i.e. "in-place" Work).

ii. Measurement shall be the responsibility of Contractor subject to verification by Owner. Mutual agreement between Owner and Contractor on all measurements is required for each progress payment and Final Payment requested before such payment can be made.

iii. Contractor may request compensation for materials stored at the Site if the following conditions are satisfied:

a. Materials are physically located within the Site boundary;

b. Invoices from suppliers are presented as backup to a request for progress payment; and

c. Materials stored at the Site are designated as relating to a specific item required by the Contract Documents.

B. For fixed unit price or time and materials Work to be performed pursuant to a Change Order hereto, Contractor shall include a brief description of the Extra Work performed together with a summary of actual units employed and/or hours worked by Contractor's employees, engaged directly in the Extra Work, by classification and the rate (and multiplier if applicable), allocated per task(s) as identified in the Schedule. Direct non-salary expenses, such as subcontracts and other direct costs and expenses, shall be itemized separately and allocated per task(s) as identified in the Schedule. In addition to the foregoing, Contractor shall submit to Owner copies of time sheets, expense reports, receipts, and other documentation necessary to substantiate each submission of Payment Forms to Owner's satisfaction.

C. Contractor shall submit its application for payment on Payment Forms supplied by Owner. Copies of these forms are provided in Section VII of the Contract Documents.

D. Within thirty (30) days following receipt and approval by Owner of Contractor's Payment Forms, Owner shall pay Contractor ninety percent (90%) of the Agreement Price for a proportionate amount of the Work which, to the best knowledge, information, and belief of Owner, has been completed in accordance with the Contract Documents, less the aggregate of all previous payments made for such Work.

E. Upon receipt of any payment from Owner hereunder, Contractor shall pay out of such monies received any amounts which are due to Subcontractors on account of such Subcontractor's work. Contractor shall require each Subcontractor to include in its invoice to Contractor the percentage actually retained by Contractor, if any. Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to its Subcontractors in a similar manner. Before any payment can be made to Contractor hereunder, Contractor shall provide a waiver and release fully executed by Contractor on a Waiver and Release Form and one executed by each Subcontractor on Waiver and Release Forms for Subcontractors which are included in Section V of the Contract Documents. In addition to, and not in limitation of, any terms or conditions of this Agreement, Contractor agrees that Owner may, in consultation with Contractor, and without obligation to do so, pay any Subcontractor (including, but not limited to, paying an amount which is made in settlement of any dispute involving Contractor and/or any Subcontractor) directly and deduct such amount from any amounts which are due to Contractor thereby reducing the total amount owed (the total Agreement Price) to Contractor for performance of the Work. In

addition, Contractor agrees to hold Owner harmless from all claims, lawsuits, costs, damages, expenses and liability for Owner's actions undertaken in accordance with the terms and conditions of this Paragraph.

F. The full amount of the Agreement Price less amounts previously paid by Owner to Contractor less amounts not due to Contractor because of a change in the Scope of the Work less amounts withheld or applied by Owner pursuant to the terms and conditions of this Agreement or applicable law will be paid to Contractor by Owner within thirty (30) days following Final Acceptance of the Work, however, as a condition precedent to Owner making Final Payment, Contractor shall file with Owner all Waiver and Release Forms (Progress payment as well as Final Payment forms) for itself and its Subcontractors on forms provided by Owner in Section V of the Contract Documents. Regardless of execution of any of the forms herein, Final Payment by Owner shall automatically constitute a waiver of all claims, liens and actions of any kind by Contractor against Owner arising out of this Agreement.

G. No payment shall be made for costs or expenses incurred by Contractor prior to issuance of a Notice to Proceed for the Work or after termination of this Agreement except as expressly provided herein.

H. If any items in any Payment Forms submitted by Contractor are disputed by Owner for any reason, including the lack of supporting documentation, Owner may temporarily delete the disputed item and pay the remaining amount of the Payment Forms. Owner shall promptly notify Contractor of the dispute and request clarification or remedial action. If any dispute is settled in Contractor's favor, Contractor shall include the settled amount on a subsequent regularly scheduled submission of Payment Forms or in a special submission of Payment Forms for the disputed item only.

I. 25% of the lump sum Bid Item 1 shall be paid to Contractor upon successful mobilization to the Site by Contractor, and when 5% of the Contract amount is earned, per Section 00150 of the Contract Documents and Technical Specifications.

5. Payments Withheld

A. Payments otherwise due to Contractor including, but not limited to, any and all retainage, may be applied by Owner against any amounts due or claimed to be due Owner from Contractor, its subsidiaries or affiliates or may be withheld by Owner on account of any of the following: work suspected by Owner to be defective and not remedied; claims filed, or reasonable evidence indicating probable filing of claims; breach of any term or condition of the Contract Documents by Contractor and/or its Subcontractors; failure of Contractor to make payments promptly to its Subcontractors (and for Subcontractors to make payment to their Subcontractors) for material, labor or other goods or services; refusal of Contractor to accept or make payment for any part of the Work; Contractor's failure to deliver Waiver and Release Forms for itself or its Subcontractors; or a reasonable doubt that the Work can be completed for the balance of the Agreement Price then unpaid and/or within the Agreement Time. If the foregoing causes are removed, then withheld payments shall promptly be made. If the said causes are not removed within a reasonable time, Owner may rectify the same at Contractor's sole cost and expense (at no cost to Owner), and/or Owner may terminate this Agreement for cause pursuant to the terms and conditions provided herein.

B. Liquidated damages of $1,000/day will be levied for each day that the Contractor fails to properly control or remedy the release of leachate or impacted stormwater from the containment area.

6. Construction Personnel and Activities

I. Supervision and Construction Procedures

A. Contractor shall supervise, manage, control and direct the Work, using the Contractor's best skill and attention.

B. Contractor shall be responsible to Owner for all acts and omissions of the Contractor's employees, Subcontractors and all other persons performing any of the Work for Contractor.

C. Contractor shall be responsible for inspection of portions of Work already performed under this Agreement to determine that such portions of the Work are in proper condition to receive subsequent Work at no cost to Owner.

D. Construction meetings shall be held at the Site weekly or at such other frequencies as agreed to by Owner and Contractor as arranged by Owner's Project Manager. The Superintendent and all of Contractor's personnel working at the Site (as appropriate) shall attend such meetings.

7. Independent Contractor

A. The Work shall be performed and furnished by Contractor as an independent contractor and under the sole supervision, management, direction and control of Contractor in accordance with the terms and conditions of this Agreement. Contractor shall not be an agent, employee or representative of Owner for any purpose. Contractor shall have full control over its Subcontractors and employees as it may see fit to assist in performance of the Work, including, but not limited to, the hiring, firing, and supervision of any such employees of Contractor except for Owner's right of removal of employees or Subcontractors of Contractor expressly provided in this Agreement and/or permitted by applicable law.

B. Contractor further agrees that the MANNER, MEANS, METHODS, MANAGEMENT, PROCEDURES, SEQUENCES AND TECHNIQUES OF CONSTRUCTION SHALL BE UNDER THE SOLE CONTROL AND IS THE SOLE RESPONSIBILITY OF CONTRACTOR.

8. Contractor's Superintendent

A. Contractor shall keep its Superintendent in attendance at the Site until Final Acceptance of the Work.

B. The Superintendent shall thoroughly understand the Contract Documents and shall insure that all of Contractor's employees and/or Subcontractors understand the tasks to be performed pursuant to such documents. The Superintendent shall communicate all necessary and/or required information to Contractor's employees and Subcontractors.

C. The Superintendent shall keep a daily diary of the Work performed and shall transmit copies of such diary to Owner on a weekly or more frequent basis.

D. The Superintendent shall attend all pre-construction and construction meetings and have the authority to make decisions on behalf of Contractor regarding performance of the Work.

9. Subcontractors and Employees

A. Nothing contained in this Agreement shall create any contractual relationship between Owner and any Subcontractor of Contractor. Notwithstanding the foregoing, any Subcontractor that executes a Waiver and Release Form as provided in Section V of the Contract Documents shall be bound by the terms and conditions contained therein to Owner and others as indicated such Waiver and Release.

B. Contractor shall temporarily defer, at no cost to Owner, the prosecution of any portion of the Work that may be necessary in the opinion of Owner for the proper advancement of the work of other contractors when such deferment can be accomplished without unreasonable interference with Contractor's Work.

C. Owner must approve of any Subcontractor selected by Contractor in writing prior to performance of any Work by such Subcontractor, although such approval does not create any contractual relationship between such Subcontractor and Owner nor does such approval relieve Contractor of any of its responsibilities or liability hereunder. Owner may require Contractor to change any Subcontractor regardless of Owner's previous approval of such Subcontractor.

D. Any part of the Work performed for Contractor by a Subcontractor shall be undertaken pursuant to a written subcontract between the Contractor and such Subcontractor, which shall be prepared on a form of subcontract satisfactory to Owner in all respects. Each such subcontract shall contain at a minimum provisions that:

i. Require that such work be performed in accordance with the terms and conditions of the Contract Documents and all laws and regulations and require that the Subcontractor be bound by the terms and

conditions of these Contract Documents and to assume toward Contractor all the obligations and responsibilities which Contractor, by such Contract Documents, assumes toward Owner;

ii. Waive all rights the contracting parties may have against one another or that the Subcontractor may have against Owner for damages caused by fire or other perils covered by the insurance required in the Contract Documents;

iii. Require the Subcontractor to carry and maintain insurance coverage in accordance with the Contract Documents, and to file certificates of insurance and certified copies of policies for such coverage with Contractor;

iv. Require the Subcontractor to submit all Waiver and Release Forms for itself and its Subcontractors on forms provided in Section V of the Contract Documents for Work completed by it and by its Subcontractors as a condition precedent to the disbursement of any progress payment next due and owing;

v. Require submission to Contractor or Subcontractor, as the case may be, of applications for payment on the Payment Forms provided in Section V of the Contract Documents together with clearly-defined invoices and billings supporting all such applications under each subcontract to which Contractor or its Subcontractor is a party;

vi. Report, so far as practicable, unit prices, lump sums, actual costs and any other feasible method for use in the determination of costs for changes in the Work in accordance with the Contract Documents;

vii. Require each Subcontractor to furnish to Contractor in a timely fashion, all information necessary for the preparation and submission of all reports, shop drawings and other submittals required herein;

viii. Require that each Subcontractor continue to perform under its subcontract in the event this Agreement is terminated and that Owner, in Owner's sole discretion, may take an assignment of said subcontract and request such Subcontractor to continue such performance;

ix. Require each Subcontractor to remove all debris created by its activities; and

x. If required by law, require each Subcontractor to submit evidence that it has a valid contractor's license that it is an equal opportunity employer and that it is in compliance with all related laws, statutes, regulations, rules, standards, orders and ordinances.

10. Operation and Maintenance Data

A. In addition to, but not in limitation of, the terms and conditions of the Contract Documents, Contractor shall deliver as applicable a minimum of three (3) complete bound instruction manuals to Owner for the materials and/or equipment incorporated into the Work. The purpose of such manuals shall be for the instruction of Owner's operating and maintenance personnel and to provide a positive source of information regarding the products, materials and/or equipment.

B. The bound instruction manuals shall include:

i. Complete instructions regarding operation and maintenance of all equipment involved including lubrication, disassembly, and reassembly;

ii. Complete nomenclature of all parts of all equipment;

iii. Complete nomenclature and part number of all replaceable parts, name and address of nearest vendor, and all other pertinent data regarding procurement procedure;

iv. Copies of all guarantees and warranties; and

v. Manufacturers' bulletins, catalog cuts and descriptive data where pertinent clearly indicating the precise items included in the Work.

11. Owner's Equipment

From time to time during the course of the Work, Owner may have its on-site earthmoving equipment available for use in aiding Contractor to perform earthwork activities. Contractor may employ the equipment when Owner

indicates its availability and desire to rent it to Contractor. Contractor and Owner shall agree on payment to Owner and other terms and conditions which are mutually agreeable to both parties as a Change Order to this Agreement for Contractor's use of such equipment. Notwithstanding the foregoing, such equipment shall be priced on a load count or hourly basis as indicated in the Change Order. The Change Order must be executed by both parties hereto prior to using any of such equipment for any earthwork activity.

12. Labor

Contractor, for itself, its employees and Subcontractors, agrees that in performance of the Work provided for in the Contract Documents:

A. Contractor shall take affirmative action to ensure that applicants are employed and treated during employment without regard to their sex, race, creed, color, or national origin;

B. Contractor shall cooperate with Owner in the conduct of all labor relations affecting the Work;

C. At Owner's request, Contractor shall provide a method of identifying its employees and checking such employees into and out of the Site. Such method must be satisfactory to Owner prior to its use at the Site and shall be provided at Contractor's sole cost and expense (at no cost to Owner);

D. Contractor shall employ at the Site only those employees who work in harmony with the employees of Owner and/or other contractors and have the requisite skills and abilities to perform the Work in a safe, good and workmanlike manner. Owner may, at any time, refuse admittance to the Site or expel from the Site any employee of Contractor and/or its Subcontractor including, but not limited to, Contractor's Superintendent whose presence Owner, in Owner's sole discretion, considers undesirable and Contractor shall indemnify, defend and hold Owner harmless from all claims, lawsuits, compensation, costs, expenses (including, but not limited to, all reasonable attorneys' and other consultants' fees and charges) or damages related to Owner's refusal to admit such individual to or expulsion of such individual from the Site; and

E. Contractor acknowledges that it is Contractor's responsibility to hire all personnel for the proper and diligent prosecution of the Work and Contractor shall use its best efforts to maintain labor peace for the duration of the Work.

13. Owner's Project Manager

Owner's Project Manager may monitor all or a portion of the Work on behalf of Owner but such monitoring shall in no manner relieve Contractor of any of its obligations, liabilities or responsibilities under the Contract Documents including, but not limited to, supervision, direction, management and coordination of the Work and shall not be used as grounds for additional payment to Contractor. Under no circumstances shall Owner, its Project Manager or other such representatives of Owner be considered to be engaged in any form of construction management activities relating to the Work.

14. Cooperation Between Trades and Progress of the Work

A. Full cooperation between all trades engaged upon the premises is mandatory. This Section of the Agreement shall be distinctly understood to bind Contractor and all of its Subcontractors to properly coordinate their Work with that of other contractors working at the Site, so that the Work may at all times proceed without interruption or delay and predetermined progress milestones contained within the Schedule are met.

B. Any loss, cost, delay, damage, or expense (including, but not limited to, all reasonable attorneys' fees, professional engineering fees and charges, sampling and testing fees, experts' fees and other consultants' fees and charges) caused by defective or improperly timed or coordinated Work shall be borne by the contractor responsible therefore, unless such loss, cost, delay, damage or expense is caused by Owner or Engineer. All remedies to repair or replace defective or damaged work shall be effected by the responsible contractor without interruption or delay to the Schedule.

C. If Contractor removes, alters, destroys, or defaces the property of Owner or the work of another contractor in the performance of the Work, Contractor shall promptly repair or replace the affected property or the Work to the satisfaction of Owner without interruption or delay to the Schedule at Contractor's sole cost and expense (including, but not limited to, all reasonable attorneys' fees, professional engineering fees

and charges, sampling and testing fees, experts' fees and other consultants' fees and charges).

D. In the event of any dispute or controversy, Contractor for itself and its Subcontractors agrees that it will continue to prosecute the Work diligently to meet the Schedule within the Agreement Time pending resolution of any such dispute or controversy.

E. When Contractor repairs or replaces defective or damaged Work (in accordance with the terms or conditions of the Contract Documents, applicable law or otherwise) Contractor shall do so at Contractor's sole cost, expense, risk and account (at no cost to Owner). Contractor shall be solely responsible for all costs and expenses of investigation, construction, reconstruction and correction of the Work in accordance with the terms and conditions of the Contract Documents including, but not limited to, all reasonable attorneys' fees, professional engineering fees and charges, sampling and testing fees, experts' fees and other consultants' fees and charges.

15. Technical Components of the Work

A. Contract Drawings and Technical Specifications

i. Contractor shall perform the Work in strict compliance with the Contract Documents, including, but not limited to, the Contract Drawings and the Technical Specifications.

ii. Contractor shall have available on the Site, at all times, one copy of the Contract Drawings and Technical Specifications, including all Addenda thereto. Contractor shall also maintain at the Site, one copy of all approved Shop Drawings, Change Orders, Field Orders, submittals and the Schedule.

iii. Owner reserves the right to make minor changes to or modifications of the Contract Drawings prior to or during performance of the Work which shall be reflected thereon. The Work shall conform to such revised drawings and to such other drawings relative thereto as may be furnished by Owner in explanation of details or reflecting minor modifications during construction, including such minor modifications as Owner may consider necessary on account of conditions discovered during performance of the Work.

B. Survey

i. Owner shall provide the initial survey indicating horizontal and vertical controls and/or reference points and bench marks for the Site. Contractor shall, by its own engineer/surveyor (who shall be registered in the state where the Site is located) and instruments, make whatever measurements and alignments that are necessary to collect the survey information required in the Contract Documents to enable it to construct each element of the Work in the correct position required, corresponding to the horizontal and vertical controls and/or reference points and bench marks established by Owner's survey. If any errors are found, Contractor shall notify Owner in writing and, unless otherwise notified by Owner in writing, shall not proceed until such errors are corrected. If Contractor does proceed without such correction having been made, such action shall be construed as its acceptance of such lines, grades, and elevations, and Contractor shall be responsible for the correctness of the same. If by reason of Contractor acting without Owner's notification for Contractor to proceed in light of errors found, and it is necessary to reconstruct any part of the Work, Contractor shall uncover, remove and reconstruct such Work in accordance with the Contract Documents at Contractor's sole expense, risk and account (at no cost to Owner).

ii. Contractor shall furnish all survey stakes, all batter boards, templates, and other devices necessary for laying out all parts of the Work. All stakes destroyed by Contractor shall be replaced by Contractor.

iii. Contractor shall record all survey data including all lines and grades and shall record all test data required by the Contract Documents. All survey and test data shall be made available to Owner on a weekly basis or at times otherwise requested by Owner.

C. Shop Drawings and Samples

i. Contractor shall submit to Owner all Shop Drawings prepared or to be used by Contractor in performing the Work at least fourteen (14) days prior to commencement of the Work (unless Owner

requests an expedited schedule) for Owner's review and approval. Contractor shall also submit to Owner for review and approval with such promptness as to cause no delay in the Work, all samples required by the Contract Documents or as otherwise requested by Owner.

ii. After checking and verifying all field measurements and after complying with applicable procedures specified in the Contract Documents, Contractor shall submit all Shop Drawings to Owner which shall bear a stamp or specific written indication that Contractor has satisfied Contractor's responsibilities under the Contract Documents with respect to the review of the submission. The data shown on the Shop Drawings and the background information for the sample shall be complete with respect to quantities, dimensions, specified performance and design criteria, installation protocol, catalog numbers, materials and similar data to enable Owner to review the information as required.

iii. All samples shall be checked by and accompanied by a specific written indication from Contractor that Contractor has satisfied all of Contractor's responsibilities under the Contract Documents with respect to the review of the submission. The submission shall clearly identify the material, supplier, pertinent data such as catalog numbers and the use for which the sample is intended.

iv. Before submission of each Shop Drawing or sample, Contractor shall have reviewed or coordinated each Shop Drawing or sample with other Shop Drawings and samples which pertain to the Work, with all facets of the Work itself and with the terms and conditions of the Contract Documents to insure compatibility therewith.

v. At the time of each submission, Contractor shall give Owner specific written notice of each variation that the Shop Drawings or samples may exhibit from the Work as described in the Contract Documents. In addition, Contractor shall cause a specific notation for each such variation to be made on each Shop Drawing and background information for the sample submitted to Owner for review and approval.

vi. Owner and Engineer shall review and approve with reasonable promptness Shop Drawings and samples, but Owner's and Engineer's review and approval will be only to assist Contractor in interpreting the scope of the Work in accordance with Owner's business and operational objectives and shall not relieve Contractor from any responsibility or liability for errors or omissions in the Shop Drawings. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions. Contractor shall make corrections required by Owner or Engineer and shall return the required number of corrected copies of Shop Drawings as indicated in the Technical Specifications or if no specific number is indicated, at least one (1) copy of such drawings and submit as required or requested by Owner new samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Owner or Engineer on previous submittals.

vii. Where a Shop Drawing or sample is to be provided hereunder, any related Work performed prior to Owner's and Engineer's review and approval of the pertinent submission will be at the sole risk, expense, account and responsibility of Contractor (at no cost or liability to Owner).

viii. All Shop Drawings, plans, drawings, specifications, and similar documents prepared by Contractor for the Work and any copies thereof shall be the sole property of Owner. Contractor shall deliver such documents to Owner at the completion of the Work or at times as may otherwise be requested by Owner.

D. All Shop Drawings shall become part of the Contract Documents after approval by Owner hereunder.

16. Substitutions

A. No item listed on the Contract Drawings, Contractor's Shop Drawings, or in the Technical Specifications by trade name or by name of manufacturer may be substituted without the prior approval of Owner. Owner reserves the sole right to accept or reject such Contractor's proposal for substitution. Contractor shall insure that any such substitution or refusal of substitution shall not cause delay or increased costs. For any substitutions, Owner and Engineer shall determine whether the substitute may be utilized and may make inquiries at Contractor's sole cost and expense to verify such claim.

B. At least fourteen (14) days prior to commencement of the Work, Contractor shall submit to Owner any

proposals for substitutions, together with samples and complete data. Owner may consider but is under no obligation to consider such proposals. In either event, Owner shall render a decision to Contractor as promptly as possible. No substitutions may be made without the prior written consent of Owner evidenced by a Change Order and approved Shop Drawing.

C. All applications for substitutions shall be accompanied by a statement of credit or extra cost attributed to the substitution.

D. Contractor shall carefully verify and shall be fully responsible for determining that the materials and/or equipment it has proposed to provide and/or install are in accordance with and will fit into the confines indicated on the Contract Drawings, Contractor's Shop Drawings and/or the Technical Specifications.

E. Unless otherwise indicated, design of the Work is based upon the material or supplier's equipment named first in the list of manufacturers in the Technical Specifications contained herein. When other manufacturers are listed and are desired to be used by Owner, Contractor may be required to make modifications or adjustments, at Contractor's sole cost and expense, to coordinate the installation of the material and/or equipment with associated elements of the Work.

17. Reports

A. Contractor shall prepare and forward to Owner at least fourteen (14) days prior to commencement of the Work, a materials and equipment report which shall include: a complete list of suppliers and/or fabricators; items to be purchased from and/or supplied by such suppliers and/or fabricators; time required for fabrication; and the scheduled delivery dates for each item to be purchased and/or supplied, leased or otherwise used for performance of the Work. As soon as available, Contractor shall furnish copies of purchase orders and other evidence of procurement to Owner.

B. Contractor shall prepare such additional reports as Owner may request.

C. During progress of the Work, Contractor shall keep at the Site, in good and legible form, a record of all work done differently from or in addition to, that shown on the Contract Drawings. Such record shall clearly and accurately describe the "as-built" conditions and dimensions in sufficient detail and accuracy to enable Owner to prepare as-built drawings of the Work. Contractor shall submit the record to Owner as soon as possible, however, all such information must be submitted to Owner in good and acceptable form prior to Final Acceptance of the Work by Owner.

D. Contractor shall submit all other submittals to Owner and others in accordance with provisions of the Technical Specifications regarding the same.

18. Dewatering

A. In addition to, and not in limitation of, any terms or conditions contained in the Technical Specifications, all Work (including, but not limited to excavation and backfilling) shall be performed under workable and dry conditions. Contractor shall be solely responsible for all dewatering in performing the Work including, but not limited to, the following:

i. Preventing surface water and subsurface or groundwater from flowing into the excavations and flooding the Site and surrounding area; and

ii. Not allowing water to accumulate in excavations; and

iii. Providing and maintaining pumps, sumps, suction and discharge lines and other dewatering system components which are necessary to properly convey water away from excavations; and

iv. Conveying water removed from excavations to existing natural channels or otherwise providing proper and appropriate disposal of such water.

B. Dewatering devices shall provide adequate filtering to prevent the removal of fines from the soil.

C. The cost of such dewatering shall already be included in the Agreement Price.

19. Inspections, Examinations and Testing

A. Access to and Testing of the Work

i. Contractor shall provide Owner, Engineer, CQA Consultant, representatives of Owner, testing agencies and governmental agencies with jurisdictional interests with proper and safe access to the Work at reasonable times for their observation, inspection and testing.

ii. Contractor shall give Owner timely notice of readiness of the Work for all required inspections, tests or approvals so as not to delay the Schedule.

iii. If federal, state or local laws, regulations, ordinances, rules, standards, orders or requirements of any public body or court having jurisdiction require any Work (or part thereof) to specifically be inspected, tested or approved, Contractor shall assume full responsibility therefore, pay all costs in connection therewith and furnish Owner and CQA Consultant with the required certificates of inspection, testing or approval.

iv. Contractor shall be responsible for and shall pay all costs in connection with any inspection or testing by Owner of a supplier of materials or equipment proposed to be incorporated into the Work, or of materials or equipment submitted to Owner for approval prior to Contractor's purchase thereof for incorporation into the Work.

v. All inspections, tests or approvals other than those undertaken directly by governmental authorities having jurisdiction shall be performed by organizations acceptable to Owner.

vi. If any Work is covered contrary to the written or oral request of Owner, it must, if requested by Owner, be uncovered for observation and replaced at Contractor's sole expense, risk and account (at no cost to Owner). Any work undertaken by Contractor pursuant to this Paragraph, must be undertaken in full compliance with the terms and conditions of the Contract Documents.

vii. If Owner considers it necessary or advisable that covered Work be observed by Owner, Engineer or CQA Consultant, or inspected or tested by others, for any reason, Contractor, at Owner's request, shall uncover, expose or otherwise make available for observation, inspection or testing as Owner may require, that portion of the Work in question, furnishing all necessary labor, material and equipment. If it is found that such Work is not in accordance with the Contract Documents, Contractor shall bear all costs and expenses (including, but not limited to, all reasonable attorneys' fees, professional engineering fees and charges, sampling and testing fees, experts' fees and other consultants' fees and charges) of such uncovering, exposure, observation, inspection, testing and of proper reconstruction of the Work to the standard necessary and/or required by the Contract Documents.

B. Inspection, Examination and Acknowledgment

i. CONTRACTOR REPRESENTS BY ITS EXECUTION OF THIS AGREEMENT THAT IT HAS HAD THE OPPORTUNITY TO INSPECT AND EXAMINE AND HAS THOROUGHLY INSPECTED AND EXAMINED THE SITE (WHERE OR UPON WHICH THE WORK IS TO BE PERFORMED), ALL APPLICABLE LAWS AND REGULATIONS, THE CONTRACT DOCUMENTS, SITE PERMIT CONDITIONS, DATA AND OTHER SUCH INFORMATION REFLECTING SURFACE AND SUBSURFACE CONDITIONS OF THE SITE EXISTING PRIOR TO PERFORMANCE OF THE WORK AND UNDER WHICH THE COMPLETED WORK SHALL OPERATE INCLUDING, BUT NOT LIMITED TO, ALL FACILITIES, THE CHARACTER, QUALITY AND QUANTITY OF MATERIAL REQUIRED, KIND OF EQUIPMENT AND FACILITIES NEEDED PRELIMINARY TO AND DURING PERFORMANCE OF THE WORK (OR IF IT HAS NOT DONE SO, WAIVES SUCH INSPECTION AND EXAMINATION AT ITS OWN RISK); THAT IT HAS OBTAINED AND CAREFULLY STUDIED (OR ASSUMES RESPONSIBILITY FOR OBTAINING AND CAREFULLY STUDYING) ALL SUCH EXAMINATIONS, INVESTIGATIONS, EXPLORATIONS, TESTS, REPORTS, DRAWINGS, STUDIES AND OTHER INFORMATION WHICH PERTAIN TO THE SURFACE, SUBSURFACE OR PHYSICAL CONDITIONS AT OR CONTIGUOUS TO THE SITE OR THAT OTHERWISE MAY AFFECT THE PROGRESS, PERFORMANCE, INSTALLATION, OPERATION OR FURNISHING OF THE WORK AS REQUIRED OR IS NECESSARY FOR THE PROPER

PERFORMANCE OF THE WORK AT THE AGREEMENT PRICE, WITHIN THE AGREEMENT TIME AND IN ACCORDANCE WITH ALL OF THE TERMS AND CONDITIONS OF THE CONTRACT DOCUMENTS; THAT IT HAS A FULL UNDERSTANDING OF THE DIFFICULTIES AND CONDITIONS WHICH MAY BE ENCOUNTERED IN PERFORMING THE WORK AND AGREES THAT THE CONTRACT DOCUMENTS ARE ADEQUATE AND REASONABLE FOR CONTRACTOR'S PERFORMANCE OF SUCH WORK. CONTRACTOR'S FAILURE TO INSPECT AND/OR EXAMINE SUCH SITE AND THE CONTRACT DOCUMENTS RESULTING IN ITS SUBSEQUENT INABILITY TO PERFORM THE WORK HEREUNDER SHALL IN NO WAY RELIEVE IT OF THE OBLIGATIONS OF THIS AGREEMENT.

ii. Contractor is responsible for reviewing all available information, data and the Contract Documents and shall confirm the location of each Facility that exists. Contractor shall take all precautions to avoid damage to all persons and property around such Facilities during performance of the Work. If Facilities must be moved to perform the Work, the cost for such moving shall already be included in the Agreement Price, otherwise, they shall be moved at Contractor's sole expense, risk and account (at no cost to Owner).

iii. Contractor agrees to advise fully all of its employees, Subcontractors and others working for Contractor at the Site, of any risks at the Site and of all necessary and/or required environmental, safety, and health procedures contained in any applicable federal, state and/or local law, regulation, ordinance, standard, rule or order (including, but not limited to all applicable OSHA requirements).

iv. Contractor acknowledges and is aware that the Site may contain residential, commercial, and/or industrial waste materials, and Contractor knowingly and voluntarily assumes all risk of injury and damage to Contractor and Contractor's property, employees, Subcontractors and others working for Contractor, caused by exposure to such waste materials while at the Site.

C. Surveys, Borings, Drawings, Studies, Test Results and Other Site Information

i. Owner shall not be responsible for furnishing surveys (except as expressly provided herein) or other information as to the physical characteristics of, legal limitations of, or utility locations for, the Site.

ii. Owner may, however, make available to Contractor, and if so Contractor is deemed to have studied the results of certain surveys, test borings, drawings, studies, test results and information that it has, if any, as to surface conditions, subsurface conditions and Site geology. Owner does not assume any responsibility whatsoever with respect to the completeness, sufficiency or accuracy of surveys or borings made; of the logs of test borings; of drawings, studies, or test results; of other investigations; or of the interpretations and conclusions made thereof; AND THERE IS NO WARRANTY OR GUARANTEE, EXPRESS OR IMPLIED, THAT THE CONDITIONS INDICATED BY SUCH SURVEYS, INVESTIGATIONS, BORINGS, LOGS, DRAWINGS, STUDIES OR INFORMATION ARE REPRESENTATIVE OF THOSE CONDITIONS EXISTING THROUGHOUT THE SITE, OR ANY PART THEREOF, OR THAT UNFORESEEN DEVELOPMENTS MAY NOT OCCUR except however, Contractor may rely on the survey for the Site which is given to Contractor by Owner and which sets the vertical and horizontal controls and identifies benchmarks for the Site.

iii. At Owner's request, Contractor shall make available to Owner the results of any Site investigation, test borings, drawings, analyses, studies, surveys, tests or other investigations conducted by or in possession of the Contractor or any of its agents or Subcontractors.

20. Compliance with Laws, Permits and Other Conditions

I. Compliance with Laws

A. In the performance of the Work hereunder, Contractor, its employees and Subcontractors agree to comply with all applicable federal, state, provincial, county and local laws, ordinances, lawful orders, rules, standards and regulations including, but not limited to, social security and income tax withholding laws, employment compensation laws, environmental, safety and health laws including those of the Occupational Safety and Health Act (OSHA) in existence at the time of execution of this Agreement and as thereafter enacted, amended and/or modified.

B. Contractor, its employees and Subcontractors represent and warrant that they have acquired and paid

for all necessary work permits (to include all required documentation to allow personnel who are not United States citizens to legally work in the United States), licenses, certificates and other forms of documentation of personnel registration and training and that their personnel have received all necessary training required to perform the Work. Contractor shall furnish copies of such documentation to Owner's Project Manager prior to commencement of performance of the Work.

C. Contractor shall be responsible for the payment of all sales, use, added value and all other federal, state and/or local taxes of any type which arise out of or are related to the Work including, but not limited to, any personal property, income, franchise, or business privilege tax assessed Contractor for conducting its operations and purchasing materials and/or equipment hereunder. All applicable taxes shall already be included in the Agreement Price.

D. Contractor shall not violate any applicable laws, regulations, ordinances, orders, rules or standards pertaining to wetlands.

E. To the fullest extent permitted by law, Contractor, on behalf of itself, its employees and its Subcontractors, agrees to indemnify, defend and hold Owner, its respective parent and/or subsidiary and/or affiliated compan(y)(ies), and their respective officers, directors, employees, agents and subcontractors harmless from any liability, penalties or damages which might be imposed by reason of an asserted or established violation of any federal, state, provincial, county and/or local law, ordinance, lawful order, rule, standard or regulation by Contractor, its employees or Subcontractors.

F. Contractor shall perform the Work in accordance with all applicable permits, certificates and licenses acquired by Owner.

II. Legal Restrictions and Waste Disposal Permit Conditions

Contractor shall not violate any zoning, setback, buffer or other locational aspects of applicable laws, codes or ordinances, or of any recorded covenants or permit conditions of any of Owner's waste disposal or other permits (including, but not limited to, those referenced in the project specifications). If Contractor observes that portions of the Contract Documents are at variance with applicable laws, statutes, ordinances, building codes, rules, regulations or permit conditions, Contractor shall notify Owner promptly in writing and any necessary changes shall be accomplished by appropriate modification to the Contract Documents.

III. Building Permits, Certificates and Licenses

A. Contractor shall procure all federal, state, county, local and all other applicable permits, certificates, bonds licenses and inspections and shall give all applicable notices and pay for all applicable governmental charges and inspection fees as required for proper performance of the Work to be performed by Contractor as applicable. Contractor shall not initiate or perform any Work until copies of the appropriate permits, certificates, bonds, licenses and inspections (if necessary or required) which are required prior to performance of the Work are submitted to Owner.

IV. Standards, Specifications, and Codes

A. Where provisions of the Contract Documents refer to or wherever the Work performed under the Contract Documents relates to the specification of the AASHTO, AIA, ASTM, NSF or other specific standards and specifications, such specifications are made a part hereof to the extent which is indicated. Where standards, specifications, codes, etc., are referred to herein, it shall be understood that such reference is to the issue in effect at the time of Contractor's performance of the Work.

B. Abbreviations for the names or designation of recognized technical societies and industry standards in general use in the Technical Specifications include but are not limited to the following:

AASHTO	American Association of State Highway and Transportation Officials
AIA	American Institute of Architects
ASTM	American Society for Testing and Materials
NSF	National Sanitation Foundation

V. Material and Workmanship

A. All materials shall be new, free from rust or other foreign matter, and of the best quality of their respective kind. The types and sources of all materials shall be subject to Owner's approval. The Work in all respects shall be performed in a good and workmanlike manner and all Work shall be performed by persons skilled in the performance of their respective duties. Such materials and workmanship shall be free from negligence.

B. Owner is privileged to reject any materials having been obtained and installed at any time and any rejected material shall be removed and replaced with approved materials or repaired in accordance with the manufacturer's recommendations by Contractor, without delay, at Contractor's sole expense, risk and account (at no cost to Owner). All materials furnished and installed under these Contract Documents shall be of approved design and manufacture and shall be limited to products regularly produced, recommended, and guaranteed for service ratings in accordance with the manufacturer's catalog data or other comprehensive literature made available to the public and in effect at the time of execution of this Agreement. In addition to the foregoing, all materials and equipment must conform to and comply with all solid waste permit conditions for the Site.

VI. Standards of Quality

If the Contract Documents including, but not limited to, the Technical Specifications and/or Contract Drawings, describe materials, devices, or equipment as those which shall be similar and equal to certain materials, devices, or equipment designated by trade or manufacturer's name and Contractor desires to use such "equal," then Contractor shall be required to demonstrate to the satisfaction of Owner that the materials, devices, or equipment it proposes to furnish are in fact, similar or equal to the quality of those designated in such documents prior to Contractor placing an order therefore or incorporating such "equal" into the Work. In addition, Contractor shall comply with all provisions of the Contract Documents regarding substitutions.

21. Patents/Copyrights

A. If, during the course of performance of the Work by Contractor under this Agreement, or within a period of one (1) year thereafter, Contractor and/or any of the Contractor's employees or Subcontractors make any invention or discovery arising out of or resulting from the Work performed by Contractor or its Subcontractors pursuant to the Contract Documents, Contractor and/or its Subcontractors shall furnish Owner with full and complete information on such invention or discovery and shall, upon request of Owner and without further compensation, assign the entire right, title and interest thereto, together with all rights to patents thereon, to Owner; authorize Owner, to apply for Letters Patent for said discovery or invention in any and all countries in its own name or in any name at its election, and Contractor and its Subcontractors shall further, upon the request of Owner and at Owner's expense, execute and deliver, or procure the execution and delivery of, any and all rightful oaths, applications for patents and other papers and generally do all lawful acts for said Owner, its successors, assigns or legal representatives to obtain and enforce patent protection on said invention in all countries.

B. To the fullest extent permitted by law, Contractor shall indemnify, defend, and hold Owner, its parent and/or subsidiary and/or affiliated compan(y)(ies) and their respective officers, directors, employees, agents and subcontractors harmless from all costs and expenses (including, but not limited to, all reasonable attorneys' fees, professional engineering fees and charges, sampling and testing fees, experts' fees and other consultants' fees and charges) and liability of any kind for or on account of infringement or claimed infringement of any patent or any patented or unpatented invention, article, material, or process manufactured or used in the performance of the Work, incorporated into the Work or occasioned by use of the Work by Owner or another.

22. Confidentiality

A. In connection with the Work to be performed under the Contract Documents, Owner may disclose to Contractor, or Contractor may have access to, through its representatives, confidential commercial information and technical data (including trade secrets in which Owner has proprietary rights) patentable as well as unpatentable (hereinafter "Information"). All such Information, howsoever disclosed, developed, or

obtained by Contractor shall not be used or disclosed to others without Owner's prior written consent unless such information is in the public sector (through no fault or breach of any term or condition of the Contract Documents by Contractor). Upon completion of the Work, or upon earlier termination of this Agreement, Contractor shall return to Owner all such prints, drawings and documents of any kind supplied by Owner, together with all copies thereof made by or for Contractor and its Subcontractors.

B. Contractor shall not release Information or discuss the Work with news media, governmental agencies, or other interested parties at any time without the prior written consent of Owner.

C. Notwithstanding the provisions of this Section of the Agreement to the contrary, Information referred to in this Section of the Agreement may be disclosed to a court of competent jurisdiction if it is legally required to be disclosed. If such Information is requested to be disclosed by such court, Contractor shall provide Owner with written notice immediately of the request for disclosure so that Owner may enforce the provisions of this Agreement, seek an appropriate protective order and/or in Owner's sole discretion, waive Contractor's compliance with selected provisions of this Agreement concerning all of a portion of such Information.

23. Liability and Guarantee

I. Protection of the Work and Safety

A. Contractor shall maintain the Work, materials and/or equipment free from injury or damage from rain, wind, water, storms, frost and/or heat. If adverse weather makes it impossible to continue performing the Work in a safe manner, in spite of employing appropriate weather precautions, Contractor shall cease performance of the Work and notify Owner of such cessation.

B. Contractor shall not permit open fires on the Site except with the prior written permission of Owner and Contractor's adherence to all applicable laws, regulations, rules, standards and orders.

C. Contractor, at its own expense, risk and account (at no cost to Owner), shall repair, replace, and maintain in service any Facilities which are damaged, broken, or otherwise rendered inoperative by Contractor or any of its Subcontractors during performance of the Work. The method used by Contractor in repairing, replacing, or maintaining such Facilities shall be approved by Owner. However, Owner's approval does not in any way relieve Contractor of any of its obligations, liabilities, and responsibilities regarding the protection, repair, replacement or maintenance of such Facilities. Contractor shall be responsible for coordination of the Work with the owners of such Facilities.

D. Contractor shall take all necessary precautions for the safety of and shall provide protection to prevent damage, injury or loss to all subcontractors [including, but not limited to, all Subcontractors (as defined herein)], visitors, invitees, and licensees on the Site; employees performing the Work and other persons who may be affected thereby or in the vicinity thereof; the Work itself (including materials and equipment to be incorporated therein); and other property at the Site or adjacent thereto such as structures and Facilities not designated for removal, relocation or replacement in the course of construction. Contractor shall comply with all applicable provisions of federal, state, local, and municipal safety laws, regulations and building codes to prevent accidents or injuries to persons on, about, or adjacent to any area where the Work is being performed.

E. Contractor shall erect and properly maintain, at all times, as necessary and required by the conditions and progress of the Work, all barricades, warning signs, scaffolding, shoring, sheeting, bracing, hazard markings (suitably illuminated) and safeguards for the protection of workmen and the public.

F. Contractor shall provide such equipment and medical facilities as are necessary to supply first aid to anyone who may be injured in connection with the Work, and shall have the capability of immediate removal and hospitalization, if required.

G. CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR THE MANNER, MANAGEMENT, MEANS, METHODS, SEQUENCES, PROCEDURES, AND TECHNIQUES NECESSARY TO PERFORM THE WORK IN A SAFE MANNER.

H. Contractor shall arrange and attend safety meetings with Owner in order to discuss any conditions at the Site perceived to be unsafe and/or any other matters relating to work safety. Meetings may be held at any time but not less frequently than weekly and may be part of the regularly scheduled construction meetings. An agenda shall be prepared for each meeting and an attendance sheet shall be signed by representatives of each party present at the meeting. Notwithstanding arranging and attending meetings, Contractor shall immediately notify Owner of any condition that is perceived to be unsafe.

II. Risk of Loss

Until Final Acceptance of the Work by Owner, all risk of loss, injury, theft, damage to or destruction of the Work including, but not limited to, materials and/or equipment contained therein (i.e. stored at the Site or incorporated into the Work) shall be borne by Contractor. Responsibility of Contractor shall extend to materials and/or equipment furnished or leased by Owner to Contractor under the terms and conditions of the Contract Documents. Contractor shall replace or repair all damaged and/or stolen work to the condition necessitated and/or required by the Contract Documents at Contractor's sole expense, risk and account at no cost to Owner.

III. Indemnification

A. To the fullest extent permitted by law, Contractor, for itself, its employees and Subcontractors shall indemnify, defend, and hold harmless Owner, its parent and/or affiliated and/or subsidiary compan(y)(ies), and their respective officers, directors, employees, agents, vendors and subcontractors from and against all claims, lawsuits, damages, losses and expenses, (including, but not limited to, all reasonable attorneys' fees, professional engineering fees, sampling and testing fees, experts' fees and other consultants' fees and charges) arising out of a breach of any terms or conditions of the Contract Documents by Contractor or its Subcontractors, errors or omissions of Contractor or its Subcontractors, or resulting from the performance of the Work; provided, that any such claim, damage, loss and/or expense resulting from performance of the Work (1) is attributable to bodily injury, sickness, disease or death (including, but not limited to, injury or death to employees and/or Subcontractors of Contractor), or to injury to or destruction of property (including the loss of use resulting therefrom) or contamination of or adverse effects on the environment (including, but not limited to, property damage to employees and/or Subcontractors of Contractor) and (2) is caused in whole or in part by the negligence, willful misconduct or strict liability of Contractor, any Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable.

B. In all claims against Owner, any person or entity indemnified hereunder, any subcontractor of Owner, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the indemnification obligation as provided herein shall not be limited in any way by any limitation on the amount or type of damages recoverable against Contractor, its employees or Subcontractors, regarding compensation or benefits payable by or for the Contractor or any Subcontractor under workers' or workmen's compensation acts, disability benefit acts or other employee benefit acts.

C. The obligations contained in this Section of the Agreement shall survive termination of this Agreement.

IV. Guarantee

A. In addition to and not in substitution or limitation of specific warranties, if any, required by law, this Agreement or the Contract Documents, Contractor warrants and guarantees for a period of one (1) year from the date of Final Acceptance of the Work by Owner that the Work to be performed and the materials and equipment to be furnished under the Contract Documents shall all be free from negligence, any errors or omissions, defects in design work done by Contractor and shall be technically correct and accurate, shall be fit and sufficient for the purposes expressed herein; that all tasks to be performed as necessary and required by the Contract Documents shall be fully and completely performed pursuant to the Contract Documents; and that all materials, equipment and finished Work shall function in accordance with the letter and intent of the Contract Documents including, but not limited to, the Technical Specifications, the

Contract Drawings and the warranty representations of Contractor.

B. In addition to, and not in limitation of, any remedy provided by law, in equity, the Contract Documents or other warranties, Contractor shall repair or replace any defective or negligently produced materials or workmanship which may develop during said one (1) year period, shall be responsible for all damages, costs and expenses (including, but not limited to, all reasonable attorneys' fees, professional engineering fees and charges, sampling and testing fees, experts' fees and other consultants' fees and charges) resulting from a breach of this warranty and guarantee by Contractor and/or its Subcontractors and Contractor shall be responsible for any damage to other work caused by the repairing of such defects, at Contractor's sole expense, risk and account (at no cost to Owner). Remedial work to be performed by Contractor shall include, but not be limited to, uncovering, removal, reinstallation, inspections and testing by Owner to determine the nature and extent of such defect. Such corrective or remedial work shall be undertaken in an expeditious fashion in accordance with a schedule developed by Owner, in Owner's sole discretion, even if additional costs are incurred in completing such work on any accelerated basis. Contractor shall be responsible for all such additional costs for accelerated work as indicated above. If requested by Owner, Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment used or to be used to repair such damage. Any such repairs or replacement and the affected Work shall be warranted by Contractor for an additional one (1) year period from the date of Final Acceptance by Owner of such repairs or replacement. At Owner's option, Owner may remedy any such defects or negligence and Contractor shall be liable for all reasonable costs arising therefrom including, but not limited to, all reasonable attorneys' fees, professional engineering fees and charges, sampling and testing fees, experts' fees and other consultants' fees and charges.

C. Contractor shall secure and deliver to Owner written warranties and guarantees from its Subcontractors reflecting the date the warranty period begins and the date upon which such warranty ends. Contractor shall transfer all manufacturer's or dealer's warranties to Owner immediately upon purchase of any materials or equipment for incorporation into the Work. Contractor shall perform no modifications to the materials or equipment or otherwise void such warranties except with the prior written consent of Owner. Contractor is responsible for the warranty of all Work, whether performed by it or by its Subcontractors at any time.

D. The warranty and remedies provided herein shall survive termination of this Agreement. Contractor shall not be entitled to an extension of the Agreement Time because of any delay in performance of the Work attributable to Owner's exercise of its rights and remedies hereunder.

V. Limitation of Liability.

NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR SPECIAL, INCIDENTAL, EXEMPLARY, PUNITIVE OR CONSEQUENTIAL DAMAGES INCLUDING WITHOUT LIMITATION LOSS OF USE, LOSS OF PROFITS OR REVENUES, OR COST OF SUBSTITUTE OR RE-PERFORMED SERVICES, SUFFERED, ASSERTED OR ALLEGED BY EITHER PARTY OR ANY THIRD PARTY ARISING FROM OR RELATING TO THIS AGREEMENT, REGARDLESS OF WHETHER THOSE DAMAGES ARE CLAIMED UNDER CONTRACT, WARRANTY, INDEMNITY, TORT OR ANY OTHER THEORY AT LAW OR IN EQUITY.

24. Waivers and Releases

A. Waivers and Releases (Upon Progress Payment and Final Payment)
Contractor, for itself and its Subcontractors (including, but not limited to, all materialmen, suppliers and laborers) and for all other persons furnishing any goods or services pertaining to the Work, hereby agrees as a condition precedent to Contractor receiving any payment under this Agreement, to furnish to Owner good and sufficient waivers and releases on Waiver and Release Forms contained in Section V of the Contract Documents for itself and to obtain and furnish to Owner similar waivers and releases from every Subcontractor (including, but not limited to, materialmen, suppliers and laborers) and all other persons furnishing goods and/or services pertaining to the Work on Waiver and Release Forms contained in Section V of the Contract Documents for "Subcontractors". These fully executed Waiver and Release Forms must accompany all Payment Forms submitted by Contractor to Owner hereunder, and be in the form of “upon receipt of the requested amount” for the Waiver and Release forms to be valid.

B. Payments Directly to Subcontractors

Contractor agrees that Owner may, in consultation with Contractor, and without obligation to do so, pay any Subcontractor directly and deduct such amount from any amounts which are due to Contractor hereunder, thereby, reducing the total amount of the Agreement Price owed to Contractor for performance of the Work by the amount so paid to such Subcontractor. In addition, Contractor agrees to hold Owner harmless from all claims, lawsuits, costs, damages, expenses and liability for such actions taken by Owner in accordance with Section 24 of this Agreement.

25. Insurance and Performance and Payment Bonds

A. Insurance

Contractor shall purchase and maintain such insurance as will protect it from claims set forth below which may arise out of or result from Contractor's performance of the Work, whether such Work is undertaken by Contractor or by any Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

i. Claims under worker's or workmen's compensation, disability benefit, and/or other similar employee benefit acts;

ii. Claims for damages because of bodily injury, occupational sickness or disease, or death of its employees;

iii. Claims for damages because of bodily injury, sickness or disease, or death of any person who is not its employee;

iv. Claims for damages insured by usual personal injury liability coverage which are sustained i) by any person as a result of an injury directly or indirectly related to the employment of such person by Contractor, or ii) by any other person;

v. Claims for damages because of injury to or destruction of tangible property, including loss of use resulting therefrom; and

vi. Claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle.

B. The insurance required by Paragraph 1 of this Section 25 of this Agreement shall be written for not less than the limits of liability specified as follows:

COVERAGE	REQUIREMENTS	MINIMUM AMOUNTS
Comprehensive General Liability	This coverage shall be written on an occurrence basis and include, but not be limited premises-operations, blanket contractual, XCU, independent contractors, products-completed, operations, personal injury and broad form property damage.	$1,000,000 Each Occurrence and $2,000,000 Annual Aggregate $2,000,000 Per Project Aggregate
Auto Liability	This coverage shall be written on an occurrence basis and include owned, hired, and non-owned vehicles.	$1,000,000 Combined Single Limit
Excess Umbrella Liability	This coverage shall be written on an occurrence basis.	$2,000,000 Combined Single Limit
Worker's Compensation Employers Liability	Statutory Worker's Compensation Coverage and Employers Liability. The employer's liability coverage shall not contain an exclusion for occupational disease.	

The insurance required under this section shall name Owner as an additional insured for the indemnity obligations under this contract (with the exception of Worker's Compensation insurance). The insurance policies shall contain a provision extending coverage on a primary basis to Owner for liabilities assumed under this contract. All policies shall contain a waiver of subrogation in favor of the Owner, and Owner will arrange with respect to its insurers to waive its rights of subrogation against Contractor's insurer for this project. The Worker's Compensation shall provide an Alternate Employer endorsement in favor of Owner. The Automobile Liability policy shall provide Motor Carrier Act Endorsement (MCS-90) and a Broadened Pollution endorsement (CA 9948) and shall cover all owned, hired and non-owned automobiles. Limits required may be satisfied by primary policies plus umbrella/excess liability.

C. Certified copies of the policies (upon Owner's request) and a Certificate of Insurance acceptable to Owner shall be filed with Owner prior to commencement of the Work. In addition, Contractor shall insure that all coverage required above remain in full force and effect even though Contractor may have to employ blasting or drilling to perform rock excavation.

D. If Contractor's insurance is canceled or amounts of coverage are reduced through aggregate erosion for any reason, Contractor shall immediately obtain new policies with the coverage stipulated herein. If Contractor fails to procure, maintain and/or pay for such insurance, Contractor agrees that Owner may, but is not obligated to, obtain such insurance on behalf of and at the sole expense of Contractor and such costs and expenses may be withheld from amounts due the Contractor under this Agreement or may be paid to Owner directly within ten (10) calendar days after receipt of an invoice from Owner for the same. In addition, Contractor agrees to hold Owner harmless from all claims, lawsuits, costs, damages, expenses and liability for such actions taken by Owner in accordance with Section 25 of this Agreement. Failure to obtain adequate insurance coverage shall not be a basis for an extension of the Agreement Time or adjustment of the Agreement Price.

E. Contractor shall name Owner as an additional insured (hereinafter referred to as the "Additional Insured") without limitation on all coverage listed in this Section of the Agreement, except for Worker's Compensation coverage. All insurance carried by Contractor in accordance with this Section of the Agreement shall be endorsed to provide that:

i. The Additional Insured is included as an additional insured with the understanding that any obligation imposed upon the insured (including, without limitation, the responsibility of paying premiums) shall be the sole obligation of Contractor and not that of the Additional Insured or any other insured;

ii. The respective interest of the Additional Insured shall not be invalidated by any action or inaction of Contractor or any other person or entity. The Additional Insured shall remain an additional insured regardless of any breach or violation by Contractor or any other person of any warranties, declarations or terms or conditions contained in such policies;

iii. With respect to such insurance, the insurer thereunder waives all rights of subrogation against the Additional Insured, any right of set-off and counterclaim and any other right to deduction whether by attachment or otherwise;

iv. Such insurance shall be primary without the right of contribution of any other insurance carried by or on behalf of the Additional Insured with respect to its respective interest as such in the Site and the Work;

v. If such insurance is canceled for any reason whatsoever including non-payment of premium or any substantial change is made in the coverage which affects a substantial interest of the Additional Insured, such cancellation or change shall not be effective as to the Additional Insured until thirty (30) days after receipt of written notice by the Additional Insured of such cancellation or change; and

vi. Any insurance carried by the Contractor in accordance with the provisions herein shall be endorsed to provide that inasmuch as the policy is written to cover more than one insured, all terms, conditions, insuring agreements and endorsements shall operate in the same manner as if there were a separate policy covering each insured.

F. If Contractor intends to charge Owner for such insurance premiums, they shall already be reflected in the Agreement Price.

26. Performance and Payment Bonds

The Contractor shall provide a standard performance and payment bond for the full amount of the Agreement Price.

27. The Work Schedule, Deliveries and Storage

I. Scheduling

A. Contractor shall be responsible for arranging and attending a meeting with Owner to develop a detailed work schedule herein referred to as "the Schedule" which shall be more detailed and descriptive than any schedule which may have been submitted to Owner prior to the execution of this Agreement.

B. The Schedule shall not exceed the Agreement Time unless agreed upon in writing by Owner and Contractor.

C. The Schedule shall be updated during the regularly scheduled construction meetings at the Site or at more frequent times as otherwise agreed to by Owner and Contractor. The update shall include the following items as well as any additional information necessary to make an accurate and informative report:

i. Actual start dates;

ii. Actual finish dates;

iii. Percentage of the Work completed (together with the number of units installed, if applicable);

iv. Whether the Work is on schedule, and if not, a statement as to how Contractor intends to get back on schedule (together with projected changes in the Schedule required for safe completion of the Work); and

v. The remaining duration of the Work in work days (together with the number of units needed to be installed, if applicable).

D. The Schedule represents the work schedule of Contractor. Contractor accepts and agrees to abide by the Schedule as formulated herein. The Schedule supersedes all prior oral or written work schedules of any type created by Contractor or Owner for performance of the Work.

E. It shall be Contractor's responsibility to promptly notify Owner in writing of any delay which may jeopardize completion of the Work in accordance with the Schedule. If, at any time, it appears to Owner

that the rate of progress of the Work is insufficient to insure completion of the Work in accordance with the Agreement Time, Owner shall notify Contractor and Contractor shall take such steps as are necessary to insure safe completion of the Work within such Agreement Time. Any additional expenses and/or costs incurred by Contractor or charges made to Owner in excess of the Agreement Price in complying with Schedule milestones (including but not limited to those incurred for overtime or additional shifts) shall be paid solely by Contractor (at no cost to Owner).

II. Deliveries

All deliveries shall be coordinated with Owner which are not specifically addressed in the Contract Documents. Owner will work with Contractor in scheduling delivery of materials to the Site.

III. Storage and Unloading

Contractor shall be solely responsible for receiving, unloading, handling and storing all materials for the Work upon delivery at the Site at Contractor's sole cost, expense (including, but not limited to drayage), risk and account (at no additional cost to Owner). Unloading must be accomplished within the Shipper's "free period" and any demurrage charges resulting from failure to do so shall be at Contractor's sole expense, risk and account (at no cost to Owner). Contractor may store material, machinery, and equipment in an area designated by Owner. Contractor is required to coordinate and relocate materials as necessary at no cost to Owner. Owner's designation of a storage area shall in no way make Owner responsible for damage to, loss or theft of such materials, machinery, and/or equipment.

28. Delays, Unknown Conditions and Suspension of the Work

A. Force Majeure

If Contractor is delayed in the prosecution or completion of the Work due solely to Acts of God or fire, floods, insurrections, riots, epidemics, acts of governmental authorities, changes in law or abnormally or unusually severe weather which are beyond the control and without the fault or negligence of Contractor and which have a material adverse effect upon Contractor's ability to complete the Work within the Agreement Time, then the Agreement Time shall be extended for a period consistent with the time by which completion is delayed. Contractor shall use its best efforts to make up any time lost by such delays, if any. Contractor shall notify Owner of any such delay and the causes therefor in writing within five (5) working days after the delay commences, otherwise Contractor will be deemed to have waived any extension of time. Contractor shall accept any extension of time from Owner in full and complete satisfaction for any increased cost or expense resulting from such excusable delay. There shall be no payment or compensation of any kind (including, but not limited to, costs, expenses and charges for standby time) to Contractor for expenses or damages arising from delay. Delays caused by the Contractor, its Subcontractors or materialmen shall not be considered reasons for an extension of time.

B. Unknown Conditions

If conditions (including, but not limited subsurface or otherwise concealed physical conditions) are encountered at the Site which are unknown physical conditions (prior to such conditions being encountered) of an unusual nature and which differ materially from those ordinarily found to exist and are not generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then written notice by Contractor shall be given to Owner promptly before such conditions are disturbed and in no event later than three (3) days after the first occurrence of each condition. Owner and Engineer will promptly investigate such conditions and, if they are unknown, unusual, differ materially from those conditions ordinarily found to exist and are not generally recognized as inherent in construction activities of the character provided for in the Contract Documents and cause a material increase or decrease in the Contractor's cost of, or time required for, performance of all or any part of the Work, Engineer will recommend to Owner an equitable adjustment in the Agreement Price, Agreement Time or both. If Engineer determines that the conditions at the Site are not unknown, unusual, and do not materially differ from those conditions ordinarily found to exist and are generally recognized as inherent in construction activities of the character provided for in the Contract Documents and that no change in the terms of the Contract Documents is justified, Engineer shall so notify Owner and Contractor in writing, stating the reasons therefore. Engineer's decision in this regard shall be final.

C. Suspension of the Work

i. Owner may, at any time and without cause, suspend the Work or any portion thereof upon giving notice to Contractor. Contractor shall strictly comply with Owner's notice and shall reasonably act to minimize the cost of such suspension. Any part of the Work not suspended shall continue to be prosecuted with full diligence by Contractor.

ii. Owner may, at any time, direct Contractor to resume the Work which was previously suspended and an equitable adjustment may be made to pay for Contractor's direct actual costs and the costs of Contractor's supplies and subcontractors, including cost of storage, demurrage, and other direct delay costs, incurred during the period of suspension and provide, if appropriate, adjustment of the Agreement Time in accordance with all other provisions of the Contract Documents relating thereto.

iii. Should Owner suspend the Work for in excess of six (6) months, and Owner and Contractor do not agree to mutually satisfactory terms to extend such suspension, such suspension shall cause this Agreement to be terminated in accordance with Section 29 of this Agreement.

iv. The right of Owner to stop the Work shall not give rise to any duty or obligation on the part of Owner to exercise this right for the benefit of Contractor or any other person or entity.

29. Agreement Termination

I. Owner's Right to Terminate for Cause

A. Owner may, without prejudice to any other right or remedy, and upon giving Contractor written notice, terminate this Agreement immediately and may (without liability being attributed to Owner) take possession of the premises and of all materials, tools, equipment, and accessories thereon and finish the Work by whatever method Owner may deem expedient for any of the following reasons:

i. Contractor is adjudged bankrupt;

ii. Contractor makes a general assignment for the benefit of its creditors;

iii. Contractor becomes insolvent;

iv. A receiver is appointed on account of Contractor's insolvency;

v. Contractor, at any time, refuses or fails to pursue the Work with due diligence; or to supply enough properly skilled workmen; or provide the proper quality and/or quantity of materials; or there is a reasonable doubt about whether the Contractor will be able to complete the Work in accordance with the Agreement Time and Agreement Price;

vi. Contractor fails to make prompt payment to Subcontractors or its workmen for material, equipment or labor;

vii. Contractor disregards any laws, regulations ordinances, permit conditions or rules of Owner; or

viii. Contractor breaches any of the terms or conditions of the Contract Documents (including, but not limited to, any provisions regarding the completion and submission of Waiver and Release Forms for Contractor and/or its Subcontractors).

B. Upon receipt of such termination notice, Contractor shall immediately discontinue the Work and deliver to Owner all permits, licenses, Contract and Shop Drawings, inspection reports, certifications or certificates obtained by Contractor relating in any way to any portion of the Work, together with a waiver and release fully executed by Contractor on a form provided by Owner in Section VII of the Contract Documents. Additionally, Contractor shall at the request of Owner, cancel any outstanding purchase orders or subcontracts or assign such purchase orders or subcontracts to Owner. Contractor shall not be entitled to receive any further payment from Owner for Work completed prior to the date of termination or any retainage until Final Acceptance of the Work pursuant to the provisions provided herein.

C. If after termination of Contractor's right to proceed for cause it is determined that there was no cause or default to terminate Contractor therefore, the rights and obligations of the parties shall be the same as if the termination had been issued by Owner under Section 29(III) of this Agreement.

II. Remedies in the Event of Owner's Termination of Contractor for Cause

A. Promptly upon termination of Contractor by Owner for cause, Owner shall make a determination of the cost of finishing the Work. Owner may finish the Work by whatever method Owner deems expedient. If the unpaid balance of the Agreement Price exceeds the expense of finishing the Work, including compensation for additional engineering, managerial, legal and administrative services, such excess shall be retained by Owner without any accounting to Contractor. If the expense of finishing the Work exceeds the unpaid balance of the Agreement Price, Contractor shall pay the difference immediately to Owner.

B. Contractor shall be liable for all costs and expenses incurred by Owner and others if Contractor is terminated by Owner for cause including, but not limited to, all reasonable attorneys' fees, professional engineering fees and charges, sampling and testing fees, experts' fees and other consultants' fees and charges. These remedies are in addition to, and not in limitation of, any remedies provided at law, in equity or otherwise pursuant to the Contract Documents of Owner.

III. Other Termination

Owner may, without prejudice to any other right or remedy, and upon giving Contractor prior written notice, unilaterally terminate this Agreement for any reason or no reason, in Owner's sole discretion. Upon receipt of such notice, Contractor shall immediately discontinue the Work unless the notice provides otherwise, and deliver to Owner all permits, licenses, certificates, drawings and all other work prepared or obtained by Contractor relating in any way to any portion of the Work, together with fully executed Waiver and Release Forms for itself and its Subcontractors. Additionally, Contractor shall, at the request of Owner, cancel any outstanding purchase orders or subcontracts or assign such purchase orders or subcontracts to Owner as requested by Owner. Owner shall pay to Contractor: i) that portion of the Agreement Price representing that portion of the Work satisfactorily completed prior to termination; ii) any direct and reasonable costs of demobilization, or termination charges associated with subcontractor and supplier demobilization and cancellation; iii) any other reasonable, necessary and direct expenses associated with such termination, and iv) a fee of seven (7%) calculated on items (ii) and (iii) above representing administrative costs incurred by Contractor and a reasonable profit thereon, less any amounts previously paid to or withheld by Contractor for such completed Work. No other amounts shall be payable to Contractor regarding such termination. In addition, the payments provided for herein shall be accepted by Contractor as its sole and exclusive compensation in the event of termination hereunder and in lieu of any and all liability of any nature whatsoever on the part of Owner.

30. The Premises and Completion of the Work

I. Substantial Completion, Final Inspection, Final Acceptance and Occupancy of the Work

A. When Contractor considers the entire Work or a designated portion thereof ready for its intended use, Contractor shall send notice to Owner certifying in writing that:

i. The Contract Documents have been reviewed; and,

ii. The Work has been inspected for compliance with the Contract Documents; and,

iii. After such inspection by Contractor, the Work has been completed in accordance with the Contract Documents; and,

iv. All equipment and systems constructed by Contractor hereunder have been tested in the presence of Owner and are operational; and

v. The Work is completed and ready for Final Inspection.

B. After receipt by Owner of such written certification that the Work is ready for Final Inspection Owner shall promptly make such Final Inspection.

C. If Owner determines that Substantial Completion i.e., the Work is sufficiently completed, in accordance with the Contract Documents, so that the Work can be utilized for the purpose for which it was

intended by Owner, has not occurred, Owner will promptly notify Contractor in writing, listing the reasons for not granting Substantial Completion and:

i. Contractor shall take immediate steps to remedy the stated deficiencies and shall send a second written certification to Owner; and

ii. Owner shall reinspect the Work; and

iii. Failure by Owner to include any items on the list of reasons for not granting Substantial Completion does not relieve Contractor of the liability or responsibility of Contractor to complete all Work in a good and workmanlike manner and in accordance with the terms and conditions of the Contract Documents.

iv. If Owner determines that Substantial Completion has occurred, Owner shall issue a certificate of Substantial Completion.

v. Owner shall have the right to exclude Contractor from the Work after the date of Substantial Completion.

D. Owner may, if it finds it necessary, occupy or use a portion or portions of the Work prior to or after Substantial Completion thereof. Occupancy or use of a portion or portions of the Work shall not constitute acceptance of the Work by Owner nor relieve Contractor of its obligations and/or liabilities hereunder.

E. After Substantial Completion **of all of the Work** has occurred, Contractor may make application for Final Acceptance to Owner. Such application may be made only if:

i. Substantial Completion (as defined herein) has occurred (i.e., all items of correction have been completed to the satisfaction of Owner, the Work has passed Final Inspection by Owner and Owner has issued a Certificate of Substantial Completion); and,

ii. Owner has received all maintenance and operating instructions for equipment and/or systems provided hereunder, schedules, guarantees, bonds, certificates of inspection, applicable certifications, Shop Drawings, record documents and other documents required to be prepared and/or delivered to Owner hereunder; and,

iii. Owner has received all fully executed Waiver and Release Forms (including Waiver and Release Forms for Final Payment) from the Contractor and all Subcontractors (as defined herein) on Waiver and Release Forms which are attached hereto in Section V of the Contract Documents; and,

iv. Owner has received Payment Forms for all remaining amounts due and owing but yet unpaid for the Work.

F. If Contractor has complied with all of the terms and conditions contained in Sections 30 of this Agreement for all of the Work, Owner shall issue Final Acceptance to Contractor for that part of the Work which is in compliance with all of the above.

31. Use of the Premises

A. Contractor shall comply with and enforce the rules and requirements of Owner and all applicable laws, regulations, ordinances and permit conditions with reference to deliveries, storage of equipment and/or material, enclosures, barriers, signs, advertisements, smoking, and deportment of employees on the premises.

B. Contractor shall conduct its operations at the premises in such a manner as to cause a minimum of inconvenience or disturbance to or interference with the normal and uninterrupted utilization of existing premises, Facilities, business operations and services adjacent to or in the vicinity of the premises. Operations which could prevent access thereto, interrupt, restrict or otherwise infringe upon the utilization or business operation thereof, shall be coordinated with Owner prior to the initiation of such operations. Contractor shall assure free, convenient, unencumbered and direct access to properties neighboring the Site for owners of such properties and their respective tenants, agents, invitees and guests.

C. Facilities shall not be interrupted without approval from Owner as to time and duration. No Facilities serving existing Site operations shall be discontinued until new service connections are installed (unless temporary connections are made to serve such Site operations).

D. The Work shall be performed during daylight hours. Non-daylight work must be approved by Owner in writing.

E. All personal vehicles shall be parked at a location designated by Owner. Only essential work related vehicles will be permitted on the Site.

F. All of Contractor's personnel including Subcontractors shall sign in and out daily at the Site, as required by Owner. Visitors, including delivery personnel, shall be escorted by Contractor's personnel while on Owner's property.

32. Housekeeping

A. Contractor shall maintain the Site, all roadways utilized to access the Site and all working areas in a reasonably clean and orderly condition. Contractor shall perform cleanups when necessary or as ordered by Owner. In no event shall cleanups be performed less frequently than once per week.

B. Contractor shall leave all surfaces free from any contamination resulting from performance of the Work. Upon completion or termination of the Work, Contractor shall remove from the Site and from all public and private property, at its own expense, all temporary structures and Facilities, tools, excess construction materials, fences and scaffolding which remain from its performance of the Work or operations hereunder. All waste materials, rubbish and all other debris of any kind resulting from performance of the Work or operation hereunder shall be disposed of pursuant to the provisions of this Section of the Agreement and the Contract Documents.

C. Owner shall provide a container for collection of all construction and other waste produced by Contractor, its employees and Subcontractors. Contractor shall be responsible for collection and delivery of the waste to the container and shall be responsible for maintaining the waste in accordance with all safety laws, rules, regulations, standards, ordinances, orders, Site permit conditions and precautions. Contractor warrants that such waste shall not contain any hazardous, explosive, highly flammable, infectious, pathological, radioactive, toxic or illegal waste as defined under any applicable laws, regulations or operating permits. Owner shall dispose of such waste.

33. Temporary Facilities

Contractor shall provide and secure all such temporary facilities and utilities as necessary to complete the Work. Such facilities and utilities shall include, but are not limited to, the following:

A. Pumps and hoses required to convey all water;

B. Toilets and sanitary facilities;

C. Commercial electrical power, if available;

D. Compressed air;

E. Signs, barricades, warning lights, scaffolding, shoring, sheeting, bracing and all safety devices;

F. Field office(s) and phone service; and/or

G. Temporary storage buildings.

34. Miscellaneous Terms and Conditions

A. Separate Contracts

Separate contracts may be awarded for different parts of the Work and/or for various types of Work at the Site. Contractor shall afford other contractors and Owner (if applicable) working on the Site reasonable opportunities for the receipt and storage of their materials and equipment and shall coordinate its work with theirs at no cost to

Owner.

B. Additional, Omitted, or Changed Work

i. Owner may authorize minor variations in the Work from the terms and conditions of the Contract Documents including, but not limited to, the Contract Drawings and Technical Specifications which do not involve an adjustment in the Agreement Price or the Agreement Time and are consistent with the overall intent of the Contract Documents. Such authorization may be implemented by a Field Order issued to Contractor and will be binding on Contractor who shall perform the Work involved promptly. If Contractor believes that a Field Order from Owner justifies an increase in the Agreement Price or an extension of the Agreement Time, Contractor shall send a written notice to Owner requesting a Change Order described below within five (5) days after receipt by Contractor of such Field Order otherwise, Contractor shall perform all work required by the Field Order promptly and no change in the Agreement Price nor Agreement Time shall be permitted.

ii. Owner, without invalidating the Agreement may, in its sole discretion, order changes in the Work or the Contract Documents within the general scope of this Agreement consisting of additions, deletions or other revisions, with the Agreement Price and the Period of Performance being adjusted accordingly. However, if Owner orders portions or all of the Work not to be performed, Owner shall do so in writing and Contractor shall delete such work as is indicated in the notice from the Work to be performed pursuant to this Agreement and shall reduce the Agreement Price and Period of Performance in proportion to such reduction. Notwithstanding any term or condition of this Agreement, a Change Order need not be executed to reflect Owner's deletion of Work from the scope of the Work but <u>may</u> be executed to reflect such change.

iii. Unless otherwise provided herein, a Change Order requested by Contractor shall be considered by Owner only if Contractor makes a request for a Change Order by sending written notice to Owner promptly but in no event later than five (5) days after the occurrence of the event giving rise to the request for a Change Order otherwise, Contractor shall not have a right to submit a Change Order to Owner for such event and no change in the Agreement Price nor Agreement Time shall be permitted. The notice to Owner must state the specific nature of the request. No request by Contractor for a change in the Contract Documents or adjustment in the Agreement Price or Agreement Time will be valid if not submitted in accordance with this Paragraph.

iv. If Owner considers a Change Order to be acceptable, it shall be executed by Owner's Authorized Representative. If Contractor considers a Change Order to be acceptable, it shall be executed by Contractor's duly authorized representative or Superintendent. The form of Change Order to be used hereunder is provided in Section V of the Contract Documents. Change Orders must be fully executed by both parties hereto prior to performance of the Extra Work which is the subject of the Change Order. Any changes in the terms or conditions of the Contract Documents as authorized by a Change Order fully executed by both parties hereto shall be performed under the applicable conditions of the Contract Documents (not modified by such Change Order). Changes that result in an increase in Agreement Price shall be calculated in accordance with the following methods:

a. <u>Firm Lump Sum</u> - If Owner requests, Contractor shall submit a written proposal covering the Extra Work on a firm lump sum basis. Owner shall review such proposal and upon mutual agreement, a Change Order to the Agreement shall be issued; and/or

b. <u>Fixed Unit Prices</u> - If Owner requests, and fixed unit prices are established in Section IX of the Contract Documents, then the increase in the Agreement Price shall be computed using such prices, <u>except</u>, however, these fixed unit prices shall apply only for quantities fluctuation of <u>+</u>20 percent of the original quantity. Quantity fluctuation in excess of <u>+</u>20 percent will require a re-evaluation of the fixed unit prices. If the fixed unit prices are not established in the Agreement or Contract Documents or such re-evaluation requires that different prices should apply, then Owner and Contractor shall negotiate and mutually agree upon fixed unit prices to apply to such changed work; and/or

c. <u>Actual Cost</u> - If Owner requests, Contractor shall perform the Extra Work covered by any increase in the Agreement Price on the basis of the actual cost incurred plus allowances for overhead and profit as provided herein. The increase in the price shall be computed as follows:

v. The direct cost of labor to Contractor at the rates set forth in Section IX of the Contract Documents shall be used, or, if no rates are attached, the effective rates established by any applicable labor agreement, including any surcharges contained in such labor agreement for fringe benefits, payroll taxes, and insurance shall apply. Such labor costs shall include all classifications up to and including General Foremen, but shall not include Contractor's clerical and supervisory employees, regardless of classification. Contractor shall receive an allowance of ten percent (10%) total for overhead and profit on the cost described in this Paragraph;

vi. The actual cost of materials incorporated into the Extra Work shall be used. Contractor must receive written authorization from Owner to furnish such materials prior to incorporation of such materials into the Extra Work. Contractor must establish that it has endeavored to obtain such materials at the lowest available prices and shall verify the cost of all materials by submitting the actual invoice. Material usage shall be subject to verification by Owner. Contractor shall receive an allowance of ten percent (10%) total for overhead and profit on the costs described in this Paragraph;

vii. The actual cost for the Extra Work subcontracted by Contractor will be allowed only when each Subcontractor has been approved in writing by Owner before Contractor commences such Extra Work. Only the net cost to Contractor shall be considered a cost hereunder that may be billed to Owner, it being understood that, on any actual cost work by its Subcontractor(s), that allowances for tools, supplies, overhead, supervision and profit to the Subcontractor(s) shall not exceed ten percent (10%);

viii. The actual cost of equipment rented by Contractor from third parties not affiliated with Contractor at no more than published rates (i.e., Bluebook Equipment Rates) plus operating costs, less the applicable discount associated with the area where the Work is being performed shall be used. Contractor shall receive an allowance of ten percent (10%) total for overhead and profit on the costs described in this Paragraph; and

ix. The cost of rental of Contractor-owned equipment which shall include the cost of fuel, oil, lubrication, supplies, small tools, necessary attachments, repairs and maintenance, depreciation, storage and insurance at rates which are attached hereto in Section IX of the Contract Documents shall be used. Such costs shall not exceed the rental rates as published in the most current Bluebook Equipment Rate Guide. If rates are not attached hereto, then the cost of such equipment shall be at actual cost not to exceed the rental rates published in the most current Bluebook Equipment Rate Guide. Hourly rental charges of equipment on the Site shall be on the basis of 1/176th of monthly rates. Operators of rental equipment shall be paid in accordance with the "labor" provisions of Section 34 of this Agreement.

x. For all purposes of the Contract Documents, the profit and overhead allowances provided herein shall be deemed complete compensation to Contractor for all cost attributed to or apportioned to the Extra Work. By way of illustration, overhead and profit shall be deemed to include, but not be limited to: Contractor's profit; cost of capital; supervision; clerical and non-manual labor; all tools having a replacement value of less than $200; expendable supplies; warehousing costs; local transportation of material and labor; all expenses of Contractor prior to beginning the Extra Work; preparatory work performed by Contractor prior to beginning the Extra Work; Extra Work performed by Contractor which does not meet the standards to which the Work should be performed under the terms and conditions of the Contract Documents, including the cost of correcting or replacing such Extra Work, taxes on Contractor's income, profit, franchise, occupational license, or personal property; and, fines or assessments against Contractor by any governmental authority.

xi. The compensation established herein for any change ordered by Owner shall be the sole and exclusive consideration for such change. Any increased overhead, extension of the Agreement Time, inefficiencies, and all other costs and profits are incorporated into the compensation established pursuant to this Section of the Agreement and are agreed upon by Contractor.

xii. If notice of any change affecting the Work or the provisions of the Contract Documents (including, but not limited to, the Agreement Price or Agreement Time) is required by the provisions of any bond to be given to a surety, the giving of any such notice shall be Contractor's responsibility, and the amount of each applicable bond shall be increased by any increase in the Agreement Price caused by such Change Order.

C. If a dispute arises Owner and Contractor will attempt to settle any dispute arising out of or relating to this Agreement through cooperation and negotiation in good faith. Either party may initiate such negotiations at any time upon written request to the other. Either party may demand that the dispute be submitted to mediation, by

written notice to the other party. When such a demand is made, the parties shall within ten (10) days jointly make arrangements for the mediation of the dispute within the State of _____ with a mutually agreeable party ("ADR Service Provider"), whose procedures for mediation of business disputes in effect on the date of the written demand for mediation shall govern the mediation in all respects, except as modified by written agreement of the parties.

35. Right to Audit

Owner shall have the right to audit all books, records and accounts of Contractor solely relating to the performance of the Work and for a period of two (2) years following Final Acceptance of the Work, during which time Contractor agrees to maintain such books, records and accounts at its own expense. Owner shall have full access to priced copies of all such records, accounts, purchase orders, invoices, equipment leases, subcontracts, time sheets and receipts of Contractor in order to verify the cost of the Work and any overhead and profit relating thereto.

36. Notice

Any notice required under this Agreement shall be given by and shall correspondingly be deemed received as follows: personal delivery (on the date of delivery); or, telecopy [on the date of transmission (if received during normal business hours)]; or, overnight express mail (on the day after delivery to a reputable overnight delivery service or the U.S Postal Service) or by registered or certified U.S. Mail, return receipt requested, (on the third day after being post-marked by the U.S. Postal Service); if addressed to the party to whom intended, and is sent with sufficient prepaid postage or delivery fees. Notice shall be given to the parties at the following addresses:

To Owner:

One copy of notice shall also be sent to the Engineering Department of Owner to the attention of Samuel Nicolai at: Casella Waste Systems, Inc.
25 Greens Hill Lane
Rutland, Vermont 05701
802-775-6198 (fax)

One copy of notice shall also be sent to the Legal Department of Owner to the attention of the General Counsel at: 25 Greens Hill Lane
Rutland, Vermont 05701
802-775-6198 (fax)

To Contractor:

Either party may change the location for receipt of notice hereunder by providing written notice to the other party as aforesaid.

37. Copies of Contract Documents Furnished to the Contractor

Upon execution of this Agreement, Owner may, if requested, provide one (1) copy of the Contract Documents to Contractor free of charge. Any additional copies shall be purchased for the cost of reproduction and handling.

38. Law and Severability

This Agreement is to be governed by the laws of the location of the Work. In the event that any provision(s) or portion of such provision(s) of the Contract Documents shall be void, unlawful or unenforceable, such provision(s) or portions thereof, shall be deemed stricken from the Contract Documents, but the Contract Documents shall not otherwise be affected and the remaining provisions, or portions thereof, shall continue in full force and effect.

39. Modification and Non-waiver

The parties agree that no change or modification to the Contract Documents, or any documents incorporated by reference herein or otherwise made a part of the Contract Documents, shall have any force or effect unless the change is in writing, dated and made a part of this Agreement. The execution of the change shall be authorized and signed in the same manner as this Agreement or as authorized by the Change Order provisions of this Agreement. In addition, any failure by Owner at any time or from time to time, to require the strict adherence to and performance of

the terms or conditions of the Contract Documents shall not constitute a waiver by Owner nor impair Owner's right to enforce such terms or conditions or any other terms or conditions of the Contract Documents.

40. Assignment

A. Contractor may not assign or subcontract any portion of the Work, right to payment or any terms or conditions of the Contract Documents without the prior written approval of Owner. The parties agree that there are no third party beneficiaries to this Agreement.

B. No assignment, transfer, or subcontract, even though consented to, shall relieve Contractor of its obligations, responsibilities and liability under the Contract Documents.

C. Should any assignee fail to perform the Work undertaken by it in a proper manner, Owner may, at Owner's option, require Contractor to terminate such assignment.

D. Owner may, in its sole discretion, freely assign this Agreement to any of its parent, subsidiary or affiliated companies or any other individual or entity.

41. Headings

All headings in this Agreement have been inserted for convenience of reference only and are not to be considered a part of this Agreement nor shall they in any way affect the interpretation of this Agreement.

42. Separate Counterparts and Telecopy

This Agreement may be executed in separate counterparts which shall collectively and separately be considered one and the same Agreement. No party shall be bound by this Agreement until Owner and Contractor have fully executed it. In addition, a telecopy or facsimile of this Agreement (including, but not limited to, executed signature pages) shall have the same legal force and effect as an original. If this Agreement is executed by telecopy or facsimile, originals of the executed Agreement shall be forwarded to both parties as soon as reasonably possible.

43. Remedies and Rights Not Exclusive

No remedies or rights herein conferred upon Owner are intended to be exclusive of any remedy or right provided by law, but each shall be cumulative and shall be in addition to every other remedy or right given hereunder or now or hereafter existing at law or in equity (including, but not limited to, the remedy of specific performance).

44. Approvals, Authorizations, Certifications, Reviews and/or Concurrences, etc. By Owner, Engineer or CQA Consultant

Any approvals, authorizations, certifications, reviews, observations, acceptances (including, but not limited to, Final Acceptance), progress payments, Final Payment, consents, inspections (including, but not limited to, Final Inspection), verifications, beliefs, monitoring, testing, opinions, indications of satisfaction, and/or concurrences by Owner, Engineer or CQA Consultant does not constitute acceptance, approval, certification nor assurance of completeness, quality, or accuracy concerning details, dimensions and quantities and shall not relieve Contractor of any obligations, responsibility or liability for Contractor's active or passive negligence, willful misconduct or strict liability, defects in workmanship, proper performance of the Work in a good and workmanlike manner, in accordance with the Contract Documents, and pursuant to the proper manner, means, methods, techniques, management, sequences and procedures of construction or safety nor shall such actions on Owner's part cause any liability or responsibility to be attributed to Owner. In addition, Contractor agrees to hold Owner indemnify, defend and hold harmless Owner from all claims, lawsuits, damages, costs, expenses (including, but not limited to, all reasonable attorneys', professional engineering, sampling and testing, experts' and other consultants' fees and charges) and liability for such actions taken by Owner as reflected in Section 34 of this Agreement.

45. Integration and Interpretation

This Agreement shall include the following documents which were previously sent to and received by Contractor in the Bid Package entitled "StageV Landfill Expansion" and which is incorporated by reference into this Agreement as fully as if set forth herein in their entirety:

A.

Section Number	Title
I	Invitation to Bid
II	Special Conditions
III	Instructions to Bidders
IV	Bid Forms and Bid Form Attachments
V	Construction Agreement and Forms
VI	Performance and Payment Bonds
VII	Technical Specifications
VIII	Contract Drawings

B. The various Contract Documents that constitute this Agreement shall, insofar as is possible, be so interpreted as to be consistent with one another. In the event of any conflict among the terms and conditions of the Contract Documents, this Agreement shall take precedence over all other documents.

C. If a discrepancy or inconsistency exists between the Contract Drawings and the Technical Specifications, Contractor shall notify Owner immediately for a resolution. Until a resolution is made by Owner, the Contract Drawings shall have precedence over the Technical Specifications (except as provided in paragraph "D" of this Section of the Agreement).

D. Among all Contract Documents (except for the Agreement which has precedence over all documents) the more stringent specifications shall have precedence over the less stringent specifications in such documents.

E. The document of the latest date shall govern unless such order of precedence is otherwise addressed in this Section of the Agreement.

F. All references in the Technical Specifications to "Industry Codes and Standards," or to "Manufacturer's Recommended Specifications," shall be deemed to refer to the latest editions or revisions of such "Standards" and "Specifications."

46. Entire Agreement and Binding Effect

This Agreement, including any Change Orders fully executed by both parties hereto and all documents incorporated by reference herein or specifically made a part of this Agreement as expressed herein, represents a negotiated agreement between and constitutes the entire agreement and understanding between Owner and Contractor. This Agreement shall supersede any prior written or oral negotiations, representations, agreements or understandings relating to the subject matter of the Contract Documents. In addition, this Agreement shall be binding upon all parties hereto, their heirs, successors, representatives and assigns.

_____	_____
By: _____	By: _____
Name: _____	Name: _____
Title: _____	Title: _____

CHANGE ORDER

CONTRACTOR:

_____

_____

_____

OWNER:

_____

_____

_____

SITE:

_____

_____

_____

PROJECT:

_____

_____

_____

CHANGE ORDER NUMBER: _____

DATE: _____

CONTRACT DESCRIPTION:

(Agreement) (Addendum) by and between

_____

and

_____

dated _____

as thereafter amended or changed pursuant to the terms of such Agreement (hereinafter referred to as the "Agreement") for the proper performance of all necessary, required and/or related Work to:

_____

_____

at the Site.

Contractor and Owner, intending to be legally bound hereby, agree to make the following changes to the Agreement:

I. Contractor shall provide all necessary and required labor, materials, tools, services, equipment and incidentals to

_____

_____

_____

II. This Change Order shall incorporate by reference the terms and conditions of the Agreement as fully as if reproduced in its entirety herein.

III. Contractor shall obtain the necessary insurance coverage and Certificates of Insurance as required by the Agreement prior to performing any Work.

IV. All other terms and conditions of the Agreement shall remain the same.

V. Change Order Summary:

A. The original Agreement Price was $ _____

B. Net change by previously authorized Change Orders $ _____

C. The Agreement Price prior to this Change Order was $ _____

D. The Agreement Price for this Change Order is $ _____

E. The new Agreement Price of the Agreement (including this Change Order) is $ _____

F. The Agreement Time for Substantial Completion of the Work required pursuant to the Agreement and this Change Order shall (be _____, 20__ (remain unchanged).

IN WITNESS WHEREOF, the parties hereto set forth their signatures as of the date first set forth above.

WITNESS:

By: _____

Printed Name: _____

CONTRACTOR:

By: _____

Printed Name: _____

Title: _____

WITNESS:

By: _____

Printed Name: _____

OWNER:

_____

CASELLA WASTE SYSTEMS, INC.

By: _____

Printed Name: _____

Title: _____

ATTACHMENT C-1

WAIVER AND RELEASE FORMS (CONTRACTOR)

WAIVER AND RELEASE FORM
(PROGRESS PAYMENT FOR CONTRACTOR)

Upon receipt of a progress payment in the sum of $_____ for labor, services, equipment, materials, permits, licenses and/or other goods or services (the "Goods and Services") provided to _____ (the "Owner") regarding the Work performed by _____ (the "Contractor") at _____ _____ as further set forth in an agreement between Owner and Contractor, dated _____, for _____as thereafter amended or modified (hereafter referred to as the "Agreement"), Contractor on behalf of itself, its employees, agents, subcontractors, vendors, materialmen and suppliers, at any tier, (hereafter collectively and individually referred to as the "Releasors") does hereby, to the fullest extent permitted by law and to the extent of receipt of the amount of the progress payment reflected above hereby, waives, releases and forever relinquishes, *pro tanto*, any and all: mechanics' liens; levies of any kind; attachment liens; judgment liens; execution liens; stop notices; bond rights; claims, lawsuits, losses, damages, costs and expenses (including, but not limited to, all attorneys', professional engineering, testing and sampling, experts' and other consultants' fees and charges) (hereafter collectively and individually referred to as the "Claims") which the Releasors had previously, have at the present time or may have in the future pertaining to the Goods and Services furnished or installed in connection with the Work (as defined in the Agreement) including, but not limited to, such Claims against or concerning the following: retainage or other funds not yet paid in accordance with the terms and conditions of the Agreement, land, buildings, structures, additions, improvements or personalty constructed under the Agreement and/or arising out of the Work furnished or installed thereunder; and/or all other assets (hereafter collectively and individually referred to as the "Assets") of Owner its parent corporation, its subsidiar(y)(ies) and affiliated companies and their respective officers, directors, shareholders, agents, employees, representatives, subcontractors, their successors and assigns (hereafter collectively and individually referred to as the "Releasees").

In addition to, and not in limitation of, any term or condition contained in the Agreement, to the fullest extent permitted by law, Contractor shall indemnify, defend and hold Releasees harmless, from any Claims against Releasees or the Assets and shall fully satisfy of record any such Claims incurred by Releasees because of the Contractor's or any of the Releasors' performance of the Work and breach of any terms or conditions of the Agreement or this Waiver and Release, at Contractor's sole cost and expense (including, but not limited to, all recording, reasonable attorneys', professional engineering, experts' and other consultants' fees and charges). If Contractor fails to satisfy any such Claims of record within five (5) calendar days after Owner's request to Contractor to do so, Owner may, but is not obligated to, satisfy such Claims of record and charge all costs and expenses associated therewith (including, but not limited to, all reasonable attorneys', professional engineering, experts', recording and other consultants' fees and charges) to Contractor who shall be solely responsible to pay for such charges (at no cost to the Releasees).

This Waiver and Release Form covers a progress payment for the Goods and Services provided to Owner for Work performed through _____ only and does not cover any retention or Goods and Services furnished or installed after that date.

WITNESS:	**CONTRACTOR:**
By: _____	By: _____
Printed Name: _____	Printed Name: _____
	Title: _____

WAIVER AND RELEASE FORM
(FINAL PAYMENT FOR CONTRACTOR)

Upon receipt of Final Payment in the sum of $_____ for labor, services, equipment, materials, permits, licenses and/or other goods or services (the "Goods and Services") provided to _____ (the "Owner") regarding the Work (as defined in the Agreement) performed by _____ (the "Contractor") at _____ _____, as further set forth in an agreement between Owner and Contractor, dated _____, for _____ _____ as thereafter amended or modified (the "Agreement"), Contractor on behalf of itself, its employees, agents, subcontractors, vendors, materialmen and suppliers, at any tier, (hereafter collectively and individually referred to as the "Releasors") does hereby to the fullest extent permitted by law:

A. Waive, release and forever relinquish any and all mechanics' liens; levies of any kind; attachment liens; judgment liens; execution liens; stop notices; bond rights; claims, lawsuits, losses, damages, costs and expenses (including, but not limited to, all attorneys', professional engineering, testing and sampling, experts' and other consultants' fees and charges) (hereafter collectively and individually referred to as the "Claims") which the Contractor had previously, has at the present time or may have in the future pertaining to such Goods and Services furnished or installed in connection with the Work (as defined in the Agreement) including, but not limited to, such Claims against or concerning the following: retainage or other funds not yet paid in accordance with the terms and conditions of the Agreement, land, buildings, structures, additions, improvements or personalty constructed under the Agreement and/or arising out of the Work furnished or installed thereunder; and/or all other assets (hereafter collectively and individually referred to as the "Assets") of Owner, its parent corporation, its subsidiar(y)(ies) and affiliated companies and their respective officers, directors, shareholders, agents, employees, representatives, subcontractors, their successors and assigns (hereafter collectively and individually referred to as "Releasees"); and,

B. Warrant that there are no amounts or Claims owed by the Contractor or the Releasors to any person or entity which could become the basis for a Claim against Releasees and in addition to, but not in limitation of, any terms or conditions contained in the Agreement, shall indemnify, defend and hold Releasees harmless, from any and all Claims whatsoever arising at law or in equity, or otherwise which Releasors may have against Releasees or the Assets by reason of any matter, cause or thing whatsoever arising out of performance of the Work, the Agreement and/or this Waiver and Release. Contractor shall fully satisfy of record any such Claims against Releasees or the Assets at Contractor's sole cost and expense (including, but not limited to, recording, reasonable attorneys', professional engineering, experts' and other consultants' fees and charges). If Contractor fails to satisfy such Claim of record within five (5) calendar days after Owner's request to Contractor to do so, Owner may, but is not obligated to, satisfy such Claim of record and charge all costs and expenses associated therewith (including, but not limited to, all reasonable attorneys', professional engineering, experts', recording and other consultants' fees and charges) to Contractor who shall be solely responsible to pay for such charges (at no cost to Releasees).

WITNESS:	**CONTRACTOR:**
By: _____	By: _____
Printed Name: _____	Printed Name: _____
	Title: _____

ATTACHMENT C-2

WAIVER AND RELEASE FORMS (SUBCONTRACTORS)

WAIVER AND RELEASE FORM
(PROGRESS PAYMENT FOR SUBCONTRACTOR)

Upon receipt of a progress payment in the sum of $_____ for all labor, services, equipment, rental, materials, permits, licenses and/or other goods or services (hereinafter the "Goods and Services") for _____ _____ (attach purchase order, agreement or scope of work and mark as Exhibit A) (hereafter referred to as the "Work") which is provided to _____ (the "Contractor") as part of the Work performed pursuant to an agreement between Contractor and _____ (the "Owner") dated _____, for _____ at _____ as thereafter amended or modified (the "Agreement"), the Undersigned on behalf of itself, its employees, agents, subcontractors, vendors, materialmen and suppliers, at any tier, (hereafter collectively and individually referred to as the "Subcontractor Releasors") does hereby, to the fullest extent permitted by law and to the extent of receipt of the amount of the progress payment reflected above hereby, waives, releases and forever relinquishes, *pro tanto*, any and all: mechanics' liens; levies of any kind; attachment liens; judgment liens; execution liens; stop notices; bond rights; claims, lawsuits, losses, damages, costs and expenses (including, but not limited to, all attorneys', professional engineering, testing and sampling, experts' and other consultants' fees and charges) (hereafter collectively and individually referred to as the "Claims") which the Subcontractor Releasors had previously, have at the present time or may have in the future pertaining to the Goods and Services furnished or installed in connection with the Work including, but not limited to, such Claims against or concerning the following: retainage or other funds not yet paid in accordance with the terms and conditions of the Agreement, land, buildings, structures, additions, improvements or personalty constructed under the Agreement and/or arising out of the Work furnished or installed thereunder; and/or all other assets (hereafter collectively and individually referred to as the "Assets"), of Owner its parent corporation, its subsidiar(y)(ies) and affiliated companies and their respective officers, directors, shareholders, agents, employees, representatives, subcontractors, their successors and assigns (hereafter collectively and individually referred to as the "Releasees").

To the fullest extent permitted by law, the Undersigned shall indemnify, defend and hold the Releasees harmless, from any Claims against the Releasees or the Assets and shall fully satisfy of record any such Claims against the Releasees or the Assets at the Undersigned's sole cost and expense (including, but not limited to, all recording, reasonable attorneys', professional engineering, experts' and other consultants' fees and charges) arising out of performance of the Work and breach of any terms or conditions of this Waiver and Release by the Undersigned or the Subcontractor Releasors. If the Undersigned fails to satisfy any such Claims of record within five (5) calendar days after Owner's request to the Undersigned to do so, Owner may, but is not obligated to, satisfy such Claims of record and charge all costs and expenses associated therewith (including, but not limited to, all reasonable attorneys', professional engineering, experts', recording and other consultants' fees and charges) to the Undersigned who shall be solely responsible to pay for such charges (at no cost to the Releasees).

This Waiver and Release Form covers a progress payment for the Goods and Services provided to Contractor or Owner for the Work performed through _____ only and does not cover any retention or Goods and Services furnished or installed after that date.

WITNESS:	**CONTRACTOR:**
By: _____	By: _____
Printed Name: _____	Printed Name: _____
	Title: _____

WAIVER AND RELEASE FORM
(FINAL PAYMENT FOR SUBCONTRACTOR)

Upon receipt of Final Payment in the sum of $_____ for all labor, services, equipment, rental, materials, permits, licenses and/or other goods or services (hereinafter the "Goods and Services") for _____ _____ (attach purchase order, agreement or scope of work and mark as Exhibit A) (hereafter referred to as the "Work") which is provided to _____ (the "Contractor") as part of the Work performed pursuant to an agreement between Contractor and _____ (the "Owner") dated _____, for _____ at _____ as thereafter amended or modified (the "Agreement"), the Undersigned on behalf of itself, its employees, agents, subcontractors, vendors, materialmen and suppliers, at any tier, (hereafter collectively and individually referred to as the "Subcontractor Releasors") does hereby to the fullest extent permitted by law:

A. Waive, release and forever relinquish any and all mechanics' liens; levies of any kind; attachment liens; judgment liens; execution liens; stop notices; bond rights; claims, lawsuits, losses, damages, costs and expenses (including, but not limited to, all attorneys', professional engineering, testing and sampling, experts' and other consultants' fees and charges) (hereafter collectively and individually referred to as the "Claims") which the Subcontractor Releasors had previously, have at the present time or may have in the future pertaining to such Goods and Services furnished or installed in connection with the Work including, but not limited to, such Claims against or concerning the following: retainage or other funds not yet paid in accordance with the terms and conditions of the Agreement, land, buildings, structures, additions, improvements or personalty constructed under the Agreement and/or arising out of the Work furnished or installed thereunder; and/or all other assets (hereafter collectively and individually referred to as the "Assets") of Owner, its parent corporation, its subsidiar(y)(ies) and affiliated companies and their respective officers, directors, shareholders, agents, employees, representatives, subcontractors, their successors and assigns (hereafter collectively and individually referred to as "Releasees"); and,

B. Warrant that there are no amounts or Claims owed by the Subcontractor Releasors to any person or entity which could become the basis for a Claim against Releasees and shall indemnify, defend and hold Releasees harmless, from any and all Claims whatsoever arising at law or in equity, or otherwise which Subcontractor Releasors may have against Releasees or the Assets by reason of any matter, cause or thing whatsoever arising out of the Undersigned's or Subcontractor Releasors' performance of the Work or this Waiver and Release. The Undersigned shall fully satisfy of record any such Claims at the Undersigned's sole cost and expense (including, but not limited to, recording, reasonable attorneys', professional engineering, experts' and other consultants' fees and charges). If the Undersigned fails to satisfy such Claim of record within five (5) calendar days after Owner's request to the Undersigned to do so, Owner may, but is not obligated to, satisfy such Claim of record and charge all costs and expenses associated therewith (including, but not limited to, all reasonable attorneys', professional engineering, experts', recording and other consultants' fees and charges) to the Undersigned who shall be solely responsible to pay for such charges (at no cost to Releasees).

WITNESS:	**CONTRACTOR:**
By: _____	By: _____
Printed Name: _____	Printed Name: _____
	Title: _____

SECTION VI

PERFORMANCE AND PAYMENT BONDS

Exhibit B

Construction Performance Bond

Any singular reference to Contractor, surety, Owner or other party shall be considered plural where applicable.

CONTRACTOR (Name and Address):

SURETY (Name and Principal Place of Business):

OWNER (Name and Address):

CONSTRUCTION CONTRACT
Date:
Amount:
Description (Name and Location):

BOND
Date (Not earlier than Construction Contract Date):
Amount:
Modifications to this Bond Form:

CONTRACTOR AS PRINCIPAL
Company: (Corp. Seal)

Signature:
Name and Title:

SURETY
Company: (Corp. Seal)

Signature:
Name and Title:

CONTRACTOR AS PRINCIPAL
Company: (Corp. Seal)

SURETY
Company: (Corp. Seal)

EJCDC No. 1910-28A (1984 Edition)
Prepared through the joint efforts of The Surety Association of America, Engineers' Joint Contract Documents Committee. The Associated General Contractors of America, and the American Institute of Architects.

1. The Contractor and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference. *

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except to participate in conferences as provided in Subparagraph 3.1.

3. If there is no Owner Default, the Surety's obligation under this Bond shall arise after:

3.1. The Owner has notified the Contractor and the Surety at its address described in Paragraph 10 below, that the Owner is considering declaring a Contractor Default and has requested and attempted to arrange a conference with the Contractor and the Surety to be held not later than fifteen days after receipt of such notice to discuss methods of performing the Construction Contract. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default; and

3.2. The Owner has declared a Contractor Default and formally terminated the Contractor's right to complete the contract. Such Contractor Default shall not be declared earlier than twenty days after the Contractor and the Surety have received notice as provided in Subparagraph 3.1; and

3.3. The Owner has agreed to pay the Balance of the Contract Price to the Surety in accordance with the terms of the Construction Contract or to a contractor selected to perform the Construction Contract in accordance with the terms of the contract with the Owner.

4. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

4.1. Arrange for the Contractor, with consent of the Owner, to perform and complete the Construction Contract; or

4.2. Undertake to perform and complete the Construction Contract itself, through its agents or through independent contractors; or

4.3. Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and the contractor selected with the Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 6 in excess of the Balance of the Contract Price incurred by the owner resulting from the Contractor's default; or

4.4. Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:

1. After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, tender payment therefor to the Owner; or

2. Deny liability in whole or in part and notify the Owner citing reasons therefor.

5. If the Surety does not proceed as provided in Paragraph 4 with reasonable promptness, the Surety shall be deemed to be in default on this Bond fifteen days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Subparagraph 4.4, and the Owner refuses the payment tendered or the Surety has denied liability in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

6. After the Owner has terminated the Contractor's right to complete Construction Contract, and if the Surety elects to act under Subparagraph 4.1, 4.2, or 4.3 above, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. To limit of the amount of this Bond, but subject to commitment by the Owner of the Balance of the Contract Price to mitigation of costs and damages on the Construction Contract, the Surety is obligated without duplicate for:

6.1. The responsibilities of the Contractor for correction of defect work and completion of the Construction Contract;

6.2. Additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions failure to act of the Surety under Paragraph 4; and

6.3. Liquidated damages, or if no liquidated damages are specified, the Construction Contract, actual damages caused by delay performance or non-performance of the Contractor.

7. The Surety shall not be liable to the Owner or others for obligation the Contractor that are unrelated to the Construction Contract, and Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on Bond to any person or entity other than the Owner or its heirs, executors, administrators, or successors.

8. The Surety hereby waives notice of any challenge, including change time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

9. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the ~~location in which the or part of the work is located~~ **and shall be instituted within two years after Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform obligations under this Bond, whichever occurs first. If the provision this Paragraph are void or prohibited by law, the minimum period limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

10. Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the signature page.

11. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

12. Definitions.

12.1. Balance of the Contract Price: The total amount payable by Owner to the Contractor under the Construction Contract, all proper adjustments have been made, including allowance the Contractor of any amounts received or to be received, the Owner in settlement of insurance or other claims for ages to which the Contractor is entitled, reduced by all and proper payments made to or on behalf of the Contractor under the Construction Contract.

12-2. Construction Contract: The agreement between the Owner, the Contractor identified on the signature page, including Contract Documents and changes thereto.

12-3. Contractor Default: Failure of the Contractor, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Construction Contract.

12.4. Owner Default: Failure of the Owner, which has neither remedied nor waived, to pay the Contractor as required by Construction Contract or to perform and complete or comply with the other terms thereof, in any material respect.

13. Any Contractor selected to perform the obligations of the Contractor under the construction contract must be approved, in advance, by the Owner, which approval shall not be unreasonably withheld.

*lncluding, without limitations, the one year correction period under Paragraph 23 (IV) of the Construction Agreement.

**insert “State of New Hampshire”

(FOR INFORMATION ONLY-Name, Address and Telephone)

AGENT or BROKER:

OWNER'S REPRESENTATIVE (Architect, Engineer or other party)

Exhibit C

CONSTRUCTION PAYMENT BOND

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

CONTRACTOR (Name and Address):

SURETY (Name and Principal Place of Business):

OWNER (Name and Address):

CONSTRUCTION CONTRACT

Date:
Amount:
Description (Name and Location):

BOND

Date (Not earlier than Construction Contract Date):
Amount:
Modifications to this Bond Form:

CONTRACTOR AS PRINCIPAL

Company: (Corp. Seal)

Signature:

Name and Title:

SURETY

Company: (Corp. Seal)

Signature:

Name and Title:

CONTRACTOR AS PRINCIPAL

Company: (Corp. Seal)

SURETY

Company: (Corp. Seal)

EJCDC No. 1910-28B (1984 Edition)
Prepared through the joint efforts of the Surety Association of America, Engineers= Joint Contract Documents Committee. The Associated General Contractors of America, and the American Institute of Architects.

1. The Contractor and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner to pay for labor, materials and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference.*

2. With respect to the Owner, this obligation shall be null and void if the Contractor:

2.1 Promptly makes payment, directly or indirectly, for all sums due Claimants, and

2.2 Defends, indemnifies and holds harmless the Owner from all claims, demands, liens or suits by any person or entity who furnished labor, materials or equipment for use in the performance of the Construction Contract, provided the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 12) of any claims, demands, liens or suits and tendered defense of such claims, demands, liens or suits to the Contractor and the Surety, and provided there is no Owner Default.

3. With respect to Claimants, this obligation shall be null and void if the Contractor promptly makes payment, directly or indirectly, for all sums due.

4. The Surety shall have no obligation to Claimants under this Bond until:

4.1 Claimants who are employed by or have a direct contract with the Contractor have given notice to the Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to the Owner, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.

4.2 Claimants who do not have a direct contract with the Contractor:

1. Have furnished written notice to the Contractor and sent a copy, or notice thereof, to the Owner, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials were furnished or supplied or for whom the labor was done or performed; and

2. Have either received a rejection in whole or in part from the Contractor, or not received within 30 days of furnishing the above notice any communication from the Contractor by which the Contractor has indicated the claim will be paid directly or indirectly; and

3. Not having been paid within the above 30 days, have sent a written notice to the Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to the Owner, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to the Contractor.

5. If a notice required by Paragraph 4 is given by the Owner to the Contractor or to the Surety, that is sufficient compliance.

6. When the Claimant has satisfied the conditions of Paragraph 4, the Surety shall promptly and at the Surety's expense take the following actions:

6.1 Send an answer to the Claimant, with a copy to the Owner, within 45 days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed.

6.2 Pay or arrange for payment of any undisputed amounts.

7. The Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

8. Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any Construction Performance Bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of Construction Contract are dedicated to satisfy obligations of the Contractor and the Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

9. The Surety shall not be liable to the Owner, Claimants or others obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

11. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the ** ~~location in which work or part of the work is located~~ or after the expiration of one year, from the date (1) on which the Claimant gave the notice required Subparagraph 4.1 or Clause 4.2 (iii), or (2) on which the last labor service was performed by anyone of the last materials or equipment work furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a deft in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the Owner or the Contractor shall be mailed, delivered to the address shown on the signature page. Actual receipt of notice by Surety, the Owner or the Contractor, however accomplish shall be sufficient compliance as of the date received at the address shown on the signature page.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed incorporated herein. The intent is, that this Bond shall be construed statutory bond and not as a common law bond.

14. Upon t by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.

15. DEFINITIONS

15.1 Claimant: An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor labor, materials or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Construction Contract, architectural and engineering services required for performance of work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted; the jurisdiction where the labor, materials or equipment furnished.

15.2 Construction Contract: The agreement between the Owner and the Contractor identified on the signature page, including Contract Documents and changes thereto.

15.3 Owner Default: Failure of the Owner, which has neither remedied nor waived, to pay the Contractor as required by Construction Contract or to perform and complete or comply with the other items thereof, in any material respect.

*lncluding, without limitations, the one year correction period under Paragraph 23 (IV) of the Construction Agreement.

** insert "State of New Hampshire"

(FOR INFORMATION ONLY-Name, Address and Telephone)

AGENT or BROKER: OWNER'S REPRESENTATIVE (Architect, Engineer or other party.

SECTION VII

TECHNICAL SPECIFICATIONS

The following Technical Specifcations are incorporated by this reference into this Section of the Contract Documents as fully as if reproduced in their entirety herein.

TECHNICAL SPECIFICATIONS

DIVISION 1
GENERAL ADMINISTRATION

Section No.	***Description***
00150	Measurement and Payment
01005	Administrative Provisions
01051	Grades, Lines and Levels
01090	Abbreviations and Symbols
01200	Project Meetings
01300	Submittals
01400	Quality Assurance/Quality Control (QA/QC)
01500	Construction Facilities and Temporary Controls
01600	Material and Equipment Handling
01700	Contract Closeout
01720	Project Record Documents

SECTION 00150
MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Measurement of Quantities
B. Scope of Payment
C. Payment for Increased and Decreased Quantities
D. Eliminated Bid Items
E. Partial Payments
F. Payment for Materials on Hand
G. Incidental (Subsidiary) Work
H. Measurement and Payment of Bid Items

1.02 RELATED REQUIREMENTS

A. PART I Contract Documents
B. PART II All Technical Specifications

1.03 GENERAL

A. Each unit and lump sum price stated in the Bid Proposal shall constitute full compensation, as herein specified, for each item of the work completed.

B. All unit price bid items will be measured to determine final quantities of Work in place after completion of the Work and prior to the Final Payment of the Contract.

C. All units of measurement shall be standard United States units as applied to the specific items of work by industry tradition and as interpreted by the Engineer.

1.04 PARTIAL PAYMENT/MONTHLY PAY ESTIMATE

A. After Award of the Contract and prior to the Contractor's Mobilization on-site, the Contractor shall submit a breakdown of component quantities (and their unit prices) of the individual lump sum unit bid prices. This information shall form the basis for preparation of the monthly cost estimate in the "Monthly Progress Summation" form.

B. Prior to request for partial payment, the Contractor's superintendent or other authorized representative of the Contractor shall meet with the Engineer and determine and agree upon quantities of the unit price work accomplished and/or completed during the work period.

C. Once each month the Contractor will prepare a "Monthly Progress Summation" form as part of his partial payment request. The Payment Application shall be prepared on a form acceptable to the Owner and approved by the Engineer. The form shall be in a computer spreadsheet format and compatible with Microsoft Excel.

D. These completed forms will provide the basis of the Engineer's review of monthly quantity estimates upon which payment will be made. Items not appearing on the "Monthly Progress Summation" will not be considered for payment.

E. The Contractor shall submit with each payment application a bill of sale, invoice, or other documentation warranting that the Owner has received the material and equipment free and clear of all liens and that the materials and equipment are covered by appropriate insurance per paragraph 14.2 of the General Conditions.

1.05 SCOPE OF PAYMENT

A. For lump sum payment items, payments to the Contractor will be based upon the Engineer's estimate of percentage completion of the lump sum tasks. The estimate shall be based on approximated quantities of work completed in accordance with the Plans and Specifications and shall be reviewed and approved by the Engineer.

For unit price payment items (where applicable), payments to the Contractor will be made for the actual quantities of contract items performed and accepted in accordance with the plans and specifications. Upon completion of the construction, if these actual quantities show either an <u>increase</u> or <u>decrease</u> from the quantities given in the Proposal Form, the contract unit prices will still prevail, except as provided hereinafter.

B. The Contractor shall accept as payment as herein provided, full compensation for furnishing all materials, labor, tools, equipment, and incidentals necessary to the completed work and for performing all work contemplated and embraced by the contract. The payment shall be made with the prices contained in the Bid Proposal and shall include compensation for all loss or damage arising from the nature of the work, or from the action of the elements, or from any unforeseen difficulties which may be encountered during the prosecution of the work and until its final acceptance by the Engineer, and for all risks of every description connected with the prosecution of the work, except as provided herein, and also for all expenses incurred in consequence of the suspension of the work as herein authorized.

C. The payment of any partial estimate or of any retained percentage except by and under the approved final invoice in no way shall affect the obligation of the Contractor to repair or renew any defective parts of the construction or to be responsible for any damage due to such defects.

1.06 PAYMENT FOR INCREASED OR DECREASED QUANTITIES

A. When alterations in the quantities of work not requiring supplemental agreements are ordered and performed, the Contractor shall accept payment in full at the contract price for the actual quantities of work done. No allowance will be made for anticipated profits.

Unit quantity bid items and prices shall apply to extra authorized work <u>or</u> decreases in work as determined by the Engineer, where required work is in addition to or decreased from the limits of work indicated on the Plans.

B. Increased or decreased work involving supplemental agreements will be paid for as stipulated in such agreements.

C. Measurements for increased or decreased work shall be based on actual field surveys performed jointly by the Engineer and Contractor unless other measurement techniques are approved by the Engineer.

1.07 ELIMINATED ITEMS

A. The Engineer may eliminate any items from the Contract should they be found unnecessary for the proper completion of the work contracted. Such action shall in no way invalidate the contract, and no allowance will be made for items so eliminated in making final payment to the Contractor.

1.08 PARTIAL PAYMENT

A. Partial Payments shall be made monthly as the work progresses. All partial invoices and payments shall be subject to correction in the final quantity invoice and payment.

B. No monthly payment shall be required to be made when, in the judgment of the Engineer, the work is not proceeding in accordance with the provisions of the contract, or when, in his judgment, the total value of the work done since the last payment amounts to less than $10,000.

1.09 PAYMENT FOR MATERIAL DELIVERED ON LUMP SUM PROJECTS

A. At the discretion of the Engineer, acting upon the request of the Contractor, an invoice, accompanied by receipted bills, may be made for payment of all or part of the value of acceptable, non-perishable materials and equipment which are to be incorporated into the contract which have been delivered to the site of the work or in acceptable storage places, and not used at the time of such invoice.

B. Materials, when so paid for by the Owner shall become the property of the Owner and in the event of default on the part of the Contractor, the Owner may use, or cause to be used, these materials in the construction of the work provided for in the contract.

C. The Contractor shall be responsible for any damage to, or loss of, these materials.

D. The amount thus paid by the Owner shall go to reduce estimated amounts due the Contractor as the material is used in the work.

1.10 INCIDENTAL WORK

A. Incidental work items for which payment is not measured or made include but are not limited to, the following items:

1. Bond, insurance, and administrative costs.
2. Incidental Site Preparation, including removal of existing debris in the work area, and disposing of the materials at authorized disposal facilities.
3. Clean up.
4. Security, signs, safety equipment, etc.
5. Restoration of property.
6. Cooperation with other Contractors.
7. Utility crossing, unless otherwise paid for.
8. Minor items - such as replacement of fences, guard rails, rockwalls, etc.
9. Dewatering.
10. Roadway and parking area - signage.
11. Erosion control.
12. Preconstruction photographs.

13. Temporary utilities.
14. Traffic regulation.
15. Other associated work.
16. Testing.
17. All other work indicated on the Drawings or in the Specifications which is required and not specifically indicated in the bid items below.

Item Number 1 – General Conditions

MEASUREMENT: This item will be measured as a unit.

PAYMENT: Payment for General Conditions will be full compensation for all labor, materials, equipment, administration required to mobilize the Contractor's work force and initiate administrative functions, both on site and off site. Payment will include compensation for the provision of the Contractor's field office per specification 01500, and all other on-site activities required to start Work. In addition, payment shall include full compensation for demobilizing Contractor's equipment, completion of administrative and closeout tasks, and removal of all construction related temporary materials from the site.

Partial payment under bid item #1 General Conditions will be as follows:

The adjusted contract amount for construction items used below is defined as the total contract amount less the lump sum bid for General Conditions.

25% of the lump sum bid will be paid upon complete mobilization.

25% of the lump sum bid will be paid upon Substantial Completion.

40% of the lump sum bid will be paid upon Final Completion.

10% of the lump sum bid will be paid upon full demobilization, site restoration completion and all as-built survey information has been provided.

Upon completion of all work under this contract, payment for the remainder of the lump sum bid will be made. The amount bid for General Conditions cannot exceed ten percent (10%) of the total Bid Price.

Item Number 2 – Excavation and Filling

MEASUREMENT: This item will be an estimated percentage of total work under this item at the time of the pay period close.

PAYMENT: Payment for this item will be full compensation for all labor, materials, and equipment required to complete all excavation, filling and grading to the prepared subgrade as shown on the Plans and as necessary to complete the work. Item also includes excavation and filling to the proposed landfill subgrade and to proposed perimeter berm grades outside the landfill footprint, and sorting and stockpiling excavated materials in designated areas as required in all respects of the Contract Documents.

Item Number 3 – Erosion Control & Site Stabilization

MEASUREMENT: This item will be an estimated percentage of total work under this item completed during each pay period.

PAYMENT: Payment for this item will be full compensation for all labor, materials, and equipment required to complete all erosion control and site stabilization work as shown on the Plans. Payment for this item includes the installation and maintenance of all temporary erosion control devices and all appurtenant work in full conformance with the Drawings and Specifications.

This item shall include all other work required to complete the Work not included on other payment items.

Item Number 4 – Demolition

MEASUREMENT: This item will be an estimated percentage of total work under this item at the time of the pay period close.

PAYMENT: Payment for this item will be full compensation for all labor, materials and equipment required to demolish existing leachate manholes, valve chamber, forcemain, Geokon unit, underground electric, culverts, gas headers/laterals and groundwater wells in full conformance with the Drawings and Specifications.

Item Number 5 – Roadway, Site Work and Stormwater Ponds

MEASUREMENT: This item will be an estimated percentage of total work under this item at the time of the pay period close.

PAYMENT: Payment for this item will be full compensation for all labor, materials, and equipment required to construct the perimeter access road including installation of common borrow to achieve required subgrades, gravels, woven geotextile, guardrail and all appurtenant work in full conformance with the Drawings and Specifications.

Item Number 6 – Waste Excavation & Odor Control

MEASUREMENT: This item will be an estimated percentage of total work under this item at the time of the pay period close.

PAYMENT: Payment for this item will include full compensation for all labor, materials and equipment required to excavate and relocate intermediate cover soils and waste materials in full conformance with the Drawings and Specifications. Work includes removing waste materials to the required grade, decommissioning and extending the existing landfill gas collection system in the excavation area, installation of temporary tarp and ballasts, and relocation and filling of waste materials, including installation of daily and intermediate soil cover materials, and provision and utilization of odor control agent as deemed necessary by Engineer and Owner. Item also includes preparation and implementation of Site Safety & Contingency Work Plan.

Item Number 7 – Temporary Stormwater Management

MEASUREMENT: This item will be an estimated percentage of total work under this item at the time of the pay period close.

PAYMENT: Payment for this item will include full compensation for all labor, materials and equipment required to temporarily manage stormwater generated within the Stage V footprint in full conformance with the Drawings and Specifications. Work includes construction of primary and

secondary stormwater containment walls and providing stormwater discharge pumps to remove accumulated stormwater within the Stage V footprint.

Contractor shall take all measures and precautions necessary to properly control the temporary stormwater management system and containment berm required for the connection to the existing Stage IV Phase I primary and secondary liner systems and construction of the new Stage V sump. Contractor shall prevent any stormwater from escaping from the containment area to the leachate collection system. Contractor shall operate and maintain the containment system and pumps 24 hours per day for the duration that the containment system is operational, and have on-site back up pumps and back-up gas/diesel powered generators in the event existing electrical connections or generator cease to function.

Item Number 8 – Screened Till Fill

MEASUREMENT: This item will be an estimated percentage of total work under this item at the time of the pay period close.

PAYMENT: Payment for the screened till fill materials will be full compensation for all labor, materials, equipment required to procure and install the screened till in full conformance with the Drawings and Specifications.

Item Number 9 – Secondary 60-mil HDPE Textured Liner

MEASUREMENT: This item will be an estimated percentage of total work under this item at the time of the pay period close.

PAYMENT: Payment for this item will be full compensation for all labor, materials, and equipment required to procure the 60-mil textured HDPE secondary liner system. This includes all warranties, providing all quality control documentation, and all other work required to achieve full compliance with the Drawings and Specifications. The material quantity estimated on the bid proposal is for liner installed to the limit of the anchor trench shown on the plan. The quantity estimate takes the sideslopes into consideration but does not include an allowance for waste material.

60-mil textured HDPE liner may be procured by the Owner for either or both phases of the project which will include sufficient quantity to complete the project plus an additional 10% for waste material. Additional liner required to complete the project shall be procured by the Contractor at its cost in the event the Owner procures the liner. The Owner may remove this item from either or both phases of the project without penalty to the Owner.

Item Number 10 – Installation of Secondary 60-mil HDPE Textured Liner

MEASUREMENT: This item will be an estimated percentage of total work under this item at the time of the pay period close.

PAYMENT: Payment for this item will be full compensation for all labor, materials, and equipment required to install the 60-mil textured HDPE secondary liner system. This includes all seaming, testing, replacing, or other remedial work, warranties, providing all quality control documentation, and all other work required to achieve full compliance with the Drawings and Specifications. The material quantity estimated on the bid proposal is for liner installed to the limit of the anchor trench shown on the plan. The quantity estimate takes the sideslopes into consideration but does not include an allowance for waste material.

Item Number 11 – Secondary Bi-Planar 250-mil Drainage Geocomposite

MEASUREMENT: This item will be an estimated percentage of total work under this item at the time of the pay period close.

PAYMENT: Payment for this item will be full compensation for all labor, materials, and equipment required to procure the secondary double sided drainage geocomposite in full conformance with the Drawings and Specifications. The material quantity estimated on the bid proposal is for drainage composite installed to the limit of the anchor trench shown on the plan. The quantity estimate takes the sideslopes into consideration but does not include an allowance for waste material.

Drainage geocomposite may be procured by the Owner for either or both phases of the project which will include sufficient quantity to complete the project plus an additional 10% for waste material. Additional drainage geocomposite required to complete the project shall be procured by the Contractor at its cost in the event the Owner procures the drainage geocomposite. The Owner may remove this item from either or both phases of the project without penalty to the Owner.

Item Number 12 – Installation of Secondary Bi-Planar 250-mil Drainage Geocomposite

MEASUREMENT: This item will be an estimated percentage of total work under this item at the time of the pay period close.

PAYMENT: Payment for this item will be full compensation for all labor, materials, and equipment required to install the secondary double sided drainage geocomposite in full conformance with the Drawings and Specifications. The material quantity estimated on the bid proposal is for drainage composite installed to the limit of the anchor trench shown on the plan. The quantity estimate takes the sideslopes into consideration but does not include an allowance for waste material.

Item Number 13 – Secondary Leachate Collection System

MEASUREMENT: This item will be an estimated percentage of total work under this item at the time of the pay period close.

PAYMENT: Payment for this item will be full compensation for all labor, materials, and equipment required to furnish and install all secondary leachate collection piping and cleanouts, pump station manhole and riser, non-woven geotextiles, additional double-sided geocomposite, geosynthetic clay liner, ¾” crushed stone and other materials in full conformance with the Drawings and Specifications.

Item Number 14 – Select Sand

MEASUREMENT: This item will be an estimated percentage of total work under this item at the time of the pay period close.

PAYMENT: Payment for this item will be full compensation for all labor, materials, and equipment required to procure, and install select sand in full conformance with the Drawings and Specifications.

Item Number 15 – Primary 60-mil HDPE Textured Liner

MEASUREMENT: This item will be an estimated percentage of total work under this item at the time of the pay period close.

PAYMENT: Payment for this item will be full compensation for all labor, materials, and equipment required to procure the 60-mil textured HDPE primary liner system. This includes all warranties, providing all quality control documentation, and all other work required to achieve full compliance with the Drawings and Specifications. The material quantity estimated on the bid proposal is for liner installed to the limit of the anchor trench shown on the plan. The quantity estimate takes the sideslopes into consideration but does not include an allowance for waste material.

60-mil textured HDPE liner may be procured by the Owner for either or both phases of the project which will include sufficient quantity to complete the project plus an additional 10% for waste material. Additional liner required to complete the project shall be procured by the Contractor at its cost in the event the Owner procures the liner. The Owner may remove this item from either or both phases of the project without penalty to the Owner.

Item Number 16 – Installation of Primary 60-mil HDPE Textured Liner

MEASUREMENT: This item will be an estimated percentage of total work under this item at the time of the pay period close.

PAYMENT: Payment for this item will be full compensation for all labor, materials, and equipment required to install the 60-mil textured HDPE primary liner system. This includes all seaming, testing, replacing, or other remedial work, warranties, providing all quality control documentation, and all other work required to achieve full compliance with the Drawings and Specifications. The material quantity estimated on the bid proposal is for liner installed to the limit of the anchor trench shown on the plan. The quantity estimate takes the sideslopes into consideration but does not include an allowance for waste material.

Item Number 17 – Primary Bi-Planar 300-mil Drainage Geocomposite

MEASUREMENT: This item will be an estimated percentage of total work under this item at the time of the pay period close.

PAYMENT: Payment for this item will be full compensation for all labor, materials, and equipment required to procure the primary double sided drainage geocomposite in full conformance with the Drawings and Specifications. The material quantity estimated on the bid proposal is for drainage composite installed to the limit of the anchor trench shown on the plan. The quantity estimate takes the sideslopes into consideration but does not include an allowance for waste material.

Drainage geocomposite may be procured by the Owner for either or both phases of the project which will include sufficient quantity to complete the project plus an additional 10% for waste material. Additional drainage geocomposite required to complete the project shall be procured by the Contractor at its cost in the event the Owner procures the drainage geocomposite. The Owner may remove this item from either or both phases of the project without penalty to the Owner.

Item Number 18 – Installation of Primary Bi-Planar 300-mil Drainage Geocomposite

MEASUREMENT: This item will be an estimated percentage of total work under this item at the time of the pay period close.

PAYMENT: Payment for this item will be full compensation for all labor, materials, and equipment required to install the secondary double sided drainage geocomposite in full conformance with the Drawings and Specifications. The material quantity estimated on the bid proposal is for drainage

composite installed to the limit of the anchor trench shown on the plan. The quantity estimate takes the sideslopes into consideration but does not include an allowance for waste material.

Item Number 19 – Primary Leachate Collection System

MEASUREMENT: This item will be an estimated percentage of total work under this item at the time of the pay period close.

PAYMENT: Payment for this item will be full compensation for all labor, materials, and equipment required to furnish and install all primary leachate collection piping and cleanouts, connection to existing Stage IV Phase I piping, non-woven geotextiles, additional double-sided geocomposite, geosynthetic clay liner, ¾" crushed stone, 1.5" crushed stone (or 4" washed bank run stone) and other materials in full conformance with the Drawings and Specifications.

Item Number 20 – Forcemain

MEASUREMENT: This item will be an estimated percentage of total work under this item at the time of the pay period close.

PAYMENT: Payment for this item will be full compensation for all labor, materials, and equipment required to furnish and install the 3" forcemain and dual-walled forcemain outside of anchor trench, relocate existing forcemain outside of the Stage V work area and through the Stage IV Phase I waste excavation area and install forcemain air release chamber and other materials in full conformance with the Drawings and Specifications.

Item Number 21 – Stormwater Management and Stabilization

MEASUREMENT: This item will be an estimated percentage of total work under this item at the time of the pay period close.

PAYMENT: Payment for this item will be full compensation for all labor, materials, and equipment required to furnish and install stormwater improvements in full conformance with the Drawings and Specifications. This work includes construction of Detention Ponds 5 and 6, outlet structure, stone outlet protection, stormwater swales, culverts and headwalls, expansion of the western toe swale, plunge pool and loam and seed disturbed areas.

Item Number 22 – Landfill Gas Improvements

MEASUREMENT: This item will be an estimated percentage of total work under this item at the time of the pay period close.

PAYMENT: Payment for this item will be full compensation for all labor, materials and equipment required to furnish and install HDPE gas header pipe and appurtenances. This includes all pipe fusing and connections, testing, replacing, or other remedial work, warranties, providing all quality control documentation, and all other work required to achieve full compliance with the Drawings and Specifications.

Item Number 23 – ¾" Stone

MEASUREMENT: This item will be measured as the number of tons of ¾" Stone installed under this item at the time of the pay period close. This bid item is in the event of a material shortage, to be approved by the Owner. Tons of ¾" Stone are to be measured on the NCES scale.

PAYMENT: Payment for this item will be full compensation for all labor, materials and equipment required to furnish additional ¾" Stone necessary to complete the work required to achieve full compliance with the Drawings and Specifications.

Item Number 24 – 1.5" Stone

MEASUREMENT: This item will be measured as the number of tons of 1.5" Stone installed under this item at the time of the pay period close. This bid item is in the event of a material shortage, with quantities to be approved by the Owner. Tons of 1.5" Stone are to be measured on the NCES scale.

PAYMENT: Payment for this item will be full compensation for all labor, materials and equipment required to furnish additional 1.5" Stone necessary to complete the work required to achieve full compliance with the Drawings and Specifications. This bid item is in the event of a material shortage, with quantities to be approved by the Owner.

Item Number 25 – NHDOT Type C Stone

MEASUREMENT: This item will be measured as the number of tons of NHDOT Type C Stone installed under this item at the time of the pay period close. This bid item is in the event of a material shortage, with quantities to be approved by the Owner. Tons NHDOT Type C Stone are to be measured on the NCES scale.

PAYMENT: Payment for this item will be full compensation for all labor, materials and equipment required to furnish additional NHDOT Type C Stone necessary to complete the work required to achieve full compliance with the Drawings and Specifications. This bid item is in the event of a material shortage, with quantities to be approved by the Owner.

Item Number 26 – NHDOT Type A Rip-Rap Fill

MEASUREMENT: This item will be measured as the number of tons of NHDOT Type A Rip-Rap Fill installed under this item at the time of the pay period close. This bid item is in the event of a material shortage, with quantities to be approved by the Owner. Tons of NHDOT Type A Rip-Rap Fill are to be measured on the NCES scale.

PAYMENT: Payment for this item will be full compensation for all labor, materials and equipment required to furnish additional NHDOT Type A Rip-Rap Fill necessary to complete the work required to achieve full compliance with the Drawings and Specifications. This bid item is in the event of a material shortage, with quantities to be approved by the Owner.

Item Number 27 – Crushed Gravel (NHDOT Item 304.3)

MEASUREMENT: This item will be measured as the number of tons of Crushed Gravel (NHDOT Item 304.3) installed under this item at the time of the pay period close. This bid item is in the event of a material shortage, with quantities to be approved by the Owner. Tons of Crushed Gravel (NHDOT Item 304.3) are to be measured on the NCES scale.

PAYMENT: Payment for this item will be full compensation for all labor, materials and equipment required to furnish additional Crushed Gravel (NHDOT Item 304.3) necessary to complete the work required to achieve full compliance with the Drawings and Specifications. This bid item is in the event of a material shortage, with quantities to be approved by the Owner.

Item Number 28 – Gravel (NHDOT Item 304.2)

MEASUREMENT: This item will be measured as the number of tons of Gravel (NHDOT Item 304.2) installed under this item at the time of the pay period close. This bid item is in the event of a material shortage, with quantities to be approved by the Owner. Tons of Gravel (NHDOT Item 304.2) are to be measured on the NCES scale.

PAYMENT: Payment for this item will be full compensation for all labor, materials and equipment required to furnish additional Gravel (NHDOT Item 304.2) necessary to complete the work required to achieve full compliance with the Drawings and Specifications. This bid item is in the event of a material shortage, with quantities to be approved by the Owner.

Item Number 29 – Screened Till Fill (Procured and Processed at Adjacent Property)

MEASUREMENT: This item will be measured as the number of tons of Screened Till Fill procured and processed at the adjacent property installed under this item at the time of pay period close. This bid item is provided as an alternative for the Contractor to take advantage of an adjacent material supply. The Bidder is encouraged to contact the property owner to obtain pricing. The property owner's contact information will be made available at the pre-bid conference. The quantity and quality of the material is not known but there is believed to be sufficient quantity to complete a significant portion of the project.

PAYMENT: Payment for this item will be full compensation for all labor, materials and equipment required to furnish Screened Till Fill from the adjacent property owner necessary to complete the work required to achieve full compliance with the Drawings and Specifications.

Item Number 30 – Select Sand (Procured and Processed at Adjacent Property)

MEASUREMENT: This item will be measured as the number of tons of Select Sand procured and processed at the adjacent property installed under this item at the time of pay period close. This bid item is provided as an alternative for the Contractor to take advantage of an adjacent material supply. The Bidder is encouraged to contact the property owner to obtain pricing. The property owner's contact information will be made available at the pre-bid conference. The quantity and quality of the material is not known but there is believed to be sufficient quantity to complete a significant portion of the project.

PAYMENT: Payment for this item will be full compensation for all labor, materials and equipment required to furnish Select Sand from the adjacent property owner necessary to complete the work required to achieve full compliance with the Drawings and Specifications.

Item Number 31 – Addition or Reduction of Common Excavation

MEASUREMENT: This item will be measured as the number of cubic yards of additional or reduced common excavation at the time of the pay period close. This bid item is in the event of differing existing topography than that shown on the plans due to NCES processing of existing stockpiles in the Stage V Construction Area. Additional or reduced quantities of common excavation are to be approved by the Owner.

PAYMENT: Payment (or credit to NCES) for this item will be full compensation for all labor, materials and equipment required for additional common excavation necessary to complete the work

required to achieve full compliance with the Drawings and Specifications. Additional or reduced quantities of common excavation are to be approved by the Owner.

END OF SECTION

SECTION 01005
ADMINISTRATIVE PROVISIONS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Title of Work and type of Contract.
B. Work Sequence.
C. Contractor Use of Premises.
D. Alternates.
E. Applications for Payment.
F. Coordination.
G. Field Engineering.
H. Reference Standards.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

Work of this Contract includes, but is not limited to the following components:

A. Site preparation, including excavation and filling to achieve secondary liner subgrade as shown on the Drawings.

B. Construction of stormwater ponds and installation of associated structures.

C. Installation of screened till fill materials.

D. Installation of the primary and secondary HDPE Liner Systems including the HDPE liners, select sand layers, and double-sided drainage geocomposites.

E. Installation of the leachate collection system including:
   1. HDPE leachate piping
   2. Cleanouts/vents

F. Installation of landfill gas collection piping and appurtenances.

G. Sitework including erosion control, roadways, drainage structures, swales, and loaming and seeding of disturbed areas.

H. All appurtenant and related work specified herein.

1.03 CONTRACT METHOD

Construct the Work under the lump sum and unit price contract as defined in the Bid Proposal and "MEASUREMENT AND PAYMENT" Section 00150.

1.04 WORK SEQUENCE

Prior to commencing the Work, the Contractor shall submit for approval, to the Owner and Engineer, a detailed description of the order of work. This description once approved

by the Engineer, shall be followed. Permission for any deviations from schedule shall be requested in writing for approval.

1.05 COORDINATION

A. Coordination With Other Contractors:
In the event other Contractors are doing work in the same area simultaneously with this project, the Contractor shall coordinate his proposed construction with that of the other Contractors. The Engineer will designate a priority on the work being carried out when the Contractors cannot agree.

B. Coordination With Utility Companies:
When the work exposes or comes within close proximity to existing utilities, the Contractor shall use all safety precautions coordinated with the utility companies. Contractor shall also coordinate with utilities for the relocation of overhead service.

C. The Contractor shall execute excavation, backfilling, cutting, and patching to integrate elements of Work, uncover ill-timed, defective, and non-conforming work, and provide samples for testing.

D. The Contractor shall coordinate all work with the landfill operators with respect to on-going ash landfill operations at the site.

1.06 REFERENCE STANDARDS

A. For products specified by association or trade standards, comply with the requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Referenced standards shall be the version of the standard that is in effect as of the Bid date, except when a specific date is specified.

1.07 APPLICABLE CODES

The Contractor is responsible for obeying all local, state, and federal laws and regulations while performing this work and for obtaining any applicable building and construction permits and fees associated therewith.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01051
GRADES, LINES, AND LEVELS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Designation of survey work to be performed.
B. Contractor's responsibility for establishment and accuracy of grades.
C. Owner's responsibility for establishment and verification of grades and levels.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 Article 4.4, "Reference Points", of the General Conditions is amended as follows:

A. Construct all Work under this Contract in compliance with the alignments indicated on the Plans.

B. The Contractor shall be responsible for providing competent personnel to perform the following:

1. Layout and control of all temporary bench marks, grades, lines, and levels.
2. Layout and setting proposed building corners, anchor trench, pipe installation, lines, and grades.
3. Layout measurement markers for various courses of materials.
4. All staking.
5. Layout and setting of embedded items.

C. The Contractor shall employ competent personnel to provide the above-mentioned surveying functions, to be overseen by a Registered Professional Engineer or Land Surveyor (New Hampshire Licensed) at no cost to the Owner. Said professional must direct the surveying functions as outlined in Paragraph B, and certify the record drawings as required in Section 01720 par. 1.05, A.

D. The Contractor shall safeguard all points, grade marks, and bench marks established on the Work. Should any reference points provided by the Owner or established by the Contractor be destroyed, the replacement will be at the cost of the Contractor. The Contractor shall assume the entire expense of rectifying work

improperly constructed due to failure to maintain and protect such established points and marks.

E. The Contractor shall give the Engineer forty eight (48) hours minimum notice of the time and place where observation or verification by the Engineer is required or requested.

3.02 MEASUREMENT AND PAYMENT

No separate payment will be made for any items of work, materials, parts, equipment, supplies, or related items required to perform and complete the requirements of this section. The costs for all such items required shall be considered subsidiary to other items of this Contract and shall not be paid for separately.

END OF SECTION

SECTION 01090
ABBREVIATIONS AND SYMBOLS

PART 1 GENERAL

1.1 DESCRIPTIONS

Where any of the following abbreviations are used in these Specifications, they shall have the meaning set forth opposite each.

AASHTO	American Association of State Highway and Transportation Officials
AC	Alternating Current
ACI	American Concrete Institute
ACP	Asbestos Cement Pipe
AGA	American Gas Association
AIC	Ampere Interrupting Capacity
AGMA	American Gear Manufacturers Association
AIEE (IEEE)	American Institute of Electrical Engineers (Institute of Electrical and Electronics Engineers, Inc.)
AISC	American Institute of Steel Construction
amp	Ampere
125-16 Amer. Std.	American Standard for Cast Iron Pipe Flanges and Flanged Fittings, Class 125 (ASA B16 11960)
ANSI	American National Standards Institute
API	American Petroleum Institute
ASA	American Standards Association
ASCE	American Society of Civil Engineers
ASH & AE	American Society of Heating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWG	American or Brown and Sharpe Wire Gauge
AWWA	American Water Works Association
BOD	Biochemical Oxygen Demand
c.f.	Cubic Foot
c.f.m.	Cubic Foot per Minute
c.f.s.	Cubic Foot per Second
CI	Cast Iron
CIPRA	Cast Iron Pipe Research Association
CSI	Construction Specifications Institute
c.y.	Cubic Yards
DC	Direct Current
DI	Ductile Iron
DOT	Department of Transportation
EDR	Equivalent Directional Radiation
EPA	U.S. Environmental Protection Agency
Fed. Spec.	Federal Specifications issued by the Federal Supply Service of the General Service Administration
FmHA	Farmers Home Administration

fps	Feet per Second
ft.	Feet
gal.	Gallons
gpd	Gallons per Day
gpm	Gallons per Minute
HP	Horsepower
IBR	Institute of Boiler and Radiator Manufacturers
in.	Inches
inter.	Interlock
ISA	Instrument Society of America
kva	Kilovolt-ampere
kw	Kilowatt
lb.	Pound
lf	Linear Feet
max.	Maximum
MCB	Master Car Builders
MGD	Million Gallons Per Day
Min.	Minimum
NBS	National Bureau of Standards
NEC	National Electrical Code (Latest Edition)
NEMA	National Electrical Manufacturers Association
NEWWA	New England Water Works Association
NHDES	New Hampshire Department of Environmental Services
NHDOT	New Hampshire Department of Transportation
NPT	National Pipe Thread
NSF	National Sanitation Foundation
OS&Y	Outside Screw and Yoke
PCA	Portland Cement Association
ppm	Parts per Million
%	Percent
psi	Pounds per Square Inch
psig	Pounds per Square Inch Gauge
PVC	Polyvinyl Chloride
rpm	Revolutions per Minute
s.f.	Square Foot
SSPC	Steel Structures Painting Council
STL. W.G.	U.S. Steel Wire, Washburn and Moen, American Steel and Wire Cos., or Roebling Gauge
s.y.	Square Yard
TDH	Total Dynamic Head
USAS	Standards of the United States of America Standards Institute (formerly American Standards Association)
USS GAUGE	United States Standard Gauge
VC	Vitrified Clay
WSP	Working Steam Pressure

END OF SECTION

SECTION 01200
PROJECT MEETINGS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Contractor attendance and participation in preconstruction conferences.
B. Contractor attendance at progress meetings and pre-installation conferences.

1.02 RELATED REQUIREMENTS

A. Section 01005 - Administrative Provisions: Coordination of work.
B. Section 01300 - Submittals: Progress schedules.
C. Section 01300 - Submittals: Shop drawings, product data, and samples.
D. Section 01400 - Quality Assurance/Quality Control.
E. Section 01700 - Contract Closeout: Project record documents.

1.03 PRECONSTRUCTION CONFERENCES

A. After award of the bid and prior to beginning construction, a conference will be held with representatives of the Contractor, Owner, and Engineer to discuss schedules in the Project. This conference is intended to establish lines of communication between the parties involved. Time and place of the preconstruction conference will be determined at time of bid award.

B. The Engineer will administer the preconstruction conference at the Project site for clarification of Contractor responsibilities in use of the site and for review of administrative procedures.

1.04 PROGRESS MEETINGS

A. The Engineer will schedule Project meetings throughout progress of the Work at one week to two week intervals.

B. The Owner will make physical arrangements for meetings. The engineer will prepare agenda with copies for participants, preside at meetings, record minutes, and distribute copies to participants and those affected by decisions made at meetings.

C. Attendance: Job superintendent, major subcontractors, and suppliers; Owner representative, and Engineer as appropriate to agenda topics for each meeting.

D. Suggested Agenda: Review of Work progress, status of progress schedule and adjustments thereto, delivery schedules, submittals, maintenance of quality standards, pending changes and substitutions, and other items affecting progress of Work.

E. The Contractor's representatives at project meetings shall have the authority to make relevant decisions on behalf of the Contractor.

1.05 PRE-INSTALLATION CONFERENCES

A. When required in the individual specification Section, convene a preconstruction conference prior to commencing work of the Section.

B. Require attendance of entities directly affecting, or affected by, work of the Section.

C. Review conditions of installation, preparation and installation procedures, and coordination with related work.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01300
SUBMITTALS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Procedures.
B. Construction Progress Schedules.
C. Schedule of Values.
D. Shop Drawings.
E. Product Data.
F. Samples.
G. Manufacturers' Instructions.
H. Manufacturers' Certificates.
I. Project Record Documents.

1.02 RELATED REQUIREMENTS

A. Section 01005 - Administrative Provisions.
B. Section 01400 - Quality Assurance/Quality Control.
C. Section 01600 - Material and Equipment Handling.
D. Section 01700 - Contract Closeout.

1.03 PROCEDURES

A. Deliver the submittals to CMA Engineers, Inc., at 35 Bow Street, Portsmouth, NH, 03801.

B. Transmit each item under an Engineer-accepted form either through electronic means or hard copy. Identify the Project, Contractor, subcontractor, major supplier; identify the pertinent Drawing sheet and detail number, and Specification Section number, as appropriate. Identify deviations from Contract Documents. Provide space for the Contractor and the Engineer review stamps.

C. Submit initial progress schedules and schedule of values in duplicate within seven (7) days after date of the Owner-Contractor Agreement. After review by the Engineer, revise and resubmit the schedules, as required. Submit revised schedules reflecting changes since previous submittal with each Application for Payment.

D. Comply with the progress schedule for submittals related to the progress of Work. Coordinate submittal of related items.

E. After the Engineer's review of the submittal, revise and resubmit the submittal, as required, identifying changes made since the previous submittal.

F. Distribute copies of the reviewed submittals to concerned persons. Instruct recipients to promptly report any inability to comply with provisions of the submittal.

G. Do not proceed with the Work unless the shop drawings submitted have been reviewed by the Engineer.

1.04 CONSTRUCTION PROGRESS SCHEDULES

A. Submit a horizontal bar chart with separate bars for each major trade, project component, or operation, identifying the first work day of each week.

B. Show the complete sequence of construction by activity, identifying the work of separate stages and other logically grouped activities. Show the projected percentage of completion for each item of Work as of the time of each Application for Progress Payment.

C. Show the submittal dates required for shop drawings, product data, samples, product delivery dates, including those furnished by the Owner (if any), and the start and finish times, including all temporary breaks in continuity, of each task or operation.

D. The Contractor shall provide an updated project schedule at the weekly project meetings and as requested by the Engineer.

1.05 SCHEDULE OF VALUES

A. Submit a typed schedule on 8-1/2 x 11 inch paper; the Contractor's standard form or computer printout will be considered on request.

B. The schedule shall be formatted in accordance with the Bid Form. Identify each line item with the number and title of the major specification sections. For multiple component items, use sub-heading breakdown with cost distribution.

C. Include in each line item amount the quantities measured from the Contract Documents multiplied by the unit cost equal to the total for the item.

D. Include in each line item a directly proportional amount of Contractor's overhead and profit.

E. Revise the schedule to list change orders, for each application for payment.

1.06 SHOP DRAWINGS/SUBMITTALS

A. The CONTRACTOR shall submit to the ENGINEER one (1) electronic copy in PDF format or six (6) hard copies of shop drawings for approval three (3) copies to be returned to the CONTRACTOR). At the time of submission, the CONTRACTOR shall call to the OWNER’s and ENGINEER’s attention, in

writing, any deviations that the shop drawings may have from the requirements of the Contract Documents.

B. The CONTRACTOR shall submit the shop drawings marked as either "Submitted as Specified" or "Submitted as Equal to Specified".

1. Where any article is specified by trade name or name of manufacturer with the clause "or equal," it is intended to establish the quality of the article. If the CONTRACTOR proposes to use material or equipment of another manufacturer as an "or equal" to the specified material or equipment, all shop drawings shall conform to the following requirements, conditions, and procedures:

a. Substitution of equipment or materials other than those specified will be permitted, providing, in the opinion of the ENGINEER, such equipment or material is equal to or better than that specified. The decision of the OWNER and the ENGINEER with respect to approval or disapproval of any material or equipment proposed to be substituted as an "or equal" is final. The CONTRACTOR shall have no claim of any sort by reason of such decision.

b. If the CONTRACTOR proposes to substitute materials or equipment as "or equal" to those specified, it shall be his responsibility to furnish complete, specific, detailed information from the manufacturer or supplier of the material or equipment he proposes to furnish, in which the requirements of the Contract Documents are shown to be met. This shall consist of a point-by-point comparison of the Contract Documents requirements with the material or equipment proposed to be furnished. In the event the Contract Documents mention a model number or other designation and manufacturer in lieu of the detailed description and manufacturer, a point-by-point comparison of the equipment specified under the Contract and that proposed to be substituted shall be furnished. The burden of responsibility to furnish this information is with the CONTRACTOR. If incomplete or irrelevant data is submitted as evidence of compliance with the Contract Documents, the data will be returned and the request for approval will be denied.

C. The ENGINEER will review and stamp the shop drawings in one of the following ways:

1. No Exceptions Taken
2. Corrections as Noted - No Resubmission Required
3. Make Corrections Indicated - Resubmission Required
4. Rejected, See Remarks - Revise and Resubmit
5. No Action Taken

D. The CONTRACTOR is responsible for thoroughly reviewing the shop drawing information before forwarding it to the ENGINEER. The shop drawing information submitted must clearly indicate compliance with the Contract Documents by enumerating the specified performance, materials of construction, protective coatings, size, etc.; if compliance with the specification is not clearly defined or ambiguous, the shop drawing information will have to be resubmitted in its entirety.

E. All shop drawing information must be submitted in a timely fashion to allow a thorough review by the ENGINEER and to ensure that delivery of the equipment will coincide with the construction schedule. Failure of the shop drawings to comply with the Contract Documents, requiring subsequent resubmittals, may adversely affect the construction schedule. Any such delays are solely the responsibility of the CONTRACTOR. The OWNER and ENGINEER will not entertain or approve any claims by the CONTRACTOR for additional costs or extensions of contract time based on failure to obtain shop drawing approvals.

F. The OWNER's and the ENGINEER's comments will be returned to the CONTRACTOR within 14 days of receipt of submittal. The OWNER's and the ENGINEER's comments will include specific details as to what or where the shop drawings do not comply with the Contract Documents. The OWNER and the ENGINEER shall review only such data and details as are transmitted to him by the CONTRACTOR. The CONTRACTOR shall coordinate between all suppliers and subcontractors.

G. The OWNER and the ENGINEER will review a maximum of two (2) shop drawing submittals for each piece of equipment. If additional submittals are required, the CONTRACTOR shall be responsible for the costs incurred by the OWNER and ENGINEER to review the additional submittals. The OWNER will be reimbursed by the CONTRACTOR for this additional cost by the credit Change Order.

H. Three hard (3) copies or one (1) electronic copy in PDF format of the approved shop drawings will be returned to the CONTRACTOR by the ENGINEER. If the CONTRACTOR requires more copies be returned, then additional copies shall be included in the original submittal.

I. The CONTRACTOR's attention is specifically directed to the fact that no items shall be fabricated, nor equipment or materials ordered, nor any construction performed, prior to review by the OWNER and ENGINEER of shop drawings applicable thereto.

1.07 PRODUCT DATA

A. Mark each copy to identify the applicable products, models, options, and other data. Supplement the manufacturers' standard data to provide information unique to the Work.

B. Submit one (1) electronic copy in PDF format or six (6) hard copies of all required product data to Engineer.

1.08 MANUFACTURER'S INSTRUCTIONS

A. When required in the individual Specification Section, submit manufacturer's printed instructions for delivery, storage, assembly, installation, adjusting, and finishing, in quantities specified for the product data.

1.09 SAMPLES

A. Submit samples to illustrate the functional characteristics of the product, with integral parts and attachment devices. Coordinate the submittal of different categories for interfacing of the work.

B. Include the identification on each sample, giving full information.

C. Submit the number of samples specified in the respective Specification section; two (2) of which will be retained by Engineer. Reviewed samples which may be used in the Work are indicated in the applicable Specification Section.

1.10 FIELD SAMPLES

A. Provide field samples of finishes at Project as required by the individual Specifications section. Install the sample complete and finished. Acceptable samples in place may be retained in completed Work.

1.11 SOIL SAMPLES AND TESTING

The Contractor shall furnish all labor and equipment necessary to retrieve soil samples for laboratory tests completed by the Engineer. The Contractor shall be required to excavate test pits as required onsite to allow sampling and evaluation of soil materials. No soil or other material requiring Engineer's review shall be imported to the site, or incorporated into the work without Engineer's review.

Submittals for soil sampling and testing shall be as specified in Sections 02223, 02232, and 02234.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 DEVIATIONS

No deviations in construction from the submitted and reviewed shop drawings will be allowed without the written authorization of the Engineer.

END OF SECTION

SECTION 01400
QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED
- A. General Quality Assurance and Quality Control
- B. Definitions
- C. QA/QC Personnel
- D. Testing Laboratory Services

1.02 RELATED REQUIREMENTS
- A. Special Conditions
- B. Supplementary General Conditions
- C. General Conditions
- D. Section 01005 - Administrative Conditions
- E. Section 01300 - Submittals
- F. Section 02223 - Filling
- G. Section 02270 - Erosion Control
- K. Section 02930 - Loaming and Seeding

1.03 GENERAL QUALITY ASSURANCE AND QUALITY CONTROL

A. The Contractor shall implement a QC plan designed to:
- a. Control and maintain the quality of vendors, manufacturers, products, services, site conditions, and workmanship.
- b. Produce work of the specified quality.
- c. Maintain a safe working environment for all workers or personnel on the project site.
- d. Fulfill the contractor's responsibilities enumerated in the Contract Documents.

B. The Owner shall pay for consultant or other services to provide QA tests or reviews in addition as identified for QA responsibilities in this section or other sections of the Contract Documents. These QA tests are in addition to tests, certifications, or other documentation that are the responsibility of the Contractor. If the results of supplemental QA testing indicate a defective or non-complying condition, the cost of removal, replacement, and follow-up tests and reviews shall be borne by the Contractor.

C. Specific QA/QC tests, procedures, reports, and responsibilities are included within appropriate sections of the Contract Documents related to the product or installation and may be included by reference to published standards.

1.04 DEFINITIONS

Construction Quality Assurance Plan: A system of activities that provide assurance that the facility was constructed as specified in the design. Construction quality assurance refers to measures taken by the QA organization to assess if the installer or contractor is in compliance with the plans and specifications for a project.

Construction Quality Control Plan: A planned system of inspections that are used to directly monitor and control the quality of a construction project. Construction quality control refers to measures taken by an installer or contractor to determine compliance with the requirements for materials and workmanship as stated in the plans and specifications for the project.

Engineer: A qualified professional engineer retained by the Owner to:

Administer the construction contract.
Provide technical coordination of the design, permitting, and construction issues.
Approve all construction contract change orders.
Monitor inspections and testing.
Provide statements and reports to regulating agencies.
Maintain construction records during the construction period.
Assure compliance with a QA Plan.

QA Inspector: A representative of the owner responsible for independent inspection of construction project materials, workmanship, systems, or components. The QA inspector may also be a representative of the project engineer.

1.05 QA/QC PERSONNEL

A. Contractor's Quality Control Manager (CQC)

1. The CQC Manager is the Contractor's representative in overall charge of the implementation of the QC Plan. The CQC Manager may have other responsibilities such as Contractor's Superintendent.

2. The CQC Manager shall be experienced in the fields of construction related to the project and may designate specific QC tasks to other Contractor's employees or Subcontractor's representatives for specialized installations.

3. The CQC Manager shall be responsible for the following:

a. Review of Contract Documents for the project.
b. Review and compilation of daily logs, test data, and other documentation.
c. Submission to the Engineer of all QC documentation required by the Contract Documents.

B. Engineer and Resident Project Representative

1. The Engineer is the Owner's representative in the administration of the Construction Contract.

2. The Engineer's Resident Project Representative works under the supervision of the Engineer, reports directly to the Engineer, and shall be experienced and knowledgeable about the project work.

3. The Engineer shall complete a certification for submittal to NHDES that based upon inspections and testing conducted or collected pursuant to the Contract Documents, the facility has been constructed in accordance with approved plans and specifications. The Contractor's full compliance with the contract

documents, particularly with respect to all issues pertaining to the quality of the work, and the provision by the Contractor (and the Subcontractors) of all testing data required by the contract documents, are required in order for the Engineer to make this certification.

C. Quality Assurance Inspector

1. The Owner or Engineer may retain additional QA personnel to assist in the implementation of QA Plans.

2. The QA inspector shall have specific experience related to the assigned QA task(s).

3. The QA inspector may be the same individual as the resident project representative.

1.06 TESTING LABORATORY SERVICES

A. When required, the Owner shall retain and pay for services of an Independent Testing Laboratory to perform QC tests or other services to demonstrate acceptability or conformance of various work products with the Contract Documents.

B. Independent testing laboratory services will be performed in accordance with prevailing rules of governing authorities and with specified standards.

C. The Contractor shall comply with specified standards or protocols in the sampling, collection, documentation, and shipping of laboratory samples. The Contractor is responsible to obtain the services of qualified individuals to collect and ship samples, as necessary.

D. The Contractor shall notify the Engineer 72 hours prior to the expected time of sample collection.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01500
CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES (without limiting the Contractor's responsibilities for construction safety):

A. Temporary Utilities: Electricity, lighting, heat, ventilation, telephone service, water, and sanitary facilities.

B. Temporary Controls: Safety program, barriers, enclosures and fencing, protection of the Work, and water control.

C. Construction Facilities: Access roads, parking, progress cleaning, project signage, and temporary buildings.

1.02 TEMPORARY ELECTRICITY

A. Provide and pay for power service required from the appropriate electric utility company.

1.03 TEMPORARY HEAT

A. Provide and pay for heat devices and heat as required to maintain specified conditions for construction operations and field offices.

1.04 TEMPORARY VENTILATION

A. Ventilate enclosed areas to assist in the cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

1.05 TELEPHONE SERVICE

A. Provide, maintain, and pay for telephone service to Contractor’s field office at time of project mobilization to final completion.

1.06 TEMPORARY WATER SERVICE

A. Provide, maintain, and pay for suitable quality portable water service required for construction operations.

1.07 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures.

1.08 PROJECT SAFETY

A. The Contractor shall design and implement a program that addresses the specific safety requirements of this project.

1.09 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations.

B. Provide protection for plant life designated to remain. Replace damaged plant life.

C. Protect vehicular traffic, stored materials, site, and structures from damage.

1.10 WATER CONTROL

A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

1.11 TEMPORARY EROSION CONTROL

A. The Contractor shall furnish and install all required temporary erosion control facilities to comply fully with the New Hampshire Department of Environmental Services requirements and as called for in these specifications.

1.12 EXTERIOR ENCLOSURES

A. The Contractor shall provide temporary insulated enclosures to accommodate acceptable working conditions, protection for products, and to allow for temporary heating and maintenance to required ambient temperatures identified in individual Specification Sections.

1.13 PROTECTION OF INSTALLED WORK

A. Protect installed Work and provide special protection where specified in individual Specification Sections.

B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.

C. Prohibit traffic from landscaped areas.

1.14 SECURITY

A. Provide security and facilities to protect Work, and existing facilities, from unauthorized entry, vandalism, or theft.

1.15 ACCESS ROADS

A. The Contractor shall maintain landfill access roads which the Contractor utilizes during construction. The Contractor shall construct and maintain temporary roads accessing public thoroughfares to serve construction area.

B. Extend and relocate as Work progress requires. Provide detours necessary for unimpeded traffic flow.

C. Provide and maintain access to fire hydrants, free of obstructions.

1.16 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition. Provide appropriate containers for collection and containment of waste materials.

B. Remove waste materials, debris, and rubbish from site and dispose off-site.

1.17 FIELD OFFICES AND SHEDS

A. The Contractor shall provide field offices for their own use from mobilization to final completion.

B. The offices shall be weather-tight with lighting, telephone, fax, photocopier, electrical outlets, heating, cooling and ventilating equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.

C. Locate offices and sheds away from existing and new structures, and in a location where the construction work is reasonably visible from the trailers.

1.18 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary above-grade or buried utilities, equipment, facilities, and materials prior to the Substantial Completion review.

B. Remove underground installations to a minimum depth of 4 feet. Grade site as indicated.

C. Clean and repair damage caused by the installation or use of temporary work.

D. Restore existing facilities used during construction to original or better condition. Restore permanent facilities used during construction to the specified condition.

PART 2 PRODUCT

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01600
MATERIAL AND EQUIPMENT HANDLING

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Products.
B. Transportation and Handling.
C. Storage and Protection.
D. Product Options.
E. Products List.
F. Substitutions.

1.02 RELATED REQUIREMENTS

A. Section 01005 - Administrative Provisions
B. Section 01400 - Quality Assurance/Quality Control
C. Section 01700 - Contract Closeout

PART 2 PRODUCTS

2.01 GENERAL

A. Products include the material, equipment, and systems used on this Project.

B. Comply with the Specifications and referenced standards as minimum requirements.

C. Components required to be supplied in quantity within a Specification section shall be the same, and shall be interchangeable.

2.02 TRANSPORTATION AND HANDLING

A. Transport products by methods that will avoid product damage and deliver them in undamaged condition in the manufacturer's unopened containers or packaging.

B. Provide equipment and personnel to handle unloading and storage of the products by methods to prevent soiling or damage.

C. Promptly inspect the shipments to assure that the products comply with requirements, the quantities are correct, and the products are undamaged.

2.03 STORAGE AND PROTECTION

A. Store products in accordance with the manufacturer's instructions, with intact and legible seals and labels.

B. For exterior storage of fabricated products, place on sloped supports above ground. Cover the products subject to deterioration with an impervious sheet covering; provide ventilation to avoid condensation.

C. Store loose granular materials on solid surfaces in a well-drained area. Prevent mixing of the materials with foreign matter.

D. Arrange storage to provide access for inspection. Periodically inspect to assure that products are undamaged, and are maintained under required conditions.

2.04 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Furnish any product meeting those standards.

B. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not specifically named.

C. Products Specified by Naming Several Manufacturers: Products of named manufacturers meeting specifications: No options, no substitutions will be allowed.

2.05 PRODUCTS LIST

A. Within 15 days after the date of the Owner-Contractor Agreement, submit a complete list of major products proposed for use, with name of the manufacturer, trade name, and model number of each product.

2.06 SUBSTITUTIONS

A. Only within 15 days after date of the Agreement will the Engineer consider requests from the Contractor for substitutions. Subsequently, substitutions will be considered only when a product becomes unavailable due to no fault of the Contractor.

B. Document each request with complete data substantiating the compliance of the proposed substitution with the Contract Documents.

C. The request constitutes a representation that the Contractor:

1. Has investigated the proposed product and determined that it meets or exceeds, in all respects, the specified product.
2. Will provide the same warranty for substitution as for the specified product.
3. Will coordinate installation and make other changes which may be required for the Work to be complete in all respects.
4. Waives claims for additional costs which may subsequently become apparent.

D. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals without separate written request, or when acceptance will require substantial revision of the Contract Documents.

E. The Engineer will determine acceptability of the proposed substitution, and will notify the Contractor of acceptance or rejection in writing within a reasonable time.

F. Only one request for the substitution will be considered for each product. When substitution is not accepted, provide the specified product.

2.07 SYSTEM DEMONSTRATION

A. Prior to the final inspection, demonstrate operation of the entire system to the Owner.

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01700
CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Closeout Procedures.
B. Final Cleaning.
C. Project Record Documents.
D. Operation and Maintenance Data.
E. Warranties and Bonds.
F. Spare Parts and Maintenance Materials.

1.02 RELATED REQUIREMENTS

A. General Conditions
B. Section 01005 - Administrative Provisions.
C. Section 01500 - Construction Facilities and Temporary Controls
D. Section 01720 - Project Record Documents

1.03 CLOSEOUT PROCEDURES

A. Comply with the procedures stated in the General Conditions of the Contract for issuance of the Certificate of Substantial Completion.

B. When the Contractor considers the Work has reached final completion, submit a written certification that the Contract Documents have been reviewed, the Work has been inspected, and that the Work is complete in accordance with the Contract Documents and is ready for the Engineer's inspection.

C. In addition to the submittals required by the conditions of the Contract, provide submittals required by the governing authorities, and submit a final statement of accounting giving the total adjusted Contract Sum, previous payments, and the sum remaining due.

D. The Engineer will issue a final Change Order reflecting approved adjustments to the Contract Sum not previously made by Change Order.

1.04 FINAL CLEANING

A. Perform the final cleanup prior to final inspection.

B. Clean the interior and exterior surfaces exposed to view.

C. Clean the entire site and remove temporary construction.

D. Remove waste and surplus materials, rubbish, and the construction facilities from the Project and from the site.

1.05 PROJECT RECORD DOCUMENTS

A. Refer to Section 01720 of these specifications for details of the required project record documents.

1.06 OPERATION AND MAINTENANCE MANUALS:

A. The Contractor shall prepare four (4) copies of the manuals and deliver the manuals to the Engineer for approval.

B. Operating and maintenance manuals shall be prepared by the Contractor for all equipment and fixtures supplied by the Contractor with loose-leaf pages mounted in hard covers and shall include as a minimum the following:

1. Index and tabs.

2. Data sheets showing model numbers and serial numbers of equipment, and additional data as required to identify applicable portions of standard sections of the operating and maintenance manuals.

3. Instructions for storage, installation, start-up, operation, shut-down, inspection and maintenance.

4. Applicable drawings, corrected to show field changes.

5. Contract diagrams.

6. Test data.

7. Parts listed and recommended spare parts.

8. Address and phone number of nearest manufacturer-authorized service facility.

9. Guarantees.

10. All additional data specified or relative to operations and maintenance of the constructed project.

C. Submission of manuals: Manuals must be submitted at least fourteen (14) working days prior to issuance of the "Certificate for Substantial Completion".

The approved manual shall be a requirement for final inspection and final payment.

1.07 WARRANTIES AND BONDS

A. Provide duplicate, notarized copies. Execute the Contractor's submittals and assemble documents executed by subcontractors, suppliers, and manufacturers. Provide a table of contents and assemble in a binder with a durable plastic cover.

B. Submit the material prior to the final application for payment. For equipment put into use with Owner's permission during construction, submit within ten (10) days after first operation. For items of work delayed materially beyond date of substantial completion, provide an updated submittal within (10) days after acceptance, listing the date of acceptance as start of warranty period.

1.08 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, and maintenance materials in quantities specified in each Section, in addition to that used for construction of work. Coordinate with the Owner, deliver to project site and obtain a receipt prior to final payment.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01720
PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 DESCRIPTION

A. Maintain at the site for the Owner's permanent records one copy of:

1. Record Drawings
2. Specifications
3. Addenda
4. Change Orders and other Modifications to the Contract
5. Owner Field Orders or Written Instructions
6. Shop Drawings, Product Data, and Samples
7. Field Test Records
8. Field notes documenting the horizontal and vertical location of project components

B. Related Work Specified Elsewhere:

1. Section 01300 - Submittals
2. Section 01700 - Contract Closeout

1.02 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Store the documents and samples in the Contractor's field office apart from documents used for construction.

1. Provide files and racks for storage of the documents.
2. Provide a locked cabinet or secure storage space for the storage of samples.

B. In a form acceptable to the Owner and Engineer, maintain the record documents in a clean, dry, legible condition, and in good order. Do not use the record documents for construction purposes.

C. Make the documents and samples available at all times for inspection by the Owner and Engineer.

D. The Contractor’s resident superintendent shall document all changes on the record drawings upon construction of that item of work. Record drawings and supporting documentation shall be kept current with work in progress and should reflect work completed on periodic payment applications. The Record Drawings shall be reviewed on a weekly basis by the Engineer.

E. The project record drawings shall also include a field survey performed and stamped by a NH Licensed Land Surveyor which includes the following:

1. Topographic plan of the completed work, at 2 foot contour intervals, showing all site work.
2. The final horizontal coordinates and invert elevations of all conduits, pipes, manholes, and other buried structures.
3. Spot elevations and horizontal coordinates.
    a. Landfill subgrade fill (spot elevation at all breaks in slope)
    b. All secondary and primary panel locations, all repair locations, spot elevations at breaks in slope, and all anchor trench locations (break in slope and end of panel)
    c. All buildings and foundations
    d. All stormwater piping, swales, headwalls and manholes
    e. All locations and top of pipe elevations of leachate collection piping, leachate transmission lines, leachate forcemains, gas collection laterals and headerpipes and wellhead locations.
4. All leak detection electrode locations.
5. The bench marks and construction baseline shown on the plans.

1.03 MARKING

Mark with red erasable pencil and, where feasible, use other colors also.

1.04 RECORDING

A. Label each document "PROJECT RECORD" in neat large printed letters.

B. Record information concurrently with construction progress.

1. Do not cover any work until the required information has been incorporated in the "RECORD DRAWINGS."

1.05 SUBMITTAL

A. At substantial completion, the Contractor shall provide a red line set of the Record Drawings to the Engineer for review and approval together with certification that all deviations from the Contract have been recorded on it and that the record drawings reflect the Work that has been performed. The field survey information required in paragraph 1.02 E shall be provided as an AutoCAD 2009 or newer drawing on a disk.

B. Final payment on this Contract will not be made until the RECORD DRAWINGS have been reviewed and approved by the Engineer.

END OF SECTION

TECHNICAL SPECIFICATIONS

DIVISION 2
SITE WORK

Section No.	***Description***
02220	Selective Demolition
02222	Excavation
02223	Filling
02231	Select Aggregates
02232	Stone Fill
02234	Select Sand
02270	Erosion Control
02273	Drainage Geocomposite
02274	Woven Geotextile Fabric
02275	Non-Woven Geotextile Filter Fabric
02276	HDPE Liner
02279	Geosynthetic Clay Liner
02541	Gravel Roadway
02555	Temporary HDPE Geomembrane Tarp
02614	Culverts and Storm Drains
02619	HDPE Pipe and Fittings
02700	Manholes, Frames and Covers
02930	Loaming and Seeding
02960	Decommissioning/Extension of Monitoring Wells

SECTION 02220
SELECTIVE DEMOLITION

PART 1- GENERAL

1.10 SCOPE OF WORK

A. CONTRACTOR shall provide all labor, materials, equipment and incidentals necessary to perform the selective demolition required to complete the Work shown on the Plans and specified herein. Work may include, but not be limited to, excavation, backfill, removal of portions of the active landfill gas extraction system, forcemain removal, pipe demolition, underground electric removal and removal of manhole structures.

1.20 SUBMITTALS

A. CONTRACTOR shall submit to ENGINEER a Work Plan for performing the Work described in this Section and indicated on the Plans.

PART 2- PRODUCTS

(Reserved)

PART 3- EXECUTION

3.01 ACTIVE LANDFILL GAS EXTRACTION SYSTEM

A. CONTRACTOR shall expose and remove portions of the active landfill gas (LFG) extraction system where shown on the Drawings. This may include removal of LFG header and lateral pipes, LFG condensate traps, and LFG condensate drain pipes.

B. CONTRACTOR shall coordinate all work on the LFG extraction system with the OWNER. CONTRACTOR shall provide OWNER with notice of disturbance or interruption of service of the system at least 24 hours prior to the work. The LFG extraction system shall be shut down for no more than 8 hours, and shall operate for no less than 24 hours between service interruptions.

C. CONTRACTOR shall dispose of LFG system materials on-site where directed by the OWNER.

3.02 LEACHATE FORCEMAIN, VALVE CHAMBER AND MANHOLES

A. CONTRACTOR shall expose, remove and relocate portions of the leachate forcemain and associated structures where shown on the Drawings. This will include removal of existing HDPE forcemain piping, concrete manholes and a concrete valve chamber.

B. CONTRACTOR shall coordinate all work on the leachate forcemain with the OWNER. CONTRACTOR shall provide OWNER with notice of disturbance or interruption of service of the system at least 24 hours prior to the work. The new perimeter forcemain must be operational prior to demolition of the existing forcemain and associated structures.

C. CONTRACTOR shall dispose of the leachate forcemain and associated structures on-site where directed by the OWNER.

3.03 UNDERGROUND ELECTRIC

A. CONTRACTOR shall expose and remove portions of underground electric where shown on the Drawings. This work includes removal of conduit and electric lines.

B. CONTRACTOR shall coordinate all work on the underground electric with the OWNER. CONTRACTOR shall provide OWNER with notice of disturbance or interruption of service of the system at least 24 hours prior to the work. The new electric line and leachate forcemain must be operational prior to demolition of the existing electric and associated structures.

C. CONTRACTOR shall dispose of the conduit, wiring and associated structures on-site where directed by the OWNER.

D. Removal of overhead electric lines will be completed by others and not part of this contract.

3.04 GEOKON UNIT

A. CONTRACTOR shall expose and remove the Geokon unit manhole where shown on the Drawings. Removal of the unit will include draining the settlement fluid lines estimated to be less than 10 gallons). The fluid is a 50/50 ethylene glycol/water mixture.

B. CONTRACTOR shall dispose of the GEOKON unit as directed by the OWNER.

C. CONTRACTOR shall dispose of the settlement fluid in accordance with State and Federal regulations.

3.05 CULVERTS AND HEADWALLS

A. CONTRACTOR shall expose and remove existing culverts and headwalls shown on the Drawings.

B. CONTRACTOR shall dispose of the culverts and headwalls as directed by the OWNER.

END OF SECTION

SECTION 02222
EXCAVATION

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Excavation and processing of excavated materials.

B. Stockpiling of fill materials.

C. Excavation for liner subgrade and utilities.

D. Excavation and disposal of unsuitable and excess materials.

E. Excavation of MSW and transport of excavated materials to the location designated on the Plans.

1.02 RELATED REQUIREMENTS

A. Section 01400 - Quality Assurance/Quality Control

B. Section 01500 - Construction Facilities and Temporary Controls

C. Section 02223 - Filling

D. Section 02270 - Erosion Control

E. Section 13001 – Site Safety and Contingency Work Plan

1.03 PROTECTION

A. Protect the bench-marks established for project construction.

B. Protect excavations by shoring, bracing, sheet piling, underpinning or other methods required to prevent cave-in or loose soil from falling into the excavation.

C. Notify the Engineer of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.

D. Grade the perimeter to prevent surface water run-off into the excavation.

E. Barricade or otherwise protect, consistent with the project safety program, open excavations occurring as part of this work and post with warning lights.

F. Protect adjacent structures and facilities from damage caused by settlement, movement, undermining and other hazards created by earthwork operations.

G. Dust Control: Use all necessary means to control dust caused by the Contractor's operation. Prevent dust from being a nuisance to the public. The use of calcium chloride is not acceptable. Moisture addition must be limited so as not to adversely affect soil handling. The use of other agents for dust control is subject to the approval of the Engineer.

H. Dewatering: Remove water from excavations to a point lower than the proposed subgrade of the work.

I. Odor Control: The Contractor shall install the temporary geomembrane cover and extend the existing landfill gas collection system to assist with the control of odors when final waste excavation grades are completed as indicated on the Plans. Contractor shall limit the area of waste excavation each day to the extent practical in order to minimize potential generation of odors. At the end of each day of waste excavation, Contractor shall install a minimum of 4-inches of common borrow cover over exposed waste materials.

1.04 JOB CONDITIONS

A. SITE CONDITIONS: Data referring to subsurface conditions in Appendix A are not intended as representations or warrants of continuity of such conditions between soil borings. The information is made available for the convenience of the Contractor and the Owner will not be responsible for interpretations or conclusions drawn by the Contractor.

1.05 DISTURBANCE OF EXCAVATED AND FILLED AREAS DURING CONSTRUCTION

A. The Contractor shall take the necessary steps to avoid subgrade disturbance during excavations, including dewatering and restricting the use of equipment in areas above optimum moisture level.

B. All areas disturbed during excavation that will not meet compaction requirements shall be removed and replaced with fill meeting structural requirements at no extra cost to Owner.

PART 2 PRODUCTS

2.01 MATERIALS

1. Common Borrow - Soil to be procured from off-site and utilized as common borrow fill shall have all rocks and material greater than eight (8) inches in

diameter removed and no more than 30% fines passing the #200 sieve. Common Borrow fill in contact with geosynthetic materials shall have a maximum particle size of one (1) inch. Suitable fill shall be free from combustible, organic, and frozen materials, loam, roots, topsoil, wood, trash, snow, ice and other objectionable material, or as identified by the Engineer, or laboratory analysis.

2. Unclassified Waste - Waste materials including soil cover and cover to be excavated from areas as indicated on the Drawings. May include refuse, wood chips, metal, masonry, concrete, boulders, or debris and other unclassified waste.

3. Till- Soil to be procured from offsite and utilized as the 12" screened till layer shall meet the requirements of Screened Till in Section 02223, for use by the Contractor as fill beneath the liner system and other areas indicated on the Drawings.

4. Unsuitable Fill - Excavated material not meeting the requirements for reuse as topsoil or intermediate or daily cover which may not be used as fill due to excess moisture, trash, organics, or other unsatisfactory materials. This includes materials excavated from beneath the existing primary and secondary geomembrane

PART 3 EXECUTION

3.01 PREPARATION

A. Set and verify required lines and grades prior to starting the excavation. This work should be performed and verified by a registered land surveyor or professional engineer licensed to practice in the State of New Hampshire.

B. It will be the responsibility of the Contractor to establish a construction baseline on-site. The Contractor shall perform all necessary construction layout from this baseline, maintain the baseline as necessary, and perform whatever survey is required to control his work.

3.02 EXCAVATION

A. Excavation consists of the removal and stockpiling or disposal of materials encountered when establishing required grade elevations as shown on the Plans and in accordance with these Specifications. If rock boulders greater than twelve (12) inches diameter are encountered within six (6) inches of the depth of excavation, they shall be removed and the resulting hole shall be backfilled with Common Borrow, or Screened Till.

B. Excavation for utilities: The trench for the pipes shall be excavated to the required line and grade and of sufficient width to permit thorough compacting and

tamping of the fill material under the haunches and around the pipe. In general, utility trenches shall be excavated to 6 inches below the bottom of the utility line to accommodate bedding material as specified hereinafter. Soft or unsuitable material encountered below the normal bedding line of the pipe shall be removed as directed, replaced with regular fill, and thoroughly compacted.

C. Excavation for structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 feet, and extending a sufficient distance from structures to permit installation of service, other construction required, and for inspection.

D. Excavation of Unclassified Waste Material: Excavation of existing cover material and waste material shall be completed to the limits indicated on the Drawings. All work will be completed in accordance with the Site Safety and Contingency Work Plan developed by the Contractor, in accordance with Section 13001. Excavated waste materials and shall be placed in the active landfill at a location designated by the Owner.

Excavation of waste materials shall be performed in a manner which controls odors, dust, vectors, and migration of waste. At a minimum, the "active area" of the excavation shall be covered with a minimum four (4) inches of suitable fill at the end of each day.

3.03 COMPACTION OF EXCAVATED SUBGRADE

A. Upon completion of the excavation to proposed subgrade, the conditions shall be inspected by the Engineer for acceptance. The entire area shall be fine graded to remove undulations or isolated high or low spots. The subgrade shall be proof rolled, and any soft yielding areas shall be excavated and backfilled with common borrow, or screened till.

B. Upon completion of excavation in areas beneath the proposed liner system, the natural subgrade shall be compacted to at least 95% of the maximum dry density as determined by ASTM D698, Method C.

C. Compaction equipment in open areas shall consist of vibratory rollers, or other equivalent compaction equipment reviewed by the Engineer.

D. Compaction equipment in confined areas (in trenches and adjacent to walls, piers, footings and standpipes) shall consist of hand-guided vibratory equipment or mechanical tampers reviewed by the Engineer.

E. Upon completion of the excavation in areas outside the landfill where fill will be placed, the subgrade shall be proof-rolled by two coverages of the rear wheels of

a fully loaded ten-wheel dump truck, or by other suitable equipment as reviewed by the Engineer.

3.04 STOCKPILING

1. Place, grade and shape stockpiles for proper drainage. Erosion control devices shall be used as necessary to minimize sediment transport away from the area.

2. Fill unsuitable for use as regular fill and excess materials shall be handled in accordance with Part 3.05.

3.05 DISPOSAL OF UNSUITABLE and EXCESS MATERIALS

The Contractor shall dispose of all unsuitable and excess materials on-site in a location or locations designated by the Owner or as shown on the Plans. Contractor shall take no material from the site.

Unsuitable and excess materials are defined as follows:

A. Unsuitable Material - Material containing significant clay, silt, or organic material, or material greater than eight inches (8") in diameter, or other materials identified on the contract drawings.

B. Excess Materials - Materials not meeting the definition in “A” above but which do not meet any of the specifications for materials required for this project, and/or materials in excess of the total quantity of materials required for this construction project.

C. No material shall be removed from the site. Unsuitable and excess materials shall be stored at separate locations on site as directed by the Owner.

3.06 STABILITY OF EXCAVATIONS

A. Slope sides of excavations to comply with OSHA regulations and local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible due to space restrictions or instability of material excavated. Maintain the sides and the slopes of excavations in a safe condition until completion of backfilling.

B. Shoring and bracing: Provide adequate shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition. Trench shoring and bracing shall comply with local codes and authorities having jurisdiction. Maintain shoring and bracing in excavation regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses. All temporary shoring and bracing plans shall be designed and stamped by a New Hampshire licensed professional engineer.

3.07 DEWATERING

A. Control of surface water is a critical requirement of the work. All necessary actions shall be taken to minimize the effect of precipitation and runoff on the work. Upgradient runoff shall be diverted from active or completed work areas, and all work shall be graded and crowned to promote runoff.

B. The Contractor shall prevent surface water and subsurface or groundwater from flowing into excavations or onto any work and from flooding the project site and surrounding area.

C. Water shall not accumulate in excavations. Contractor shall remove water to prevent softening of subgrades and soil changes detrimental to stability of the subgrade. The Contractor shall dewater excavated areas as required to perform the work, and in such a manner as to preserve the undisturbed state of subgrade material.

D. The Contractor shall provide and maintain pumps, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

E. The Contractor shall prevent migration of sediment in accordance with erosion control requirements of this Contract.

3.08 COLD WEATHER PROTECTION

A. Protect excavation bottoms against freezing when the atmospheric temperature is less than 35º F. The Contractor shall take whatever actions are necessary during the period of construction, to prevent freezing of any areas which are to receive fill as part of this work. No fill shall be placed on areas which are frozen. The Contractor shall also comply with the requirements of Section 203, Paragraph 3.7.8 of the NHDOT Standard Specifications.

3.09 REMOVAL OF UNSATISFACTORY SOIL MATERIALS

A. Unsatisfactory soil materials shall be as defined in Paragraph 3.05 (unsuitable materials).

B. Excavate unsatisfactory soil materials encountered that extend below required elevations, to the additional depth directed by the Engineer. Do not over-excavate without prior authorization of the Engineer.

C. Such additional excavation, provided it is not due to fault or neglect of Contractor, will be measured as directed by Engineer and paid for in accordance with the measurement and payment section.

D. Material that is above or below optimum moisture for compaction of the particular material in place as determined by the Engineer, and is disturbed by the Contractor during construction operations so that proper compaction cannot be reached shall be construed as unsuitable bearing material or unsatisfactory soil material. This material shall be removed and replaced with compacted gravel fill at no additional charge to the Owner.

END OF SECTION

SECTION 02223
FILLING

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Furnishing, placing, and compaction of suitable fill (borrow) and bedding sand.
B. Placing and compaction of screened till from on-site till materials, procured by Owner.
C. Coordination with the Engineer for completion of all required tests.

1.02 RELATED REQUIREMENTS

A. Section 01300 - Submittals
B. Section 01400 - Quality Assurance/Quality Control
C. Section 02222 – Excavation
D. Section 02231 – Select Aggregates
E. Section 02232 - Stone Fill
F. Section 02234 - Select Sand
G. Section 02270 - Erosion Control
H. Section 02930 - Loaming and Seeding

1.03 REFERENCES

A. ASTM C136/C117 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregate and Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing

B. ASTM D1557 Method “C” - Moisture-Density Relations of Soils and Soil-Aggregate Mixture using 10 lb. (4.54 kg) Hammer and 18-inch (457 mm) Drop.

C. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.

D. ASTM D6938 - 08a Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

E. ASTM D5084 - Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.

F. ASTMD5321 – Standard Test Method for Direct Shear Testing of Geosynthetic Material and Soil Interfaces.

1.04 TESTS

A. Soil testing and compaction tests shall be performed by the Engineer in coordination with the Contractor.

B. Test and analysis of fill materials shall be performed by the Engineer in coordination with the Contractor.

C. Tests and analyses of fill materials will be performed in accordance with ASTM C136/C117, ASTM D1557, ASTM D6938-08a, ASTM D5084 and ASTM D5321 and conditions set forth in Section 02223, 2.02 "Quality Control and Quality Assurance."

PART 2 PRODUCTS

2.01 FILL

A. General

For all fill materials to be used, samples, sieve analysis, and laboratory data indicating maximum dry densities and optimum moisture for field control tests shall be obtained by the Engineer prior to use as fill on site. The Contractor shall excavate, screen, and stockpile materials as required for sampling by the Engineer prior to delivery and placement.

B. Common Borrow Fill

Suitable borrow from off-site sources to be utilized as common borrow fill shall consist of soil with all rocks or material greater than 8" removed and no more than 30% passing the No. 200 sieve. Suitable fill shall be free from combustible, organic and frozen materials, loam, roots, topsoil, wood, trash, snow, ice, and other objectionable materials, or as identified by the Engineer.

C. Screened Till

Screened Till for use as the 12 inches of screened till fill and pipe bedding shall consist of inorganic mineral soil free of organic material, loam, trash, snow, ice, frozen soil, or other unsuitable materials and shall conform to the following gradation:

U. S. Standard Sieve Size	% Finer By Weight
1 inch	100
No. 4	80-100
No. 40	60-100
#200	20 – 70

Screened till shall have a hydraulic conductivity of less than $1x10^{-4}$ cm/sec when as demonstrated by ASTM D5084, when placed and compacted as specified as a subgrade fill beneath the secondary liner.

1. Interface Shear Strength: Testing completed by the Engineer shall demonstrate that the interface shear strength is equal to or greater than a strength envelope of 26^0 between the 60-mil textured HDPE liner and the proposed screened till.

2. The interface shear strength shall be determined by an interface shear test performed in accordance with ASTM D5321. The normal stresses applied shall be 1, 3, 10, 25, and 50 psi. The strain rate shall not exceed 0.04 inches per minute. The 60-mil textured HDPE geomembrane shall be tested in the machine direction. The tests shall be continued until residual shear strengths are achieved, or to a maximum 2-inch displacement. The Screened Till shall be compacted to 93% of maximum dry density per ASTM D1557, and a moisture content of 2% wet of optimum.

   The laboratory test reports shall include plots of shear strength versus normal stress for peak and large displacement values, and stress versus strain plots for tests run at each normal load application. A minimum of two (2) tests shall be completed.

3. Test results not meeting the minimum requirements shall be reviewed by the Engineer for possible conformance with the overall design objectives.

D. For other fill materials see Section 02234 Select Sand, Section 02541 - Gravel Roadway, and Section 02930 - Loaming and Seeding, as applicable.

2.02 QUALITY CONTROL AND QUALITY ASSURANCE

A. During earthwork operations, the Engineer will be present on the site to monitor and document the Contractor's activities relative to contract compliance.

B. The Engineer shall complete laboratory analyses of a minimum of two (2) representative samples of common borrow and screened till. The Engineer shall conduct laboratory grain size analysis, moisture density testing, and permeability in accordance with ASTM C136/C117, ASTM D1557, and ASTM D5084, respectively, to demonstrate conformance with Parts 2.01 and 3.02 of this Section.

C. The Contractor shall provide a sample for Engineer’s laboratory analysis of at least one (1) representative sample of common borrow fill and screened till for each 5,000 cubic yards of material to be placed. The Engineer shall conduct laboratory grain size analysis and moisture density testing in accordance with ASTM C136/C117 and D1557, respectively, to demonstrate conformance with Parts 2.01 and 3.02 of this Section.

D. The results of laboratory testing shall be reviewed by the Engineer prior to placement of fill materials. Costs for re-sampling and subsequent laboratory testing of all non-complying materials shall be borne by the Contractor.

E. Field tests will be performed by the Engineer on in-place fill and backfill materials to confirm that specified densities are being achieved with the minimum required coverages and compaction equipment utilized by the Contractor. The Engineer will select locations and frequency for in-place density testing. At a minimum, the frequency of field tests shall be as follows:

1. Common Borrow Fill: 1 test per 10,000 ft^2 installed
2. Screened Till: 1 test per 10,000 ft^2 installed

F. Acceptable materials placed and compacted to below the specified density shall alternatively be:

1. Recompacted as required to achieve the specified density.
2. Removed and replaced with properly placed and acceptably compacted material.

G. Materials placed and compacted which do not conform to project specifications for the area placed shall be removed and replaced with suitable material by the Contractor.

H. The Contractor will bear all costs incurred in the recompaction, removal, and replacement of fill not meeting density requirements.

PART 3 EXECUTION

3.01 PREPARATION

A. Fill to be used must be reviewed by the Engineer.

B. The subgrade which is to receive the fill shall be fine-graded and compacted in accordance with Section 02222 "Excavation" and reviewed by the Engineer.

C. All excavated surfaces shall be within 0.10'(+) and 0.20'(-) ft. of required line and grade.

D. Surfaces to be filled against which are steeper than 4:1 shall be scarified or stepped and compacted to provide a bond with the new material.

E. Fill materials will not be placed or compacted on frozen ground or during unfavorable weather conditions. Backfill operations will not be resumed until the moisture content and fill density is satisfactory to the Engineer.

F. All fill material shall be placed "in-the-dry" on a prepared ground surface acceptable to the Engineer. The Contractor shall drain away ponded areas as required to perform the placement of fill in-the-dry.

3.02 FILLING AND COMPACTION

A. Approved suitable material shall be installed in lifts no greater than as specified.

B. Lifts shall be compacted to at least the specified percentage of maximum dry density, within 3% of optimum moisture content. Field testing of these lifts will be performed in accordance with ASTM D6938-08a, and Paragraph 2.02 of this Section.

C. Do not proceed with the next layer of fill until the preceding layer has been tested and approved by the Engineer.

D. Areas at which tests indicate insufficient compaction shall be recompacted and retested until the areas conform to the requirements of this specification.

E. For the materials specified herein, the following placement and compaction requirements are included:

	Maximum Lift Before Compaction	Minimum % of Maximum Density per ASTM D1557
Common Borrow Fill	12"	93
Screened Till	12"	93

3.03 BACKFILLING OF UTILITES AND PIPING

A. After pipes and joints have been inspected and approved by the Engineer, screened till bedding or crushed stone (See Section 02232) shall be carefully placed and compacted and tamped in 6-inch layers under, around, and to the spring line of the pipe to firmly support the pipe, and prevent lateral movement.

B. Care shall be taken to provide recesses in the bedding or trench bottom, as required, to relieve each bell of any load.

C. Backfill from the top of the bedding to 12-inches above the pipe shall be completed in 12-inch layers with screened till sand, evenly on both sides of the pipe.

D. The remainder of the backfill may be material removed from the trench excavation and shall be placed in approximately 12-inch layers and compacted to 93% of the

maximum dry density, as demonstrated by in-place density testing completed by the Engineer.

3.03 FINAL GRADING

A. Perform all finish grading required to attain the elevations shown on the Plans, to within 0.1 feet, to eliminate all ponded water, or as otherwise indicated.

B. Areas to be seeded shall be raked to remove all stones and other unsatisfactory material, and shall be suitably compacted.

3.04 TREATMENT AFTER COMPLETION OF GRADING

A. After grading is complete and the Engineer has finished his reviews, the Contractor shall permit no further excavating, filling, grading, or vehicular access except to maintain erosion or sediment control. Use all means necessary to prevent erosion of freshly graded areas during construction and until such time as permanent drainage and erosion control measures have been installed.

END OF SECTION

SECTION 02231
SELECT AGGREGATES

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Furnishing and placement of crushed stone around perforated pipe, and below structures.

B. Furnishing and placement of select gravel as a filter material adjacent to crushed stone.

1.02 RELATED REQUIREMENTS

A. Section 01300 - Submittals
B. Section 01400 - Quality Assurance/Quality Control
C. Section 02222 - Excavation
D. Section 02275 - Non-woven Geotextile Filter Fabric
E. Section 02619 - High Density Polyethylene Piping and Fittings
F. Section 02700 - Manholes, Frames and Covers
G. Section 02751 - Precast Valve Vaults and Chambers

1.03 SUBMITTAL

A. The Contractor shall provide laboratory data from a minimum of 1 representative sample indicating that the crushed stone and select gravel meets the grain size distribution specified below.

PART 2 PRODUCTS

2.01 3/4" CRUSHED STONE

A. Crushed stone shall be durable crushed rock consisting of the angular fragments obtained by breaking and crushing solid or shattered natural rock, and reasonably free from sand, clay, loam or deleterious material and not more than one percent (1%) of satisfactory material passing a No. 200 sieve will be allowed to adhere to the crushed stone.

B. The crushed stone shall be uniformly blended according to the grading requirements for the respective stone sizes shown in the following table:

Square Opening Sieve	% Passing by Weight
3/4 "	90 - 100
3/8 "	20 - 55
#4	10 - 30
#20	0 - 10

PART 3 EXECUTION

3.01 PREPARATION

Areas to receive crushed stone shall have the specified geotextiles and/or other geocomposite layers overlying the liner as shown on the drawings.

3.02 INSTALLATION

A. Crushed stone shall be placed around the perforated pipes in accordance with the Drawings, and in a manner which will produce a reasonable well-graded mass of stone. The stone shall not be dropped or dumped in a manner that will cause damage to the pipes or liners.

END OF SECTION

SECTION 02232
STONE FILL

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Procurement of stone fill, rip-rap, and crushed stone materials.

B. Placement of stone and rip-rap fill for stabilization of drainage swales and slopes or as select materials around leachate collection piping as shown on the Drawings or as ordered by Engineer.

1.02 RELATED REQUIREMENTS

A. Section 02275 - Non-Woven Geotextile Fabric
B. Section 02270 - Erosion Control
C. Section 02273- Drainage Geocomposite

PART 2 PRODUCTS

2.01 MATERIALS

A. Stone and Rip-rap Fill for Placement in Leachate Sumps, Stormwater Ponds, Stabilization of Drainage Swales, and Culvert Outlet Protection:

1. Stone and rip-rap shall conform to NHDOT Specifications for Stone Fill Class B, Class C and Class D Section 585 “Stone Fill” and Rip-rap Type A, Section 583 “Rip-rap”, as indicated on the Drawings.

2. Stone and rip-rap fill shall be hard, durable, angular in shape; resistant to weathering and to water action; free from overburden, spoil, and organic material.

3. The acceptability of the processed stone will be determined by visual inspection or by suitable tests. If testing is required, suitable samples of stone shall be taken in the presence of the Engineer at least fourteen (14) days in advance of the time when the placing of stone fill is expected to begin.

4. Control of gradation will be by visual inspection. If necessary, the Contractor shall provide two (2) samples of rock, at least five tons (5T) each, meeting the gradation specified above. These samples shall be used as a reference for judging the gradation of the stone fill supplied.

5. Any difference of opinion between the Engineer and the Contractor shall be resolved by dumping and checking the gradation of two (2) random truckloads of stone. Mechanical equipment, a sorting site, and labor

needed to assist in checking gradation shall be provided by the Contractor at no additional cost of the Owner.

B. 1½" Crushed Stone

1. Crushed stone shall be hard, durable, angular in shape; resistant to weathering and to water action; free from overburden, spoil, and organic material.
2. Crushed stone shall be washed, uniformly blended and meet the following gradation:

Sieve Size	Percent Passing by Weight
1 ½ -inch	100
1 inch	75-100
¾ inch	45-75
No. 4	10-45
No. 200	0-5

3. The Engineer shall collect a sample of the processed crushed stone for laboratory testing. Materials not meeting the requirements of this section shall not be used in the Work.

PART 3 EXECUTION

3.01 PLACEMENT OF STONE FILL AND FOR RIP RAP STABILIZATION

A. Stone fill in the landfill shall be placed directly over the drainage geocomposite and pipes as shown on the Drawings.

B. Placement of stone fill over geomembrane and drainage geocomposite materials shall be by "low ground pressure" (LGP) rated equipment having a bearing pressure of no greater than 4.7 pounds per square inch measured at 12 inches above the geomembrane. No equipment will be allowed at any time directly on the liner or geotextile fabric.

C. Stone fill shall be placed by LGP equipment in lifts no less than 12 inches.

D. Non LGP equipment which is necessary to operate over the landfill shall be operated on additional depths of stone fill or other materials to provide an equivalent bearing pressure of 4.7 pounds per square inch at 12 inches above the geomembrane.

E. Coordinate placement of stone fill with the installation of other components of work shown on the Plans, taking all measures to prevent damage to these materials while placing the stone fill.

F. The stone fill layer will be spread to a consistent depth and uniform surface, being

compacted only by passage of the low ground pressure machinery. No vibratory equipment is to be used in compacting the stone fill.

G. Stone fill in drainage swales shall be placed directly over a 10 oz. non-woven geotextile fabric within the prepared swales and on slopes, starting at the downstream end. Rip rap shall be placed over a 16 oz non-woven geotextile fabric within prepared swales, and slopes, starting at the downstream end.

H. Stone fill and rip rap for culvert outlet protection shall be placed directly over a 10 oz. and 16 oz. non-woven geotextile fabric, respectively, to the limits shown on the Plans.

I. All stone fill and rip rap shall be placed in a manner which will produce a reasonably well-graded mass of stone with the minimum practicable percentage of voids. The entire mass of stone shall be placed, so as to be in conformance with the lines, grades, and thicknesses shown on the plans.

J. Stone fill and rip rap shall be placed to its full course thickness at one operation and in such a manner as to avoid displacing the underlying material. Placing of stone fill in layers, or by dumping into chutes, or by similar methods likely to cause segregation, will not be permitted.

K. The larger stones shall be well distributed and the entire mass of stone shall conform to the gradation specified in paragraph 2.01. All material going into stone fill protection shall be so placed and distributed that there will be no large accumulations of either the larger or smaller sizes of stone.

L. It is the intent of these specifications to require compact stone fill protection in which all sizes of material are distributed within their proper proportions. Hand placing or rearranging of individual stones by mechanical equipment may be required to the extent necessary to secure the results specified.

END OF SECTION

SECTION 02234
SELECT SAND

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Procurement of select sand and placement of the twelve (12) inch layer of select sand as shown on the Drawings.

1.02 RELATED REQUIREMENTS

A. Section 01300 - Submittals
B. Section 01400 - Quality Assurance / Quality Control
C. Section 02223 - Filling
D. Section 02273 - Drainage Geocomposite

1.03 REFERENCE STANDARDS

A. ASTM C136/C117 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregate and Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing

B. ASTM D1557: Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort

C. ASTM D5084: Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

D. ASTM D5321: Test Method for Direct Shear Testing of Geosynthetic Material and Soil Interfaces

E. ASTM D4373: Test Method for Determining Calcium Carbonate Content of Soils

1.04 SUBMITTALS

A. The Contractor shall provide a sample for laboratory testing by the Engineer to determine that the select sand meets the specified grain size distribution and hydraulic conductivity for at least every 3,000 cy delivered to the site.

B. The Contractor shall submit all proposed low ground pressure (LGP) equipment for Engineer's review.

C. The Engineer shall complete direct shear box tests of the select sand and the proposed drainage geocomposite to demonstrate compliance of interface friction,

in accordance with Part 2.01 of this Section.

D. The Contractor shall provide one sample for laboratory testing by the Engineer for calcium carbonate content from each source of select sand.

PART 2 PRODUCTS

2.01 SELECT SAND

A. Select sand shall be well graded sand without excessive fines, free from loam clay, and organic matter and meeting the following grain size distribution:

U.S. Standard Sieve Size	% Finer By Weight
1 in.	100
#4	60-100
#10	40-95
#40	10-50
#100	0-20
#200	0-10

B. Select sand shall not contain more than 15 percent calcium carbonate as determined by ASTM D 4373. At least one test shall be performed on a representative sample from each source.

C. Select sand shall have a hydraulic conductivity greater than or equal to 1×10^{-3} cm/sec as determined by ASTM D 2434.

D. Interface Shear Strength: Testing completed by the Engineer shall demonstrate that the interface shear strength is equal to or greater than a strength envelope of 26^0 between the 60-mil textured HDPE liner and the select sand.

a. The interface shear strength shall be determined by an interface shear test performed in accordance with ASTM D5321. The normal stresses applied shall be 1, 3, 10, 25, and 50 psi. The strain rate shall not exceed 0.04 inches per minute. The 60-mil textured HDPE geomembrane shall be tested in the machine direction. The tests shall be continued until residual shear strengths are achieved, or to a maximum 2-inch displacement. The select sand shall be compacted to 95% of maximum dry density per ASTM D1557, and a moisture content of 2% wet of optimum.

b. The laboratory test reports shall include plots of shear strength versus normal stress for peak and large displacement values, and stress versus strain plots for tests run at each normal load application. A minimum of two (2) tests shall be completed.

c. Test results not meeting the minimum requirements shall be reviewed by the Engineer for possible conformance with the overall design objectives

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that the stockpiled select sand is reviewed by the Engineer.

B. Verify the lines and grades to which the select sand is to be placed and compacted.

C. Verify that the area on which select sand is to be placed is free from debris, snow, ice, or water and that the ground surface is not frozen.

3.02 PLACEMENT OF MATERIALS

A. Placement of the select sand over geomembrane and drainage geocomposite materials shall be by "low ground pressure" (LGP) rated equipment having a bearing pressure of no greater than 4.7 pounds per square inch measured at 12 inches above the geomembrane. No equipment will be allowed at any time directly on the liner or geotextile fabric.

B. Select sand shall be placed by LGP equipment in lifts no less than the proposed minimum thickness for that area. In no case shall this be less than 12 inches.

C. Non LGP equipment which is necessary to operate over the landfill shall be operated on additional depths of sand or other materials to provide an equivalent bearing pressure of 4.7 pounds per square inch at 12 inches above the geomembrane.

D. Coordinate placement and compaction of the select sand with the installation of other components of work shown on the Plans, taking all measures to prevent damage to these materials while placing the select sand.

E. The select sand layer will be spread to a consistent depth and uniform surface, being compacted only by passage of the low ground pressure machinery. No vibratory equipment is to be used in compacting the select sand.

F. The select sand layer may not require testing for compaction densities if the Engineer believes that the sand is being placed in layers and compacted as required. If requested by Engineer, Contractor shall coordinate for testing by the Engineer to demonstrate a minimum 90% of maximum dry density is achieved.

END OF SECTION

SECTION 02270
EROSION CONTROL

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Installation and maintenance of temporary erosion control devices.

B. Erosion control measures to fully manage runoff and potential erosion conditions which may develop during construction and prior to the functioning of completed permanent erosion control devices.

C. Compliance with federal, state and local regulations pertaining to erosion control, and the Site Specific Permit conditions for this project.

1.02 RELATED REQUIREMENTS

A. Section 02222 - Excavation
B. Section 02223 - Filling
C. Section 02232 - Stone Fill
D. Section 02930 - Loaming and Seeding

1.03 DESIGN CRITERIA

A. Conduct all construction in a manner and sequence that causes the least practical disturbance of the physical environment.

B. Stabilize disturbed earth surfaces in the shortest practical time and employ any and all such temporary erosion control devices as may be necessary until such time as adequate soil stabilization has been achieved.

C. The erosion control devices shown on the Drawings and as specified herein represent the minimum required work for erosion control. The Contractor shall add to these minimum devices any and all measures to effectively prevent migration of sediment from the work area.

PART 2 PRODUCTS

2.01 BALED HAY

20" X 20" X 30" - 40 lbs/bale minimum, free from primary noxious week seeds and rough or woody materials.

2.02 SAND BAGS

Heavy cloth bags of approximately one cubic foot capacity filled with sand or gravel.

2.03 MULCH

Mulch shall consist of cured hay. When air dried in the loose state, the contents of a representative bale shall lose not more than 15 percent of the resulting air dry weight of the bale. It shall be free from primary noxious weed seeds and rough or woody materials.

2.04 EROSION CONTROL BLANKET

A. Erosion control blankets shall be Curlex II, manufactured by American Excelsior Company, DS75 manufactured by North American Green, or approved equal.

B. The Contractor shall store the blanket in a manner which protects them from damage by construction traffic and extended ultraviolet exposure.

C. Type of fasteners and their spacing shall be in accordance with the manufacturer's recommendations.

2.05 STONE FILL

As defined in Section 02232 "Stone Fill" and as required by the Plans. Stone used to contingent check claims shall be crushed stone as defined in Section 02232.

2.06 SILT FENCE

A. The silt fence shall be Propex Silt-Stop sediment control fabric or approved equal.

B. Support poles and fastenings to be used shall be as specified by the manufacturer.

C. Spacing and location of poles and fastenings shall be in accordance with the manufacturer's recommendations, or more frequently if required.

2.07 TEMPORARY SEEDING

Prior to establishment of the final vegetation on disturbed areas, placement and establishment of temporary grasses will be completed if required. Seed for temporary control shall be annual or perennial ryegrass. Hay mulch shall be applied to temporary seeded areas at a rate of 1½ to 2 tons per acre.

2.08 BONDED FIBER MATRIX

A. Bonded fiber matrix shall be installed on all vegetated slopes steeper than 3:1. Acceptable manufacturers include:
   1. Mat Inc. (Soil Guard);
   2. Central Fiber Corporation (Spray Matt);
   3. Terra Novo (Earthguard Fiber Matrix); or
   4. Approved equal.

PART 3 EXECUTION

3.01 TEMPORARY EROSION CHECKS

A. Construct temporary erosion checks in ditches and other locations required to effectively control erosion.

B. The erosion control procedures shall conform to NHDOT Specifications, Division 600, Section 645 "Erosion Control".

C. Construct temporary barriers along the toe of embankments when necessary or as designated by the Engineer.

D. Construct temporary side drains in intervals as necessary or as designated by the Engineer.

E Haybale barriers and stone check dams shall be installed in drainage swales where shown on the Plans. Haybales will be staked and maintained prior to and during construction until disturbed areas have a healthy stand of grass and sediment transport has ceased. Additional haybale barriers may be required as conditions dictate, and shall be placed as necessary.

F. Silt fence shall be installed along the limits of work where shown on the Plans, and at any other locations as necessary to control erosion as conditions dictate.

3.02 BONDED FIBER MATRIX

A. Contractor shall apply a Bonded Fiber Matrix on vegetated slopes steeper than 3:1 in accordance with the manufacturers' recommendations for long-term erosion control.

3.03 INSTALLATION OF EROSION CONTROL BLANKET

A. CHANNEL INSTALLATION

1. Erosion control blankets shall be installed as directed by the Engineer in accordance with manufacturer's instructions. The extent of erosion control blankets shall be as shown on Drawings.

2. Erosion control blankets shall be installed parallel to the flow of water. The first roll shall be centered longitudinally in mid-channel and anchored with staples, as required by the manufacturer. Subsequent rolls shall follow from channel center outward and be abutted to allow installation of a common row of staples.

3. Successive lengths of erosion control blankets shall be overlapped ("shingled") sufficiently for a common row of staples with the upstream end on top. Staple the overlap across the end of each of the overlapping lengths.

4. A trench shall be located at the upstream termination. Erosion control blanket shall be stapled to the bottom of the trench. Backfill and compact the trench.

B. SLOPE INSTALLATION

1. Erosion control blankets shall be installed as directed by the Engineer in accordance with manufacturer's instructions. The extent of erosion control blankets shall be as shown on Drawings, where required.

2. Erosion control blankets shall be oriented in vertical strips and anchored with staples, as required by the manufacturer. Adjacent strips shall be abutted to allow for installation of a common row of staples. Horizontal joints between erosion control blankets shall be overlapped sufficiently for a common row of staples ("shingled") with the uphill end on top.

3. Where exposed to overland sheet flow, a trench shall be located at the uphill termination. Erosion control blanket shall be stapled to the bottom of the trench. Backfill and compact the trench.

4. Where terminating in a channel, slope erosion control blanket shall overlap channel erosion control blanket sufficiently for a common row of staples.

3.04 EROSION CONTROL IMPLEMENTATION

A. During construction and thereafter, erosion control measures are to be implemented as shown on the Plans, and additionally as may be necessary to manage conditions as they occur. The smallest practical areas of land should be exposed at any one time during development. When the land is exposed during development, the exposure should be kept to the shortest practical period of time as approved by the Engineer.

B. Erosion rills or gullies in the Work area or in areas topographically below the work area shall be regraded and seeded at no additional cost to the Owner until an accepted vegetative stand is established.

END OF SECTION

SECTION 02273
DRAINAGE GEOCOMPOSITE

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Furnishing and installation of drainage geocomposite materials, consisting of an HDPE drainage net bonded on both sides to non-woven polypropylene geotextile fabrics.

1.02 RELATED REQUIREMENTS

A. Section 01300 - Submittals
B. Section 01400 - Quality Assurance/Quality Control
C. Section 02223 - Filling
D. Section 02234 - Select Sand
E. Section 02276 - High Density Polyethylene (HDPE) Liner
F. Section 02279 - Geosynthetic Clay Liner (GCL)

1.03 QUALITY CONTROL

A. Provide the manufacturer's certification that the drainage geocomposite has been manufactured and successfully tested in accordance with the appropriate ASTM standards.

B. Drainage geocomposite shall be supplied in rolls marked or tagged with the following:
   1) Name of manufacturer.
   2) Product identification.
   3) Lot number.
   4) Roll number.
   5) Roll dimensions.

1.04 SUBMITTALS

A. The Contractor shall submit manufacturer or laboratory data indicating that the proposed materials meet the specifications outlined in Part 2.02, 2.03 and 2.04 A, B and C of this section.

B. The Contractor shall submit quality control certificates issued by the manufacturer for the geonet and geotextile components of the drainage geocomposite. The certificates shall include roll numbers and identification, and results of quality control tests completed at the minimum frequency specified in Part 2 of this section.

C. The Contractor shall submit representative samples form the proposed drainage geocomposite to the Engineer for transmissivity testing and interface sheer strength testing per Part 2.04 of this section.

D. Requirements for testing of interface shear strength between the primary (non base area) and secondary drainage geocomposite and the textured HDPE geomembrane and the drainage geocomposite and the proposed select sand are included in Part 2.04 of this section.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Primary Drainage Gecomposite
   1. GSE Fabrinet UF Geocomposite
   2. Approved equivalent

B. Secondary Drainage Geocomposite
   1. GSE Fabrinet UF Geocomposite
   2. Approved equivalent.

2.02 NON-WOVEN POLYPROPYLENE GEOTEXTILE FILTER FABRIC

A. The filter fabric on all of the geocomposite materials shall consist of an 8 oz non-woven continuous polypropylene filament fibers. It shall be tear resistant and be capable of conducting water.

B. The fabric shall retain its durability and strength when it is wet.

C. The Contractor shall provide quality control certificates from the manufacturer for the fabric used in the manufacturing of the drainage geocomposite. The filter fabric shall have the following minimum physical properties as determined by the appropriate test method.

Physical Property	**Test Method**	**Frequency**	**Minimum Average Roll Values Physical Properties**
Fabric Weight	ASTM D5261	1/90,000 SF	8.0 oz./yd^2
Water Flow Rate	ASTM D4491	1/540,000 SF	95 gpm/ft^2
Grab Strength[1]	ASTM D4632	1/90,000 SF	220 lbs
Grab Elongation[1]	ASTM D4632	1/90,000 SF	50%
Puncture Resistance	ASTM D4833	1/90,000 SF	120 lbs
Apparent Opening Size[2]	ASTM D4751	1/540,000 SF	Sieve Seize #80

1. Weakest Principal Direction
2. AOS sieve # must be ≥ #80

2.03 HIGH DENSITY POLYETHYLENE (HDPE) DRAINAGE NET

A. The Contractor shall provide quality control certificates from the manufacturer for the drainage net used in the manufacturing of the drainage geocomposite. The HDPE drainage net shall have the following minimum physical properties as determined by the appropriate test method.

Physical Property	**Test Method**	**Frequency**	**Minimum Average Value**	
			Secondary	*Primary*
Polymer Density	ASTM D1505	1/50,000 SF	0.94 g/cm^3	0.94 g/cm^3
Carbon Black Content	ASTM D4218	1/50,000 SF	2%	2%
Nominal Thickness	ASTM D5199	1/50,000 SF	250 mil	300 mil
Tensile Strength MD	ASTM D5035	1/50,000 SF	75 lb/in	100 lb/in

2.04 DOUBLE-SIDED DRAINAGE GEOCOMPOSITE

A. The double-sided drainage geocomposite shall be manufactured by heat bonding geotextile filter fabric to both faces of the HDPE drainage net. No burn through geotextiles shall be permitted. No glue or adhesive shall be permitted.

B. The bond between the geotextile and HDPE drainage net shall exhibit a minimum average peel strength of 1 lb. per inch and a minimum per roll of 0.5 lb. per inch (ASTM D7005). Peel strength of the manufactured geocomposite shall be tested at a minimum of every 50,000 square feet, by the Manufacturer.

C. The primary drainage geocomposite shall have a minimum transmissivity of 1.6×10^{-3} m^2/s when tested with ASTM D4716 between select sand and textured HDPE liner at a normal load of 10,000 psf and a gradient of 0.02 with a seat time of 100 hours in accordance with GRI-GM8.

D. Transmissivity tests shall be completed by the Engineer at a minimum frequency of 1 per 50,000 square feet and at least one per lot.

E. Contractor shall provide samples of geocomposite materials to the Engineer for transmissivity testing prior to shipment to the site.

D. Interface Shear Strength – Testing Completed by Engineer

1. Contractor shall provide samples of the proposed materials required for interface testing, as specified below, to the Engineer for testing prior to shipment to the site. Laboratory testing shall demonstrate that the interface shear strength is equal to or greater than a strength envelope of 26^0 between the following surfaces:

a. The primary double-sided drainage geocomposite and the proposed 60-mil textured HDPE geomembrane.

b. The secondary double-sided drainage geocomposite and the proposed 60-mil textured HDPE geomembrane.

2. The interface shear strength shall be determined by an interface shear test performed in accordance with ASTM D5321. The normal stresses applied shall be 1, 3, 10, 25, and 50 psi, all under inundated conditions. The strain rate shall not exceed 0.04 inches per minute. The drainage geocomposite and the 60-mil textured HDPE geomembrane shall be tested in the machine direction. The tests shall be continued until residual shear strengths are achieved, or to a maximum 2-inch displacement.

   The laboratory test reports shall include plots of shear strength versus normal stress for peak and large displacement values, and stress versus strain plots for tests run at each normal load application. A minimum of two (2) tests shall be completed for each interface.

3. Test results that do not meet the minimum requirements are to be reviewed by the Engineer for possible conformance with the overall design objectives.

2.05 STORAGE

A. Materials shall be stored on-site in a manner consistent with the manufacturer's recommendations.

B. Damaged materials will not be used for installation.

PART 3 EXECUTION

3.01 INSTALLATION

A. The installer shall handle all geocomposite rolls in such a manner as to ensure they are not damaged in any way, and the following shall be complied with:

   The geocomposite shall be placed as shown on the plans and with the preferential flow direction (if any) perpendicular to the topographic contours. Wherever possible, the geocomposite shall be rolled down the slope over the "textured" HDPE in such a manner as to continually keep the geocomposite in tension. If necessary, the geocomposite shall be positioned by hand after being unrolled to minimize wrinkles. The geocomposite cannot be placed in the horizontal direction (i.e., across the slope and mid-slope seams are unacceptable).

In the presence of wind, all geocomposite rolls in place shall be weighted with sandbags or the equivalent. Such sandbags shall be installed during placement and shall remain until replaced with cover material.

Installation of geocomposite shall be done in a manner to protect underlying geomembrane, as applicable. No cutting of geocomposite shall be allowed directly on geomembrane. Use of four or six wheel ATV's weighing less than 650 lbs may be permitted to operate directly over the geocomposite provided that they do not exceed a speed of 5 mph, and refrain from abrupt starts, stops and turns. If operation of ATV is not done in a manner to protect the geocomposite and the integrity of the geotextile, the Engineer may prohibit their use, at no additional cost to the Owner, and require that damaged areas be repaired. Any other equipment used shall provide protection of the geomembrane and geocomposite and meet low ground pressure requirements.

B. When joining two pieces along the roll length, the white or yellow geotextile filter fabric and net shall be lapped a minimum of 4 inches, and plastic ties shall secure the net at intervals no greater than every 5 feet. The spacing of the ties within anchor trenches shall not exceed 6 inches. The bottom layers of the geotextile shall be overlapped and the top layers shall be stitched along the entire length of the seam. Metallic ties are unacceptable. The composite shall not be welded to this geomembrane. Heat fusion of seams will not be allowed.

C. When joining two pieces end to end, the net shall be lapped a minimum of 12 inches, and shall be secured by plastic ties approximately every 12 inches. The geotextile shall be overlapped a minimum of 6 inches, shingled in a downslope manner consistent with the direction of flow, and sewn or heat bonded to each other. Any exposed edge of geonet shall be covered with a continuous strip of geotextile (same as geocomposite), sewn to the top geotextile and folded under the geocomposite a minimum of 6 inches.

D. Care shall be taken to keep the composite clean and free from debris prior to installation. If composite is not free of soil and debris before installation, it shall be cleaned by the Contractor just prior to installation. Geocomposite damaged during or prior to installation shall be removed and replaced at no additional cost to the Owner.

E. The Contractor shall sequence construction so that select sand or other geosynthetics can cover the geocomposite within 14 days of deployment. Areas that have been exposed for longer than 14 days shall be protected from UV degradation with an acceptable material (i.e., sacrificial geotextile, or opaque plastic).

F. The Contractor shall limit the dust accumulation on the upper geotextile after installation and prior to placement of select sand, stone or geosynthetics.

Excessive dust accumulation, as determined by the Engineer, may require replacement of geocomposite materials.

3.02 REPAIR

A. Any holes or tears in the geocomposite shall be repaired by placing a patch extending a minimum of twelve (12) inches beyond the edge of hole or tear. The patch shall be secured by tying fasteners through the patch material and to the geotextile and geonet of the installed panel at a minimum spacing of 6 inches. A geotextile cap shall be heat bonded to the geotextile of the panel and patch shall extend a minimum of 6 inches beyond the patch.

3.03 PLACEMENT OF OVERLYING MATERIALS

A. The Contractor shall place all overlying sand, stone and geosynthetic materials in a manner so that the underlying material is not damaged, excessive stresses are not introduced, and wrinkles are minimized.

B. Contractor shall utilize hand placement of materials or casting of materials in advance of dozer grading of cover soils or stone to minimize wrinkles and to prevent geocomposite from folding over on itself.

END OF SECTION

SECTION 02274
WOVEN GEOTEXTILE FABRIC

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

Furnishing and installation of woven geotextile fabric as a separation/reinforcement layer beneath the roadway gravels.

1.02 RELATED REQUIREMENTS

A. Section 01300 - Submittals
B. Section 01400 - Quality Control

1.03 QUALITY CONTROL

Provide the manufacturer's certification that the woven geotextile fabric has been manufactured and successfully tested in accordance with the appropriate ASTM standards.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Propex 200 ST
B. US Fabrics US 200
C. Approved equal by Engineer

2.02 WOVEN GEOTEXTILE FABRIC

A. Geotextile fabric shall consist of woven polypropylene monofilament yarns which are designed for geotechnical applications. It shall be treated for ultraviolet light resistance.

B. The geotextile fabric shall retain its durability and strength when it is wet.

C. Geotextile fabric shall be resistant to tears; abrasion and the forces generated by installation of specified backfill materials and shall meet the following minimum requirements:

PHYSICAL PROPERTY	TEST METHOD	PERFORMANCE REQUIREMENTS
Grab Tensile Strength	ASTM D-4632	200 lbs
Trapezoidal Tear Strength	ASTM D-4533	75 lbs
Mullen Burst Strength	ASTM D-3786	400 psi
Puncture Strength	ASTM D-4833	70 lbs

PART 3 EXECUTION

3.01 PREPARATION

A. Areas to receive woven geotextile fabric shall be graded to lines and grades shown of the Construction Drawings. Contractor shall remove protruding rocks or other materials that may damage the fabric.

3.02 INSTALLATION

A. Place fabric immediately prior to installation of backfill.

B. Install and anchor fabric to minimize wrinkles and in accordance with the manufacturer's recommendations and as specified herein. The fabric surface shall conform closely with the prepared subgrade. Fold-over wrinkles shall be eliminated prior to backfill.

C. The ends of fabric on slopes shall be keyed into the soil at least six (6) inches to hold the fabric in place.

D. The fabric shall be lapped a minimum of three (3) feet when joining two pieces together. Shingle all laps in the direction of anticipated water flow.

E. Fabric damaged during or prior to installation shall be removed and replaced at no additional cost to the Owner.

END OF SECTION

SECTION 02275
NON-WOVEN GEOTEXTILE FILTER FABRIC

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Furnishing and installation of non-woven geotextile filter fabric.

1.02 RELATED REQUIREMENTS

A. Section 02232 - Stone Fill

1.03 QUALITY CONTROL

A. Provide the manufacturer's certification that the geotextile filter fabric has been manufactured and successfully tested in accordance with the appropriate ASTM standards.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Propex Geosynthetics
B. Skaps Industries
C. TNS Advanced Technologies
D. Approved Equivalent

2.02 GEOTEXTILE FILTER FABRIC

A. The filter fabric shall consist of non-woven continuous filament fibers which are formed into a sheet by heat bonding. It shall be tear resistant and be capable of conducting water. Fabric materials provided shall be 10oz. beneath NHDOT “C” Stone and 16 oz. beneath NHDOT Rip Rap, or as indicated on the Drawings.

B. The fabric shall retain its durability and strength when it is wet, and shall be non-biodegradable.

C. The fabric shall be capable of withstanding direct exposure to sunlight for 30 days without measurable deterioration.

D. The filter fabric shall have the following minimum physical properties as determined by the appropriate test method:

Physical Property	Test Method	Minimum Average Roll Value	
Fabric Weight	ASTM D5261	10 oz./S.Y.	16 oz./S.Y.
Water Flow Rate (through fabric)	ASTM D4491	95 gpm/S.F.	50 gpm/S.F.
Grab Strength (Weakest Principal direction)	ASTM D4632	250 lbs.	380 lbs.
Grab Elongation (Weakest principal direction)	ASTM D4632	50%	50%
Trapezoid Tear (Weakest principal direction)	ASTM D4533	95 lbs.	140 lbs.
CBR Puncture Resistance	ASTM D6241	650 lbs.	1000 lbs.
Apparent Opening Size	ASTM D4751	Sieve Size #70	Sieve Size #70

PART 3 EXCECUTION

3.01 INSTALLATION

A. Fabric shall be hand placed in all locations as shown on the Plans, and where specified. The fabric shall be deployed on slopes in continuous lengths, parallel to slope direction. Mid-slope seams are not allowed.

B. When jointing two pieces, the filter fabric shall be lapped a minimum of 18 inches, shingled to shed water.

C. Filter fabric damaged during or prior to installation or during placement of overlying soil or stone shall be removed and replaced at no additional cost to the Owner.

END OF SECTION

SECTION 02276
HIGH DENSITY POLYETHYLENE (HDPE) LINER

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Furnishing of Textured 60-mil HDPE liner
B. Quality Control for liner materials
C. Field installation of the liner
D. Leak location survey

1.02 RELATED REQUIREMENTS

A. Section 01400 - Quality Assurance/Quality Control
B. Section 01720 - Project Record Drawings
C. Section 02223 – Filling
D. Section 02231 – Select Aggregates
E. Section 02232 - Stone Fill
E. Section 02234 - Select Sand
F. Section 02273 - Drainage Geocomposite
G. Section 02279 - Geosynthetic Clay Liner (GCL)

1.03 APPLICABLE STANDARDS, CODES, AND REGULATIONS

A. ASTM Standards for High Density Polyethylene Geomembrane
B. Geosynthetics Research Institute – GRI-GM13 – latest revision
C. ASTM D5321 - Test Method for Direct Shear Testing of Geosynthetic Material and Soil Interfaces
D. ASTM D6747 - Standard Guide for Selection of Techniques for Electrical Detection of Potential Leak Paths in Geomembranes

1.04 QUALIFICATIONS

A. Liner Manufacturer:

The liner manufacturer shall have at least five (5) years continuous experience in the manufacture of HDPE geomembrane rolls and/or experience totaling 10,000,000 sq. ft. of manufactured HDPE geomembrane. The manufacturer shall permit the owner or his authorized representatives to visit the manufacturing plant.

B. Liner Installer:

The liner installer shall have successful experience in the installation of HDPE sheet using the dual hot wedge seaming method on projects with similar requirements to this project; and which is acceptable to, or licensed by the manufacturer of the primary materials for the installation of these materials.

Installer shall have a minimum of five (5) years experience performing this type of work.

C. Supervisor:

Installation shall be performed under the direction of a single competent English speaking installation supervisor who shall remain on-site and be in responsible charge throughout the liner installation, including subgrade acceptance, liner layout, seaming, testing and repairs, and all other related activities. The installation supervisor shall have supervised the installation of at least 3,000,000 sf of polyethylene geomembrane. Actual seaming shall be performed under the direction of a master seamer who may be the same person as the installation supervisor, and who has a minimum of 1,000,000 sf polyethylene geomembrane seaming experience using the same type of seaming apparatus as that specified in this project. The installation supervisor or master seamer must be on-site whenever seaming is being performed.

D. Quality Control:

The Contractor shall establish a Quality Control (QC) Representative who shall be responsible in the field for the quality and integrity of the HDPE liner installation. This responsibility shall include the inspection, testing, and documentation of all liner installation work as performed by the installer. The QC Representative shall have performed these duties on a minimum of 3,000,000 sf of HDPE membrane installation.

E. Laboratory:

The Engineer shall engage a qualified, independent laboratory acceptable by the Owner for use in completing the off-site tests of destructive samples specified herein.

Results of independent laboratory testing shall be transmitted directly from the lab to the Engineer and Contractor as soon as the data is available.

F. Liner Leak Location Survey:

The Contractor shall engage a qualified, independent testing company, acceptable by the Owner, to conduct a geomembrane electrical leak location survey following installation of the primary liner and placement of the geocomposite, select drainage sand, and select stone fill.

The independent testing company shall have performed these services on a minimum of 3,000,000 sf of geomembrane installation and shall have been performing such services for a minimum of 5 years.

Pre-qualified independent leak location contractors include:

1. Leak Location Services, Inc.
   16124 University Oak

San Antonio, TX 78249
(210) 408-1241

2. Hutchinson Group, Ltd.
4280 Old William Penn Highway
Murrysville, PA 15668
(724) 325-3996

G. Contractor Responsible for Subcontractors:

The roles of any subcontractor shall not relieve the Contractor of any responsibilities whatsoever under this contract. The Contractor shall be responsible for the actions and performance of the manufacturer, installer, supervisor, and QC representative under this contract. A Contractor's representative shall be on-site during all geomembrane installation activities.

1.05 SUBMITTALS

A. Prior to release of the geomembrane for shipment to the job site, the Contractor shall submit the following to the ENGINEER:

1. Written certification that the material was manufactured and tested in accordance with the requirements of GRI-GM13.

2. Quality control certificates for each batch of resin and production of geomembrane in accordance with the testing requirements of GRI-GM13.

3. Quality control certificates shall be signed by the responsible Quality Assurance (QA) personnel employed by the Manufacturer.

4. Conformance testing shall be performed in accordance with the requirements and standards specified in GRI-GM13 and as specified herein for the HDPE membrane and its installation. Certificates of compliance shall be submitted for each roll to be used on the project prior to its release for shipment to the job site. Certificates of Compliance for HDPE welding rod to be used on the project shall be submitted.

5. Shop Drawings showing the following:

   a. Proposed layout of the HDPE membrane system.

   b. Details of jointing the HDPE membrane, anchoring, penetrations, repair, testing, areas of slack for anticipated thermal contraction, locations of leak detection electrodes and wiring, and other construction details

6. Manufacturer's completed projects resume.

7. Installer's completed project resume.

8. Installer's crew identification list and resumes.

9. Installation schedule.

10. Manufacturer's and installer's warranty as described in Part 1.07.
11. Leak Location Contractor’s completed projects resume.
12. Leak location Contractor’s crew identification list and resumes.
13. The Contractor shall provide representative samples of the proposed geomembrane to the Engineer to complete direct shear box testing of the proposed 60-mil textured HDPE geomembrane and screened till/select sand to demonstrate compliance of interface friction as required in Section 02223 (Filling).
14. The Engineer shall complete direct shear box testing of the proposed 60-mil textured HDPE geomembrane and drainage geocomposites to demonstrate compliance of interface friction as required in Section 02273 (Drainage Geocomposite).

B. Roll Identification:

1. Each roll shall have a permanently affixed label with the following information:
   a. Name of manufacturer
   b. Date of manufacture
   c. Thickness of material (actual)
   d. Roll number
   e. Roll length
   f. Roll width

C. Record Drawings and QC Reports (See Parts 3 and 4)

1.06 QUALITY ASSURANCE

A. General:

Quality of the liner installation shall be the responsibility of the Contractor. The Contractor, in fulfilling this responsibility, will be assisted by his designated Manufacturer, Installer, QC representative, and Leak Location Contractor. The Contractor will be responsible for performing the Quality Assurance/Quality Control tasks outlined herein. The Engineer may conduct additional independent testing and inspections. These actions will not remove any responsibility of the Contractor under this Contract.

B. Lines of Authority:

The Contractor shall establish an Installation Supervisor and a QC Representative who will assist the Contractor in his responsibilities in the quality of the liner installation. The QC Representative shall assist in coordinating the timing and sequencing of liner installation and testing with the Engineer.

C. Leak Location Survey:

The Contractor shall coordinate an electrical leak location survey following installation of the primary liner and placement of geocomposite, and primary select sand and stone (as applicable). The Contractor shall be responsible for removing cover materials to expose located leaks and shall be responsible for coordinating and repairing leaks and geotextile, and replacing sand materials. The contractor shall also be responsible for coordinating and paying for re-testing of the repair areas.

1.07 MATERIAL AND WORKMANSHIP WARRANTY

A. Contractor shall provide a written material warranty signed by the Manufacturer and a workmanship warranty signed by the Installer, both for the repair/replacement of defective materials and workmanship characterized by leakage, abnormal aging or deterioration of materials, and other failures of the flexible membrane to perform as required. The specified warranty period is ten (10) years for materials and two (2) years for workmanship after date of final acceptance. The terms and conditions of the warranties are presented in Exhibits D and E to the Agreement.

B. The warranty shall be a direct warranty from the Manufacturer (or Installer as the case may be) to the Owner. The warranties shall be signed and presented to the Owner prior to Substantial Completion. No payment in excess of 90 percent of all payments to be due under the appropriate payment items for HDPE liner shall be made until the warranties, in their correct form hereunder, are received and approved by the Owner.

1.08 SUBGRADE CERTIFICATION

A. Prior to installation of liner materials, the Contractor shall submit a certification, signed also by the installer, that they have inspected the subgrade and accept the conditions for liner installation.

1.09 GEOMEMBRANE PRE-CONSTRUCTION MEETING

A. As soon as practical after the Contractor mobilizes the installation crew, but before any installation activities occur, a specific pre-construction conference shall be held.

The following persons shall be present:

1. Engineer Project Manager and Resident Engineer
2. General Contractor and Superintendent
3. Engineer Subconsultant QA Representative (if applicable)
4. Geomembrane Installer Site Superintendent and Quality Control Representative

5. Affected Subcontractors

B. Agenda:

1. Introductions and Explanation of Roles
2. General Overview of Specifications and Plans
3. Review Proposed Installation Schedule
4. Review of Installer/Contractor QC Procedures
5. Review of Engineers QA Procedures
6. Destructive Test Sites
7. Leak Location Survey
8. Review of Contractor Personnel - Roles and Responsibilities
9. Reports and Record Drawing Information
10. Site Cleaning

PART 2 PRODUCTS

2.01 MATERIALS

A. Properties:

1. The geomembrane shall be manufactured from new, first quality polyethylene resin of the type specified. Polyethylene geomembrane shall meet all requirements for the specified end use. Reclaimed polymer shall not be added to the resin except for regrind, reworked or trim polymer of exactly the same formulation as the geomembrane produced during the manufacturing process. "Regrind" polymer shall not exceed 10% by weight. Recycled or reclaimed sheet materials shall not be included in the manufacturing process.

B. Resin - all batches or resin shall be tested for the following characteristics:

Resin Density	ASTM D 1505/D 792	.932
Melt Index	ASTM D 1238 E	<1.0 g/10 min.

Any resin not meeting the above specification shall not be used in the manufacture of material. The Contractor shall furnish results of all such tests to the Engineer and shall certify the quality of the raw material.

C. The double sided textured geomembrane shall demonstrate the following typical properties.

PROPERTY	TEST	VALUE	
Thickness	ASTM D5994	min avg	57 mils
		lowest for 8 of 10	54 mils
		lowest for 2 of 10	51 mils
Asperity Height	ASTM D 7466		16 mils
Tensile Strength (Yield) (lbs/in.)	ASTM D6693 Type IV		125
Tensile Strength (Break) (lbs/in.)	ASTM D6693 Type IV		100
Elongation at Yield (%)	ASTM D6693 Type IV (1.3" gauge)		12%
Elongation at Break (%)	ASTM D6693 Type IV (2.0" gauge)		100%
Tear Resistance (lbs)	ASTM D1004 Die C		42
Puncture Resistance (lbs)	ASTM D4833		130
Carbon Black Content	ASTM D1603/4218		2% by weight
High Pressure Oxidative Induction Time (OIT)	ASTM D5885		400 min.
Oven Aging at 85°C High Pressure OIT	ASTM D5721 ASTM D5885	% retained after 90 days	80%
UV Resistance High Pressure OIT	GRI-GM11 ASTM D5885	% retained after 1600 hours	50%

D. The geomembrane shall be produced as to be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter, and shall not have striations, non-uniform texturing, pinholes or bubbles on the surface. Texturing shall be on both sides.

Rolls which have evidence of surface defects such as undispersed resin, incomplete texturing, creases, pinholes, non-uniform texturing or other defects,

based upon the judgement of the Engineer, shall be rejected and removed from the site.

E. The Contractor shall provide quality control certificates from the manufacturer for each roll of material. These QC certificates shall match the resin lot numbers with the roll numbers for the 60-mil geomembrane.

1. Samples shall be taken evenly spaced across the entire width of the roll, if no sampling protocol is stipulated in the particular test method, and shall not include the first wrapping or outer layer of the roll (about 3 feet).
2. Quality Control testing of the manufactured geomembrane shall be performed as a minimum in accordance with GRI-GM13, and at the following frequency for the following material properties. Where the following differs from GRI-GM13, the more stringent shall apply. A QC certificate shall be provided for each roll, which documents the following testing:

TEST	PROCEDURE	FREQUENCY
Thickness	ASTM D5944	Each Roll
Specific Gravity	ASTM D1505	500,000 sf
Yield Strength	ASTM D6693-Type IV	50,000 sf
Yield Elongation	ASTM D6693-Type IV	50,000 sf

TEST	PROCEDURE	FREQUENCY
Tensile Strength (1.3" gauge)	ASTM D6693-Type IV	50,000 sf
Tensile Elongation (2.0" gauge)	ASTM D6693-Type IV	50,000 sf
Carbon Black Content	ASTM D1603	50,000 sf

HDPE extrusion welding rod or beads shall exhibit the same properties as the geomembrane.

F. Minimum width of manufactured flexible membrane sheets shall be 22 ft. The edge of the 60-mil rolls shall not have textured material (4-in min) to enable seaming of smooth, non-contaminated product.

G. Shipping and Storage

Material shall be packaged, handled, stored, transported, re-stored, re-handled, and deployed in a manner so as not to cause any damage.

1. Unloading of rolls or pallets at the site should be such that no damage to the geomembrane occurs.
2. Pushing, sliding, or dragging of rolls or pallets of geomembranes shall not be permitted.
3. Offloading at the site shall be performed with cranes or fork lifts in a workmanlike manner such that damage does not occur to any part of the geomembrane.

4. Suitable means of securing the rolls or pallets shall be used such that shifting, abrasion, or other adverse movement does not occur.

H. Storage

1. If storage of rolls or pallets of geomembranes at the site is to occur longer than 6 months, a sacrificial covering or temporary shelter should be provided to protect against precipitation, ultraviolet exposure, and accidental damage.
2. Temporary storage at the site should be in an area where standing water can not accumulate at any time.
3. Geomembranes shall be stored on-site in a manner consistent with the manufacturer's recommendations.
4. Geomembranes shall be stored to avoid deformation of rolled goods or contamination from foreign substances. Rolls shall be fully supported over their entire length. Rolls may be stacked no more than three rolls high.

    a. Appropriate handling equipment shall be used when moving rolled material, such as slings and spreader bars.

    b. Damaged rolls will not be used for installation.

I. Other materials: All welding material shall be of a type recommended and supplied by the Manufacturer and shall be delivered in the original sealed containers - each with an indelible label bearing the brand name, manufacturer's mark number and complete directions as to proper storage.

PART 3 EXECUTION

3.01 SUBGRADE PREPARATION

A. Conditions: Surfaces to be lined shall be smooth and free of vegetation, rocks, stones, sticks, roots, sharp objects or debris of any kind. Rounded corners shall be provided in all directional changes and in the anchor trench to avoid sharp bends in the membrane. No standing water or excessive moisture shall be allowed on the subgrade.

B. Acceptance: The Installer shall certify in writing that the surface to be lined is acceptable. Submittal of written acceptance may proceed incrementally according to the installation schedule. No geomembrane liner shall be placed on subgrade deemed unsuitable by the Engineer.

3.02 INSTALLATION

A. The liner shall be placed over the prepared subgrade in such a manner as to minimize handling. The sheets shall be placed to minimize field seaming. Horizontal field seams on the slopes shall not be acceptable. Only those sheets of

liner material which can be seamed in one day shall be unpackaged and placed in position. Slope seams shall be minimized and run as close to the line of slope as possible particularly in corners.

Installation of the primary liner shall be sequenced and, where applicable, coordinated with the installation of the underlying geosynthetic clay liner (GCL) such that the GCL is covered by the liner at the end of each day and is kept dry. Any GCL which gets hydrated shall be removed and replaced at no cost to the owner.

B. Each panel of HDPE membrane shall be laid out and installed in accordance with the approved Shop Drawings. Any changes must be submitted to the Engineer in writing for approval prior to installation of liner.

C. Installation of the HDPE liner shall be done in the presence of the Engineer or his designated representative. Deployment shall proceed between ambient temperatures of 40°F to 104°F. Geomembrane placement shall not be done during any precipitation, or in the presence of excessive winds.

D. Bridging of the liner will not be accepted. The liner shall be installed to accommodate thermal contraction at the lowest anticipated operating temperature. Areas that exhibit bridging shall be temporarily ballasted. If the temporary ballast fails to mitigate the bridging, the panel will be cut and additional compensating geomembrane installed and tested.

E. Deployment:

1. No equipment or tools shall damage the geomembrane or subgrade by handling, traffic or other means. Subgrade ruts or ridges shall be removed prior to final positioning of the geomembrane.

2. No personnel working on the geomembrane shall smoke, wear damaging shoes, or engage in other activities that could damage the geomembrane.

3. The method used to unroll the panels shall not cause scratches or crimps in the geomembrane and shall not damage the supporting soil or underlying geomembrane.

4. Methods used to place panels shall minimize wrinkles, (especially differential wrinkles between adjacent panels or sheets).

5. Adequate loading (e.g., bagged drainage sand or similar items that will not damage the geomembrane) shall be placed to prevent uplift by wind. Continuous loading may be required along edges of panels during periods of high winds.

6. Direct contact by machinery or deployment vehicles (4 or 6-wheel cart) with the geomembrane shall be avoided, i.e., the geomembrane in traffic

areas to be protected by geotextiles, extra geomembrane, or other suitable materials. Proposed protection plan shall be reviewed by Engineer.

F. Penetrations: The membrane shall be installed around pipes as shown on the Drawings. Install to provide an effective, watertight seal. Construction and installation of the pipe boot shall be performed in the presence of the Engineer or his designated representative. Testing of all pipe boots shall be required.

Liner installer shall coordinate with Contractor on space required for extrusion welding and vacuum testing around pipe/boot penetrations.

Boot fabrication and testing shall be as follows:

1. Boots shall be fabricated in the field to fit the pipe penetration.

2. The boot shall be temporarily removed, skirt attached to a temporary base sheet with the barrel of the boot welded shut, and air tested to 2-3 psi (min/max); apply soapy water to all prefabricated seams to locate any leaks.

3. If no leaks are found, remove temporary base sheet, open boot barrel, and reinstall on pipe.

4. Extrusion weld boot flap to liner, and boot barrel to HDPE pipe.

5. Place liner sleeve over boot barrel covering end of boot and weld sleeve to boot barrel and pipe.

6. Air test sleeve (2-3 min/max psi) for 5 minutes to evaluate boot barrel seal. If no pressure drop is observed, grind and extrude air test penetration and vacuum test extrusion.

7. Vacuum test extrusion seams of boot and skirt joint with liner.

All pipe boots, vents, and patches shall be of the same material as the membrane sheet. Gaskets, sealing materials, or other means used to secure the membrane shall be compatible with and have a lifespan at least equal to that of the HDPE membrane.

3.03 SEAMING METHODS

A. Approved process for seaming is fusion welding for all seams. Wherever possible, the split hot wedge seaming method shall be used to allow air pressure testing of the liner seams.

1. Extrusion welding may be allowed for repairs and around penetrations through the liner. All proposed extrusion weld locations shall be approved by the Engineer.

2. Proposed alternatives and locations must be submitted for review to the Engineer.

3. Details of the specific apparatus to be used for seaming, including seaming using approved methods, shall be submitted for approval by the Engineer prior to commencement of seaming.

B. Fusion Process: Fusion seams will be produced by self-propelled wedge welding apparatus.

1. The apparatus shall be equipped with gauges to monitor weld temperature.

2. Weld temperature and machine speed shall be varied according to ambient conditions to maintain and demonstrate a consistent acceptable weld, as described in Section 4.01.B.

3. All welding surfaces shall be kept clean and dry.

C. Extrusion Process: Extruded seams will be produced by extruding molten resin between or at the edge of two preheated overlapped sheets of geomembrane to affect a homogeneous bond.

1. The extrusion apparatus shall be equipped with gauges to monitor extrudate and operating temperatures.

2. Temperature and flow rates shall be varied according to ambient conditions to maintain and demonstrate a consistent acceptable weld, as described in Section 4.01.B.

3. The extruder shall be purged of all heat degraded or cooled extrudate prior to the commencement of each seaming sequence, and disposed of off the geomembrane surface.

4. The extrudate rod shall be certified by the Manufacturer and certification supplied as in Section 1.05, Submittals.

5. Following heat tacking, the weld area shall be prepared by grinding to a depth of less than 0.005 in in the sheet surface to be in contact with the extrudate. Extrudate shall cover all grind marks.

6. The weld area shall be kept clean and dry.

D. The installer shall maintain at least one spare operable seaming unit of each type on site at all times.

3.04 SEAMING PROCEDURES

A. To achieve the proper support and cleanliness of fusion welded seams, the installer shall use a temporary support surface or shield between the geomembrane and the subgrade.

At swales, drainage benches, anchor trenches, or other similar abrupt vertical changes, the installer shall provide temporary shoring or support systems to allow linear seaming of the geomembrane and prevent unnecessary damage. Temporary shoring or bridging shall be adequate to allow proper overlap of adjacent panels and adequate strength to support the weight of materials, equipment and personnel.

B. Seams shall be aligned so as to create a smooth and wrinkle free surface in the overlap area.

C. Extrusion Welding

1. Grinding required along a seam shall be done concurrent with or within ten minutes of the seaming operation and shall not damage the geomembrane, as in Section 3.02.

2. Installer shall determine preheat requirements and wind effects on extrusion seaming operations.

3. Artificially induced cooling of extrudate welds, by water or any other means, shall not be allowed. Care shall be taken during vacuum testing that extruded welds being vacuum tested are at ambient temperatures.

D. Cross Seams: The top and bottom excess overlap shall be removed and the top and bottom edge of the cross-seam shall be ground to a smooth transition prior to seaming.

E. No seaming shall be attempted in wet weather where the geomembrane is exposed to the elements.

F. Geomembrane deployment or seaming shall proceed between ambient temperatures of 40°F to 104°F.

G. Where possible, seam overlaps shall be shingled to shed water.

H. Where possible, low areas shall be patched, tested and inspected first to prevent interference of ponded water with testing procedures.

I. All patches shall have rounded corners, shall consist of the approved geomembrane material and shall extend beyond the edge of any defect a minimum of 4 in. in all directions.

J. All seams shall be labeled on the geomembrane with the following information:
1. Machine identification number
2. Operator, date, time
3. Direction of travel of seaming equipment

K. No "fish mouths" shall be allowed within the seam area. Where "fish mouths" occur, the material shall be cut, patched, and welded.

L. Any membrane area showing injury due to scuffing, puncture, or distress from any cause shall be replaced or repaired with an additional piece of HDPE membrane at no cost to the Owner.

3.05 PANEL LAYOUT

A. Proposed

1. The Contractor shall submit shop drawings showing proposed placement of panels and seams, and these shall be reviewed by the Engineer, prior to commencement of installation.
2. Seams shall be numbered on an accepted plan and include dimensions.
3. Slope seams shall be run as close to the line of the slope as possible.
4. Penetrations and irregular configurations shall be detailed and submitted to the Engineer for review prior to installation.

B. Record Drawings

1. The Contractor shall provide final record layout drawings of the 60-mil liner to reflect any changes from proposed layout.
2. Record drawings shall include the identification by number and location of all panels, patches and detail work, including the location and identification of areas chosen for destructive test sampling.

   All panels, seams, repair patches, cap strips and penetrations shall be documented by field survey performed by a land surveyor licensed to practice in the project state. Locations of leak location electrodes installed beneath the primary liner and leak location test holes in the primary geomembrane shall also be documented by the surveyor on the record drawings.

   The survey shall be certified by the surveyor and submitted to the Engineer as an AutoCAD 2004, or higher version, drawing on a compact disk. The geomembrane survey information shall be submitted prior to covering the geomembrane.

   Repair locations of leaks discovered during the leak location survey of the primary geomembrane shall be documented by field survey performed by a land surveyor licensed to practice in the project state. Surveyor services are considered subsidiary to the geomembrane installation and repair and the costs of survey documentation shall be the responsibility of the Contractor.

3. Copies of the installer’s field QC documentation shall be submitted to the Engineer prior to covering the geomembrane. The installer’s report is required prior to acceptance of the geomembrane system. The Contractor

shall not be allowed to place soil or geosynthetic materials over any installed geomembrane until full, written field QC documentation is submitted to the Engineer.

Copies of the installer's field QC documentation shall be submitted to the Engineer prior to covering repair locations following the leak location survey of the primary geomembrane. The Contractor shall not be allowed to replace soil materials over repaired geomembrane until full, written field QC documentation is submitted to the Engineer.

PART 4 QUALITY CONTROL

4.01 QUALITY CONTROL DURING INSTALLATION

A. Site Test Equipment: The Contractor shall maintain on -site, in good working order, the following items:

1. Field Tensiometer

   a. The tensiometer shall be motor driven and have jaws capable of traveling at a measured rate of 2 in/min.
   b. The tensiometer shall be equipped with a gauge which measures the force in unit pounds exerted between the jaws.
   c. The tensiometer shall be calibrated and certified for use on this project. A copy of the calibration certificate shall be submitted to the Engineer.

2. Coupon Cutter

   A die cutter machined to cut 1"x5" liner sample coupons for field testing shall be provided and maintained in good working condition.

3. Vacuum Box

   a. The vacuum box shall consist of a rigid housing with a transparent viewing window on the top and a soft, closed-cell neoprene gasket completely attached to the bottom of the housing.
   b. The housing shall be equipped with a bleed valve.
   c. A separate vacuum source shall be connected to the vacuum box such that a negative pressure of 2 - 3 psi (5" - 6" mercury) can be created and maintained inside the box.
   d. A solution consisting of soap and water shall be dispensed on the seam immediately ahead of the vacuum box.
   e. Vacuum box testing shall not proceed when temperatures are below 32°F.

4. Air Pressure Test Equipment - This method shall apply when the split hot wedge seaming method is used.

a. Equipment shall consist of an air pump capable of generating and maintaining a positive pressure of between 20 and 30 psi.
b. A manometer capable of reading up to 30 psi attached to a needle or nipple shall be used to pressurize the air channel in the seam.

Spark Testing - This method shall be completed on welds in areas where both air pressure testing and vacuum testing are not possible.

a. Equipment shall consist of a hand held device capable of generating a high voltage.
b. Conductive aluminum tape shall be placed beneath the seam prior to welding.

6. Alternatives shall be submitted for review to the Engineer. All testing methods shall be submitted to the Engineer for review prior to commencement of testing.

B. Non-Destructive Testing

1. Test Seams

a. Test seams shall be made to verify that adequate conditions exist for field seaming to proceed.
b. Each seamer shall produce a test seam at the beginning of each shift and every four hours thereafter.
c. If a seaming operation has been suspended for more than one hour or if an equipment failure occurs for any reason, a test seam shall be produced prior to resumption of seaming operations.

2. Test seams shall be made in the field on pieces of the approved membrane. Each test seam shall be at least 4 ft. long by 1 ft. wide and with sufficient overlap in the seam for peel and sheer testing in the field tensiometer.

3. Pass/Fail Criteria: With the Engineer or his representative present, the Contractor shall cut six coupons 1" by 5" from the test seam for field testing. The coupons shall be cut in pairs from both ends and the center of the test seam. From each pair, one coupon shall be tested in the field tensiometer in peel and one in shear. 100% of samples shall pass.

a. Shear Strength: Both top and bottom of the coupon shall be tested in shear and shall register not less than 90% of the tensile strength at yield of the field parent material as determined in 4.01. B.3.d, and exhibit an acceptable location of break code as defined in 4.01 B.3.c. The shear percent elongation at break shall exceed 50% and is defined as follows:

$E = L/L_o * 100$

where

E = elongation %
L = extension at end of test
L_o = original average length (usually 1.0 in)

b. Peel Adhesion: Both sides of wedge welded seam coupons and one side of extrusion welded seams shall be tested in peel. Acceptable samples tested in peel shall register equal to or more than the greater of 60% of the manufacturer's specified minimum yield strength of the parent sheet or 60% of the tensile strength at yield of the parent material as determined in paragraph 4.01. B3c, and exhibit an acceptable location of break code as defined in 4.01.3.b. The peel separation (incursion) shall not exceed 25% and is defined as follows:

$$S = A/A_o * 100$$

where

S = separation %
A = average are of separation or incursion
A_o = original bonding area

The peel adhesion for the welded tie-in seam connection of new geomembrane to existing geomembrane materials shall register equal to or more than the 60% of the manufacturer’s specified minimum shear strength and exhibit an acceptable break code. The parent material strength is not an appropriate comparison for a tie-in seam, due to differing materials.

c. As defined by GRI-GM13 and ASTM D6392 the following location of break codes are not acceptable and shall result in failure of the test:

Hot Wedge: AD, AD-BRK >25%
Extrusion: AD1, AD2, AD-WLD (unless strength is achieved)

d. The parent material yield strength shall be determined as follows:

One 1" x 5" coupon will be cut from each sheet (both sides of seam) which makes up the "test seam" and "test sample." The coupons will be cut no less than 4 inches from the center line of the seam with the long dimension of the coupon perpendicular to the line of the seam. Each sample will be tested in tension to

determine its yield strength. The minimum of the two yield strength value obtained will be used as the parent material yield strength.

For the laboratory testing required in paragraph 4.02.A.6, the testing laboratory will be required to record and document the two test coupon's yield strength results and the results of the five shear and ten peel test series required in paragraph 4.02.A.6.a. The test samples shall be of sufficient length to accommodate this testing.

As a result of this testing and as specified in paragraph 4.02.A.3, the CQA inspector may increase the amount of destructive testing at no additional cost to the Owner.

e. If the seam fails to pass, the welder and seaming apparatus shall not be used for field seaming until acceptable pre-weld tests are achieved.

4. Vacuum Testing

a. 100% of all vacuum testing shall be observed by the Engineer or his representative.
b. All extrusion welded and non-air channel seams of the 60-mil liner shall be evaluated using vacuum box testing. The seams of the 60-mil rub sheet shall not require non-destructive testing.
c. The solution shall be applied to the test section and the vacuum box placed over the section. The bleed valve is then closed and the vacuum valve opened.
d. Once a tight seal and a negative pressure of 2 - 3 psi has been established, the test section shall be visually examined for a period of not less than 10 seconds to determine whether bubbling of the soapy solution is occurring.
e. The vacuum box is then moved and the process is repeated on the next adjacent section. A minimum 3 inch visible overlap shall be provided between all test sections.
f. All locations where bubbling of the solution was observed shall be clearly marked for repairs with a high visibility marker and recorded by number on field test reports.
g. Any failed portion of seam shall be repaired in accordance with Section 3.03 and 3.04 and re-tested.

5. Air Pressure Testing

a. The air channel shall be sealed off at both ends.
b. If the end of a seam will be an integral part of the geomembrane, the sealing shall be done in such a way that it does not harm the geomembrane.

c. The pressure feed device shall be inserted into the air channel at one end of the seam and pressurized to 30 psi.

d. The feed valve shall be closed and the pressure sustained for a period of not less than 5 minutes. The pressure shall then be released by opening the air channel at the opposite end of the seam.

e. The drop in pressure on the manometer shall verify the continuity of the air channel. If there is no pressure drop, the seam shall be checked for air channel blockage(s). If more than three problem areas are revealed, the seam shall be removed and a cap strip installed. The cap strip testing shall follow normal air channel test protocols.

f. If a pressure loss of greater than 2 psi is observed or if the required pressure cannot be reached then the seam shall be rejected.

g. All faulty areas along the seam shall be identified and repaired in accordance with Sections 3.03 and 3.04 and re-tested by non-destructive means.

h. Vacuum testing shall be allowed on split wedge welds only when the faulty area cannot be isolated using air pressure testing.

i. All holes created during air pressure testing shall be sealed on completion of the test and vacuum tested.

6. Spark Testing

a. Spark testing shall only be completed in areas where both air pressure testing and vacuum testing are not possible.

b. Conductive aluminum tape shall be placed beneath the seam prior to welding. Copper wire shall not be used.

c. Upon completion of weld, enable spark tester and hold approximately 1 inch above the weld and move slowly along the entire length of the weld. Spark will indicate a hole in the seam which shall be marked and repaired with an additional weld.

d. Spark testing shall not be completed if flammable gases are present in the area to be tested.

7. All liner seams shall be non-destructively tested by the Installer over their full length to verify the integrity of the seam.

a. Non-destructive testing shall be performed concurrently with field seaming.

b. Prefabricated field seams which will be inaccessible after installation, such as those under structures or fastened to penetrations, shall be tested prior to final installation.

c. All non-destructive testing shall be observed and documented by the Engineer or his representative.

8. Approved non-destructive testing procedure is as above. Alternate procedures shall be submitted for review to the Engineer prior to the commencement of non-destructive testing. Contractor shall notify the Engineer at least 48 hours prior to commencement of any field testing.

C. Destructive Testing

1. Destructive testing of field seams shall be performed at selected locations in order to verify the criteria given in Section 4.01.B.

   a. All sampling and testing shall be done concurrently with field seaming so that verification of field seam properties is made as the work progresses and corrective action implemented.

2. Test samples shall be randomly selected with a minimum of one test location occurring within each 500 ft of seam. The Engineer may require a minimum of one destructive sample per day, and retains the option of increasing the number of samples in suspect areas.

   a. Sample locations shall be determined by the QC Representative and the Engineer, with consideration to the difficulty of subsequent repair and testing of the test site.
   b. The Installer shall not be informed in advance of the locations where the seam sample will be taken.

3. The Engineer may increase the amount of destructive testing if the results of previous testing indicate a failure rate of 10% or more, at no additional cost to the Owner.

   a. Additional samples may also be required when Installer or Engineer have reason to suspect the presence of excess crystallinity, contamination, faulty seaming or any other reason affecting seam quality.

4. The test sample shall measure a minimum of 12 in wide by 40 in long with seam centered lengthwise along the sample.

   a. Prior to cutting the laboratory sample, two (2) one inch wide sample strips shall be cut using an approved template from each end of the sample. Two additional sample strips will be cut to determine parent material yield strength.
   b. These strips shall be tested by the Installer in the field tensiometer. Parent, peel, and shear yield strength will be recorded in accordance with Section 4.01.B.
   c. If acceptable, the sample shall be cut into <u>three</u> 12 in lengths.

5. Samples shall be cut by the Installer, indelibly numbered and identified, and the locations recorded and submitted to the Engineer for laboratory testing.

6. The results of laboratory testing shall be faxed directly to the Engineer and Contractor not more than 48 hours after the samples have been received by the testing facility. Laboratory testing results shall determine the acceptability of a seam.

   a. Laboratory testing shall be performed in accordance with the methods given in ASTM D6693 or ASTM D6392-99 and meet the criteria given in Section 4.01.B.3. In addition to the 2 parent strength coupons, 10 test coupons shall be cut with from 5 coupons for shear and 5 coupons for peel tests. 100% of samples shall pass.

7. The area from which the destructive test sample was taken shall be repaired without delay in accordance with the procedures given in Section 3.03 and 3.04 and shall be non-destructively tested in accordance with Section 4.01.B.

D. Inspection and Acceptance

1. As the work progresses, the QC Representative shall document all locations requiring repair work and verify all repairs have been successfully made by the Installer.

2. The QC Representative shall field verify functional ability and accuracy of Installer's equipment on a daily basis.

3. A field seam shall only be considered acceptable when all destructive test locations on that seam have passed laboratory testing and acceptable non-destructive testing has been performed. The following procedures shall apply in the event that a seam fails field or laboratory testing.

   a. The Installer may reconstruct the seam between the previous passing test location and the next passing test location and retest, or

   b. The Installer may elect to trace the extent of an unacceptable seam to some intermediate location. This shall involve taking 1 inch template-cut cross-sections from the seam at a minimum distance of 10 feet in both directions from the failed test location.

      (1) These samples shall be tested in the field tensiometer in both shear and peel in accordance with Section 4.01.B.3.

      (2) If one or both of these samples fail the field test, tracing along the seam shall continue at minimum 10 feet increments until a passing result is recorded in both directions from the failed test location. If three additional tests fail on either side of the initial test site, the seam shall be rejected and either cap stripped or reconstructed. Further incremental testing shall be performed until acceptable test results are achieved. These additional tests may continue onto previous or subsequent seam work

performed by the seaming technician, welding machine, or both.

c. If more than one field seaming unit is employed, tracing of a failed weld shall only be done along seams welded by the same equipment used to weld the seam in question.

4. Reconstructed seams less than 150 ft in length shall be non-destructively tested in accordance with Section 4.01.B. Reconstructed seams greater than 150 feet in length shall be destructively tested in accordance with Section 4.01.B.3.

5. The entire geomembrane surface shall be examined continuously by the QC Representative to confirm that it is free of any defects, holes, blisters, undispersed raw materials, or contamination by foreign matter. Upon completion of the installation of each liner, and prior to covering the liner, a final review will be made by the Engineer and the QC Representative.

6. The geomembrane surface shall be cleaned by the Contractor prior to final review. The liner shall be free of dust, mud, debris or other material that would prevent examination of the surface.

7. Any defects or suspect areas shall be clearly marked by the Engineer or QC Representative. Such defects or suspect areas shall be repaired and non-destructively tested in accordance with Section 4.01.B by the Contractor.

8. As the work progresses, the Contractor's representative, Installation Supervisor and QC representative shall make continuous efforts to prevent the accumulation of waste materials on the liner surface and staging areas. Provision shall be made for containment of waste as the installation proceeds.

F. Submittal of Quality Control Documentation

1. Contractor shall provide written documentation regarding quality control results from each item specified in this section in a format(s) approved by Engineer.
2. Written documentation will be provided to Engineer on a regular basis as the installation proceeds, at a minimum once per week.
3. A separate report with all documentation will be submitted upon completion of the installation. A separate report with all documentation will be submitted upon completion of the leak location survey and leak repairs.

G. Drainage Geocomposite, Select Sand and 1.5” Stone Placement

1. Prior to covering any portion of the liner system, the Contractor shall submit all QC documentation to the Engineer for review, comment and submittal as required to regulatory agencies.

2. The QC representative shall identify any wrinkles which may have been built into the geomembrane. Any wrinkle which may result in fold over of liner material upon placement of sand or stone fill shall be cut, repaired and tested by the Contractor.

3. The QC Representative shall identify any slope toe, declivity, or other surface transitions which might result in bridging of the geomembrane during placement of the sand blanket. Any such area shall be cut, repaired and tested by the Installer.

4. The QC Representative shall coordinate with the installer, engineer and leak location contractor to create 0.25 in diameter test holes in the primary geomembrane to be used in calibration of leak location equipment.

5. Equipment used for placing and compacting the sand blanket or stone fill shall not be driven directly on the geomembrane or composite. Such equipment shall be closely monitored during placement to ensure that no damage occurs to the geomembrane or composite.

6. A minimum thickness of 12 in of select sand or stone fill cover shall be maintained between the geomembrane and drainage geocomposite and earth moving equipment. Only low ground pressure (LGP) tracked vehicles, having a maximum ground pressure of 4.7 psi shall be used at the minimum thickness.

7. For calculating equivalent ground pressure for non-LGP equipment operating on top of greater thicknesses, equivalent ground pressure shall be calculated at 12 in above the liner surface and shall meet LGP.

8. In all cases, the placement of sand blanket or stone fill shall be done with caution and in a manner which is least likely to cause wrinkles in, or damage to, the geomembrane and composite. In order to eliminate wrinkles, significant methods must be employed including but not limited to use of hand labor and equipment to cast and place sand.

9. Drainage sand, stone fill and topsoil materials shall be placed upslope or laterally on slopes greater than 5:1.

G. Electrical Leak Location Survey

1. Following the installation of the primary geomembrane and the placement of the geocomposite and select sand or stone (as applicable), the Contractor shall provide an electrical leak location survey of the entire primary liner. The survey will be conducted to detect leaks in the geomembrane caused during installation of the liner and cover materials.

   Electrical leak location survey services are considered subsidiary to the geomembrane installation and repair. The costs of the leak location survey, leak location documentation, repair of geomembrane leaks,

replacement of cover materials, and re-survey of repaired leak locations, shall be the responsibility of the Contractor.

2. The Contractor shall coordinate with the geomembrane Installer, Engineer, and the Leak Location Contractor to position the leak location electrodes beneath the primary geomembrane. The electrodes and wiring shall be a permanent installation with wires left at the edge of the anchor trench with enough wire left to connect to in the future if necessary. Wiring shall exit from the anchor trench and be terminated in accordance with the requirements of the testing company.

3. A minimum of two (2) test holes with a diameter of 0.25 in shall be made in the geomembrane. The locations of these test holes shall be coordinated with the QC Representative, Installation Supervisor, Leak Location Contractor and Engineer.

   Test holes shall be made with a drill to remove, rather than displace, the HDPE material in the hole. All burrs from the edges and bottom side of the test holes shall be removed. Test holes shall be made in an area where the geomembrane has intimate contact with the underlying subgrade or GCL.

   Test holes shall be located at the farthest positions away from any electrode installed under the geomembrane, but at least 50 ft from the edge of the geomembrane.

   Locations of the test holes shall be included in the QC documentation and record drawing survey.

4. The Contractor shall provide electrical isolation at the perimeter of the drainage sand. Electrical isolation is achieved by leaving approximately a one-foot wide area of liner exposed around the perimeter of the landfill cell or leaving a minimum of six inches of bare liner protruding from the backfilled anchor trench.

5. Prior to conducting the leak location survey, the Contractor shall remove all standing water from the surface of the drainage sand.

6. Sufficient moisture must be available at the leak locations in the geomembrane surface for electrical leak detection to be performed accurately. Sufficient moisture shall be provided by the Contractor at least 24 hours in advance of the leak location survey by one of the following methods. Additional water shall be added if necessary during the testing to ensure successful results.
   a. Rainfall of 0.1 in or greater on the bare geomembrane;
   b. Uniformly wetting the earth materials covering the geomembrane with water to field capacity.

   Additional water may need to be applied shortly before and/or during the leak location survey to moisten the drainage sand materials.

7. A performance test shall be conducted at the test hole locations to verify operation and calibration of the leak location system and equipment.

   a. Leak location measurements shall be made and recorded along closely spaced parallel lines in the vicinity of the test holes. The lines shall be located in an area extending at least 20 ft before and beyond the test holes. This data is the leak signal plus noise signal (S+N).
   b. A line of data shall be taken and recorded directly over the test hole with the leak location excitation source turned off or connected to an isolated load to measure the background noise level (BN).
      The background noise level shall be defined as the difference between the maximum and minimum measured voltage with the excitation source turned off.
   c. The recorded leak location data shall be examined to determine the peak-to-peak leak signal plus electrical noise signal to background electrical-noise ratio, R=(S+N)/BN , for each of the recorded data lines. The measured leak signals must have the characteristics of an electrical leak. Data points that deviate extremely from the theoretical leak signals shall not be used to determine R.
   d. The farthest lateral lines of data with an R value greater than 3.0 shall be noted. The average of the lateral distance from the leak for the two lines is defined to be the leak detection distance for the 0.25 in diameter leak.

8. The leak location data shall be taken on survey lines spaced no further apart than twice the leak detection distance determined for a 0.25 in diameter leak as determined in the performance testing. The measurement electrode spacing shall be no less than that used for the performance test. The spacing between measurements shall be no more than that used for the performance test.

9. Leak location data shall be recorded, plotted, and analyzed for leak signals. The positions of the leak signals shall be located and the leaks excavated by the Contractor. The leaks shall be repaired or electrically isolated from the earth materials. Additional leak location survey data shall be collected near the located leak after the leak is repaired or electrically isolated to ensure that no additional leaks are present. The survey data shall be repeated on the two closest survey lines for a distance extending 20 ft before and beyond the leak. If another leak is detected, the process shall be repeated until no additional leaks are detected.

10. Daily results of the work shall be communicated to the Engineer. A report assembled by the Leak Location Contractor documenting the electrical leak location surveys shall be submitted within 14 days of the completion of each leak survey. The reports shall document the methodology used,

the locations and descriptions of the leaks, and a diagram of the facility showing the approximate leak locations.

11. Copies of the installer's field QC documentation shall be submitted to the Engineer prior to covering repair locations following the leak location survey of the primary geomembrane. The Contractor shall not be allowed to replace soil materials over repaired geomembrane until full, written field QC documentation is submitted to the Engineer.

    Contractor shall provide written documentation regarding quality control results recorded during repair of located leaks. Documentation shall be made according to each item specified in this section in a format(s) approved by Engineer.

12. Repair locations of leaks discovered during the leak location survey or the primary geomembrane shall be documented by field survey performed by a land surveyor licensed to practice in the project state. The survey shall be certified by the surveyor and submitted to the Engineer prior to covering the geomembrane.

PART 5 COMPLETION OF WORK

5.01 REQUIREMENTS

A. All required deployment, seaming, repairs, testing, records and site clean-up shall be completed by the Contractor.

B. Contractor shall submit a comprehensive quality control report, including all QC documentation specified in this section to the Engineer.

C. The Engineer shall be satisfied that the information provided by the Contractor indicates that the geomembrane has been installed in accordance with the above Specifications.

D. Contractor shall dispose of all trash, waste material and equipment used in connection with the work and shall leave the premises in an acceptable condition.

END OF SECTION

SECTION 02279
GEOSYNTHETIC CLAY LINER

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. This work shall consist of furnishing and installing geosynthetic clay liner beneath the primary liner as described or shown in the Contract drawings or specifications.

B. Panel Layout Plan.

1.02 RELATED REQUIREMENTS

A. Section 01300 - Submittals
B. Section 01400 - Quality Control/Quality Assurance
C. Section 02223 - Filling
D. Section 02234 - Select Sand
E. Section 02276 - High Density Polyethylene (HDPE) Liner

1.03 APPLICABLE STANDARDS, CODES AND REGULATIONS

A. American Society for Testing and Materials (ASTM):

1. ASTM D6496 - Standard Test Method for Determining Average Bonding Peel Strength Between the Top and Bottom Layers of Needle Punched Geosynthetic Clay Liner.
2. ASTM D4643 - Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.
3. ASTM D4833 - Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
4. ASTM D5199 - Test Method for Measuring Thickness of Geotextiles and Geomembranes.
5. ASTM D5261- Standard Test Methods for Measuring Mass per Unit Area of Geotextiles.
6. ASTM D5887 - Standard Test Method if Index Flux Through Saturated Geosynthetic Clay Liner Specimens using a Flexible Wall Permeameter.
7. ASTM D5890 - Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liner.
8. ASTM D5993 - Test Method for Measuring the Mass Per Unit Area of Geosynthetic Clay Liner.
9. ASTM D6768 - Standard Test Method for Tensile Strength of Geosynthetic Clay Liners.

10. ASTM D6243 - Standard Test Method for Determining Internal and Interface Shear Resistances of Geosynthetic Clay Liner by the Direct Shear Method.

1.04 QUALIFICATIONS

A. Installer:

The installer shall be trained and experienced in field handling, storing, deploying, and installing GCL. Alternatively, the Contractor shall engage an experienced Subcontractor who shall meet the experience requirements.

B. Contractor Responsible for Subcontractors - The roles of any subcontractor shall not relieve the Contractor of any responsibilities whatsoever under this contract. The Contractor shall be responsible for the actions and performance of the manufacturer and installer.

1.05 SUBMITTALS

A. Manufacturer's Certificate of Compliance shall be submitted and reviewed prior to installation.

B. The Contractor shall submit to the Engineer samples of the proposed GCL, and quality control certificates issued by the manufacturer for each roll of GCL. The certificates shall include roll number and identification. The certificates shall also include results of quality control tests completed at the minimum frequency specified, and at least one per lot, for the properties identified in Part 2.03. A lot is defined as a group of rolls manufactured from the same production line. The QC certificates shall be signed by the responsible Quality Assurance personnel employed by the manufacturer. This submittal shall be made at least 10 days prior to delivery of materials to the site.

C. The Engineer shall complete laboratory tests for Peel Strength of the on-site GCL in accordance with ASTM D6496, at a minimum frequency of one (1) test per 50,000 sf of GCL to be placed.

D. The Engineer shall also complete interface and internal shear strength testing of material proposed for use at the site in accordance with Part 2.02 B and 2.03 B.

1.06 MATERIAL HANDLING

A. Material shipping, storage, and handling shall be in accordance with the manufacturer’s recommendations. The Contractor shall be responsible for the shipping, handling, storage, and care of the GCL from the time of delivery to the site until final acceptance of the completed work by the Owner and shall be liable for all damages to the materials during such time.

B. Inform Owner a minimum 72 hours before any delivery.

C. Roll Identification:

1. Provide GCL rolls wrapped in relatively impermeable and opaque protective covers and marked or tagged with the following information:
   a. Manufacturer's name.
   b. Product identification.
   c. Date of manufacture.
   c. Shipping lot - keyed to acceptable Certificate of Compliance.
   d. Roll number.
   e. Roll dimensions.
   f. Roll weight.

2. Indicate special handling marked on GCL itself, e.g., "This Side Up".

3. Conformance testing shall be conducted by the Manufacturer in accordance with Part 2.03 to indicate Conformance with the Specifications.

D. Handle GCL to ensure panels are not damaged.

E. Store GCL in a dry place under a roof or other protective cover; protect from moisture by placing on skids, pallets, or dry ground.

F. Any damaged packaging or rolls shall be cause for rejection, subsequent removal from the site, and replacement at no additional cost to the Owner.

G. The Engineer shall observe rolls upon delivery and prior to deployment at the site and report any deviations from the above requirements to the Contractor.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. BentoLiner; GSE

B. Bentomat; CETCO Lining Technologies

C. Or equal products.

2.02 GENERAL

A. Except when specifically authorized, do not furnish special run or value added products.

B. GCL:

1. Flexible, layered liner consisting of continuous layer of sodium bentonite sandwiched between two non-woven geotextile carrier layers, and reinforced with needle-punched fibers.

2. GCL shall be of type to maintain integrity during installation, placement, and covering procedures.

3. Bentonite adhesive shall be non-toxic and water soluble.

2.03 GEOSYNTHETIC CLAY LINER (GCL)

A. The GCL shall have the following minimum physical properties as determined by the appropriate test method:

Material Property	**Test Method**	**Frequency**	**Required Value**
Non-Woven Carrier Layer			
Cap carrier sheet, non-woven polypropylene geotextile	ASTM D5261	1/200,000 ft^2	6.0 oz/yd^2
Bottom carrier sheet, non-woven polypropylene geotextile	ASTM D5261	1/200,000 ft^2	6.0 oz/yd^2
Bentonite			
Montmorillonite Content			90 Meq. min.
Bentonite Swell Index	ASTM D5890	1/100,000 lb	24 mL/2 g min.
Bentonite Fluid Loss	ASTM D5891	1/100,000 lb	18 mL max.
Bentonite Moisture Content	ASTM D4643	1/100,000 lb	12% max.
GCL			
Bentonite Mass/Area	ASTM D5993	1/40,000 ft^2	0.75 lb/ft^2
Nominal Thickness	ASTM D5199	1/40,000 ft^2	0.24 in. min.
GCL Grab Strength	ASTM D6768	1/200,000 ft^2	150 lb
GCL Grab Elongation	ASTM D6768	1/200,000 ft^2	100% Typ.
GCL Peel Strength	ASTM D6496	1/200,000 ft^2	3.5 lbs/in min.
Puncture Resistance	ASTM D4833	1/200,000 ft^2	220 lbs Typ.
GCL Hydraulic Conductivity	ASTM D 5084	1/week	5×10^{-9} cm/sec max.
GCL Index Flux	ASTM D 5887	1/week	1×10^{-8} m^3/m^2/sec max.
GCL Hydrated Internal Sheer Strength	ASTM D 6243	Periodic	500 psf Typ.

PART 3 EXECUTION

3.01 SUBGRADE

A. The bentonite mat shall be installed over a surface graded to the tolerances shown on the Contract drawings or geosynthetic materials fully installed as described in other specification sections.

B The underlying subgrade shall exhibit no ruts or other surface deformities.

3.02 ACCEPTANCE

A. The Contractor shall submit in writing the installer's certificate that the surface to be lined is acceptable. After submittal of written acceptance, the Contractor may proceed incrementally according to the installation schedule.

3.03 INSTALLATION

A. The GCL mat shall be placed over the prepared subgrade in such a manner as to minimize handling. Horizontal seams on the slopes shall not be acceptable. Only those sheets of material that can be covered in one day shall be unpackaged and placed in position. Seams shall be perpendicular to the toe of slope at all times.

B. Each panel of GCL shall be laid out and installed in accordance with the approved Shop Drawings. Any changes must be submitted to the Engineer in writing for approval prior to installation of liner.

C. Installation of the GCL shall be done in the presence of the Engineer or his designated representative.

D. Deployment:

1. No equipment or tools shall damage the mat by handling, traffic or other means.
2. No personnel working on the geomembrane shall engage in activities that could damage the mat.
3. The method used to unroll the panels shall not cause scratches or crimps in the liner and shall not damage the supporting soil or underlying liner.
4. Methods used to place panels shall minimize wrinkles, especially differential wrinkles between adjacent panels or sheets, while providing sufficient material to prevent bridging.
5. GCL must be covered by geomembrane by the end of the day.

6. Direct contact by machinery with the GCL shall be avoided. The mat shall be protected by geotextiles, extra geomembrane, or other suitable materials.

7. If the GCL panels do not include the Supergroove Technology: Overlap of adjacent panels shall be 6 in minimum at each side, 24 in at each end. Contacting surfaces shall be cleaned prior to installation of overlapping sheets. Seams shall receive additional granular bentonite at a minimum of 1/4 pound per linear foot. This strip of bentonite shall be 2 in wide (minimum), approximately 4 in from the edge. Additional fasteners or adhesives may be required to hold panels in place. These shall be reviewed by the Engineer prior to installation.

   If the GCL panels include the Supergroove Technology supplemental bentonite is not required on the longitudinal overlaps. Longitudinal seams should be overlapped a minimum of 6 inches. End-of-panel overlapped seams should be overlapped 24 inches for Bentomat. End of panel overlap seams shall receive additional granular bentonite at a minimum of ¼ pound per linear foot.

8. Installation shall be performed in a manner which protects underlying geosynthetics, and must meet the requirements for low ground pressure equipment, as applicable.

E. Penetrations: The GCL shall be installed around pipes as shown on the Drawings. Install to provide a watertight seal.

3.04 PROTECTION

A. A minimum of 12 in of soil cover shall be placed prior to operation of machinery.

B. Only low ground pressure (LGP) tracked equipment will be allowed on soil over liner covered surfaces. LGP is defined as equipment that distributes no greater than 4.7 psf.

C. Rips or tears shall be repaired with additional bentonite mat with a minimum of 12 in overlap on all edges. Additional bentonite powder shall be placed between the patch and original liner at a rate of 1/4 psf. This strip of bentonite shall be 2 in wide (minimum), approximately 4 in from the edge.

D. No GCL shall be placed in wet conditions. It is the Contractor's responsibility and sole risk to accurately assess the probability of rain or other precipitation in scheduling installation activities. Any GCL exposed to moisture prior to covering shall be removed and replaced at no additional cost to the Owner.

E. Prevent wind uplift by providing adequate temporary loading or anchoring (for example, sandbags, tires) that shall not damage GCL.

3.05 WRINKLES AND SHRINK COMPENSATION

A. All wrinkles shall be removed and patched (see 3.04.C) prior to placement of cover materials.

B. The Contractor shall allow for shrink compensation to avoid wrinkles and to assure the specified adjacent panel seam overlap.

END OF SECTION

SECTION 02541
GRAVEL ROADWAY

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Production from on site materials or procurement from off-site source and placement of crushed stone (fine and coarse) for roadways and roadbase as shown on the Plans.

1.02 RELATED REQUIREMENTS

A. Section 01300 - Submittals
B. Section 01400 - Quality Assurance/Quality Control
C. Section 02222 - Excavation
D. Section 02223 - Filling

PART 2 PRODUCTS

2.01 GENERAL

A. Materials shall conform to NHDOT Specifications, Division 300, Section 304 "Aggregate Base Course".

B. The materials shall consist of hard durable particles or fragments of stone or gravel. Crushed stone and crushed ledge rock shall be made from rock from which the overburden has been stripped, and consist of clean, durable fragments of ledge rock of uniform quality reasonably free of elongated pieces.

C. Materials that break up when alternately frozen and thawed or wetted and dried shall not be used.

2.02 GRADATION

A. Crushed stone (fine) and crushed stone (coarse) shall be free from injurious amounts of organic material, loam, snow, ice, frozen soil and other objectionable materials, and shall conform to the following gradations:

Item No.	304.4	304.5
Item	Crushed Stone (fine)	Crushed Stone (coarse)
Sieve Size	Percent Passing by Weight	
3 ½ in	--	100
3 in	--	85-100
2 ½ in	100	--
2 in	85-100	60-90
¾ in	45-75	40-70
#4	10-45	15-40
#200 (total sample)	0-5	0-5

2.03 QUALITY CONTROL

A. The Contractor shall provide certification that the gravel and crushed gravel used in construction of the roadway complies with the required gradations. Furnish the certification in accordance with Section 01300 "Submittals", and Section 01400 "Quality Assurance/Quality Control".

B. When materials are produced from processing of on-site boulders and rock, Contractor shall provide results of laboratory testing every 1,000 CY of materials to be installed, in order to demonstrate conformance with the requirements of Part 2.02 A.

PART 3 EXECUTION

A. Materials shall be furnished and placed in their final location with as little segregation as possible.

3.02 PLACEMENT AND COMPACTION

A. Placement and compaction of materials used in the construction of gravel roadways shall conform to NHDOT Specifications, Division 300, Section 304 "Aggregate Base Course".

B. A layer of woven geotextile (Section 02274) shall be installed over the prepared subgrade and beneath the base course (coarse crushed stone) materials, prior to installation of the fine coarse crushed stone.

END OF SECTION

SECTION 02555
TEMPORARY HDPE GEOMEMBRANE TARP

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Furnishing of 30 mil textured geomembrane
B. Quality Control for geomembrane tarp
C. Field installation of the tarp

1.02 RELATED REQUIREMENTS

A. Section 01400 - Quality Assurance/Quality Control
B. Section 02220 – Selective Demolition
C. Section 02222 – Excavation
D. Section 02273 - Drainage Geocomposite
E. Section 02619 – HDPE Pipe and Fittings

1.03 QUALIFICATIONS

A. Liner Manufacturer:

The manufacturer of the temporary HDPE geomembrane tarp shall have manufactured and fabricated not less than 15,000,000 square feet of HDPE geomembrane.

A. Liner Installer:

The installer shall have demonstrated, by previous experience, the ability to do the work, and shall be approved and/or licensed by the temporary HDPE geomembrane tarp material supplier. The installer shall provide the services of a competent English-speaking field superintendent throughout the installation of the liner and all appurtenant structures. Personnel performing seaming operations shall be qualified by experience. All field seams shall be inspected over their full length by the Installer Specifications.

1.04 SUBMITTALS

A. The manufacturer shall furnish complete written instructions for the storage, handling, installation, seaming, repair, and inspection of the temporary HDPE geomembrane tarp material in compliance with this Specification and conforming to the conditions of his warranty. A copy of all manufacturer literature shall be submitted to the ENGINEER upon request.

B. The manufacturer or his designated representative shall furnish panel layouts as

required for the temporary HDPE geomembrane tarp installation.

C. Brand of temporary HDPE geomembrane tarp to be used, and a statement from the supplier detailing its properties and composition.

D. Warranties regarding quality of workmanship, materials, and performance of the synthetic material.

E. Make, model, year, total weight(s), and tire pressure(s) of deployment vehicle(s) [All Terrain Vehicle(s)].

F. Panel layout drawings showing the installation layout, identifying panel identification numbers and field seams, as well as any variance or additional details which deviate from the project Drawings or Specifications. The layout shall be adequate for use as a construction plan and shall include dimensions and details as appropriate.

G. Shop Drawings, showing extent, sizes, panel identification numbers, and details of the temporary HDPE geomembrane tarp, including recommendations for terminating the tarp and proposed methods of sealing around penetrations if different than shown on the Drawings, shall be submitted prior to the start of temporary HDPE tarp installation. Except for special requirements due to configuration and/or termination of the temporary HDPE geomembrane tarp, maximum use of large size panels shall be made. Previous experiences at the facility should be taken into consideration when evaluating the panel placement layout with regards to deployment methods and weather concerns.

H. QC plans detailing proposed QC procedures shall be submitted prior to the start of the temporary HDPE tarp installation.

I. Samples of all materials and certificates of specifications shall be submitted to the Engineer

J. During the course of the work, the INSTALLATION CONTRACTOR shall maintain As-Built Drawings showing, but not limited to, panel layout and identification, seam type and identification, and repair locations and identifications. The INSTALLATION CONTRACTOR shall submit working copies of the As-Built Drawings to the ENGINEER upon request, and shall submit a final copy to the ENGINEER prior to moving off the site.

1.05 PRE-CONSTRUCTION MEETING

A. A pre-construction meeting is required between the Owner, Engineer, Contractor, and Installer prior to the start of any work on-site. The intent of the meeting is to discuss the requirements of these Contract Documents to ensure that all parties involved are familiar with their respective responsibilities.

PART 2- PRODUCTS

2.1 TEMPORARY HDPE GEOMEMBRANE TARP

A. Temporary HDPE Geomembrane Tarp shall be 30 mil textured HDPE geomembrane and demonstrate the following typical properties:

PROPERTY	TEST	VALUE
Thickness (min)	ASTM D5994	27 mils
Asperity Height	ASTM D 7466	16 mils
Tensile Strength (Yield) (lbs/in.)	ASTM D6693 Type IV	45
Tensile Strength (Break) (lbs/in.)	ASTM D6693 Type IV	63
Elongation at Yield (%)	ASTM D6693 Type IV (1.3" gauge)	12%
Elongation at Break (%)	ASTM D6693 Type IV (2.0" gauge)	100%
Tear Resistance (lbs)	ASTM D1004 Die C	21
Puncture Resistance (lbs)	ASTM D4833	45
Carbon Black Content	ASTM D1603/4218	2% by weight

PART 3- EXECUTION

3.1 INSTALLATION

A. Temporary HDPE Tarp shall be installed in accordance with the manufacturer's recommendations, and as shown on the Drawings and specified herein.

B. As indicated on the Contract Drawings, an anchor trench shall be excavated around the area to be lined at the edge of the tarp, except where noted on the Drawings. The trench shall be constructed according to the specifications of the Drawings. Care shall be taken when constructing the trench to avoid construction equipment from coming in direct contact with the cover material.

C. A proper ballasting system is required for the majority of cover applications. The ballast system may incorporate an anchor trench.

D. The entire subgrade surface should be inspected prior to placement of the cover panels. Observation and/or approval by the Engineer and Owner may be required.

E. Project panel layouts must be completed for reference during panel layout. The layout should specify panel configuration and seam location. The design should minimize the number of both field seams and seams oriented across (horizontal) the slope.

F. Panels are to be placed in their respective locations as specified by the layout drawings. In the event the panels are misplaced or moved, a revised layout diagram must be completed indicating the change.

G. Unacceptable conditions for panel installation include the presence of any excessive standing water, high winds, or extreme temperatures. Installation temperatures should range between 0°F and 100°F. During extremely warm temperatures it is recommended that installation and seaming take place in early mornings or evenings to avoid unnecessary membrane damage or unacceptable seams.

H. The method, personnel, and equipment used for panel installation must not damage the cover membrane or the supporting subgrade surface. Proper repair procedures must be followed should any damage occur.

I. No individuals will be allowed on the liner surface wearing improper footwear that may damage the cover membrane in any way. This also includes smoking or any action that may result in damage.

J. Proper ballasting must be provided to protect against wind uplift. Ballasting systems shall be minimum 25 pound polyethylene sandbags placed every 10 feet on center and fastened to minimum 5/8”diameter (Tensile strength 3500 lbs min.) polypropylene rope spaced at 10 feet on center in two directions.

K. Panels should be positioned to minimize handling and to allow enough slack to compensate for shrinkage.

L. All holes and tears in the Temporary HDPE Tarp shall be noted and repaired as specified by the manufacturer and approved by the Engineer.

3.2 FIELD SEAMING REQUIREMENTS

A. The Temporary HDPE Geomembrane Tarp, especially the seaming area, should be kept clean, dry and free of any contaminants or debris.

B. Individual Temporary HDPE Geomembrane Tarp panels should be deployed per the panel layout configuration and overlapped a minimum of four (4) inches before seaming.

C. Field seaming of Temporary HDPE Geomembrane Tarp panels shall be in accordance with the manufacturer's methods and recommendations.

END OF SECTION

SECTION 02614
CULVERTS AND STORM DRAINS

PART 1 GENERAL

1.01 SUMMARY

This work shall consist of furnishing and installing, or removing and relaying, pipes, pipe end sections, and pipe sleeves at the locations shown or ordered, including the necessary joints, fittings, and connections as required. All excavation, bedding, backfill, compaction, and site restoration required to complete the pipe installation shall be included in this work.

1.02 RELATED REQUIREMENTS

A. Section 01300 - Submittals
B. Section 01400 - Quality Assurance/Quality Control
C. Section 02222 - Excavation
D. Section 02223 - Filling
E. Section 02232 - Stone Fill

1.03 QUALITY ASSURANCE

A. All drainage pipe and fittings shall conform to the requirements of NHDOT Specifications, Division 600, Section 603 "Culverts and Storm Drains".

1.04 SUBMITTALS

A. Submit shop drawings in conformance with Sections 01300 "Submittals" and 01400 "Quality Assurance/Quality Control".

B. Submit the manufacturer's Certificate of Compliance with specified ASTM Standards.

PART 2 PRODUCTS

2.01 MATERIALS

A. Corrugated polyethylene pipe shall be ADS N-12 or equivalent, and have a smooth interior for improved flow characteristics. Equivalent products shall conform to AASHTO M 294.

B. To facilitate field jointing or corrugated metal piping, the ends of individual pipe sections shall meet the requirements of Section 7.7/1 of AASHTO M 36 and Section 18.3 of AASHTO M 191.

C. Section 9.1.3 of AASHTO M 36 and Section 19.3 of AASHTO M 196 do not apply.

D. Joining of polyethylene pipe shall be completed in accordance with the manufacturer's recommendations.

E. Furnish AASHTO designation Class IV reinforced concrete pipe with integral bell-and-spigot joints. Furnish fittings of approved equal structural integrity to the pipe and have bell-and-spigot configuration identical to that of the pipe.

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor shall provide for the temporary diversion of water in order to permit the installation of the culvert in a dry trench.

B. Where soft or other unsuitable material is encountered, all such unsuitable material shall be removed and replaced with acceptable 1 ½ inch crushed stone bedding material. Soft or unsuitable excavation and backfill replacement up to 12 inches below the proposed pipe invert grades is subsidiary work; unsuitable excavation and back fill replacement greater than 12 inches below pipe invert grades shall be paid for under alternate bid items for additional authorized excavation and filling. Where bedrock or other rock material is encountered, it shall be removed to a point 12 inches below design pipe invert grades.

C. Granular backfill or other approved material shall be used to backfill the spaces left by the excavation of material removed in accordance with 3.01 B. The material shall be uniformly compacted to 95 percent of its maximum density as determined by ASTM D-1557 Method "C".

D. The width of trenches shall be held to a minimum consistent with the space required to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Trenching below the top of the pipe shall be kept to a minimum of three times the diameter of the pipe. The width of the trench above the pipe may be at the Contractor's option.

E. The pipe shall be placed at the designated location on a prepared foundation so that the flow line of the pipe will conform to the required grade.

F. Where the top of the pipe would lie above the natural ground, sufficient compacted fill shall be constructed at pipe locations to ensure that the pipe is placed in a trench equal in depth to at least the height of the pipe. The fill shall be constructed on each side of the pipe for a distance equal to at least 5 times the diameter of the pipe.

3.02 BEDDING

A. Bedding for pipes less than 48 inches in diameter or span shall consist of preparing and shaping the bottom of the trench and installing a minimum of 6 inches of crushed stone bedding (Section 02232) beneath the pipe and up to the spring line of the pipe as indicated on the Drawings with reasonable closeness and with uniform density and stability. Recesses shall be excavated for the bells of pipe.

B. Bedding for all pipes 48 inches or more in diameter or span shall consist of bedding the pipe on a carefully prepared bed of 6 inches of 1 ½ inch crushed stone (Section 02232) material, shaped by means of a template to fit the lower part of the pipe exterior. Bedding shall be installed up to the spring line of the pipe as indicated on the Drawings.

3.03 LAYING AND JOINING PIPE

A. Proper facilities shall be provided for lowering the sections of pipe into the trench. Each section shall be securely attached to the adjoining section by the approved method for the type of joint used.

B. Sections of corrugated and smooth polyethylene pipe shall be joined with hinged split couplings.

C. Joints between dissimilar pipes shall be made in accordance with the recommendations of the pipe manufacturer.

3.04 END SECTIONS

A. End sections shall be installed in accordance with the recommendations of the manufacturer or as directed.

B. Necessary excavation shall be made to the required depth and contour for the section. Where ledge is encountered, the trench shall be excavated 12 inches below the bottom of the end section and the area refilled to grade with suitable material, thoroughly tamped, and carefully shaped.

C. Connections between concrete end sections and pipe culverts shall be by standard tongue and groove joints or as ordered.

3.05 BACKFILLING

A. Select sand shall be backfilled from the top of the bedding material to 12 inches above the top of the pipe.

B. Backfill from the top of select sand to proposed subgrade of roadways or other fill shall be completed with common borrow or excavated materials, with all rocks, lumps or clods larger than 3 inches removed.

C. All backfill material shall be compacted at near optimum moisture content, in layers layers not exceeding 6 inches in compacted thickness, by pneumatic tampers, vibratory compactors, or other approved means. Care shall be exercised to thoroughly compact the backfill under the haunches of the pipe and to ensure that the compacted backfill material is in direct contact with the sides of the pipe. Fill at the sides of the pipe may be compacted by rolling or operating heavy equipment parallel with the culvert, provided care is taken to avoid displacement or damage of the pipe. Material in the vicinity of pipes shall be compacted to not less than 95 percent of ASTM D1557, Method C.

D. The Contractor shall place an adequate protecting cover of earth or other approved material over the structure before allowing equipment or traffic to pass over it.

3.06 MANHOLE CONNECTIONS

A. Pipes shall be grouted into manhole wall using non-shrink grout.

3.07 WORKMANSHIP

A. Any pipe which is not true to alignment and grade or which shows any undue settlement after laying or is damaged, shall be removed and relayed or replaced without extra compensation.

END OF SECTION

SECTION 02619
HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Quality assurance of pipe and fittings.
B. Delivery and storage of piping.
C. Installation of the piping.
D. Testing of installed piping.

1.02 RELATED REQUIREMENTS

A. Section 01400 - Quality Assurance/Quality Control
B. Section 02222 - Excavation
C. Section 02223 - Filling
D. Section 02276 - High Density Polyethylene (HDPE) Liner

1.03 SERVICE AND TYPE REQUIREMENTS

Except as otherwise specified or authorized, high density polyethylene pipe and fittings shall be of the type, grade, schedule, or pressure rating indicated on the Plans and as approved by the Engineer for its service function.

1.04 QUALITY ASSURANCE

A. Provide all required manufacturer's certifications and test results in accordance with Section 01400 prior to delivery of the pipe on site.

B. Provide all test results of the HDPE piping system prior to substantial completion of the Project.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Performance Pipe
B. ISCO pipe
C. Approved equal

2.02 MATERIALS

A. PIPE:

1. ASTM D1248 Type III, Class C of the standard dimensional ratio (SDR) indicated on the Plans. All leachate and landfill gas piping shall be of IPS pipe size.

2. Piping shall be manufactured in accordance with ASTM F 714. Provide manufacturer's certification that the piping has been tested in accordance with ASTM D2837.

3. The HDPE pipe shall have the following minimum physical properties as determined by the appropriate test method.

Physical Property	Test Method	Required
Density	ASTM D1505	0.955 g/cm^3
Tensile Yield Strength	ASTM D638	3200
Tensile Modulus of Elasticity	ASTM D638	130,000 psi
Flexural Modulus	ASTM D790	135,000 psi
Melt Index	ASTM D1238	0.10 gm/10 min

B. FITTINGS:

1. Butt fusion molded and fabricated fittings shall be pressure rated to match the system piping to which they are fused, and manufactured in accordance with ASTM D 3261.

2. Provide factory fabricated dual containment fittings from the same manufacturer as the pipe materials.

3. Fittings shall have the same or higher pressure rating as the pipe.

4. The Drawings may not show all the fittings required and the Contractor shall provide all fittings required to complete the work.

C. GASKETS AND HARDWARE

1. All gaskets shall be Viton. Joint hardware shall be 304 stainless steel.

D. SUPPORT SPACERS FOR DUAL CONTAINMENT PIPE

1. Support spacers shall be manufactured from non-metallic, corrosion resistant material.
2. Supports shall have broad, smooth bearing surfaces.
3. Support spacers shall be manufactured to maintain the specified annulus between the carrier and containment pipes.

4. Supports shall allow unrestricted passage of monitoring or alarm system cables, possible flow of liquid from the carrier, and leak testing.

PART 3 EXECUTION

3.01 PIPING DELIVERY AND STORAGE

A. Piping delivered on site shall be clean, new, and bear the manufacturer's identification and SDR designation. Piping shall be unloaded and stored on site on pallets in accordance with the manufacturer's recommendations.

B. Piping damaged en route to the site or during the unloading will be rejected and shall be removed from the site and replaced with new piping meeting specification.

3.02 INSTALLATION OF PIPING

A. GENERAL:

1. Lay out piping as shown on the Plans. Any deviation from the layout shown must be approved by the Engineer.

2. Piping shall be cut from measurements taken at the site and not from the Plans. All necessary provisions shall be taken in laying out piping to provide for expansion and contraction.

B. INSPECTION OF PIPING:

1. Carefully inspect all pipe and fittings before installation, removing all dirt. The pipe should be installed with the markings up for visual inspection and verification.

2. All pipe shall have smooth exterior and interior surfaces, be first quality, be free from cracks, blisters, and other imperfections, and be true to shape or form throughout each length. Piping judged by the Engineer to be unacceptable shall be removed from the site and new undamaged pipe shall be provided at no extra cost to the Owner.

3. The interior of the pipeline shall be kept free from all dirt, joint material, and other foreign materials as the work progresses. Tight fitting stoppers or bulkheads shall be securely placed at the ends and any other openings of the pipe when work is stopped temporarily, or at the end of the days work to prevent dirt or trash from entering the pipe.

C. PIPE JOINTING:

1. Pipe joints and fittings shall be butt fused at 440 or 500ºF and shall be socket or sidewall fused at 500ºF. Fusing shall be performed using manufacturer approved equipment and shall be in accordance with the manufacturer's recommendations. When shown on the Plans, piping shall be joined using the stainless steel repair clamps equivalent Dresser Style 364 with Viton.

2. Flanged connections shall be completed with fabricated flange adapters and, convoluted stainless steel back-up rings on installations below ground, and epoxy coated carbon steel backup rings shall be used above grade. Use Viton full face gaskets only. All fasteners shall be Type 18-8 or Type 304 stainless steel below grade, and zinc plated steel above grade. Hot dipped galvanized fasteners are not permitted.

3. Protect below grade bolts and flanges by covering with 6-mil thick polyethylene wrap. Duct tape wrap to HDPE pipe.

4. Electrofusion couplings, where used, shall be installed per manufacturer’s recommendations. The outside diameter of the HDPE pipe and face shall be prepared in accordance with the manufacturers recommendations prior to installing the coupler.

D. CARRIER PIPE/FITTING SUPPORT SPACERS PLACEMENT

1. Support spacers shall be secured at a minimum of 4-foot intervals to align pipe for fusion welding adjacent to fittings and bends.
2. Support spacers shall not restrict longitudinal movement between the carrier and containment pipe.
3. If dual walled pipe is not manufactured with internal spacers, Contractor shall install a least three spacers on either side of all simultaneous butt fusion joints to maintain correct alignment of the carrier pipe within the containment pipe.

E. PIPE PENETRATIONS:

Penetrations of the HDPE piping through the HDPE liner membrane shall be sealed between the exterior surface of the piping and the edge of the liner penetration as shown on the Plans. The method of sealing shall be an approved procedure by both manufacturers of the HDPE piping and HDPE liner. The seals at all penetrations shall be inspected and approved by the Engineer prior to backfilling with Select Sand.

3.03 PIPE EMBEDMENT AND BACKFILL

A. The HDPE pipe and fittings shall be installed in full compliance with the manufacturer's recommendations.

B. The pipe shall be embedded with bedding, haunching, and initial backfill materials that provide stable and permanent support to the pipe. These materials shall be as shown on the Plans.

C. Care should be taken to ensure that the haunching of the pipe is performed without disturbing the pipe. Initial backfill shall be placed in 6-inch layers and hand tamped to assure compaction.

D. Leachate force main piping shall be insulated with waterproof, closed-cell foam insulation when the top of the pipe is less than 5-feet below ground surface or within 5-feet of a stormwater drainage pipe.

3.04 TESTING OF GRAVITY, SOLID WALL PIPELINES

Testing of a section of pipe shall be performed using the below stated equipment according to stated procedures and under the observation of the inspecting Engineer.

A. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.

B. Pneumatic plugs shall be braced or blocked when installed in the test section.

C. All air used shall pass through a single control panel.

D. Three (3) individual hoses shall be used for the following connections:

1. From control panel to pneumatic plugs for inflation.

2. From control panel to sealed line for introducing the low pressure air.

3. From sealed line to control panel for continually monitoring the air pressure rise in the sealed line.

Procedures: All pneumatic plugs shall be seal tested before being used in the actual test installation. One (1) length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psig. The sealed pipe shall be pressurized to 5 psig. The plugs shall hold against the pressure without bracing and without movement of the plugs out of the pipe.

After a reach of pipe has been backfilled and cleaned, and the pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each manhole and inflated to 25 psig. Low pressure air shall be introduced until internal pipe pressure reaches 4 psig greater than the average back pressure of any ground water that may be over the pipe. At least two minutes shall be allowed for the air pressure to stabilize.

After the stabilization period (3.5 psig minimum pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected. The portion of the line being tested shall be termed "acceptable" if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig (greater than the average back pressure of any ground water that may be over the pipe) shall not be less than the time shown for the given diameters in the following table:

Pipe Diameter In Inches	Minutes
4	2.0
6	3.0
8	4.0
10	5.0
12	6.0
15	7.5
18	9.0
21	10.5
24	12.0
30	14.0
36	17.0

For purposes of determining test pressure in areas where ground water is known to exist, the Contractor shall install sumps or monitoring wells adjacent to the pipeline to be tested.

A measurement from the top of ground water to top of pipe in the test section in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings. (For example, if the height of water is 11½ feet, then the added pressure will be 5 psig, and the 2.5 psig will then be 7.5 psig. The allowable drop of one pound and the timing remain the same.)

If installation fails to meet the above requirements for the air test, the Contractor shall correct the pipeline until an acceptable test is achieved.

The Contractor shall provide as required the proper plugs, bracing, and other equipment required to perform all tests. Testing of each section of HDPE installed shall include the portions of service connections that are to be installed under the Contract.

Where ground water is confirmed to be high, the Engineer, at his option, may elect to accept infiltration measurements in lieu of air testing.

These tests shall be conducted at all times in the presence of the Engineer. Should a pipe section which has previously been tested indicate any water infiltration, or otherwise appear suspect to the Engineer, the Contractor shall conduct confirmation air tests on the line at no additional cost.

3.05 PRESSURE TESTING OF FORCE MAINS

Testing of the polyethylene force mains shall be performed using the below stated procedures under the observation of the inspecting Engineer:

A. Water will be used to hydrostatically pressure test the force main.

B. All free air must be removed from the line.

C. The pressure in the section shall be measured as close as possible to the lowest point of the test section.

D. Prior to testing, the pipe shall be covered at intervals and curves to hold the pipe in place. Flanged connections shall be left exposed for visual leak inspection.

Procedure:
Pressure in the line shall be raised at a steady rate to 1.5 times the rated operating pressure of the pipe or the lowest rated component of the system. The initial pressure test shall be applied and allowed to stand without make up pressure for 2-3 hours to allow for diametric expansion or pipe stretching to stabilize.

After the equilibration period, the test section can be returned to the 1.5 times operating pressure and the final test pressure held for 3 hours. If there are no visual leaks or significant pressure loss during the final test period, the section of force remains passes the test.

Pressure drop will not only occur due to pressure expansion but also due to temperature fluctuations. As temperatures increase, gauge pressure will decrease. Make up water for expansion during the test which exceeds 0.25 gallons/100 feet of pipe is not acceptable.

END OF SECTION

SECTION 02700
MANHOLES, FRAMES, AND COVERS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Installation of manholes.
B. Quality assurance of materials incorporated.
C. Testing of manholes.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 – Submittals
B. Section 01400 – Quality Assurance/Quality Control
C. Section 02222 – Excavation
D. Section 02223 – Filling and Compaction

1.03 QUALITY CONTROL

A. This Section shall govern the inspection of materials delivered to the job site as part of the furnishing of materials necessary for the construction of items defined in the specification. The Engineer shall inspect materials shipped to the job site under this Section of the specifications and shall bring to the attention of the Contractor any materials which do not meet the specifications in this Section of the Contract. The Engineer's failure to detect faulty materials does not relieve the Contractor of his responsibility to construct the project in full compliance with the Contract Documents.

B. Submit shop drawings and manufacturer's literature in conformance with Section 01300 "Submittals."

C. PRECAST CONCRETE PRODUCTS

1. Acceptable Manufacturers:

a. Superior Concrete
b. American Precast Corp.
c. Old Castle Precast
d. Michie Corp.
e. Approved equal

1.04 DEFINITIONS

The standards named in this specification refer to the latest approved (published) edition thereof:

ASTM C-478	Precast Reinforced Concrete Manhole Sections
ASTM C-267	Test Method for Chemical Resistance of Mortars
ASTM C-109	Test Method for Compressive Strength of Hydraulic Cement Mortars
ASTM A-48	Grey and Ductile Iron Fittings

PART 2 PRODUCTS

2.01 BASIC REQUIREMENTS

A. Pre-cast manhole section assemblies or monolithically cast-in-place structure (with steel reinforcement) shall withstand H20 wheel loading and shall not leak in excess of one gallon per day per vertical foot of manhole for the life of the structure. A period in excess of 25 years shall be the life of the structure.

2.02 MATERIALS

Materials of construction for manholes shall be as follows:

A. CONCRETE for precast and cast-in-place bases or complete manholes shall conform to the requirements for Class AA concrete in Section 520 of the New Hampshire Department of Public Works and Highways standard specifications (NHDPW&H).

B. REINFORCING STEEL for cast-in-place concrete shall conform to the requirements of the New Hampshire Department of Public Works and Highways standard specifications for billet-steel bars or welded steel wire fabric.

C. PRE-CAST CONCRETE BARREL SECTIONS, cones, and bases shall conform to ASTM C478 except as may be otherwise shown in these Specifications. The barrel sections shall be designed to handle H20 wheel loading.

D. MANHOLE FRAME AND COVER shall provide a 30-inch diameter clear opening. Sewer manhole covers shall have the word “SEWER” in 3 inch letters cast into the top surface. The castings shall be of good quality, heavy duty, strong, tough, even-grained cast iron, smooth, free from scale, lumps, blisters, sand holes, and defects; contact surfaces of covers and frames shall be machined at the foundry, to prevent rocking of covers in any orientation. All castings shall be thoroughly cleaned and subject to a careful hammer inspection. Watertight manhole covers and frames shall be designed to handle H20 wheel loading.

E. CASTING shall be equal to Class 30, conforming to the ASTM standard specifications for gray iron castings, designation A48. Castings shall be sandblasted and given two coats of coal-tar-pitch varnish, applied in a satisfactory manner so as to make a smooth coating, tough, tenacious, and not brittle or with any tendency to scale off. Damaged coatings shall be repaired by the Contractor to the satisfaction of the Engineer.

F. MORTAR shall be composed of Portland cement, hydrated lime, and sand, in the proportions of one part cement to ½ part lime to 4-1/2 parts sand, (by volume). In no case shall the volume of sand exceed 3 times the sum of the volume of cement and lime.

G. CEMENT shall be Type II Portland cement conforming to ASTM C-150.

H. HYDRATED LIME shall be Type S conforming to the ASTM C-207 Standard Specification for Hydrated Lime for Masonry purposes, Designation C207.

I. SAND shall consist of inert natural sand conforming to the ASTM Standard Specifications for Concrete (Fine) Aggregates, Designation C33.

J. BRICK MASONRY for shelf, invert, and grade adjustment shall comply with ASTM C-32, clay or shale, for grade SS hand brick.

K. CONCRETE wall penetration seals shall be Kor-N-Seal or equal.

L. MANHOLE STEPS shall be polypropylene coated Grade 60 reinforcing bar ASTM c-478 & OSHA STD 1-1.9. Steps shall have non-skid safety serrations on the foot contact surface and meet requirements set forth by Env-Wq 704.10 (k) (18) (l).

PART 3 EXECUTION

3.01 EXCAVATION

Excavate the pit for a manhole structure no wider than the manhole diameter plus 4', allowing 2' around the structure unless otherwise directed by the Engineer.

3.02 MANHOLE CONSTRUCTION

The manholes shall be constructed as follows:

A. Concrete structures shall be pre-cast reinforced concrete, or cast-in-place reinforced concrete.

B. Base sections shall be monolithic to a point 6 inches above the crown of the incoming pipe, and shall be pre-cast reinforced concrete or pre-cast non-reinforced concrete.

C. Horizontal joints between sections of pre-cast concrete shall be of a type which shall, in general, depend for water-tightness upon a double row of an elastomeric or mastic-like sealant. Kent #2, Ram Nek, EZ shall be approved.

D. Pipe to manhole joints shall depend for water-tightness upon Kor-N-Seal wall sleeves.

E. All pre-cast sections and bases shall have the date of manufacture and the name or trademark of the manufacturer impressed or indelibly marked on the inside wall.

F. Manhole step rungs shall be 14” wide and be spaced vertically 12” on center.

G. Water Repellent (silane-siloxane) shall be applied to all exposed concrete surfaces.

3.03 INSTALLATION OF MANHOLES

Installation of manhole bases and sections.

A. Pre-cast bases shall be placed on a 6-inch minimum layer of 3/4” crushed stone. The excavation shall be properly dewatered while placing bedding material and setting the base or pouring concrete. Water-stops shall be used at the horizontal joint of cast-in-place manholes.

B. Perform jointing in strict accordance with the manufacturer’s recommendations.

C. Install structures level and plumb and to the elevations and in the locations shown on the Drawings.

D. Install frames and hatch as indicated on the Drawings, and as recommended by the manufacturer

E. A leakage test shall then be made in accordance with paragraph 3.04 "Manhole Testing".

F. Following satisfactory completion of the leakage test, the frame and cover shall be placed with the tops conforming accurately to the grade as shown on the drawings.

G. Set frames concentric with the top of the masonry and in a full bed of mortar, so that the space between the top of the manhole masonry and the bottom flange at the frame shall be completely filled and made watertight.

H. Place a thick ring of mortar extending to the outer edge of the masonry all around and on the top of the bottom flange.

I. Finish the mortar so that it will be smooth and have a slight slope to shed water away from the frame.

J. When the work on each manhole is complete, clean the frame seat and set the cover in place.

3.04 MANHOLE TESTING

A. Test manholes prior to backfilling, mortaring joints, and installing the bench and inverts. Vacuum tests shall be conducted with equipment provided by the Contractor and reviewed by the Engineer. The Engineer shall be present, given timely notification by the Contractor for all vacuum tests.

B. Vacuum shall be created in pre-cast structures to 10 inches of mercury with an allowable drop of one inch for the times and heights listed below:

Structure Height	**Minutes**
5 - 10'	3
10'-15'	3.5
15'-20'	4

C. If vacuum testing is not possible, as determined by the Engineer, the manhole may be hydrostatically tested as directed by the Engineer. Permission to perform hydrostatic or other alternative testing methods must be granted by the NH DES Wastewater Engineering Bureau prior to testing.

D. The cost of any testing and repairs shall be included in the Contractor’s bid price. Should any manhole not pass the test, it shall be resealed and retested at the Contractor's expense until the test requirements have been achieved.

END OF SECTION

SECTION 02930
LOAMING AND SEEDING

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Generate loam materials from the existing capping system to be removed during the course of the project, test, amend, and place loam, seed, lime, fertilizer, and mulch on all areas disturbed during construction, where shown on the Plans, and as directed by the Engineer.

1.02 RELATED REQUIREMENTS

A. Section 02223 - Filling
B. Section 02270 - Erosion Control

1.03 SUBMITTALS

A. The Contractor shall furnish all materials to be used in performing the work under this Contract. Prior to use, the Contractor shall be required to furnish the following information to the Engineer.

1. Copies of delivery tickets showing the net weight of materials delivered to the job site.

2. Certification from the suppliers of ground limestone showing:

   a. Magnesium oxide content
   b. Total calcium oxide neutralizing equivalent, and
   c. Gradation of the ground limestone

3. Certification that the fertilizer meets the requirements of NHDOT Specifications, Division 600, Section 643 "Fertilizer for Grasses".

4. The bag tag for each variety of mix and bag of seed showing test results and the date of test.

1.04 CERTIFICATE OF PROVISIONAL ACCEPTANCE

A. The Owners Representative will inspect all work upon the written request of the Contractor received at least ten days before the anticipated date of inspection.

B. Seeded areas shall be reviewed for acceptance only after all areas have a close stand of grass with no bare spots greater than two inches in diameter, at least 90%

of the grass established shall be permanent grass species and the lawns have been maintained for a minimum of ninety (90) days prior to inspection.

C. Furnish full and complete written instructions for maintenance of all lawns to the Owner at the time of provisional acceptance.

E. Owner's Representatives inspection shall determine if the seeded areas are acceptable and whether maintenance shall continue in any part.

F. After all necessary corrective work and clean-up has been completed, and maintenance instructions have been received by the Owner, the Owner's Representative will certify in writing the acceptance of the seeded areas. The Contractor's responsibility for maintenance of seeded areas shall cease on receipt of the Certificate of Provisional Acceptance.

1.05 EXAMINATION OF CONDITIONS

A. All areas to be seeded shall be inspected by the Contractor before starting work and any defects, such as incorrect grading, drainage problems, etc., shall be reported to the Owner's Representative prior to beginning this work. The commencement of work by the Contractor shall indicate his acceptance of the areas to be seeded, and he shall assume full responsibility for the work of this Section.

PART 2 PRODUCTS

2.01 TOPSOIL

A. Existing topsoil materials removed from the capping system at the site shall be processed to meet the requirements of NHDOT Specifications Division 600, Section 641 "Loam"

B. The topsoil shall be screened to remove all particles greater than one (1) inch in any diameter, and be reasonably free from subsoil, clay lumps, stones, brush, objectionable stumps, roots, litter, toxic substances, and other material or substances which may be harmful to plant growth or be a hindrance to grading, planting and maintenance operations.

C. A sample of the processed topsoil materials shall be provide to the Engineer for laboratory testing, to determine recommended fertilizer application rates and whether any additives are required. Contractor shall treat the topsoil to meet the specifications.

E. Topsoil shall be applied to areas disturbed during construction, where shown on the Plans, and as directed by the Engineer to a depth of four (4) inches after spreading and rolling.

2.02 LIME

A. Lime shall conform to NHDOT Specifications Division 600, Section 642 "Limestone".

2.03 FERTILIZER

A. Fertilizer to be used must be the equivalent of a standard 15-15-15 mixture and shall be approved by the Engineer. Fertilizer shall be a standard commercial grade fertilizer conforming to all State and Federal regulations and to the standards of the Association of Official Agricultural Chemists. The analysis shall represent respective percentages of nitrogen, phosphoric acid, and potash.

2.04 SEED

A. All seed shall be certified as to mixture, germination, and purity, and as being in conformity with the NHDOT Specifications, Division 600, Section 644 "Grass Seed".

B. The Contractor shall use approved slope erosion resistant seed mix for erosion control of sloped areas and use grass mix for level areas.

2.05 MULCH

A. Only hay or straw shall be used. The materials shall not be musty, moldy, caked, or of otherwise low quality. If the seed is applied hydraulically, a suitable wood fiber mulch may be used in place of hay or straw.

B. Mulch application shall be at a minimum rate of 1½ to 2 tons hay/acre.

C. Bonded Fiber Matrix, as described in Section 02270, shall be applied on seeded areas with slopes steeper than 3:1.

PART 3 EXECUTION

3.01 SEEDING PERIODS

A. Unless otherwise authorized, the Contractor shall do all seeding during the following periods:

1. April 1 and July 1
2. August 15 and October 15

3. If seeding is done beyond October 15, the Contractor shall apply mulch at a rate of 2 to 2½ tons per acre, but no more than 3 tons/acre.

Seeding shall not be done during windy weather or when the ground is frozen, excessively wet, or otherwise untillable.

3.02 SEED BED PREPARATION

A. Seed will be applied to a well-conditioned smooth firm seedbed, prepared to a depth of three (3) inches. Clods or other obstructions generally larger than two (2) inches in diameter of thickness that will prevent uniform seeding shall be removed or reduced in size.

B. Hard or caked seed bed shall be reconditioned before the seed is applied.

C. Care must be taken by the Contractor to see that ruts or ridges are not created on the graded areas.

3.03 LIMING, FERTILIZING, AND SEEDING

A. Lime, fertilizer and seed may be applied by any of the methods described in NHDOT Specifications, Division 600, Section 644 "Grass Seed". The rates of application shall conform NHDOT Specifications, Division 600, Section 642, 643, and 644 "Limestone", "Fertilizer for Grasses", and "Grass Seed".

B. Lime and fertilizer shall be applied based upon nutrient availability of the soil and worked into the soil at the time of seed bed preparation.

3.04 MULCHING

A. MULCH:

Immediately after the area has been seeded, it shall be uniformly covered by a mulch of hay or straw at the rate of 1½ to 2 tons per acre.

3.05 MAINTENANCE AND PROTECTION

A. Maintenance shall begin immediately after any area is seeded and shall continue for ninety (90) days or until final written acceptance by the Owner’s Representative, whichever is longer.

B. Maintenance shall include reseeding, mowing, watering, weeding, liming and fertilizing.

C. Watering of Seeded Areas:

1. First Week: The Contractor shall provide all labor and arrange for all watering necessary to establish an acceptable lawn. In the absence of an adequate rainfall, watering shall be performed daily or as often as necessary during the first week and in sufficient quantities to maintain moist soil to a depth of at least two inches.
2. Second and Subsequent Weeks: The Contractor shall water the lawn as required to maintain adequate moisture, in the upper two inches of soil, necessary for the promotion of deep root growth.
3. Watering shall be done in a manner which will provide uniform coverage, prevent erosion due to application of excessive quantities over small areas, and prevent damage to the finished surface by the watering equipment. The Contractor shall furnish sufficient watering equipment to apply one complete coverage to the seeded areas in an eight (8) hour period.

D. Protection:

1. Seeded and sodded areas shall be protected by a three foot high barrier constructed of two-by-four stakes or iron pipes set eighteen inches in the ground at ten foot intervals and connected by No. 10 wire. Flags of white cloth shall be secured to the wire at center points between stakes.
2. Barriers must be raised immediately after seeding or sodding and shall be maintained until acceptance.

E. Reseeding: After the grass in seeded areas has appeared, all areas and parts of areas which, in the opinion of the Owner's Representative, fail to show a uniform stand of grass, for any reason whatsoever, shall be reseeded and such areas and parts of areas shall be seeded repeatedly until all areas are covered with a satisfactory growth of grass. Reseeding together with necessary grading, fertilizing, and trimming shall be done at the expense of the Contractor.

F. Mowing:

1. Seeded Areas: The Contractor shall keep seeded areas mowed until written acceptance of the seeding by the Owner's Representative by cutting to a height of two inches (2") when growth reaches three inches (3") or as directed by the Owner's Representative .
2. Mowing shall include removal of clippings.

G. Fertilizing: A second application of fertilizer, as specified herein, shall be applied after one (1) season of growth of a minimum of two (2) months duration, but only during the months of April, May, August or September. Fertilizer shall be applied at the rate of thirty (30) pounds per one thousand (1,000) square feet.

H. Liming: If more than one initial application of limestone is required by the soils analysis to bring the pH of the stockpiled topsoil/loam borrow to a specified

range, the Contractor shall be responsible for all additional required lime applications.

3.05 GUARANTEE PERIOD

A. The Contractor shall guarantee all seeded areas for a period of one (1) year following the date of Provisional Acceptance. During the guarantee period, the Contractor shall make periodic inspections of seeded areas and to determine if any remedial actions are necessary to prevent erosion or damage to seeded areas.

B. At the end of the guarantee period, the Engineer and Owner shall observe the vegetation, at the written request of the Contractor, at least ten (10) days before anticipated date. Seeded area not demonstrating satisfactory vegetation, as determined by the Engineer and Owner, shall be repaired, reseeded, and maintained to meet all requirements specified herein.

C. After the completion of all necessary corrective work, the Engineer shall issue a certificate of final acceptance, which shall terminate the Contractors responsibility for the seeded areas.

END OF SECTION

SECTION 02960
DECOMMISSIONING/EXTENSION OF MONITORING WELLS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. The proper decommissioning and extension of monitoring wells within the work area of the Contract.

B. The Contractor shall engage a licensed New Hampshire water well contractor, familiar with the installation, extension and decommissioning of monitoring wells and the NHDES guidelines and policy regarding this work.

1.02 RELATED REQUIREMENTS

A. Section 02222: Excavation.

1.03 QUALITY ASSURANCE

A. Powdered bentonite and Portland cement shall be of the type appropriate for the work.

B. Monitoring wells shall be designed, installed, and decommissioned in accordance with the practices described in NHDES Groundwater Management and Groundwater Release Detection Permits, Env-Or-610.04.

1.04 SUBMITTALS

A. Manufacturer and specification data on bentonite.

B. Specific work plan, with descriptions of pumping equipment, for use in the specified work.

1.05 INSPECTION ON TESTING

A. All work completed under this section shall be done in the presence of the Engineer.

PART 2 PRODUCTS

2.01 MATERIALS

A. Bentonite shall be of type appropriate for the intended use.

2.02 EQUIPMENT

A. The pumps for the grouting operation shall be specifically suited for the intended use.

PART 3 EXECUTION

3.01 DECOMMISSIONING

Existing monitoring wells and piezometers will be abandoned as follows:

1. Each well will be sounded to determine the total depth of the well prior to abandonment procedures.

2. The well will be sealed by injecting cement/bentonite grout from the bottom of the well to 5.0 feet below ground surface with a tremie pipe. The tremie pipe will be placed near the bottom of the well installation. Continue to pump the grout into the well installation while removing the tremie pipe and any remaining casing. The grout level will be maintained at a depth of 5.0 feet below existing ground surface.

3. The grout will consist of approximately 5 lbs. of granular bentonite mixed with 7.5 gallons of water per bag of Portland cement (94 lbs.) Pumps for grouting operations shall be of the screw-feed or non-piston type, which will deliver an even, continuous flow. The grout will be allowed to set for 48 hours. The abandoned well will be checked for grout settling.

4. The existing cement grout surface seal and protective casing will be removed to a depth of 5.0 feet below ground surface with a hand held pneumatic jack hammer or backhoe powered hoe ram.

5. The remaining borehole annulus will be backfilled with native soils and hand compacted and mounded in a fashion to promote surface drainage away from the abandoned well. Several days after completion of the abandonment procedures, the surface grade will be checked and, if necessary, completed as described above.

3.02 EXTENSION

A. Any monitoring wells requiring extension through soil fill shall be performed without using a solvent seal. The PVC riser shall be extended to 2.8 feet above proposed grade.

B. A protective casing with locking cap shall also be installed from the existing grade to three (3) feet above closure grade. The casing shall be sealed with cement grout below the existing grade to prevent movement during filling operations.

C. The Contractor shall use caution during the filling process, so that the extended well is not disturbed. Any damages to the extended wells shall be repaired at no additional cost to the Owner.

3.03 SHORTENING

A. Depths of any monitoring wells requiring shortening shall be confirmed prior to excavations around the monitoring wells.

Excavation should be performed in a manner which avoids damage to the wells. Any damage to the wells shall be repaired at no additional cost to the Owner.

B. No monitoring well shall be shortened to a height below five feet above the top of the well screen.

C. Excavation shall proceed to remove the existing well to the required grade. The PVC riser shall be cut at an elevation 2.8 feet above final grade.

D. A protective casing with locking cap shall be installed to an elevation three (3) feet above final grade. The casing shall be sealed with cement grout below the final grade to anchor the casing.

END OF SECTION

TECHNICAL SPECIFICATIONS

DIVISION 11
EQUIPMENT

Section No.	***Description***
11312	Leachate Pumps and Controls

SECTION 11312
LEACHATE PUMPS AND CONTROLS

PART 1 GENERAL

1.01 DESCRIPTION

A. Furnish and install leachate sump pumps and related accessories, including:
1. Two (2) Secondary Leachate Sideslope Riser Pumps (one as a spare).
2. One (1) Primary Leachate Sideslope Riser Pump.
3. Level control, flow meters, and appurtenances as shown in the plans and specified herein and as required for a complete operating system.

B. The duplex and simplex control of the pump will be controlled by the pump control panels, to be provided by the Owner and installed by the Contractor.

C. The interior of the leachate pump station building is classified as Class 1, Division 1, Group D environment. All instrument wiring and controls shall be intrinsically safe or rendered intrinsically safe through the use of barrier devices, or shall be rated explosion proof and installed in a manner that preserves that rating.

1.02 QUALITY ASSURANCE

Qualifications of Manufacturers: The pumps shown and specified are based on the products manufactured by EPG Companies, Inc. Catalog numbers and references are given only as an indication of the quality of materials and workmanship to be used. Equal products by other manufacturers, approved by the Engineer and Owner, will be acceptable in accordance with the terms outlined in the Contract Documents.

1.03 QUALITY CONTROL

A. The pumps shall conform to all applicable requirements of NEMA, IEEE, NEC, FM, SWPA and Hydraulic Institute. For purposes of this specification, the revision and/or version of the referenced standards in effect on the date of bid shall apply.

B. The Pumps specified shall be the products of reputable manufacturers who have been regularly engaged in the design, manufacture and furnishing of Water/Wastewater Pumping Equipment for at least ten (10) years. The manufacturer of the pump shall assume full responsibility for the compatibility of all the components of the pump station. The motor and pump shall be manufactured by one company providing sole source responsibility for the warranty of the unit. Manufacturers who do not manufacture the submersible motor and who limit their warranty to that of the motor manufacturer shall not be acceptable. Additionally, the products of third party packagers, assemblers or distributors shall neither be considered equal, nor shall they be acceptable.

C. The flow meters shall be the products of reputable manufacturers who have been regularly engaged in the design, manufacture and furnishing of Water/Wastewater Flow Monitoring Equipment at least ten (10) years

1.04 SUBMITTALS

A. Copies of all materials required to establish compliance with the specifications shall be submitted in accordance with Section 01300. Submittals shall be submitted within thirty (30) days after the award of the Contract and shall include at least the following:

1. Certified shop and erection drawings showing important details of construction, wiring diagrams, and dimensions.

2. Descriptive literature, bulletins and/or catalogs of the equipment.

3. Certified factory test data on the characteristics and performance of the pumps. Data shall include guaranteed performance curves based on actual shop tests of similar units which shows that the pump meets the specified requirements for head, capacity, and horsepower. The curves shall be submitted on an 8-1/2 inches by 11-inch sheet.

4. All data and assumptions used to size and/or select the equipment.

5. The weight of each component.

6. A complete, total bill of materials for all equipment.

7. A list of the manufacturers recommended spare parts with the manufacturer's current price of reach item. Include gaskets and bearings on the list. List bearings by bearing manufacturer's numbers only.

8. Complete description of surface preparation and shop prime painting.

9. Operation and Maintenance Manuals of the equipment and components.

B. In the event that it is impossible to conform to certain details of the specifications due to different manufacturing techniques, describe completely all nonconforming aspects.

1.05 EQUIPMENT FURNISHED BY OTHERS

A. Control panels for the pump station will be furnished by the Owner and installed by the Contractor.

1.06 DESIGN CRITERIA

A. The system shall be complete with submersible pumps, motor controls, electrical wiring and conduits, piping and valves, liquid level sensors, lift out assemblies, and all other necessary appurtenant items.

B. The pumps shall be suitable for installation into a 24-inch diameter HDPE SDR 17 side slope riser pipe on a 3:1 slope with a 24-inch diameter HDPE SDR 17 perforated pipe at the bottom of the sump as shown on the Drawings.

C. The operating condition for the simplex secondary leachate pump at the Stage V pump station shall be 30 gpm at 54 feet TDH with 230 VAC, single phase motor. The pump shall be EPG Series 8 SurePump Model WSDPT 8-2, 0.75 hp, 304 stainless steel construction, with solids handling impeller as manufactured by EPG Companies, or approved equivalent.

D. The operating condition for the simplex primary leachate pump at the Stage IV pump station shall be 105 gpm at 50 feet TDH with 230 VAC, single phase motor. The pump shall be EPG Series 18 SurePump Model WSDPT 18-2, 3.00 hp, 304 stainless steel construction, with solids handling impeller as manufactured by EPG Companies, or approved equivalent.

PART 2 PRODUCTS

2.01 PUMPS AND CARRIAGE SYSTEM

A. The submersible sideslope riser pumps shall be self contained, squirrel cage induction type designed to operate at continuous full load either submerged or non-submerged without the need for any external cooling devices or water jackets. The wheeled sump drainer pumps shall pump down to within 8 inches of the sump bottom without any loss of performance or damage to the pump. External priming or pump down systems shall not be acceptable.

B. The pump bowls, impellers, shaft, guide vanes, housing and filter screen shall be stainless steel.

C. Seals, bushings and diaphragms shall be Viton.

D. The power cables shall be 100 feet in length. The cables shall be furnished with a pigtail 12 inches above the pump, and made from type SO extra hard usage cord from the pigtail to the receptacle with fittings suitable for Class I, Division I, Group D environment. Conductor size shall be as specified on the Drawings.

E. All exposed metal parts of the pump/motor shall be cleaned, primed and finished with the manufacturer's standard paint system.

F. The secondary leachate pump shall be mounted in a stainless steel carriage that is designed for sideslope leachate riser applications. All wheels of the carriage must

remain in contact with the inside diameter of the riser pipe to assure a straight path of travel of the pump to the base of the riser pipe and shall prevent the pump from twisting movement due to the starting torque of the motor. The carriage must provide for easy removal of the pump in the field shall the pump require service. The pump and carriage shall be capable of entry into the riser pipes described above in Part 1.06 B and must be able to travel over welding beads and perforations in the leachate collection riser pipe fabrication as shown in the Drawings.

G. The carriage shall be equipped with a cable lug and connector welded to the outside of the bottom of the carriage. Lug and connector shall not interfere with the movement of the carriage. A 3/16" stainless steel wire rope shall be provided from the lug to the pump station for retrieval of the pump.

H. The leachate pump discharge piping shall be polyethylene meeting the requirements of ASTM D-1428 and ASTM D-2737, 160 psi rating. The discharge piping connectors shall be Buna-N gasket "T" compression style with stainless steel beveled gripper ring and split clamp, sized to match discharge piping and meeting AWWA C-800. A metal insert shall be used inside the end of the discharge pipe.

2.02 PRESSURE GAUGES

A. Pressure gauges shall be 2.5-inch diameter, glycerin filled stainless steel case, satin finish.

B. Window shall be polycarbonate or laminated glass. Dial shall be white with black markings. Accuracy shall be ±1 percent of full scale.

C. Gauge shall be bottom outlet, flush mounted style, with ¼-inch NPT stainless steel connection. Pressure range shall be 0 - 100 pounds per square inch gauge (psig).

D. Provide each pressure gauge with a plug type, isolation valve as indicated on the Drawings to allow removal of the gauge under operating pressure.

2.03 FLOOD SWITCH

A. The flood switch shall be a float activated leak sensor comprised of a stainless steel float suitable for Class I Div I environments.

B. Acceptable Manufacturer: Pneumerator LS600-LDSS

2.4 FLOW SENSOR

A. Flow sensor shall be intrinsically safe, PVC, non-magnetic flow sensors with impeller. Meters shall be provided with a programmable analog transmitter and programming kit to communicate with pump control panel.

B. Acceptable manufacturers: Data Industrial Model 228 PV, or Krohne, Inc.

C. Sensor shall include Viton O-rings, stainless steel shaft, nylon impeller and Teflon bearings.

2.5 LEVEL TRANSMITTERS

A. Level transmitters for leachate sumps shall be submersible piezoresistive pressure sensing type, with Type 316 stainless steel construction, welded stainless steel diaphragm, 24VDC excitation, 2-wire 4-20mA output, and integral sealed signal cable with vent tube.

B. Install aneroid bellows assembly for atmospheric pressure reference in the junction box on the leachate sump side riser pipes, unless otherwise noted. Use manufacturer-supplied vented cable full length to bellows.

C. Level transmitters shall be intrinsically safe. Circuit shall be rendered intrinsically safe by zener barrier (to be provided by OWNER) in the control panel.

D. Acceptable Manufacturer: WIKA Instrument Corporation LS-l0 transducer with Pressure Systems, Inc. Series 815 Aneroid Bellows.

PART 3 EXECUTION

3.01 INSTALLATION

A. The configuration of the pumps, discharge force mains, disconnects, valves, flow meters, control panel and level sensors shall be as shown on the Drawings. The installation of the pumping system shall be completed in accordance with written instructions provided by the manufacturer.

B. All electrical wiring shall be as specified in applicable NEC and NEMA standards.

C. Prior to start up and field testing, all foreign matter shall be removed from the perforated sump pipes, risers and pumps. Any lubricants or other materials used in servicing the system shall be cleaned from al equipment and concrete surfaces.

3.02 TESTING

After installation, a minimum 15-minute field test shall be performed on each pump with clean water. The test shall demonstrate to the satisfaction of the Owner that the equipment meets all specified performance criteria, is properly installed, and operates smoothly without exceeding the full load amperage rating of the motor or excessive motor heating. Additionally, the submersible Sump Drainer Pumps shall operate within the acceptable Field Vibration limits as established by the Hydraulic Institute for this class of equipment.

3.03 WARRANTY

A material and workmanship warranty shall be provided by the Contractor and/or manufacturer for a period of one year from the date of the Owner's final inspection and acceptance of the installed equipment. This warranty shall cover the cost of labor and materials, including removal and reinstallation costs, required to correct any defect.

3.04 FIELD SERVICE

The Contractor shall provide a minimum of two days of field service by an authorized, factory trained representative of the Pump Manufacturer for installation and start up. Services shall include, but not necessarily be limited to, inspection of the completed installation to ensure that it has been performed in accordance with the manufacturer's instructions and recommendation, supervision of all field testing and activation of the Manufacturer's Warranty. A minimum of 1–day of field training of Owners personnel shall also be provided by the manufacturer.

The Contractor shall be responsible for coordinating the required field services with the Pump Manufacturer.

3.05 GENERAL

A. Install components to allow access for maintenance. Care shall be taken in the installation to ensure sufficient space is provided between instruments and other equipment for ease of removal and servicing.

3.06 FLOW SENSORS AND LEVEL SWITCHES

A. All instrumentation shall be installed in accordance with the manufacturer's installation requirements.

B. Flush chips and other debris from pipe before installing flow sensors.

C. Install flow sensors to allow minimum 10 pipe diameters in uninterrupted straight pipe upstream and 5 pipe diameters downstream from any valves or fittings. Verify this requirement has been met prior to installation of the flow meter.

D. Installation hardware shall include all details including special brackets and mounting hardware which may be necessary to properly install the instruments. Brackets and mounting hardware shall be stainless steel.

E. All mechanical fasteners such as bolts, nuts, screws, cinch anchors, clamps, etc. shall be stainless steel, unless otherwise specified.

F. Install level switches in accordance with distances indicated on the Drawings. Switches shall be installed in a manner that does not interfere with unobstructed vertical movement of the float. Switches shall be installed in normally open position, raising of the float shall cause switch closure.

3.07 LEVEL TRANSMITTERS

A. Level transmitters shall be installed in accordance with the manufacturer's installation recommendations.

B. Level transmitters in landfill leachate sumps shall be securely fastened to pump carriage such that transmitter is located beneath the pump and near the discharge end of the pump body when the pump is installed in the sump.

3.08 SIGNAL WIRING

A. All signal wiring shall be installed by the CONTRACTOR's electrical contractor. CONTRACTOR shall provide excavation, bedding and backfill for conduit runs installed by CONTRACTOR's electrician, as shown on the Drawings.

B. Electrical contractor shall make all wiring connections between Control Panels and field instrumentation. Install signal wiring conduit to right hand bottom of Control Panels, power wiring to left-hand bottom.

C. Electrical contractor shall install Class I, Division I sealing glands at conduit penetrations through building wall.

D. Electrical contractor shall install signal wiring from terminal to terminal with no intermediate splicing. Connect signal wire ground to control panel ground.

E. Electrical contractor shall loosely coil, securely cap and tape ends of unused signal wire pairs.

END OF SECTION

TECHNICAL SPECIFICATIONS

DIVISION 13
SPECIAL CONSTRUCTION

Section No.	***Description***
13001	Site Safety and Contingency Work Plan Outline

SECTION 13001
SITE SAFETY AND CONTINGENCY WORK PLAN OUTLINE

PART 1 GENERAL

1.01 DESCRIPTION

A. The North Country Environmental Services landfill site is located off Trudeau Road in the Town of Bethlehem. The existing landfill occupies approximately 36 acres of site. Elsewhere on the site are located the landfill gas and leachate management facilities, and truck scale.

The lined landfill was first permitted by NHDES in 1987 to accept municipal solid waste, construction and demolition debris, asbestos waste, and non-hazardous special wastes including industrial wastes, wastewater sludge, and ash materials. Prior to the lined landfill operation, an unlined landfill was operated at the site. Waste materials from this landfill have been incorporated into the lined landfill, and the unlined area has been constructed over by portions of the lined landfill.

B. The Stage V expansion of the landfill will require excavation and relocation and regrading of waste materials to provide access to existing liner materials, and management of existing leachate generated from the landfill. Air quality degradation, potentially flammable gas, gas emissions, and noxious odors, and nauseating odors may occur during the execution of the Work due to the decomposition of waste. Review of recorded asbestos waste disposal locations has indicated that asbestos wastes are not anticipated to be encountered during the waste excavation and relocation.

C. Facility personnel and commercial haulers will be accessing the operating landfill disposal of solid waste during the expansion construction. The Contractor shall employ practices that ensure health and safety of others. Most of the landfill expansion and waste excavation work is not in the general vicinity of the operating area, however site access roads will be shared by the Contractor and the facility operators and commercial haulers.

D. The purpose of the Site Safety and Contingency Work Plan (SSACWP) outline is to assist the Contractor in assessing specific site hazards which may be encountered, to suggest safety procedures which will reduce personnel exposure to hazardous conditions, and to outline emergency response procedures. The Contractor shall prepare the final SSACWP for Contractor's work. The SSACWP shall be submitted to the Engineer for review and submittal to NHDES within two weeks following Notice of Award and prior to beginning site work. All comments from Engineer and NHDES must be addressed prior to commencing activities that disturb waste. The SSACWP will provide for the identification of

hazardous site conditions and shall provide for discontinuance of the work in the area identified and notice to the Engineer of the location, time, type of waste and action taken.

E. This Contract anticipates that the Work will be performed in Level D personal protective equipment (PPE), supported by health-and-safety monitoring and appropriate response actions.

F. The Contractor shall be fully responsible for liabilities, claims, or damages, which are the result of the Contractor's negligence, willful misconduct or failure to comply with any part of this Contract.

G. The Contractor shall be solely responsible for the safety of employees and subcontractors. The Contractor shall comply with all applicable provisions of National and Local safety laws and building codes to prevent accidents or injury to persons on, about or adjacent to the premises where the work is being performed. The Contractor shall erect and properly maintain at all times, as required by the conditions and progress of the Work, all necessary safeguards and barricades for the protection of employees on the Work and the safety of others employed near the Work and the public, and shall post danger signs and warning lights clearly indicating potential hazards created by features of the construction.

H. The Contractor shall provide the developed SSACWP and shall coordinate safety requirements for all representatives visiting the site, including the Engineer (including resident engineer), the Owner, the NHDES, and all other visitors to the site.

I. The Contractor shall immediately report in writing, giving full details to the Engineer, Contractor shall immediately report the accident by telephone or messenger whether the accident occurs on or adjacent to the site, causes death, serious personal injury or substantial property damage. If a claim is made or suit is filed by anyone against the Contractor or any subcontractor on account of any accident, the Contractor shall promptly report the facts in writing to the Engineer giving full details of the claim.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. The Contractor is required to maintain appropriate health and safety equipment on-site for the use of personnel at times during excavation of waste materials, or when the potential exists for exposure to noxious or hazardous conditions.

B. The Contractor shall maintain at the site, at a minimum, a combustible gas indicator, oxygen meter, and hydrogen sulfide detector for the duration of the work.

C. In addition, the Contractor shall maintain fire extinguishers, first aid kits, eye wash and other related safety equipment on-site for the duration of the Work.

D. All safety equipment shall be inspected periodically by the Contractor and maintained in good working order. The Contractor shall clearly tag and/or remove from the site, any equipment that does not pass the Contractor's inspection, and replace such equipment immediately.

PART 3 EXECUTION

3.01 SITE SAFETY AND CONTINGENCY WORK PLAN - GENERAL

A. The Contractor shall prepare a SSACWP in accordance with 29 CFR 1910.120. The plan will include at a minimum, the following for each phase of the Work: identification of specific site hazards, risk analysis, personal protection program, and an air monitoring plan. In addition, the plan shall include a comprehensive work plan and also outline emergency contacts and response actions. The Contractor's SSACWP shall include the elements described in the SSACWP Required Elements Outline, Part 3.05 of this section.

B. The Contractor's SSACWP shall be prepared by a certified industrial hygienist or a person certified as a safety professional experienced with similar types of projects. The Plan shall include a signed statement from the preparer attesting the adequacy of the Plan.

C. The Contractor shall submit the prepared SSACWP to the Engineer within 2 weeks after Contract award and before initiating any site activities. Any comments provided by the Engineers and NHDES must be addressed prior to commencing work that will disturb waste. The Engineer's review does not relieve the Contractor of responsibilities for SSACWP completeness, accuracy, and implementation.

D. All Work shall be consistent with the applicable provisions of Federal, State, and Local laws, including 29 CFR 1926. The Contractor shall comply with all applicable OSHA requirements.

E. The Contractor shall provide copies of the Contractor's SSACWP to all emergency contacts, including the Engineer, Owner, Local Fire Department, Police Department, NHDES-Waste Management Division and Hospital identified in the Plan. The Contractor shall also provide notification of scheduled SSACWP meetings and provide briefings to the emergency contacts and agencies listed in this section.

3.02 SAFETY PERSONNEL - GENERAL

A. The Contractor's SSACWP shall identify a primary Site Manager who will be available on-site at all times while construction work is in progress. The Site Manager shall be responsible for site activities related to the performance of Work. The Site Manager shall also serve as the Contractor's representative and point of contact for all on-site communications. All communication with the Site Manager shall be considered to be communication with the Contractor. An Alternate Manager shall also be designated to carry out the responsibilities of the primary Site Manager when the primary Site Manager is not available.

B. The Contractor shall designate a site Safety Officer for the duration of the project. The Safety Officer shall be experienced with work similar in nature to this project along with hazardous materials identification and monitoring. The Contractor may designate an alternate Safety Officer having qualifications meeting this section, to carry out the responsibilities of the primary Safety Officer when the primary Safety Officer is unavailable.

C. The Safety Officer shall be trained according to the requirements of CFR 29 1910.130 and shall maintain certification throughout the duration of the project.

D. The Safety Officer shall be present on-site during all on-site activities that may potentially involve hazardous material, including waste excavation, or other intrusive activity.

E. The Safety Officer shall be responsible for the SSACWP implementation.

3.03 ADDITIONAL CONSIDERATIONS FOR SSACWP DEVELOPMENT

Reports on the landfill operation and waste materials received at the facility will be made available to the Contractor. The Contractor is provided the following additional considerations for SSACWP development.

A. Physical Hazards: The Contractor should recognize construction physical hazards. Physical hazards include the following: heavy equipment operation during excavation of solid waste, falling trees during clearing and grubbing, steep and potentially unstable slopes, bulky waste materials, boulders, or other objects which may become dislodged and move downslope during excavations, obscured vision due to dust or other obstructions, sharp objects and unstable footing on waste.

B. Air: Decomposition of MSW organic materials may generate landfill gases such as methane, carbon dioxide and hydrogen sulfide. Landfill gas may migrate through the waste surface at the face of waste excavation. Excavating and regrading waste may also create dust which may contain trace concentrations of metals or organic compounds.

Excavation and relocation of waste is anticipated to result in the release of potentially obnoxious and nauseating odors. The SSACWP shall include provisions in the event of nauseating odors.

C. Leachate: Landfill leachate will also be encountered during the waste excavation work and liner system construction.

E. Storm Water: Storm water runoff may contain residual compounds resulting from contact with wastes in the landfill.

3.04 SITE SAFETY AND CONTINGENCY WORK PLAN REQUIRED ELEMENTS OUTLINE

The requirements for the Contractor's SSACWP shall be as described in the following outline. The order of the Contractor's SSACWP sections may be modified by the Contractor. The Contractor may also include additional sections or provisions as needed or required based on the Contractor's approach to completing the Work. The absence of particular provisions in the outline does not relieve the Contractor of developing appropriate sections or procedures for site work in accordance with applicable OSHA standards. The Contractor shall ensure that all subcontractors engaged to perform work for Contractor either adopt the Contractor's SSACWP provisions or develop a SSACWP consistent with the following outline.

A. Introduction: This section shall describe the Contractor's SSACWP purpose. This section shall describe the health and safety responsibilities of the Contractor and subcontractors in performing the Work. This section shall describe the general OSHA training requirements for personnel involved in site field work.

B. Site Description/History: This section shall briefly describe relevant physical site features including the following: location, size, layout, topography, surface water and ground water. The site history shall briefly describe relevant previous site activities which may assist site workers in understanding the nature of wastes anticipated during construction activities.

C. Project Description and Work Plan: This section shall briefly describe the general tasks to be conducted by Contractor. The project description and work plan section shall include categories of site work such as excavation, grading, liner placement and methane vent pipe installation.

D. Personnel, Responsibilities and Training Requirements: This section shall include the Contractor personnel names, company affiliation, responsibility and whether the individual will be on-site during specific tasks. This section shall name a Site Manager, Alternate Site Manager, Safety Officer, and an Alternate Safety Officer. Contractor's construction foreman, heavy equipment operators and laborers may be listed as "VARIOUS". All site personnel shall read and sign the Contractor's SSACWP. This section should also list Engineer representatives, municipal

emergency response representatives and appropriate regulatory agency officials. The training and medical monitoring requirements specified in 29 CFR 1910.120 for each individual or class of individuals shall be specified in this section. The level of training and medical monitoring per individual shall be appropriate for the tasks assigned.

E. Hazardous Material Summary: This section shall include the general categories of the waste physical and chemical characteristics which may be encountered during site work.

F. Hazards of Concern: This section shall include the applicable general hazards of concern for consideration during site work. Example hazards of concern include the following: heat stress, cold stress, explosive or flammable substances, oxygen deficiency, radiological, biological, noise, toxicity, corrosivity and physical hazards.

G. Overall Hazard Evaluation Per Task: This section shall include a qualitative assignment of risks as high, medium, low or unknown to health and safety resulting from site work per task. This section shall include justification of the PPE level used for each site task based on the qualitative risk designation. Justification for selection of PPE may include: the hazards of anticipated wastes, the nature of the task, and selection of air monitoring procedures and/or frequency to evaluate that the proper level of PPE is maintained.

H. Protective Clothing: This section shall establish the anticipated task-specific levels of PPE (such as A, B, C or D) based on the task-specific hazard evaluation. This section shall include a task-specific description of the levels of PPE including the anticipated respiratory and protective clothing requirements for each task.

I. Environmental Monitoring Equipment and Procedures: This section shall establish the task-specific environmental monitoring equipment and monitoring procedures to be employed during site work. This section shall include the instrument type and the monitoring parameter (for example methane) for each monitoring device employed during site work and a description of calibration procedures to be followed for the instrument. This section shall establish task and instrument specific monitoring frequencies to be employed during site work. This section shall establish the task-specific conditions under which levels of PPE shall be upgraded in response to environmental monitoring.

J. Mitigation of Physical Hazards: This section shall include a description of mitigating procedures for task-specific physical hazards that will be employed during site work. This section may include a description of mitigating procedures for fall prevention, fire and explosion hazards, electrical hazards and heavy equipment operation hazards.

K. Personnel Decontamination Procedures: This section shall establish personnel decontamination procedures for each level of PPE (such as A, B, C or D) anticipated during site work, including personnel and equipment washing and rinsing procedures. This section shall include a description of the on-site storage method to be employed during site work for used disposable and reusable protective clothing pending final off-site or on-site disposal.

L. Equipment Decontamination Procedures: This section shall establish procedures to decontaminate equipment that contacts hazardous material, if applicable.

M. Site Control: This section shall establish procedures to reduce contact of site personnel and equipment with contaminated or potentially contaminated materials, including procedures for reducing site access to non-project personnel or non-essential vehicular traffic.

N. Heat/Cold Stress Monitoring: This section shall establish procedures to monitor site personnel and site weather conditions to control heat and cold stress. Monitoring may include ambient air temperature, cloud cover and site personnel heart rates and oral temperatures.

O. Emergency Procedures: This section shall establish mitigation procedures to be followed for potential emergencies during the Work. Potential emergencies may include personnel chemical exposure through potential exposure pathways, personnel injury, fire or explosion and spills of hazardous or potentially hazardous materials. Mitigation procedures may include assessing personnel exposure pathways and vital signs, rendering appropriate first aid measures, contacting fire and/or ambulance units and spill assessment and containment measures. This section shall also establish emergency evacuation procedures if Work area evacuation is necessary during site work. Emergency evacuation procedures may include evacuation signals, evacuation routes and staging areas for the assembling of evacuated personnel.

P. Emergency Equipment: This section shall designate emergency or safety equipment required on-site during the Work. Emergency equipment may include extra protective clothing, first aid kits, fire extinguishers, portable telephones, air horns, and air purifying respirators with suitable cartridges.

Q. Emergency Contacts: This section shall include a listing all personnel or agencies that require notification during an emergency. The listing should include the contact name and phone number and where the contact can be located. The listing should include the Project Manager or supervisor, the Safety Officer, the Owner, the Engineer, the local fire and police departments, NHDES Waste Management Division, and appropriate State of New Hampshire and federal agencies. The listing should also include medical emergency contact information including the nearest hospital with emergency services with the hospital address and telephone number, the telephone number of the nearest ambulance service

and directions with a map showing the most direct route to the hospital. The Emergency Contact list shall also be posted at the job site trailer.

3.05 RESPONSE PROCEDURES

A. It is anticipated that materials encountered in the landfill will consist of household garbage, some construction/demolition waste, ash materials, and unclassified wastes. However, if potentially hazardous materials are encountered during the progress of the Work, the Contractor shall immediately implement the following:

1) All work in the immediate area will be suspended, and site personnel will be evacuated to a safe zone.
2) All materials suspected of being hazardous shall immediately be reported to the Engineer and Owner.
3) The Contractor's Safety Officer and the Engineer will assess if the material is hazardous by observation, screening, or if necessary, by sampling and analysis by the Contractor.
4) The Contractor shall maintain a log of all incidents related to the discovery of potentially hazardous materials which shall be available to the Owner and Engineer at all times.

B. If the material is assessed to be a hazard, the Contractor will notify the Engineer and Owner. The notification must include the following:

1) The name and telephone number of the person reporting.
2) The landfill location where the material was observed.
3) Identification and approximate quantity of materials discovered.
4) The extent of on-site hazards and personnel injuries, if any.
5) An assessment of hazards to health and safety of on-site personnel, and nearby people, if applicable.
6) Recommendations to control or remove the site hazard.

END OF SECTION

TECHNICAL SPECIFICATIONS

DIVISION 16
ELECTRICAL

Section No.	***Description***
16402	Electrical Work

SECTION 16402
ELECTRICAL WORK

PART 1 GENERAL

1.01 GENERAL

A. Include Conditions of the Contract and applicable parts of Division 1.

B. Examine all other sections of the specifications for requirements which affect the work of this Section, whether or not such requirements are particularly mentioned herein.

C. Coordinate the work of this section with the related work of other trades, and cooperate with such trades to assure the steady progress of all work of this Contract.

D. Where the National Electrical Code appears in this specification, it shall be interpreted to mean the latest edition.

1.02 SCOPE

A. The work covered by this Section consists of furnishing all labor, materials, equipment, supplies, devices, electrical apparatus, stand-by power connections, power service, connections to alarm/control panels, disconnects, and the performance of all operations necessary for the installation and/or modification of electrical facilities in and about the structures and around the grounds, as indicated on the Contract Documents.

B. This work shall include all costs involved in providing secondary power service and distribution and new telephone service and distribution at the facilities and any costs involved with any other special utilities on the project. Without limiting the work required under this specification section, the following is included:

1. Provide new electric power and telephone underground services at Pump Station I and new telephone and data underground distribution from Pump Station I to the locations indicated on the contract drawings.

2. At pump station I provide conduit and wire for high level alarm in leak detection chamber and/or other pit remote from pump station.

3. All conduit and wire for sump pumps, process pumps, level control transducers, float switches, lighting, etc.

4. Provision and installation of meter socket, panel board, motor starters, disconnects, manual transfer switches, switches, lighting, etc.

5. Provision and installation of terminal box for portable stand-by power connection.

6. Provision of all conduits and wires for connection to control panels by EOS Research. Coordinate with vendor and providing Contractor.

7. All other electrical installations required to provide complete, functioning facilities operating as per design and specifications.

8. Obtain all electrical permits, etc. required.

1.03 WORK OF OTHER SECTIONS

A. Refer to other Sections in this specification as appropriate and/or required.

1) The Owner will arrange for the relocation of electrical and telephone utility poles and wiring, and the Contractor and Subcontractor shall coordinate their work with that of the utilities. The Owner will pay the utilities directly for their line relocation work.

1.04 SUBMITTALS

A. Shop Drawings:

1. Within thirty days after award of the Contract, submit shop drawings in accordance with the requirements of the General Conditions and in the manner described therein. Shop drawings shall indicate specifications section and paragraph requiring equipment indicated.

2. Shop drawings are required on all major pieces of equipment in the following list, but not necessarily limited thereto: breakers; motor starters; panel boards; contactors; relays of all types involved; push button stations; pull, junction, and terminal boxes; disconnect switches; lighting fixtures; wiring devices; etc.

B. Samples:

1. Within thirty days after award of the Contract, submit samples of all materials requested by the Engineer. Samples shall be prepared and submitted in accordance with the requirements of General Conditions, all postage and transportation costs being paid by the Contractor submitting same.

C. Record Drawings:

1. In accordance with requirements of the Supplementary General Conditions, the Subcontractor shall furnish and keep on the job at all times one complete set of blackline prints of the electrical work, on which shall be clearly, neatly and accurately noted, promptly as the work progresses, all architectural and electrical changes, revisions, and additions to the work. Wherever work is installed otherwise than as shown on the Contract Drawings, such changes shall be noted.

2. The Subcontractor shall indicate on these prints the daily progress by coloring in the various apparatus and associated appurtenances as they are installed.

3. No approval of requisition for payment for work installed will be given unless supported by record prints as required above.

4. At the conclusion of work, prepare record drawings in accordance with the requirements of the Supplementary General Conditions.

D. Operating Instructions and Maintenance (O&M) Manual:

1. The Subcontractor shall instruct, to the Owner's satisfaction, such persons as the Owner designates in the proper operation and maintenance of systems and their parts.

2. Parties indicated above sign affidavits stating that the above instructions were given by the Electrical Subcontractor.

3. Furnish in accordance with General Conditions operating and maintenance manuals and forward same to the Engineer for transmittal to the Owner.

4. The operating instructions shall be specific for each system and shall include copies of posted specific instructions.

5. For maintenance purposes, provide shop drawings, parts lists, specifications and manufacturer's maintenance bulletins for each piece of equipment. Provide name, address and telephone number of the manufacturer's representative and service company, for each piece of equipment so that service or spare parts can be readily obtained.

E. Manufacturers' Data:

1. Within thirty days of award of Contract, the Subcontractor shall submit for Engineer's approval a complete list of manufacturers' names of all materials and equipment proposed for the project.

2. After approval of the above list, the Subcontractor shall submit for Engineer's approval complete detailed manufacturers' data consisting of bulletins, shop drawings, and parts lists of the materials and equipment to be furnished, as required.

3. Shop drawings and manufacturers' data submitted must bear the Electrical Subcontractor's stamp stating that the shop drawings and data have been checked and meet the plans and specifications before being submitted for Engineer' s approval, or they will not be considered and will be returned for resubmission. If the shop drawings and data show proposed variations from the requirements of the plans and specifications because of standard practice or other reason, specific mention shall be made of such variations in the letter of transmittal.

4. The Electrical Subcontractor shall assume the entire cost and responsibility for any changes in the work, which may be occasioned by approval of materials other than those specified.

5. Errors, omissions, and coordination of shop drawings shall be the sole responsibility of the Subcontractor whether or not the shop drawings are approved.

6. In the event that any specified manufacturer's number has been superseded by a new number since the writing of this specification, the new manufacturer's number shall be immediately submitted to the Engineer for approval. It shall be the responsibility of the Subcontractor to notify the Engineer of any superseded manufacturers' numbers mentioned in these

specifications.

1.05 QUALITY ASSURANCE

A. Applicable Standards, Permits and Codes:

1. The installation shall comply with all laws applying to electrical installations in effect in Bethlehem, New Hampshire, and with regulations of any other governmental body or agency having jurisdiction, including OSHA; with regulations of the National Electrical Code where such regulations do not conflict with those laws, with the regulations of the company involved, with the telephone utility, and with ASHRAE Standard 70, as amended.

2. File all required notices and plans. Obtain and pay for all permits, inspections, licenses, and certificates required for work under this Section.

3. If any portion of the electrical plans or specifications conflict with any laws or ordinances with regard to type of materials, equipment, or fixtures to be used, the Electrical Subcontractor shall bring it to the Engineer's attention at least seven days before submitting the bid. Otherwise the cost of all work necessary to make the installation comply with said laws or ordinances shall be paid by the Electrical Subcontractor and shall become a part of this Contract.

1.06 EXAMINATION OF SITE AND CONTRACT DOCUMENTS

A. Before submitting prices or beginning work, thoroughly examine the site and the Contract Documents.

B. No claim for extra compensation will be recognized if difficulties are encountered which an examination of site conditions and Contract Documents prior to executing the Contract would have revealed.

1.07 DRAWINGS

A. The Subcontractor shall refer to the electrical drawings and civil plans and details for a full comprehension of the extent and detail of the work to be performed. These drawings are intended to be supplementary to the specifications, and any work indicated, mentioned, or implied in either is to be considered as specified by both.

B. All work shown on the drawings is intended to be approximately correct to the scale of the drawings, but figured dimensions and detailed drawings are diagrammatic and are not intended to show every detail of construction or the exact location of equipment. Where building construction makes it advisable or necessary to change the location of equipment, the Subcontractor shall perform such work without cost to the Owner or written request of the Engineer. Any doubt as to the intended location of equipment shall be resolved by the Engineer before proceeding with the installation.

C. The intent is to obtain an electrical installation of all systems, complete in every detail within and about the structures, and with all facilities properly interconnected with power and telephone. The Electrical Subcontractor shall furnish and install all such parts as may be necessary to complete the systems in accordance with the best trade practice and to the satisfaction of the Engineer. Upon completion, the electrical systems and all equipment throughout the structures shall operate properly and adequately and function as intended.

D. In any discrepancy between requirements of any Section, between notes on the drawings, between drawings, between details in the specifications, or between drawings and specifications, that which is in the best interest of the Owner shall apply.

1. Testing by Contractor: Provide equipment and personnel for operating test of electrical system.

2. Changes by Contractor: The Contract Drawings indicate the extent and schematic arrangement of the conduit and wiring systems. If changes from the drawings are deemed necessary by the Contractor, submit details of such changes within 30 days of award of Contract. Make no changes without written authorization of Engineer. Where conduit routings are not indicated, coordinate with Engineer, General Contractor, and other Subcontractors to insure no conflicts result from routings selected.

1.08 ELECTRICAL REFERENCE SYMBOLS

A. Standard symbols have been employed where such will meet the need. These are augmented and modified to illustrate as necessary. The chart on the Contract Drawings is intended to illustrate all symbols and explain the function and installation method of the device represented. When not clear, or where one has been inadvertently omitted, it shall be the responsibility of the Electrical Subcontractor to obtain a ruling on the intent before proceeding with any work.

1.09 TEMPORARY POWER

A. The Contractor or Electrical Subcontractor shall furnish and install temporary feeders of proper capacity power required for construction. Contractor is responsible for providing an adequate source of power at no added cost to Owner. Sufficient outlets shall be installed at convenient locations so that extension cords of not over 50 feet will reach all areas requiring power.

B. The General Contractor and all subcontractors shall furnish their own extension cords and such lamps as may be required for their work, and shall pay for the cost of temporary wiring of construction offices or shanties used by them and any temporary wiring of a special nature for light and power required other than that mentioned above.

C. All temporary wiring shall be completely removed as its use is no longer required. No temporary wiring shall remain at completion of the project.

1.10 GUARANTEE

A. Contractor's guarantee for items furnished covers and includes:

Faulty or inadequate design
Improper installation
Defective workmanship and materials

B. Warranties of Manufacture:

Not less than one year
As specified
As normally supplied if greater than one year

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. All materials, devices, and equipment, unless specifically accepted, shall be new.

2.02 IDENTIFICATIONS

A. All materials shall bear UL labels where such have been established for the particular device.

B. All devices shall show make, type, serial number (where applicable), voltage, amperage, wattage, motor ratings, and all other pertinent data.

C. All wire shall have make, type of insulation, size, and voltage rating clearly marked upon it.

2.03 SLEEVES/JUNCTION BOXES/ANCHORS

A. The Subcontractor shall advise the Contractor of locations for all sleeves, openings, anchors, supports, conduits, and boxes, and shall provide same so that they may be built into the job wherever feasible.

2.04 ACCESS PANELS

A. Furnish, for installation by the General Contractor, all metal access panels required for access to services provided under this Section.

B. Coordinate locations and sizes of all such panels with the Contractor, subject to the Engineer's approval.

2.05 CONDUITS

A. Exterior:

1. Buried conduit may be Schedule 80 PVC where permitted by Code or they shall be PVC coated rigid galvanized steel. Conduits below concrete slabs, and to five feet outside of foundation walls shall be rigid galvanized steel, PVC coated. Where PVC is used, all elbows and/or offsets shall be PVC coated rigid galvanized steel. Only PVC coated rigid galvanized steel shall be used above grade.

B. Exterior Above Grade:

1. PVC coated rigid galvanized steel only. PVC may be utilized at utility poles for risers in accordance with the utility company's standards.

C. Interior:

1. Interior conduits shall be PVC coated rigid galvanized steel or rigid aluminum. Fittings, boxes, and related items for interior work shall be manufactured by Crouse Hinds, Appleton, or approved equal.

2. Minimum size conduit for light and power wiring shall be 1/2”.

D. General:

1. The use of nonmetallic conduit or raceway within a structure or below floor slabs is not permitted.

2. Rigid galvanized conduit shall be manufactured by Youngstown Sheet and Tube Company, Republic Steel, or equivalent.

3. In non-classified locations, liquid-tight flexible metallic conduit shall be used to tie in all motors or similar equipment. Provide minimum 2 ft. diameter loop at all locations. In classified areas, Class 1, Division 1, Group C and D rated flexible conduit with corrosion resistant overall jacket shall be used.

4. PVC conduit shall be Type II by Carlon Products or approved equal and may be used only where Code permitted.

5. PVC coated rigid galvanized conduit shall be approved equal to Rob Roy "Plasti-Bond Red" with 40 mil PVC exterior coating and with urethane (red) interior coating. Where conduit is field cut and threaded, PVC surface is damaged, and/or elsewhere where manufacturer’s instructions/recommendations are to field apply added protection, the Contractor shall provide the coating utilizing the manufacturer’s recommended product.

6. Aluminum conduit may be used on this project.

7. All terminations of conduits shall have smooth, rounded bushings. All conduit 1" and larger shall have insulation which may be integral with the bushing connector, or an insulated bushing may be added.

8. All rigid conduit joints shall be threaded. Do not use any type of clamp on fittings. All plastic joints shall be cemented or heat welded.

9. All bends for telephone/data conduits or ducts shall be 36" minimum radius.

10. Provide expansion joints on all conduits rising from below grade at utility poles and/or any other structure, and at all other locations required by codes/ordinances. In classified areas, provide Class 1, Division 1, Group C and D seal fittings on conduit before expansion fitting and after expansion fitting.

11. Provide seals for all conduits that penetrate barriers between heated and unheated areas in accordance with NEC Article 300.7, A.

2.06 WIRE AND CABLE

A. All cable and wire shall comply with the latest requirements and specifications of the NFPA and/or the Insulated Power Cable Engineers Association (IPCEA) and shall be as manufactured by General Cable, General Electric, Anaconda, Phelps Dodge, or approved equal, unless otherwise specified or indicated.

B. All conductors used in the wiring system shall be soft-drawn copper wire having a conductivity of not less than 98% of that of pure copper, unless otherwise indicated or specified. All conductors shall be stranded. Solid conductors are not acceptable. Aluminum conductors are not permitted.

C. All wire and cable shall be stamped approximately every two feet to indicate voltage, type, temperature rating, UL listing, manufacturers' name, size, etc.

D. All underground conductors shall be installed in conduits. All underground conductors shall enter manholes, building walls, or termination points through a protective galvanized steel conduit sleeve of appropriate size.

E. All cable and wire shall be: 600 volt; installed in approved raceways or conduit; not less than No. 12 AWG (except that No. 14 AWG may be used for control wiring).

F. Insulation for cable and wire shall be as follows*:*

Wet or Moist Locations	XHHW-2
Feeders to Panels, other	XHHW-2

G. All internal wiring to fixtures shall be minimum No. 14 AWG, silicon rubber insulated (150°C) with minimum 300 volt insulation.

H. All branch circuit wiring from panelboards to any outlet on the circuit over 50' but under 100' shall be No. 10 AWG for the first half of the circuit, over 100' but under 175', use No. 8 AWG for the first half, or as otherwise required to provide no greater than 3% voltage drop at the most remote device on the circuit.

I. The following color code shall be used for all conductors. The colors must be fast, fadeless, and capable of withstanding cleaning.

	120/240 Volt (Single Phase)
Phase A	Black
Phase B	Red
Phase C	-
Neutral	White
Bond	Green

J. Multi-conductor control cables shall be approved equal to GE SI-58779, Flame resistant.

K. Multi-conductor shielded cables shall be approved equal to GE SI-58760, #16 AWG, with individual grouping shielded.

L. All circuit wires shall be tagged in cabinets, etc., with 1/16" thick tags securely fastened to the conductors with a heavy type of linen wrap at time wires are pulled in and tested. Circuit numbers shall be indicated on the tags. Tags shall not be removed for any reason.

M. At least 8" loops or ends shall be left at each outlet for the installation of devices or fixtures in the future. All wires in outlet boxes not for the connection to fixtures at that outlet shall be rolled up, connected together, and taped.

N. Wires and cables shall be carefully handled during installation.

O. When a lubricant is necessary for pulling wires, it must be listed by UL and be of such consistency that it will leave no obstruction or tackiness that will prevent pulling out old wires or pulling in new wires or additional wires. No soap flakes or vegetable soaps will be permitted.

P. Conductors shall be continuous from panelboard to outlet and from outlet to outlet. No splices shall be made except within junction or outlet boxes.

Q. Splices and taps in wires No. 8 AWG and larger shall be made with crimp-on type connectors designed for the purpose. All connections between wires at fixtures and boxes shall be made with UL approved 600 volt pressure connectors equal to Ideal "Wire-Nut" or “Wing-Nut” (on lighting or general purpose receptacles and only in dry locations).

R. Type NM, NMC, AC, MC, or similar cables shall not be permitted on this project. All wiring is to be installed in conduit.

S. All conductors and connections shall be free of grounds, shorts and opens.

T. Telephone wiring/cables shall conform to requirements of the local telephone company.

2.07 OUTLET BOXES

A. All boxes shall be held to wood surfaces by wood screws. On metal surfaces, boxes shall be held by metal-to-metal screws or by machine bolts.

B. Any outside boxes or boxes mounted exposed in the structures shall be cast metal type with integral threaded hubs (style similar to Crouse Hinds FS or FD) where not in classified locations. Boxes shall be of the same material as the conduit they are utilized on and those on PVC coated conduit shall be PVC coated to match the conduit. Bell style boxes will not be accepted.

2.08 PULL BOXES AND JUNCTION BOXES (above grade)

A. Pull boxes, cabinet boxes, and junction boxes shall be constructed of code gauge sheet metal to match the conduits involved of not less than the minimum size recommended by the National Electrical Code. Boxes shall be furnished with screw-fastening covers. Where several feeders pass through a common pull box, they shall be tagged to indicate clearly their electrical characteristics, circuit number, and panel designation. Where pull boxes must be used in finished areas, the Engineer shall be consulted for the location, style of cover, and finish of box. The location shall always be as inconspicuous as possible. Where shown on the

drawings, sizes of pull boxes, terminal boxes and junction boxes shall be followed or next larger standard trade size shall be used. Add pull boxes when such are deemed advantageous.

B. Boxes in classified areas shall be Class 1, Division 1, Group C and D labeled and of a material that matches the conduits involved.

2.09 PULLING CABLES

A. All raceways are to be equipped with conductors. Swab all conduit before cable is drawn into them. Any crushed raceways shall be replaced before drawing in cable. Where cable pulling compounds are required, materials specifically intended for that purpose may be utilized.

2.10 DISCONNECTS

A. Where shown on the Drawings, or when NEC required whether or not shown, install disconnect switches appropriate for the application. When serving motors, they shall be motor rated. Those for equipment (if any) outdoors shall be in NEMA 4X SS enclosures, or as otherwise indicated on Contract Drawings.

B. Switches shall be heavy duty, quick make and break type. They may be non-fused by a solid copper bar, silver-plated, heavy duty on motors over 2 HP. For small motors (1/8 HP and less), a toggle switch, motor rated, may be used; otherwise, they shall be approved equal to Square D Type HU (where not in classified areas). Manual starters with overload protection built in are approved when NEC acceptable.

C. Where multiple equipment items are supplied from a common circuit or where otherwise required by code, disconnects shall be fused type.

D. Manual transfer switches shall be NEMA 4X SS enclosed, 2 PDT, padlockable in both the “ON” position and the “OFF” position. Switches shall be UL listed for use on NEC Article 702 “Optional Standby Systems”.

2.11 OVERCURRENT PROTECTION SERVICES

A. Overcurrent protection for motors is to be in the starters. There is to be protection in each phase wire. Overcurrent protection of conductors is by thermal and magnetic molded case circuit breakers in the panelboards. Where combination starters are used, the breaker is to be a motor circuit protector with only magnetic trips. These must be supplied from a branch circuit protected by a thermal and magnetic trip breaker.

2.12 WIRE CONNECTORS AND DEVICES

A. All wire joints shall be made with a pressure squeezed connector such as T & G Stakon and Ideal, or bolted clamp such as made by Dessert. Twist-on type wire nuts are also permitted for general lighting and receptacle circuits in dry locations only. Make up to terminals shall be mechanical squeeze connector. Wherever only a screw connector is available, install a conductor terminal like T & G

Stakon spade or donut and designed for the application and compression set to the conductor.

B. Cover all joints made with non-insulated clamp devices with Scotch brand plastic electrical tape. Type #88 may be used at any joint and shall be used whenever the temperature of joint or the room is below 50°F. In the summer, or when temperature is above 60°F, new type #33 plus may be used. Triple wrap joints, each wrap having a 50% overlay.

2.13 SWITCHES AND PLATES (if any)

A. Switches shall be industrial specification grade, 20 amperes at 120/277 volts, with ivory handle, such as Bryant 4901-I, for SPST applications. For three-way use No. 4903-1, and for four-way use 4904-1. All switches shall have clamp type terminals screw set.

B. Mount all switches vertically, wall-flush, and at a height of 4'-0", surface mounted.

C. All switches must have machine screw held wire and be back wired. Automatic grips will not be permitted. All switches must be classed as heavy duty.

D. All flush plates (if any) are to be smooth-line nylon, one piece construction for all grouped switches, or Mulberry equivalent. On surface boxes they shall match the box style for the device installed.

E. Switches and plates shall be a product of Bryant, General Electric, or Hubbell.

F. Provide Class 1, Division 1, Group C, D enclosed switches in all locations.

2.14 CONVENIENCE AND OTHER OUTLETS AND PLATES

A. Where "GFI" receptacles are indicated on drawings, it is the intent that ground fault protection be provided by individual Class A, 20 Ampere, 120 volt, GFI receptacles for each device shown, equal to Bryant GFR53FT-1.

B. Outdoors and elsewhere as shown, use weatherproof covers conforming to NEC Article 406.8 (B) for use while not attended.

C. Automatic grip set outlets are not permitted.

D. On exposed FS and FD boxes in non-classified areas, use cast feraloy covers matching the box or stainless steel as above, if styled for the box. In corrosive areas, outdoors and in damp locations, use device plate that is weather proof with the attachment plug inserted or removed, in full conformance with NEC Article 406.8 (B), so the load may be plugged in and not attended while in use. Enclosures shall be UL listed and must include a gasket between the hinged cover and mounting/base plate, and between the enclosure and the mounting surface. These devices shall be as manufactured by Tay Mac Corp., Tempe, AZ; 1-888-440-9045.

E. Outlets and plates shall be a product of Bryant, Hubbell, or General Electric.

F. There are not to be any convenience receptacles installed in any classified areas. All buildings and pits are classified as Class 1, Division 1.

2.15 MOTORS

A. These specifications relating to motors and motor control apply to all motors and controls furnished by this section or any other section.

B. Each section supplying motor drive apparatus will be responsible for supplying an electric motor of sufficient size for the duty performed. These shall not be oversized beyond a normal safety factor, except that standard design ratings for next above motor size required will be used. Unless otherwise specified, all motors shall have open frames, Class A insulation and continuous duty classification based on a 40°F ambient temperature of reference.

C. Motor Control: Each motor or group of motors, requiring a single control shall be provided with a suitable controller and devices, which shall perform the functions specified for the respective motors in other sections of these specifications. All controllers shall conform to the adopted standards and recommended practices of the industrial control standards for the National Electrical Manufacturers Association and the standards for industrial control equipment of Underwriters' Laboratories, Inc.

D. All motors utilized with VFD drives shall be premium efficiency, inverter duty rated. All motors shall be in conformity with serving utility efficiency requirements to permit OWNER to obtain rebate.

E. Thermal Overload Protection. Each motor shall be provided with an overload protective device, integral with either the motor or controller. Unless otherwise specified, the protective device shall be of the manually reset type. Manual controllers for motors shall be specifically designed for the purpose, and shall have an HP rating adequate for the motor. Automatic control devices such as thermostats or floats are satisfactory, for direct control provided they are designed for that purpose and have an adequate HP rating.

F. Provide all motor starters. All motors are single phase. Starters shall be NF Disconnect Combination type, Size 1 minimum. Overload relays shall have a N.O. Auxiliary Contact (close on overload trip), for field wiring to alarm system. All starters shall have a 2-N.O. and 2-N.C. auxiliary contacts for Owner’s field wiring. Control voltage shall be 120 Volts AC. Provide control power transformers in all starters for 240 volt motors, with both primary and one secondary lead fused. Start/stop controls shall be outputs from EOS Research control panels. Starters located outdoors shall be NEMA 4X SS enclosed.

2.16 PRIMARY AND SECONDARY SERVICE

A. A new 240/120 volt, single phase, 3 wire service shall be provided underground from the utility to Pump Station I by this SUBCONTRACTOR. A single power feed conduit and a spare conduit shall be installed.

2.17 ELECTRICAL SERVICE AND DISTRIBUTION SYSTEM

A. The Subcontractor shall furnish all labor, materials, etc. necessary for a complete approved electrical service as required by the structure, including inspection and approval by the utility and local inspection departments.

B. The Subcontractor shall notify the utility company in writing, with a copy to the Engineer, no later than ten days after signing construction contracts, as to when the power service will be required.

C. Existing utilities (power, telephone, etc.) are being relocated under a separate purchase order by the Owner with the utilities, and that work is not part of the electrical work under this specification. Any required pole mount transformers are to be provided by the utility and paid for by the Owner.

D. The word “utility” here-in refers to overhead electrical and communication lines.

2.18 UNDERGROUND ELECTRICAL SERVICES

A. Underground service shall comply with all requirements of the National Electrical Code, National Electrical Safety Code, local utility company, and local enforcing authority.

B. Furnish and install secondary lugs on transformer as required.

C. It may be run in PVC coated rigid galvanized conduit (as indicated in item 2.05 Conduits, this specification section) approved for electrical use. Conduit shall be 36" below grade and pitched to drain.

D. Install yellow plastic marking tape 12" above all buried distribution.

2.19 METERING

A. Provide new service entrance/metering on the building. Power company is PSNH, Contractor shall coordinate with PSNH for metering requirements.

2.20 IN GROUND HAND HOLES (if any)

A. Hand holes shall be approved equal to Quazite by Hubbell, H20 highway rated with concrete base below to insure vehicle traffic does not cause hand holes to be deflected downward, or as specified on the plans. Hand holes shall be sized per NEC for the conduits involved. New hand holes are required for the relocated underground telephone and instrumentation/data wiring.

2.21 PANELBOARDS

A. Panelboards shall be provided with main lugs or main breakers and branch circuit breakers, according to the schedule on the Drawings.

B. The general requirements for the panels are shown on the Drawings including mounting and gutters. Mount the panels 6’-6” up to top of roughing cabinets. Gutters shall not be less than 5”. Breaker frame size is shown on the Drawings. Handle ties will not be permitted anywhere. Multi-pole breakers shall have common trip and one handle.

C. All breakers shall be trip-free, suitable for switching, and thermal magnetic. All breakers shall be bolted to bus type secured in place by holding bolt. "Space" means provisions for adding breakers. Breakers or busses shall contain terminations or tappings designed for these attachments. All points of contact between bus and sub-bus shall be of copper full silvered between all contact surfaces. All breakers shall have an interrupting capacity for 22,000 amperes at 240 volts AC (symmetrical RMS amperes).

D. Note that the breakers supplying outdoor receptacles are not the ground fault interrupter type. Design requires GFI receptacles, specifically.

E. Provide a type written tabulation indication fixture outlets, devices, machines, or apparatus served by each breaker and their room location. This shall follow coding on the Drawings with breakers numbered from top to bottom. Mount tabulation inside the door in a frame for the purpose, with a transparent plastic cover.

F. Panelboards shall be NEMA 4X SS with cover-in-cover design if available. Provide Alternate Bid if NEMA 3R is acceptable to Owner.

G. Panelboards provided under this Contract shall be Square D.

2.22 BALANCING OF LOADS

A. The Contractor shall balance all loads between phases in all panels, etc., around the neutral. Neutral conductors shall be the same size as phase conductors unless specifically noted otherwise. No Common neutrals will be permitted.

B. All circuits shall be distributed among the phases so as to restrict any phase load imbalance to less than 10% at any panelboard.

C. After completion of the installation, record under full load conditions, the current flow in each phase feeder. Submit four copies to the Engineer giving name and location of each panel, etc.

D. Circuit members assigned to home runs and devices on the Drawings are for purposes of indicating individual circuits and are intended to correspond with the circuit numbers in the panels. The panelboard directory shall designate each circuit and its associated load. If numbers deviate from the drawings, the as-built drawings shall reflect this.

2.23 TELEPHONE

A. Provide new underground telephone service conduit 3" minimum at pump station site. Provide wiring to EOS research panel at the pump station.

B. Provide telephone surge arrestor on the service.

C. Overhead telephone wiring and its relocations are provided by the telephone utility and paid for by the Owner independent of the work under this bid.

2.24 EMERGENCY LIGHTS, EXIT SIGNS

A. Provide per fixture schedule (if any).

2.25 WIRING OF MECHANICAL AND OTHER EQUIPMENT

A. The Electrical Subcontractor shall wire all power to, providing and installing local disconnects for, all mechanical equipment and equipment by other trades or this section per Contract Drawings. This shall include but not be limited to:

Pumps, level transducers, float switches, etc.

NOTE: Review plans and specifications for all sections providing equipment to be wired to determine special wiring or control requirements to be provided for such under this specification section.

2.26 TRANSFORMERS (if any)

A. NEMA ST20, general purpose, dry-tape, self-cooled, ventilated. Provide transformers in a NEMA 1 enclosure. Transformer shall have 220°C insulation system with a temperature rise not exceeding 115°C under full rated load in a maximum ambient of 40°C. Transformer shall be capable of carrying continuously 115% of the nameplate KVA without exceeding the insulation rating. Transformers shall be TP-1 labeled, copper wound.

2.27 INSTRUMENTATION

A. The subcontractor under this section shall provide all conduit for and provide and install all signal cables for instrumentation provided under all Sections of these specifications, including provision of all required 120 volt power wiring and interconnections of signal cables. Review other Specification Sections for equipment requirements. Float switches, flow meters, transducers, etc. are provided under other specification sections.

2.28 STAND-BY POWER PROVISIONS

A. Provide all conduit, wire and connection/terminal box for stand-by generator connection at pump station #1.

2.29 EOS RESEARCH CONTROL PANELS

A. Coordinate installation of control panels by EOS Research at Pump Station I. Panels and enclosures are provided by EOS and installed by Contractor. Contractor shall install required conduit, cabling and signal wires into the panel enclosure provide by EOS, and leave a pigtail for connection by EOS.

B. Provide all conduits and interconnecting wires between various field devices, telephone services, pump starters, remote push buttons and pilot light(s), etc.

C. Communication lines between EOS Panel at Pump Station I and between EOS Panel at existing Flow Metering Building shall include a network cable and signal wires installed in a 2” conduit and connected to the existing electrical junction

box located to the north of the Stage I Flow Metering Building. Connections to existing communication lines from Flow Metering Building will be made at the junction box to interconnect Pump Station I with the required alarm signals from the existing underground storage tanks.

1. Network cable shall be Belden #9842 *(2 pair). The wire shall be tinned copper, polyethylene insulated, twisted pairs and include an Overall Beldfoil aluminum-polyester shield and 24 AWG stranded tinned copper drain wire, Overall tinned copper braid shield (90% coverage) and a chrome PVC jacket.
2. Communication lines shall be Belden #9556 12-conductor (6-pair) 18 AWG wire with overall Beldfoil shield and drain wire and chrome PVC jacket.

D. Coordinate with EOS as to cable types required for all field instruments.

E. Coordinate with EOS for their connections of the cables to their panels.

F. EOS Research is responsible for any programming, etc. of controls within their panels and for provision of all required outputs and acceptance of all inputs.

2.30 ELECTRIC HEATER

A. Provide, install, wire and connect electric heater in Pump Station #1. Heater shall be approved equal to those noted in the schedule on the Contract Drawings.

2.31 MAIN SERVICE BREAKERS/OVERCURRENT PROTECTIVE UNITS

A. Provide new main service breakers for utility at the pump station.

2.32 DIALERS

Not applicable to this Specification Section.

2.33 NAMEPLATES

Provide nameplates for all items of equipment on all panelboards, controllers, selector switches, starters, safety switches, push-button stations, feeder switches and relay and equipment enclosures.

Nameplates shall be black laminated plastic or bakelite, approximately 3/4" x 2-1/2" x 1/16", with four edges neatly beveled. Lettering shall be engraved, white, with a height of approximately 3/16" x 1/4".

Provide two holes in nameplate and secure to equipment with non-ferrous screws. If adequate space is not available on item to which nameplate is to be affixed nameplate may be installed adjacent to and as close to the item as possible, and in a position where it is readily visible.

Notations on nameplates shall be exactly the same as corresponding notations that appear on the Drawings. Submit proposed engraving list for approval before obtaining.

2.34 EQUIPMENT SUPPORTS

Provide all structural supports required for proper attachment of all equipment. Wall mounted equipment shall be installed to maintain at least 1½" air space between equipment and supporting walls. Groups or arrays of equipment may be mounted on adequately sized stainless steel channels, angles or bars. Prefabricated stainless steel channels equal to those manufactured by Unistrut or Kindorf are acceptable. All fasteners shall be stainless steel.

Equipment suspended from ceilings shall be supported by adjustable threaded stainless steel rods of adequate strength. No hangers may be secured to furred or suspended ceilings or attached to or carried through ductwork.

Supports shall be orientated vertically behind starters, panelboards, and other electrical enclosures.

2.35 DELIVERY, STORAGE AND PROTECTION

A. The Subcontractor shall be responsible for the work and equipment until finally inspected, tested and accepted. Carefully store materials and equipment, that are not immediately installed, after delivery to the site. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing material.

B. Each Subcontractor shall protect work and material of other trades from damage that might be caused by that Subcontractor's work or workers and shall make good a damage thus caused.

PART 3 INSTALLATION

3.01 GENERAL

A. The entire work provided in this specification shall be constructed and finished in every respect in a workmanlike and substantial manner.

B. The Subcontractor shall obtain detailed information from the manufacturer of apparatus as to the proper method of installing and connecting same. The Subcontractor shall also obtain all information from the Contractor and other Subcontractors that may be necessary to facilitate the work and the completion of the whole project.

C. Before installing any of the work, the Subcontractor shall see that it does not interfere with the clearances required for finished columns, pilasters, partitions, walls, and ceilings, as shown on the Contract Drawings and details.

D. Work installed by the Subcontractor which interferes with or modifies the architectural design as shown on the Contract Drawings shall be changed as directed by the Engineer, and all costs incidental to such changes shall be paid by the Subcontractor.

E. In any and all cases of discrepancy in figures, plans or specifications the matter shall be immediately submitted to the Engineer for decision.

3.02 SITE VISITS

A. The Subcontractor will be required to visit the site as the work progresses and to carefully investigate the structural and finished conditions affecting all details of the work, and shall arrange such work required to meet such conditions.

3.03 CUTTING AND PATCHING

A. It is the duty of the Subcontractor to furnish and install all sleeves required in the performance of this Contract and to furnish to the Contractor the size and location of all openings required on the performance of this contract, and it shall be the duty of the Contractor to provide the required openings during construction.

B. If this Subcontractor fails to provide for all sleeves and openings as required in the performance of this Contract, the Subcontractor shall instruct the Contractor, who shall do such cutting, drilling, patching and grouting and so forth necessary for the proper installation of this Subcontractor's work. The Contractor is to charge this Subcontractor for this work and it shall be done at no additional expense to the Owner.

C. Should the Contractor, after having been fully advised by the Subcontractor, fail to arrange for this work, the Subcontractor shall promptly notify the Engineer in writing of such failure. In the event of any disagreement between the Electrical Subcontractor and the Contractor over the foregoing, and in the absence of any written requests or agreements between the two, the decision of the Engineer shall be final.

3.04 ALUMINUM CONDUITS

Aluminum conduits may be installed within the building.

3.05 INTERIOR CONDUIT SYSTEMS

A. Electrical Subcontractor shall coordinate with Engineer as to locations, sizes and number of conduit sleeves to be installed through cast concrete.

B. Exposed runs of conduit shall have supports not more than 6' -0" apart and shall be installed with runs parallel or perpendicular to walls, structural member, or intersections of vertical planes and ceilings with right angle turns consisting of cast metal fittings or symmetrical bends. Conduit bends and offsets shall be avoided where possible, but where necessary, shall be made with an approved hickey or conduit bending machine. Conduit which has been crushed or deformed in any way shall not be installed. Expansion fittings shall be used to provide for expansion joints. Wooden plugs inserted in masonry or concrete shall not be used to secure conduits or boxes. Conduits shall be supported on/by approved types of stainless steel fasteners: wall brackets, ceiling trapeze, straphangers or pipe straps, secured by means of toggle bolts in hollow masonry units, expansion bolts in concrete or brick, machine screws on metal surfaces, and wood screws on wood construction. Provide stainless steel hardware for stainless steel support systems. Conduit shall be installed in such a manner as to insure

against trouble from the collection of condensation, and all runs of conduit shall be so arranged as to be devoid of traps wherever possible. The Contractor shall exercise the necessary precautions to prevent the lodgment of dirt, trash, or plaster in conduits, fittings, or boxes during the course of installation. A run of conduit which has become clogged shall be entirely freed of the accumulation or shall be replaced.

C. In corrosive/damp areas, all clamps, fasteners, etc. shall be stainless steel with stainless steel fasteners. (All areas on this project are considered corrosive/damp.)

D. Conduits shall be securely fastened to all junction boxes, pull boxes, and panelboards with locknuts and bushings, care being taken to establish a firm mechanical and electrical contact between the box and the conduit.

E. Flexible conduit shall be installed only where necessary to overcome vibration at motor connection, and shall be as short as possible between the motor terminal box and the junction box on the branch circuit rigid conduit.

F. All rigid metallic conduit shall utilize threaded fittings.

G. Conduit shall conform to item 2.05, this specification section.

H. Pull boxes, junction boxes and cabinet boxes shall be per item 2.08, this specification section.

3.06 CONDUCTORS

A. A complete system of conductors shall be installed in the raceway system, except where otherwise noted. Conductors shall be continuous from outlet to outlet, and no splices shall be made except within outlet or junction boxes. Compression type connectors properly taped shall be utilized for all splices

3.07 OUTLETS

A. Outlets shall be installed in locations as indicated on the Contract Drawings. The Subcontractor shall study the general construction plans in relation to the spaces surrounding each outlet in order that the work may fit the other work required by these specifications. Where necessary, the Subcontractor shall relocate outlets so that installed fixtures will not interfere with other work or equipment.

3.08 DEVICE PLATES (non-classified areas)

A. Device plates shall be installed on each outlet to suit the device installed therein. Plates shall normally be installed vertically, with an alignment tolerance of 1/16".

3.09 GROUNDING

A. The conduit system and the neutral conductor of the wiring system shall be grounded. The grounded connection between the electric system neutral and the conduit system shall be made at the main electrical service panel. A bare copper conductor sized per NEC shall be installed in non-metallic conduit from the breaker enclosure to 3 driven ground rods ¾” diameter X 10 ft. long, copperweld, spaced in a triangular pattern with rods 10 ft. on center.

B. In addition, the ground electrode conductor shall be connected by a process approved equal to "Cadweld" process to ground rods and also to reinforcing steel in any associated building foundation, to steel columns in any building with a steel frame, and to any metallic waterline (if any). Provide certified test of recognized testing agency that ground resistance does not exceed 25 ohms.

C. Ground wires shall be grouped and bonded to panel boxes, not to system neutrals. The ground terminal or receptacles shall be bonded to outlet boxes with No. 12 AWG bare or green insulated wire, or other suitable means per the National Electrical Code.

D. All electric equipment shall be grounded.

E. Conduit and/or raceway shall not be utilized as the bonding conductor.

3.10 EXPLOSION PROOF REQUIREMENTS

A. Where encountered, equipment shall be Class 1, Division 1, Group C, D rated. Interior of pump station is so rated.

3.11 PULLING CABLES

A Cables shall be installed utilizing pulling equipment designed for the types of wireways or conduits installed. Where lubricating material is required, it shall be a material manufactured for and designated by UL label as suitable for the types of insulation involved on the conductors. Care shall be taken during cable pulling not to cause kinks or sharp bends in the conductors. If insulation on conductors is cut or nicked during pulling, the conductors involved shall be removed and replaced at no added cost to the Owner. During pulling, the maximum strain applied to the conductors shall not exceed 50% of the ultimate strength of the conductors.

3.12 FIELD TESTS

A. As an exception to requirements that may be stated elsewhere in the Contract, the Engineer shall be given 5 working days notice prior to each test.

B. Distribution Conductors 600 Volt Class: Test all 600 volt class conductors to verify that no short circuits or accidental grounds exist. Make tests using an instrument which applies a voltage of approximately 500 volts to provide a direct reading in resistance.

C. Ground Rods: Test ground rods for ground resistance value before any wire is connected. Use a portable ground testing meggar to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground electrode under test. Provide one copy of the meggar manufacturer's directions for use of the ground meggar indicating the method to be used.

D. Test Report:

600 volt cables (identify each cable & test result).

Grounding Electrodes & Systems (identify electrodes and systems, each test).

3.13 EXAMINATION AND APPROVAL OF WORK

A. No work shall be covered before examination and approval by the Engineer and by all inspectors and authorities having jurisdiction. Replace any imperfect or condemned work with work conforming to requirements and satisfactory to the Engineer, without extra cost to the Owner. If work is covered before due inspection and approval, the Subcontractor shall pay all costs of uncovering and reinstating work.

3.14 CLEAN UP AND REPAIR

A. At the completion of the work, the work area shall be left clean. Any damage caused to work of other trades by electrical installation shall be repaired at the expense of the Electrical Subcontractor.

3.15 GUARANTEE

A. Attention is directed to provisions of the General Conditions regarding guarantees and warranties for work under this Contract.

B. Manufacturer shall provide standard guarantees for work under this Section. However, such guarantees shall be in addition to and not in lieu of all other liabilities, which the manufacturer and Subcontractor may have by law or by other provisions of the Contract Documents.

C. All materials, items or equipment and workmanship furnished under this Section shall carry the standard warranty against all defects in material and workmanship for a period of not less than one year from the date of final acceptance of the work. Any fault due to defective or improper material, equipment, workmanship or design which may develop within that period shall be made good, forthwith by and at the expense of the Subcontractor, including all other damage done to areas, materials and other systems resulting from this failure.

D. This Subcontractor shall guarantee that all elements of the systems are of sufficient capacity to meet the specified performance requirements as are set forth herein or as indicated.

E. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the guarantee period, the affected part or parts shall be replaced by the Subcontractor.

F. This Subcontractor shall furnish, before the final payment is made, a written guarantee covering the above requirements.

END OF SECTION

SECTION VIII

CONTRACT DRAWINGS

The attached Contract Drawings entitled, "Stage V Landfill Expansion Construction Drawings" which were prepared by Engineer are incorporated by this reference into this Attachment as fully as if reproduced in their entirety herein.

NORTH COUNTRY ENVIRONMENTAL SERVICES, INC.
STAGE V LANDFILL EXPANSION

Bethlehem, New Hampshire

Construction Drawings

January 2015

Sheet Index

1. Cover Sheet
2. Existing Conditions & Overall Site Plan
3. Proposed Overall Site Plan
4. Existing Conditions, Waste Excavation, & Demolition Plan
5. 2015 Work Plan
6. Proposed Secondary Liner Grading Plan
7. Proposed Primary Drainage Stone Grading Plan
8. Proposed Detention Pond 5 & 6 Grading Plan
9. Erosion Control and Site Layout Plan
10. Landfill Cross Sections
11. Details - Landfill
12. Details - Sump Modification & Construction
13. Details - Riser Modification & Construction
14. Details - Site Work
15. Details - Erosion Control
16. Details - Temporary Environmental Controls

Locus Plan

Prepared By:

CMA ENGINEERS

Prepared For:

north country ENVIRONMENTAL SERVICES

Bethlehem, New Hampshire 03574

Project Location

Plan References:

The horizontal and vertical locations of all underground/buried features including, but not limited to leachate collection pipes, liner location, forcemain, culverts, tanks, sumps, and utilities were obtained from the following plans:

A. "Record Drawings, 1987 Construction Sanco Landfill Expansion, Phase I Construction" prepared for Sanco, Inc. by Kimball Chase Company, Inc. of Portsmouth, New Hampshire dated March 25, 1988. (Stage I Phase I)

B. "Record Drawings 1988/1989 Construction" prepared for Consumat Sanco, Inc. by Goldberg-Zoino & Associates, Inc. dated March 1990. (Stage I Phase II and Stage I Phase III)

C. "Phase IV – Record Drawings" prepared for Consumat Sanco, Inc. by Goldberg-Zoino & Associates, Inc. dated January 1993. (Stage I Phase IV)

D. "Stage II Phase II Record Drawings" prepared for North Country Environmental Services, Inc. by Sanborn, Head & Associates of Concord, New Hampshire dated March 1999. (Stage II Phase II)

E. "Stage III Construction Record Drawings" prepared for North Country Environmental Services, Inc. by Sanborn, Head & Associates of Concord, New Hampshire dated December 2000. (Stage III)

F. "Record Drawings, Stage III Gas System Modifications" prepared for North Country Environmental Services, Inc. by Sanborn, Head & Associates of Concord, New Hampshire dated July 2005.

G. "Stage IV Phase I Construction Drawings" prepared for North Country Environmental Services, Inc. by Sanborn, Head & Associates, Inc. of Concord, New Hampshire dated July 2005 and revised April 2006. (Stage IV Phase I)

H. "Interim Stage IV Phase I Construction Record Drawings" prepared for North Country Environmental Services, Inc. by Sanborn, Head & Associates of Concord, New Hampshire dated August 2006. (Stage IV Phase I)

I. "2007 Landfill Gas Improvements Record Drawings" prepared for North Country Environmental Services, Inc. by CMA Engineers, Inc. of Portsmouth, New Hampshire dated April 2008.

J. "Stage IV Phase I Overlay Liner Construction Record Drawings" prepared for North Country Environmental Services, Inc. by CMA Engineers, Inc. of Portsmouth, New Hampshire dated August 2008.

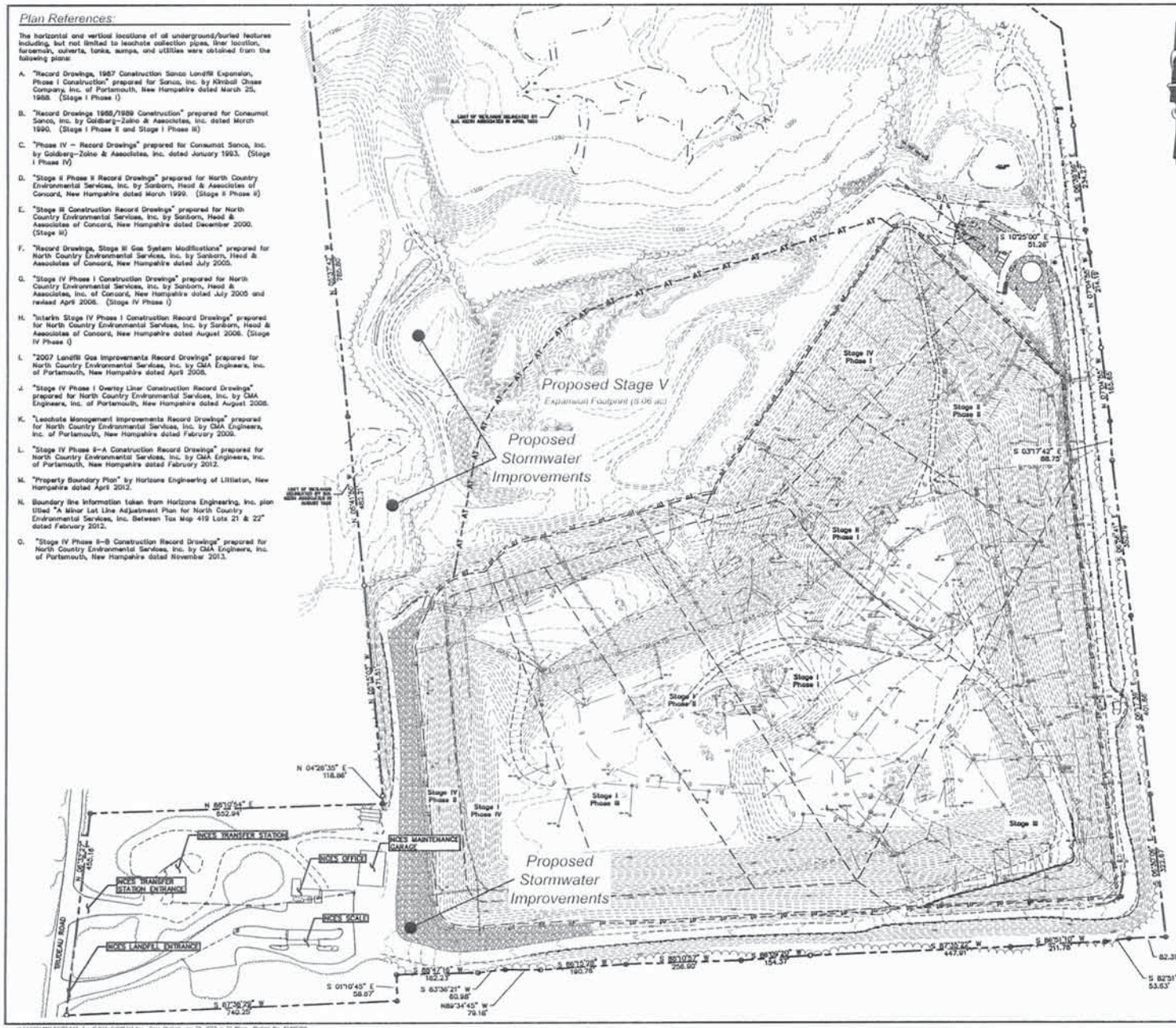
K. "Leachate Management Improvements Record Drawings" prepared for North Country Environmental Services, Inc. by CMA Engineers, Inc. of Portsmouth, New Hampshire dated February 2009.

L. "Stage IV Phase II-A Construction Record Drawings" prepared for North Country Environmental Services, Inc. by CMA Engineers, Inc. of Portsmouth, New Hampshire dated February 2012.

M. "Property Boundary Plan" by Horizons Engineering of Littleton, New Hampshire dated April 2012.

N. Boundary line information taken from Horizons Engineering, Inc. plan titled "A Minor Lot Line Adjustment Plan for North Country Environmental Services, Inc. Between Tax Map 419 Lots 21 & 22" dated February 2012.

O. "Stage IV Phase II-B Construction Record Drawings" prepared for North Country Environmental Services, Inc. by CMA Engineers, Inc. of Portsmouth, New Hampshire dated November 2013.



Notes:

1. This facility is an active landfill. Grades within the landfill footprint will change as filling progresses. The footprint of proposed Stage V is located in the vicinity of the common borrow pit containing virgin and stockpiled materials. Grades within the common borrow pit will change due to material use and stockpiles will be relocated prior to landfill construction. Proposed grades outside the proposed anchor trench will change based on topography at time of construction.

2. Existing topography shown within the treeline is developed from the August 19, 2014 aerial photogrammetry performed by Eastern Topographics. Topography north of the treeline is taken from the Stage IV Design Drawings prepared by SHA and dated March 2002. Existing topography shown in the area of Proposed Detention Pond 6 is approximate and based on Sheet 1A of the Record Drawings for Stage I of the landfill prepared by Sanborn, Head and Associates, Inc. dated December 1998 (Revised November 1999).

3. Existing limit of wetlands were delineated by B.H Keith Associates in August 1995 and April 1999.

4. Proposed features on this plan are for reference purposes only. See following sheets for additional detail.

Legend:

- Existing 2' Contour
- Existing 10' Contour
- Existing Property Line
- Existing Tree Line
- Existing Limit of Wetland
- Existing Edge of Gravel
- Existing Retaining Wall
- Existing Edge of Pond
- Existing Primary Leachate Pipe
- Existing Secondary Leachate Pipe
- Existing Leachate Force Main
- Existing Overhead Electric
- Existing Monitoring Well
- Existing Secondary Leachate Collection System Manhole/Pump Station
- Existing Primary Leachate Collection System Manhole/Pump Station
- Existing Leak Detection Manhole
- Existing Valves
- Existing Gas Probe
- Existing Soil Vapor Probe
- Existing Gas Extraction Well and Wellhead
- Existing Gas Vent
- Existing Gas Line
- Existing Underground Electric
- Existing Fence
- Existing Anchor Trench
- Existing Limit of Waste
- Proposed Anchor Trench

JAN 2015	ISSUED FOR PERMITTING	RJT
	Revised per NHDES Tech Mtg. 10/28/2015	SJH

CMA ENGINEERS
CIVIL ENVIRONMENTAL ENGINEERS

DESIGNED: RJT
DRAWN: EKL/LJS
CHECKED: RJT
DATE: JAN 2015
PROJECT: 833
SCALE: 1" = 100'

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Existing Conditions & Overall Site Plan

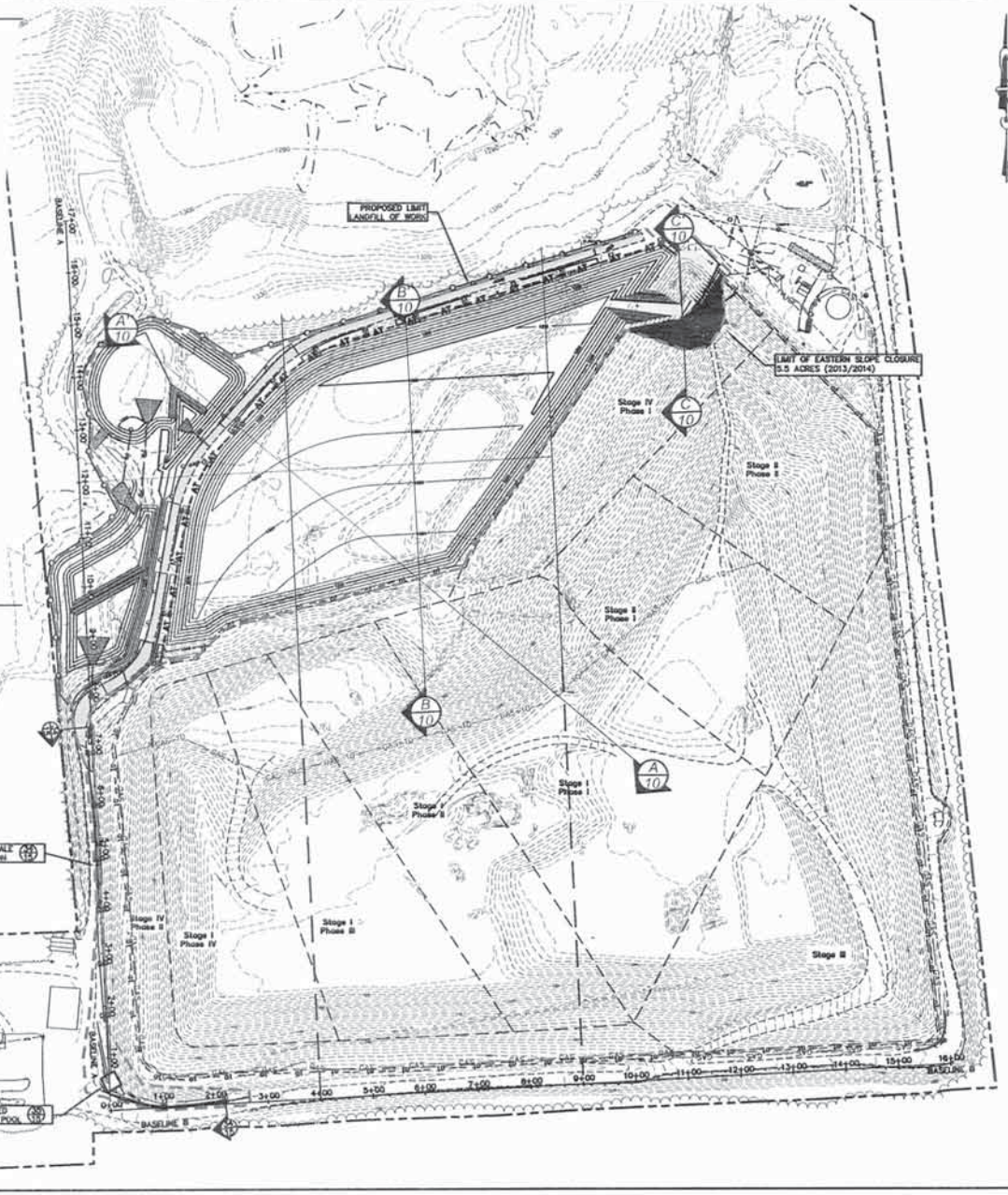
DRAWING 2

2015 Construction Sequence Notes

1. Establish vertical and horizontal control.
2. Install and maintain sedimentation and erosion controls as specified and as shown on Sheet 9.
3. Install new gas header condensate loop over Stage VI Phase I (See Sheet 4).
4. Decommission existing monitoring wells, gas header pipe, culverts and overhead electric per specifications.
5. Clear and grub and remove existing topsoil from limits of work to area designated by owner.
7. Install temporary forcemain as depicted on Sheet 4.
8. Complete excavation to proposed Stage V subgrade elevation and stockpile excavated soils at location determined by Owner (not more than 1 mile one-way). Construct silt fence perimeter around stockpiles.
9. Excavate and relocate waste (area designated by owner not more than 1 mile one-way) in Stage IV Phase I to access Stage IV Phase I sump area.
10. Construct secondary stormwater containment wall after primary liner demo in waste excavation area (weld flap to existing Stage IV Phase I liner.
11. Construct perimeter berm.
12. Construct stormwater improvements including Detention Ponds 5 and 6, expansion of the western swale and plunge pool.
13. Construct gas header modifications in waste relocation area and install temporary LFG collectors and temporary gas collection tarp.
14. Install 12" screened till layer to the limit shown on Sheet 5.
15. Install GCL layer where secondary leachate piping is to be installed (base areas only) and in sump area.
16. Install 60-mil HDPE secondary liner to the limit shown on Sheet 5 and weld to existing Stage IV secondary liner.
17. Install secondary drainage geocomposite layer to limit of secondary stormwater containment wall and the limit shown on Sheet 5.
18. Install secondary leachate piping to the limit shown on Sheet 5 – including second layer of drainage geocomposite, secondary pump station manhole and tie in secondary forcemain to Stage IV Phase I Side Riser Building.
19. Install 3/4" stone and gravel layers over secondary leachate piping.
20. Install 12" drainage sand layer to limit of secondary stormwater containment wall and the limit shown on Sheet 5.
21. Install GCL layer where primary leachate piping is to be installed (base areas only).
22. Install 60-mil HDPE primary liner to limit of secondary stormwater containment wall and the limit shown on Sheet 5.
23. Remove secondary stormwater containment wall and connect Stage V secondary drainage geocomposite to Stage IV Phase I secondary drainage geocomposite.
24. Construct primary stormwater containment wall.
25. Weld Stage V primary liner to Stage IV primary liner.
26. Install primary drainage geocomposite to limit of primary stormwater containment wall and the limit shown on Sheet 5.
27. Install phase separation berm.
28. Install sump in northeast corner of Phase II cell to pump accumulated stormwater.
29. Install primary leachate piping, including second layer of drainage geocomposite, to the limit shown on Sheet 5 and connect Stage V leachate collection pipe to Stage IV Phase I sump riser.
30. Install 3/4" stone over primary leachate piping.
29 Install 3" HDPE forcemain, 14" HDPE gas header pipe, condensate trap, valve and riser to Phase I Project limit. Provide end caps for future Phase II tie in.
30. Install 18" stone layer over primary drainage geocomposite to the limit shown on Sheet 5.
31. Loam and seed disturbed areas outside of anchor trench.
32. Site cleanup and demobilization.

2016 Construction Sequence Notes

1. Establish vertical and horizontal control.
2. Install and maintain sedimentation and erosion controls as specified and as shown on Sheet 9.
3. Pump any accumulated stormwater from the Stage V excavation area and discharge to existing sediment forebay of Detention Ponds 4, 5 or 6.
4. Inspect 2015 construction work and make repairs as necessary.
5. Demolish existing Geokon Unit.
6. Install 12" screened till layer.
7. Install GCL layer where secondary leachate piping is to be installed (base areas only).
8. Install 60-mil HDPE secondary liner and weld to existing Stage IV secondary liner.
9. Install secondary drainage geocomposite layer
10. Install secondary leachate piping including second layer of drainage geocomposite.
11. Install 3/4" stone and gravel layers over secondary leachate piping.
12. Install 12" drainage sand layer.
13. Install GCL layer where primary leachate piping is to be installed (base areas only).
14. Install 60-mil HDPE primary liner and weld to existing Phase IV primary liner.
15. Install primary drainage geocomposite and tie into existing Stage IV drainage geocomposite.
18. Install primary leachate piping.
17. Install perimeter 3" leachate forcemain and 14" HDPE LFG header pipe, condensate trap, valves and risers.
18. Demolish existing leachate forcemain and associated structures.
19. Install 18" stone layer over primary drainage geocomposite.
20. Loam and seed disturbed areas.
21. Site cleanup and demobilization.



Notes:

1. Existing topography shown within the treeline is developed from the August 19, 2014 aerial photogrammetry performed by Eastern Topographics. The topography has been modified to depict approximate post-stockpile surface grades on this plan. Topography north of the treeline is taken from the Stage IV Design Drawings prepared by SHA and dated March 2002. Existing topography shown in the area of Proposed Detention Pond 5 is approximate and based on Sheet 1A of the Record Drawings for Stage I of the landfill prepared by Sanborn, Head and Associates, Inc. dated December 1988 (Revised November 1989).
2. Existing limit of wetlands were delineated by B.H Keith Associates in August 1995 and April 1999.
3. Proposed features on this plan are for reference purposes only. See following sheets for additional detail.
4. Proposed topography shown within the proposed Stage V landfill expansion on this plan are top of secondary liner.
5. Construction baselines and section alignments shown on this sheet are used for landfill cross sections on Sheet 10.

Legend:

- Existing 2' Contour
- Existing 10' Contour
- Existing Property Line
- Existing Tree Line
- Existing Limit of Wetland
- Existing Guardrail
- Existing Edge of Gravel
- Existing Retaining Wall
- Existing Edge of Pond
- Existing Primary Leachate Pipe
- Existing Secondary Leachate Pipe
- Existing Leachate Force Main
- Existing Overhead Electric
- Existing Monitoring Well
- Existing Secondary Leachate Collection System Manhole/Pump Station
- Existing Primary Leachate Collection System Manhole/Pump Station
- Existing Leak Detection Manhole
- Existing Valves
- Existing Gas Probe
- Existing Soil Vapor Probe
- Existing Gas Extraction Well and Wellhead
- Existing Gas Vent
- Existing Gas Line
- Existing Underground Electric
- Existing Fence
- Existing Anchor Trench
- Existing Limit of Waste
- Proposed Anchor Trench
- Proposed Limit of Work
- Proposed 10' Contour
- Proposed 2' Contour
- Proposed Gravel Road
- Proposed Drainage Pipe
- Proposed Waste Excavation
- Proposed Silt Fence
- Proposed Stone Check Dam

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North Country Environmental Services
Bethlehem, NH
Stage V Landfill Expansion
Construction Drawings
Proposed Overall Site Plan

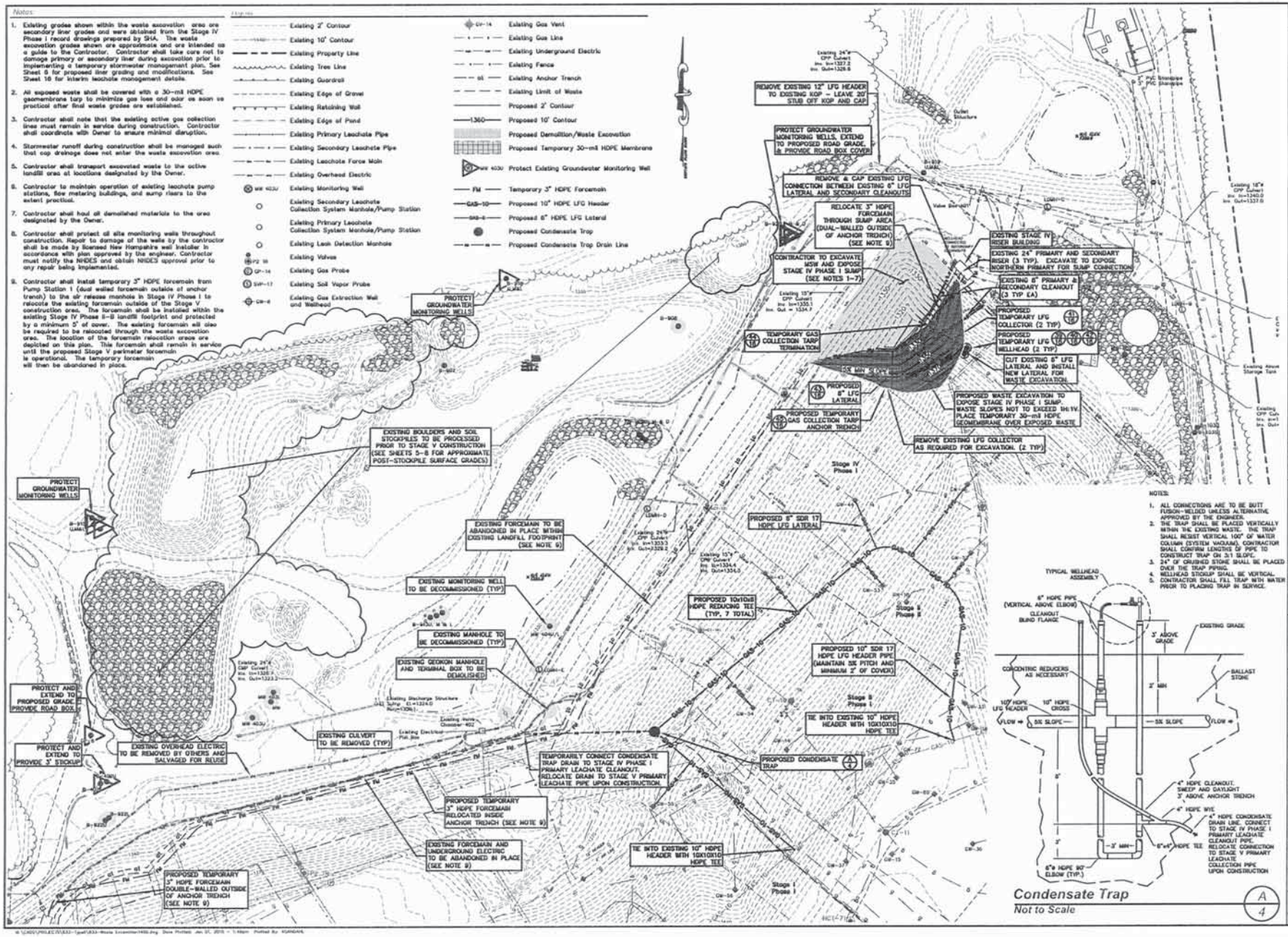
Drawing No. 3

Notes:

1. Existing grades shown within the waste excavation area are secondary liner grades and were obtained from the Stage IV Phase I record drawings prepared by SHA. The waste excavation grades shown are approximate and are intended as a guide to the Contractor. Contractor shall take care not to damage primary or secondary liner during excavation prior to implementing a temporary stormwater management plan. See Sheet 6 for proposed liner grading and modifications. See Sheet 16 for interim leachate management details.
2. All exposed waste shall be covered with a 30-mil HDPE geomembrane tarp to minimize gas loss and odor as soon as practical after final waste grades are established.
3. Contractor shall note that the existing active gas collection lines must remain in service during construction. Contractor shall coordinate with Owner to ensure minimal disruption.
4. Stormwater runoff during construction shall be managed such that cap drainage does not enter the waste excavation area.
5. Contractor shall transport excavated waste to the active landfill area at locations designated by the Owner.
6. Contractor to maintain operation of existing leachate pump stations, flow metering buildings, and sump risers to the extent practical.
7. Contractor shall haul all demolished materials to the area designated by the Owner.
8. Contractor shall protect all site monitoring wells throughout construction. Repair to damage of the wells by the contractor shall be made by licensed New Hampshire well installer in accordance with plan approved by the engineer. Contractor must notify the NHDES and obtain NHDES approval prior to any repair being implemented.
9. Contractor shall install temporary 3" HDPE forcemain from Pump Station 1 (dual walled forcemain outside of anchor trench) to the air release manhole in Stage IV Phase I to relocate the existing forcemain outside of the Stage V construction area. The forcemain shall be installed within the existing Stage IV Phase II-B landfill footprint and protected by a minimum 5' of cover. The existing forcemain will also be required to be relocated through the waste excavation area. The location of the forcemain relocation areas are depicted on this plan. This forcemain shall remain in service until the proposed Stage V perimeter forcemain is operational. The temporary forcemain will then be abandoned in place.

Legend

- Existing 2' Contour
- Existing 10' Contour
- Existing Property Line
- Existing Tree Line
- Existing Guardrail
- Existing Edge of Gravel
- Existing Retaining Wall
- Existing Edge of Pond
- Existing Primary Leachate Pipe
- Existing Secondary Leachate Pipe
- Existing Leachate Force Main
- Existing Overhead Electric
- Existing Monitoring Well
- Existing Secondary Leachate Collection System Manhole/Pump Station
- Existing Primary Leachate Collection System Manhole/Pump Station
- Existing Leak Detection Manhole
- Existing Valves
- Existing Gas Probe
- Existing Soil Vapor Probe
- Existing Gas Extraction Well and Wellhead
- Existing Gas Vent
- Existing Gas Line
- Existing Underground Electric
- Existing Fence
- Existing Anchor Trench
- Existing Limit of Waste
- Proposed 2' Contour
- Proposed 10' Contour
- Proposed Demolition/Waste Excavation
- Proposed Temporary 30-mil HDPE Membrane
- Protect Existing Groundwater Monitoring Well
- Temporary 3" HDPE Forcemain
- Proposed 10" HDPE LFG Header
- Proposed 6" HDPE LFG Lateral
- Proposed Condensate Trap
- Proposed Condensate Trap Drain Line



NOTES:

1. ALL CONNECTIONS ARE TO BE BUTT FUSION-WELDED UNLESS ALTERNATIVE APPROVED BY THE ENGINEER.
2. THE TRAP SHALL BE PLACED VERTICALLY WITHIN THE EXISTING WASTE. THE TRAP SHALL RESIST VERTICAL 100" OF WATER COLUMN (SYSTEM VACUUM). CONTRACTOR SHALL CONFIRM LENGTHS OF PIPE TO CONSTRUCT TRAP ON 3:1 SLOPE.
3. 24" OF CRUSHED STONE SHALL BE PLACED OVER THE TRAP PIPING.
4. WELLHEAD STICKUP SHALL BE VERTICAL.
5. CONTRACTOR SHALL FILL TRAP WITH WATER PRIOR TO PLACING TRAP IN SERVICE.

Condensate Trap
Not to Scale

A
4

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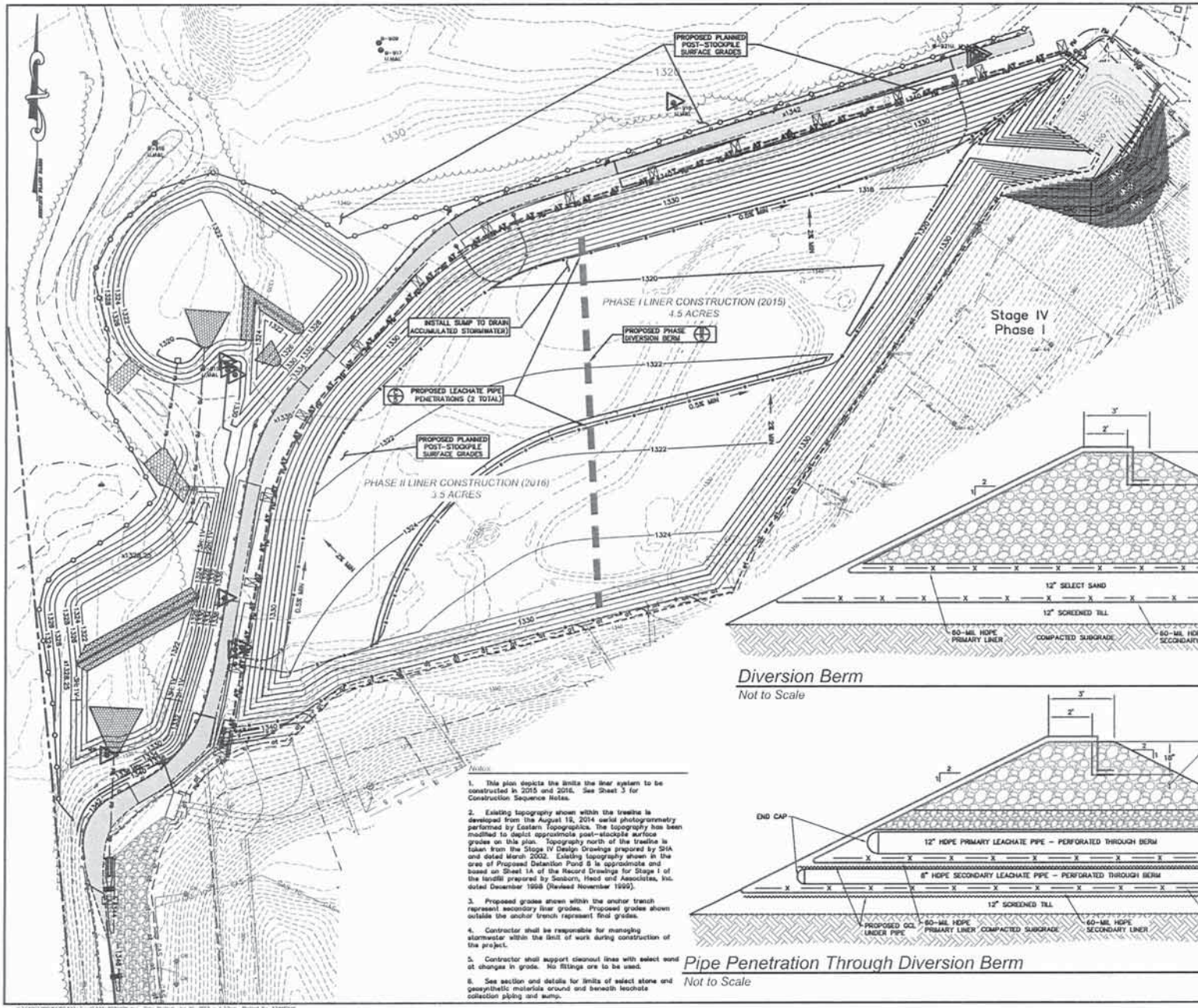
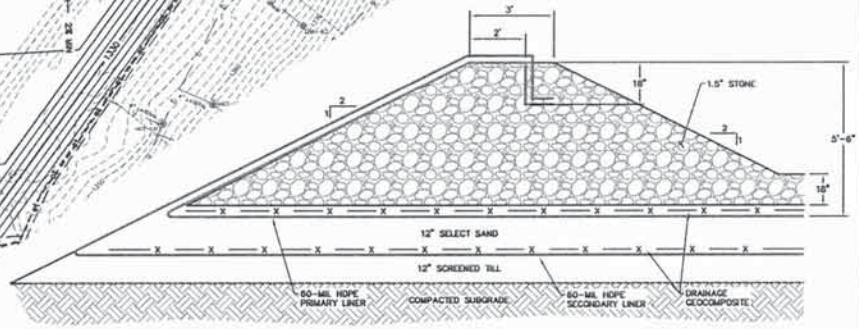
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Existing Conditions, Waste Excavation & Demolition Plan

4

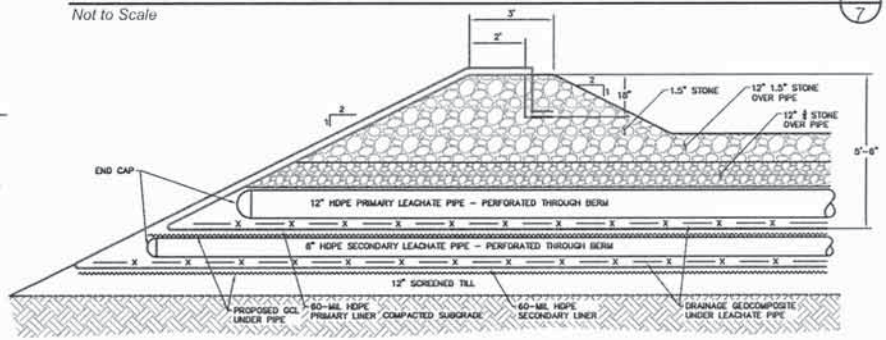




Diversion Berm

Not to Scale

B/7



Pipe Penetration Through Diversion Berm

Not to Scale

C/7

Notes:

1. This plan depicts the limits the liner system to be constructed in 2015 and 2016. See Sheet 3 for Construction Sequence Notes.

2. Existing topography shown within the treeline is developed from the August 19, 2014 aerial photogrammetry performed by Eastern Topographics. The topography has been modified to depict approximate post-stockpile surface grades on this plan. Topography north of the treeline is taken from the Stage IV Design Drawings prepared by SHA and dated March 2002. Existing topography shown in the area of Proposed Detention Pond 5 is approximate and based on Sheet 1A of the Record Drawings for Stage I of the landfill prepared by Sanborn, Head and Associates, Inc. dated December 1998 (Revised November 1999).

3. Proposed grades shown within the anchor trench represent secondary liner grades. Proposed grades shown outside the anchor trench represent final grades.

4. Contractor shall be responsible for managing stormwater within the limit of work during construction of the project.

5. Contractor shall support cleanout lines with select sand at changes in grade. No fittings are to be used.

6. See section and details for limits of select stone and geosynthetic materials around and beneath leachate collection piping and sump.

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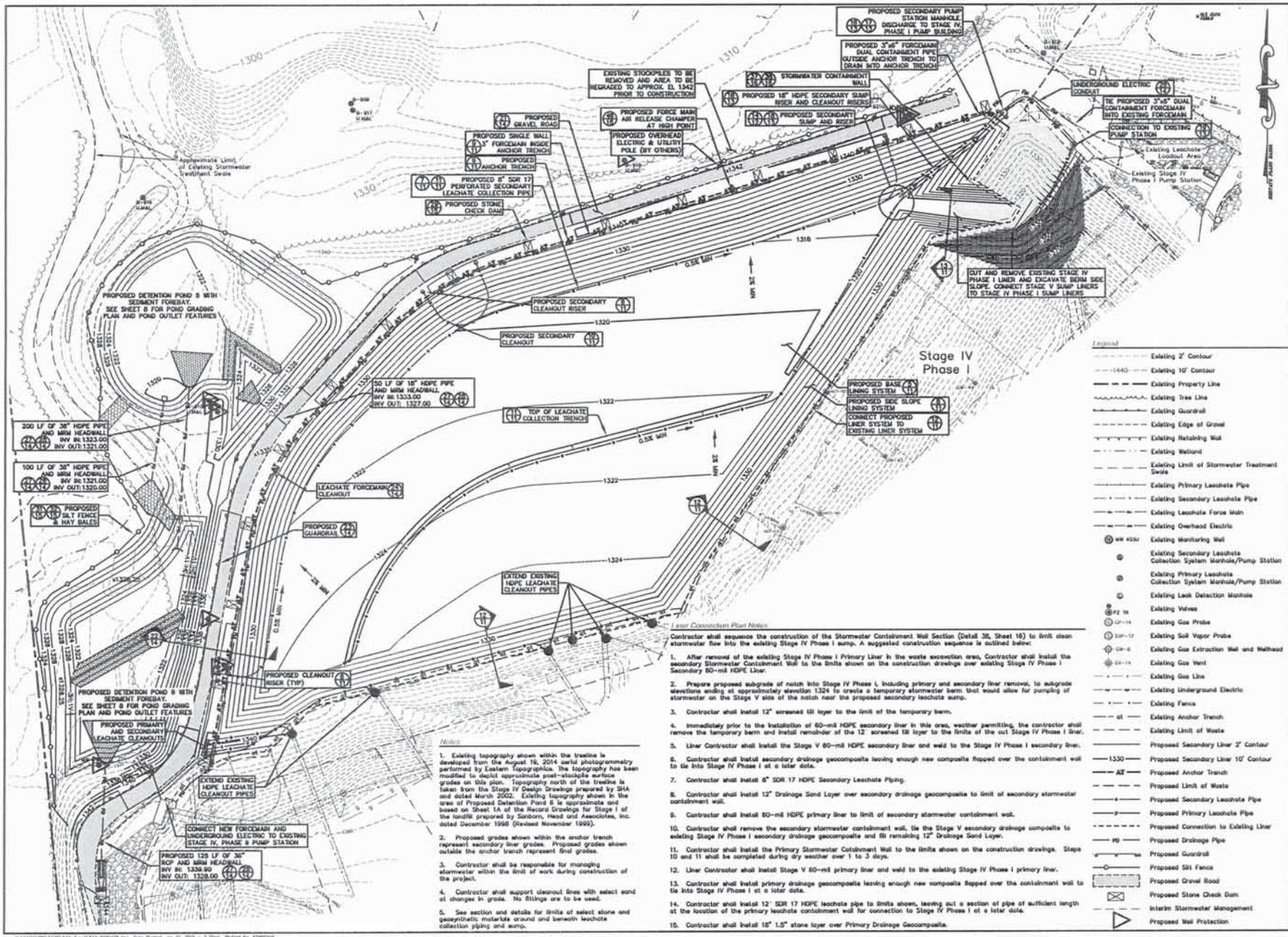
Stage V Landfill Expansion
Construction Drawings
2015 Work Plan

drawing no.
5



Notes

1. Existing topography shown within the treeline is developed from the August 19, 2014 aerial photogrammetry performed by Eastern Topographics. The topography has been modified to depict approximate post-stockpile surface grades on this plan. Topography north of the treeline is taken from the Stage IV Design Drawings prepared by SHA and dated March 2002. Existing topography shown in the area of Proposed Detention Pond 6 is approximate and based on Sheet 1A of the Record Drawings for Stage I of the landfill prepared by Sanborn, Head and Associates, Inc. dated December 1998 (Revised November 1999).

2. Proposed grades shown within the anchor trench represent secondary liner grades. Proposed grades shown outside the anchor trench represent final grades.

3. Contractor shall be responsible for managing stormwater within the limit of work during construction of the project.

4. Contractor shall support cleanout lines with select sand at changes in grade. No fittings are to be used.

5. See section and details for limits of select stone and geosynthetic materials around and beneath leachate collection piping and sump.

Liner Connection Plan Notes

Contractor shall sequence the construction of the Stormwater Containment Wall Section (Detail 3B, Sheet 16) to limit clean stormwater flow into the existing Stage IV Phase I sump. A suggested construction sequence is outlined below:

1. After removal of the existing Stage IV Phase I Primary Liner in the waste excavation area, Contractor shall install the secondary Stormwater Containment Wall to the limits shown on the construction drawings over existing Stage IV Phase I Secondary 60-mil HDPE Liner.

2. Prepare proposed subgrade of notch into Stage IV Phase I, including primary and secondary liner removal, to subgrade elevations ending at approximately elevation 1324 to create a temporary stormwater berm that would allow for pumping of stormwater on the Stage V side of the notch near the proposed secondary leachate sump.

3. Contractor shall install 12" screened till layer to the limit of the temporary berm.

4. Immediately prior to the installation of 60-mil HDPE secondary liner in this area, weather permitting, the contractor shall remove the temporary berm and install remainder of the 12" screened till layer to the limits of the cut Stage IV Phase I liner.

5. Liner Contractor shall install the Stage V 60-mil HDPE secondary liner and weld to the Stage IV Phase I secondary liner.

6. Contractor shall install secondary drainage geocomposite leaving enough new composite flapped over the containment wall to tie into Stage IV Phase I at a later date.

7. Contractor shall install 6" SDR 17 HDPE Secondary Leachate Piping.

8. Contractor shall install 12" Drainage Sand Layer over secondary drainage geocomposite to limit of secondary stormwater containment wall.

9. Contractor shall install 60-mil HDPE primary liner to limit of secondary stormwater containment wall.

10. Contractor shall remove the secondary stormwater containment wall, tie the Stage V secondary drainage composite to existing Stage IV Phase I secondary drainage geocomposite and fill remaining 12" Drainage Sand Layer.

11. Contractor shall install the Primary Stormwater Containment Wall to the limits shown on the construction drawings. Steps 10 and 11 shall be completed during dry weather over 1 to 3 days.

12. Liner Contractor shall install Stage V 60-mil primary liner and weld to the existing Stage IV Phase I primary liner.

13. Contractor shall install primary drainage geocomposite leaving enough new composite flapped over the containment wall to tie into Stage IV Phase I at a later date.

14. Contractor shall install 12" SDR 17 HDPE leachate pipe to limits shown, leaving out a section of pipe of sufficient length at the location of the primary leachate containment wall for connection to Stage IV Phase I at a later date.

15. Contractor shall install 18" 1.5" stone layer over Primary Drainage Geocomposite.

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Stage V Landfill Expansion
Construction Drawings

Proposed Secondary Liner Grading Plan

Drawing No. 6

Notes

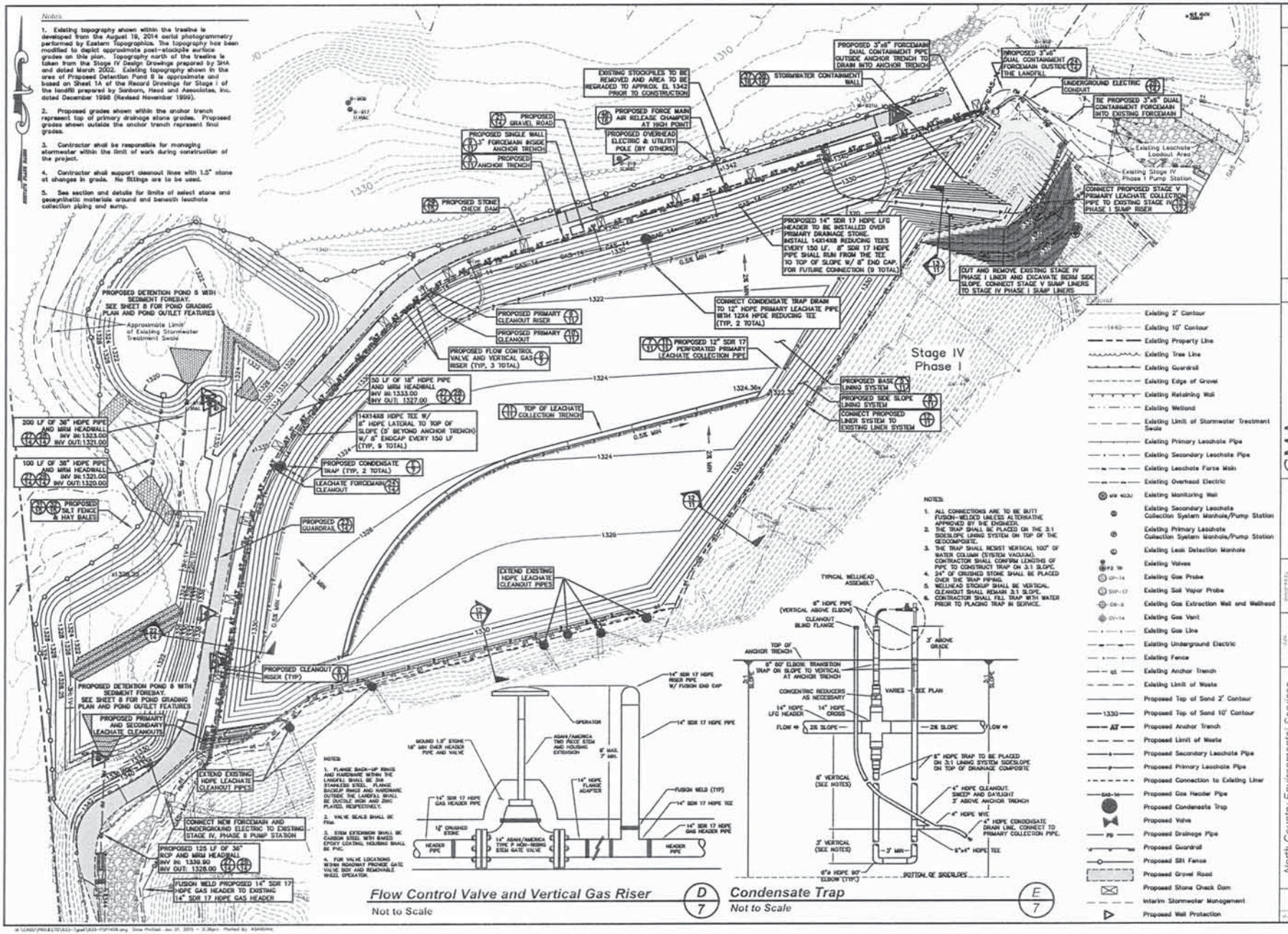
1. Existing topography shown within the treeline is developed from the August 19, 2014 aerial photogrammetry performed by Eastern Topographics. The topography has been modified to depict approximate post-stockpile surface grades on this plan. Topography north of the treeline is taken from the Stage IV Design Drawings prepared by SHA and dated March 2002. Existing topography shown in the area of Proposed Detention Pond 8 is approximate and based on Sheet 1A of the Record Drawings for Stage I of the landfill prepared by Sanborn, Head and Associates, Inc. dated December 1998 (Revised November 1999).

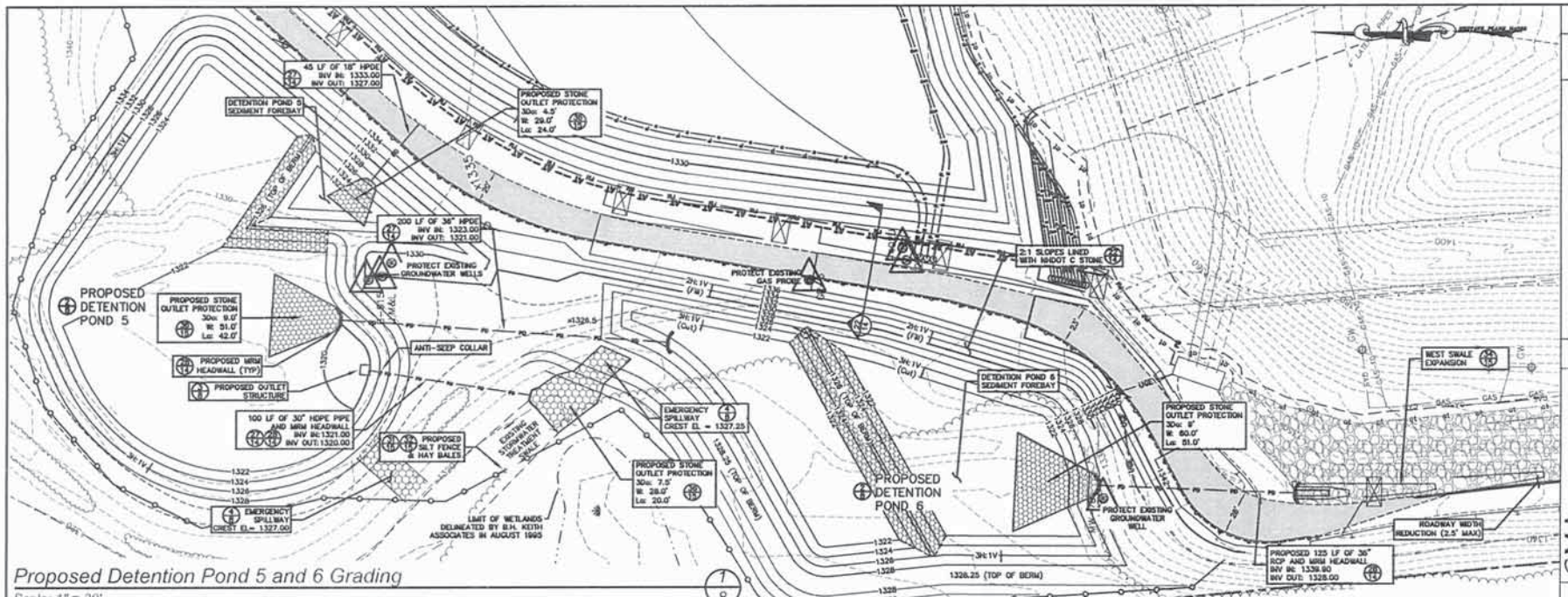
2. Proposed grades shown within the anchor trench represent top of primary drainage stone grades. Proposed grades shown outside the anchor trench represent final grades.

3. Contractor shall be responsible for managing stormwater within the limit of work during construction of the project.

4. Contractor shall support cleanout lines with 1.5" stone at changes in grade. No fittings are to be used.

5. See section and details for limits of select stone and geosynthetic materials around and beneath leachate collection piping and sump.

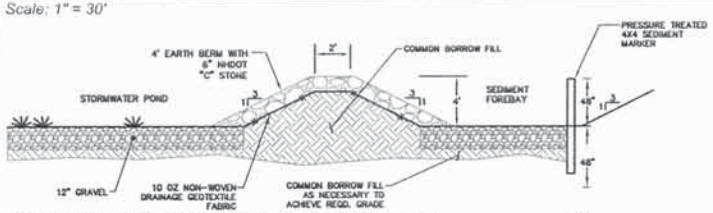




Proposed Detention Pond 5 and 6 Grading

Scale: 1" = 30'

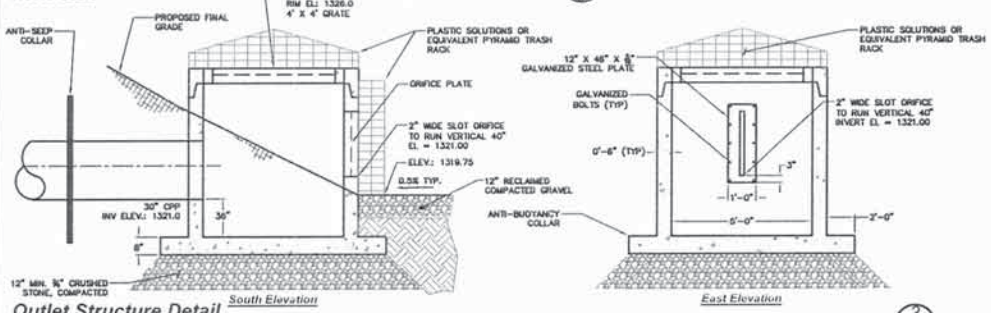
1/8



Stormwater Pond with Sediment Forebay

Not to Scale

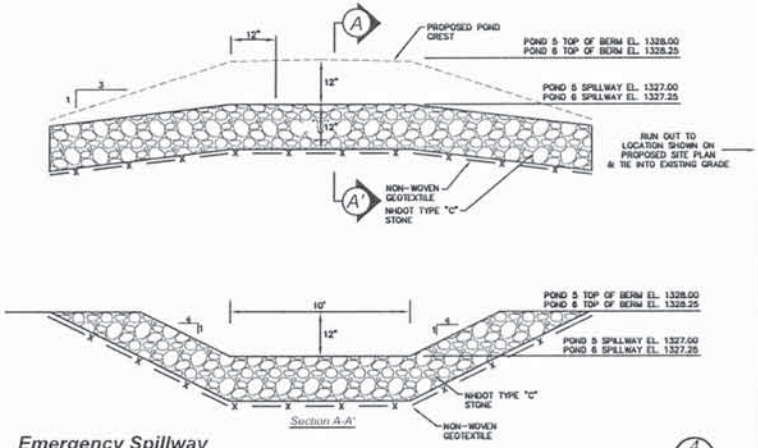
2/8



Outlet Structure Detail

Not to Scale

3/8



Emergency Spillway

Not to Scale

4/8

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Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Proposed Detention Pond 5 & 6
Grading Plan

8

Erosion Control Notes:

1. Prior to construction and thereafter erosion control measures are to be implemented as noted. The smallest practical area of land should be exposed at any one time during development. When land is exposed during development, the exposure should be kept to the shortest practical period of time. Land should not be left exposed during the winter months.

2. Hay bale barriers shall be installed and maintained along limits of work where shown. Additional hay bales shall be added as required by the Engineer. Hay bales will be staked and maintained prior to and during construction until disturbed areas are covered with crushed gravel or have a healthy stand of grass.

3. All disturbed areas and side slopes which are finish graded with no further construction to take place shall be seeded and mulched within 72 hours. All seed, lime and fertilizer programs shall conform to all applicable sections of the specifications.

4. Any disturbed areas which are to be left temporarily, or longer than two weeks and which will be regraded later during construction, shall be machine hay mulched and seeded at the rate of 2 tons per acre. The smallest practical area shall be disturbed during construction, but in no case shall exceed 5-acres at any one time before disturbed areas are stabilized.

5. Avoid use of undisturbed areas whenever possible during construction. Construction traffic shall travel the roadbeds of existing and future roads.

6. Silt fence shall be installed & maintained where shown and additional silt fence added as required by the Engineer prior to any on-site grading or disturbance of existing surface material. It should be maintained during and after development to remove sediment from runoff water and from land undergoing development. Where possible natural drainage ways should be utilized and left open to remove clean excess surface water. The silt fence is to be maintained and cleaned until all slopes have a healthy stand of grass.

7. Erosion control devices shall be inspected weekly and after every 0.5-in of rainfall.

8. All disturbed areas shall have a minimum of 4 inches of loam placed, before being seeded and mulched unless otherwise shown. Erosion control matting shall be placed on all slopes steeper than 3:1 and within grass lined swales as shown.

9. After all disturbed areas have been stabilized, the temporary erosion control measures are to be removed and accumulated sediment disposed of in an on site location designated by the Owner.

10. Baled hay and mulch shall be meetings of acceptable herbaceous growth, free from noxious weeds or woody stems, and shall be dry.

11. Silt fences shall be minimum of 36 inches high with the bottom of the fabric keyed into the ground (see detail). Posts shall be of wood or steel.

12. The erosion control devices shown on the Drawings and as specified in the specifications represent the minimum required for erosion control. The Contractor shall add to these devices any and all measures as required by the Engineer to effectively prevent migration of sediment from the work area.

13. All slopes and disturbed areas to be seeded shall comply with the NHDES Section 644 WF Seed Type 40.

14. Lime shall conform to NHDOT specifications, Div. 600, sec. 642 "Limestone". Limestone shall be applied by either the dry or hydraulic method as described in NHDOT Div 600, sec. 644.2.5. The amount of limestone applied should be based on evaluation of soil tests conducted by the contractor. The minimum rate of 2 tons per acre or 100 lbs per sq. ft. shall be applied if required.

15. Fertilizer to be used must be the equivalent of a 15-15-15 mixture and shall be reviewed by the Engineer. Fertilizer shall conform to NHDOT specifications Div. 600, Sec. 643 "Fertilizer for Grasses." Kinds and amounts of fertilizer should be based on evaluation of soil tests conducted by the contractor. The minimum amounts applied shall be as follows:

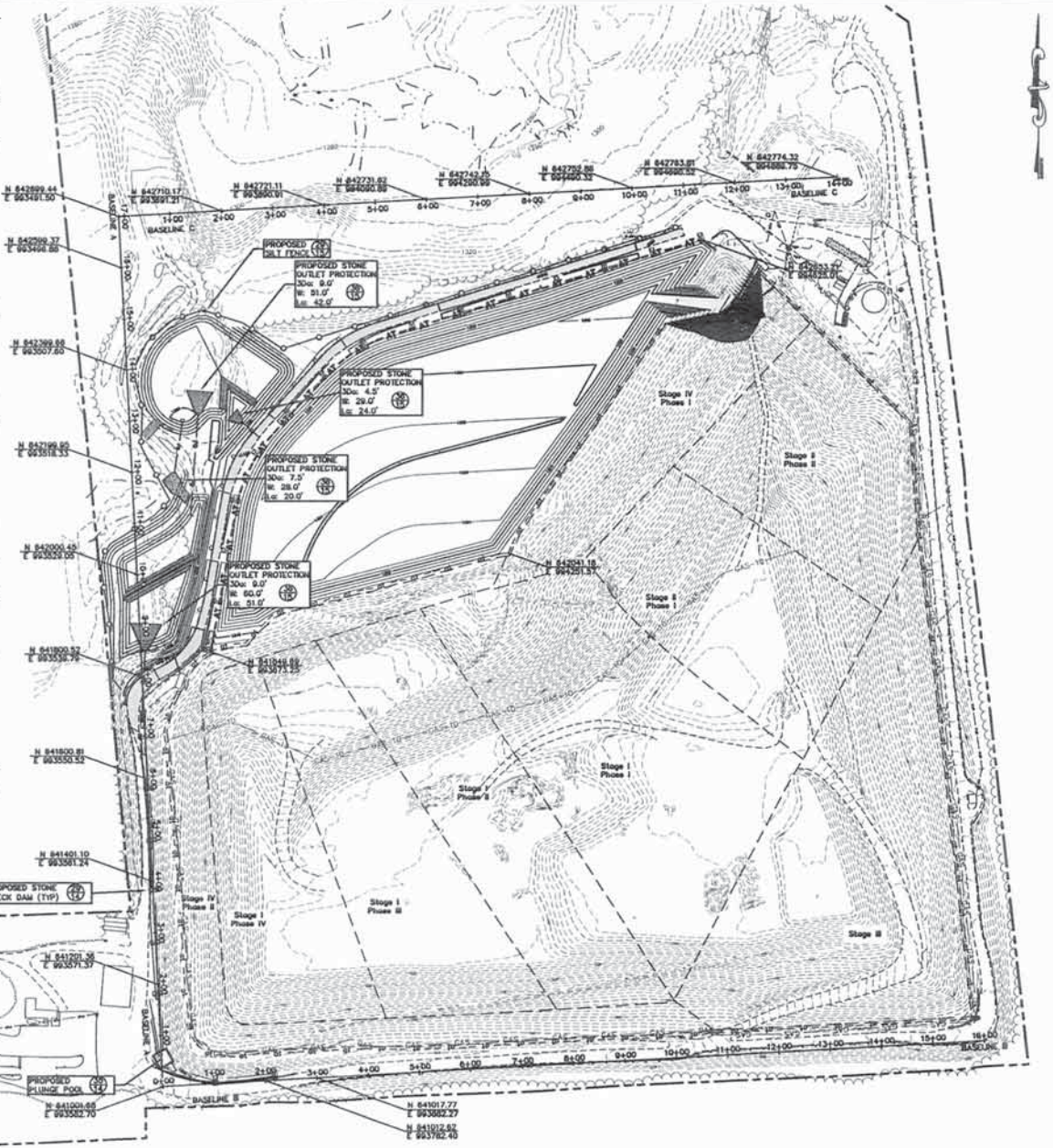
Nitrogen (N) 150 lbs per acre or 1.1 lbs per 1000 s.f.
Phosphorus (P 0) 100 lbs per acre or 2.3 lbs per 1000 s.f.
Potash (K 0) 100 lbs per acre or 2.3 lbs per 1000 s.f.

(Note: This is the equivalent of 500 lbs per acre of 10-20-20 fertilizer or 1000 lbs per acre of 5-10-10)

16. All proposed swales must be stabilized prior to directing runoff to them.

17. All roadways to be stabilized within 72 hours of achieving finished grade.

18. All areas shall be stabilized within 45 days of initial disturbance. An area shall be considered stable if one of the following has occurred:
- Base course gravels have been installed in areas to be paved;
- A minimum of 85% vegetated growth has been established;
- A minimum of 3-in of non-erosive material such as stone or rip rap has been installed; or
- Erosion control blankets have been properly installed.



Winter Construction Notes:

Winter Construction notes prepared in accordance with Rule Env-Wq 1505.05

1. All proposed vegetated areas which do not exhibit a minimum of 85% vegetative growth by November 30th, or which are disturbed after November 30th, shall be stabilized by seeding and installing bonded fiber matrix and soil stabilizer at a rate of 3,000 lb/acre and 10 gallons/acre respectively for stabilization over winter. The seeding and mulching shall not occur over accumulated snow or on frozen ground and shall be completed in advance of thaw or spring melt events;

2. All ditches or swales which do not exhibit a minimum of 85% vegetative growth by November 30th, shall be stabilized temporarily with stone or erosion control blankets appropriate for the design flow conditions; and

3. After November 30th, incomplete road or parking surfaces, where work has stopped for the winter season, shall be protected with a minimum of 3 inches of crushed gravel per NHDOT Item 304.3.

Legend:

- Existing 2' Contour
- Existing 10' Contour
- Existing Property Line
- Existing Tree Line
- Existing Limit of Wetland
- Existing Guardrail
- Existing Edge of Gravel
- Existing Retaining Wall
- Existing Edge of Pond
- Existing Primary Leachate Pipe
- Existing Secondary Leachate Pipe
- Existing Leachate Force Main
- Existing Overhead Electric
- Existing Monitoring Well
- Existing Secondary Leachate Collection System Manhole/Pump Station
- Existing Primary Leachate Collection System Manhole/Pump Station
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- Existing Gas Line
- Existing Underground Electric
- Existing Fence
- Existing Anchor Trench
- Existing Limit of Waste
- Proposed Anchor Trench
- Proposed Limit of Work
- Proposed 10' Contour
- Proposed 2' Contour
- Proposed Gravel Road
- Proposed Drainage Pipe
- Proposed Waste Excavation
- Proposed Stone Check Dam
- Proposed Silt Fence

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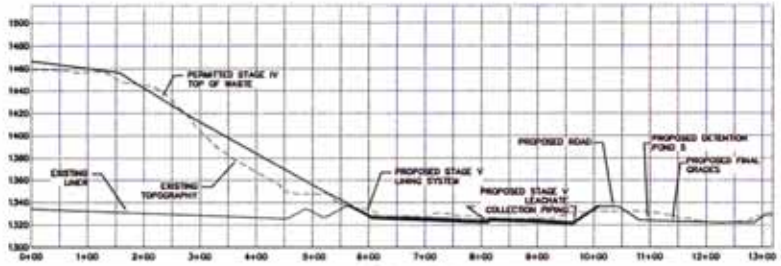
Stage V Landfill Expansion
Construction Drawings

Erosion Control and
Site Layout Plan

9

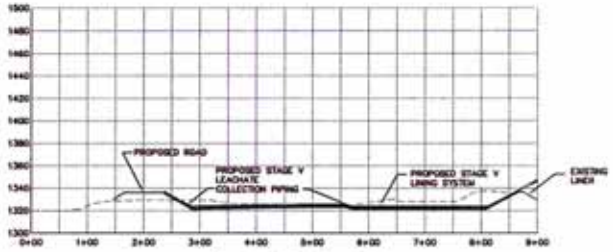
Notes:

1. Section Lines are shown on Sheet 3



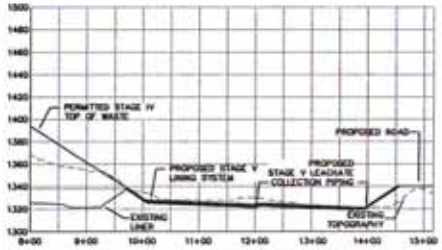
Section A-A'

Horizontal: 1" = 100'
Vertical: 1" = 50'



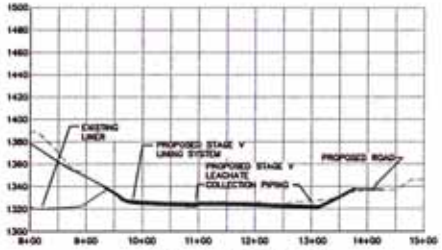
Baseline A Station 12+00

Horizontal: 1" = 100'
Vertical: 1" = 50'



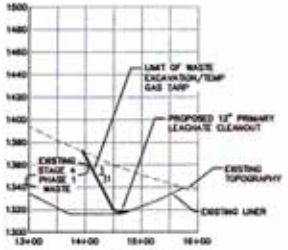
Section B-B'

Horizontal: 1" = 100'
Vertical: 1" = 50'



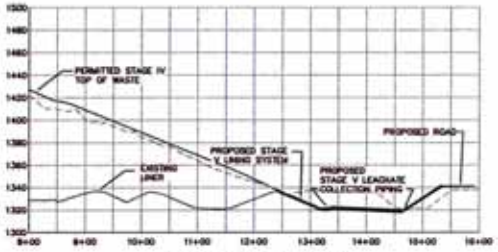
Baseline B Station 4+00

Horizontal: 1" = 100'
Vertical: 1" = 50'



Section C-C'

Horizontal: 1" = 100'
Vertical: 1" = 50'



Baseline B Station 9+00

Horizontal: 1" = 100'
Vertical: 1" = 50'

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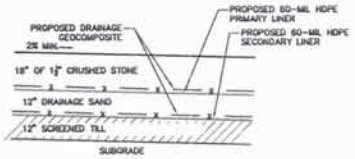
Stage V Landfill Expansion
Construction Drawings
Landfill Cross Sections

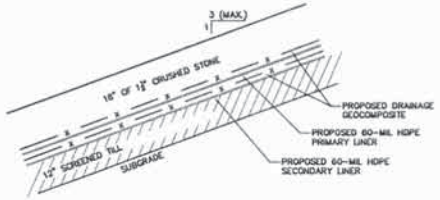
10



Typical Liner Section (Base Areas)

Not to Scale

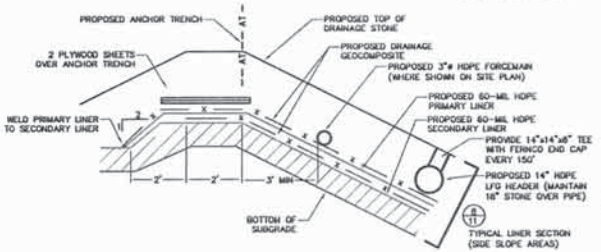
5/6 5/7



Typical Liner Section (Side Slope Areas)

Not to Scale

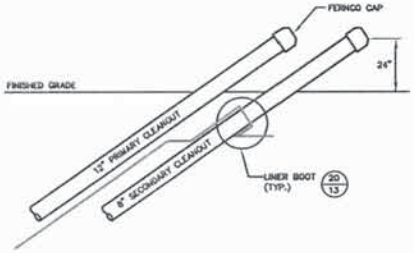
8/6 8/7 8/14



Typical Anchor Trench

Not to Scale

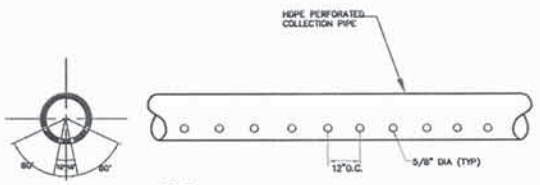
9/6 9/7 9/14



Primary & Secondary Cleanout Riser

Not to Scale

6/6 6/7

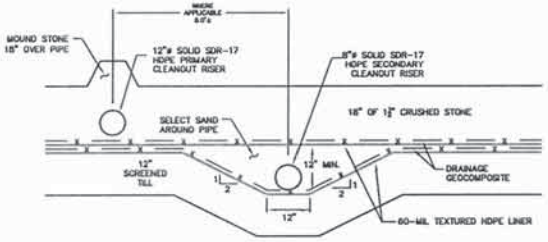


NOTES:
1. PRIMARY LEACHATE COLLECTION PIPE INSIDE LANDFILL SHALL BE 12" DIA. HDPE SDR 17
2. SECONDARY LEAK DETECTION PIPE INSIDE LANDFILL SHALL BE 8" DIA. HDPE SDR 17
3. PRIMARY & SECONDARY PIPES ARE NON-PERFORATED WHEN PASSING THROUGH FLAPS, PHASE SEPARATION, AND INTERMEDIATE BERMS. SEE APPROPRIATE SECTIONS AND DETAILS.
4. PRIMARY AND SECONDARY CLEANOUT/KNIT PIPES ARE NON-PERFORATED.

Perforated Collection Pipe

Not to Scale

7/6 7/7

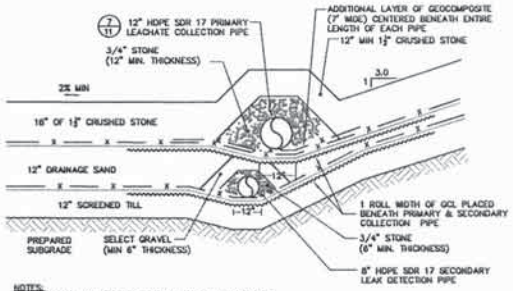


NOTES:
1. SEE BOOT REQUIREMENTS FOR SECONDARY CLEANOUT AT ANCHOR TRENCH THIS SHEET.
2. CLEANOUTS SHALL EXTEND 24" ABOVE FINISHED GRADE AND PROVIDED WITH FERNCO CAP.

Primary & Secondary Cleanout Cross Section

Not to Scale

10/6 10/7

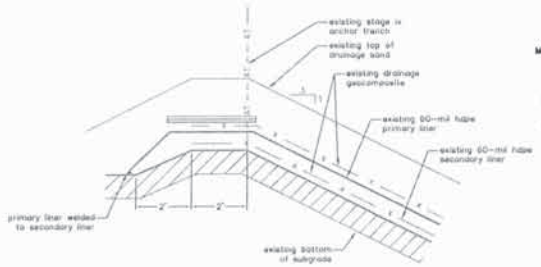


NOTES:
1. MATERIALS AROUND PIPES TYPICAL FOR ALL LOCATIONS
2. PIPES ARE PERFORATED

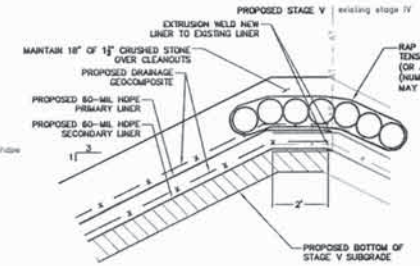
Leachate Collection Pipe

Not to Scale

11/6 11/7



EXISTING

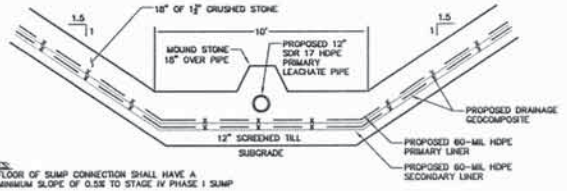


PROPOSED

Liner Connection to Stage IV

Not to Scale

12/6 12/7



NOTES:
1. FLOOR OF SUMP CONNECTION SHALL HAVE A MINIMUM SLOPE OF 0.5% TO STAGE IV PHASE I SUMP

Connection to Stage IV Phase I Sump

Not to Scale

13/6 13/7

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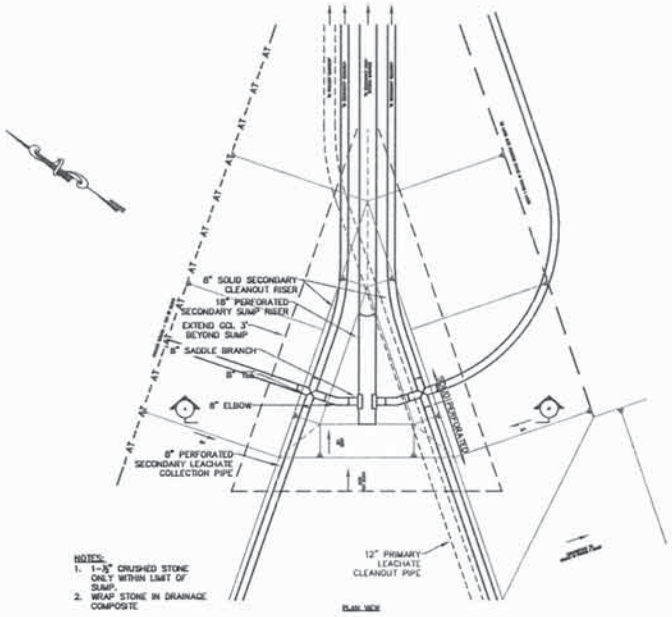
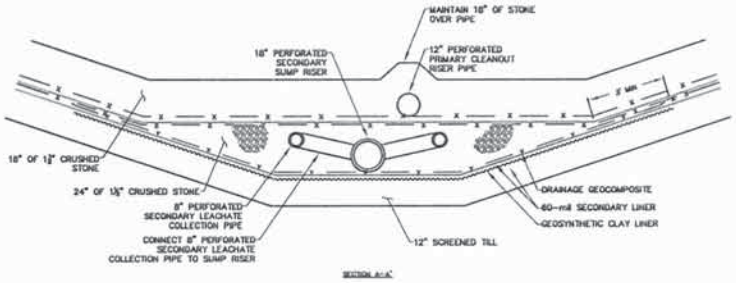
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Details - Landfill

Drawing No. 11

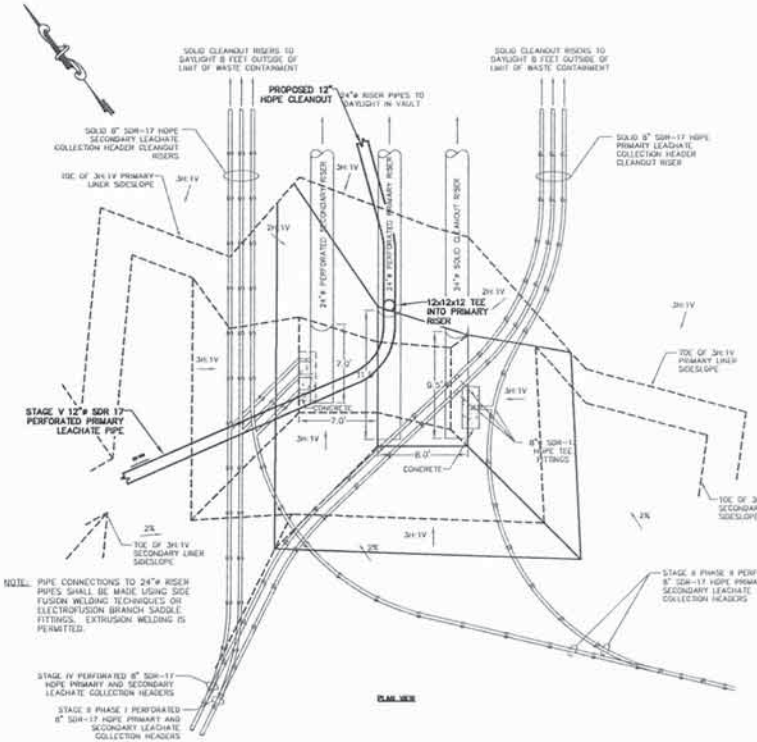


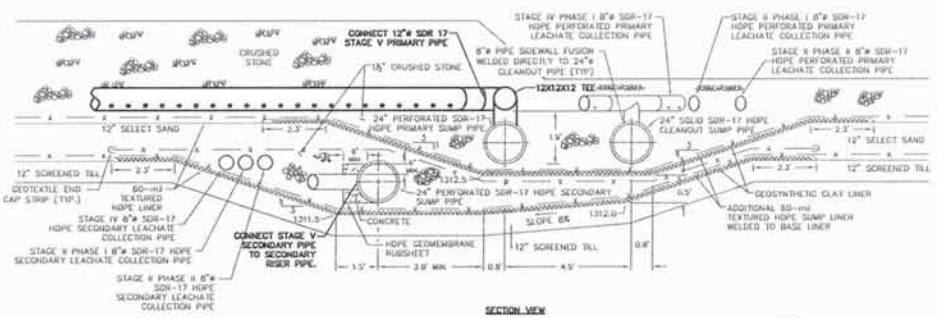


Stage V Secondary Sump

Not to Scale

14
6





Connection to Stage IV, Phase I Sump

Not to Scale

15
7

CMA ENGINEERS

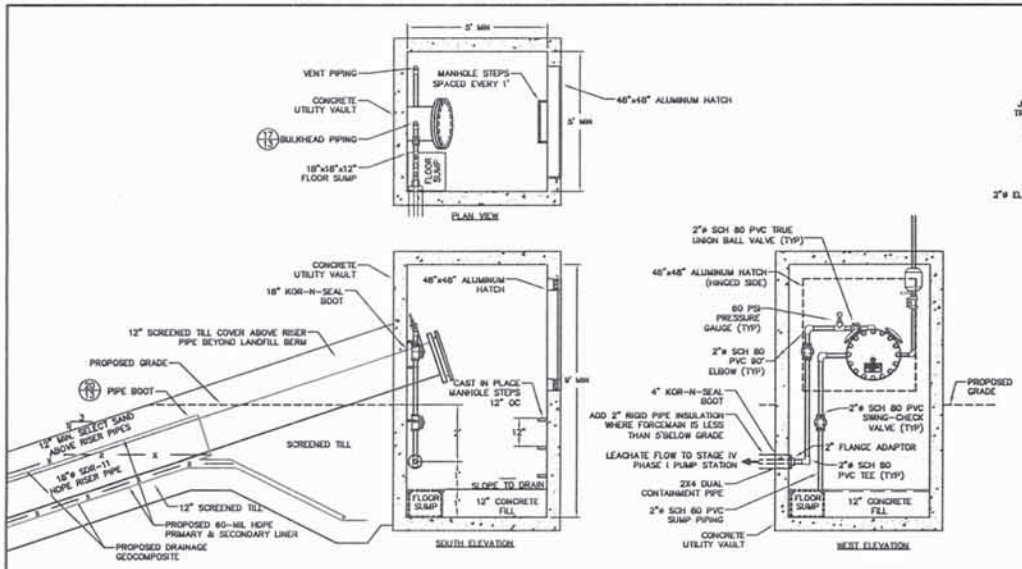
DATE	JAN 2012
PROJECT NO.	833
DRAWN BY	BASJS
DESIGNED BY	RJS
REVIEWED BY	RJS

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

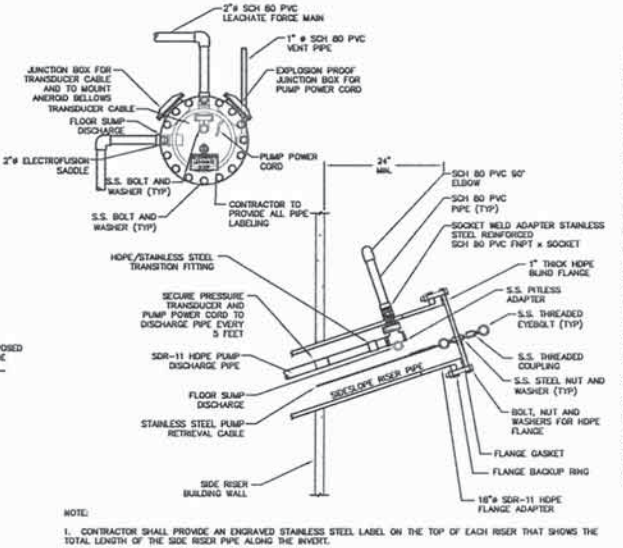
Details
Sump Modification & Construction

Drawing No.
12



Secondary Pump Station Manhole
Not to Scale

16/6



NOTE:

1. CONTRACTOR SHALL PROVIDE AN ENGRAVED STAINLESS STEEL LABEL ON THE TOP OF EACH RISER THAT SHOWS THE TOTAL LENGTH OF THE SIDE RISER PIPE ALONG THE INVERT.

EQUIPMENT LIST

PITLESS ADAPTER – MODEL NW STAINLESS STEEL DISCHARGE ADAPTER, EPG COMPANIES, INC., MAPLE GROVE, MN, (800)443-7526.

FLANGE BACKUP RING – DUCTILE IRON FLANGE BACKUP RING WITH POWDERCOAT EPOXY COATING.

BOLTS FOR FLANGE (16 PER FLANGE)– GRADE 8 PLAIN STEEL HEX-HEAD CAP SCREWS, 1-1/8"-7 STANDARD THREAD, 8-1/2" LONG.

HEX NUTS FOR FLANGE (16 PER FLANGE)–PLAIN STEEL HEX FULL NUT, 1-1/8"-7.

WASHERS FOR FLANGE (32 PER FLANGE)– PLAIN STEEL SAE STANDARD FLAT WASHER, 1-1/8" SCREW SIZE, 2-1/4" O.D., 9/64" THICK.

FLANGE GASKETS – ½-INCH THICK VITON FULL FACE FLANGE GASKET.

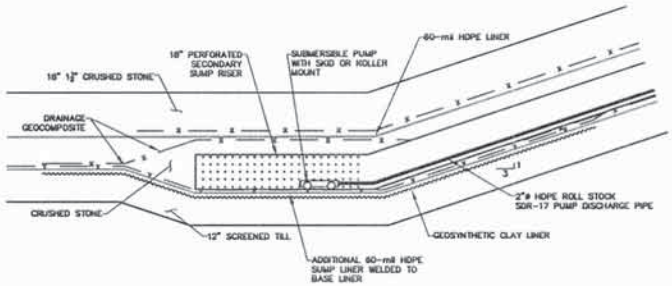
PUMP CORD JUNCTION BOX – EXPLOSION PROOF JUNCTION BOX, 4" x 4" MINIMUM INTERIOR DIMENSIONS.

PROVIDE PASS-THROUGH SINGLE TIER TERMINAL BLOCKS FOR PUMP POWER AND TRANSDUCER CONDUCTORS. PROVIDE LABELS FOR EACH TERMINAL.

EXTEND PRESSURE TRANSDUCER CABLE VENT TUBE TO ANEROID BELLOWS MOUNTED IN THE TRANSDUCER CABLE JUNCTION BOX ON THE WALL OF THE SIDESLOPE RISER PIPE.

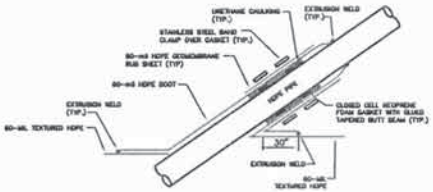
Bulkhead Piping Detail
Not to Scale

17/6



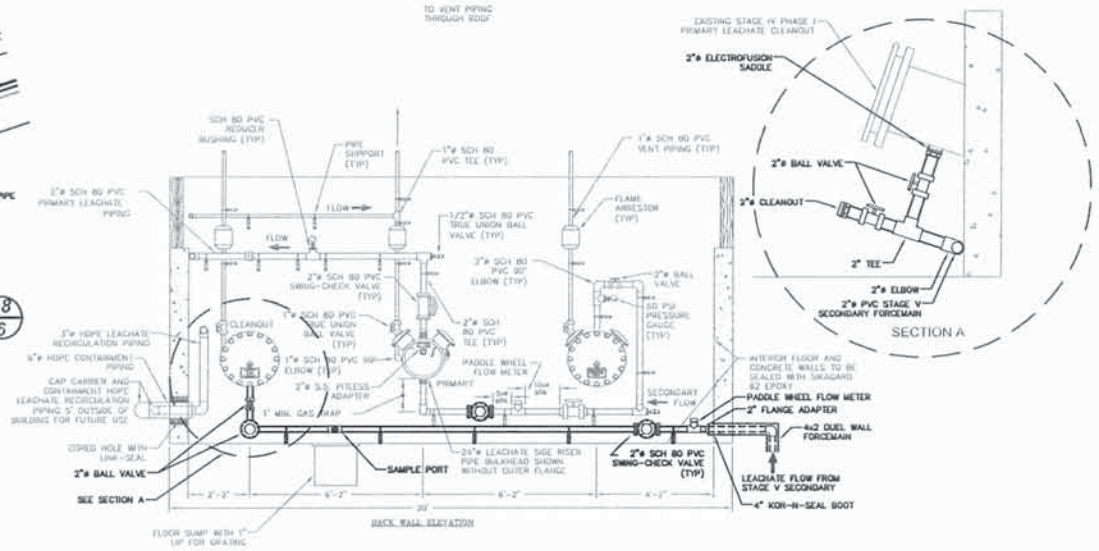
Proposed Secondary Sump Riser to Manhole Pump Station
Not to Scale

18/6



Typical Boot Detail
Not to Scale

20/11 20/13



Proposed Alterations To Stage IV Side Riser Building Piping
Not to Scale

19/6

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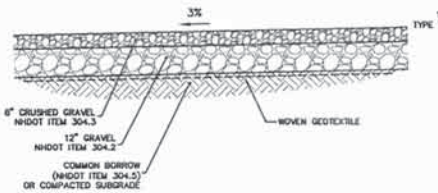
JAN 2013

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

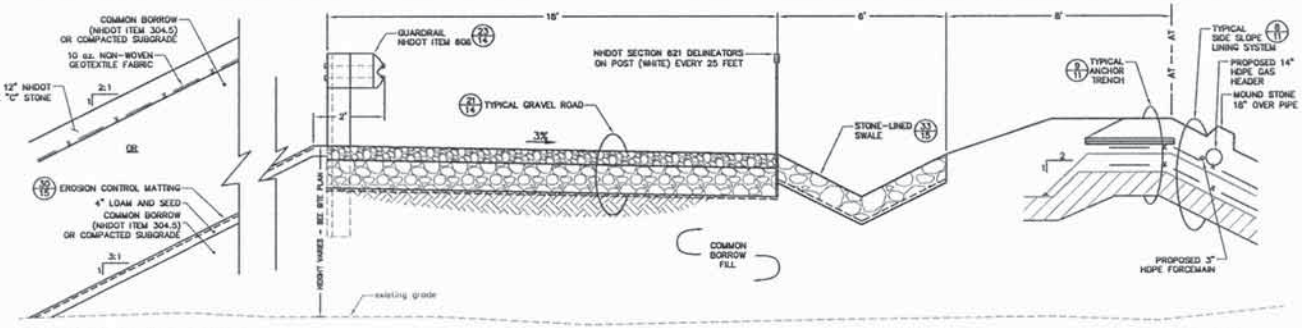
Details
Riser Modification & Construction

13



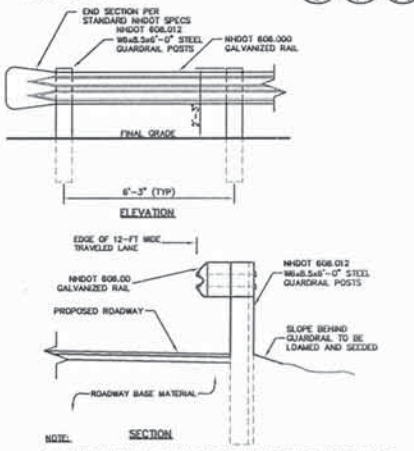
Typical Gravel Road Section (21/6) (21/7) (21/14)

Not to Scale



Landfill Berm & Roadway (22/6) (22/7) (22/8)

Not to Scale

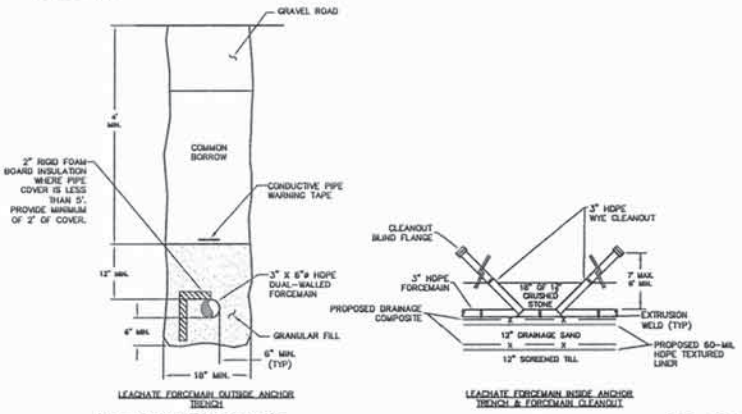


NOTE:

1. GUARDRAIL AND POSTS SHALL CONFORM WITH SECTION 608 OF THE NHDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION.

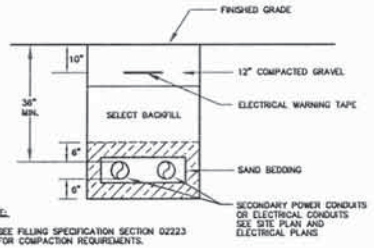
Typical Guardrail Detail (23/6) (23/7) (23/14)

Not to Scale



Leachate Forcemain (24/6) (24/7)

Not to Scale

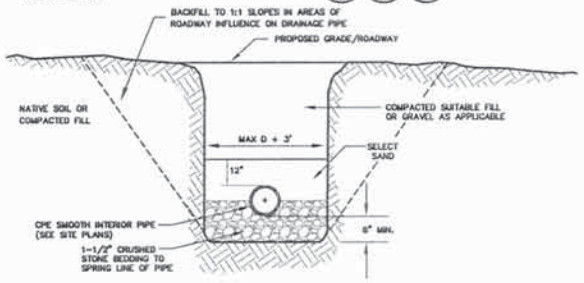


NOTE:

1. SEE FILLING SPECIFICATION SECTION 02223 FOR COMPACTION REQUIREMENTS.

Underground Electric Conduit Detail (26/6) (26/7)

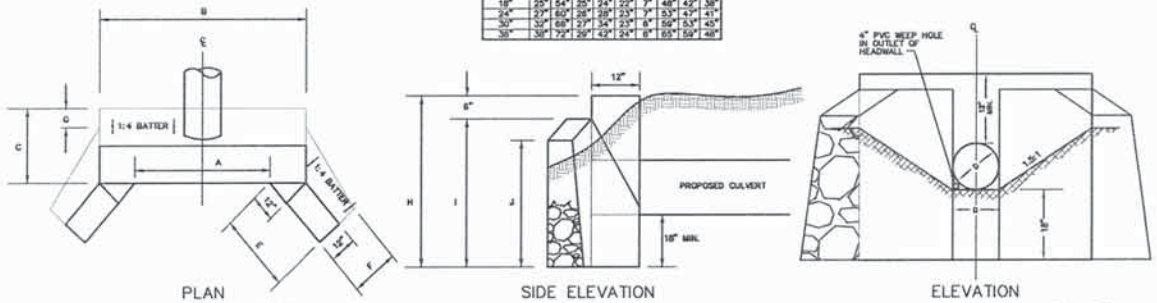
Not to Scale



Typical Drainage Pipe Trench (27/6) (27/7) (27/8)

Not to Scale

DIAMETER D	A	B	C	E	F	G	H	I	J
15"	33"	54"	34"	20"	22"	7"	43"	36"	30"
18"	33"	54"	35"	24"	22"	7"	48"	42"	36"
24"	27"	60"	28"	28"	23"	7"	53"	47"	41"
30"	33"	66"	27"	34"	23"	8"	59"	53"	45"
36"	36"	72"	29"	42"	24"	8"	65"	59"	48"



Masonry Rubble (MRM) Headwall (28/6) (28/7) (28/8)

Not to Scale

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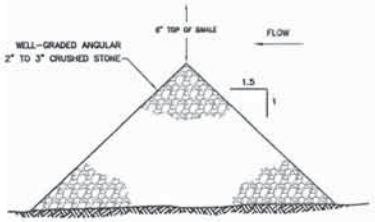
Stage V Landfill Expansion
Construction Drawings

Details - Site Work

14



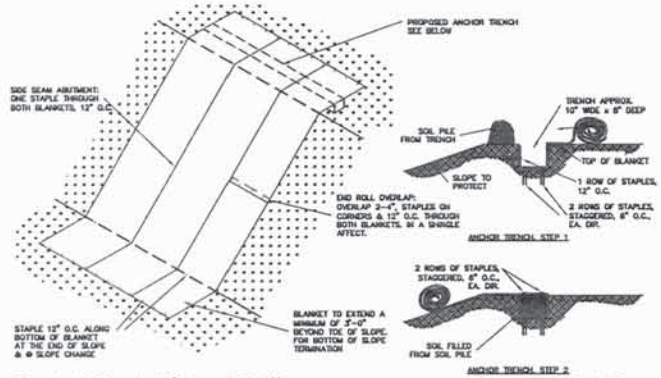
NOTES:

1. PLACE CRUSHED STONE TO WITHIN 6" OF TOP OF DRAINAGE WAY.
2. FOR ACTIVE DRAINAGE OUTFLOW CHECK DAMS SHALL BE PLACED IN SERIES ALONG FLOW LINE TO RETAIN SEDIMENTS.

Stone Check Dam

29/6 29/7 29/9

Not to Scale



Erosion Control Blanket Slope Detail

30/9 30/14

Not to Scale

Erosion Control Notes

1. Prior to construction and thereafter erosion control measures are to be implemented as noted. The smallest practical area of land should be exposed at any one time during development. When land is exposed during development, the exposure should be kept to the shortest practical period of time. Land should not be left exposed during the winter months.

2. Hay bale barriers shall be installed and maintained along limits of work where shown. Additional hay bales shall be added as required by the Engineer. Hay bales will be staked and maintained prior to and during construction until disturbed areas are covered with crushed gravel or have a healthy stand of grass.

3. All disturbed areas and side slopes which are finish graded with no further construction to take place shall be seeded and mulched within 72 hours. All seed, lime and fertilizer programs shall conform to all applicable sections of the specifications.

4. Any disturbed areas which are to be left temporarily, or longer than two weeks and which will be regraded later during construction, shall be machine hay mulched and seeded at the rate of 2 tons per acre. The smallest practical area shall be disturbed during construction, but in no case shall exceed 5-acres at any one time before disturbed areas are stabilized.

5. Avoid use of undisturbed areas whenever possible during construction. Construction traffic shall travel the roadbeds of existing and future roads.

6. Silt fence shall be installed & maintained where shown and additional silt fence added as required by the Engineer prior to any on-site grading or disturbance of existing surface material. It should be maintained during and after development to remove sediment from runoff water and from land undergoing development. Where possible natural drainage ways should be utilized and left open to remove clean excess surface water. The silt fence is to be maintained and cleaned until all slopes have a healthy stand of grass.

7. Erosion control devices shall be inspected weekly and after every 0.5-in of rainfall.

8. All disturbed areas shall have a minimum of 4 inches of loam placed, before being seeded and mulched unless otherwise shown. Erosion control matting shall be placed on all slopes steeper than 3:1 and within grass lined swales as shown.

9. After all disturbed areas have been stabilized, the temporary erosion control measures are to be removed and accumulated sediment disposed of in an on site location designated by the Owner.

10. Baled hay and mulch shall be mowings of acceptable herbaceous growth, free from noxious weeds or woody stems, and shall be dry.

11. Silt fences shall be minimum of 36 inches high with the bottom of the fabric keyed into the ground (see detail). Posts shall be of wood or steel.

12. The erosion control devices shown on the Drawings and as specified in the specifications represent the minimum required for erosion control. The Contractor shall add to these devices any and all measures as required by the Engineer to effectively prevent migration of sediment from the work area.

13. All slopes and disturbed areas to be seeded shall comply with the NHDES Section 644 WF Seed Type 45.

14. Lime shall conform to NHDOT specifications, Div. 600, sec. 642 "Limestone". Limestone shall be applied by either the dry or hydraulic method as described in NHDOT Div 600, sec. 644.2.5. The amount of limestone applied should be based on evaluation of soil tests conducted by the contractor. The minimum rate of 2 tons per acre or 100 lbs per sq. ft. shall be applied if required.

15. Fertilizer to be used must be the equivalent of a 15-15-15 mixture and shall be reviewed by the Engineer. Fertilizer shall conform to NHDOT specifications Div. 600, Sec. 643 "Fertilizer for Grasses." Kinds and amounts of fertilizer should be based on evaluation of soil tests conducted by the contractor. The minimum amounts applied shall be as follows:

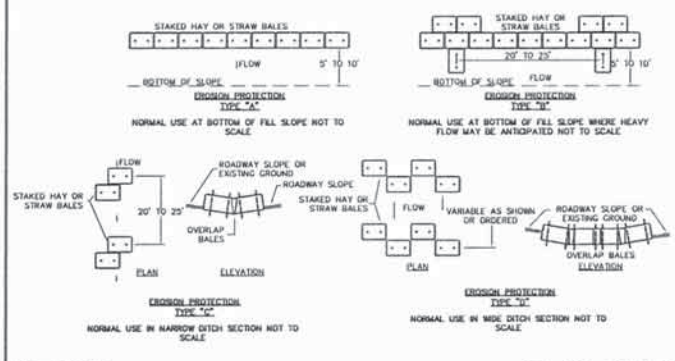
Nitrogen (N) 150 lbs per acre or 1.1 lbs per 1000 s.f.
Phosphate (P O) 100 lbs per acre or 2.2 lbs per 1000 s.f.
Potash (K O) 100 lbs per acre or 2.2 lbs per 1000 s.f.

(Note: This is the equivalent of 500 lbs per acre of 10-20-20 fertilizer or 1000 lbs per acre of 5-10-10)

16. All proposed swales must be stabilized prior to directing runoff to them.

17. All roadways to be stabilized within 72 hours of achieving finished grade.

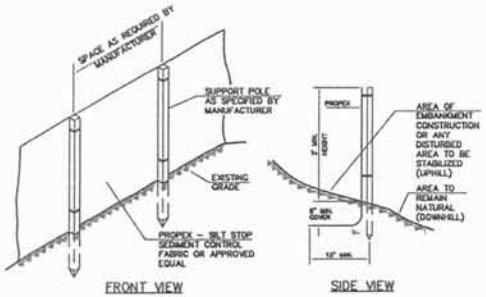
18. All areas shall be stabilized within 45 days of initial disturbance. An area shall be considered stable if one of the following has occurred:
-Base course gravels have been installed in areas to be paved;
-A minimum of 85% vegetated growth has been established;
-A minimum of 3-in of non-erosive material such as stone or rip rap has been installed; or
-Erosion control blankets have been properly installed.



Hay Bales

31/6 31/7 31/8 31/9

Not to Scale



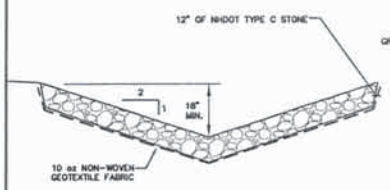
NOTE:

1. AT A MINIMUM, SILT FENCE IS TO BE INSTALLED TO PROTECT WETLAND AREAS, WATERWAYS, EXISTING AND PROPOSED DRAINAGE FEATURES, SLOPES, LAWNS AND PLANTINGS ADJACENT TO THE WORK.

Silt Fence

32/6 32/7 32/8 31/9

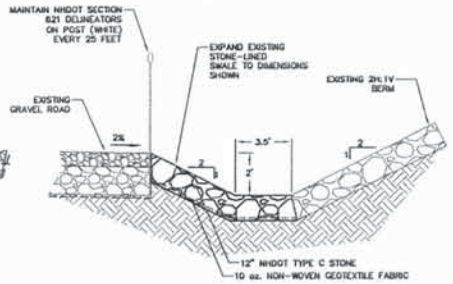
Not to Scale



Stone-Lined Swale

33/14

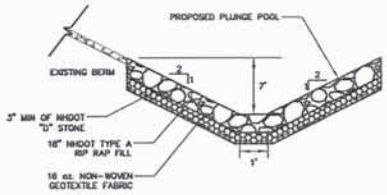
Not to Scale



West Swale Expansion Section

34/6 34/7 34/8

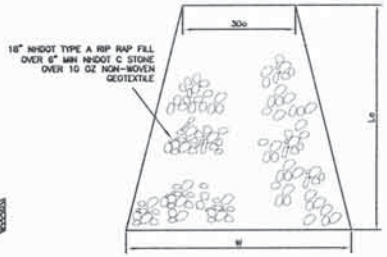
Not to Scale



Plunge Pool Detail

35/3 35/9

Not to Scale



NOTE:

1) STONE TO BE A MINIMUM OF 24" DEEP.

2) CONTRACTOR RESPONSIBLE FOR REMOVING DEBRIS OR SEDIMENT WHICH ENTERS STONE PRIOR TO STABILIZATION.

3) SEE DRAWINGS FOR REQUIRED DIMENSIONS.

Typical Culvert Outlet Protection

36/8 36/9

Not to Scale

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CIVIL/ENVIRONMENTAL ENGINEERS

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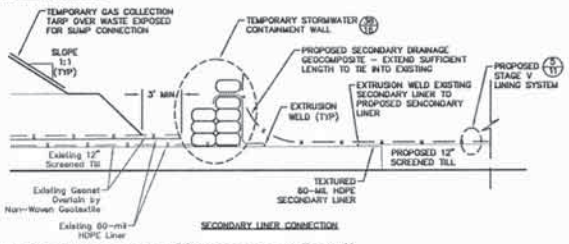
North Country Environmental Services
Bethlehem, NH

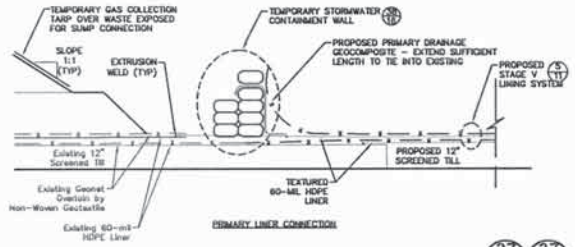
Stage V Landfill Expansion
Construction Drawings

Details - Erosion Control

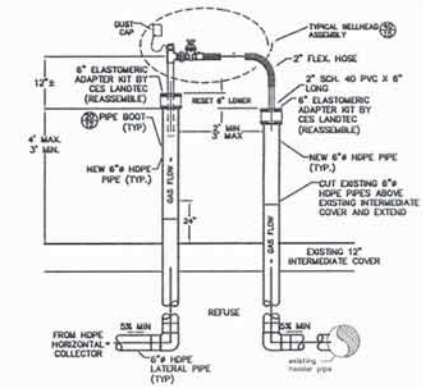
15

NOTE: CONTRACTOR SHALL TAKE ALL MEASURES AND PRECAUTIONS NECESSARY TO PROPERLY CONTROL THE TEMPORARY STORMWATER MANAGEMENT SYSTEM AND CONTAINMENT BERM REQUIRED FOR THE CONNECTION TO THE EXISTING STAGE IV PHASE I PRIMARY AND SECONDARY LINER SYSTEMS AND CONSTRUCTION OF THE NEW STAGE V SUMP. CONTRACTOR SHALL PREVENT ANY STORMWATER FROM ESCAPING FROM THE CONTAINMENT AREA TO THE LEACHATE COLLECTION SYSTEM. CONTRACTOR SHALL OPERATE AND MAINTAIN THE CONTAINMENT SYSTEM AND PUMPS 24 HOURS PER DAY FOR THE DURATION THAT THE CONTAINMENT SYSTEM IS OPERATIONAL, AND TO HAVE ON-SITE BACK UP PUMPS AND BACK-UP GAS/DIESEL POWERED GENERATORS IN THE EVENT EXISTING ELECTRICAL CONNECTIONS OR GENERATOR CEASE TO FUNCTION.

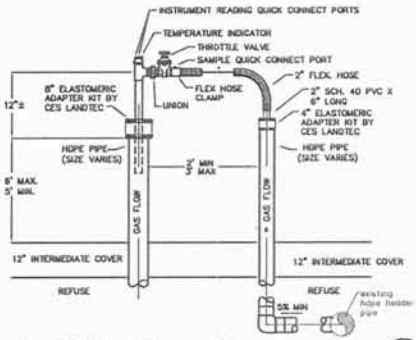




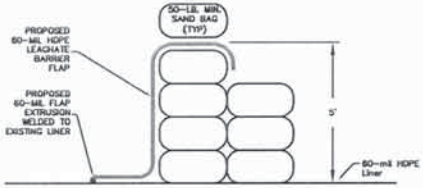
Interim Stormwater Management Detail (37/6 37/7)
Not to Scale



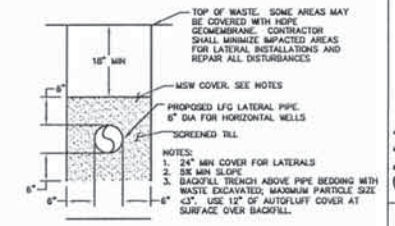
Horizontal Gas Collection Wellhead (39/4)
Not to Scale



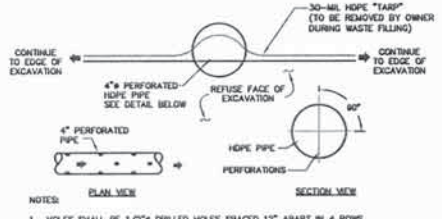
Typical Wellhead Assembly (40/4 40/16)
Not to Scale



Typical Stormwater Containment Wall Section (38/6 38/7)
Not to Scale



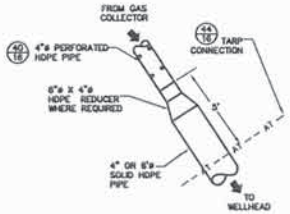
Landfill Gas Lateral (43/4)
Not to Scale



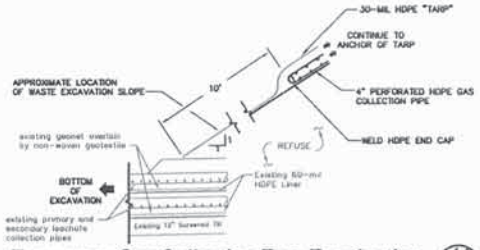
NOTES:

1. HOLES SHALL BE 1/2"ø DRILLED HOLES SPACED 12" APART IN 4 ROWS ALONG THE LENGTH OF THE PIPE. ROWS SHALL BE LOCATED 90° APART OFFSET 6" ALONG THE AXIS OF THE PIPE.

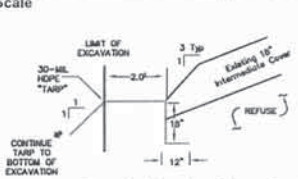
Temporary Horizontal Collector (41/4 41/16)
Not to Scale



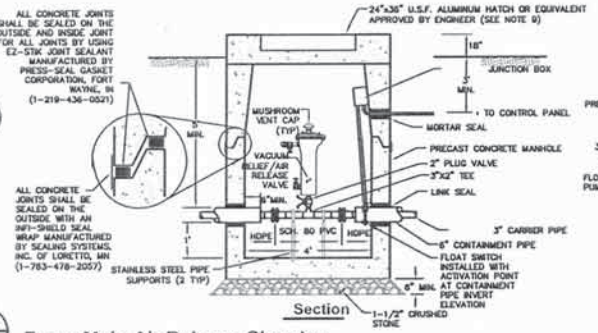
Gas Collector Connection (42/4 42/16)
Not to Scale

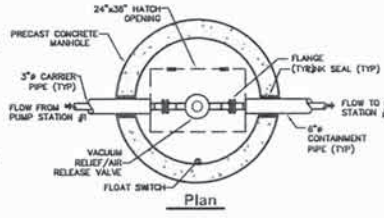


Temporary Gas Collection Tarp Termination (44/4 44/16)
Not to Scale



Temporary Gas Collection Tarp Anchor Trench (45/4)
Not to Scale





GENERAL LEAK DETECTION AND AIR RELEASE CHAMBER NOTES:

1. ASSUME CLASS 1 DIVISION 1 GROUP D ATMOSPHERE IN ALL BELOW-GRADE STRUCTURES, INCLUDING MANHOLES AND VALVE BOXES.
2. TWO COATS OF SIKAGARD 62 SHALL BE APPLIED TO THE FLOOR AND WALLS OF ALL THE MANHOLES INCLUDING ACROSS ALL BARREL SECTION JOINT SURFACES. CONCRETE SURFACE TO BE COATED SHALL BE DRY, FREE OF SURFACE VOIDS, HONEYCOMBED CONCRETE, CRACKS, MORTAR SMEARS, DIRT, AND FORM RELEASE AGENTS. SURFACE DEFECTS SUCH AS CRACKS, HOLES, OR CAVITIES SHALL BE FILLED AND FINISHED FLUSH WITH A PORTLAND CEMENT GROUT OR CONCRETE. VOIDS IN SURFACES ARE TO BE FILLED TO CREATE A SMOOTH, SLIGHTLY POROUS SURFACE. CLEAN ALL SURFACES TO REMOVE DIRT, MUD, DEBRIS, DUST, LAITANCE, ETC.
3. DRAIN PIPE PERFORATIONS SHALL BE 3/8"ø HOLES SPACED 120° RADIALLY AND 6" ALONG AXIS OF PIPE.
4. FLOAT SWITCH CIRCUITS SHALL BE INTRINSICALLY SAFE.
5. PIPE SUPPORT NOT SHOWN. CONTRACTOR SHALL PROVIDE SUPPORTS AND RESTRAINTS AS REQUIRED TO SECURE THE PIPE SYSTEM IN THE MANHOLES.
6. PROVIDE FULL-FACE VITON GASKET FOR ALL FLANGE CONNECTIONS.
7. CONTAINMENT PIPES ARE TO BE LEFT OPEN-ENDED IN MANHOLES UNLESS OTHERWISE NOTED.
8. FORCE MAIN PIPING SHALL BE SDR-17 CARRIER PIPE WITHIN SDR-17 CONTAINMENT PIPE UNLESS OTHERWISE NOTED.
9. ALUMINUM HATCH SHALL BE U.S.F. FABRICATION TYPE WAPS (FLOODTIGHT/GASTIGHT) WITH STAPLE FOR PADLOCK. HATCH SHALL BE CAST INTO CHAMBER COVER.

Force Main Air Release Chamber (46/6 46/7)
Not to Scale

CMA ENGINEERS

JAN 2011

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Details
Temporary Environmental Controls

16

TECHNICAL SPECIFICATIONS

Appendix A

Boring Logs

MAINE TEST BORINGS, INC. BREWER, MAINE 04412	CLIENT American Waste Disposal	SHEET 1 OF 2 HOLE NO. 102
DRILLER Ervin Giguere	PROJECT NAME Landfill wells	LINE & STATION
M.S. JOB NUMBER 84-157	LOCATION Bethlehem, New Hampshire	OFFSET

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BARREL	
AT ____ FT. AFTER ____ HOURS	TYPE	NW	SS		DATE START 9-6-84 DATE FIN. 9-10-84
AT ____ FT. AFTER ____ HOURS	SIZE I.D.	3"	1 3/8"		SURFACE ELEV.
	HAMMER WT.	300	140		GROUND WATER ELEV.
	HAMMER FALL	16"	30"		

CASING BLOWS PER FOOT	SAMPLE NO.	O.D.	PEN.	REC.	DEPTH @ BOT.	BLOWS PER 6" ON SAMPLER 0-6	6-12	12-18	VANE READING	DEPTH	STRATUM DESCRIPTION
Probe											Brown silty fine sand.
Auger										3.0	
"											Brown gravelly medium to coarse sand.
"											
"											
"	1D	2"	18"		6.5	6	10	19			
"											
"											
"											
"	2D	2"	6"		10.5	100	+			10.0	
"											Brown gravelly medium to coarse sand w/ cobbles.
"											
"											
"											
"											
"	3D	2"	18"		16.5	26	31	30			
"											
"											
"											
"											
17	4D	2"	18"		21.5	89	110	132			
32											
47											
52											
59											
16	5D	2"	18"		26.5	55	68	74			
12											
10											
9											
10											
11	6D	2"	18"		31.5	23	37	39			
10											
9											
10											
8											
11	7D	2"	18"		36.5	37	53	89			
12											
14										38.0	
17											
23											

SAMPLES
D = Split Spoon
C = 2" Shelby Tube
U = 3½" Shelby Tube

SOIL CLASSIFIED BY:
[X] Driller - Visually
[ ] Soil Technican - Visually.
[ ] Laboratory Tests

REMARKS:

HOLE NO. 102

MTB-14

MAINE TEST BORINGS, INC. BREWER, MAINE 04412	CLIENT American Waste Disposal	SHEET 2 OF 2 HOLE NO. 102
DRILLER Ervin Giguere	PROJECT NAME Landfill wells	LINE & STATION
M.B. JOB NUMBER 84-157	LOCATION Bethlemen, New Hampshire	OFFSET

GROUND WATER OBSERVATIONS

AT _____ FT. AFTER _____ HOURS

AT _____ FT. AFTER _____ HOURS

	CASING	SAMPLER	CORE BARREL
TYPE	NW	SS	
SIZE I.D.	4"	1 3/8"	
HAMMER WT.	300	140	
HAMMER FALL	16"	30"	

DATE START 9-6-84 DATE FIN. 9-10-84

SURFACE ELEV. _____

GROUND WATER ELEV. _____

CASING BLOWS PER FOOT	SAMPLE NO.	O.D.	PEN.	REC.	DEPTH @ BOT	BLOWS PER 6" ON SAMPLER 0-6	6-12	12-18	VANE READING	DEPTH	STRATUM DESCRIPTION
16	8D	2"	18"		41.5	22	37	39			Brown sandy silt w/trace of gravel.
17											
16											
18											
12										45.0	
23	9D	2"	18"		46.5	47	60	78			Gray gravelly sandy silt.
26											
27											
29											
12											
23	10D	2"	18"		51.5	46	86	97			
26											
27											
29											
31											
29	11D	2"	12"		56.0	157	225				
33										57.0	
42											Gray sandy silt w/trace of gravel.
51											
56											
72	12D	2"	12"		61.0	113	200			61.0	
108											
273											
496											
637											
											Bottom of boring @ 61.0' Installed well.

SAMPLES
D = Split Spoon
C = 2" Shelby Tube
U = 3¼" Shelby Tube

SOIL CLASSIFIED BY:
[XX] Driller - Visually
[ ] Soil Technican - Visually
[ ] Laboratory Tests

REMARKS:

HOLE NO. 102

MTB-14

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT: Sanco Landfill, Bethlehem, NH

REPORT OF BORING NUMBER B-102S
SHEET 1 OF 1
DATE 12/18/86 FILE D-20002

BORING CO. Maine Test Borings, Inc.
FOREMAN Ervin Giquere
GZA ENGINEER Mitch Plummer

BORING LOCATION See exploration location plan
GROUND ELEV. 1335.4 MSL
DATE STARTED 12/18/86 DATE ENDED 12/19/86

CASING
SIZE: SSA to 10', NW to 25'
HAMMER: 300 lb.
FALL: 16"

SAMPLER
TYPE: 1-3/8" Std. SS OTHER:
HAMMER: 140 lb.
FALL: 30"

GROUNDWATER READINGS

DATE	DEPTH	CASING AT	STABILIZATION TIME
12/23	35.4	piez.	4 days

DEPTH	CAS. BL. /FT.	SAMPLE NO.	PEN./REC.	DEPTH	BLOWS/6"
10	10				
	12				
	27				
	158				
15	214				
	68				
	93				
	78				
	127				
20	233				
	39				
	36				
	38				
	27				
25	23				

SAMPLE DESCRIPTION

No samples obtained.

Bottom of boring at 38.5'

STRATA CHG. and GEN. DESC.

14'
14.7'
BOULDER
38.5'

EQUIPMENT INSTALLED

1.0' CONCRETE SEAL
BENTONITE SEAL
2.0'
PROTECTIVE CASING
WASHED SAND
1½" PVC RISER PIPE
15.0'
BENTONITE SEAL
18.0'
COLLAPSED FORMATION
20.0'
BENTONITE SEAL
21.0'
23.4'
FILTER SAND
1½" PVC SLOTTED WELLSCREEN
38.3'
38.5'
COLLAPSED FORMATION

RMKS.: 1, 2, 3, 4, 5

REMARKS:
1. No samples taken; refer to boring B-102 drilled by Maine Test Borings, Inc. on 9-10/11-84 for stratigraphy.
2. On 12/18/86 boring B-102S encountered obstruction and refusal to augers at 15.8'. Boring was subsequently relocated approximately 10' north of first attempt and continued.
3. No refusal encountered.
4. Washed ahead of casing from 10' to bottom of boring.
5. Groundwater monitoring well with 7' x 3" ID protective steel casing equipped with vented locking cap installed at completion of boring. 2.9' stick-up above ground surface.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORINGS LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO FACTORS NOT ACCOUNTED FOR AT THE TIME MEASUREMENTS WERE MADE.

MAINE TEST BORINGS, INC. BREWER, MAINE 04412	CLIENT American Waste Disposal	SHEET 1 OF 2 HOLE NO. 103
DRILLER Kevin Giguere	PROJECT NAME Landfill wells.	LINE & STATION
JOB NUMBER 84-157	LOCATION Bethlehem, New Hampshire	OFFSET

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BARREL	
AT ____ FT. AFTER ____ HOURS	TYPE	NW	SS		DATE START 9-10-84 DATE FIN. 9-11-84
	SIZE I.D.	3"	1 3/8"		SURFACE ELEV.
AT ____ FT. AFTER ____ HOURS	HAMMER WT.	300	140		GROUND WATER ELEV.
	HAMMER FALL	16"	30"		

CASING BLOWS PER FOOT	SAMPLE NO.	O.D.	PEN.	REC.	DEPTH @ BOT.	BLOWS PER 6" ON SAMPLER 0-6	6-12	12-18	VANE READING	DEPTH	STRATUM DESCRIPTION
Probe											
Auger											Brown gravelly sandy silt w/cobbles & boulders.
"											f-c SA,
"											
"											
"	1D	2"	18"		6.5	30	49	48			
"											
"										8.0	
"											
"											
"											
17	2D	2"	18"		11.5	57	78	110			Brown gravelly fine to coarse sand w/ cobbles.
27											
34											
51											
63											
17	3D	2"	18"		16.5	79	56	71			
14											
14											
17											
21											
12	4D	2"	18"		21.5	39	51	63			
12											
11											
13											
17											
11	5D	2"	18"		26.5	47	81	110			
21											
12											
13											
15											
13	6D	2"	18"		31.5	62	119	137			
16											
17											
16											
17											
19	7D	2"	18"		36.5	37	53	96			
16											
18										38.0	
19											
19											

SAMPLES
D = Split Spoon
C = 2" Shelby Tube
U = 3½" Shelby Tube

SOIL CLASSIFIED BY:
[XX] Driller - Visually
[ ] Soil Technican - Visually
[ ] Laboratory Tests

REMARKS:

HOLE NO. 103

MTB-14

MAINE TEST BORINGS, INC. BREWER, MAINE 04412	CLIENT American Waste Disposal	SHEET 2 OF 2 HOLE NO. 103
DRILLER Ervin Giguere	PROJECT NAME Landfill wells.	LINE & STATION
M.T.B. JOB NUMBER 84-157	LOCATION Bethlehem, New Hampshire	OFFSET

GROUND WATER OBSERVATIONS

AT _____ FT. AFTER _____ HOURS

AT _____ FT. AFTER _____ HOURS

	CASING	SAMPLER	CORE BARREL
TYPE	NW	SS	
SIZE I.D.	3"	1 3/8"	
HAMMER WT.	300	140	
HAMMER FALL	16"	30"	

DATE START 9-10-84 DATE FIN. 9-11-84

SURFACE ELEV. _____

GROUND WATER ELEV. _____

CASING BLOWS PER FOOT	SAMPLE NO.	O.D.	PEN.	REC.	DEPTH @ BOT.	BLOWS PER 6" ON SAMPLER 0-6	6-12	12-18	VANE READING	DEPTH	STRATUM DESCRIPTION
16	8D	2"	18"		41.5	21	22	28			Brown gravelly sandy silt.
17											
19											
20											
21											
	9D	2"	18"		46.5	22	29	51		47.0	
											Refusal @ 47.0' Installed well.

SAMPLES

D = Split Spoon

C = 2" Shelby Tube

U = 3½" Shelby Tube

SOIL CLASSIFIED BY:

[X] Driller - Visually

[ ] Soil Technican - Visually

[ ] Laboratory Tests

REMARKS:

HOLE NO. 103

MTB-14

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT: Sanco Landfill, Bethlehem, NH

REPORT OF BORING NUMBER B-103D
SHEET 1 OF 2
DATE 12/9/86 FILE D-20002

BORING CO. Maine Test Boring
FOREMAN Tom Schaefer
GZA ENGINEER Mitch Plummer

BORING LOCATION See exploration location plan
GROUND ELEV. 1333.0 MSL
DATE STARTED 12/9/86 DATE ENDED 12/10/86

CASING
SIZE: S.S.A to 15', NW to 49'
HAMMER: 300 lb.
FALL: 16"

SAMPLER
TYPE: 1 3/8" I.D. Std. SS OTHER:
HAMMER: 140 lb.
FALL: 30"

GROUNDWATER READINGS

DATE	DEPTH	CASING AT	STABILIZATION TIME
12/23	35.6	piez.	13 days

DEPTH	CAS. BL./FT.	SAMPLE NO.	PEN./REC.	DEPTH	BLOWS/6"	SAMPLE DESCRIPTION	STRTA. CHG. and GEN. DESC.	EQUIPMENT INSTALLED	RMKS.
								CONCRETE	
								0.5' SEAL	
								PROTECTIVE CASING	
								WASHED SAND	
5								4.5' BENTONITE SEAL 5.0'	
10								WASHED SAND	
15						No Samples taken 0'-45'.			1
								18.2' BENTONITE SEAL 19.4'	
20	3								
	3								
	11								
	21								
25	39							1½" PVC RISER PIPE	
	82								
	89								
	205								
	95								
30	87								
	19								
	24								
	56								
	85							WASHED SAND	
35	178								
	18								
	19								
	27								
	28								
	90								
40	30							40.7'	
	52							BENTONITE SEAL	
	94								
	125							43.3'	
	185							44.5'	
45	47	S-1	18/12	45-46.5	52-65-115	Very dense, gray-green, SILT, trace fine Sand.	SILT		
	68							1½" SLOTTED PVC WELL SCREEN	
	92						48.3'		
	110						BOULDER	FILTER SAND	2
	75								

REMARKS: 1. Refer to boring B-103 drilled by Maine Test Borings, Inc. on 9-10/11-84 for stratigraphy.
2. Boulder encountered at approximately 48.3'; roller bit advanced to approximately 49.2'; cored to approximately 52' through 1 boulder.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORINGS LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO FACTORS NOT ACCOUNTED FOR AT THE TIME MEASUREMENTS WERE MADE.

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT: Sanco Landfill, Bethlehem, NH

REPORT OF BORING NUMBER B-103D
SHEET 2 OF 2
DATE 12/10/86 FILE D-20002

BORING CO. Maine Test Boring
FOREMAN Tom Schaefer
GZA ENGINEER Mitch Plummer

BORING LOCATION See exploration location plan
GROUND ELEV. 1333.0 MSL
DATE STARTED 12/09/86 DATE ENDED 12/10/86

CASING
SIZE: S.S.A to 15', NW to 49'
HAMMER: 300 lb.
FALL: 16"

SAMPLER
TYPE: 1 3/8" I.D. Std. SS OTHER:
HAMMER: 140 lb.
FALL: 30"

GROUNDWATER READINGS

DATE	DEPTH	CASING AT	STABILIZATION TIME

DEPTH	CAS. BL. /FT.	SAMPLE NO.	PEN./REC.	DEPTH	BLOWS/6"	SAMPLE DESCRIPTION	STRATA CHG. and GEN. DESC.	EQUIPMENT INSTALLED	RMKS.
50							52'	FILTER SAND	
55		S-2	6/6	55-55.5	130	Very dense, gray-green, fine to coarse SAND, some Silt, trace Gravel	SILTY SAND	1½" SLOTTED PVC WELL SCREEN	
60						No Recovery.	60.2'	60'	3
		S-3	2/0	60-60.2	100/2"	Bottom of Boring @ 60.2'.			4 5

REMARKS:
3. Washed ahead of casing from 10' to bottom of boring.
4. No refusal encountered.
5. Groundwater monitoring well with 7' x 3" ID protective steel casing equipped with a vented locking cap installed at completion of boring. 3' stickup above ground surface.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORINGS LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO FACTORS NOT ACCOUNTED FOR AT THE TIME MEASUREMENTS WERE MADE.

GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

Bethlehem, NH

SHEET 1 OF 1
DATE 9/22/87 FILE 11-20002.2

BORING CO. Maine Test Borings, Inc.
FOREMAN Irving Giguere
GZA ENGINEER Doug Lansing

BORING LOCATION See Exploration Location Plan 404U
GROUND ELEV. 1348.65 Site Datum
DATE STARTED 9/21/87 DATE ENDED 9/22/87

CASING	SAMPLER
SIZE: 5SA to 10', NW to 45'	TYPE: 2" x 18" split spoon OTHER:
HAMMER: 300 lb	HAMMER: 140 lb
FALL: 30	FALL: 30"

GROUNDWATER READINGS

DATE	DEPTH	CASING AT	STABILIZATION TIME
9/25	41.9	screened	48 hours

DEPTH	CAS. BL. /FT.	SAMPLE NO.	PEN./REC.	DEPTH	BLOWS/6"	SAMPLE DESCRIPTION	STRTA. CHG. and GEN. DESC.	EQUIPMENT INSTALLED	RMKS.
						No Samples Obtained.	GLACIAL TILL	PROTECTIVE CASING; CEMENT/BENTONITE SEAL; -4'; 1½" PVC RISER PIPE; FILTER SAND AND FORMATION MATERIAL; 36.5'; BENTONITE SEAL; 38'; 40.4'; 1½" PVC (.01" slotted) WELL SCREEN; FILTER SAND	1
							47' STRATIFIED DRIFT		

Bottom of boring at 51'.

REMARKS: 1. No samples obtained, refer to B-404L for stratigraphy.
2. Monitoring well with 4.5' x 3" protective steel casing equipped with a vented locking cap installed at completion of boring.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORINGS LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO FACTORS NOT ACCOUNTED FOR AT THE

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT: Sanco Landfill, Bethlehem, NH

REPORT OF BORING NUMBER ____ SHEET 1 OF 1 DATE 9/8/87 FILE D-20002.2

4 of L

BORING CO. Maine Test Borings, Inc.
FOREMAN Irving Glowere
GZA ENGINEER Doug Lansing

BORING LOCATION See Exploration Location Plan
GROUND ELEV. 1348.42 Site Datum
DATE STARTED 9/8/87 DATE ENDED 9/21/87

CASING
SIZE: SSA to 5', NW to 107', BX to 142'
HAMMER: 300 lb.
FALL: 20

SAMPLER
TYPE: 2" x 18" split spoon OTHER:
HAMMER: 140 lb.
FALL: 30"

GROUNDWATER READINGS

DATE	DEPTH	CASING AT	STABILIZATION TIME

DEPTH	CAS. BL. /FT.	SAMPLE NO.	PEN./REC.	DEPTH	BLOWS/6"	SAMPLE DESCRIPTION	STRATA CHG. OR GEN. DESC.	EQUIPMENT INSTALLED	RMKS.
								PROTECTIVE CASING; CEMENT/BENTONITE SEAL; 4'	1
5	26, 96, 155, 115, 185	S-1	18/18	5-6.5	35-42-51	Very dense, olive-brown, fine to coarse SAND, some Silt, trace fine Gravel.	GLACIAL TILL; 8' BOULDER		
10	6, 6, 11, 17, 42	S-2	18/18	10-11.5	24-24-26	Dense, olive-brown, fine to medium SAND, some Silt, trace Gravel.	10' GLACIAL TILL	14" PVC RISER PIPE	
15	19, 26, 54, 47, 49	S-3	18/16	15-16.5	17-19-22	Dense, olive-brown, fine to medium SAND, some Silt, trace Gravel.			
20	27, 23, 42, 110, 173	S-4	12/5	20-21	63-100	Very dense, olive-brown, fine to medium SAND and Gravel, trace Silt.	21' BOULDER 22'	FILTER SAND AND FORMATION MATERIAL	
25	81, 78, 92, 132, 164	S-5	12/2	25-26	67-100	Very dense, olive-brown, GRAVEL and fine Sand, little Silt.	GLACIAL TILL		2
30	41, 53, 70, 64, 51	S-6	18/18	30-31.5	24-47-53	Very dense, olive-brown, SILT, trace fine Sand.			
35	63, 99, 96, 149, 102	S-7	6/6	35-35.5	95/6"	Very dense, olive-brown, SILT and fine Sand, trace medium to coarse Sand.			
40	95, 98, 179, 88, 89	S-8	18/16	40-41.5	48-62-71	Very dense, olive-brown, fine SAND, trace Silt.	43' STRATIFIED DRIFT	41'; BENTONITE SEAL; 44.5'	
45	137, 159, 173, 198, 340	S-9	12/6	45-46	52-97	Very dense, olive-brown, fine SAND and Silt, with layers of medium to coarse Sand, trace fine Gravel.		FORMATION MATERIAL	
50									

REMARKS:
1. Washed ahead of casing with bit from 10 feet.
2. Shoe of split spoon broke off in hole at 11 feet, moved rig 10 feet north and drilled to refusal at 8 feet, moved 5 feet and drove casing to 20 feet when casing broke leaving 10 feet of NW casing in hole. Moved rig 5 feet again and completed the boring.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORINGS LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO FACTORS NOT ACCOUNTED FOR AT THE TIME MEASUREMENTS WERE MADE.

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT: Sanco Landfill, Bethlehem, NH

REPORT OF BORING NUMBER: [illegible]-124
SHEET: 2 OF: [illegible]
DATE: 9/10/87 FILE: D-200-02.2

404L

BORING CO.: Maine Test Borings, Inc.
FOREMAN: Irving Giguere
GZA ENGINEER: Doug Lansing

BORING LOCATION: See Exploration Location Plan
GROUND ELEV.: 1348.42 Site Datum
DATE STARTED: 9/8/87 DATE ENDED: 9/21/87

CASING
SIZE: SSA to 5', NW to 107', BX to 142'
HAMMER: 300 lb
FALL: 24

SAMPLER
TYPE: 2" x 18" split spoon OTHER:
HAMMER: 140 lb
FALL: 30"

GROUNDWATER READINGS

DATE	DEPTH	CASING AT	STABILIZATION TIME

DEPTH	CAS. BL./FT.	SAMPLE NO.	PEN./REC.	DEPTH	BLOWS/6"	SAMPLE DESCRIPTION	STRTA. CHG and GEN. DESC.	EQUIPMENT INSTALLED	RMKS.
	208	S-10	0/0	50	75/0"	No Recovery.			1
	224								
	363								
	147								
	154								
55	161								
	157								
	126								
	115								
	265								
60	75	S-11	18/16	60-61.5	32-65-53	Very dense, olive-brown, fine to coarse SAND, trace fine Gravel, trace Silt.		1½" PVC RISER PIPE	
	81								
	76								
	77								
	293								
65	87						STRATIFIED DRIFT		
	86								
	81								
	87								
	176								
70	120	S-12	18/16	70-71.5	43-52-57	Very dense, olive-brown, SILT with 1/8" - 1/4" thick layers of Clayey SILT or fine Sand.			
	310								
	126						73.4'		
	86						BOULDER		
75	87						74		
	94								
	124								
	123						78'	COLLAPSED FORMATION MATERIAL	
	115						BOULDER		
80	273						79.1'		
	95	S-13	18/5	80-81.5	76-81-93	Very dense, olive-brown, fine to coarse SAND, little Gravel, little Silt.			
	161								
	497								
	469								
85	517								
	87								
	348								
	478								
	398								
90	84								
		S-14	11/10	90-90.6	70-150/5"	S-14: Very dense, olive-brown, fine to coarse SAND, some Gravel, little Silt.			
		S-14A				S-14A: Very dense, gray, SILT and fine Sand, trace fine Gravel.	STRATIFIED DRIFT		
95									
100									

REMARKS: 1. No penetration with sampler, probable cobble.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORINGS LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO FACTORS NOT ACCOUNTED FOR AT THE TIME MEASUREMENTS WERE MADE.

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT: Sanco Landfill, Bethlehem, NH

REPORT OF BORING NUMBER: B-404L
SHEET: 3 OF: 3
DATE: 9/14/87 FILE: D-20002.2

4O4L

BORING CO.: Maine Test Borings, Inc.
FOREMAN: Irving Giguere
GZA ENGINEER: Doug Lansing

BORING LOCATION: See Exploration Location Plan
GROUND ELEV.: 1346.42
DATE STARTED: DATE ENDED:

CASING
SIZE: SSA to 5', NW to 107', BX to 142'
HAMMER: 300 lb
FALL: 20

SAMPLER
TYPE: 2" x 18" split spoon OTHER:
HAMMER: 140 lb
FALL: 30"

GROUNDWATER READINGS

DATE	DEPTH	CASING AT	STABILIZATION TIME

DEPTH	CAS. BL. /FT.	SAMPLE NO.	PEN./REC.	DEPTH	BLOWS/6"	SAMPLE DESCRIPTION	STRTA. CHG and GEN. DESC.	EQUIPMENT INSTALLED	RMKS.
		S-15	12/5	100-101	36/163	Very dense, gray, SILT, trace fine Sand.		FORMATION MATERIAL	
105								106'	
							STRATIFIED DRIFT	BENTONITE SEAL	4, 5
110		S-16	6/6	110-110.5	150/6"	Very dense, gray, fine SAND, little Silt.		111.5'	
115									
120		S-17	5/5	120-120.4	42/4"	Very dense, gray, SILT and fine Sand with one 1/4" thick Clayey SILT layer.		FORMATION MATERIAL	
125									
130		S-18	6/6	130-130.5	167/6"	Very dense, gray, SILT and fine SAND with two 1/2" thick Clay layers.	131.5'	131.4'	6
135							GLACIAL TILL	1½" PVC (.01" slotted) WELL SCREEN; FILTER SAND	
140		S-19	12/12	140-141	82-73	Very dense, gray, SILT and fine to medium Sand.	142'	141'; 142'	
						Bottom of boring at 142'.			

REMARKS:
4. NW casing could not be driven past 107 feet.
5. Washed ahead open hole from 90 to 132 feet and placed BX casing to 132 feet, BX (2½") casing then used to advance hole from 132 to 142 feet.
6. Gravel and cobbles encountered from 132 to 142 feet accompanied by a loss of drilling water into the formation.
7. Monitoring well with 7' x 3" I.D. protective steel casing equipped with a vented locking cap installed at completion of boring.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORINGS LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO FACTORS NOT ACCOUNTED FOR AT THE TIME MEASUREMENTS WERE MADE.

Sanborn, Head & Associates, Inc.

Log of Monitoring Well MW-801

PROJECT NO.: *1560.1*

PROJECT: *NCES Stage II/Phase II Construction*

DATE STARTED: *11/24/98* DATE FINISHED: *11/24/98*

LOCATION: *Bethlehem, New Hampshire*

SURFACE ELEVATION: *1344.5 (NAVD '88)*

DRILLING METHOD: *Mobile B-57 w/4-1/4" ID HSA*

DRILLING COMPANY: *Tri-State Drilling and Boring*

FOREMAN: *Wayne Ault*

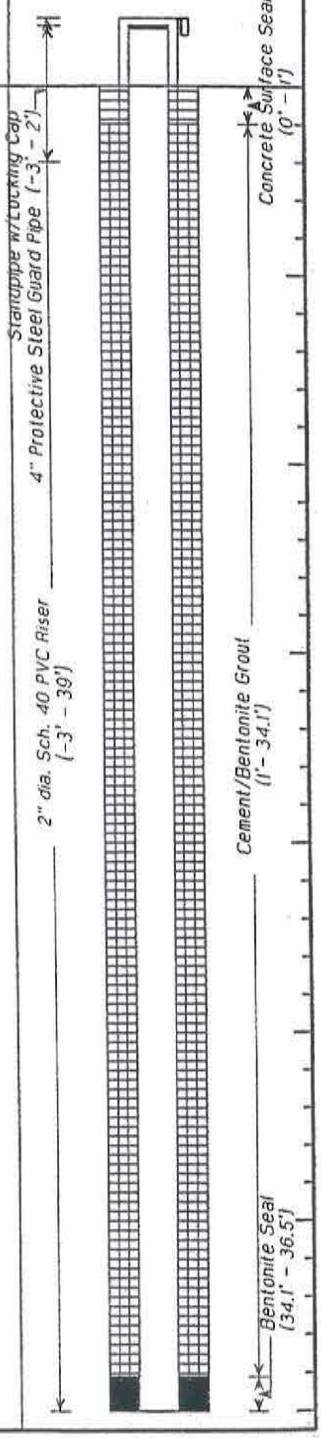
LOGGED BY: *DRP* CHECKED BY: *RSS*

GROUNDWATER READINGS

DATE	TIME	DEPTH	CASING	STAB. TIME
11/24/98	1240	41.26' PVC	Well Inst.	1 hr.

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
5							FILL	No samples obtained. See boring log 801A.
10								
15	S-1 15-17'	5-9 16-18	24/7				STRATIFIED DRIFT	S-1: Medium dense, Olive-gray, fine to medium SAND, and Silt, trace Gravel; three 1/2-1" thick stratified Sand seams. Dry.
20	S-2 20-22'	12-14 12-20	24/17					S-2: Medium dense, gray, fine to coarse SAND, trace Gravel, trace Silt. Stratified. Dry.
25	S-3 25-27'	5-12 18-22	24/15					S-3: Dense, gray, fine to medium SAND, trace Gravel, trace Silt. Stratified. Dry.
30	S-4 30-32'	12-33 41-40	24/17					S-4: Very dense, light-brown-gray, fine to coarse SAND, some Gravel, trace Silt; 1" thick fine Sand and Silt seam at 41.5'. Dry.
35								

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Monitoring Well MW-801

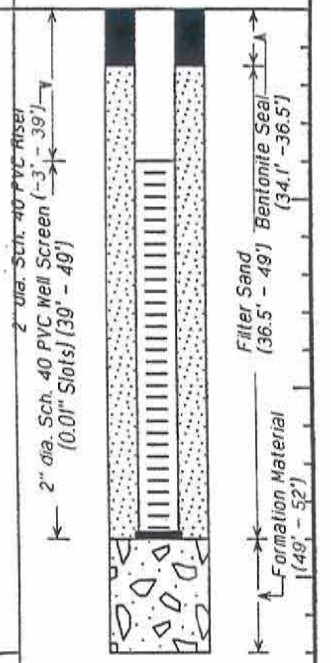
PROJECT NO.: *1560.1*

PROJECT: *NCES Stage II/Phase II Construction*

DATE STARTED: *11/24/98* DATE FINISHED: *11/24/98*

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
	S-5 35-37'	15-23 32-39	24/15					S-5: Very dense, light brown, fine to coarse SAND, some Gravel, trace Silt. Dry.
40	S-6 40-42'	5-9 40-42	24/17					S-6: Dense, dark gray, fine SAND and SILT. Wet.
							STRATIFIED DRIFT	
45	S-7 45-47'	5-8 12-15	24/19					S-7: Medium Dense, dark gray, fine SAND and SILT. Wet.
50	S-8 50-51'	5-10 12-18	12/6					S-8: Very stiff, dark gray, SILT and CLAY:
	S-8A 51-52'		12/6					S-8A: Change at 51' to blue, Clayey SILT. Wet.
								Bottom of Boring at 52'.
55								
60								
65								
70								
75								

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Monitoring Well MW-801A

PROJECT NO.: *1560.1*

PROJECT: *NCES STAGE II/PHASE II CONSTRUCTION*

DATE STARTED: *9/18/98* DATE FINISHED: *9/18/98*

LOCATION: *Bethlehem, New Hampshire*

SURFACE ELEVATION: *1338±*

DRILLING METHOD: *Mobile B-57 w/4-1/4" ID HSA*

DRILLING COMPANY: *Tri State Drilling and Boring*

FOREMAN: *Wayne Ault*

LOGGED BY: *DRP* CHECKED BY: *RSS*

GROUNDWATER READINGS

DATE	TIME	DEPTH	CASING	STAB. TIME

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION	REMARKS
	S-1 0-2'	2-1 1-2	24/14	ND			FILL	S-1: Very loose, brown, fine SAND, some Silt, trace Gravel, trace Organic Material. Dry. FILL.	
5	S-2 5-7'	4-3 1-2	24/0	ND				S-2: No Recovery.	
10	S-3 10-12'	3-4 6-10	24/15	ND				S-3: Loose, olive-brown, fine to medium SAND, little Silt, trace Gravel. Dry.	
								Bottom of Boring at 12.5' at Auger Refusal.	
15								**Notes:** 1. Hole moved 4.5' NW. No well installed.	
20									
25									
30									
35									

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT: Sanco Landfill, Bethlehem, NH

REPORT OF BORING NUMBER P-1
SHEET 1 OF 2
DATE 12/29/86 FILE D-20002

BORING CO. Heine Test Borings, Inc.
FOREMAN Ervin Gilmore
GZA ENGINEER Hitchcock Plummer

BORING LOCATION See exploration location plan
GROUND ELEV. 1320 MSL
DATE STARTED 12/29/86 DATE ENDED 12/31/86

CASING: SIZE: SSA to 10'; NW casing to 20'; HAMMER: 300 lb.; FALL: 16"

SAMPLER: TYPE: Standard split-spoon; OTHER:; HAMMER: 400 lb.; FALL: 30"

GROUNDWATER READINGS

DATE	DEPTH TO WATER	CASING AT	TIME TAKEN

DEPTH	CAS. BL./FT.	SAMPLE NO.	PEN./REC.	DEPTH	BLOWS/6"	SAMPLE DESCRIPTION	STRATA CHG. ORG. GEN. DESC.	EQUIPMENT INSTALLED	RMKS.
		S-1	24/21	2-4	8-23-32-31	Very dense, gray-brown, fine to coarse SAND, some Silt, little Gravel.	SILTY SAND		
							4'		
5		S-2	24/21	4-6	29-42-73-71	Very dense, gray, fine SAND, little Silt, trace Gravel.			
		S-3	24/15	6-8	53-79-83-82	Very dense, gray, fine SAND, little Silt, trace Gravel.			1
	31	S-4	24/22	8-10	32-57-72-93	Very dense, gray, fine SAND, little Silt, trace Gravel.	SILTY FINE SAND		
	29								
10	54	S-5	24/12	10-12	29-30-34-95	Very dense, gray, fine SAND, some Silt, trace Gravel.			2
	37								
	169	S-6	24/14	12-14	125-79-46-59	Very dense, gray, fine SAND, little Silt, little Gravel.			3
	151								
	81	S-7	24/12	14-16	51-41-71-69	Very dense, gray-brown, fine to medium SAND, little Silt, little Gravel.	14'		
15	87						SAND		
	70	S-8	24/17	16-18	43-36-61-98	Very dense, brown, fine to medium SAND, little Silt, trace Gravel.			
	213						18'		
	109	S-9	12/11	18-19	76-193	Very dense, gray-brown, fine to coarse SAND, some Silt, trace Gravel.			
	463								
20		S-10	18/15	20-21	141-141-203	Very dense, brown, fine to coarse SAND, some Gravel, little Silt.	SILTY SAND		
		S-11	11/11	22-23	142-217/5"	Very dense, brown, fine to coarse SAND, some Silt, little Gravel.			
25		S-12	17/16	24-25.4	59-27-200/5"	Very dense, gray-brown, fine to coarse SAND, some Silt, little Gravel.			

REMARKS:
1. S-3" 2" brown, fine to coarse SAND, some Silt, at top of sample.
2. S-5: Some thin laminae of Silty SAND.
3. S-6: One broken cobble in spoon.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORINGS LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO FACTORS NOT ACCOUNTED FOR AT THE TIME MEASUREMENTS WERE MADE.

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT: Sanco Landfill, Bethlehem, NH

REPORT OF BORING NUMBER: P-1
SHEET 2 OF 2
DATE 12/30/86 FILE D-20002

BORING CO. Maine Test Borings, Inc.
FOREMAN Kevin Gildere
GZA ENGINEER Mitchell Plumer

BORING LOCATION See exploration location plan
GROUND ELEV. 1320 MSL
DATE STARTED 12/29/86 DATE FINISHED 12/31/86

CASING
SIZE: SSA to 10' - NX to 20'
HAMMER: 300 lb.
FALL: 16"

SAMPLER
TYPE: Standard split-spoon OTHER:
HAMMER: 140 lb.
FALL: 30"

GROUNDWATER READINGS

DATE	DEPTH	TIME OF	STABILIZATION TIME

DEPTH	CAS. BL. /FT.	SAMPLE NO.	PEN./REC.	DEPTH	BLOWS/6"	SAMPLE DESCRIPTION	STRATA CHG. GRA. DESC.	EQUIPMENT INSTALLED	RMKS.
							26'		
		S-13	24/23	26-28	35-42-56-51	Very dense, gray, SILT and fine to coarse Sand, little Gravel.			
		S-14	24/23	28-30	47-56-62-57	Very dense, bluish-gray, SILT and fine to coarse Sand, little Gravel. No Plasticity.	SANDY SILT		
30		S-15	24/24	30-32	18-26-32-38	Very dense, bluish-gray, SILT and fine to coarse SAND, little Gravel. No Plasticity.			
		S-16	24/24	32-34	22-27-33-42	Very dense, bluish-gray, SILT and fine to coarse Sand, little Gravel. No Plasticity.			
35		S-17	24/24	34-36	20-32-42-56	Very dense, bluish-gray, SILT and fine to coarse SAND, little Gravel. No Plasticity.	36'		
		S-18	24/24	36-38	27-39-47-56	Hard, bluish-gray, SILT & CLAY, some fine Sand, trace Gravel. Low plasticity.	SANDY SILT & CLAY		
		S-19	19/18	38.4-40	37-43-52-51/1"	Very dense, brown, fine to medium SAND & Gravel, little Silt.	38.1' Coarse 38.4' GRAVELLY SAND		
40'						BOTTOM OF BORING @ 40.0'.	40.0'		5, 7

REMARKS:
4. Unable to allow reasonable stabilization time; no groundwater readings.
5. No refusal encountered.
6. Washed ahead of casing from 10' to bottom of boring.
7. Boring sealed with bentonite/cement grout upon completion.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORINGS LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO FACTORS NOT ACCOUNTED FOR AT THE TIME MEASUREMENTS WERE MADE.

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT: Sanco landfill, Bethlehem, NH

REPORT OF BORING NUMBER P-4
SHEET 1 OF 2
DATE 12/22/86 FILE D-20002

BORING CO. Maine Test Boring
FOREMAN Ervin Cloutier
GZA ENGINEER Mitch Plumer

BORING LOCATION See exploration location plan
GROUND ELEV. 1341 MSL
DATE STARTED 12/22/86 DATE ENDED 12/29/86

CASING: SIZE SSA to 9', HW to 35'; HAMMER: 300 lb.; FALL: 16"

SAMPLER: TYPE: 1 3/8" I.D. Std. SS; HAMMER: 140 lb.; FALL: 30"; OTHER: "

GROUNDWATER READINGS

DATE	DEPTH	CASING AT	STABILIZATION TIME
12/24	33.1	35'	Overnight
12/29	35.5	30'	5 days

DEPTH	CAS. BL. /FT.	SAMPLE NO.	PEN./REC.	DEPTH	BLOWS/6"	SAMPLE DESCRIPTION	STRATA CHG. GEN. DESC.	EQUIPMENT INSTALLED	RMKS.
							TOPSOIL 1'		
		S-1	18/12	1-2.5	6-7-24	Dense, brown, fine to medium SAND, some Silt, some Gravel.	SILTY SAND		
		S-2	18/12	2.5-4	21-27-103	Very dense, gray-brown, fine to medium SAND, some Silt, some Gravel.	4'		
5		S-3	18/13	4-5.5	24-23-40	Very dense, gray, fine to coarse SAND, little Silt, trace Gravel.			
		S-4	24/20	5.5-7.5	27-40-35-42	Very dense, gray, fine to coarse SAND, little Silt, trace Gravel.	SAND		
		S-5	18/12	7.5-9	24-29-36	Very dense, gray, fine to coarse SAND, little Silt, trace Gravel.			
10	19 / 21	S-6	24/16	9-11	10-14-23-24	Dense, gray-brown, fine SAND, little Silt.	9"		
	47 / 119	S-7	18/12	11-12.5	21-23-24	Dense, gray-brown, fine SAND, little Silt.	FINE SAND		
	167 / 108	S-8	24/18	12.5-14.5	23-112-93-122	Very dense, gray-brown, fine SAND little Silt.	13'		
15	51	S-9	16/9	14.5-15.0	83-134-200/4"	Very dense, gray-brown, fine to coarse SAND, little Gravel, little Silt.	SAND 15.7'		
	79 / 127	S-10	18/12	16.5-18	42-72-102	Very dense, gray-brown, fine to coarse SAND; little Gravel, little Silt.	BOULDER 16.5' SAND		
	372 / 39	S-11	24/18	18-20	106-124 221-239	Very dense, gray-brown, fine to coarse SAND and Gravel, some Silt; grading to fine to coarse SAND, little Gravel, little Silt.			
20	273 / 312	S-12	5/5	20-20.4	63/5"	Very dense, dark gray, fine SAND, little Silt.	20.4' BOULDER 21.7'		
	327 / 507	S-13	24/12	22-24	32-61-68-178	Very dense, greenish-brown, fine to coarse SAND, little Silt, trace Gravel.	SAND		
	117	S-14	5/0	24-24.4	237/5"	No Recovery.	24.4' COBBLE		

REMARKS:

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORINGS LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO FACTORS NOT ACCOUNTED FOR AT THE TIME MEASUREMENTS WERE MADE.

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT: Sapco Landfill, Bethlehem, NH

REPORT OF BORING NUMBER P-5
SHEET 2 OF 2
DATE 12/22/86 FILE D-20002

BORING CO. Maine Test Boring, Inc.
FOREMAN Ervin Siquera
GZA ENGINEER Mitchell Plumer

BORING LOCATION See exploration location plan
GROUND ELEV. 1343 MSL
DATE STARTED 12/22/86 DATE ENDED 12/23/86

CASING: SIZE SSA to 9'; NW casing to 35'; HAMMER 300 lb; FALL 16"

SAMPLER: TYPE: Standard split-spoon OTHER; HAMMER 140 lb; FALL: 16"

GROUNDWATER READINGS

DATE	DEPTH	CASING AT	STABILIZATION TIME

DEPTH	CAS. BL. /FT.	SAMPLE NO.	PEN./REC.	DEPTH	BLOWS/6"	SAMPLE DESCRIPTION	STRATA CHG. AND GEN. DESC.	EQUIPMENT INSTALLED	RMKS.
	47								
	143	S-15	24/12	26-28	42-62-117	Very dense, fine to medium SAND, trace Silt.	SAND		
					123				
	469								
	44	S-16	16/12	28-29.3	32-117-182/4"	Very dense, gray-green, fine to coarse SAND, some Gravel, little Silt.			
	70						29.3' COBBLE		
30	89						29.8'		
	47								
	44	S-17	24/16	32-34	37-78-147-161	Very dense, gray-brown, fine to coarse SAND, trace Silt, trace Gravel.			
	50								
	323	S-18	18/12	34-35.5	42-90-231	Very dense, grayish-greenish, fine to coarse SAND, some Gravel, little Silt.	SAND		1 2
35									
		S-19	24/20	36-38	75-80-125-149	Very dense, gray-brown, fine to coarse SAND, little Silt, trace Gravel.			
		S-20	24/24	38-40	89-192-216-231	Very dense, brown, fine to coarse SAND, little Gravel, little Silt.			3
40							40.0'		4 5
						Bottom of Boring @ 40.0'.			

REMARKS:
1. S-18: some subtle layering of fine SILT & SAND lenses.
2. Permeability test conducted from 38' to 40'.
3. Boring sealed with bentonite/cement grout upon completion.
4. No refusal encountered.
5. Washed ahead of casing from 10' to bottom of boring.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORINGS LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO FACTORS NOT ACCOUNTED FOR AT THE TIME MEASUREMENTS WERE MADE.

.INE TEST BORINGS, INC. .EWER, MAINE 04412	CLIENT Sanco, Inc.	SHEET 1 OF 3 HOLE NO. B-202
ILLER Gerry Rudnicki	PROJECT NAME landfill	LINE & STATION
B JOB NUMBER 86-4	LOCATION Bethlehem, NH	OFFSET

GROUND WATER OBSERVATIONS

AT ____ FT AFTER ____ HOURS

AT ____ FT. AFTER ____ HOURS

	CASING	SAMPLER	CORE BARREL
TYPE	NW	SS	
SIZE I.D.	3"	1 3/8"	
HAMMER WT.	300	140	
HAMMER FALL	16"	30"	

DATE START 1/14/86 DATE FIN. 1/17/86

SURFACE ELEV. ____

GROUND WATER ELEV. ____

	CASING BLOWS PER FOOT	SAMPLE NO	O.D	PEN.	REC	DEPTH @ BOT	BLOWS PER 6" ON SAMPLER 0-6	6-12	12-18	VANE READING	DEPTH	STRATUM DESCRIPTION
	"											Brown silty fine sand w/med. to coarse sand, gravel, cobbles.
	"	D	2"	2"	0.0	2.2	100					
	"										4.0	
	"											
	62	1D	2"	12"		6.0	90	106				
	147											Brown Clay silty fine sand w/med. to coarse sand, gravel, cobbles
	296											
	313											
shed	27											
ad	29	2D	2"	8"		10.7	93	100				
"	110										11.5	
"	86											
	96											
	125											
	18											
	31	3D	2"	18"		16.5	63	56	41			Brown silty fine to med. sand w/coarse sandy gravel, cobbles.
"	43											siltier w/depth
"	62											Brown Till
	69											
	60											
	96	4D	2"	18"		21.5	51	34	27			
	88											
	88											
	75											
	53											
	50	5D	2"	18"		26.5	45	46	30			
	71										28.0	
	64											
	62											
"	44	6D	2"	12"		31.0	140	99				Brown fine to med. sand w/gravel, cobbles, trace of boulders, trace of silt.
"	80											Brown Sand and gravel
"	78										33.0	
"	165											
"	249											
"	65											
"	59	7D	2"	18"		36.5	73	47	57			Brown fine to med. sandy gravel w/cobbles & silt.
"	96											
"	170											
"	250											

SAMPLES
D = Split Spoon
C = 2" Shelby Tube
U = 3½" Shelby Tube

SOIL CLASSIFIED BY:
[X] Driller - Visually
[ ] Soil Technician - Visually
[ ] Laboratory Tests

REMARKS:

HOLE NO. B-202

TB-14

MAINE TEST BORINGS, INC. BREWER, MAINE 04412	CLIENT Sanco, Inc.	SHEET 2 OF 3 HOLE NO. B-202
DRILLER Gerry Rudnicki	PROJECT NAME Landfill	LINE & STATION
T.B. JOB NUMBER 86-4	LOCATION Bethlehem, NH	OFFSET
GROUND WATER OBSERVATIONS AT ____ FT AFTER ____ HOURS AT ____ FT. AFTER ____ HOURS	TYPE: CASING NW, SAMPLER SS, CORE BARREL ____ SIZE I.D.: 3", 1 3/8" HAMMER WT.: 300, 140 HAMMER FALL: 16", 30"	DATE START 1/14/86 DATE FIN 1/17/86 SURFACE ELEV. ____ GROUND WATER ELEV. ____

	CASING BLOWS PER FOOT	SAMPLE NO.	O.D.	PEN.	REC.	DEPTH @ BOT	BLOWS PER 6" ON SAMPLER 0-6	6-12	12-18	VANE READING	DEPTH	STRATUM DESCRIPTION
asred	52											
d ead	124	8D	2"	16"		41.3	49	90	100			Brown fine to med. sandy gravel w/cobbles & silt.
"	65											
"	140										44.0	
"	195											Gray silty sand and gravel
"	139											
"	192	9D	2"	18"		46.5	60	46	106			
"	197											
"	242											
"	288											
	86											
	99	10D	2"	18"		51.5	39	25	25			Gray silty fine to coarse sandy gravel w/cobbles. GREY TILL
	120											
	204											
	140											
	71	D	2"	2"	0.0	55.2	150					
	105											
"	212											
"	281											
"	416											
"	129	11D	2"	12"		61.0	84	163				
"	123											
"	134											
"	236											
"	342											
"	63											
"	100	12D	2"	16"		66.3	93	107	150			
"	122											
"	120										69.0	
"	143											
"	109	D	2"	2"	0.0	70.2	150					
"	187											
"	273											
"	457											
"	271											
"	124	D	2"	4"	0.0	75.3	150					Cobbles with gray fine sand, trace of med. to coarse sand, gravel, silt.
"	112	D	2"	2"	0.0	76.2	150					
"	150											
"	500											
"												

SAMPLES
D = Split Spoon
C = 2" Shelby Tube
U = 3½" Shelby Tube

SOIL CLASSIFIED BY:
[X] Driller - Visually
[ ] Soil Technician - Visually
[ ] Laboratory Tests

REMARKS

HOLE NO. B-202

MTB-14

MAINE TEST BORINGS, INC. TEWER, MAINE 04472	CLIENT Sanco, Inc.	SHEET 3 OF 3 HOLE NO. B-202
ILLER Gerry Rudnicki	PROJECT NAME landfill	LINE & STATION
.O. JOB NUMBER .6-4	LOCATION Bethlehem, NH	OFFSET
GROUND WATER OBSERVATIONS AT ____ FT AFTER ____ HOURS AT ____ FT. AFTER ____ HOURS	TYPE: CASING NW, SAMPLER SS, CORE BARREL ____ / SIZE I.D.: 3", 1 3/8" / HAMMER WT.: 300, 140 / HAMMER FALL: 16", 30"	DATE START 1/14/86 DATE FIN. 1/17/86 / SURFACE ELEV. ____ / GROUND WATER ELEV. ____

CASING BLOWS PER FOOT	SAMPLE NO.	O.D.	PEN.	REC.	DEPTH @ BOT	BLOWS PER 6" ON SAMPLER 0-6	6-12	12-18	VANE READING	DEPTH	STRATUM DESCRIPTION
washed ahead	T3D	2"	14"		81.2	64	43	150			Cobbles w/gray fine sand, trace of med. to coarse sand, gravel, silt.
"										83.0	
											Bottom of boring @ 83.0' Installed 2 wells

SAMPLES
D = Split Spoon
C = 3" Shelby Tube
J = 3¼" Shelby Tube

SOIL CLASSIFIED BY:
[x] Driller - Visually
[ ] Soil Technician - Visually
[ ] Laboratory Tests

REMARKS:

HOLE NO. B-202

MTB-14

MAINE TEST BORINGS, INC.
BREWER, MAINE 04412

CLIENT: Sanco, Inc.

SHEET 1 OF 1
HOLE NO. B-202A

DRILLER: Gerry Rudnicki

PROJECT NAME: landfill

LINE & STATION:

A.T.D. JOB NUMBER: 86-4

LOCATION: Bethlehem, NH

OFFSET:

GROUND WATER OBSERVATIONS
AT ____ FT AFTER ____ HOURS
AT ____ FT. AFTER ____ HOURS

	CASING	SAMPLER	CORE BARREL
TYPE	NW		
SIZE I.D.	3"		
HAMMER WT.	300		
HAMMER FALL	16"		

DATE START 1/21/86 DATE FIN. 1/21/86
SURFACE ELEV.
GROUND WATER ELEV.

CASING BLOWS PER FOOT	SAMPLE NO	O.D.	PEN.	REC.	DEPTH @ BOT	BLOWS PER 6" ON SAMPLER 0-6	6-12	12-18	VANE READING	DEPTH	STRATUM DESCRIPTION
probe											Brown silty fine sand w/med. to coarse sand, gravel, & cobbles.
"											
"											
"										4.0	
"											
"											
"											Brown ~~Gray~~ silty fine sand w/med. to coarse sand, fine gravel & cobbles.
"											
"											
"											
"										11.5	
"											
"											
"											
50											Brown silty fine to med. sand w/coarse sand, gravel, & cobbles.
52											
61											
51											
59										20.0	
											Bottom of boring @ 20.0'
											Installed well

SAMPLES
D = Split Spoon
C = 2" Shelby Tube
U = 3" Shelby Tube

SOIL CLASSIFIED BY:
[X] Driller - Visually
[ ] Soil Technician - Visually
[ ] Laboratory Tests

REMARKS:

HOLE NO. B-202A

MTB-14

MAINE TEST BORINGS, INC. BREWER, MAINE 04412	CLIENT Sanco, Inc.	SHEET 1 OF 1 HOLE NO. B-205
DRILLER Gerry Rudnicki	PROJECT NAME landfill	LINE & STATION
F&B JOB NUMBER 86-4	LOCATION Bethlehem, NH	OFFSET

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BARREL	
AT ____ FT AFTER ____ HOURS	TYPE	NW	SS		DATE START 1/10/86 DATE FIN. 1/13/86
AT ____ FT. AFTER ____ HOURS	SIZE I.D.	3"	1 3/8"		SURFACE ELEV.
	HAMMER WT.	300	140		GROUND WATER ELEV.
	HAMMER FALL	16"	30"		

CASING BLOWS PER FOOT	SAMPLE NO.	SAMPLE D.O.	SAMPLE PEN.	SAMPLE REC.	SAMPLE DEPTH @ BOT	BLOWS PER 6" ON SAMPLER 0-6	6-12	12-18	YANG READING	DEPTH	STRATUM DESCRIPTION
prime											
"											
"	1D	2"	5"		2.4	100					Brown silty fine sand w/med. to coarse gravel, cobbles, trace of boulders
"											
"											
126										5.2	
161	2D	2"	18"		6.5	36	58	69			
103											
76											
66											Gray, brown silty fine sand - fine sandy silt w/ trace of coarse sand
21											
26	3D	2"	18"		11.5	13	14	19			
43											
51											
53											
30										16.2	
32	4D	2"	18"		16.5	17	15	25			
46											
31											
57											Brown silty fine sand - fine sandy silt w/med. to coarse sand, trace of gravel.
ashed 31	5D	2"	12"		21.0	58	78				
head 26											
" 20											
" 27										24.0	
" 29											
" 21											
" 19	6D	2"	17"		26.4	35	64	100			
" 42											
" 43											Gray fine sandy silt w/trace of silt layers, & fine sand layers.
" 52											
" 40	7D	2"	12"		31.0	50	118				
" 43											
" 42											
77											
114											
										36.5	
	8D	2"	18"		36.5	42	77	121			
											Bottom of boring @ 36.5' Installed well

SAMPLES
D = Split Spoon
C = 2" Shelby Tube
U = 3½" Shelby Tube

SOIL CLASSIFIED BY:
[X] Driller - Visually
[ ] Soil Technician Visually
[ ] Laboratory Tests

REMARKS

HOLE NO. B-205

MTB-14

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT: Sanco Landfill, Bethlehem, NH

REPORT OF BORING NUMBER B-107
SHEET 2 OF 2
DATE 1/6/87 FILE D-20002

BORING CO. Haley Foot Boring, Inc.
FOREMAN Tom Schaefer
GZA ENGINEER Paul Sirois/Mitch Plumer

BORING LOCATION See exploration location plan
GROUND ELEV. 1351.8 MSL
DATE STARTED 1/6/87 DATE ENDED 1/14/87

CASING
SIZE: HW to 21', NW to 80'
HAMMER: 300 lb.
FALL: 16"

SAMPLER
TYPE: Split Spoon OTHER:
HAMMER: 140 lb.
FALL: 30"

GROUNDWATER READINGS

DATE	DEPTH	CASING AT	STABILIZATION TIME
1/9	40.5	45	overnight
1/12	42.5	60	overnight

DEPTH	CAS. BL./FT.	SAMPLE NO.	PEN./REC.	DEPTH	BLOWS/6"	SAMPLE DESCRIPTION	STRATA CHG. OR GEN. DESC.	EQUIPMENT INSTALLED	RMKS.
								0.5' CONCRETE SEAL	
								1.0' BENTONITE SEAL	1
		S-1	18/18	2-3.5	7-12-12	Medium dense, brown, fine to coarse SAND, trace Gravel, trace silt.		PROTECTIVE CASING	
5								WASHED SAND	
		S-2	18/18	5-6.5	12-13-13	Medium dense, brown, fine to medium SAND, little silt.		6.0' BENTONITE SEAL	
								8.0'	
10	66	S-3	18/14	10-11.5	22-28-34	Very dense, brown, fine to coarse SAND, trace Gravel, trace silt.	SAND	WASHED SAND	
	92								
	97								
	140								
	171								
15	24	S-4	18/12	15-16.5	54-130-205	Very dense, brown, fine to medium SAND, little Silt.		3/4" PVC RISER PIPE	
	27								
	26								
	28								
	31								
20	29	S-5	13/13	20-21.1	73-113-124/1"	Very dense, brown, fine to coarse SAND, little Silt, little Gravel.	21.2' BOULDER 22.5'		
	32								
	47								
	53								
	97								
25	57	S-6	18/18	25-25.8	65-198/4"	Very dense, brown, fine to coarse SAND, little silt, little Gravel.	SAND		
	51								
	89								
	49								
	47						29'	COLLAPSED FORMATION	
30	53	S-7	5/5	30-30.4	199/5"	Very dense, brown, fine to coarse SAND, some Gravel, little silt.		29.5' BENTONITE SEAL	
	57								
	61								
	79								
	85								
35	59	S-8	3/1	35-35.3	154/3"	Very dense, brown, fine to coarse SAND, some Gravel, little silt.	GRAVELLY SAND		
	73								
	76								
	83							37.8'	
	97								
40	198	S-9	18/12	40-41.5	65-118-198	Very dense, brown, fine to medium SAND, little Silt.	40'	40.0'	
	73							WASHED SAND	
	39								
	46								
	49								
45	23	S-10	18/15	45-46.5	24-32-65	Very dense, fine to medium SAND, little Silt, trace Gravel.	SAND	3/4" SLOTTED PVC WELLSCREEN	2
	27								
	26								
	31								
	39						49'	50.0'	

REMARKS:

1. Boring advanced with solid stem augers to 10'; augers removed and NW casing subsequently driven to 20'. Encountered 1.3' diameter boulder at 21.2' and cored with NX core barrel after advancing roller bit to 22'. Removed NW casing and drove HW to 21', Spon H core barrel through boulder and telescoped NW casing through open hole to 25'. Washed ahead of casing from 20' to bottom of boring.
2. Permeability tests conducted at 45' and 80'.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORINGS LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO FACTORS NOT ACCOUNTED FOR AT THE TIME MEASUREMENTS WERE MADE.

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT: Sanco Landfill, Bethlehem, NH

REPORT OF BORING NUMBER D-307
SHEET 2 OF 2
DATE 1/8/87 FILE D-20002

BORING CO. Haine Test Boring, Inc.
FOREMAN Tom Schaffot
GZA ENGINEER Paul Sirois/Mitch Plumer

BORING LOCATION See exploration location plan
GROUND ELEV. 1351.0 MSL
DATE STARTED 1/6/87 DATE ENDED 1/14/87

CASING
SIZE HW to 21', NW to 80'
HAMMER 300 lb.
FALL 16"

SAMPLER
TYPE: Split Spoon OTHER:
HAMMER 140 lb.
FALL: 30"

GROUNDWATER READINGS

DATE	DEPTH	READING AT	STABILIZATION TIME

DEPTH	CAS. BL/FT.	SAMPLE NO.	PEN./REC.	DEPTH	BLOWS/6"	SAMPLE DESCRIPTION	STRTA. CHG. & GEN. DESC.	EQUIPMENT INSTALLED	RMKS.
	28	S-11	6/6	50-50.5	106	Very dense, gray, fine to coarse SAND and Gravel, trace Silt.	GRAVELLY SAND	50.5' WASHED SAND; BENTONITE SEAL; 52.5'	
	36								
	99								
	123								
55	167								
	107								
	215						56'		
	237								
	298								
	362								
60	62	S-12	18/15	60-61.5	32-49-137	Very dense, fine to coarse SAND, little Silt, trace Gravel.	SAND	3/4" PVC RISER PIPE	1
	74								
	153								
	107								
	109							COLLAPSED FORMATION	
65	197						66'		
	234								
	234								
	293								
	327								
70	131	S-13	18/16	70-71.5	66-85-147	Very dense, gray, fine to coarse SAND, some Gravel, trace Silt.	GRAVELLY SAND	73.0' BENTONITE SEAL	
	149								
	152								
	153								
75	173						75'	75.0' COLLAPSED FORMATION	
	71							76.0' BENTONITE SEAL	
	78						SAND	76.5' FILTER SAND	
	89								
	124							78.5' 3/4" SLOTTED PVC WELLSCREEN	
	132								
80		S-14	18/12	80-81.5	43-62-67	Very dense, brown, fine to coarse SAND, little Silt, trace Gravel.	81.5'	80.5' 81.5' COLLAPSED FORMATION	2
						Bottom of Boring @ 81.5'.			

REMARKS:
3. S-12: No recovery in first attempt; 15" recovery in second attempt.
4. No refusal encountered.
5. Piezometer with 7' x 3" ID protective steel casing equipped with a vented locking cap installed at completion of boring. 2.5' stickup above ground surface.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORINGS LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO FACTORS NOT ACCOUNTED FOR AT THE TIME MEASUREMENTS WERE MADE.

GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

Northtown, MN

SHEET 1 / 1 DATE [illegible] FILE [illegible]

B-401

DRILLING CO. Hatch Test Borings, Inc.

FOREMAN Irvin Glover

GEO ENGINEER Doug Lensing

BORING LOCATION See Exploration Location Plan

GROUND ELEV. 3362.14 Site Datum

DATE STARTED 9/22/87 DATE ENDED 9/22/87

CASING: SIZE: 5CA to 5', HW to 45'; HAMMER: 300 lb; FALL: 30

SAMPLER: TYPE: 2" x 18" split spoon OTHER; HAMMER: 140 lb; FALL: 30"

GROUNDWATER READINGS			
DATE	DEPTH	CASING AT	STABILIZATION TIME
9/25	33.7'	screened	48 hours

DEPTH	CAS. BL. /FT.	SAMPLE NO.	PEN./REC.	DEPTH	BLOWS/6"	SAMPLE DESCRIPTION	STRTA. CHG. OR GEN. DESC.	EQUIPMENT INSTALLED	RMKS.
5		S-1	18/18	5-6.5	18-22-21	Dense, olive-brown, fine to medium SAND, little Silt, trace Gravel.		PROTECTIVE CASING; CEMENT/BENTONITE SEAL 1'; FORMATION MATERIAL	
	10								
	26								
	43								
	105								
10	167						GLACIAL TILL	9'; BENTONITE SEAL 11'	
	6	S-2	12/12	10-11	31-37-7	Very dense, olive-brown, fine to medium SAND, trace Silt, trace fine Gravel.			
	3								
	67								
	213								
15	239							1½" PVC RISER PIPE	
	27	S-3	6/3	15-15.5	126/4"	Very dense, olive-brown, fine to medium SAND, some Silt, little Gravel.			
	29								
	29								
	22							FILTER SAND AND FORMATION MATERIAL	
20	19								
	27	S-4	6/6	20-20.5	100/6"	Very dense, olive-brown, fine to medium SAND, some Silt, little Gravel.			
	43								
	26							23'	
	36							BENTONITE SEAL 24'	
	49								
	31	S-5	12/12	25-26	46-15	Very dense, olive-brown, fine to medium SAND, some Silt, little Gravel.			
	36								
	45						28'	FILTER SAND	
	43								
	57								
30	46	S-6	6/6	30-30.5	105/6"	Very dense, olive-brown, fine to medium SAND, trace Silt, trace fine Gravel.		30'	
	31								
	41								
	39						STRATIFIED DRIFT		
35	52								
	30	S-7	18/18	35-36.5	31-36-66	Very dense, olive-brown, fine to medium SAND, trace Silt, trace Gravel.			
	35								
	40								
	42							1½" PVC (0.01" slotted) WELL SCREEN	
40	78								
	32	S-8	18/12	40-41.5	31-37-49	Very dense, olive-brown, fine to medium SAND, little fine Gravel, trace Silt.			
	33								
	27								
	41								
45	63								
		S-9	18/12	45-46.5	37-46-59	Very dense, olive-brown, fine SAND, trace Silt.			
50								50'	
		S-10	18/18	[illegible]	30-37-54	Very dense, olive-brown, fine to medium SAND, trace Silt.	51.5'		
52						Bottom of boring at 51.5			

REMARKS: 1. A thickness of approximately 18 inches of topsoil had been removed from the boring location to facilitate access.
2. Washed ahead of casing from 5 feet to bottom of the boring.
3. Monitoring well with 7' x 2" I.D. steel casing equipped with a vented locking cap installed at completion of the boring.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORINGS LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO FACTORS NOT ACCOUNTED FOR AT THE

RECEIVED OCT 03 1994

B-503

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT: Sanco Landfill, Bethlehem, NH

REPORT OF BORING NUMBER B-503
SHEET 1 OF 1
DATE 9/15/87 FILE: P-20002.2

BORING CO. Maine Test Boring
FOREMAN John Hulnicki
GZA ENGINEER Doug Lanoing

BORING LOCATION See Monitoring Well Location Plan
GROUND ELEV 1951.6'
DATE STARTED 9/15/87 DATE ENDED 9/16/87

CASING
SIZE: 3" ID from 10'
HAMMER: 300 lb.
FALL: 20"

SAMPLER
TYPE: 2" x 18" split spoon OTHER:
HAMMER: 100 lb.
FALL: 30"

GROUNDWATER READINGS

DATE	DEPTH	DRILLING AT	STABILIZATION TIME
9/16	Dry	37	10 hours
9/17	42.8	screened	18 hours
9/21	42.9	screened	5 days

DEPTH	CAS. BL. /FT.	SAMPLE NO.	PEN./REC.	DEPTH	BLOWS/6"	SAMPLE DESCRIPTION	STRATA CHG. GEN. DESC.	EQUIPMENT INSTALLED	RMKS.
						Dark brown, fine to medium SAND, some silt, with organic material, and with 1-3" diameter boulders observed at surface.	TOPSOIL 1.0'	PROTECTIVE CASING; CEMENT/BENTONITE SEAL	
5		S-1	6/4	5-5.5	130/6"	Very dense, olive-gray, fine to medium SAND, little Silt, trace Gravel.		4'	1
10	19	S-2	8/6	10-10.7	94-50/2"	Very dense, olive-gray, fine to medium SAND, little Silt, trace fine Gravel.			
	12								
	1								
	1								
	85							1½" PVC RISER PIPE	
15	36	S-3	6/6	15-15.5	200/6"	Very dense, olive-gray, fine to medium SAND, little Silt, little Gravel.	GLACIAL TILL		
	35								
	30								
	36								
	108								
20	41	S-4	6/6	20-20.5	90/6"	Very dense, olive-gray, fine to coarse SAND, some Gravel, little Silt.		FILTER SAND AND FORMATION MATERIAL	
	25								
	22								
	24								
	170								
25	52	S-5	3/1	25-25.5	300/2"	Similar to above.			
	75								
	107								
	180								
	50								
30	80	S-6	6/5	30-30.5	135/6"	Very dense, olive-gray, fine to coarse SAND, some Gravel, little Silt.		32.0'	
	130								
	94							BENTONITE SEAL	
	153								
	170								
35	110	S-7	0/0	35	150/0"	No recovery.		35.7'	
	103								
	51								
	30						39'		
	210							40'	
40	67	S-8	3/1	41-41.3	100/3"	Very dense, olive-gray, GRAVEL and fine to coarse Sand, little Silt.			
	40							1½" PVC (.01" slotted) WELL SCREEN	
	214	C-1	12/9	43-44		Cobble with Gravel.			
	225	C-2	12/6	44-45		Cobble with Gravel.	STRATIFIED DRIFT		
45	137							FILTER SAND	
	65								
	200								
	240								
	280								
50		S-9	22/10	50-51	70-96	Very dense, brown to gray, fine to coarse SAND, little Gravel, trace Silt.		50'	

Bottom of boring at 51.0'.

REMARKS: 1. Washed ahead of casing from 10 feet to bottom of boring.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORINGS LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER

Sanborn, Head & Associates, Inc.

Log of Well B-901U

PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *3/31/99* DATE FINISHED: *3/31/99*

LOCATION: *Bethlehem, New Hampshire*

SURFACE ELEVATION: *1363.80' (NAVD '88)*

DRILLING METHOD: *CME 550x Rig w/41/4" ID HSA*

DRILLING COMPANY: *Capital Environmental Drilling, Inc.*

FOREMAN: *Mark Voisine*

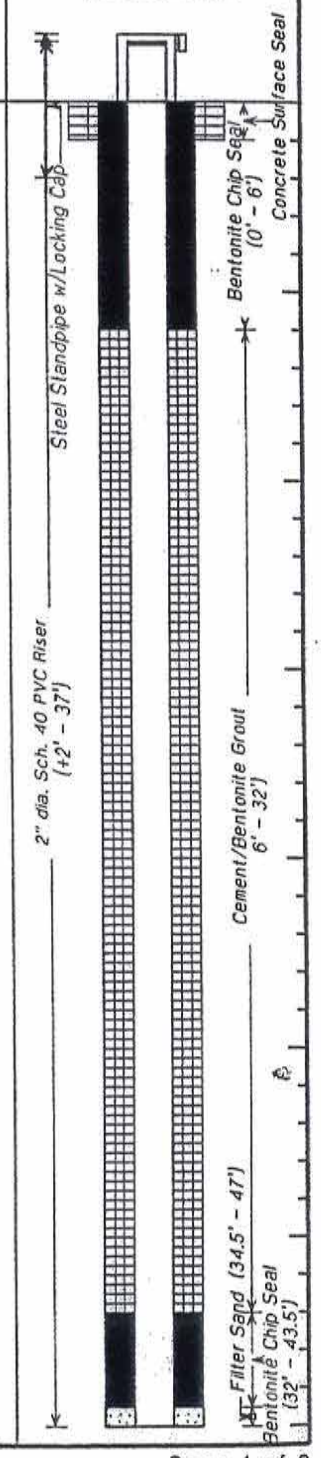
LOGGED BY: *DRP* CHECKED BY: *RSS*

GROUNDWATER READINGS

DATE	TIME	DEPTH	CASING	STAB. TIME
3/31/99	16:00	47.2'PVC	Well Inst	15 mins
4/1/99	08:45	47.2'PVC	Well Inst	16.5 hrs.
4/2/99	07:45	47.3'PVC	Well Inst.	40 hrs.

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 – 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
	S-1 0-2'	12-7 7-3	24/18				TILL FILL	S-1: Medium dense, fine to coarse SAND, some Silt, trace Gravel, FILL;
							TOPSOIL	Change at 1.5' to brown, SILT, little Organic Material, trace fine to medium Sand. TOPSOIL. Dry.
5	S-2 5-7'	15-20 17-24	24/20					S-2: Dense, olive, fine to coarse SAND and Silt, trace Gravel. Dry.
10	S-3 10-12'	9-13 25-36	24/15					S-3: Dense, olive, fine to medium SAND and SILT, trace Gravel. Dry.
15	S-4 15-16' S-4A 16-17'	14-26 60-40	24/16				STRATIFIED DRIFT	S-4: Very dense, olive, fine SAND and Silt, trace Gravel; stratified. S-4A: Change at 16' to gray-brown, fine to coarse SAND and Gravel, little Silt. Dry.
20	S-5 20-22'	26-49 97-83	24/22					S-5: Very dense, olive, fine to coarse SAND, some Silt, little Gravel, stratification from 20-21'. Dry.
25	S-6 25-27'	29-69 90-100/3.5"	22/22					S-6: Very dense, olive, fine to coarse SAND, some Silt, trace Gravel, slight stratification. Dry.
30	S-7 30-32'	17-19 32-50	24/20					S-7: Very dense, olive, Clayey SILT, trace fine Sand, stratified with 3" thick fine Sand seam at 30.3'. Dry. S-8: Very dense, olive, Clayey SILT, trace fine Sand, slight stratification. Moist.
35								

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-901U

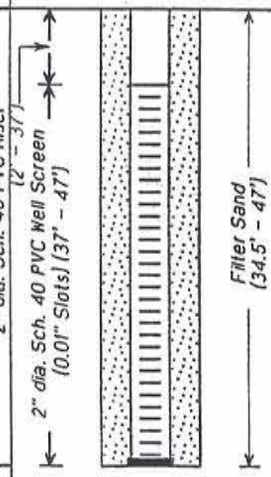
PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *3/31/99* DATE FINISHED: *3/31/99*

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 – 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
	S-8 35-37'	17-28 34-52	24/18					
	S-9 37-39'	17-27 31-35	24/21					S-9: Very dense, olive, Clayey SILT, trace fine Sand, slight stratification. Wet.
	S-10 39-40.2	13-22 36-48	24/18					S-10: Very dense, olive, SILT & CLAY, trace fine Sand, stratified. Wet;
40	S-10A 40.2'-41'	19-37 41-45	24/20				STRATIFIED DRIFT	S-10A: Change at 40.2' to olive, fine to medium SAND, trace Silt. Dry.
	S-11 41-43'							S-11: Very dense, olive-brown, fine to coarse SAND, little Gravel, trace Silt;
	S-12 43-45'	11-27 25-34	24/15					Change at 42.5' to olive, SILT, trace fine Sand. Stratification. Wet.
45	S-13 45-47'	7-11 18-30	24/19					S-12: Very dense, olive, fine to coarse SAND, little Silt, trace Gravel. Wet.
								S-13: Very dense, olive, fine to coarse SAND, trace Gravel, trace Silt, Slight stratification. Wet.
								Bottom of Boring at 47'.
50								**Notes:**
								1) Approximately 1-1.5' of frost observed in first soil sample.
								2) Groundwater was observed in soil samples from 35-47'.
55								3) The presence of landfill gas was noted during drilling and after the well was installed. Measurements of gas venting from the top of the completed well with an Indstrial Scientific LTX-310 02/LEL/H2S meter indicated 20.97% oxygen, 0% H2S and 100% LEL.
60								
65								
70								
75								

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-901L

PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/01/99* DATE FINISHED: *4/07/99*

LOCATION: *Bethlehem, New Hampshire*

SURFACE ELEVATION: *1361.4' (NAVD '88)*

DRILLING METHOD: *CME 550x Rig PW/HW Cased Boring*

DRILLING COMPANY: *Capital Environmental Drilling, Inc.*

FOREMAN: *Mark Voisine*

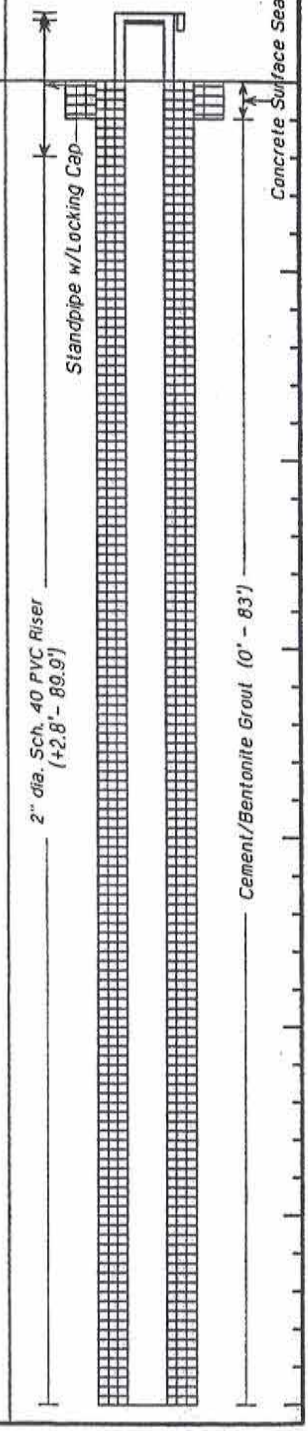
LOGGED BY: *DRP* CHECKED BY: *RSS*

GROUNDWATER READINGS

DATE	TIME	DEPTH	CASING	STAB. TIME
4/2/99	07:30	34.1'PVC	Well Inst	15 mins
4/5/99	08:30	45.1'PVC	Well Inst	64.5 hrs.
4/7/99	08:30	47.75'PVC	Well Inst.	100.5 hrs.

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
5								
10								No Samples obtained from 0-47'. See log of well B-901U for soil descriptions.
15							STRATIFIED DRIFT	
20								
25								
30								
35								

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-901L

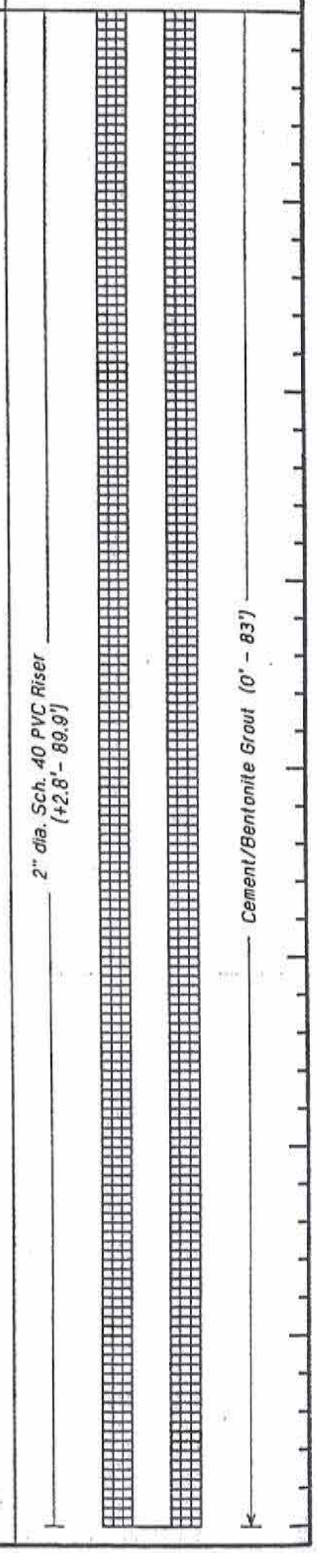
PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/01/99* DATE FINISHED: *4/07/99*

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
40								
45								
	S-1 47-49'	38-49 44-55	24/12					S-1: Very dense, olive, fine to coarse SAND, little Silt. Slight stratification. Wet.
	S-2 49-51'	53-51 57-58	24/16					S-2: Very dense, olive, fine to coarse SAND, little Silt, trace Gravel. Slight stratification. Wet.
50	S-3 51-53'	18-39 39-43	24/11					S-3: Very dense, olive, fine to coarse SAND, little Silt, trace Gravel. Wet.
	S-4 53-55'	34-40 42-61	24/14					S-4: Very dense, olive, fine to coarse SAND and Gravel, trace Silt;
55	S-5 55-57'	42-31 19-34	24/9				STRATIFIED DRIFT	Change at 54' to olive, fine to medium SAND, little Silt, trace Gravel. Wet.
								S-5: Dense, olive, fine to coarse SAND and Gravel, little Silt. Wet.
	S-6 57-58'	42-49 69-82	24/13					S-6: Very dense, olive-gray, fine to medium SAND, little Silt, trace Gravel, slight stratified discolorations throughout;
	S-6A 58-49'							
60	S-7 59-61'	83-48 80-75	24/14					Change at 58' to olive-gray, fine to coarse SAND and Gravel, little Silt. Wet.
								S-7: Very dense, olive-gray, fine to coarse SAND and GRAVEL, little Silt. Wet.
	S-8 61-63'	69-98 100/4'	16/4					S-8: Very dense, fine to coarse SAND and Gravel, trace Silt. Wet.
	S-9 63-65'	71-50 54-50	24/13					S-9: Very dense, olive-gray, fine to coarse SAND and Gravel, trace Silt. Wet.
65	S-10 65-67'	161/6"	6/4					S-10: Very dense, olive and brown, fine to coarse SAND and Gravel, trace Silt. Wet.
	S-11 67-67.5'	115/6"	6/0					S-11: No recovery.
70	S-12 69-69.9	85-100/4	10/5					S-12: Very dense, gray-brown, fine to coarse SAND and Gravel, little Silt. Wet.
	S-13 71-73'	50-109/6'	12/6					S-13: Very dense, gray, GRAVEL, little fine to coarse Sand, trace Silt. Wet.
	S-14 73-75'	75-64 77-86	24/17					S-14: Very dense, gray, fine to coarse SAND and GRAVEL, trace Silt,
75								Change at 73.3' to gray, fine to medium SAND, trace Gravel, trace Silt. Stratified. Wet.

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-901L

PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

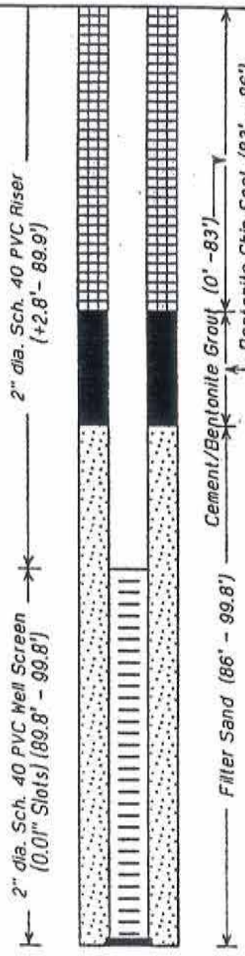
DATE STARTED: *4/01/99* DATE FINISHED: *4/07/99*

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
	S-15 75-77'	67-87 99-62	24/12				STRATIFIED DRIFT	S-15: Very dense, gray, fine to coarse SAND, little Gravel, little Silt. Stratified. Wet.
	S-16 77-77.7	103-100/3"	9/4				GLACIAL TILL	S-16: Very dense, gray GRAVEL and fine to coarse Sand, some Silt. Wet.
80	S-17 79-81'	92-113 100/3"	15/10					S-17: Very dense, gray, fine to coarse SAND, some Gravel, some Silt. Wet.
	S-18 81-83'	87-154	12/9					S-18: Very dense, gray, fine to coarse SAND and Gravel, little Silt; Changed at 81.3' to gray, fine to coarse SAND and Silt, trace Gravel. Wet.
	S-19 83-85'	234	6/6					S-19: Very dense, gray, fine to coarse SAND and Silt, little Gravel. Wet.
85	S-20 85-87'	217	6/3					S-20: Very dense, gray, fine to coarse SAND and SILT, little Gravel. Wet.
	S-21 87-89'	169	6/3					S-21: Similar to S-20
	S-22 89-91'	170	6/3					S-22: Similar to S-21
90	S-23 91-93'	237	6/3					S-23: Similar to S-21
	S-24 93-95'	502	6/3					S-24: Very dense, gray, fine to coarse SAND, some Silt, little Gravel. Wet.
95	S-25 95-97'	232	6/3					S-25: Very dense, gray, fine to coarse SAND, and Silt, trace Gravel. Wet.
	S-26 98-99.8	183	6/3					S-26: Similar to S-25.
00								Bottom of Boring at 99.8'.
105								
110								
115								

Notes:

1) Falling head (wick) tests performed with wicks at 49 to 51 feet. and 93 to 95 feet.

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-902L

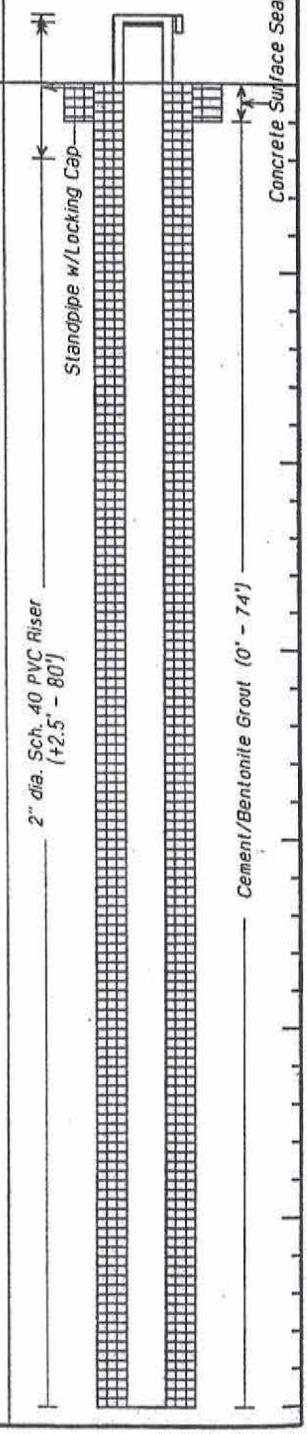
PROJECT: *North Country Environmental Services, Inc.*	PROJECT NO.: *1647*
LOCATION: *Bethlehem, New Hampshire*	DATE STARTED: *4/08/99* DATE FINISHED: *4/13/99*
DRILLING METHOD: *CME 550x Rig PW/HW Cased Boring*	SURFACE ELEVATION: *1369.8' (NAVD '88)*
DRILLING COMPANY: *Capital Environmental Drilling, Inc.*	
FOREMAN: *Mark Voisine*	
LOGGED BY: *DRP/WDB* CHECKED BY: *RSS*	

GROUNDWATER READINGS

DATE	TIME	DEPTH	CASING	STAB. TIME
4/13/99	07:30	42.1'	Ground	96 hrs.

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 – 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
5								
10								No samples obtained from 0-56'. See log of well B-902U for soil descriptions.
15							STRATIFIED DRIFT	
20								
25								
30								
35								

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-902L

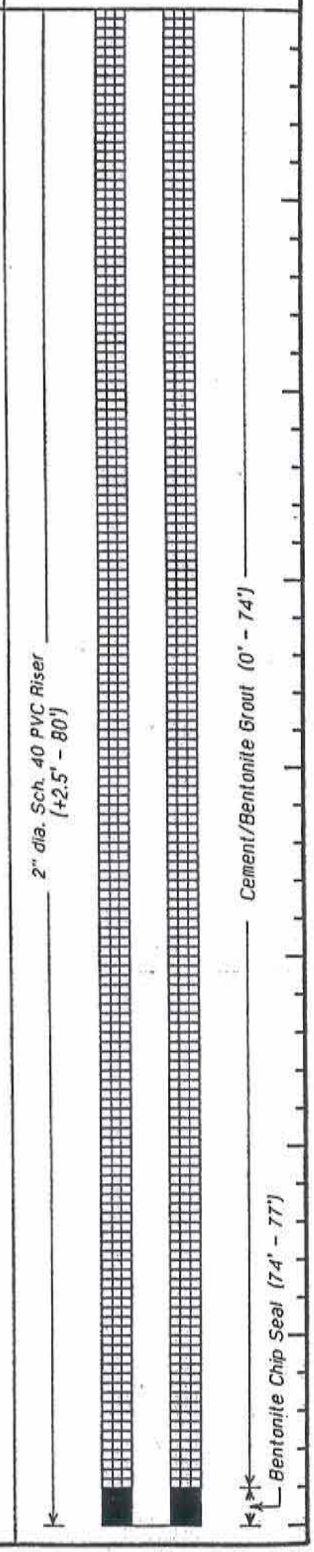
PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/08/99* DATE FINISHED: *4/13/99*

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 – 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
40								
45								
50							STRATIFIED DRIFT	
55	S-1 56-58'	48-54 70-79	24/11					S-1: Very dense, brown, fine to coarse SAND, little Silt, trace Gravel. Wet.
	S-2 58-60'	34-40 55-53	24/10					S-2: Very dense, brown, fine to coarse SAND, little Silt, trace Gravel. Wet.
60	S-3 60-62'	27-48 48-57	24/9					S-3: Very dense, brown, fine to coarse SAND, little Silt. Wet.
	S-4 62-64'	34-37 46-66	24/9					S-4: Very dense, gray, fine to coarse SAND, some Silt. Wet.
65	S-5 64-66'	32-41 57-104	23/18					S-5: Very dense, gray to brown, fine to coarse SAND, little Silt, trace Gravel. Wet.
	S-6 66-66.5'	155/6"	6/6					S-6: Very dense, gray to brown, fine to coarse SAND, little Silt, trace Gravel. Wet.
	S-7 68-70'	83-71 52-55	24/11					S-7: Very dense, brown to gray, fine to coarse SAND, some Gravel, trace Silt. Stratified. Wet.
70	S-8 70-72'	205/6"	6/4					S-8: Very dense, gray, fine to coarse SAND, some Silt, little Gravel. Wet.
	S-9 72-74'	150/2.5"	2.5/0				GLACIAL TILL	S-9: No recovery.
75	S-10 74-76'	200/3.5"	3.5/1					S-10: Very dense, gray, fine to coarse SAND and SILT, little Gravel. Wet.

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-902L

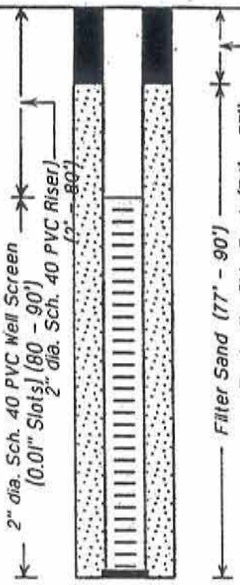
PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/08/99* | DATE FINISHED: *4/13/99*

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 – 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
	S-11 76-78'	200/3"	3/0				GLACIAL TILL	S-11: No recovery.
	S-12 78-80'	200/3"	3/0					S-12: No recovery.
80	S-13 80-82'	200/2"	2/0					S-13: No recovery.
	S-14 82-84'	275/2"	2/2					S-14: Very dense, gray, fine to coarse SAND and SILT, little Gravel. Wet.
85	S-15 85-85.5'	113/6"	6/4					S-15: Very dense, gray, SILT and fine to coarse Sand, little Gravel. Wet.
	S-16 88-88.5'	123/6"	6/3					S-16: Very dense, gray, SILT and fine to coarse Sand, trace Gravel. Wet.
90								Bottom of Boring at 90'.
95								**Notes:** 1) Falling head (wick) tests were performed with wicks at 68 to 70 feet and 82 to 84 feet.
00								
105								
110								
115								

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-902U

PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/07/99* DATE FINISHED: *4/08/99*

LOCATION: *Bethlehem, New Hampshire*

SURFACE ELEVATION: *1369.8' (NAVD '88)*

DRILLING METHOD: *CME 550x Rig w/4-1/4" ID HSA*

DRILLING COMPANY: *Capital Environmental Drilling, Inc.*

FOREMAN: *Mark Voisine*

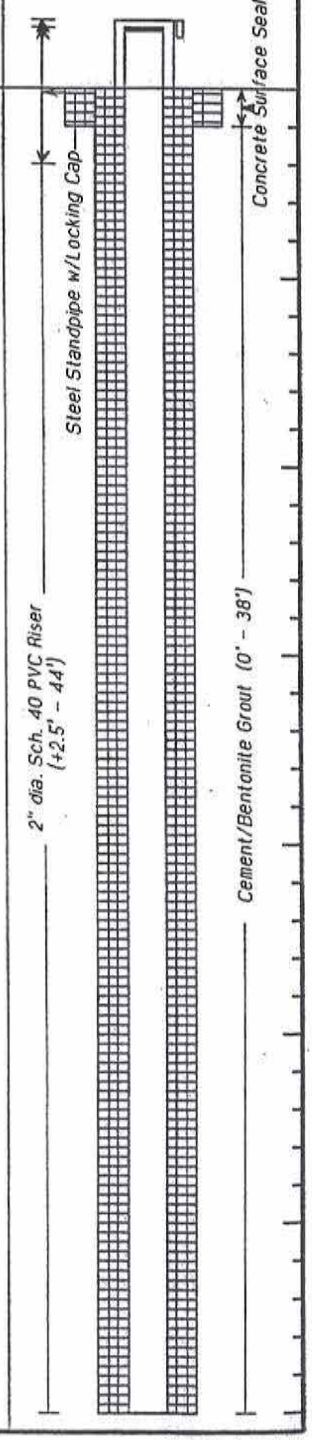
LOGGED BY: *DRP* CHECKED BY: *RSS*

GROUNDWATER READINGS

DATE	TIME	DEPTH	CASING	STAB. TIME
4/8/99	07:30	42.5'PVC	46'	15 hrs.
4/8/99	14:30	56.8'PVC	Well Inst	15 mins.
4/9/99	09:30	56.5'PVC	Well Inst.	27 hrs.

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 – 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
	S-1 0-2'	23-24 28-17	24/3					S-1: Very dense, olive-brown, fine to coarse SAND, some Gravel, little Silt.
5	S-2 5-7'	22-25 35-33	24/24					S-2: Very dense, olive-gray, fine to medium SAND, some Silt, trace Gravel. Stratified. Dry.
10	S-3 10-12'	14-19 18-21	24/24					S-3: Dense, olive-gray, SILT, some fine Sand. Stratified. Dry.
15	S-4 15-17'	12-14 15-17	24/18				STRATIFIED DRIFT	S-4: Medium dense, olive-gray, SILT, trace Gravel, trace fine Sand. Stratified. Dry.
20	S-5 20-22'	25-52 64-100/5'	23/19					S-5: Very dense, olive, fine to coarse SAND and Silt, little Gravel; 1/4 to 1/2" thick Sand seams comprising approximately 15 % of sample. Dry.
25	S-6 25-27'	26-56 74-91	24/20					S-6: Very dense, olive, fine SAND, trace Silt, trace Clay seams comprising <5% of sample. Dry.
30	S-7 30-32'	43-69 81-90	24/20					S-7: Very dense, olive, fine SAND and Silt. Stratified. Dry.
35								

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-902U

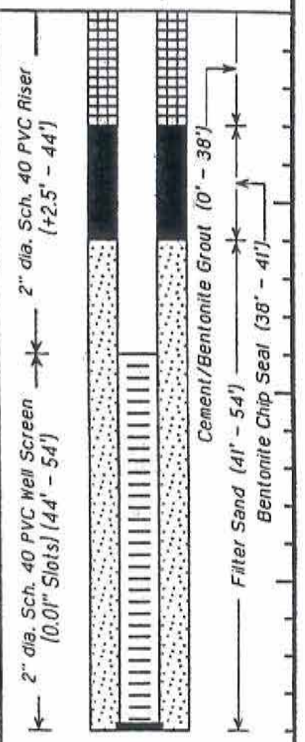
PROJECT NO.: 1647

PROJECT: North Country Environmental Services, Inc.

DATE STARTED: 4/07/99 | DATE FINISHED: 4/08/99

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
	S-8 35-37'	34-71 100/5'	17/15				STRATIFIED DRIFT	S-8: Very dense, olive-gray, SILT, little fine Sand, stratified Silt seams comprising <25% of sample. Dry.
40	S-9 40-41'	30-57 53-77	24/17					S-9: Very dense, olive, fine SAND and Silt;
	S-9A 41-42'							S-9A: Change at 41' to SILT, some fine Sand. Stratified. Wet.
	S-10 42-44'	29-53 53-69	24/20					S-10: Very dense, olive, SILT, trace fine Sand. Stratified. Wet.
45	S-11 44-46'	19-51 69-77	24/20					S-11: Very dense, olive, SILT, trace fine Sand, trace orange staining. Stratified. Wet.
	S-12 46-48'	24-48 52-68	24/19					S-12: Very dense, olive, SILT, some fine Sand. Stratified. Wet.
	S-13 48-50'	20-35 52-64	24/18					S-13: Very dense, olive, SILT, trace fine Sand. Stratified. 6" thick Silt layer in tip of spoon.
50	S-14 50-52'	21-33 70 100/5'	24/18					S-14: Very dense, olive, SILT, trace fine Sand. Stratified, Wet;
	S-15 52-54'	21-39 48-39	24/16					Change at 51.8' to fine to medium SAND, trace Silt.
	S-16 54-56'	8-25 35-43	24/14					S-15: Very dense, olive-gray, fine to medium SAND, little Silt. Stratified. Wet.
55								S-16: Very dense, gray-brown, fine to coarse SAND, little Silt. Stratified. Wet.
								Bottom of Boring at 56'.
60								**Notes:** 1) Auger advancement stopped short of desired well depth because auger could not be turned. Spoon sample S-16 was collected and the well was installed. The augers were removed with the drill head and winches.
65								
70								
75								

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-903L

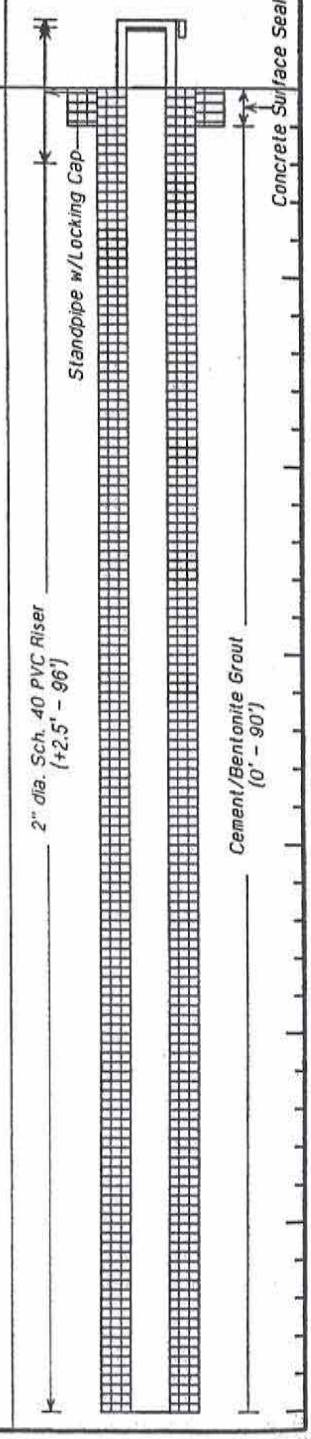
PROJECT: *North Country Environmental Services, Inc.*	PROJECT NO.: *1647*
LOCATION: *Bethlehem, New Hampshire*	DATE STARTED: *4/21/99* DATE FINISHED: *4/26/99*
DRILLING METHOD: *CME 550x Rig PW/HW Cased Boring*	SURFACE ELEVATION: *1379.8' (NAVD '88)*
DRILLING COMPANY: *Capital Environmental Drilling, Inc.*	
FOREMAN: *Mark Voisine, Greg Meadows*	
LOGGED BY: *WDB* CHECKED BY: *DRP*	

GROUNDWATER READINGS

DATE	TIME	DEPTH	CASING	STAB. TIME

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 – 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
5								
10								
15							STRATIFIED DRIFT	
20								No samples obtained from 0-70'. See log of well B-903U for soil descriptions.
25								
30								
35								

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-903L

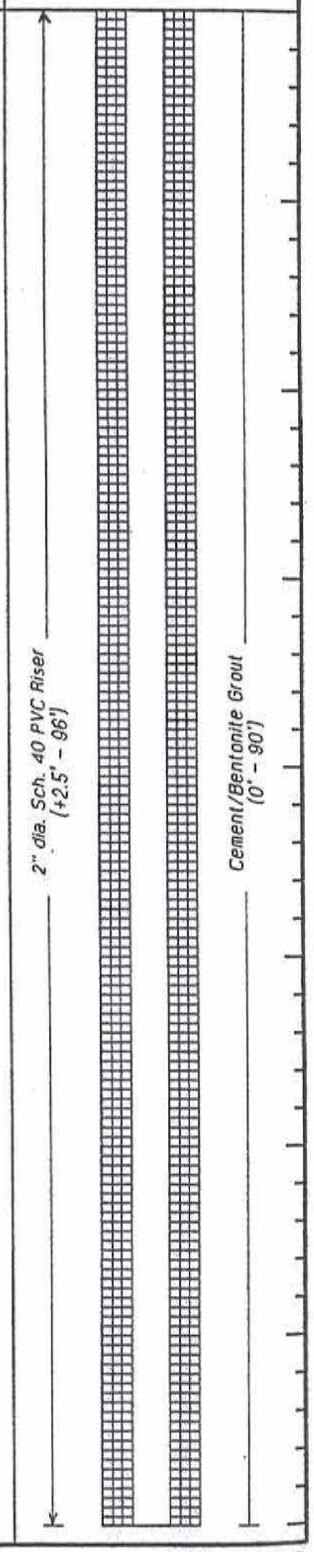
PROJECT NO.: 1647

PROJECT: North Country Environmental Services, Inc.

DATE STARTED: 4/21/99 | DATE FINISHED: 4/26/99

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 – 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
40								
45								
50								
55							STRATIFIED DRIFT	
60								
65								
70	S-1 70-72'	34-47 100/1"	13/5					S-1: Very dense, olive, fine to coarse SAND, little Silt, trace Gravel. Wet.
	S-2 72-73'	101-100/4"	10/6					S-2: Very dense, olive, fine to coarse SAND, little Silt, trace Gravel. Wet.
75	S-3 74-76'	56-58 61-50	24/10					S-3: Very dense, olive, fine to coarse SAND, some Silt, trace Gravel. Wet.

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-903L

PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

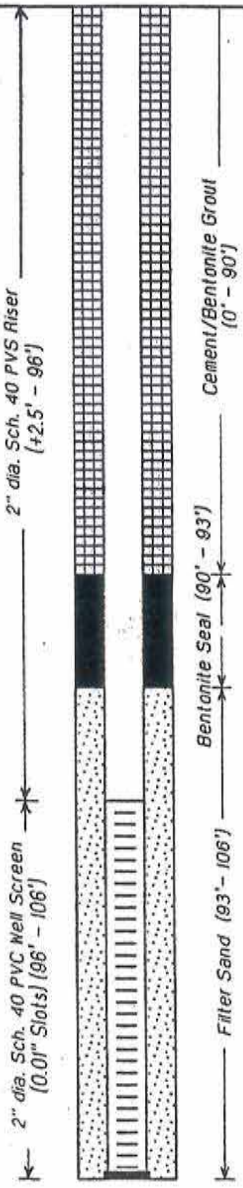
DATE STARTED: *4/21/99* DATE FINISHED: *4/26/99*

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
	S-4 76-78'	30-52 71-99	24/10				STRATIFIED DRIFT	S-4: Very dense, olive-gray, fine to coarse SAND, little Silt, trace Gravel. Stratified. Wet.
	S-5 78-80'	30-59 46-37	24/7					S-5: Very dense, olive-gray, fine to coarse SAND and Silt. Wet.
80	S-6 80-82'	33-41 80-100/5'	23/8					S-6: Very dense, olive-gray, fine to coarse SAND, little Silt, trace Gravel. Wet.
	S-7 82-83'	27-100/5'	11/9					S-7: Very dense, olive-gray, fine to coarse SAND, some Gravel, little Silt. Wet.
85	S-8 84-85.8	74-62 14-100/4'	22/12					S-8: Very dense, gray, fine to medium SAND, some Silt. Wet.
	S-9 86-86.5	102/6"	6/4				GLACIAL TILL	S-9: Very dense, olive-gray, SILT and fine to coarse Sand, little Gravel. Wet.
	S-10 88-88.5	111/6"	6/4					S-10: Very dense, gray, Clayey SILT, and fine to coarse Sand. Wet.
90	S-11 90-91.5	55-74 100/5.5"	7.5/10					S-11: Very dense, gray, SILT, little fine Sand. Wet.
	S-12 92-93.5	69-98 100/4.5"	16.5/8					S-12: Very dense, olive-gray, fine to medium SAND and Silt, trace Gravel.
95	S-13 94-94.5	111/6"	6/0					S-13: (No recovery).
	S-14 96-97'	93-100/5'	11/7					S-14: Very dense, olive-gray, fine to medium SAND, some Silt, trace Gravel. Wet.
	S-15 98-98.3	150/4"	4/1					S-15: Very dense, olive-gray, fine to coarse SAND and Silt. Wet.
100	S-16 100-100.5'	214/6"	6/3					S-16: Very dense, olive-gray, fine to coarse SAND and Silt.
	S-17 102-102.3'	100/3"	3/2					S-17: Very dense, olive-gray, fine to coarse SAND and Gravel, some Silt. Wet.
105	S-18 104-104.3'	100/4"	4/1					S-18: Very dense, olive-gray, fine to coarse SAND and Silt, trace Gravel. Wet.
110								Bottom of Boring at 106'.
115								

Notes:

1) Falling head (wick) tests performed with wicks at 72 to 74 feet and 100-102 feet.

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-903U

PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/20/99* | DATE FINISHED: *4/20/99*

LOCATION: *Bethlehem, New Hampshire*

SURFACE ELEVATION: *1379.7' (NAVD '88)*

DRILLING METHOD: *CME 550x Rig w/4-1/4" ID HSA*

DRILLING COMPANY: *Capital Environmental Drilling, Inc.*

FOREMAN: *Mark Voisine, Greg Meadows*

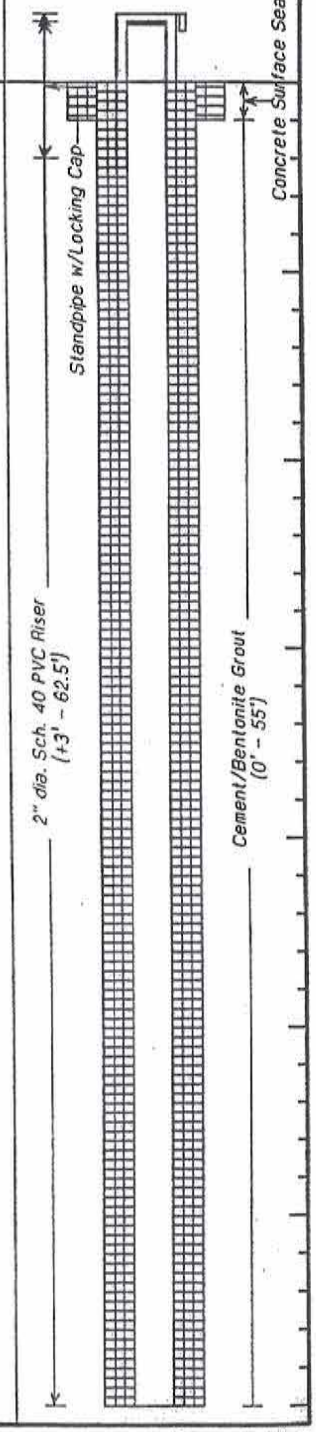
LOGGED BY: *WDB* | CHECKED BY: *DRP*

GROUNDWATER READINGS

DATE	TIME	DEPTH	CASING	STAB. TIME

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 – 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
5	S-1 5-7'	10-16 17-16	24/22					S-1: Dense, olive, SILT and fine Sand, trace Gravel. Moist.
10	S-2 10-12'	17-29 33-40	24/23					S-2: Very dense, olive, SILT, little Sand, trace Gravel. Moist. Stratified
15	S-3 15-16'	27-39 42-64	24/24				STRATIFIED DRIFT	S-3: Very dense, olive, SILT, little Sand, trace Gravel. Moist. Stratified
20	S-4 20-22'	11-16 15-17	24/20					S-4: Dense, olive, SILT, little fine Sand, trace Gravel. Moist. Stratified seams of fine Sand throughout.
25	S-5 25-26'	31-63 90-73	24/24					S-5: Very dense, olive, SILT, little fine Sand, trace Gravel. Moist.
30	S-6 30-32'	26-73 91-89	24/22					S-6:Very dense, olive, SILT, little fine to medium Sand, trace Gravel. Moist. Stratified.
35								

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-903U

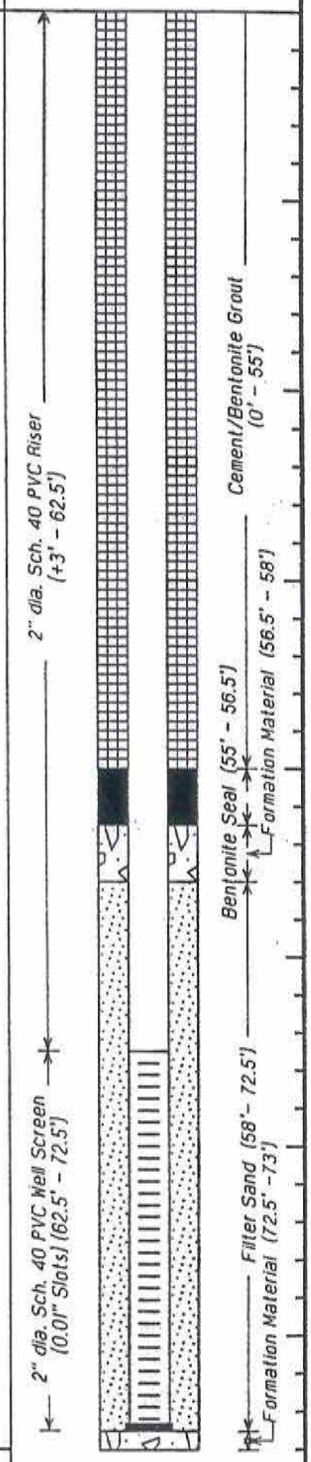
PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/20/99* DATE FINISHED: *4/20/99*

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
	S-7 35-37'	22-37 48-57	24/22					S-7: Very dense, fine SAND, trace Silt. Moist. Stratified w/layers of SAND, some Silt.
40	S-8 40-42'	17-32 36-45	24/20					S-8: Very dense, olive, SILT, some fine Sand. Moist.
45	S-9 45-47'	22-34 45-56	24/21					S-9: Very dense, olive, SILT, little fine Sand. Wet.
50	S-10 50-52'	24-44 57-69	24/21					S-10: Very dense, olive, fine SAND and Silt. Wet. Stratified.
							STRATIFIED DRIFT	
55	S-11 55-57'	15-31 44-49	24/20					S-11: Hard, olive-brown, SILT and CLAY. Wet. Stratified.
60	S-12A 60-61' S-12B 61-62'	22-54 58-59	24/19					S-12A: Hard, olive, SILT and CLAY. Moist. Stratified. S-12B: Very dense, gray, fine SAND, trace Silt, trace Gravel. Moist.
65	S-13 65-67'	18-23 36-42	24/15					S-13: Very dense, gray to brown, fine to medium SAND, trace Gravel, trace Silt. Moist to Wet.
	S-14 67-69'	7-25 26-35	24/17					S-14: Very dense, gray to brown, fine SAND, little Silt. Wet.
70	S-15 69-71'	3-23 WOR-40	24/24					S-15: Gray to brown, fine to medium SAND, trace Silt, trace Gravel. Stratified. Wet.
	S-16 71-73'	32-50 64/2"	14/8					S-16: Very dense, gray to orange-brown, fine to coarse SAND, little Gravel, trace Silt. Stratified. Wet.
75								Bottom of Boring at 73'.

WELL DIAGRAM



Sanborn, Head & Associates, Inc.	Log of Well B-903U
	PROJECT NO.: *1647*
PROJECT: *North Country Environmental Services, Inc.*	DATE STARTED: *4/20/99* DATE FINISHED: *4/20/99*

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION	WELL DIAGRAM
80								**Notes:** 1) The presence of landfill gas was observed during drilling and after the well was installed. Measurements of gas venting from the top of the completed well with an Indstrial Scientific LTX-310 02/LEL/H2S meter indicated 20.87% oxygen, 0% H2S and 100% LEL.	
85									
90									
95									
100									
105									
110									
115									

Sanborn, Head & Associates, Inc.

Log of Well B-904L

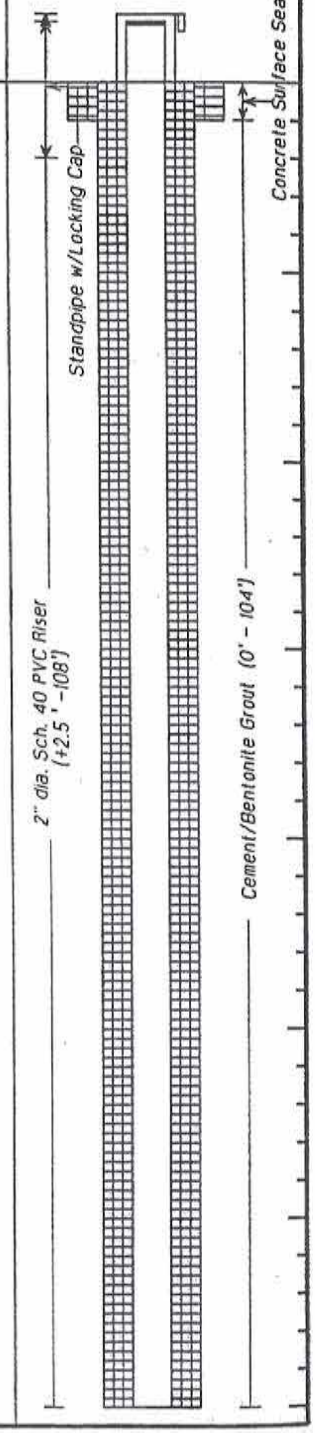
PROJECT: *North Country Environmental Services, Inc.*	PROJECT NO.: *1647*
LOCATION: *Bethlehem, New Hampshire*	DATE STARTED: *4/15/99* DATE FINISHED: *4/15/99*
DRILLING METHOD: *CME 550x Rig PW/HW Cased Boring*	SURFACE ELEVATION: *1377.2' (NAVD '88)*
DRILLING COMPANY: *Capital Environmental Drilling, Inc.*	
FOREMAN: *Mark Voisine, Greg Meadows*	
LOGGED BY: *WDB* CHECKED BY: *RSS*	

GROUNDWATER READINGS

DATE	TIME	DEPTH	CASING	STAB. TIME
4/18/99	09:30	64.1'	Ground	72 hrs.

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
5								
10								No samples obtained from 0-68'. See well log B-904U for soil descriptions.
15							STRATIFIED DRIFT	
20								
25								
30								
35								

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-904L

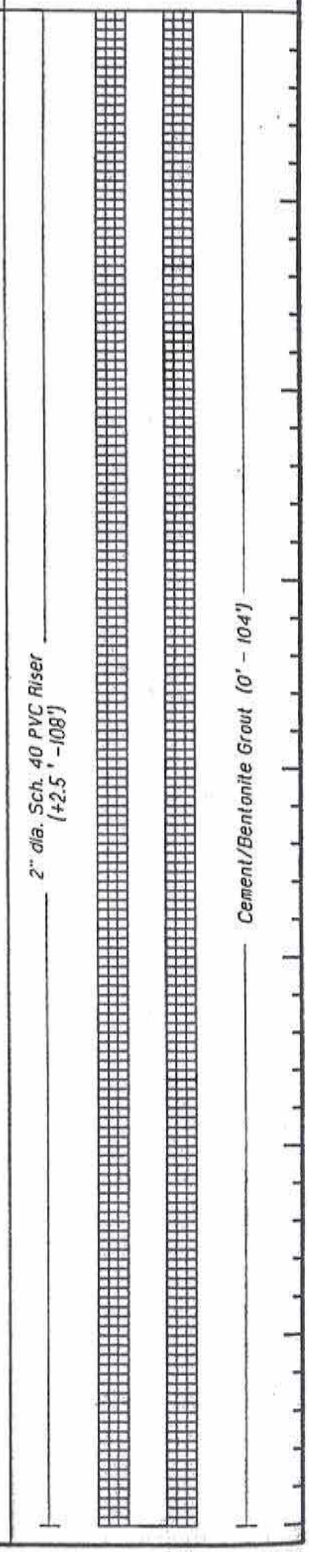
PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/15/99* DATE FINISHED: *4/15/99*

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
40								
45								
50								
55							STRATIFIED DRIFT	
60								
65								
	S-1 68-70'	40-45 57-71	24/12					S-1: Very dense, brown, fine SAND, trace Silt, trace Gravel. Wet.
70	S-2 70-72'	53-46 40-45	24/12					S-2: Very dense, brown, fine to coarse SAND, little Silt. Wet.
	S-3 72-74'	29-55 50-70	24/10					S-3: Very dense, brown, fine to coarse SAND, little Silt. Wet.
75	S-4A 74-75.5	55-80 88-69	24/8					S-4A: Very dense, brown, fine SAND, some Silt. Wet.

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-904L

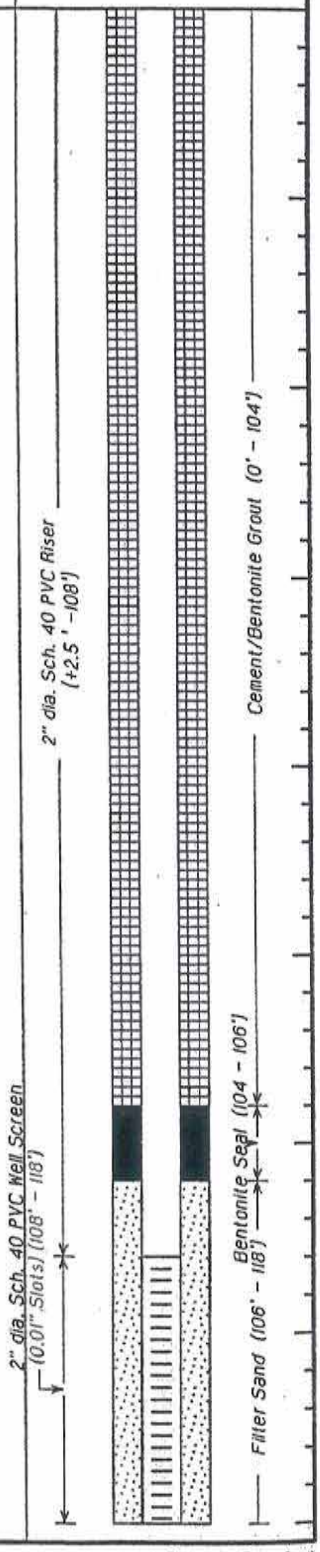
PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/15/99* DATE FINISHED: *4/15/99*

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 – 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
	S-4B 75.5-76'	49-62 56-77	24/8				STRATIFIED DRIFT	S-4B: Very dense, brown, fine to coarse SAND, little Silt. Wet.
	S-5 76-78'							S-5: Very dense, brown, fine to coarse SAND, little Silt. Stratified. Wet.
	S-6A 78-79.5'	50-78 84-106/6'	24/13					S-6A: Very dense, olive-brown, fine SAND, some Silt. Wet.
80	S-6B 79.5-80'	58-82 73-76	24/12					S-6B: Very dense, brown, fine to coarse SAND, little Silt. Wet.
	S-7 80-82'							S-7: Very dense, brown to gray, fine to coarse SAND, trace Silt. Wet.
	S-8 82-84'	19-35 62-68	24/8					S-8: Very dense, gray, fine to medium SAND, some Silt, trace Gravel. Wet.
	S-9A 84-85'	44-58 61-56	24/18					S-9A: Very dense, gray, fine to medium SAND, little Silt, trace Gravel. Wet.
85	S-9B 85-86'							S-9B: Very dense, gray, fine to coarse SAND, some Silt, little Gravel. Wet.
	S-10 86-88'	40-56 58-79	24/12					S-10: Very dense, gray, fine SAND and Silt, trace Gravel. Stratified. Wet.
	S-11 88-90'	59-93 108/6'	18/11					S-11: Very dense, gray, fine SAND, some Silt, trace Gravel. Wet.
90	S-12 90-92'	66-71 90-100/5'	23/12					S-12: Very dense, gray, fine SAND, some Silt, trace Gravel. Stratifed. Wet.
	S-13 92-93.5	83-83 100/5.5"	17.5/8					S-13: (Similar to S-12).
95	S-14 94-95.5	52-90 100/5'	17/11					S-14: Very dense, gray, fine to medium SAND and Silt, trace Gravel. Stratified. Wet.
	S-15 96-96.5'	175/6"	6/6				GLACIAL TILL	S-15: Very dense, gray, fine to coarse SAND and Silt, trace Gravel. Wet.
	S-16 98-98.4'	200/5"	5/5					S-16: Very dense, gray, fine to coarse SAND and Silt, some Gravel. Wet. Wet.
100	S-17 100-102'	168/6"	6/4					S-17: Very dense, gray, SILT and fine to coarse Sand, trace Gravel. Wet.
	S-18 102-102.4'	200/5"	5/4					S-18: Similar to S-17
105								
110	S-19 109-111'	200/5"	5/4					S-19: Similar to S-18.
115	S-20 114-116'	160/4.5"	4.5/0					S-20: No recovery.

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-904L

PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/15/99* DATE FINISHED: *4/15/99*

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION	WELL DIAGRAM
							GLACIAL TILL		
120								Bottom of Boring at 118'. **Notes:** 1) Falling head (wick) tests were performed with wicks at 68 to 70 feet and 100 to 102 feet.	2" dia. Sch. 40 PVC Well Screen (0.01" Slots) (108' - 118') Filter Sand (106' - 118')
125									
130									
135									
140									
145									
150									
155									

Sanborn, Head & Associates, Inc.

Log of Well B-904U

PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/14/99* DATE FINISHED: *4/14/99*

LOCATION: *Bethlehem, New Hampshire*

SURFACE ELEVATION: *1377.2' (NAVD '88)*

DRILLING METHOD: *CME 550x Rig w/4-1/4" ID HSA*

DRILLING COMPANY: *Capital Environmental Drilling, Inc.*

FOREMAN: *Mark Voisine, Greg Meadows*

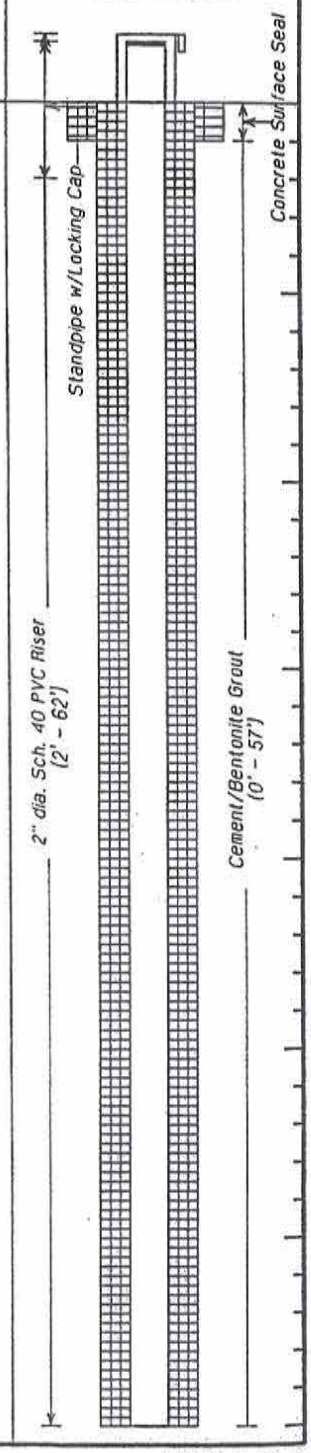
LOGGED BY: *WDB* CHECKED BY: *RSS*

GROUNDWATER READINGS

DATE	TIME	DEPTH	CASING	STAB. TIME

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0–200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
							FILL	
							TOPSOIL	
5	S-1 5-7'	16-17 21-36	24/19					S-1: Dense, olive-brown, fine to medium SAND, some Silt, trace Gravel. Moist.
10	S-2 10-12'	13-22 28-40	24/18					S-2: Dense, olive-brown, SILT, some fine to medium Sand, trace Gravel. Moist.
15	S-3 15-16'	21-40 43-42	24/20					S-3: Very dense, gray, SILT, little fine Sand, trace Gravel. Moist.
							STRATIFIED DRIFT	
20	S-4 20-22'	69-27 36-71	24/17					S-4: Very dense, gray, SILT, some fine Sand, trace Gravel. Moist.
25	S-5 25-26'	45- 106/6"	12/7					S-5: Very dense, gray, SILT, some fine Sand, trace Gravel. Moist.
30	S-6 30-32'	23-46 62-74	24/19					S-6: Very dense, gray, SILT, little fine Sand. Moist. Stratified. Moist.
35								

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-904U

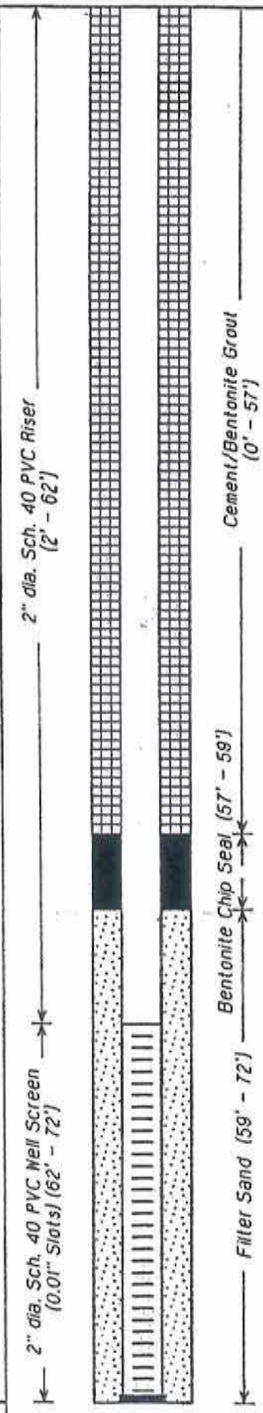
PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/14/99* DATE FINISHED: *4/14/99*

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 – 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
	S-7 35-37'	24-39 47-77	24/20					S-7: Very dense, gray, SILT, trace fine Sand. Stratified with Silt and Sand seams. Moist.
40	S-8 40-42'	44-106/5'	11/7					S-8: Very dense, gray, fine to coarse SAND, trace Silt. Moist.
45	S-9 45-47	27-73 100/4.5"	24/14					S-9: Very dense, gray, fine SAND, trace Silt. Moist.
50	S-10 50-52'	22-60 72-100/5.5"	23.5/17					S-10: Very dense, gray, fine to coarse SAND, trace Gravel, trace Silt. Stratified. Moist.
							STRATIFIED DRIFT	
55	S-11 55-57'	23-50 47-40	24/18					S-11: Very dense, gray, fine to medium SAND, trace Silt. Moist.
60	S-12 60-62'	22-50 58-83	24/14					S-12: Very dense, gray, fine to medium SAND, trace Silt. Moist.
65	S-13 65-67'	30-49 35-43	24/17					S-13: Very dense, gray, fine to coarse SAND, trace Gravel, trace Silt. Wet.
	S-14A 67-68.7'	21-43-	24/16					S-14A: Very dense, gray, fine SAND, little Silt, trace Gravel. Wet.
	S-14B 68.7-69'	50-54						S-14B: Very dense, gray, fine to coarse SAND, little Silt. Wet.
70	S-15 70-72'	8-27 24-30	24/14					S-15: Very dense, brown, fine to coarse SAND, little Silt. Wet.
								Bottom of Boring at 72'.
75								**Notes:**

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Boring B-905

PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/27/99* | DATE FINISHED: *4/27/99*

LOCATION: *Bethlehem, New Hampshire*

SURFACE ELEVATION: *1333'± (NAVD '88)*

DRILLING METHOD: *CME 550x Rig w/4-1/4" ID HSA*

DRILLING COMPANY: *Capital Environmental Drilling, Inc.*

FOREMAN: *Mark Voisine, Greg Meadows*

LOGGED BY: *WDB* | CHECKED BY: *DRP*

GROUNDWATER READINGS

DATE	TIME	DEPTH	CASING	STAB. TIME

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION	REMARKS
5	S-1 5-7'	11-14 14-23	24/18				STRATIFIED DRIFT	S-1: Medium dense, olive-brown, fine SAND, and Silt, trace medium to coarse Sand, trace Gravel. Moist.	
10	S-2 10-12'	10-14 12-18	24/19					S-2: Medium dense, olive-brown, fine to medium SAND and Silt, trace Gravel. Moist.	
15	S-3 15-16'	12-30 47-61	24/22					S-3: Very dense, olive-brown, fine to coarse SAND, some Silt, trace Gravel. Moist.	
20	S-4 20-21.1'	34-56 100/2"	14/14				GLACIAL TILL	S-4: Very dense, olive-brown, fine to coarse SAND, some Gravel, some Silt. Moist.	
25	S-5 25-26'	85-100/3	9/9					S-5: Very dense, olive-brown, fine to coarse SAND, some Gravel, some Silt. Moist.	
30								Bottom of boring at 26'. **Notes:** 1) Auger refusal in first attempt at 23 feet. Set over and drilled to 26 feet and encountered refusal again.	
35									

Sanborn, Head & Associates, Inc.

Log of Boring B-906

PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/27/99* | DATE FINISHED: *4/27/99*

LOCATION: *Bethlehem, New Hampshire*

SURFACE ELEVATION: *1350'± (NAVD '88)*

DRILLING METHOD: *CME 550x Rig w/4-1/4" ID HSA*

DRILLING COMPANY: *Capital Environmental Drilling, Inc.*

FOREMAN: *Mark Voisine, Greg Meadows*

LOGGED BY: *WDB* | CHECKED BY: *DRP*

GROUNDWATER READINGS

DATE	TIME	DEPTH	CASING	STAB. TIME

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION	REMARKS
5	S-1 5-7'	100/ 4"	4/4				STRATIFIED DRIFT	S-1: Dense, olive-brown, fine to medium SAND, some Silt, trace Gravel. Moist.	
10	S-2 10-12'	10-16 24-59	24/20					S-2: Dense, olive-brown, SILT and fine Sand, trace Gravel. Moist.	
15	S-3 15-17'	26-47 55-44	24/20				GLACIAL TILL	S-3: Very dense, olive-brown, fine to coarse SAND, some Silt, trace Gravel. Moist.	
20	S-4 20-21.1'	40-89 75/2"	14/14					S-4: Very dense, olive-brown, fine to coarse SAND, some Silt, trace Gravel. Moist.	
25								Bottom of Boring at 22'.	
30								**Notes:** 1) Auger refusal at 22 feet.	
35									

Sanborn, Head & Associates, Inc.

Log of Well B-907

PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/29/99* DATE FINISHED: *4/29/99*

LOCATION: *Bethlehem, New Hampshire*

SURFACE ELEVATION: *1338.5' (NAVD '88)*

DRILLING METHOD: *CME 550x Rig w/4-1/4" ID HSA*

DRILLING COMPANY: *Capital Environmental Drilling, Inc.*

FOREMAN: *Mark Voisine, Greg Meadows*

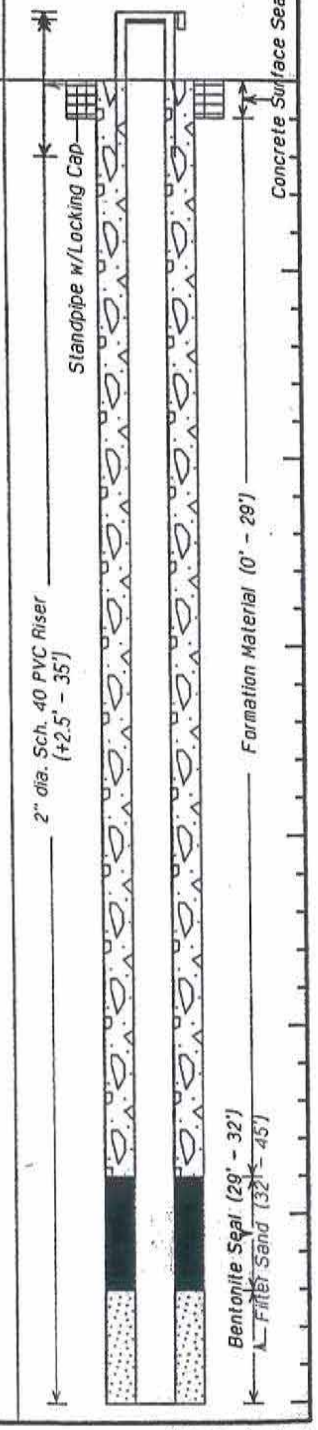
LOGGED BY: *WDB* CHECKED BY: *RSS*

GROUNDWATER READINGS

DATE	TIME	DEPTH	CASING	STAB. TIME
4/29/99	13:30	35.3'	Ground	0 hrs.

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
5	S-1 5-7'	40-28 23-32	24/16					S-1: Very dense, olive-brown, fine to coarse SAND and Silt, trace Gravel. Dry.
10	S-2 10-12'	5-12 16-24	24/23					S-2: Very stiff, olive, Clayey SILT. Moist.
							STRATIFIED DRIFT	
15	S-3 15-17'	8-13 13-15	24/20					S-3: Hard, olive, SILT, some fine Sand. Moist to dry.
20	S-4 20-22'	11-11 13-12	24/16					S-4: Medium dense, olive, fine SAND, some Silt. Moist.
25	S-5 25-27'	13-36 42-32	24/16					S-5: Hard, brown, Clayey SILT, and fine to coarse Sand, some Gravel. Moist.
30	S-6 30-30.8	36-100/3"	9/9				GLACIAL TILL	S-6: Hard, brown, Clayey SILT and fine to coarse Sand, little Gravel. Moist.
35								

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-907

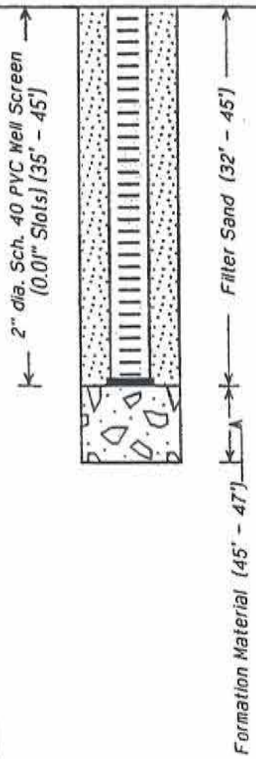
PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/29/99* DATE FINISHED: *4/29/99*

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
	S-7 35-36'	75-100/5'	11/11				GLACIAL TILL	S-7: Very dense, olive, fine to coarse SAND and SILT, trace Gravel. Moist.
40	S-8A 40-41' S-8B 41-41.5' S-8C 41.5-42'	11-18 33-35	24/24				STRATIFIED DRIFT	S-8A: Medium dense, olive, fine to medium SAND, trace Silt, trace Gravel. Wet. S-8B: Change at approximately 41' to olive, SILT and CLAY. Stratified. S-8C: Change at approximately 41.5' to olive, fine to medium SAND, some Silt. Wet.
45	S-9 45-47'	2-12 20-28	24/24					S-9: Dense, brown, fine to medium SAND, little Silt. Wet.
								Bottom of Boring at 47'.
								Notes:
50								
55								
60								
65								
70								
75								

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-908

PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/28/99* DATE FINISHED: *4/28/99*

LOCATION: *Bethlehem, New Hampshire*

SURFACE ELEVATION: *1353' (NAVD '88)*

DRILLING METHOD: *CME 550x Rig w/4-1/4" ID HSA*

DRILLING COMPANY: *Capital Environmental Drilling, Inc.*

FOREMAN: *Mark Voisine, Greg Meadows*

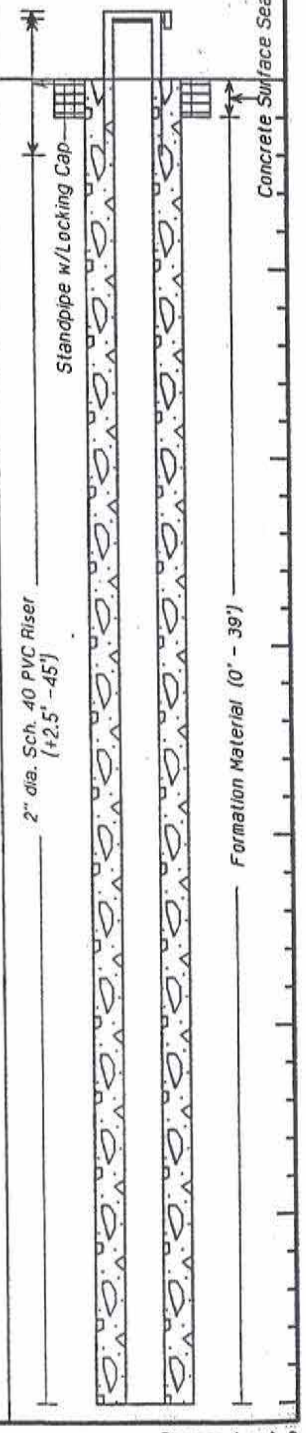
LOGGED BY: *WDB* CHECKED BY: *RSS*

GROUNDWATER READINGS

DATE	TIME	DEPTH	CASING	STAB. TIME

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 – 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
5								S-1: Dense, gray, fine to medium SAND, some Silt, trace Gravel. Moist.
10								S-2: Very dense, gray, fine to medium SAND, some Silt, trace Gravel. Moist.
15								S-3: Medium dense, gray, SILT, and fine to medium Sand, trace Gravel. Moist.
							STRATIFIED DRIFT	
20								S-4: Dense, gray, fine to medium SAND, some Silt, trace Gravel. Moist.
25	S-5 25-27'	7-10 13-14	24/20					S-5: Medium dense, olive, fine to medium SAND and Silt, trace Gravel. Moist.
30	S-6A 30-31' S-6B 31-32'	11-17 18-27	?/?					S-6A: Dense, olive, fine to medium SAND, little Silt, trace Gravel. S-6B: Change at approximately 31' to olive, SILT and CLAY. Stratified.
35								

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-908

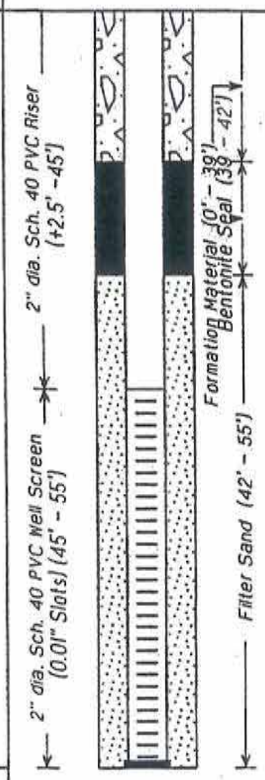
PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/28/99* DATE FINISHED: *4/28/99*

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
	S-7 35-37'	16-28 50-86	24/22					S-7: Very dense, olive, fine SAND, some Silt, trace Gravel. Moist.
40	S-8 40-42	21-36 48-56	24/20					S-8: Hard, olive, Clayey SILT. Stratified with Silt lenses. Moist.
45	S-9 45-47	18-28 35-46	24/20				STRATIFIED DRIFT	S-9: Hard, olive, Clayey SILT. Stratified. Moist.
50	S-10 50-52'	4-16-23 35	24/21					S-10: Dense, brown, fine to coarse SAND, some Silt, trace Gravel. Wet.
55								Bottom of Boring at 55'.
60								
65								
70								
75								

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-909

PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/30/99* DATE FINISHED: *4/30/99*

LOCATION: *Bethlehem, New Hampshire*

SURFACE ELEVATION: *1322.7' (NAVD '88)*

DRILLING METHOD: *CME 550x Rig w/4-1/4" ID HSA*

DRILLING COMPANY: *Capital Environmental Drilling, Inc.*

FOREMAN: *Mark Voisine, Greg Meadows*

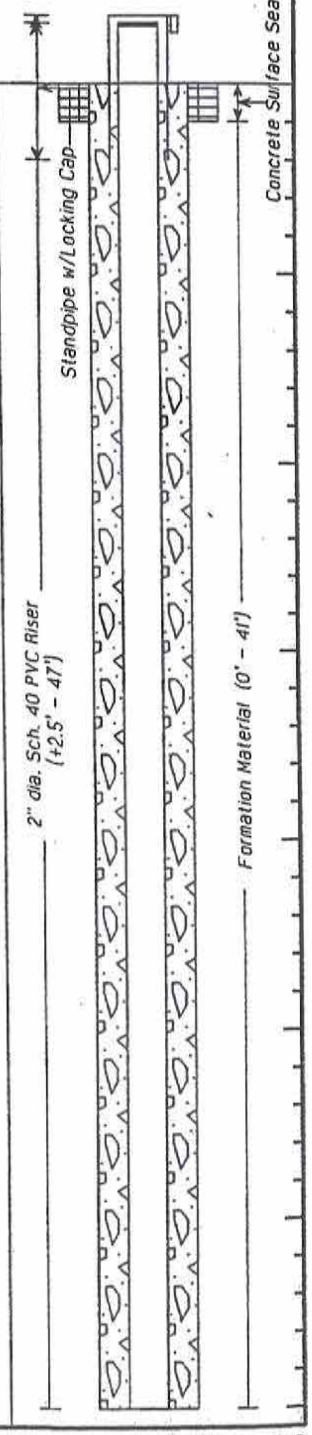
LOGGED BY: *WDB* CHECKED BY: *RSS*

GROUNDWATER READINGS

DATE	TIME	DEPTH	CASING	STAB. TIME
4/29/99	13:30	35.3'	Ground	0 hrs.

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 – 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
5								
10	S-1 10-11.3'	34-55 100/4"	16/16					S-1: Very dense, olive-gray, fine to coarse SAND and Silt, trace Gravel. Moist.
15							GLACIAL TILL	
20	S-2 20-22'	43-72 70-63	24/18					S-2: Similar to S-1.
25								
30	S-3 30-31'	51-100/6"	10/10					S-3: Very dense, olive, fine to coarse SAND and Silt, little Gravel. Moist.
35								

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-909

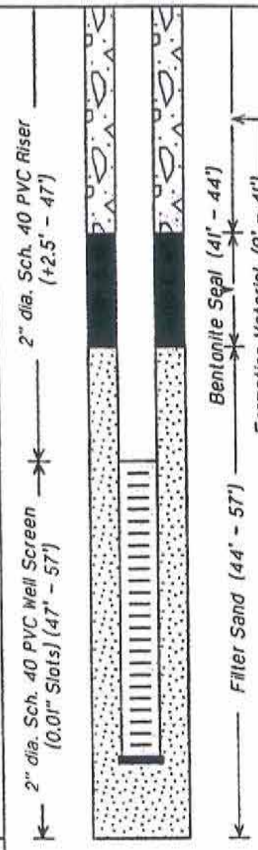
PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/30/99* DATE FINISHED: *4/30/99*

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
40	S-4 40-42'	20-29 37-43	24/20					S-4: Stiff, olive, SILT and CLAY. Stratified.
45							STRATIFIED DRIFT	
50	S-5 50-52'	14-26 33-47	24/20					S-5: Similar to S-4.
55								Bottom of Boring at 57'.
								Notes:
60								
65								
70								
75								

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-910

PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/28/99* DATE FINISHED: *4/28/99*

LOCATION: *Bethlehem, New Hampshire*

SURFACE ELEVATION: *1275.7' (NAVD '88)*

DRILLING METHOD: *CME 550x Rig w/4-1/4" ID HSA*

DRILLING COMPANY: *Capital Environmental Drilling, Inc.*

FOREMAN: *Mark Voisine, Greg Meadows*

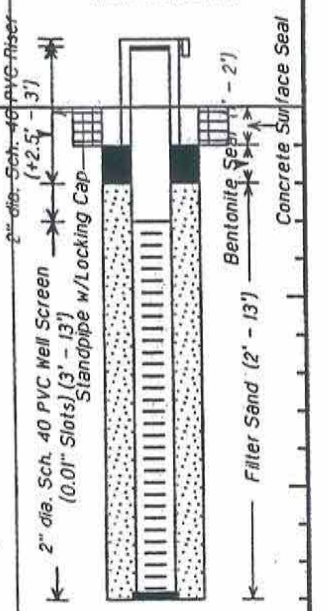
LOGGED BY: *WDB* CHECKED BY: *RSS*

GROUNDWATER READINGS

DATE	TIME	DEPTH	CASING	STAB. TIME

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
5	S-1 5-7'	6-7 8-8	24/15				STRATIFIED DRIFT	S-1: Medium dense, brown, fine to coarse SAND, little Silt, little Gravel. Wet.
10	S-2 10-12'	2-4 8-11	24/9				GLACIAL TILL	S-2: Medium dense, olive, fine to coarse SAND and Silt, little Gravel. Wet.
15	S-3 15-17'	2-6 12-14	24/11					S-3: Dense, gray, fine to coarse SAND, some Silt, little Gravel. Wet.
								Bottom of Boring at 17'.
								Notes:
20								
25								
30								
35								

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-911

PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/27/99* DATE FINISHED: *4/27/99*

LOCATION: *Bethlehem, New Hampshire*

SURFACE ELEVATION: *1317.8' (NAVD '88)*

DRILLING METHOD: *CME 550x Rig w/4-1/4" ID HSA*

DRILLING COMPANY: *Capital Environmental Drilling, Inc.*

FOREMAN: *Mark Voisine, Greg Meadows*

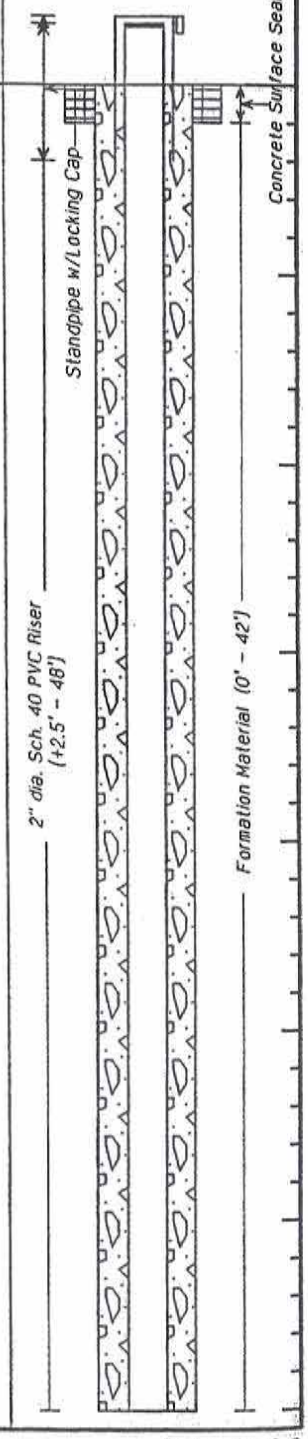
LOGGED BY: *WDB* CHECKED BY: *RSS*

GROUNDWATER READINGS

DATE	TIME	DEPTH	CASING	STAB. TIME

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
5	S-1 5-7'	14-16 15-21	24/20				STRATIFIED DRIFT	S-1: Dense, olive, fine to coarse SAND, little Silt, trace Gravel. Moist.
10	S-2 10-12'	17-30 32-33	24/24					S-2: Very dense, olive, fine to coarse SAND and Silt, trace Gravel. Moist.
15	S-3 15-17'	25-29 36-45	24/24					S-3: Very dense, olive, fine to coarse SAND, some Silt, trace Gravel. Moist.
20	S-4 20-22'	23-39 39-45	24/22				GLACIAL TILL	S-4: Very dense, olive, fine to coarse SAND, some Silt, trace Gravel. Moist. (Wet between 21.5 to 22').
25	S-5 25-26.4'	38-82 100/5"	17/20					S-5: Very dense, olive, fine to coarse SAND, some Silt, trace Gravel. Moist.
30	S-6 30-31.3'	65-85 100/4.5"	16.5/16.5					S-6: Very dense, olive, fine to coarse SAND, some Silt, trace Gravel. Moist.
35								

WELL DIAGRAM



Sanborn, Head & Associates, Inc.

Log of Well B-911

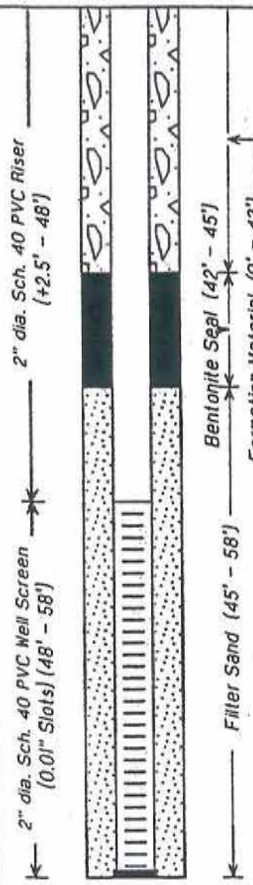
PROJECT NO.: *1647*

PROJECT: *North Country Environmental Services, Inc.*

DATE STARTED: *4/27/99* DATE FINISHED: *4/27/99*

DEPTH feet	SAMPLE NO. Depth (ft.)	BLOWS/6"	PEN/REC (in.)	PID (ppm) VALUES	PID (ppm) PROFILE 0 200	GRAPHIC LOG	STRATUM DESCRIPTION	GEOLOGIC DESCRIPTION
	S-7 35-36.9'	46-67 96-100/4"	22/21				GLACIAL TILL	S-7: Very dense, olive, SILT, some fine to coarse Sand, trace Gravel. Moist.
40								
45	S-8 45-45.5	100/5"	5/5					S-8: Very dense, olive, fine to coarse SAND, some Silt, trace Gravel. Moist.
50								
55	S-9 55-56.6'	85-94 100/5.5"	17.5/11					S-9: Very dense, olive, fine to coarse SAND, some Silt, trace Gravel. Moist.
								Bottom of Boring at 58'.
								Notes:
60								
65								
70								
75								

WELL DIAGRAM



Sanborn, Head & Associates, Inc.
CONSULTING ENGINEERS & SCIENTISTS

Log of Monitoring Well B-913U

Project: NCES Landfill
Location: Bethlehem, NH
SHA Project No.: 1649.1
Drilling Method: Mobile B-53 Rig w/4" HW Casing
Sampling Method: Splitspoon
Drilling Company: Capital Environmental Drilling, Co. Inc
Foreman: Mark Voisine
Date Started: 8-30-00 Date Finished: 8-31-00
Logged By: DRP Checked By: RSS

Ground Elevation: 1338.6'
TOC Elevation: 1342.71'
PVC Elevation: 1342.53'
Datum: NAVD '88

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8-31-00	0745	25.2'	Ground	5'	14.5 hrs.
9-5-00	0900	31.2'	PVC	Well	---

Depth (ft)	Casing Blows per ft	Sample Information: Sample No.	Depth (ft)	Spoon Blows per 6"	Pen/Rec (in.)	PID Values (ppm)	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
-2											2.9'
0								---0'---			Protective Steel Guard Pipe
2											
4											
6											
8											
10											2" dia. Sch 40 PVC Riser
12											
14								GLACIAL TILL			Cement/Bentonite Grout
16											16.5'
18											Bentonite Chip Seal
20											20'
22								---23'---			22.7'

Sanborn, Head & Associates, Inc.
CONSULTING ENGINEERS & SCIENTISTS

Log of Monitoring Well B-913U

Project: NCES Landfill
Location: Bethlehem, NH
SHA Project No.: 1649.1
Drilling Method: Mobile B-53 Rig w/4" HW Casing
Sampling Method: Splitspoon
Drilling Company: Capital Environmental Drilling, Co. Inc
Foreman: Mark Voisine
Date Started: 8-30-00 Date Finished: 8-31-00
Logged By: DRP Checked By: RSS

Ground Elevation: 1338.6'
TOC Elevation: 1342.71'
PVC Elevation: 1342.53'
Datum: NAVD '88

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8-31-00	0745	25.2'	Ground	5'	14.5 hrs.
9-5-00	0900	31.2'	PVC	Well	---

Depth (ft)	Casing Blows per ft	Sample Information: Sample No.	Depth (ft)	Spoon Blows per 6"	Pen/ Rec (in.)	PID Values (ppm)	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
25											
27		S-1	26-28'	23 75 90 100	24/13			STRATIFIED DRIFT	S-1: Very dense, olive-gray, fine to medium SAND, some Silt, trace Gravel. Stratified. Moist.		Filter Sand
29											2" dia. Sch. 40 PVC Screen (0.01")
31		S-2	31-33'	49 52 60 69	24/12				S-2: Very dense, olive, SILT, little fine Sand. Moist.		--32.7'---
33								---33'---	Boring terminated at 33'.		
35									NOTES: 1. Ground surface raised 1.5' prior to installing protective steel casing.		
37											
39											
41											
43											
45											
47											

Sanborn, Head & Associates, Inc.
CONSULTING ENGINEERS & SCIENTISTS

Log of Monitoring Well B-913M

Project: NCES
Location: Bethlehem, NH
SHA Project No.: 1649.1
Drilling Method: B-53 Rig w/4" & 5" HW Casing
Sampling Method: Splitspoon
Drilling Company: Captal Environmental Drilling, Co. Inc.
Foreman: Mark Voisine
Date Started: 8-25-00 Date Finished: 8-30-00
Logged By: KcLM/DRP Checked By: RSS

Ground Elevation: 1339.4'
TOC Elevation: 1342.35
PVC Elevation: 1341.77'
Datum: NAVD '88

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8-28-00	0830	N/A	-	-	-
8-29-00	0745	30.0'	Ground	39'	14 hrs.
8-30-00	0820	27.9'	Ground	39'	17 hrs.
8-30-00	1745	33.9'	PVC	Well Inst.	2 hrs

Depth (ft)	Casing Blows per ft	Sample Information: Sample No.	Depth (ft)	Spoon Blows per 6"	Pen/Rec (in.)	PID Values (ppm)	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
-2											2.9'
0								---0'---			Protective Steel Guard Pipe
		S-1	0-2'	3 4 8 22	24/13				S-1: Medium dense, light gray, SILT and fine Sand. Dry.		
2											
4									S-2: Very dense, dark gray, fine to medium SAND, little Silt, trace Gravel. Layer of Silt.		
		S-2	4-6'	22 31 40 41	24/13						
6											
8								GLACIAL TILL			
									S-3:Very dense, gray, fine to medium SAND, little Silt, trace Gravel.		
10		S-3	9-10.9'	WR\12" 99 100\5"	23/14						
12											
14									S-4: Very dense, dark gray, fine SAND, some Silt, trace Gravel.		
		S-4	14-15.4'	40 79 100\5"	17/14						
16											
18											2" dia. Sch. 40 PVC Riser
									S-5: Very dense, dark gray, fine to medium SAND, some Silt, little Gravel.		
20		S-5	19-20.3'	55 78 100\4"	16/12						
22											
								---23'---			

Sanborn, Head & Associates, Inc.
CONSULTING ENGINEERS & SCIENTISTS

Log of Monitoring Well B-913M

Project: NCES
Location: Bethlehem, NH
SHA Project No.: 1649.1
Drilling Method: B-53 Rig w/4" & 5" HW Casing
Sampling Method: Splitspoon
Drilling Company: Captal Environmental Drilling, Co. Inc.
Foreman: Mark Voisine
Date Started: 8-25-00 Date Finished: 8-30-00
Logged By: KcLM/DRP Checked By: RSS

Ground Elevation: 1339.4'
TOC Elevation: 1342.35
PVC Elevation: 1341.77'
Datum: NAVD '88

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8-28-00	0830	N/A	-	-	-
8-29-00	0745	30.0'	Ground	39'	14 hrs.
8-30-00	0820	27.9'	Ground	39'	17 hrs.
8-30-00	1745	33.9'	PVC	Well Inst.	2 hrs

Depth (ft)	Casing Blows per ft	Sample Information: Sample No.	Depth (ft)	Spoon Blows per 6"	Pen/Rec (in.)	PID Values (ppm)	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
											Cement/Bentonite Grout
25		S-6	24-26'	11 39 95 107	24/12				S-6: Very dense, olive, fine SAND and SILT, trace Gravel. Stratified with fine to medium Sand, trace Gravel.		
27											
29		S-7	29-31'	20 55 59 90	24/11				S-7: Very dense, olive, SILT, little fine SAND, stratified with a thin layer of medium Sand.		
31											
33											
35	67-77 86-49 169	S-8	34-36'	30 44 49 55	24/13			STRATIFIED DRIFT	S-8: Very dense, olive, SILT, little fine Sand.		
37											
39		S-9	39-41'	41 44 52 62	24/13				S-9: Similar to S-8.		
41											
43											
45		S-10	44-46'	31 51 62 76	24/13				S-10: Similar to S-8		
47		S-11	46-48'	32 51 69 53	24/13				S-11: Similar to S-8.		Cement/Bentonite Grout

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Log of Monitoring Well B-913M

Project: NCES
Location: Bethlehem, NH
SHA Project No.: 1649.1
Drilling Method: B-53 Rig w/4" & 5" HW Casing
Sampling Method: Splitspoon
Drilling Company: Captal Environmental Drilling, Co. Inc.
Foreman: Mark Voisine
Date Started: 8-25-00 Date Finished: 8-30-00
Logged By: KcLM/DRP Checked By: RSS

Ground Elevation: 1339.4'
TOC Elevation: 1342.35
PVC Elevation: 1341.77'
Datum: NAVD '88

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8-28-00	0830	N/A	-	-	-
8-29-00	0745	30.0'	Ground	39'	14 hrs.
8-30-00	0820	27.9'	Ground	39'	17 hrs.
8-30-00	1745	33.9'	PVC	Well Inst.	2 hrs

Depth (ft)	Casing Blows per ft	Sample Information: Sample No.	Depth (ft)	Spoon Blows per 6"	Pen/ Rec (In.)	PID Values (ppm)	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
		S-12	48-50'	30 52 62 87	24/16			STRATIFIED DRIFT	S-12: Very dense, olive, SILT, trace fine Sand.		
50		S-13	50-52'	31 47 55 58	24/18				S-13: Similar to S-12.		2" dia. Sch. 40 PVC Riser
52		S-14	52-54'	32 37 49 75	24/18				S-14: Similar to S-12.		
54		S-15	54-56'	49 42 47 53	24/20				S-15: Similar to S-12.		
56		S-16	56-58'	42 47 63 74	24/20				S-16: Similar to S-12.		
58		S-17	58-60'	43 51 62 81	24/18				S-17: Similar to S-12.		
60		S-18	60-62'	22 47 63 96	24/12				S-18: Similar to S-12.		
62		S-19	62-64'	33 49 59 136	24/22				S-19: Hard, olive, Clayey SILT, trace fine Sand.		
64		S-20	64-66'	29 47 52 78	24/12				S-20: Very dense, olive, SILT, trace fine Sand.		
66		S-21	66-67.9'	45 58 78 100\5"	23/17				S-21: Hard, olive, Clayey SILT. Stratified Sand and Silt lens comprising <10% of sample.		
68		S-22	68-70'	49 52 75 98	24/12				S-22: Similar to S-21.		Cement/Bentonite Grout
70		S-23	70-70.5'	75 160	12/8				S-23: Hard, olive, Clayey SILT, stratified Sand and Silt lens comprising <5% of sample.		
		S-23A	70.5-71'						S-23A: Very dense, gray, fine to coarse SAND, some Silt, little Gravel. Wet.		
72		S-24	72-74'	38,48	24/20				S-24: Hard, gray, Clayey SILT, stratified with fine to medium Sand seams comprising <10% of sample.		73'

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Log of Monitoring Well B-913M

Project: NCES
Location: Bethlehem, NH
SHA Project No.: 1649.1
Drilling Method: B-53 Rig w/4" & 5" HW Casing
Sampling Method: Splitspoon
Drilling Company: Captal Environmental Drilling, Co. Inc.
Foreman: Mark Voisine
Date Started: 8-25-00 Date Finished: 8-30-00
Logged By: KcLM/DRP Checked By: RSS

Ground Elevation: 1339.4'
TOC Elevation: 1342.35
PVC Elevation: 1341.77'
Datum: NAVD '88

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8-28-00	0830	N/A	-	-	-
8-29-00	0745	30.0'	Ground	39'	14 hrs.
8-30-00	0820	27.9'	Ground	39'	17 hrs.
8-30-00	1745	33.9'	PVC	Well Inst.	2 hrs

Depth (ft)	Casing Blows per ft	Sample No.	Depth (ft)	Spoon Blows per 6"	Pen/ Rec (in.)	PID Values (ppm)	Stratum Log	Stratum Description	Geologic Description	Well Diagram	Well Description
75		S-25	74-75.5'	38 67 125\6"	18/12			STRATIFIED DRIFT	S-25: Hard, gray, SILT and CLAY, stratified Silt and Sand seams comprising <10% of sample. Dry.		Bentonite Chip Seal
77		S-26	76-78'	257\6"	24/0				S-26: No recovery.		76'
79		S-27	78-80'	84 104 95 92	24/18				S-27: Very dense, gray and brown, fine to medium SAND, little Silt. Wet.		78.4'
81		S-28	80-82'	35 61 74 106	24/14				S-28: Very dense, brown, fine to medium SAND, little Silt. Wet.		2" dia. Sch. 40 PVC Screen (0.01" Slots)
83		S-29	82-84'	44 69 64 78	24/16				S-29: Very dense, gray, fine SAND, trace Silt. Wet.		
85		S-30	84-86'	40 50 55 58	24/13				S-30: Very dense, brown, fine SAND, trace Silt, stratified. Wet.		Filter Sand
87		S-31	86-88'	38 64 94 99	24/10				S-31: Very dense, brown, fine SAND, little Silt. Wet.		
89		S-32	88-89.2'	36 61 175 3"	15/9				S-32: Very dense, olive-gray, fine SAND, some Silt, trace Gravel, stratified. Wet.		88.4'
								---90'---			
91								GLACIAL TILL			Formation Material
		S-33	92-92.9'	127 100\5	-				S-33: Very dense, brown, fine to coarse SAND, little Silt, little Gravel. TILL. Wet.		
93								---92.9'---	Boring terminated at 92.9'.		92.9'
95											
97											

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Log of Monitoring Well B-913L

Project: NCES
Location: Bethlehem, NH
SHA Project No.: 1649.1
Drilling Method: B-53 Rig w/4" & 5" HW Casing
Sampling Method: Splitspoon
Drilling Company: Captal Environmental Drilling, Co. Inc.
Foreman: Mark Voisine
Date Started: 8-31-00 Date Finished: 9-5-00
Logged By: DRP Checked By: RSS

Ground Elevation: 1339.2'
TOC Elevation: 1342.44'
PVC Elevation: 1341.92'
Datum: NAVD '88

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time

Depth (ft)	Casing Blows per ft	Sample Information: Sample No.	Depth (ft)	Spoon Blows per 6"	Pen/Rec (in.)	PID Values (ppm)	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
-2											2.9'
0								---0'---			Protective Steel Guard Pipe
2											
4											
6											
8											
10											Cement/Bentonite Grout
12								GLACIAL TILL			
14											
16											
18											2" dia. Sch. 40 PVC Riser
20											
22											

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Log of Monitoring Well B-913L

Project: NCES
Location: Bethlehem, NH
SHA Project No.: 1649.1
Drilling Method: B-53 Rig w/4" & 5" HW Casing
Sampling Method: Splitspoon
Drilling Company: Captal Environmental Drilling, Co. Inc.
Foreman: Mark Voisine
Date Started: 8-31-00 Date Finished: 9-5-00
Logged By: DRP Checked By: RSS

Ground Elevation: 1339.2'
TOC Elevation: 1342.44'
PVC Elevation: 1341.92'
Datum: NAVD '88

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time

Depth (ft)	Casing Blows per ft	Sample Information: Sample No.	Depth (ft)	Spoon Blows per 6"	Pen/ Rec (in.)	PID Values (ppm)	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
25											
27											
29											
31											
33								STRATIFIED DRIFT			
35											Cement/Bentonite Grout
37		S-1	36.5'-37.2'	109 103\3"	9/6				S-1: Very dense, olive-gray, fine to coarse SAND, some Gravel, some Silt. Moist.		
39											
41		S-2	41-43'	93 94 100\3"	15/7				S-2: Very dense, brown, fine to coarse SAND, some Gravel, little Silt. Moist.		
43											
45											2" dia. Sch. 40 PVC Riser
47											

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Log of Monitoring Well B-913L

Project: NCES
Location: Bethlehem, NH
SHA Project No.: 1649.1
Drilling Method: B-53 Rig w/4" & 5" HW Casing
Sampling Method: Splitspoon
Drilling Company: Captal Environmental Drilling, Co. Inc.
Foreman: Mark Voisine
Date Started: 8-31-00 Date Finished: 9-5-00
Logged By: DRP Checked By: RSS

Ground Elevation: 1339.2'
TOC Elevation: 1342.44'
PVC Elevation: 1341.92'
Datum: NAVD '88

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time

Depth (ft)	Casing Blows per ft	Sample Information: Sample No.	Depth (ft)	Spoon Blows per 6"	Pen/Rec (in.)	PID Values (ppm)	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
50											
52											
54											
56											
58											
60								STRATIFIED DRIFT			2" dia. Sch. 40 PVC Riser
62											
64											
66											
68											Cement/Bentonite Grout
70											
72											

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Log of Monitoring Well B-913L

Project: NCES
Location: Bethlehem, NH
SHA Project No.: 1649.1
Drilling Method: B-53 Rig w/4" & 5" HW Casing
Sampling Method: Splitspoon
Drilling Company: Captal Environmental Drilling, Co. Inc.
Foreman: Mark Voisine
Date Started: 8-31-00 Date Finished: 9-5-00
Logged By: DRP Checked By: RSS

Ground Elevation: 1339.2'
TOC Elevation: 1342.44'
PVC Elevation: 1341.92'
Datum: NAVD '88

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time

Depth (ft)	Casing Blows per ft	Sample Information: Sample No.	Depth (ft)	Spoon Blows per 6"	Pen/ Rec (in.)	PID Values (ppm)	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
75											
77											
79											
81											
83								STRATIFIED DRIFT			
85											
87											
89											
								---90'---			
91											
93											
95		S-3	94-94.2'	200 \2.5"	2.5/2			GLACIAL TILL	S-3: Very dense, gray, fine to coarse SAND, some Silt, little Gravel. TILL.		95' Bentonite Chip Seal
97											97'

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Log of Monitoring Well B-913L

Project: NCES
Location: Bethlehem, NH
SHA Project No.: 1649.1
Drilling Method: B-53 Rig w/4" & 5" HW Casing
Sampling Method: Splitspoon
Drilling Company: Captal Environmental Drilling, Co. Inc.
Foreman: Mark Voisine
Date Started: 8-31-00 Date Finished: 9-5-00
Logged By: DRP Checked By: RSS

Ground Elevation: 1339.2'
TOC Elevation: 1342.44'
PVC Elevation: 1341.92'
Datum: NAVD '88

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time

Depth (ft)	Casing Blows per ft	Sample Information: Sample No.	Depth (ft)	Spoon Blows per 6"	Pen/ Rec (in.)	PID Values (ppm)	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
											99'
100		S-4	99-101'	183 \5	24/5				S-4: Very dense, gray, fine to coarse SAND, some Silt, trace Gravel. TILL.		
102											2" dia. Sch. 40 PVC Screen (0.01" Slots)
104								GLACIAL TILL	S-5: Very dense, gray, fine to medium SAND, some Silt, trace Gravel. TILL.		Filter Sand
		S-5	104-104.4'	200\5"	5/4						
106											
108		S-6	107-107.5'	200 \5.5"	5.5/4				S-6: Very dense, gray, fine to medium SAND, some Silt, little Gravel. TILL.		
								---109'---			109'
									Boring terminated at 109'.		
110											
112											
114											
116											
118											
120											
122											

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Log of Monitoring Well B-914U

Project: NCES Landfill
Location: Bethlehem, NH
SHA Project No.: 1649.1
Drilling Method: CME 55x ATV w/5" & 4" HW Casing
Sampling Method: Splitspoon
Drilling Company: Capital Environmental Drilling, Co. Inc
Foreman: Jim Hurlburt
Date Started: 8-28-00 Date Finished: 8-28-00
Logged By: DRP Checked By: RSS

Ground Elevation: 1345.4'
TOC Elevation: 1348.23'
PVC Elevation: 1347.55'
Datum: NAVD '88

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8-28-00	1325	36.0'	PVC	39'	30 mins.
8-28-00	1550	37.3'	PVC	Well Inst.	2 hrs.

Depth (ft)	Casing Blows per ft	Sample Information: Sample No.	Depth (ft)	Spoon Blows per 6"	Pen/Rec (in.)	PID Values (ppm)	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
-2											2.7'
0								---0'---			Protective Steel Guard Pipe
2											
4											
6											
8											
10											
12									No samples taken from 0-29'. See log of B-914L.		
14											2" dia. Sch. 40 PVC Riser
16								STRATIFIED DRIFT			
18											
20											
22											

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Log of Monitoring Well B-914U

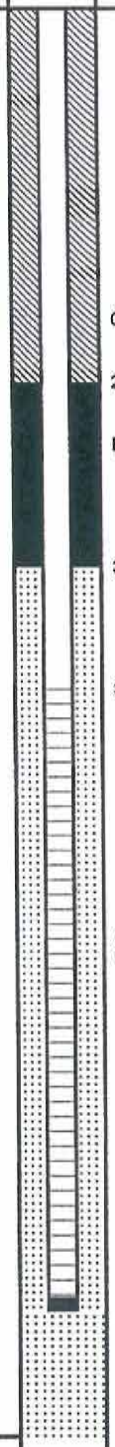
Project: NCES Landfill
Location: Bethlehem, NH
SHA Project No.: 1649.1
Drilling Method: CME 55x ATV w/5" & 4" HW Casing
Sampling Method: Splitspoon
Drilling Company: Capital Environmental Drilling, Co. Inc
Foreman: Jim Hurlburt
Date Started: 8-28-00 Date Finished: 8-28-00
Logged By: DRP Checked By: RSS

Ground Elevation: 1345.4'
TOC Elevation: 1348.23'
PVC Elevation: 1347.55'
Datum: NAVD '88

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8-28-00	1325	36.0'	PVC	39'	30 mins.
8-28-00	1550	37.3'	PVC	Well Inst.	2 hrs.

Depth (ft)	Casing Blows per ft	Sample No.	Depth (ft)	Spoon Blows per 6"	Pen/Rec (in.)	PID Values (ppm)	Stratum Description	Geologic Description
25								
27								
29		S-1	29-31'	33 45 62 99	24/12			S-1: Very Dense, gray, fine to medium SAND, trace Silt, trace Gravel.
31								
33								
35		S-2	34-36'	35 54 65 58	24/15		STRATIFIED DRIFT	S-2: Very dense, brown grading to gray, fine to coarse SAND, little Silt, trace Gravel. 3" thick stratified layers of coarse Sand and Gravel at 34'.
37								
39		S-3	39-41'	11 39 59 55	24/13			S-3: Very dense, gray, SILT, and fine Sand. 3" thick layer of fine to medium Sand at 39'.
41								
43								
45		S-4	44-46'	43 80 99 98	24/17		---46'---	S-4: Very dense, brown, fine to medium SAND, little Silt. 3" thick layer of fine to coarse Sand and Gravel, some Silt at 44' Wet.
47								Bottom of boring at 46'.



Well Description
Cement/Bentonite Grout
29'
Bentonite Chip Seal
32'
34'
2" dia. Sch. 40 PVC Screen (0.01" Slots)
Filter Sand
44'
46'

Sanborn, Head & Associates, Inc.
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Log of Monitoring Well B-914L

Project: NCES Landfill
Location: Bethlehem, NH
SHA Project No.: 1649.1
Drilling Method: CME 550X ATV w/5" & 4" HW Casing
Sampling Method:
Drilling Company: Capital Environmental Drilling, Co, Inc
Foreman: Jim Hurlbut
Date Started: 8-24-00 Date Finished: 8-25-00
Logged By: DRP Checked By: RSS

Ground Elevation: 1346.4'
TOC Elevation: 1349.45'
PVC Elevation: 1348.64'
Datum: NAVD '88

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8-24-00	1730	7.5' and	TOC	49'	2 mins.
8-25-00	0700	37.1'	Ground	49'	13.5' hrs.
8-28-00	1545	39.9'	PVC	-	3 days

Depth (ft)	Casing Blows per ft	Sample Information: Sample No.	Depth (ft)	Spoon Blows per 6"	Pen/Rec (in.)	PID Values (ppm)	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
-2											3.0'
0								---0'---			Protective Steel Guard Pipe
		S-1	0-2'	2 3 8 17	24/7				S-1: Medium dense, gray, fine to medium SAND and Silt, trace Gravel. S-1A: Medium dense, gray, fine to medium SAND, trace Gravel, trace Silt.		
2											
4		S-2	4-6'	27 30 31 33	24/12				S-2: Very dense, olive, SILT, some fine Sand. Stratified.		
6											2" dia. Sch. 40 PVC Riser
8											
10		S-3	9-11'	13 19 22 28	24/16				S-3: Dense, olive, SILT, little fine Sand, stratified with fine layers of fine Sand and Silt.		
12								STRATFIED DRIFT			
14		S-4	14-16'	29 48 57 76	24/12				S-4: Very dense, gray, fine to medium SAND, trace Silt, trace Gravel.		
16											Cement/Bentonite Grout
18											
20		S-5	19-21'	28 70 70 87	24/12				S-5: Very dense, gray, fine to medium SAND, little Silt, trace Gravel.		
22											

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Log of Monitoring Well B-914L

Project: NCES Landfill
Location: Bethlehem, NH
SHA Project No.: 1649.1
Drilling Method: CME 550X ATV w/5" & 4" HW Casing
Sampling Method:
Drilling Company: Capital Environmental Drilling, Co, Inc
Foreman: Jim Hurlbut
Date Started: 8-24-00 Date Finished: 8-25-00
Logged By: DRP Checked By: RSS

Ground Elevation: 1346.4'
TOC Elevation: 1349.45'
PVC Elevation: 1348.64'
Datum: NAVD '88

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8-24-00	1730	7.5' and	TOC	49'	2 mins.
8-25-00	0700	37.1'	Ground	49'	13.5' hrs.
8-28-00	1545	39.9'	PVC	-	3 days

Depth (ft)	Casing Blows per ft	Sample Information: Sample No.	Depth (ft)	Spoon Blows per 6"	Pen/ Rec (in.)	PID Values (ppm)	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
25		S-6	24-26'	30 38 43 55	24/12				S-6: Very dense, gray, fine SAND, trace Silt, slight stratification.		
27											
29		S-7	29-31'	38 48 58 65	24/12				S-7: Very dense, gray, fine to medium SAND, trace Silt, trace Gravel.		
31											2" dia. Sch. 40 PVC Riser
33											
35		S-8	34-36'	33 43 45 66	24/13				S-8: Very dense, gray-brown, fine to medium SAND, little Silt, trace Gravel. Stratified. Moist.		
37								STRATIFIED DRIFT			
39		S-9	39-40'	30 43 44 50	24/10				S-9: Very dense, gray, fine to medium SAND, little Silt. Moist.		
41		S-9A	40.8-41'						S-9A: Very dense, gray, SILT, little fine Sand.		Cement/Bentonite Grout
		S-10	41-43'	23 50 76/	23/13				S-10: Very dense, gray, fine SAND and SILT, Stratified with thin layers of Silt and Sand.		
43		S-11	43-45'	46 83 98/	23/13				S-11: Very dense, gray, fine to medium SAND, little Silt. Stratified.		
45		S-12	45-46'	60 90 75/	23/17				S-12: Very dense, gray, fine to medium SAND, little Silt.		
		S-12A	46-47'						S-12A: Very dense, brown, fine to coarse SAND, little Silt, trace Gravel.		
47			47-49'		23/14				S-13: Very dense, brown, fine to coarse SAND, trace Gravel, trace Silt.		

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Log of Monitoring Well B-914L

Project: NCES Landfill
Location: Bethlehem, NH
SHA Project No.: 1649.1
Drilling Method: CME 550X ATV w/5" & 4" HW Casing
Sampling Method:
Drilling Company: Capital Environmental Drilling, Co, Inc
Foreman: Jim Hurlbut
Date Started: 8-24-00 Date Finished: 8-25-00
Logged By: DRP Checked By: RSS

Ground Elevation: 1346.4'
TOC Elevation: 1349.45'
PVC Elevation: 1348.64'
Datum: NAVD '88

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8-24-00	1730	7.5' and	TOC	49'	2 mins.
8-25-00	0700	37.1'	Ground	49'	13.5' hrs.
8-28-00	1545	39.9'	PVC	-	3 days

Depth (ft)	Casing Blows per ft	Sample Information: Sample No.	Depth (ft)	Spoon Blows per 6"	Pen/ Rec (in.)	PID Values (ppm)	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
		S-13		60,61 67,	23/14			STRATIFIED DRIFT	S-13: Very dense, brown, fine to coarse SAND, trace Gravel, trace Silt.		
50		S-14	49-51'	30 45 48/	24/13				S-14: Very dense, gray, fine to medium SAND, some Silt. Stratified.		
52		S-15	51-53'	47 48 58/	24/13				S-15: Very dense, gray, fine SAND and SILT, trace Gravel. Stratified with medium to coarse Sand seams comprising <10% of sample.		
54		S-16	53-55'	25 42 61/	24/12				S-16: Very dense, gray, fine SAND and SILT, with medium to coarse Sand and Gravel seams comprising <40% of sample.		2" dia. Sch. 40 PVC Riser
56		S-17	55-57'	25 42 61/	24/14				S-17: Very dense, gray, SILT, little fine Sand. Stratified.		
58		S-18	57-59'	39 100\4"	10/5				S-18: Very dense, gray, fine to medium SAND, some Silt, trace Gravel.		
60		S-19	59-59.5'	120	6/4				S-19: Very dense, gray, fine SAND and SILT.		
								---61'---			
62		S-20	61-62.2'	8 22 150\2"	14/4			GLACIAL TILL	S-20: Very dense, gray, fine to medium SAND, some Silt, trace Gravel. TILL.		Cement/Bentonite Grout
64		S-21	63-63.8'	55 100\4"	10/6				S-21: Very dense, gray, fine to medium SAND, some Silt, trace Gravel. Rock in tip of spoon. TILL.		
66											-66.5'
68											Bentonite Chip Seal
		S-22	68-68.4'	100\5"	5/5				S-22: Very dense, gray, fine to coarse SAND, some Silt, trace Gravel. TILL.		-69'
70											
											-71.1'
72											2" dia. Sch. 40 PVC Screen (0.01" Slots)

Sanborn, Head & Associates, Inc.
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Log of Monitoring Well B-914L

Project: NCES Landfill
Location: Bethlehem, NH
SHA Project No.: 1649.1
Drilling Method: CME 550X ATV w/5" & 4" HW Casing
Sampling Method:
Drilling Company: Capital Environmental Drilling, Co, Inc
Foreman: Jim Hurlbut
Date Started: 8-24-00 Date Finished: 8-25-00
Logged By: DRP Checked By: RSS

Ground Elevation: 1346.4'
TOC Elevation: 1349.45'
PVC Elevation: 1348.64'
Datum: NAVD '88

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8-24-00	1730	7.5' and	TOC	49'	2 mins.
8-25-00	0700	37.1'	Ground	49'	13.5' hrs.
8-28-00	1545	39.9'	PVC	-	3 days

Depth (ft)	Casing Blows per ft	Sample Information: Sample No.	Depth (ft)	Spoon Blows per 6"	Pen/ Rec (in.)	PID Values (ppm)	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
		S-23	73-73.4'	100\5"	5/3				S-23: Very dense, gray, fine to coarse SAND, some Silt, trace Gravel. TILL.		
75											Filter Sand
77											
79											
									S-24: Very dense, gray, fine to coarse SAND, some Silt, trace Gravel. TILL.		
81		S-24	80-80.5'	150\6"	6/4			---81'--- GLACIAL TILL	Boring terminated at 81'. No refusal encountered.		-81.1'
83											
85											
87											
89											
91											
93											
95											
97											

NOTES

1. Roller bit advanced to each soil sample depth interval and prior to driving casing to the following depths: 5" ID HW Casing installed to 19.5', 4" ID HW casing installed to 61'.

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Log of Well MW-915U

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Ryan Mingarelli
Date Started: 12-7-00 Date Finished: 12-8-00
Logged By: KeLM Checked By: PMS

Ground Elevation: 1335.4
TOC Elevation: 1338.46
PVC Elevation: 1338.20

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
12-7-00	1600		Ground	31'	
12-14-00	0930	27.12	Ground	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
-2											-3.0'
											-2.75'
											Protective Steel Casing
0								0'	Refer to MW-915L boring log for geologic descriptions.		0'
2											
4											2" dia. Sch 40 PVC Riser Pipe (-2.75 to 28')
6								Stratified Drift			
8											Cement/Bentonite Grout (0 to 23')
10											
12											
14											

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Log of Well MW-915U

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Ryan Mingarelli
Date Started: 12-7-00 Date Finished: 12-8-00
Logged By: KeLM Checked By: PMS

Ground Elevation: 1335.4
TOC Elevation: 1338.46
PVC Elevation: 1338.20

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
12-7-00	1600		Ground	31'	
12-14-00	0930	27.12	Ground	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									Refer to MW-915L boring log for geologic descriptions.		
16											Cement/Bentonite Grout (0 to 23')
18											2" dia. Sch 40 PVC Riser Pipe (-2.75 to 28')
20											
22								Stratified Drift			23'
24											Bentonite Chip Seal (23 to 26')
26											26'
											Filter Sand (26 to 38.5')
28											28'
	S-1	29-31'	99 100\2"		9/5				S-1: Very dense, gray, fine to medium SAND, some Silt, trace Gravel, orange discoloration throughout. Moist.		2" dia Sch 40 PVC Well Screen (0.010" Slots) (28 to 38')
30											

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Log of Well MW-915U

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Ryan Mingarelli
Date Started: 12-7-00 Date Finished: 12-8-00
Logged By: KeLM Checked By: PMS

Ground Elevation: 1335.4
TOC Elevation: 1338.46
PVC Elevation: 1338.20

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
12-7-00	1600		Ground	31'	
12-14-00	0930	27.12	Ground	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
32	S-2	31-33'	100\4"		4/1				S-2: Very dense, gray, fine to coarse SAND, little Silt. Moist.		2" dia Sch 40 PVC Well Screen (0.010" Slots) (28 to 38')
34	S-3	33-35'	102\6"		6/4			Stratified Drift	S-3: Very dense, brown-gray, fine to medium SAND, little Silt, trace Gravel. Moist.		
36	S-4	35-37'	150\6"		6/4				S-4: Very dense, brown-gray, fine to medium SAND, little Silt, trace Gravel. Wet.		Filter Sand 26 to 38.5')
38	S-5	37-39'	69 100\5"		11/10				S-5: Very dense, gray, fine to medium SAND, some Silt, trace fine Gravel. Moist.		38' Bottom Cap
								---38.5'---	Boring terminated at 38.5'.		38.5'
40											
42											
44											
46											

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Log of Well MW-915M

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Ryan Mingarelli
Date Started: 12-11-00 Date Finished: 12-13-00
Logged By: Kelm Checked By: PMS

Ground Elevation: 1335.5
TOC Elevation: 1338.63
PVC Elevation: 1338.09

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
12-11-00	1530		Ground	48'	
12-12-00	1600		Ground	65'	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
-2											-3.2'
											-2.70'
											Protective Steel Casing
0								0'	Refer to MW-915L boring log for geologic descriptions.		0'
2											
4											Cement/bentonite Grout (0 to 71')
6								Stratified Drift			
8											2" dia. Sch 40 PVC Riser Pipe (-2.70 to 75.5')
10											
12											
14											

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Log of Well MW-915M

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Ryan Mingarelli
Date Started: 12-11-00 Date Finished: 12-13-00
Logged By: Kelm Checked By: PMS

Ground Elevation: 1335.5
TOC Elevation: 1338.63
PVC Elevation: 1338.09

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
12-11-00	1530		Ground	48'	
12-12-00	1600		Ground	65'	

Depth (ft)	Sample No.	Depth (ft)	Blows Spoon per 6"	Blows Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									Refer to MW-915L boring log for geologic descriptions.		
16											
18											
20											Cement/Bentonite Grout (0 to 71')
22								Stratified Drift			2" dia. Sch 40 PVC Riser Pipe (-2.70 to 75.5')
24											
26											
28											
30											

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Log of Well MW-915M

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Ryan Mingarelli
Date Started: 12-11-00 Date Finished: 12-13-00
Logged By: Kelm Checked By: PMS

Ground Elevation: 1335.5
TOC Elevation: 1338.63
PVC Elevation: 1338.09

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
12-11-00	1530		Ground	48'	
12-12-00	1600		Ground	65'	

Depth (ft)	Sample No.	Depth (ft)	Blows Spoon per 6"	Blows Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									Refer to MW-915L boring log for geologic description.		
32											
34											Cement/Bentonite Grout (0 to 71')
36											2" dia. Sch 40 PVC Riser Pipe (-2.70 to 75.5')
								Stratified Drift			
38											
40											
42											
44											
46											

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Log of Well MW-915M

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Ryan Mingarelli
Date Started: 12-11-00 Date Finished: 12-13-00
Logged By: Kelm Checked By: PMS

Ground Elevation: 1335.5
TOC Elevation: 1338.63
PVC Elevation: 1338.09

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
12-11-00	1530		Ground	48'	
12-12-00	1600		Ground	65'	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									Refer to MW-915L boring log for geologic descriptions.		
48											
50											
52											Cement/Bentonite Grout (0 to 71')
								Stratified Drift			
54											2" dia. Sch 40 PVC Riser Pipe (-2.70 to 75.5')
56											
58											
								59'			
60								TILL			
62											

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Log of Well MW-915M

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Ryan Mingarelli
Date Started: 12-11-00 Date Finished: 12-13-00
Logged By: Keim Checked By: PMS

Ground Elevation: 1335.5
TOC Elevation: 1338.63
PVC Elevation: 1338.09

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
12-11-00	1530		Ground	48'	
12-12-00	1600		Ground	65'	

Depth (ft)	Sample No.	Depth (ft)	Blows Spoon per 6"	Blows Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
64											Cement/Bentonite Grout (0 to 71')
66											2" dia. Sch 40 PVC Riser Pipe (-2.70 to 75.5')
68											
70								TILL			
											71'
72											Bentonite Chip Seal (71 to 74')
74											74'
	S-1	74-76'	150\4"		4/3				S-1: Very dense, brown black, fine to coarse SAND, some Gravel, discoloration throughout. Moist.		Filter Sand (74 to 82')
											75.5'
76									S-2: Very dense, gray, fine to coarse Gravel, discoloration throughout. Moist.		2" dia Sch 40 PVC Well Screen (0.010" Slots) (75.5 to 81')
	S-2	76-78'	107\6"		6/4				S-3: Very dense, gray, GRAVEL, some fine to coarse Sand, trace Silt. Moist.		
78											

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Log of Well MW-915M

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Ryan Mingarelli
Date Started: 12-11-00 Date Finished: 12-13-00
Logged By: Kelm Checked By: PMS

Ground Elevation: 1335.5
TOC Elevation: 1338.63
PVC Elevation: 1338.09

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
12-11-00	1530		Ground	48'	
12-12-00	1600		Ground	65'	

Depth (ft)	Sample No.	Depth (ft)	Blows Spoon per 6"	Blows Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
	S-3	78-80'	100\3"		4/3						2" dia Sch 40 PVC Well Screen (0.010" Slots) (75.5 to 81')
80								TILL	S-4: Very dense, gray brown, fine to coarse SAND, little Gravel, trace Silt, discoloration throughout. Moist.		
	S-4	80-82'	100\4"		4/3						81' Bottom Cap
82								---82'---	Boring terminated at 82'.		82'
84											
86											
88											
90											
92											
94											

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Log of Well MW-915D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Ryan Mingarelli
Date Started: 11-30-00 Date Finished: 12-5-00
Logged By: KeLM Checked By: PMS

Ground Elevation: 1335.4
TOC Elevation: 1338.40
PVC Elevation: 1338.16

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
12-15-00	0900	30'	Ground	79'	
12-6-00	0900	31.0'	Ground	99'	
12-12-00	0900	35.67'	Ground	Well Inst.	
12-13-00	0900	36.2'	Ground	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
-2											-3.0'
											2.75'
											Protective Steel Casing
0								---0'---	S-1: Loose, dark brown, TOPSOIL, some Wood fragments, trace Vegetation. Moist.		0'
	S-1	0-2'	WOR 2 4 6	WOR	24/4			TOPSOIL			
2				WOR				---2'---			
				11							
4				33					S-2: No Recovery.		
	S-2	4-6'	100\5"	18	5/0						2" dia Sch 40 PVC Riser Pipe (-2.75 to 106.5')
6				WOR							
				WOR				Stratified Drift			Cement/Bentonite Grout (0 to 103')
8				24							
				WOR					S-3: Vey dense, gray brown, fine SAND and SILT, trace Gravel, stratified Silt seams. Dry.		
10	S-3	9-11'	36 45 44 40	WOR	24/14						
				WOR							
12				WOR							
				WOR							
14											

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Log of Well MW-915D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Ryan Mingarelli
Date Started: 11-30-00 Date Finished: 12-5-00
Logged By: KeLM Checked By: PMS

Ground Elevation: 1335.4
TOC Elevation: 1338.40
PVC Elevation: 1338.16

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
12-15-00	0900	30'	Ground	79'	
12-6-00	0900	31.0'	Ground	99'	
12-12-00	0900	35.67'	Ground	Well Inst.	
12-13-00	0900	36.2'	Ground	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows Spoon per 6"	Blows Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									S-4: Dense; otherwise similar to S-3.		
	S-4	14-16'	20 23 21 23	8/6"	24/13						
16											
18											
									S-5: Very dense, brown gray, fine to medium SAND, some Silt, trace Gravel, trace Clay, orange coarse Sand partings, dark gray Clay seams. Dry.		
20	S-5	19-21'	103\6"		6/6						2" dia Sch 40 PVC Riser Pipe (-2.75 to 106.5')
22											Cement/Bentonite Grout (0 to 103')
24								Stratified Drift	S-6: Very dense, gray, fine to medium SAND, some Silt. Moist.		
	S-6	24-26'	49 100\6"		12/10						
26											
28											
	S-7	29-31'	55 100\5"		11/10				S-7: Very dense, gray, fine to medium SAND and SILT, trace Gravel, orange discoloration. Moist.		
30											

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Log of Well MW-915D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Ryan Mingarelli
Date Started: 11-30-00 Date Finished: 12-5-00
Logged By: KeLM Checked By: PMS

Ground Elevation: 1335.4
TOC Elevation: 1338.40
PVC Elevation: 1338.16

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
12-15-00	0900	30'	Ground	79'	
12-6-00	0900	31.0'	Ground	99'	
12-12-00	0900	35.67'	Ground	Well Inst.	
12-13-00	0900	36.2'	Ground	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
32											
34	S-8	34-36'	85 100\4"		10/6				S-8: Very dense, gray, fine to medium SAND, some Silt, trace fine Gravel, trace Clay. Moist.		
36											2" dia Sch 40 PVC Riser Pipe (-2.75 to 106.5')
38											Cement/Bentonite Grout (0 to 103')
40	S-9	39-41'	59 100\4"		10/6			Stratified Drift	S-9: Very dense, gray, SILT and fine SAND, trace fine Gravel. Moist.		
42											
44	S-10	44-47'	53 77 100\4"		16/15				S-10: Very dense, brown-gray, fine to medium SAND, little Silt, orange discoloration, stratified Silt seams. Moist.		
46											

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Log of Well MW-915D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
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2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Ryan Mingarelli
Date Started: 11-30-00 Date Finished: 12-5-00
Logged By: KeLM Checked By: PMS

Ground Elevation: 1335.4
TOC Elevation: 1338.40
PVC Elevation: 1338.16

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
12-15-00	0900	30'	Ground	79'	
12-6-00	0900	31.0'	Ground	99'	
12-12-00	0900	35.67'	Ground	Well Inst.	
12-13-00	0900	36.2'	Ground	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
48											
									S-11: Very dense, brown, fine to medium SAND, little Silt, Moist. Stratified.		
50	S-11	49-51'	62 74 100\5"		17/15						
52								Stratified Drift			
											2" dia Sch 40 PVC Riser Pipe (-2.75 to 106.5')
54									S-12: Very dense, brown, fine to coarse SAND, little fine Gravel, trace Silt, bottom 7" fine Sands. Moist. Stratified.		
	S-12	54-56'	33 77 78 79		24/19						Cement/Bentonite Grout (0 to 103')
56											
58											
								59---			
60								Boulder			
62											

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Log of Well MW-915D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Ryan Mingarelli
Date Started: 11-30-00 Date Finished: 12-5-00
Logged By: KeLM Checked By: PMS

Ground Elevation: 1335.4
TOC Elevation: 1338.40
PVC Elevation: 1338.16

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
12-15-00	0900	30'	Ground	79'	
12-6-00	0900	31.0'	Ground	99'	
12-12-00	0900	35.67'	Ground	Well Inst.	
12-13-00	0900	36.2'	Ground	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows Spoon per 6"	Blows Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
64	S-13	64.5-66.5	100\5"		5/3			64.5' TILL	S-13: Very dense, brown, fine to coarse SAND, little Silt, trace Gravel. Moist.		
66								66' Boulder			
68								68'			2" dia Sch 40 PVC Riser Pipe (-2.75 to 106.5')
70	S-14	69-71'	155\6"		6/4				S-14: Very dense, gray-brown, fine to coarse SAND, little Gravel, trace Silt, trace Clay, coarse Sand seams. Moist.		Cement/Bentonite Grout (0 to 103')
72	S-15	71-73'	200\4"		4/4				S-15: Very dense, brown, fine to coarse SAND, little Gravel, little Silt, stratified Silt partings. Moist.		
74	S-16	74-76'	96 100\1"		7/5			TILL	S-16: Very dense, gray-brown, fine to coarse SAND, little fine Gravel, trace Silt, discoloration throughout. Moist.		
76	S-17	76-78'	200\5"		5/4				S-17: Very dense, gray-brown, fine to coarse SAND, little Gravel, trace Silt, discoloration throughout. Moist.		
78											

Sanborn, Head & Associates, Inc.
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Log of Well MW-915D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Ryan Mingarelli
Date Started: 11-30-00 Date Finished: 12-5-00
Logged By: KeLM Checked By: PMS

Ground Elevation: 1335.4
TOC Elevation: 1338.40
PVC Elevation: 1338.16

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
12-15-00	0900	30'	Ground	79'	
12-6-00	0900	31.0'	Ground	99'	
12-12-00	0900	35.67'	Ground	Well Inst.	
12-13-00	0900	36.2'	Ground	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows Spoon per 6"	Blows Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
80	S-18	79-81'	66 55 87 100		24/13				S-18: Very dense, brown, fine to coarse SAND, some Gravel, trace Silt, discoloration throughout. Moist.		
82											
84									S-19: Very dense, brown, fine to coarse SAND, little Gravel, trace Silt, trace Clay, discoloration throughout. Moist.		
	S-19	84-86'	92 105\6"		12/10			TILL			2" dia Sch 40 PVC Riser Pipe (-2.75 to 106.5')
86											
											Cement/Bentonite Grout (0 to 103')
88											
									S-20: Very dense, brown, fine to coarse SAND, little Gravel, trace Silt, trace Clay, dark gray Clay seams, discoloration throughout. Moist.		
90	S-20	89-91'	79 120\6"		12/10						
92											
94											

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Date Started: 11-30-00 Date Finished: 12-5-00
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Ground Elevation: 1335.4
TOC Elevation: 1338.40
PVC Elevation: 1338.16

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
12-15-00	0900	30'	Ground	79'	
12-6-00	0900	31.0'	Ground	99'	
12-12-00	0900	35.67'	Ground	Well Inst.	
12-13-00	0900	36.2'	Ground	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
	S-21	94-96'	200\6"		6/4				S-21: Very dense, brown, fine to medium SAND, some Silt. Moist.		
96											
								TILL			
98											2" dia Sch 40 PVC Riser Pipe (-2.75 to 106.5')
									S-22: Very dense, dark gray, fine to medium SAND, some fine Gravel, little Silt. Wet.		
100	S-22	99-101'	100\3"		3/2						Cement/Bentonite Grout (0 to 103')
								---101'---			
102								Boulder			
								---103'---			103'
104									S-23: Very dense, dark gray, fine to medium SAND, little Silt, trace fine Gravel, discoloration throughout. Wet.		Bentonite Chip Seal (103 to 105.5')
	S-23	104-106'	100\3"		3/1						105.5' Filter Sand (105.5 to 111')
106											106.5'
								TILL			
108											2" dia. Sch 40 PVC Well Screen (0.010" Slots) (106.5 to 110.5')
	S-24	109-110'	47 59 61 100\5"		23/10				S-24: Very dense, dark gray, fine to medium SAND, some Gravel, little Silt, discoloration throughout. Wet.		
110											

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Log of Well MW-915D

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TOC Elevation: 1338.40
PVC Elevation: 1338.16

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
12-15-00	0900	30'	Ground	79'	
12-6-00	0900	31.0'	Ground	99'	
12-12-00	0900	35.67'	Ground	Well Inst.	
12-13-00	0900	36.2'	Ground	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
											110.5' Bottom Cap
								—111'—			111'
									S-25: Rock Fragments retrieved from cuttings, orange, pink, black and white. Granite.		
112	S-25	111-114'									
								Bedrock			
114									S-26: Similar to S-25.		Bentonite Chip Seal (111 to 116')
	S-26	114-116'									
116								—116'—			116'
									Boring terminated at 116'.		
118											
120											
122											
124											
126											

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Log of Well MW-916U

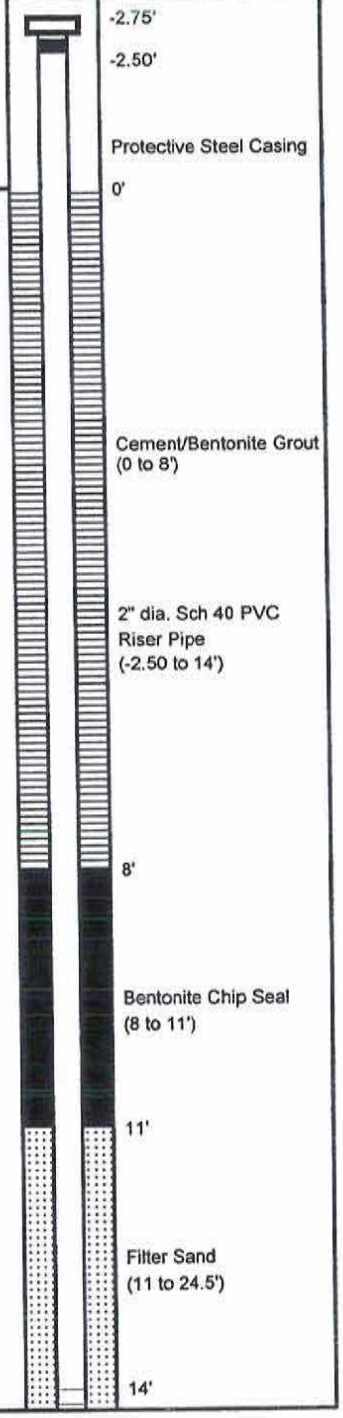
Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Jeff Hall
Date Started: 11-13-00 Date Finished: 11-22-00
Logged By: KeLM Checked By: PMS

Ground Elevation: 1321.2
TOC Elevation: 1323.99
PVC Elevation: 1323.76

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
11-13-00	0820	16.2'	Ground	10'	
11-14-00	1620	15.35'	Ground	Well Inst.	
11-15-00	0810	15.0'	Ground	Well Inst.	
11-20-00	0815	14.75'	Ground	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows Spoon per 6"	Blows Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description
-2									
0	S-1	0-0.5'	2 3		6/6			0'	S-1: Loose, dark brown, fine to medium SAND, little Silt, trace Vegetation. Moist.
	S-1A	0.5-2'	4 9		18/13				S-1A: Medium dense, gray, fine SAND, some Silt, trace Gravel. Moist.
2									
4				14					S-2: Very dense, gray, fine to medium SAND, some Silt, trace Gravel, brown Silt partings. Moist.
	S-2	4-6'	44 60 37 43	11	24/10				
6								Till	
				44					
8				64					
10	S-3	9-11'	88 79 100\5"		17/12				S-3: Very dense, gray, fine to medium SAND, trace Gravel, dark gray Silt lenses around Gravel. Moist.
12									
14									



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Log of Well MW-916U

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
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2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Jeff Hall
Date Started: 11-13-00 Date Finished: 11-22-00
Logged By: KeLM Checked By: PMS

Ground Elevation: 1321.2
TOC Elevation: 1323.99
PVC Elevation: 1323.76

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
11-13-00	0820	16.2'	Ground	10'	
11-14-00	1620	15.35'	Ground	Well Inst.	
11-15-00	0810	15.0'	Ground	Well Inst.	
11-20-00	0815	14.75'	Ground	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
	S-4	14-15'	100\5"		5/4				S-4: Very dense, gray, fine SAND and SILT, some Gravel, orange brown discoloration throughout. Moist.		
16											2" dia. Sch 40 PVC Well Screen (0.010" Slots) (14 to 24')
18											Filter Sand (11 to 24.5')
20	S-5	19-20'	58 88 100\5"		17/14			Till	S-5: Very dense, gray, fine to medium SAND, some Silt, little Gravel, orange Silt discolorations throughout. Wet.		
22											
24									S-6: Very dense, gray, fine SAND, some Silt, trace Gravel, orange Silt discolorations throughout. Moist.		24' Bottom Cap 24.5'
	S-6	24-26'	60 100\4"		10/6						
26											Bentonite Chip Seal (24.5 to 37')
28											
	S-7	29-31'	56 100\5"		11/8				S-7: Very dense, gray, fine SAND and SILT, trace Gravel, orange Silt partings. Wet.		
30											

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Log of Well MW-916U

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Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Jeff Hall
Date Started: 11-13-00 **Date Finished:** 11-22-00
Logged By: KeLM **Checked By:** PMS

Ground Elevation: 1321.2
TOC Elevation: 1323.99
PVC Elevation: 1323.76

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
11-13-00	0820	16.2'	Ground	10'	
11-14-00	1620	15.35'	Ground	Well Inst.	
11-15-00	0810	15.0'	Ground	Well Inst.	
11-20-00	0815	14.75'	Ground	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
32											Bentonite Chip Seal (24.5 to 37')
34									S-8: Very dense, gray, fine SAND and SILT, trace Gravel. Wet.		
	S-8	34-36'	54 100\4"		10/8			Till			
36									S-9: Very dense, gray, fine SAND and SILT, trace Gravel. Wet.		
	S-9	36-38'	80 100 3"		9/7						37'
38									S-10: Very dense, gray, fine SAND, some Silt, trace Gravel. Moist.		
	S-10	38-40'	100 100\2"		8/6						
40									S-11: Very dense, brown-gray, fine to medium SAND, little Silt, trace Gravel, trace Clay, medium Sand lenses, light gray Clay lenses. Wet.		Formation Material (37 to 50')
	S-11	40-42'	52 100\4"		10/8						
42									S-12: Similar to S-11.		
	S-12	42-44'	120\6"		6/5			43'---			
44								Stratified Drift	S-13: Very dense, brown-gray, fine to coarse SAND, trace Gravel, trace Silt. Moist.		
	S-13	44-46'	100\4"		4/4						
46											

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Log of Well MW-916U

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Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
11-13-00	0820	16.2'	Ground	10'	
11-14-00	1620	15.35'	Ground	Well Inst.	
11-15-00	0810	15.0'	Ground	Well Inst.	
11-20-00	0815	14.75'	Ground	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
	S-14	46-48'	150\6"		6/4			Stratified Drift	S-14: Very dense, brown gray, fine to coarse SAND, little Gravel, trace Silt. Moist.		Formation Material (37 to 50')
48											
	S-15	48-50'	35 66 100\4"		16/11				S-15: Very Dense. Brown. Fine to medium SAND, trace Gravel, trace Silt. Moist.		
50								---50'---	Boring terminated at 50'. Drive shoe separated from casing at 50'. Hole collapsed to 37'.		50'
52											
54											
56											
58											
60											
62											

Sanborn, Head & Associates, Inc.
CONSULTING ENGINEERS & SCIENTISTS

Log of Well MW-916M

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Jeff Hall
Date Started: 11-14-00 Date Finished: 11-22-00
Logged By: Keim Checked By: PMS

Ground Elevation: 1321.1
TOC Elevation: 1324.13
PVC Elevation: 1323.91

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
11-16-00	0815	25.4'	Ground	49'	
11-20-00	1640	35.2'	Ground	96'	
11-21-00	0800	35.2'	Ground	96'	
11-22-00	1500	38.56'	PVC	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
-2											-3.0'
											-2.75'
											Protective Steel Casing
0								---0'---	Refer to MW-916U boring log for geologic descriptions.		0'
2											
4											2" dia. Sch 40 PVC Riser Pipe (-2.75 to 84.5')
6											Cement/Bentonite Grout (0 to 79.5')
								Till			
8											
10											
12											
14											

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Log of Well MW-916M

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Date Started: 11-14-00 Date Finished: 11-22-00
Logged By: Kelm Checked By: PMS

Ground Elevation: 1321.1
TOC Elevation: 1324.13
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Groundwater Readings

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Depth (ft)	Sample No.	Depth (ft)	Blows Spoon per 6"	Blows Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									Refer to MW-916U boring log for geologic descriptions.		
16											
18											
20											2" dia. Sch 40 PVC Riser Pipe (-2.75 to 84.5')
22								Till			Cement/Bentonite Grout (0 to 79.5')
24											
26											
28											
30											

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Log of Well MW-916M

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Depth (ft)	Sample No.	Depth (ft)	Blows Spoon per 6"	Blows Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									Refer to MW-916U boring log for geologic descriptions.		
32											
34								Till			2" dia. Sch 40 PVC Riser Pipe (-2.75 to 84.5')
36											
38											Cement/Bentonite Grout (0 to 79.5')
40											
42								43'			
44									S-1: Very dense, brown gray, fine to coarse SAND, little Gravel, little Silt. Moist.		
	S-1	44-46'	100\4"	63	4/2			Stratified Drift			
46				85							

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Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
	S-2	46-48'	142 93 93 80	94	24/15				S-2: Very dense, gray brown, fine to coarse SAND, little Silt, trace Gravel. Moist.		
48				59							
	S-3	48-50'	53 56 100 100\4"	60	22/18				S-3: Very dense, brown gray, fine to medium SAND, little Silt, trace Gravel, Bottom 3" stratified light gray Silt and orange fine SAND. Moist. *Wick test performed fron 48-50'.		
50				126							
	S-4	50-52'	42 65 73 69	24	24/17				S-4: Very dense, brown gray, fine to medium SAND, little Silt, trace Gravel, thin stratified clayey-Silt layers. Moist.		
52				31				Stratified Drift			2" dia. Sch 40 PVC Riser Pipe (-2.75 to 84.5')
	S-5	52-54'	35 52 69 90	33	24/17				S-5: Very dense, brown, fine to medium SAND, some Silt, trace Gravel. Moist.		
54				44					S-6: Similar to S-5.		Cement/Bentonite Grout (0 to 79.5')
	S-6	54-56'	25 45 100\5"	48	17/10						
56				72					S-7: Very dense, fine to coarse SAND, some Silt, trace Gravel. Wet.		
	S-7	56-58'	69 100-5"	81	11/7						
58				80					S-8: No Recovery.		
	S-8	58-60'	100\2"	84	2/0						
60				32					S-9: Very dense, brown, fine to medium SAND, little Silt, statified. Moist. *Wick test preformed from 60-62'.		
	S-9	60-62'	62 68 77 79	64	24/16						
62				55							

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Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
	S-10	62-64'	55 56 60 64	34					S-10: Very dense, brown, fine to medium SAND, little Silt, stratified. Moist.		
64				56					S-11: Very dense, brown, fine to medium SAND, little Silt. Moist.		
	S-11	64-66'	30 51 48 54	36	24/17						
66				30					S-12: Similar to S-11.		
	S-12	66-68'	31 45 50 80	35	24/16						2" dia. Sch 40 PVC Riser Pipe (-2.75 to 84.5')
68				36					S-13: Very dense, gray brown, fine SAND, little Silt. Moist.		
	S-13	68-70'	55 60 89 96	57	24/17			Stratified Drift			Cement/Bentonite Grout (0 to 79.5')
70				34					S-14: Very dense, gray brown, fine to medium SAND and SILT, trace Gravel, stratified seams of medium SAND, stratified seams of Silt. Moist.		
	S-14	70-72'	130\6"	41	6/5						
72				48					S-15: Very dense, gray, fine to coarse SAND, little Gravel, little Silt. Moist. Stratified layers.		
	S-15	72-74'	60 95 100\3"	37	15/8						
74				55					S-16: Very dense, gray, fine to coarse SAND, some Gravel, little Silt. Moist. Stratified.		
	S-16	74-76'	80 160\6"	34	12/7						
76				39				—76'—	S-17: Very dense, gray, fine to coarse SAND, little Gravel, little Silt. Moist.		
	S-17	76-78'	38 76 100\4"	44	16/10						
78				80							

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Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
11-16-00	0815	25.4'	Ground	49'	
11-20-00	1640	35.2'	Ground	96'	
11-21-00	0800	35.2'	Ground	96'	
11-22-00	1500	38.56'	PVC	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									*Wick test preformed from 78-79'.		
				98					S-18: Very dense, black gray, medium to coarse SAND and GRAVEL. Wet. 3" splitspoon.		Cement/Bentonite Grout (0 to 79.5') 79.5'
80	S-18	79-81'	98 100\2"	53	8/7						2" dia. Sch 40 PVC Riser Pipe (-2.75 to 84.5')
				104					S-19: No recovery. 3" splitspoon.		
82	S-19	81-83'	125\6"	49	6/0						Bentonite Chip Seal (79.5 to 82.5') 82.5'
				33					S-20: Very dense, gray-black, GRAVEL, some fine to medium Sand, trace Silt. Wet. Drilling difficulty indicates cobbles.		Filter Sand (82.5 to 92')
84	S-20	83-85'	115\6"	53	6/3						84.5'
				47					S-21: Very dense, black, coarse SAND and GRAVEL. Moist. Drilling difficulty indicates cobbles.		
86	S-21	85-97'	100\3"	154	3/2			TILL			
				65					S-22: No Recovery. Rock in tip of spoon.		2" dia. Sch 40 PVC Well Screen (0.010" Slots) (84.4 to 89.5')
88	S-22	87-89'	125\5"	42	5/1						
				97					S-23: Very dense, gray black, medium to coarse SAND and GRAVEL, trace Silt. Wet. 3" splitspoon. Drilling difficulty indicates cobbles.		89.5' Bottom Cap
90	S-23	89-91'	88 100\2"		8/5						
									S-24: Similar to S-23.		
92	S-24	91-93'	150\5"		5/3						92'
	S-25	93-95'	16 100\2"		7/0				S-25: No sample recovered. All wash material.		Bentonite Chip Seal (92 to 99')
94											

Sanborn, Head & Associates, Inc.
CONSULTING ENGINEERS & SCIENTISTS

Log of Well MW-916M

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Jeff Hall
Date Started: 11-14-00 Date Finished: 11-22-00
Logged By: Keim Checked By: PMS

Ground Elevation: 1321.1
TOC Elevation: 1324.13
PVC Elevation: 1323.91

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
11-16-00	0815	25.4'	Ground	49'	
11-20-00	1640	35.2'	Ground	96'	
11-21-00	0800	35.2'	Ground	96'	
11-22-00	1500	38.56'	PVC	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows Spoon per 6"	Blows Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
								---95'---			
96											Bentonite Chip Seal (92 to 99')
								Boulder	S-26: Rock fragments from wash.		
98	S-26	97-99'									
											99'
100								---100'---			
								TILL	S-27: Very dense, orange brown gray, fine to medium SAND, some Silt. Moist.		Formation Material (99 to 103')
102	S-27	101-103'	125\1"		1/1						
								---103'---	Boring terminated at 103'. Drive shoe Separated from casing at 103'. 5" Casing to 10'.		103'
104											
106											
108											
110											

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Log of Well MW-916D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Jeff Hall/Ryan Mingarell
Date Started: 11-22-00 Date Finished: 11-29-00
Logged By: KeLM Checked By: PMS

Ground Elevation: 1321.4
TOC Elevation: 1324.26
PVC Elevation: 1323.99

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
11-22-00	1630	Dry	Ground	75'	
11-27-00	1620	Dry	Ground	94'	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
-2											-2.90'
											-2.65
											Protective Steel Casing
0								0'	Refer to MW-916U boring log for geologic descriptions.		0'
2											
4											2" dia Sch 40 PVC Riser Pipe (-2.65 to 121')
6								Till			
8											Cement/Bentonite Grout (0 to 117')
10											
12											
14											

Sanborn, Head & Associates, Inc.
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Log of Well MW-916D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Jeff Hall/Ryan Mingarell
Date Started: 11-22-00 Date Finished: 11-29-00
Logged By: KeLM Checked By: PMS

Ground Elevation: 1321.4
TOC Elevation: 1324.26
PVC Elevation: 1323.99

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
11-22-00	1630	Dry	Ground	75'	
11-27-00	1620	Dry	Ground	94'	

Depth (ft)	Sample No.	Depth (ft)	Blows Spoon per 6"	Blows Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
16											
18											
20	S-1	19-21'	100 100\3"		9/8			Till	S-1: Very dense, gray, fine SAND and SILT, little Gravel, orange Silt discoloration throughout. Wet.		2" dia Sch 40 PVC Riser Pipe (-2.65 to 121')
22											Cement/Bentonite Grout (0 to 117')
24											
26											
28											
30											

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Log of Well MW-916D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Jeff Hall/Ryan Mingarell
Date Started: 11-22-00 Date Finished: 11-29-00
Logged By: KeLM Checked By: PMS

Ground Elevation: 1321.4
TOC Elevation: 1324.26
PVC Elevation: 1323.99

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
11-22-00	1630	Dry	Ground	75'	
11-27-00	1620	Dry	Ground	94'	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									Refer to MW-916U boring log for geologic descriptions.		
32											
34								Till			
											2" dia Sch 40 PVC Riser Pipe (-2.65 to 121')
36											
											Cement/Bentonite Grout (0 to 117')
38											
40											
42											
								43'	Refer to MW-916M boring log for geologic descriptions.		
44								Statified Drift			
46											

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Log of Well MW-916D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Jeff Hall/Ryan Mingarell
Date Started: 11-22-00 Date Finished: 11-29-00
Logged By: KeLM Checked By: PMS

Ground Elevation: 1321.4
TOC Elevation: 1324.26
PVC Elevation: 1323.99

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
11-22-00	1630	Dry	Ground	75'	
11-27-00	1620	Dry	Ground	94'	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									Refer to MW-916M boring log for geologic descriptions.		
48											
50											
											2" dia Sch 40 PVC Riser Pipe (-2.65 to 121')
52								Statified Drift			
											Cement/Bentonite Grout (0 to 117')
54											
56											
58											
60									S-2: Very dense, brown-gray, fine SAND, little Silt. Moist.		
	S-2	60-62'	62 72 83 93		24/14						
62											

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Log of Well MW-916D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Jeff Hall/Ryan Mingarell
Date Started: 11-22-00 Date Finished: 11-29-00
Logged By: KeLM Checked By: PMS

Ground Elevation: 1321.4
TOC Elevation: 1324.26
PVC Elevation: 1323.99

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
11-22-00	1630	Dry	Ground	75'	
11-27-00	1620	Dry	Ground	94'	

Depth (ft)	Sample No.	Depth (ft)	Blows Spoon per 6"	Blows Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									Refer to MW-916M boring log for geologic descriptions		
64											
66											
68											
								Statified Drift			2" dia Sch 40 PVC Riser Pipe (-2.65 to 121')
70											Cement/Bentonite Grout (0 to 117')
72											
74											
76								76'			
	S-3	76-78'	77 59 60 85		24/14			TILL	S-3: Very dense, brown, fine to coarse SAND, some Gravel, trace Silt, orange and gray discolorations. Moist.		
78											

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Log of Well MW-916D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Jeff Hall/Ryan Mingarell
Date Started: 11-22-00 Date Finished: 11-29-00
Logged By: KeLM Checked By: PMS

Ground Elevation: 1321.4
TOC Elevation: 1324.26
PVC Elevation: 1323.99

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
11-22-00	1630	Dry	Ground	75'	
11-27-00	1620	Dry	Ground	94'	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									S-4: Similar to S-3.		
	S-4	78-80'	40 61 80 69		24/14						
80											
								TILL			
82											
84									S-5: Very dense, black-gray, coarse SAND. Moist.		2" dia Sch 40 PVC Riser Pipe (-2.65 to 121')
	S-5	84-86'	125\4"		4/2						
86								—86'—			Cement/Bentonite Grout (0 to 117')
88											
								Boulder			
90											
92											
94											

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Log of Well MW-916D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Jeff Hall/Ryan Mingarell
Date Started: 11-22-00 Date Finished: 11-29-00
Logged By: KeLM Checked By: PMS

Ground Elevation: 1321.4
TOC Elevation: 1324.26
PVC Elevation: 1323.99

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
11-22-00	1630	Dry	Ground	75'	
11-27-00	1620	Dry	Ground	94'	

Depth (ft)	Sample No.	Depth (ft)	Blows Spoon per 6"	Blows Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
96								96'			
	S-6	96-98'	100\3"		3/2				S-6: Very dense, gray, fine to coarse SAND, little Silt, trace Gravel. Wet.		
98								TILL			
	S-7	98-100'	100\5"		5/4				S-7: Very dense, gray white, fine to medium SAND, some Silt, little Gravel, soft Rock. Wet.		2" dia Sch 40 PVC Riser Pipe (-2.65 to 121')
100											
	S-8	100-102'	100\4"		4/4				S-8: Very dense, gray, fine to medium SAND, little Silt, trace Gravel, trace Clay. Moist.		Cement/Bentonite Grout (0 to 117')
102								102'			
	S-9	102-104'	100\1"		1/0				S-9: No Recovery.		
104								Bedrock			
	S-10	104-106'	50\0"		0/0				S-10: No Recovery. Rock fragments were orange, pink, white and black. Granite.		
106											
	S-11	106-108'	100\0"		0/0				S-11: No Recovery.		
108											
110											

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Log of Well MW-916D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Jeff Hall/Ryan Mingarell
Date Started: 11-22-00 Date Finished: 11-29-00
Logged By: KeLM Checked By: PMS

Ground Elevation: 1321.4
TOC Elevation: 1324.26
PVC Elevation: 1323.99

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
11-22-00	1630	Dry	Ground	75'	
11-27-00	1620	Dry	Ground	94'	

Depth (ft)	Sample No.	Depth (ft)	Blows Spoon per 6"	Blows Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
112	S-12	112-114'							S-12: Rock fragments were pink, orange, white and black. Angular. Granite.		2" dia Sch 40 PVC Riser Pipe (-2.65 to 121')
114	S-13	114-116'							S-13: Similar to S-12.		Cement/Bentonite Grout (0 to 117')
116	S-14	116-118'						Bedrock	S-14: Similar to S-12.		117'
118	S-15	118-120'							S-15: Similar to S-12.		Bentonite Chip Seal (117 to 120')
120	S-16	120-122'							S-16: Similar to S-12.		120' Filter Sand (120 to 124') 121'
122	S-17	122-124'							S-17: Similar to S-12.		2" dia Sch 40 PVC Well Screen (0.010" Slots) (121 to 123') 123' Bottom Cap
124								---124'---	Boring terminated at 124'. 5" casing to 30'. 4" casing spun starting at 30'.		124'
126											

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Log of Well MW-917U-A

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/ Mike Lackey
Date Started: 7/12/01 Date Finished: 7/12/01
Logged By: KeLM Checked By: PMS

Ground Elevation:
TOC Elevation:
PVC Elevation:

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
-2											
0								---0'--- Topsoil ---1'---	Refer to MW-917D monitoring well log for geologic descriptions.		0'
2											
4											
6								Upper Till			
8											Formation Material
10											
12											
14											

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Log of Well MW-917U-A

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/ Mike Lackey
Date Started: 7/12/01 Date Finished: 7/12/01
Logged By: KeLM Checked By: PMS

Ground Elevation:
TOC Elevation:
PVC Elevation:

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
								Upper Till	Refer to MW-917D monitoring well log for geologic descriptions.		Formation Material
16											
18								18'	Boring terminated at 18'.		18'
20									Notes: 1) Drive shoe and several inches of casing lost at the bottom of the borehole.		
22											
24											
26											
28											
30											

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Log of Well MW-917U

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/ Mike Lackey
Date Started: 7/12/01 Date Finished: 7/16/01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1322.5
TOC Elevation: 1325.36
PVC Elevation: 1325.14

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
7/19/01	1053	30.24'	PVC	Well Inst.	
7/20/01	1345	30.65'	PVC	Well Inst.	
7/27/01	1050	30.65'	PVC	Well Inst.	
8/2/01	1525	30.87'	PVC	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
-2											-2.80'
											-2.50'
											Protective Steel Casing
0								---0'---	Refer to MW-917D montoring well log for geologic descriptions.		0'
								Topsoil			
								---1'---			
2											
4											Cement/Bentonite Grout (0 to 19')
6								Upper Till			
											2" dia Sch 40 PVC Riser Pipe (-2.50 to 26')
8											
10											
12											
14											

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Log of Well MW-917U

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/ Mike Lackey
Date Started: 7/12/01 Date Finished: 7/16/01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1322.5
TOC Elevation: 1325.36
PVC Elevation: 1325.14

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
7/19/01	1053	30.24'	PVC	Well Inst.	
7/20/01	1345	30.65'	PVC	Well Inst.	
7/27/01	1050	30.65'	PVC	Well Inst.	
8/2/01	1525	30.87'	PVC	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows Spoon per 6"	Blows Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									Refer to MW-917D montoring well log for geologic descriptions.		
16											2" dia Sch 40 PVC Riser Pipe (-2.50 to 26')
18											Grout (0 to 19')
											19'
20								Upper Till			Bentonite Chip Seal (19 to 22')
22											22'
											Filter Sand (22 to 36')
24											
26									S-1: Very dense, gray-brown, fine to medium SAND, little Silt, trace Gravel. Wet.		26'
	S-1	26-28'	111\6"		6/4						2" dia Sch 40 PVC Well Screen (0.010" Slots) (26 to 36')
28									S-2: Very dense, gray-brown, fine to medium SAND, little Silt, trace Gravel. Wet. Orange discoloration throughout sample.		
	S-2	28-30'	100\6"		6/4						
30											

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Log of Well MW-917U

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/ Mike Lackey
Date Started: 7/12/01 Date Finished: 7/16/01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1322.5
TOC Elevation: 1325.36
PVC Elevation: 1325.14

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
7/19/01	1053	30.24'	PVC	Well Inst.	
7/20/01	1345	30.65'	PVC	Well Inst.	
7/27/01	1050	30.65'	PVC	Well Inst.	
8/2/01	1525	30.87'	PVC	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									S-3: Similar to S-2.		
	S-3	30-32'	120\5"		5/3			Upper Till			2" dia Sch 40 PVC Well Screen (0.010" Slots) (26 to 36')
32								--32'--	S-4: Very dense, gray-brown, fine to coarse SAND, some Silt, trace Gravel. Wet. Top 5" stratified, bottom 6" fine SAND and Silt.		
	S-4	32-34'	53 58 53 76		24/11						
34									S-5: Very dense, gray-brown, fine SAND, some Silt, stratified. Orange discoloration throughout sample. Wet.		Filter Sand (22 to 36')
	S-5	34-36'	22 25 53 73		24/13			Stratified Drift			
36								--36'--	Boring terminated at 36'. No refusal encountered.		36' Bottom Cap
38											
40											
42											
44											
46											

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Log of Well MW-917D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: Mark Voisine/ Mike Lackey
Date Started: 7/9/01 Date Finished: 7/11/01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1323.1
TOC Elevation: 1325.56
PVC Elevation: 1325.36

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
7/10/01	0715	28.82'	Ground	15'	19 hrs.
7/11/01	0745	28.70'	PVC	Well Inst.	
7/12/01	1150	30.54'	PVC	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
-2											-2.50'
											-2.30'
											Protective Steel Casing
0								0'			0'
	S-1	0-2'	3 5 4 7		24/7			Topsoil 1'	S-1: Loose, dark brown, fine to medium SAND, trace Gravel, trace Silt, trace Organics. Dry. TOPSOIL. Rock in tip of spoon.		
2											
4									S-2: Very dense, olive gray, fine SAND, some Silt, trace Gravel. Moist. TILL.		Cement/Bentonite Grout (1.5 to 90')
	S-2	4-6'	7 100\3"		9/7						
6								Upper Till			2" dia Sch 40 PVC Riser Pipe (-2.30 to 95')
8									S-3: Similar to S-2.		
10	S-3	9-11'	64 100\5"		11/8						
12											
14											

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Log of Well MW-917D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: Mark Voisine/ Mike Lackey
Date Started: 7/9/01 Date Finished: 7/11/01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1323.1
TOC Elevation: 1325.56
PVC Elevation: 1325.36

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
7/10/01	0715	28.82'	Ground	15'	19 hrs.
7/11/01	0745	28.70'	PVC	Well Inst.	
7/12/01	1150	30.54'	PVC	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
	S-4	14-16'	46 98 100\5"		17/9				S-4: Very dense, gray-brown, fine SAND, little Silt, trace Gravel. Moist. TILL.		
16								Upper Till			
18								---18'---			
								Boulder			Cement/BentoniteGrout (1.5 to 90')
20								---20'---	S-5: Similar to S-4.		
	S-5	20-22'	6 100\6"		9/7						
22											2" dia Sch 40 PVC Riser Pipe (-2.30 to 95')
24								Upper Till	S-6: Very dense, gray-brown, fine SAND, little Silt, trace Gravel. Moist. TILL.		
	S-6	24-26'	100\4"		4/2						
26											
28											
	S-7	29-31'	69 74		24/15				S-7: Very Dense, gray-brown, fine SAND and SILT, trace Gravel. Moist.		
30											

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Log of Well MW-917D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: Mark Voisine/ Mike Lackey
Date Started: 7/9/01 **Date Finished:** 7/11/01
Logged By: KeLM **Checked By:** PMS

Ground Elevation: 1323.1
TOC Elevation: 1325.56
PVC Elevation: 1325.36

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
7/10/01	0715	28.82'	Ground	15'	19 hrs.
7/11/01	0745	28.70'	PVC	Well Inst.	
7/12/01	1150	30.54'	PVC	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
								Upper Till			
								—31'—	S-8: Very dense, gray, fine SAND and SILT, stratified. Wet. Orange and brown discoloration throughout sample.		
32	S-8	31-33'	22 36 46 54		24/16						
									S-9: Similar to S-8.		
34	S-9	33-35'	34 45 53 60		24/13						
									S-10; Very dense, gray, SILT and fine Sand, stratifed. Wet.		
36	S-10	35-37'	28 44 61 100\3"		21/15						Cement/Bentonite Grout (1.5 to 90')
									S-11: Very dense, gray, SILT, trace fine Sand, stratified. Wet.		
38	S-11	37-39'	24 51 52 69		24/14						2" dia Sch 40 PVC Riser Pipe (-2.30 to 95')
									S-12: Similar to S-11.		
40	S-12	39-41'	23 41 66 100\5"		23/18						
									S-13: Very dense, gray SILT, trace fine Sand, stratified. Wet.		
42	S-13	41-43'	35 66 71 100\5"		23/18			Stratified Drift			
									S-14: Similar to S-13.		
44	S-14	43-45'	39 65 97 100\5"		23/14						
46											

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Log of Well MW-917D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: Mark Voisine/ Mike Lackey
Date Started: 7/9/01 Date Finished: 7/11/01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1323.1
TOC Elevation: 1325.56
PVC Elevation: 1325.36

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
7/10/01	0715	28.82'	Ground	15'	19 hrs.
7/11/01	0745	28.70'	PVC	Well Inst.	
7/12/01	1150	30.54'	PVC	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
64	S-24	63-65'	40 56 72 85		24/15				S-24: Very dense, dark gray SILT, trace fine Sand. Wet.		
66	S-25	65-67'	39 67 76 81		24/13				S-25: Very dense, gray SILT, trace fine Sand. Wet.		
68	S-26	67-69'	40 51 49 46		24/11			Stratifed Drift	S-26: Very dense, gray SILT, trace fine Sand. Wet. Stratified and discoloration throughout sample.		
70	S-27	69-71'	38 33 54 65		24/20				S-27: Very dense, brown-gray, fine to coarse SAND and SILT, stratified. Wet.		Cement/Bentonite Grout (1.5 to 90')
72	S-28	71-73'	17 27 64 80		24/13				S-28: Very dense, brown-gray, fine to coarse SAND, some Silt, stratified. Wet. Bottom 3" of spoon Silt.		2" dia Sch 40 PVC Riser Pipe (-2.30 to 95')
74	S-29	73-75'	32 90 43 53		24/10				S-29: Very dense, gray, fine SAND, some Silt, stratified. Wet. Orange discoloration throughout sample.		
76	S-30	75-77'	10 23 40 47		24/13				S-30: Very dense, gray, fine to medium SAND, little Silt, stratified Silt partings. Wet. Orange discoloration throughout sample.		
78	S-31	77-79'	21 28 42 51		24/16				S-31: Very dense, brown-gray, fine to medium SAND, little Silt, stratified Silt partings. Wet. Orange discoloration throughout sample.		

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Log of Well MW-917D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: Mark Voisine/ Mike Lackey
Date Started: 7/9/01 Date Finished: 7/11/01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1323.1
TOC Elevation: 1325.56
PVC Elevation: 1325.36

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
7/10/01	0715	28.82'	Ground	15'	19 hrs.
7/11/01	0745	28.70'	PVC	Well Inst.	
7/12/01	1150	30.54'	PVC	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
80	S-32	79-81'	28 32 55 86		24/12			Stratifed Drift	S-32: Very dense, gray, fine to medium SAND, little Silt, trace fine Gravel. Wet. Stratified Silt and Gravel partings. Orange discoloration throughout sample.		
								---81'---			
82	S-33	81-83'	64 100\5"		11/10				S-33: Very dense, brown, fine to coarse SAND, little Gravel, trace Silt. Wet. Orange discoloration throughout sample.		
84	S-34	83-85'	53 100\4"		10/4				S-34: Very dense, gray, fine to coarse SAND, some Gravel, trace Silt. Wet. Drilling difficulty indicates cobbles.		Cement/Bentonite Grout (1.5 to 90')
86	S-35	85-87'	74 73 50 100\4"		22/10			TILL	S-35: Very dense, gray-brown, fine to coarse SAND, some Gravel, trace Silt. Wet. Drilling difficulty indicates cobbles.		2" dia Sch 40 PVC Riser Pipe (-2.30 to 95')
88	S-36	87-89'	67 100\3"		9/3				S-36: Similar to S-35.		
90	S-37	89-91'	100\5"		5/2				S-37: Very dense, gray, fine to coarse SAND, some Gravel, trace Silt. Wet. Discoloration throughout sample. Drilling difficulty indicates cobbles.		90'
92	S-38	91-93'	79 74 100\4"		16/10				S-38: Very dense, olive gray, fine to coarse SAND, some Gravel, little Silt. Wet. Drilling difficulty indicates cobbles.		Bentonite Chip Seal (90-93')
94	S-39	93-95'	100\3"		3/0				S-39: No recovery.		93' Filter Sand (93 to 100')

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Log of Well MW-917D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: Mark Voisine/ Mike Lackey
Date Started: 7/9/01 Date Finished: 7/11/01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1323.1
TOC Elevation: 1325.56
PVC Elevation: 1325.36

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
7/10/01	0715	28.82'	Ground	15'	19 hrs.
7/11/01	0745	28.70'	PVC	Well Inst.	
7/12/01	1150	30.54'	PVC	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
											95'
96											Filter Sand (93 to 100')
											2" dia Sch 40 PVC Well Screen (0.010" Slots) (95 to 100')
98											
	S-40	99-100'	169 182\6"		12/4				S-40: Very dense, olive-gray, fine to coarse SAND, some Gravel, little Silt. Wet. Drilling difficulties indicates cobbles.		
100											100' Bottom Cap
								TILL			
102											
104											Formation Material (100-108')
106									S-41: Similar to S-40.		
	S-41	106-108'	52 68 74 89		24/8						
108								---108'---			108'
									Boring terminated at 108'. No refusal encountered		
									Notes: 1) Drive shoe left at bottom of borehole. 2) Observed loss of circulation water from 87 to 91'.		
110											

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Log of Well MW-918U

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/ Mike Lackey
Date Started: 7/23/01 Date Finished: 7/24/01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1327.4
TOC Elevation: 1330.10
PVC Elevation: 1329.90

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
7/24/01	0800	18.79'	Ground	Well Inst.	1 Day
7/30/01	0906	24.00'	PVC	Well Inst.	
8/2/01	1459	23.99'	PVC	Well Inst.	
8/8/01	1519	24.15'	PVC	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
-2											-2.70' Protective Steel Casing -2.50'
0								---0'--- Topsoil	Refer to MW-918D monitoring well log for geologic descriptions.		0'
								---1'---			Cement/Bentonite Grout (0 to 13')
2											
4											2" dia Sch 40 PVC Riser Pipe (-2.5 to 18')
6								Upper Till			
8											
				12							
10				59							
				40							
12				60				---12'--- Stratified Drift			13'
				46							Bentonite Chips (13 to 16')
14											

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Log of Well MW-918U

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/ Mike Lackey
Date Started: 7/23/01 Date Finished: 7/24/01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1327.4
TOC Elevation: 1330.10
PVC Elevation: 1329.90

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
7/24/01	0800	18.79'	Ground	Well Inst.	1 Day
7/30/01	0906	24.00'	PVC	Well Inst.	
8/2/01	1459	23.99'	PVC	Well Inst.	
8/8/01	1519	24.15'	PVC	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows Spoon per 6"	Blows Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
				67					Refer to MW-918D monitoring well log for geologic descriptions.		Bentonite Chips (13 to 16')
				73							
16											16'
				80							2" dia Sch 40 PVC Riser Pipe (-2.5 to 18')
				97							
18											18'
				107							Filter Sand (16 to 28.5')
				94							
20											
				108							
								Stratified Drift			
				125							
22											2" dia Sch 40 PVC Well Sreen (0.010" Slots) (18 to 28')
				147							
				205							
24											
				65							
				84							
26											
				122							
				104							
28											28' Bottom Cap
				120							28.5'
											Bentonite Chips (28.5 to 34.8')
				92							
30											

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Log of Well MW-918U

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/ Mike Lackey
Date Started: 7/23/01 Date Finished: 7/24/01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1327.4
TOC Elevation: 1330.10
PVC Elevation: 1329.90

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
7/24/01	0800	18.79'	Ground	Well Inst.	1 Day
7/30/01	0906	24.00'	PVC	Well Inst.	
8/2/01	1459	23.99'	PVC	Well Inst.	
8/8/01	1519	24.15'	PVC	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
				105							
				121							
32											Bentonite Chips (28.5 to 34.8')
				105							
				255							
34											
											34.8'
36											
								Stratified Drift			
38											
40											Filter Sand (34.8 to 47')
42									S-1: Very dense, gray, fine SAND, some Silt, trace Clay. Wet. Stratified and orange discoloration throughout sample.		
	S-1	42-44'	18 28 30 34		24/18						
44									S-2: Medium dense, gray, fine SAND, some Silt, trace Clay. Wet. Stratified and orange discoloration throughout sample.		
	S-2	44-46'	16 21 22 27		24/15						
46											

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Log of Well MW-918U

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/ Mike Lackey
Date Started: 7/23/01 Date Finished: 7/24/01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1327.4
TOC Elevation: 1330.10
PVC Elevation: 1329.90

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
7/24/01	0800	18.79'	Ground	Well Inst.	1 Day
7/30/01	0906	24.00'	PVC	Well Inst.	
8/2/01	1459	23.99'	PVC	Well Inst.	
8/8/01	1519	24.15'	PVC	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
	S-3	46-48'	16 20 22 26		24/16				S-3: Similar to S-2.		47'
48									S-4: Similar to S-2.		
	S-4	48-50'	14 17 19 25		24/15			Stratified Drift			Formation Material (47 to 52')
50									S-5: Similar to S-2.		
	S-5	50-52'	16 20 24 30		24/16						
52								---52'---	Boring terminated at 52'. No refusal encountered.		52'
54											
56											
58											
60											
62											

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Log of Well MW-918M (A)

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/ Mike Lackey
Date Started: 7/23/01 Date Finished: 7/23/01
Logged By: KeLM Checked By: PMS

Ground Elevation:
TOC Elevation:
PVC Elevation:

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
-2											
0								0	Refer to MW-918D monitoring well log for geologic descriptions.		0
2				112				Upper Till			
				121							
4				77/0.5'				4.5 Cobbles 5.5	Drilling difficulty indicates cobbles.		
6								Upper Till			Backfilled with formation material (0-30')
8								8 Cobbles	Drilling difficulty indicates cobbles.		
10								10 Upper Till			
12								12 Stratified Drift			
14											

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Log of Well MW-918M (A)

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/ Mike Lackey
Date Started: 7/23/01 Date Finished: 7/23/01
Logged By: KeLM Checked By: PMS

Ground Elevation:
TOC Elevation:
PVC Elevation:

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									Refer to MW-918D monitoring well log for geologic descriptions.		
16											
18											
20											Backfilled with formation material (0'-30')
22								Stratified Drift			
24											
26											
28											
30								---30'---			30

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Log of Well MW-918M (A)

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/ Mike Lackey
Date Started: 7/23/01 Date Finished: 7/23/01
Logged By: KeLM Checked By: PMS

Ground Elevation:
TOC Elevation:
PVC Elevation:

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time

Depth (ft)	Sample No.	Depth (ft)	Blows Spoon per 6"	Blows Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									Boring terminated at 30'.		
									Notes:		
									1) Boulders encountered at depths greater than 8 feet resulted in non-vertical borehole. Boring activities terminated.		
32											
34											
36											
38											
40											
42											
44											
46											

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Log of Well MW-918M

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/ Mike Lackey
Date Started: 7/24/01 Date Finished: 7/25/01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1327.8
TOC Elevation: 1330.54
PVC Elevation: 1330.32

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
7/25/01	0800	18.05'	Ground	35'	20 Hrs.
7/30/01	0904	24.57'	PVC	Well Inst.	
8/2/01	1458	24.65'	PVC	Well Inst.	
8/8/01	1517	24.74'	PVC	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
-2											-2.75'
											-2.50'
											Protective Steel Casing
0								0'	Refer to MW-918D monitoring well log for geologic descriptions.		0'
								Topsoil			
								1'			Cement/Bentonite Grout (0 to 40')
2											
4											
											2" dia Sch 40 PVC Riser Pipe (-2.50 to 44')
6								Upper Till			
8											
10											
12								12'			
								Stratified Drift			
14											

Sanborn, Head & Associates, Inc.
CONSULTING ENGINEERS & SCIENTISTS

Log of Well MW-918M

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/ Mike Lackey
Date Started: 7/24/01 Date Finished: 7/25/01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1327.8
TOC Elevation: 1330.54
PVC Elevation: 1330.32

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
7/25/01	0800	18.05'	Ground	35'	20 Hrs.
7/30/01	0904	24.57'	PVC	Well Inst.	
8/2/01	1458	24.65'	PVC	Well Inst.	
8/8/01	1517	24.74'	PVC	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									Refer to MW-918D monitoring well log for geologic descriptions.		
16											
18											
											Cement/Bentonite Grout (0 to 40')
20											
								Stratified Drift			
22											2" dia Sch 40 PVC Riser Pipe (-2.50 to 44')
24											
26											
28											
30											

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32											Cement/Bentonite Grout (0 to 40')
34											2" dia Sch 40 PVC Riser Pipe (-2.50 to 44')
36											
								Stratified Drift			
38											
									S-1: Dense, gray, SILT, some fine Sand. Moist.		
40	S-1	39-41	16 20 23 31		24/14						40'
	S-2A	41-42.2	17 25 24 38		24/17				S-2A: Dense, gray, SILT, some fine Sand. Moist. Stratified and Orange discoloration throughout sample.		Bentonite chips (40 to 43')
42											
	S-2B	42.2-43							S-2B: Dense, brown, fine to coarse SAND, little Silt. Moist.		43'
									S-3: Very dense, gray-brown, fine to coarse SAND, little Silt, trace Gravel. Moist. Stratified.		Filter Sand (43 to 46.5')
44	S-3	43-45	17 23 49 52		24/14						44'
											2" dia Sch 40 PVC Well Screen (0.010" Slots) (44 to 46')
	S-4	45-47	15 35 36 24		24/10				S-4: Very dense, brown, fine to coarse SAND, little Silt, trace Gravel. Moist.		
46											46' Bottom Cap

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48	S-5	47-49	24 27 32 44		24/12			Stratified Drift ---49'---	S-5: Vey dense, gray-brown, fine to coarse SAND, some Silt. Moist.		46.5' Bentonite Chips 47' Filter Sand (47-49') 49'
									Boring terminated at 49'. No refusal encountered.		
50									Notes:		
52									1) Borehole permeability test performed at S-3 (43 to 45')		
54											
56											
58											
60											
62											

Sanborn, Head & Associates, Inc.
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Log of Well MW-918D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/ Mike Lackey
Date Started: 7/17/01 **Date Finished:** 7/20/01
Logged By: KeLM **Checked By:** PMS

Ground Elevation: 1327.4
TOC Elevation: 1330.09
PVC Elevation: 1329.89

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
7/18/01	0820	20.57'	Ground	9'	
7/19/01	0800	10.40'	Ground	94'	
7/20/01	0800	33.5'	Ground	109'	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
-2											-2.70 Protective Steel Casing -2.50
0								0'			0'
	S-1	0-2'	1 3 4 7	11	24/6			Topsoil 1'	S-1: Loose, dark brown, fine to medium SAND, little Silt, trace Gravel. Dry. Rock in tip of spoon.		
2				37							
				70							
4				17					S-2: Very dense, brown-gray, fine to medium SAND, little Silt, trace Gravel. Moist. TILL.		
	S-2	4-6'	53 71 58 45	23	24/16			Upper Till			
6				19							Cement/Bentonite Grout (0 to 114')
	S-3	7-9'	28 50 48 44	16 50	24/10				S-3: Very dense, gray, fine to coarse SAND, some Silt, trace Gravel. Moist. Orange discoloration and coarse Sand parting throughout sample. TILL.		2" dia. Sch 40 PVC Riser Pipe (-2.5 to 119')
8											
10											
12								12'			
								Stratified Drift			
14											

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Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
	S-4	14-16'	12 14 17 18		24/14				S-4: Dense, gray, SILT, some fine Sand. Wet.		
16											
18											
20	S-5	19-21'	9 11 17 24		24/14			Stratified Drift	S-5: Medium dense, brown-gray, fine to coarse SAND, some Silt, Wet. Stratified Silt lenses and orange discoloration throughout sample.		Cement/Bentonite Grout (0 to 114')
22											2" dia Sch 40 PVC Riser Pipe (-2.5 to 119')
24	S-6	24-26'	21 37 47 46		24/15				S-6: Very dense, brown-gray, fine to coarse SAND, some Silt. Wet. Stratified Silt lenses and orange discoloration throughout sample.		
26	S-7	26-28'	12 26 54 71		24/14				S-7: Very dense, brown-gray, fine to coarse SAND, little Silt. Wet. Stratified Silt lenses and orange discoloration throughout sample.		
28	S-8	28-30'	41 60 69 72		24/17				S-8: Similar to S-7.		
30											

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7/19/01	0800	10.40'	Ground	94'	
7/20/01	0800	33.5'	Ground	109'	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
	S-9	30-32'	46 53 52 57		24/16				S-9: Similar to S-7.		
32	S-10	32-34'	37 32 44 60		24/17				S-10: Very dense, gray, SILT, some fine Sand. Wet. Stratified and orange discoloration throughout sample.		
34	S-11	34-36'	38 43 46 56		24/17				S-11: Similar to S-10.		
36	S-12	36-38'	26 37 51 54		24/17			Stratified Drift	S-12: Similar to S-10.		Cement/Bentonite Grout (0 to 114')
38	S-13	38-40'	31 32 65 58		24/14				S-13: Similar to S-10.		2" dia Sch 40 PVC Riser Pipe (-2.5 to 119')
40	S-14	40-42'	32 42 42 59		24/13				S-14: Very dense, gray, fine SAND and SILT. Wet. Stratified and orange discoloration throughtout sample.		
42	S-15	42-44'	32 42 46 65		24/18				S-15; Very dense, gray, fine SAND and SILT. Wet. 2" layer of fine to coarse Sand on bottom of sample.		
44	S-16	44-46'	17 16 28 37		24/15				S-16; Dense, brown, fine to coarse SAND, trace Silt. Wet.		
46											

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Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
	S-17A	46-46.5'	21 34		24/21				S-17A: Very dense, brown, fine to coarse SAND, trace Silt, Wet.		
	S-17B	46.5-47.5	49 55						S-17B: Very dense, gray, fine SAND, some Silt. Wet.		
48	S-17C	47.5-48'							S-17C: Very dense, gray-brown, fine to coarse SAND, trace Silt. Wet. Orange discoloration throughout sample.		
	S-18A	48-49'	32 44 50 69		24/22				S-18A: Very dense, brown, fine to coarse SAND, trace Silt. Wet.		
	S-18B	49-50'							S-18B: Very dense, gray, fine SAND, some Silt. Wet.		
50									S-19: Similar to S-18B.		
	S-19	50-52'	23 34 39 57		24/13						Cement/Bentonite Grout (0 to 114')
52									S-20: Similar to S-18B.		
	S-20	52-54'	19 29 36 16		24/11			Stratified Drift			2" dia Sch 40 PVC Riser Pipe (-2.5 to 119')
54									S-21: Similar to S-18B.		
	S-21	54-56'	27 23 43 53		24/16						
56									S-22: Very dense, gray, fine SAND, some Silt. Wet. Stratified and orange discoloration throughout sample.		
	S-22	56-58'	25 26 51 69		24/16						
58									S-23: Similar to S-22.		
	S-23	58-60'	46 53 93 110		24/17						
60									S-24: Similar to S-22.		
	S-24	60-62'	30 60 69 75		24/18						
62											

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	S-25	62-64'	32 44 66 91		24/17				S-25: Very dense, gray SILT, trace fine Sand. Wet. Stratified.		
64	S-26	64-66'	40 59 70 94		24/15				S-26: Very dense, gray SILT, trace fine Sand. Moist. Stratified and orange discoloration throughout sample.		
66	S-27	66-68'	20 30 34 43		24/14				S-27: Very dense, gray SILT, trace fine Sand. Moist. Stratified and orange discoloration throughout sample.		
68	S-28	68-70'	15 24 27 40		24/18				S-28: Very dense, gray SILT, trace fine Sand. Moist. Stratified and orange discoloration throughout sample.		Cement/Bentonite Grout (0 to 114')
70	S-29	70-72'	14 23 20 40		24/18			Stratified Drift	S-29: Dense, gray SILT, trace fine Sand. Moist. Stratified and orange discoloration throughout sample.		2" dia Sch 40 PVC Riser Pipe (-2.5 to 119')
72	S-30	72-74'	23 38 54 55		24/19				S-30: Hard, gray SILT and CLAY, trace fine Sand. Moist. Stratified and orange discoloration throughout sample.		
74	S-31	74-76'	12 24 39 59		24/17				S-31: Very dense, brown-gray, fine to medium SAND, little Silt. Wet. Stratified.		
76	S-32	76-78'	40 67 85 100\5"		23/17				S-32: Very dense, brown-gray, fine to medium SAND, little Silt. Wet. Stratified.		
78											

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	S-33	78-80'	27 34 45 76		24/14				S-33: Very dense, brown-gray, fine to medium SAND, little Silt. Wet. Stratified and orange and black discoloration throughout sample.		
80	S-34	80-82'	23 41 46 62		24/13				S-34: Similar to S-33.		
82	S-35	82-84'	15 33 39 69		24/12				S-35: Very dense, brown-gray, fine SAND, little Silt. Wet. Stratified and black discoloration throughout sample.		Cement/Bentonite Grout (0 to 114')
84	S-36	84-86'	26 40 52 64		24/12			Stratified Drift	S-36: Similar to S-35.		2" dia Sch 40 PVC Riser Pipe (-2.5 to 119')
86	S-37	86-88'	31 42 48 56		24/14				S-37: Similar to S-35.		
88	S-38	88-90'	26 38 46 49		24/19				S-38: Similar to S-35.		
90	S-39	90-92'	26 36 36 50		24/14				S-39: Very dense, brown-gray, fine SAND, some Silt. Moist.		
92	S-40	92-94'	27 28 40 60		24/19				S-40: Similar to S-39.		
94											

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	S-41	94-96'	32 42 73 95		24/19				S-41: Very dense, gray-brown, fine SAND, some Silt. Moist.		
96	S-42	96-98'	35 70 105\6"		18/10			Stratified Drift	S-42: Very dense, gray-brown, fine SAND, some Silt. Moist. Stratified and orange discoloration throughout sample.		
98	S-43	98-100'	30 41 61 99		24/15				S-43: Very dense, gray-brown, fine SAND, some Silt, Moist. Stratified. Orange and gray discoloration throughout sample.		Cement/Bentonite Grout (0 to 114')
100	S-44	100-102'	30 57 66 63		24/11				S-44: Very dense, gray-brown, fine to medium SAND, little Silt, Moist. Stratified and orange discoloration throughout sample.		2" dia Sch 40 PVC Riser Pipe (-2.5 to 119')
102	S-45	102-104'	33 40 42 60		24/12				S-45: Similar to S-44.		
104	S-46	104-106'	21 37 62 90		24/11				S-46: Similar to S-44.		
106	S-47	106-108'	28 34 62 100\3"		21/12				S-47: Similar to S-44.		
108								---108'--- Cobbles ---110'---	Drilling difficulty indicates cobbles and/or boulders. No sample collected.		
110											

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	S-48	110-112'	68 80 68 69		24/10				S-48: Very dense, gray-tan, fine to coarse SAND, little Gravel, trace Silt. Moist. Orange and black discoloration throughout sample.		Cement/Bentonite Grout (0 to 114')
112											2" dia Sch 40 PVC Riser Pipe (-2.5 to 119')
114									S-49: Similar to S-48.		114'
	S-49	114-116'	100\5"		5/2						Bentonite Chip Seal (114 to 117')
116								Till			117'
118											Filter Sand (117 to 124.5')
											119'
120	S-50	119-121'	85 50\1"		7/2.5				S-50: Very dense, gray-olive, fine to coarse SAND, trace Gravel, trace Silt. Moist. Orange discoloration throughout sample.		2" dia. Sch 40 PVC Well Screen (0.010" Slots) (119 to 124')
122											
124									S-51: Similar to S-50.		124' Bottom Cap
											124.5'
	S-51	124-126'	123 100\2"		7/4						Formation Material (124.5 to 126')
126								126'			126'

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Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									Boring terminated at 126'. No refusal encountered		
128											
130											
132											
134											
136											
138											
140											
142											

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Log of Well MW-919U

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driv. & Sp. Case
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/ Mike Lackey
Date Started: 7/30/01 Date Finished: 8/2/01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1341.9
TOC Elevation: 1344.53
PVC Elevation: 1344.27

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8/2/01	0800	40.02'	PVC	Well Inst.	
8/3/01	0900	39.98'	PVC'	Well Inst.	
8/8/01	1008	37.77'	PVC	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
-2											-2.75'
											-2.50' Protective Steel Casing
0								0'	Refer to MW-919M monitoring well log for geologic descriptions.		0'
2								FILL			
4								4'			2" dia. Sch 40 PVC Riser Pipe (-2.50 to 40')
6											Cement/Bentonite Grout (0 to 32')
8								TILL			
10											
12											
14											

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Log of Well MW-919U

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driv. & Sp. Case
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/ Mike Lackey
Date Started: 7/30/01 Date Finished: 8/2/01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1341.9
TOC Elevation: 1344.53
PVC Elevation: 1344.27

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8/2/01	0800	40.02'	PVC	Well Inst.	
8/3/01	0900	39.98'	PVC'	Well Inst.	
8/8/01	1008	37.77'	PVC	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									Refer to MW-919M monitoring well log for geologic descriptions.		
16								TILL			
18											
								19'			
20											2" dia. Sch 40 PVC Riser Pipe (-2.50 to 40')
22											Cement/Bentonite Grout (0 to 32')
24								Stratified Drift			
26											
28											
30											

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CONSULTING ENGINEERS & SCIENTISTS

Log of Well MW-919U

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driv. & Sp. Case
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/ Mike Lackey
Date Started: 7/30/01 Date Finished: 8/2/01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1341.9
TOC Elevation: 1344.53
PVC Elevation: 1344.27

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8/2/01	0800	40.02'	PVC	Well Inst.	
8/3/01	0900	39.98'	PVC'	Well Inst.	
8/8/01	1008	37.77'	PVC	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows Spoon per 6"	Blows Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									Refer to MW-919M monitoring well log for geologic descriptions.		Cement/Bentonite Grout (0 to 32') 2" dia. Sch 40 PVC Riser Pipe (-2.50 to 40')
32											32'
											Bentonite Chip Seal (32 to 35')
34											
											35'
36											
								Stratified Drift			Filter Sand (35 to 50')
38											
40											40'
42											2" dia Sch 40 PVC Well Screen (0.010" Slots) (40 to 50')
44											
46											

Sanborn, Head & Associates, Inc.
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Log of Well MW-919U

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME 550X ATV w/4" & 5" Driv. & Sp. Case
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/ Mike Lackey
Date Started: 7/30/01 Date Finished: 8/2/01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1341.9
TOC Elevation: 1344.53
PVC Elevation: 1344.27

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8/2/01	0800	40.02'	PVC	Well Inst.	
8/3/01	0900	39.98'	PVC'	Well Inst.	
8/8/01	1008	37.77'	PVC	Well Inst.	

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
								Stratified Drift	Refer to MW-919M monitoring well log for geologic descriptions.		Filter Sand (35 to 50')
48											2" dia Sch 40 PVC Well Screen (0.010" Slots) (40 to 50')
50								---50'---	Boring terminated at 50'. No refusal encountered.		50' Bottom Cap
52											
54											
56											
58											
60											
62											

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Log of Well MW-919M

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME ATV w/4" & 5" Driv. & Spn. Case
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Mike Lockey
Date Started: 7-23-01 Date Finished: 7-26-01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1341.5
TOC Elevation: 1344.23
PVC Elevation: 1344.06

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
-2											-3.2' Protective Steel Casing -2.75
0								0	S-1: Medium dense, light brown, fine to medium SAND, little Silt. Dry.		0
	S-1	0-2'	1 2 14 7		24/12						
2								FILL			
4								4'	S-2: Very dense. olive-gray, fine to medium SAND, little Silt, trace Gravel. Moist. Gray discoloration. Drilling difficulty indicates cobbles and/or boulders.		Cement/Bentonite Grout (0 to 90')
	S-2	4-6'	27 30 30 35		24/14						
6											
8								TILL			2" dia. Sch 40 PVC Riser Pipe (-2.75 to 95')
									S-3: Dense, olive-gray, fine to medium SAND, little Silt. Moist. Gray discoloration. Drilling difficulty indicates cobbles and/or boulders.		
10	S-3	9-11'	14 19 30 33\3"		21/8						
12											
14											

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Log of Well MW-919M

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME ATV w/4" & 5" Driv. & Spn. Case
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Mike Lockey
Date Started: 7-23-01 Date Finished: 7-26-01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1341.5
TOC Elevation: 1344.23
PVC Elevation: 1344.06

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
	S-4	14-16'	18 30 32 46		24/2			TILL	S-4: Very dense, gray-brown, GRAVEL, little fine to medium Sand, trace Silt. Moist. Rock in tip of spoon.		
16											
18											
								---19'---			
20	S-5	19-21'	9 15 14 15		24/6				S-5: Medium dense, brown, fine SAND, little Silt. Dry. Stratified and orange and gray partings.		Cement/Bentonite Grout (0 to 90')
22											2" dia. Sch 40 PVC Riser Pipe (-2.75 to 95')
24	S-6	24-26'	8 15 18 18		24/9			Stratified Drift	S-6: Dense, brown, fine to coarse SAND, little Silt. Moist. Stratified and orange discoloration.		
26	S-7	26-28'	8 14 24 34		24/15				S-7: Similar to S-6.		
28	S-8	28-30'	25 30 69 83		24/16				S-8: Very dense, brown, fine to coarse SAND, little Silt, trace Gravel. Moist. Silt partings. Stratified. White and orange seams.		
30											

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Log of Well MW-919M

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME ATV w/4" & 5" Driv. & Spn. Case
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Mike Lockey
Date Started: 7-23-01 **Date Finished:** 7-26-01
Logged By: KeLM **Checked By:** PMS

Ground Elevation: 1341.5
TOC Elevation: 1344.23
PVC Elevation: 1344.06

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
	S-9	30-32'			24/16				S-9: Similar to S-8.		
32	S-10	32-34'	31 59 52 60		24/14				S-10: Very dense, gray-brown, fine to coarse SAND, little Silt, trace Gravel. Moist. Stratified.		
34	S-11	34-36'	22 29 30 36		24/14				S-11: Very dense, gray-brown, fine SAND and SILT. Moist. Stratified and orange discoloration.		Cement/Bentonite Grout (0 to 90')
36	S-12	36-38'	19 28 34 43		24/14			Stratified Drift	S-12: Similar to S-11.		2" dia. Sch 40 PVC Riser Pipe (-2.75 to 95')
38	S-13	38-40'	15 30 30 32		24/10				S-13: Very dense, gray-brown, fine SAND, some Silt. Moist. Stratified and orange discoloration.		
40	S-14	40-42'	14 28 33 33		24/17				S-14: Similar to S-13.		
42	S-15	42-44'	18 27 32 38		24/17				S-15: Very dense, gray-brown, fine SAND and SILT. Wet. Orange discoloration.		
44	S-16	44-46'	19 25 30 30		24/16				S-16: Very dense, gray-brown SILT, some fine Sand, trace Clay. Wet. Orange discoloration.		
46											

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Log of Well MW-919M

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME ATV w/4" & 5" Driv. & Spn. Case
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Mike Lockey
Date Started: 7-23-01 Date Finished: 7-26-01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1341.5
TOC Elevation: 1344.23
PVC Elevation: 1344.06

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
	S-17	46-48'	19 20 23 30		24/12				S-17: Dense, gray-brown SILT, some fine Sand, trace Clay. Wet.		
48	S-18	48-50'	15 22 26 31		24/12				S-18: Similar to S-17.		
50	S-19	50-52'	15 22 27 35		24/16				S-19: Dense, gray-brown SILT, some Sand, little Clay. Wet. Stratified and orange discoloration.		
52	S-20	52-54'	15 28 38 39		24/8				S-20: Very dense, gray-brown, Clayey SILT, trace fine Sand. Wet. Stratified and orange discoloration.		Cement/Bentonite Grout (0 to 90')
54	S-21	54-56'	17 24 26 33		24/17				S-21: Very dense, gray-brown SILT, trace fine Sand. Wet. Stratified and orange discoloration.		2" dia. Sch 40 PVC Riser Pipe (-2.75 to 95')
56	S-22	56-58'	17 25 28 36		24/16			Stratified Drift	S-22; Very dense, gray-brown, Clayey SILT. Wet.		
58	S-23	58-60'	20 22 28 30		24/24				S-23: Similar to S-22.		
60	S-24	60-62'	18 24 29 32		24/17				S-24: Similar to S-22.		
62											

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Log of Well MW-919M

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME ATV w/4" & 5" Driv. & Spn. Case
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Mike Lockey
Date Started: 7-23-01 Date Finished: 7-26-01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1341.5
TOC Elevation: 1344.23
PVC Elevation: 1344.06

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
	S-25	62-64'	17 21 23 31		24/18				S-25: Dense, gray-brown SILT, trace Clay. Wet.		
64									S-26: Very dense, gray-brown SILT. Wet.		Cement/Bentonite Grout (0 to 90')
	S-26	64-66'	15 27 28 32		24/16						
66									S-27: Similar to S-26.		2" dia. Sch 40 PVC Riser Pipe (-2.75 to 95')
	S-27	66-68'	22 28 28 38		24/19						
68									S-28: Similar to S-26.		
	S-28	68-70'	18 22 28 32		24/17						
70								Stratified Drift	S-29: Very dense, gray-brown SILT. Wet. Stratified and orange discoloration.		
	S-29	70-72'	14 31 31 47		24/17						
72									S-30: Dense, gray-brown SILT, trace fine Sand. Wet. Stratified and orange discoloration.		
	S-30	72-74'	17 16 22 44		24/16						
74									S-31: Very dense, orange-brown, fine to medium SAND, trace Silt. Wet. Stratified.		
	S-31	74-76'	17 33 40 43		24/17						
76									S-32: Very dense, gray-brown SILT, some fine Sand. Wet. Stratified.		
	S-32	76-78'	26 44 105\6"		18/5						
78											

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Log of Well MW-919M

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME ATV w/4" & 5" Driv. & Spn. Case
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Mike Lockey
Date Started: 7-23-01 Date Finished: 7-26-01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1341.5
TOC Elevation: 1344.23
PVC Elevation: 1344.06

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
	S-33	78-80'	100\2"		2/0			Cobbles	S-33: No recovery. Drilling difficulty indicates cobbles.		
80								---80'---	S-34: Very dense, gray-brown, fine to medium SAND, some Gravel, trace Silt. Wet.		
	S-34	80-82'	100\5"		5/4						
82									S-35: Very dense, brown-orange, fine to coarse SAND, little Gravel, trace Silt. Wet. Dark brown staining at top 5" of spoon.		2" dia Sch 40 PVC Riser Pipe
	S-35	82-84'	58 72 81 100\5"		23/12			Stratified Drift			(-2.75 to 95')
84									S-36: Very dense, olive-gray, fine to coarse Sand, little Gravel, trace Silt. Wet. Top 4" of spoon orange.		
	S-36	84-86'	37 39 34 49		24/14						
86									S-37: Very dense, olive-gray, fine to coarse SAND, little Gravel, trace Silt. Wet.		
	S-37	86-88'	70 82 72 72		24/14						
88											
									S-38: Very dense, olive-gray, fine to coarse SAND, trace Gravel, trace Silt. Wet.		
90	S-38	89-91'	49 100\5"		11/4						90'
											Bentonite Chip Seal (90 to 93')
92											
											93' Filter Sand (93 to 100.5')
94											

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Log of Well MW-919M

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME ATV w/4" & 5" Driv. & Spn. Case
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Mike Lockey
Date Started: 7-23-01 Date Finished: 7-26-01
Logged By: KeLM Checked By: PMS

Ground Elevation: 1341.5
TOC Elevation: 1344.23
PVC Elevation: 1344.06

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
	S-39	94-96'	59 65 64 91		24/10			Stratified Drift	S-39: Very dense, olive-gray, fine to coarse SAND, little Silt. Wet.		95' 2" dia Sch 40 PVC Well Screen (0.010" Slots) (95 to 100') Filter Sand (93 to 100.5')
96											
98											
100	S-40	99-101'	65 77 100\5"		17/5				S-40: Very dense, olive-gray, fine to coarse SAND, little Silt. Wet.		100' Bottom Cap Formation Material (100.5-101') -101'
								---101'---	Boring terminated at 101'. No refusal encountered. NOTES: 1. Borehole advanced using 4" spun casing.		
102											
104											
106											
108											
110											

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Log of Well MW-919D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Mike Lackey
Date Started: 8-2-01 Date Finished: 8-8-01
Logged By: KeLM, DRP Checked By: PMS

Ground Elevation: 1342.5
TOC Elevation: 1345.38
PVC Elevation: 1345.14

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8/7/01	0815	50.17'	Ground	89'	16 hrs.

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
-2											-3.2' Protective Steel Casing -2.50
0				14				0'	Refer to MW-919M monitoring well log for geologic descriptions.		0'
				18							
2				20				FILL			
				20							
4				38				4'			Cement/Bentonite Grout (0 to 140')
				6							
6				8							
				11							
8				33				TILL			2" dia. Sch 40 PVC Riser Pipe (-2.5 to 145.1')
10											
12											
14											

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Log of Well MW-919D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Huriburt/Mike Lackey
Date Started: 8-2-01 Date Finished: 8-8-01
Logged By: KeLM, DRP Checked By: PMS

Ground Elevation: 1342.5
TOC Elevation: 1345.38
PVC Elevation: 1345.14

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8/7/01	0815	50.17'	Ground	89'	16 hrs.

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									Refer to MW-919M monitoring well log for geologic descriptions.		
16								TILL			
18											
								---19'---			
20											Cement/Bentonite Grout (0 to 140')
22											2" dia. Sch 40 PVC Riser Pipe (-2.5 to 145.1')
24								Stratified Drift			
26											
28											
30											

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Log of Well MW-919D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Mike Lackey
Date Started: 8-2-01 Date Finished: 8-8-01
Logged By: KeLM, DRP Checked By: PMS

Ground Elevation: 1342.5
TOC Elevation: 1345.38
PVC Elevation: 1345.14

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8/7/01	0815	50.17'	Ground	89'	16 hrs.

Depth (ft)	Sample No.	Depth (ft)	Blows Spoon per 6"	Blows Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									Refer to MW-919M Monitoring well log for geologic descriptions.		
32											
34											Cement/Bentonite Grout (0 to 140')
36											2" dia. Sch 40 PVC Riser Pipe (-2.5 to 145.1')
38											
40								Stratified Drift			
				24							
42											
				19							
				20							
44											
46											

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Log of Well MW-919D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Mike Lackey
Date Started: 8-2-01 Date Finished: 8-8-01
Logged By: KeLM, DRP Checked By: PMS

Ground Elevation: 1342.5
TOC Elevation: 1345.38
PVC Elevation: 1345.14

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8/7/01	0815	50.17'	Ground	89'	16 hrs.

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									Refer to MW-919M monitoring well log for geologic descriptions.		
48											
50											
52											Cement/Bentonite Grout (0 to 140')
								Stratified Drift			
54											2" dia. Sch 40 PVC Riser Pipe (-2.5 to 145.1')
56											
58											
60											
62											

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Log of Well MW-919D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Mike Lackey
Date Started: 8-2-01 Date Finished: 8-8-01
Logged By: KeLM, DRP Checked By: PMS

Ground Elevation: 1342.5
TOC Elevation: 1345.38
PVC Elevation: 1345.14

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8/7/01	0815	50.17'	Ground	89'	16 hrs.

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									Refer to MW-919M monitoring well log for geologic descriptions.		
64											Cement/Bentonite Grout (0 to 140')
66											2" dia. Sch 40 PVC Riser Pipe (-2.5 to 145.1')
68											
70								Stratified Drift			
72											
74											
76											
78											

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Log of Well MW-919D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Mike Lackey
Date Started: 8-2-01 Date Finished: 8-8-01
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Ground Elevation: 1342.5
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PVC Elevation: 1345.14

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8/7/01	0815	50.17'	Ground	89'	16 hrs.

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
									Refer to MW-919M monitoring well log for geologic descriptions.		
80											
82											2" dia Sch 40 PVC Riser Pipe (-2.5 to 145.1')
84								Stratified Drift			
86											
88											Cement/Bentonite Grout (0 to 140') (0'-140')
90											
92											
94											

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Log of Well MW-919D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Mike Lackey
Date Started: 8-2-01 Date Finished: 8-8-01
Logged By: KeLM, DRP Checked By: PMS

Ground Elevation: 1342.5
TOC Elevation: 1345.38
PVC Elevation: 1345.14

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8/7/01	0815	50.17'	Ground	89'	16 hrs.

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
	S-1	94-96'	27 100\3"		9/6				S-1: Very dense, brown-gray, fine to medium SAND, little Silt. Moist. Stratified.		
96											
	S-2	96-98'	95 100\5"		11/8				S-2: Very dense, brown-gray, fine to coarse SAND, little Gravel, trace Silt. Wet.		
98											Cement/Bentonite Grout (0 to 140')
	S-3	98-100'	115\6"		6/5				S-3: Very dense, gray, fine to coarse SAND, trace Silt. Wet.		
100											
	S-4	100-102'	68 121\6"		12/6				S-4: Very dense, gray, fine to coarse SAND, trace Silt. Wet. Stratified.		2" dia. Sch. 40 PVC Riser (-2.5 to 145.1') -101'
102											
	S-5	102-104'	81 112\6"		12/8				S-5: Similar to S-4.		
104								Stratified Drift			
	S-6	104-106'	75 104\6"		12/9				S-6: Very dense, gray, fine to coarse SAND, trace fine Gravel, trace Silt. Wet. Stratified.		
106											
	S-7	106-108'	124\6"		6/4				S-7: Similar to S-4.		
108	S-8	108-110'	110\6"		6/1				S-8: Very dense, gray, fine to medium SAND, little Silt. Wet.		
110											

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Log of Well MW-919D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Mike Lackey
Date Started: 8-2-01 Date Finished: 8-8-01
Logged By: KeLM, DRP Checked By: PMS

Ground Elevation: 1342.5
TOC Elevation: 1345.38
PVC Elevation: 1345.14

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8/7/01	0815	50.17'	Ground	89'	16 hrs.

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
	S-9A	110-110.5	91 100\5"		11/9				S-9A: Very dense, gray-brown, fine to coarse SAND, little Silt. Wet. Stratified.		
	S-9B	110.5-110.9'							S-9B: Very dense, gray, fine SAND, some Silt, trace Clay. Wet. Stratified. Seams of medium SAND.		
112									S-10: Very dense, gray, fine SAND, little Silt. Wet. Stratified. Stratified with medium Sand and Silt partings.		
	S-10	112-114'	86 100\5"		11/10						
114									S-11: Very dense, gray SILT, little fine Sand. Wet. Stratified.		
	S-11	114-116'	69 100\4"		10/8						
116									S-12: Very dense, gray SILT, trace Clay, trace fine Sand. Wet. Stratified and dark gray discoloration.		Cement/Bentonite Grout (0 to 140')
	S-12	116-118'	100\5"		5/1						
118								Stratified Drift	S-13: Very dense, gray, fine SAND, little Silt. Wet. Stratified.		
	S-13	118-120'	78 100\5"		11/8						
120									S-14: Similar to S-13.		2" dia. Sch. 40 PVC Riser (-2.5 to 145.1')
	S-14	120-122'	88 100\4"		10/-						
122									S-15: Very dense, gray SILT, some fine Sand. Wet.		
	S-15	122-124'	84 100\5"		11/9						
124									S-16: Similar to S-15.		
	S-16	124-126'	64 94 100\3"		15/12						
126											

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Log of Well MW-919D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Mike Lackey
Date Started: 8-2-01 Date Finished: 8-8-01
Logged By: KeLM, DRP Checked By: PMS

Ground Elevation: 1342.5
TOC Elevation: 1345.38
PVC Elevation: 1345.14

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8/7/01	0815	50.17'	Ground	89'	16 hrs.

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
	S-17	126-128'	96 100\4"		10/7				S-17: Similar to S-15.		
128									S-18: Very dense, gray SILT, some fine Sand. Stratified. Wet.		
	S-18	128-130'	112\6"		6/4						Cement/Bentonite Grout (0 to 140')
130									S-19: No recovery.		
	S-19	130-132'	111\6"		6/0						
132								Stratified Drift	S-20: Similar to S-18.		
	S-20	132-134'	93 100\3"		9/4						
134									S-21: Similar to S-18.		2" dia. Sch. 40 PVC Riser (-2.5 to 145.1')
	S-21	134-136'	69 100\4"		10/6						
136									S-22: No recovery.		
	S-22	136-138'	103\6"		6/0						
138									S-23: Very dense, gray, fine to medium SAND, little Silt. Wet. Stratified and orange discoloration.		
	S-23	138-140'	73 65 100\5"		17/7						
140									S-24: Very dense, gray, fine to medium SAND, little Silt, very slight stratification. Wet.		140'
	S-24	140-142'	65 88 100\5"		17/6						Bentonite Chip Seal (140 to 143')
142											

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Log of Well MW-919D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Mike Lackey
Date Started: 8-2-01 Date Finished: 8-8-01
Logged By: KeLM, DRP Checked By: PMS

Ground Elevation: 1342.5
TOC Elevation: 1345.38
PVC Elevation: 1345.14

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8/7/01	0815	50.17'	Ground	89'	16 hrs.

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
	S-25	142-144'	78 106\6"		12/6				S-25: Very dense, gray, fine to medium SAND, little Silt. Wet.		Bentonite Chip Seal (140-143')
144	S-26	144-144.3	150\4"		4/0				S-26: No recovery. Large gravel in tip of spoon.		Filter Sand (143 to 150.1')
146	S-27	146-146.5	183\6"		6/5				S-27: Very dense, gray, fine to coarse SAND, some Silt, little Gravel.		2" dia Sch 40 PVC Well Screen (0.010" Slots) (145.1 to 150.1')
148											
150	S-28	150-151'	98 134\6"		12/4			Stratified Drift	S-28: Very dense, gray, fine to coarse SAND, little Silt, trace Gravel. Wet.		150.1' Bottom Cap
											Bentonite Chip Seal (150.1-152.1')
152											152.1
											Pea Stone (152.1-154.1')
154											154.1
	S-29	155-156'	77 135\6"		12/6				S-29: Very dense, gray, fine SAND, little Silt. Wet. Slight stratification.		Formation Material (154.1-174.3')
156											
								—157'—			
158											

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Log of Well MW-919D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Mike Lackey
Date Started: 8-2-01 Date Finished: 8-8-01
Logged By: KeLM, DRP Checked By: PMS

Ground Elevation: 1342.5
TOC Elevation: 1345.38
PVC Elevation: 1345.14

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8/7/01	0815	50.17'	Ground	89'	16 hrs.

Depth (ft)	Sample No.	Depth (ft)	Blows: Spoon per 6"	Blows: Casing per in.	Pen/Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
160								Boulders & Cobbles			
162									Carbide button roller bit advanced from 157-167'. Drilling difficulty indicates cobbles and/or boulders. Drill cuttings consisted of white to dark gray GRANITE.		
164											
166											Formation Material (154.1 to 174.3')
	S-30	167-167.3	200\4"		4/0			---167'---	S-30: No Recovery.		
168											
170								Stratified Drift			
	S-31	171-171.1	150\1"		1/1				S-31: Very dense, gray, fine to coarse SAND, some Silt, little Gravel. Wet.		
172											
174											

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Log of Well MW-919D

Project: NCES Stage IV Hydrogeologic Study
Location: Bethlehem, New Hampshire
SHA Project No.: 1879
Drilling Method: CME ATV w/4" & 5" Driven Casing
2" split spoon
Drilling Company: Capital Environmental Drilling Services
Foreman: James Hurlburt/Mike Lackey
Date Started: 8-2-01 Date Finished: 8-8-01
Logged By: KeLM, DRP Checked By: PMS

Ground Elevation: 1342.5
TOC Elevation: 1345.38
PVC Elevation: 1345.14

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
8/7/01	0815	50.17'	Ground	89'	16 hrs.

Depth (ft)	Sample No.	Depth (ft)	Blows Spoon per 6"	Blows Casing per in.	Pen/ Rec (in.)	RQD	Graphic Log	Stratum	Geologic Description	Well Diagram	Well Description
	S-32	174-174.3	150\4"		4/2			---174.3'---	S-32: Very dense, gray, fine SAND, some Silt. Wet.		Formation Material (154.1 to 174.3')
									Boring terminated at 174.3'.		
									No refusal encountered.		
176											
178											
180											
182											
184											
186											
188											
190											

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Log of Monitoring Well B-920D

Project: NCES Stage IV
Location: Bethlehem NH
SHA Project No.: 2617.00
Drilling Method: Rotosonic
Sampling Method: Rotosonic 4" Core Barrel-20'
Drilling Company: Boart Longyear
Foreman: Matt Osterberg
Date Started: 02/20/06 **Date Finished:** 02/21/06
Logged By: K. Marshall **Checked By:** P. Rydel

Ground Elevation: 1339.9
TOC Elevation: 1341.97
PVC Elevation: 1342.16
Datum:

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
02/22/06	-	41.25'	PVC	Well installed	1 day
02/23/06	-	41.10'	PVC	Well installed	2 days

Sample No.	Depth (ft)	Pen/ Rec (ft)	PID Values (ppm)
S-1A	0 - 3	10/10	
S-1B	3 - 5		
S-2	5 - 15	10/10	
S-3A	15 - 22.5	10/8	
S-3B	22.5 - 23	13/13	
S-4A	23 - 24		
S-4B	24 - 24.5		
S-4C	24.5 - 27		
S-4D	27 - 28		
S-4E	28 - 35		
S-5A	35 - 41	20/20	
S-5B	41 - 46		
S-5C	46 - 47.5		
S-5D	47.5 - 55		
S-6A	55 - 58.5	20/20	
S-6B	58.5 - 72		
S-6C	72 - 75		
S-7A	75 - 89	20/20	
5-7B	89 - 91		
S-7C	91 - 95		
S-8A	95 - 97	20/19	
S-8B	97 - 105		

Stratum

Description	Depth
FILL	0' - 3'
SAND	3' - 15'
UPPER TILL	15' - 23'
Stratified DRIFT	23' - 125'

Geologic Description

S-1A: Brown, fine to coarse SAND, little Gravel, little Silt. Dry. FILL.
S-1B: Brown, SILT and fine Sand.
S-2: Similar to S-1B. Moist 13-15' bgs.
S-3A: Gray to brown, fine to coarse SAND, some Gravel, some Silt, trace Cobbles. Dry. TILL.
S-3B: Light gray, Broken Cobble. Dry.
S-4A: Brown, fine SAND and SILT. Wet.
S-4B: Brown, fine to coarse SAND, trace Silt. Wet.
S-4C: Similar to S-4B.
S-4D: Brown, fine to coarse SAND, trace Silt. Wet.
S-4E: Brown, fine SAND and SILT, Orange oxide staining. Wet.
S-5A: Brown to gray, 4" Dark orange layer, Fine to medium SAND, trace Silt. Wet.
S-5B: Gray brown, fine to coarse SAND, some Gravel, trace Silt. Wet.
S-5C: Brown, fine to medium SAND, some Gravel, trace Silt. Wet.
S-5D: Brown, fine to coarse SAND and GRAVEL, trace Silt, trace Cobbles. Wet.
S-6A: Brown, fine to coarse SAND, trace Silt. Wet.
S-6B: Olive brown, fine SAND and SILT, Orange oxide stratification. Wet.
S-6C: Gray brown, fine to coarse SAND, trace Gravel, trace Silt, Orange oxide stratification. Wet.
S-7A: Brown, fine SAND and SILT, Orange oxide stratification. Wet.
S-7B: Brown, fine to medium SAND, little Silt, Stratified dark brown Silt lenses. Wet.
S-7C: Brown, fine SAND and SILT, Stratified. Wet.
S-8A: Brown, fine to medium SAND, little Silt, Stratified. Wet.
S-8B: Brown, fine SAND and SILT, Stratified. Wet.

Well Diagram

Well Description

4" ID Steel Guard Pipe (-2.4 to 0')
Concrete Surface Seal (0 to 1')
Bentonite Grout (1 to 119')
2" ID 40 Sch. PVC Riser pipe (-2.4 to 125')

Sanborn, Head & Associates, Inc.
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Log of Monitoring Well B-920D

Project: NCES Stage IV
Location: Bethlehem NH
SHA Project No.: 2617.00
Drilling Method: Rotosonic
Sampling Method: Rotosonic 4" Core Barrel-20'
Drilling Company: Boart Longyear
Foreman: Matt Osterberg
Date Started: 02/20/06 **Date Finished:** 02/21/06
Logged By: K. Marshall **Checked By:** P. Rydel

Ground Elevation: 1339.9
TOC Elevation: 1341.97
PVC Elevation: 1342.16
Datum:

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
02/22/06	-	41.25'	PVC	Well installed	1 day
02/23/06	-	41.10'	PVC	Well installed	2 days

Depth (ft)	Sample Information: Sample No.	Depth (ft)	Pen/Rec (ft)	PID Values (ppm)	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
104									
106							S-8C: Gray, SILT, trace fine Sand, Stratified. Wet.		
108									
110	S-8C	105 - 115							
112									
114									
116							S-9A: Gray, SILT, trace fine Sand, Stratified. Wet.		
118	S-9A	115 - 121	20/18			Stratified DRIFT			
120									Granular Bentonite Seal (119 to 122')
122	S-9B S-9C	121 - 121.5 121.5 - 124					S-9B: Gray, fine SAND, some Silt. Wet. S-9C: Gray, fine to medium SAND, little Silt, trace Clay. Wet.		
124	S-9D	124 - 125					S-9D: Gray brown, fine SAND and SILT, Stratified. Wet.		
126									
128	S-9E	125 - 133					S-9E: Gray, fine SAND, some Silt, layers brown medium to coarse Sand. Stratified. Wet.		Filter Sand (122 to 135') 2" ID Sch. 40 PVC Well Screen (0.010" Slots) (125 to 135')
130									
132									
134	S-9F	133 - 135					S-9F: Brown to gray, fine to medium SAND, some Silt, Stratified. Wet.		
136						-----135'-----	Boring terminated at 135 feet. No refusal encountered.		
138									
140									
142									
144									
146									
148									
150									
152									
154									
156									
158									
160									
162									
164									
166									
168									
170									
172									
174									
176									
178									
180									
182									
184									
186									
188									
190									
192									
194									
196									
198									
200									
202									
204									
206									

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Log of Monitoring Well B-920M

Project: NCES Stage IV
Location: Bethlehem NH
SHA Project No.: 2617.00
Drilling Method: Rotosonic
Sampling Method: Rotosonic 4" Core Barrel-20'
Drilling Company: Boart Longyear
Foreman: Matt Osterberg
Date Started: 02/21/06 Date Finished: 02/21/06
Logged By: K. Marshall Checked By: P. Rydel

Ground Elevation: 1340.0
TOC Elevation: 1342.39
PVC Elevation: 1342.49
Datum:

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
02/22/06	-	40.58'	PVC	Well installed	1 day
02/23/06	-	40.52'	PVC	Well installed	2 days
03/07/06	-	40.84'	PVC	Well installed	~ 2 weeks

Sample No.	Depth (ft)	Pen/ Rec (ft)	PID Values (ppm)
S-1A	70 - 75	10/10	
S-1B	75 - 80		

Stratum

Description	Depth (ft)
FILL	0' – 3'
SAND	3' – 15'
UPPER TILL	15' – 23'
Stratified Drift	23' – 80'

Geologic Description

Reference Monitoring Well B-920D for Geologic description.

S-1A: Olive brown, SILT, little fine Sand. Wet.

S-1B: Brown, fine to medium SAND, little Silt, Orange layers. Stratified. Dry.

Boring terminated at 80 feet. No refusal encountered.

Well Diagram

Well Description

4"x4" Steel Guard Pipe (-2.5 to 0')
Concrete Surface Seal (0 to 1')
Bentonite Grout (1 to 64')
2" ID Sch. 40 PVC Riser pipe (-2.4 to 70')
Granular Bentonite Seal (64 to 67')
Filter Sand (67 to 80')
2" ID Sch. 40 PVC Well Screen (0.010" Slots) (70 to 80')

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Log of Monitoring Well B-920U

Project: NCES Stage IV
Location: Bethlehem NH
SHA Project No.: 2617.00
Drilling Method: Rotosonic
Sampling Method: Rotosonic 4" Core Barrel-20'
Drilling Company: Boart Longyear
Foreman: Matt Osterberg
Date Started: 02/21/06 **Date Finished:** 02/22/06
Logged By: K. Marshall **Checked By:** P. Rydel

Ground Elevation: 1340.3
TOC Elevation: 1342.55
PVC Elevation: 1342.64
Datum:

Groundwater Readings

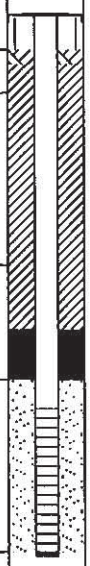
Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
02/22/06	-	27.98'	PVC	Well installed	1 hour
03/07/06	-	29.08'	PVC	Well installed	2 weeks

Sample No.	Depth (ft)	Pen/ Rec (ft)	PID Values (ppm)
S-1A	25 - 28	10/10	
S-1B	28 - 35		

Stratum

Description	Geologic Description
0' – 3' FILL	Reference Monitoring Well SH-920D for Geological description.
3' – 15' SAND	
15' – 23' UPPER TILL	
23' – 35' Stratified DRIFT	1: Brown, fine to coarse SAND, some Silt, trace Gravel, Orange oxide staining, medium to coarse Sand layers. Stratified. Wet. S-1B: Brown gray, fine SAND and SILT, Orange oxide stratification. Wet.
35'	Boring terminated at 35 feet. No refusal encountered.

Well Diagram



Well Description

- 4"x 4" Steel Guard Pipe (-2.4 to 0')
- Concrete Surface Seal (0 to 1')
- Bentonite Grout (1 to 19.5')
- 2" ID Sch. 40 PVC Riser pipe (-2.4 to 25')
- Granular Bentonite Seal (19.5 to 23')
- Filter Sand (23 to 35')
- 2" ID Sch. 40 PVC Well Screen (0.010"Slots) (25 to 35')

Sanborn, Head & Associates, Inc.
CONSULTING ENGINEERS & SCIENTISTS

Log of Monitoring Well B-921D

Project: NCES Stage IV
Location: Bethlehem NH
SHA Project No.: 2617.00
Drilling Method: Rotosonic
Sampling Method: Rotosonic 4" Core Barrel-20'
Drilling Company: Boart Longyear
Foreman: Matt Osterberg
Date Started: 02/23/06 Date Finished: 02/23/06
Logged By: K. Marshall Checked By: P. Rydel

Ground Elevation: 1339.3
TOC Elevation: 1341.45
PVC Elevation: 1341.53
Datum:

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
03/07/06	-	47.48'	PVC	Well installed	2 weeks

Depth (ft)	Sample No.	Depth (ft)	Pen/ Rec (ft)	PID Values (ppm)	Stratum Log	Stratum Description	Geologic Description	Well Diagram	Well Description
-2									4"x4" Steel Guard Pipe (-2.5 to 0')
0	S-1A	0 - 1	5/5			-----0'-----	S-1A: Gray brown, fine SAND, little Silt, trace Gravel, trace Cobbles. Dry. FILL.		Concrete Surface Seal (0 to 1')
2	S-1B	1 - 5				FILL	S-1B: Gray brown, fine to coarse SAND, some Gravel, little Silt. Dry. FILL.		
4						-----5'-----	S-2A: Light gray-brown, fine to coarse SAND, some Silt, little Gravel, trace Cobbles. Dry.		
6									
8	S-2A	5 - 12.5	10/10						
10									
12	S-2B	12.5 - 13					S-2B: Brown, fine to coarse SAND, little Silt. Dry.		
14	S-2C	13 - 15					S-2C: Brown, fine to coarse SAND, little Silt, trace Gravel. Stratified. Dry.		
16	S-3A	15 - 18.5	10/10				S-3A: Brown, fine to coarse SAND, little Gravel, trace Silt. Stratified. Moist.		
18	S-3B	18.5 - 19					S-3B: Brown, fine to coarse SAND, trace Silt. Moist.		
20									
22	S-3C	19 - 24					S-3C: Brown, fine to coarse SAND, trace Silt, trace Gravel, Stratified, seams of coarse Sand throughout. Moist.		
24	S-3D	24 - 25					S-3D: Brown, fine to coarse SAND, little Gravel, trace Silt. Moist.		
26	S-4A	25 - 26	10/10				S-4A: Gray, fine to coarse SAND, little Silt, gray Silt lenses. Stratified. Wet.		
28	S-4B	26 - 26.5					S-4B: Brown, fine to coarse SAND, some Gravel, trace Silt. Wet.		
	S-4C	26.5 - 27					S-4C: Similar to S-4A.		
30	S-4D	27 - 30					S-4D: Similar to S-4B.		
32	S-4E	30 - 31					S-4E: Gray, fine to coarse SAND, some Gravel, trace Silt, Orange oxide staining. Wet.		
	S-4F	31 - 33					S-4F: Brown, fine to coarse SAND, trace fine Gravel, trace Silt. Wet.		
34	S-4G	33 - 34					S-4G: Gray, SILT, little fine to medium Sand, Orange oxide staining. Stratified. Wet.		
36	S-4H	34 - 35					S-4H: Similar to S-4F.		
38	S-5A	35 - 40	20/18				S-5A: Gray, SILT, little fine to medium Sand, Orange oxide staining. Stratified. Wet.		
40									
42									
44									
46	S-5B	40 - 51					S-5B: Brown, fine to coarse SAND, trace Silt. Wet.		
48									
50									
52									
54	S-5C	51 - 55				Stratified DRIFT	S-5C: Similar to S-5A.		
56									
58							S-6A: Gray, SILT, little fine to coarse Sand, Orange and dark gray Silt lenses. Stratified. Wet. Coarse sand layer 1" thick at approximately 65' bgs.		Bentonite Grout (1 to 113.5')
60									2" ID Sch. 40 PVC Riser pipe (-2.5 to 120')
62									
64	S-6A	55 - 75	20/20						
66									
68									
70									
72									
74									
76	S-7A	75 - 77	20/18				S-7A: Dark gray, SILT, trace fine Sand, trace Clay. Wet.		
78	S-7B	77 - 79					S-7B: Brown, fine SAND and Silt. Wet.		
80							S-7C: Brown, fine SAND, some Silt, Stratified. Orange and dark brown seam at approximately 90.5' bgs. Wet.		
82									
84	S-7C	79 - 90.5							
86									
88									
90									
92	S-7D	90.5 - 94					S-7D: Brown, fine to medium SAND, little Silt, Stratified. Orange oxide staining.. Orange and dark brown 1.5" layer at bottom. Wet.		
94	S-7E	94 - 95					S-7E: Gray, fine to coarse SAND, trace Gravel, trace Silt. Wet.		
96	S-8A	95 - 99	20/18				S-8A: Gray, fine to coarse SAND, trace Gravel, trace Silt. Wet.		
98	S-8B	99 - 99.5					S-8B: COBBLES.		
100	S-8C	99.5 - 100							
102									

Sanborn, Head & Associates, Inc.
Consulting Engineers & Scientists

Log of Monitoring Well B-921D

Project: NCES Stage IV
Location: Bethlehem NH
SHA Project No.: 2617.00
Drilling Method: Rotosonic
Sampling Method: Rotosonic 4" Core Barrel-20'
Drilling Company: Boart Longyear
Foreman: Matt Osterberg
Date Started: 02/23/06 **Date Finished:** 02/23/06
Logged By: K. Marshall **Checked By:** P. Rydel

Ground Elevation: 1339.3
TOC Elevation: 1341.45
PVC Elevation: 1341.53
Datum:

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
03/07/06	-	47.48'	PVC	Well installed	2 weeks

Depth (ft)	Sample No.	Sample Depth (ft)	Pen/Rec (ft)	PID Values (ppm)	Stratum Log	Stratum Description	Geologic Description	Well Diagram	Well Description
104	S-8D S-8E	100 - 101 101 - 107					S-8C: Gray, fine to coarse SAND, little Gravel, trace Silt, trace Cobbles. Wet. S-8D: Brown, fine to coarse SAND, trace fine Gravel, trace Silt. Stratified. Wet. S-8E: Brown, fine to medium SAND, little Silt, Stratified. Orange oxide staining. Wet. S-8F: Brown, fine to coarse SAND, trace Silt. Stratified. Wet. S-8G: Dark gray, fine SAND, some Silt. Wet. S-9A: Gray, fine SAND, some Silt. Stratified. Wet.		
110	S-8F	107 - 112							
114	S-8G	112 - 115							
116						Stratified DRIFT			Granular Bentonite Seal (113.5 to 117')
122	S-9A	115 - 128	15/15						Filter Sand (117 to 130') 2" ID Sch. 40 PVC Well Screen (0.010" Slots) (120 to 130')
130	S-9B	128 - 130				-----130'-----	S-9B: Gray, fine SAND and SILT. Wet. Boring terminated at 130 feet. No refusal encountered.		

LOG OF BORING 2617 NCES LOGS.GPJ SANBORN HEAD AND ASSOC.GDT 4/3/07

Sanborn, Head & Associates, Inc.
Consulting Engineers & Scientists

Log of Monitoring Well B-921M

Project: NCES Stage IV
Location: Bethlehem NH
SHA Project No.: 2617.00
Drilling Method: Rotosonic
Sampling Method: Rotosonic 4" Core Barrel-20'
Drilling Company: Boart Longyear
Foreman: Matt Osterberg
Date Started: 02/23/06 Date Finished: 02/24/06
Logged By: K. Marshall Checked By: P. Rydel

Ground Elevation: 1339.6
TOC Elevation: 1341.71
PVC Elevation: 1341.82
Datum:

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time

Depth (ft)	Sample Information: Sample No.	Depth (ft)	Pen/Rec (ft)	PID Values (ppm)	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
-2									4"x 4" Steel Guard Pipe (-2.5 to 0')
0						-----0'-----			Concrete Surface Seal (0 to 1')
2						FILL	Reference Monitoring Well SH-921D for Geologic description.		
4						-----5'-----			
6									
8									
10									
12									
14									
16									
18									
20									
22									
24									
26									
28									
30									
32									
34									Bentonite Grout (1 to 65') 2" ID Sch. 40 PVC Riser pipe (-2.5 to 70')
36									
38									
40									
42						Stratified DRIFT			
44									
46									
48									
50									
52									
54									
56									
58									
60									
62									
64									
66									Granular Bentonite Seal (65 to 68')
68									
70							S-1A: Gray brown, fine SAND and Silt. Orange staining. Stratified. Wet.		
72									
74	S-1A	70 - 80	10/10						Filter Sand (68 to 80') 2" ID Sch. 40 PVC Well Screen (0.010" Slots) (70 to 80')
76									
78									
80						-----80'-----	Boring terminated at 80 feet. No refusal encountered.		
82									
84									
86									
88									
90									
92									
94									
96									
98									
100									
102									

Sanborn, Head & Associates, Inc.
CONSULTING ENGINEERS & SCIENTISTS

Log of Monitoring Well B-921U

Project: NCES Stage IV
Location: Bethlehem NH
SHA Project No.: 2617.00
Drilling Method: Rotosonic
Sampling Method: Rotosonic 4" Core Barrel-20'
Drilling Company: Boart Longyear
Foreman: Matt Osterberg
Date Started: 02/24/06 Date Finished: 02/24/06
Logged By: K. Marshall Checked By: P. Rydel

Ground Elevation: 1339.6
TOC Elevation: 1341.61
PVC Elevation: 1341.72
Datum:

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
03/07/06		33.88'	Top of PVC	-	-

Sample No.	Depth (ft)	Pen/ Rec (ft)	PID Values (ppm)
S-1A	30 - 30.7	10/10	
S-1B	30.7 - 32		
S-1C	32 - 33.5		
S-1D	33.5 - 38.5		
S-1E	38.5 - 40		

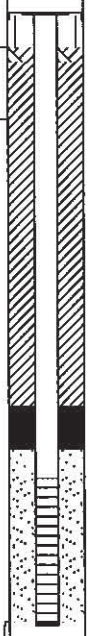
Stratum: -----0'----- FILL -----5'----- Stratified DRIFT -----40'-----

Geologic Description:

Reference Monitoring Well SH-921D for Geological description.

S-1A: Brown, fine to coarse SAND, little Gravel, trace Silt. Wet.
S-1B: Brown, fine SAND, some Silt, Orange staining. Stratified.
S-1C: Brown, fine to coarse SAND, trace Gravel, trace Silt. Stratified.
S-1D: Similar to S-1B. Bottom 3" Dark orange and Dark gray seams..
S-1E: Brown, fine to coarse SAND and Silt. Orange and Dark gray staining. Stratified. Wet.

Boring terminated at 40 feet. No refusal encountered.



Well Description:

4"x4" Steel Guard Pipe (-2.4 to 0')
Concrete Surface Seal (0 to 1')
Bentonite Grout (1 to 25')
2" ID Sch. 40 PVC Riser pipe (-2.1 to 30')
Granular Bentonite Seal (25 to 28')
Filter Sand (28 to 40')
2" ID Sch. 40 PVC Well Screen (0.010" Slots) (30 to 40')

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: North Country Environmental Services, Inc.
Location: Bethlehem, New Hampshire
Project No.: 1003.07

Log of Monitoring Well B-922U

Ground Elevation: Not Available

Drilling Method: Mini Sonic Model 1421 Track Rig with 6" Casing

Sampling Method: 4" ID Core Barrel

Drilling Company: Boart Longyear
Foreman: K. Regan
Date Started: 01/24/12 **Date Finished: 01/25/12**
Logged By: D. Porter **Checked By: P. Rydel**

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
01/24/12	13:30	14.25'	Top of PVC	N/A	Well Installed	~5 minutes
01/25/12	07:15	11.75'	Top of PVC	N/A	Well Installed	~17 hours

Depth (ft)	Sample Information: Sample No.	Depth (ft)	Pen/ Rec (ft)	Field Testing Data	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
-2									4" Dia. Protective Steel Casing with Locking Cap and Expansion Plug Set in Concrete (-3 to 2')
									2" Dia. Sch. 40 PVC Riser (-2 to 15')
0	S-1	0 - 5	5.0/ 5.0			-----0'-----	S-1 (0 to 5'): Brown, fine SAND and Silt, trace Gravel. Moist. FILL.		
2									Concrete Surface Pad (0 to 2')
4						FILL			
	S-2	5 - 10	5.0/ 5.0				S-2A (5 to 9.7'): Brown, fine to medium SAND, some Silt, little Gravel. Moist. FILL.		
6									Bentonite/Cement Grout (2 to 9.5')
8									
10	S-3	10 - 15	5.0/ 5.0			-----9.7'-----	S-2B (9.7 to 10'): Olive brown, fine to coarse SAND, little Silt, trace Gravel. Moist. TILL. S-3 (10 to 15'): Olive gray, fine to coarse SAND, some Silt, little Gravel. Moist. TILL.		
12									Bentonite Chips (9.5 to 14.5')
14									
	S-4	15 - 20	5.0/ 5.0			UPPER TILL	S-4 (15 to 20'): Gray, SILT and fine to coarse Sand, little Gravel. Moist. TILL.		2" Dia. Sch. 40 PVC Well Screen (0.010" Slots) (15 to 25')
16									
18									
20	S-5	20 - 25	5.0/ 5.0				S-4 (20 to 25'): Gray, fine to coarse SAND, some Silt, little Gravel. Moist. TILL.		Filter Sand (14.5 to 25.2')
22									

BORING LOG S:\CONDATA\1000S\1003.07\LOGS\100307 NCES B-922U & L.GPJ 2010 SANBORN HEAD V1.GLB 2010 SANBORN HEAD V1.GDT 4/20/12

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: North Country Environmental Services, Inc.
Location: Bethlehem, New Hampshire
Project No.: 1003.07

Log of Monitoring Well B-922U

Ground Elevation: Not Available

Drilling Method: Mini Sonic Model 1421 Track Rig with 6" Casing

Sampling Method: 4" ID Core Barrel

Drilling Company: Boart Longyear
Foreman: K. Regan
Date Started: 01/24/12 **Date Finished: 01/25/12**
Logged By: D. Porter **Checked By: P. Rydel**

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
01/24/12	13:30	14.25'	Top of PVC	N/A	Well Installed	~5 minutes
01/25/12	07:15	11.75'	Top of PVC	N/A	Well Installed	~17 hours

Depth (ft)	Sample Information: Sample No.	Depth (ft)	Pen/ Rec (ft)	Field Testing Data	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
22									Filter Sand (14.5 to 25.2')
24						UPPER TILL			2" Dia. Sch. 40 PVC Well Screen (0.010" Slots) (15 to 25')
						-----25.5'-----	Boring terminated at 25.5'. No refusal encountered.		Filter Sand and Formation Material (25.2 to 25.5')
26									
28									
30									
32									
34									
36									
38									
40									
42									
44									
46									

NOTES:

1. Approximately 150 gallons of potable water was used during drilling operations.

BORING LOG S:\CONDATA\1000S\1003.07\LOGS\100307 NCES B-922U & L.GPJ 2010 SANBORN HEAD V1.GLB 2010 SANBORN HEAD V1.GDT 4/20/12

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: North Country Environmental Services, Inc.
Location: Bethlehem, New Hampshire
Project No.: 1003.07

Log of Monitoring Well B-922L

Ground Elevation: Not Available

Drilling Method: Mini Sonic Model 1421 Track Rig with 6" Casing

Sampling Method: 4" ID Core Barrel

Drilling Company: Boart Longyear
Foreman: K. Regan
Date Started: 01/23/12 **Date Finished: 01/25/12**
Logged By: D. Porter **Checked By: P. Rydel**

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
01/23/12	15:45	6.5'	Ground Surface	40'	40'	~5 minutes
01/24/12	07:50	12.8'	Ground Surface	40'	40'	~18 hours
01/24/12	13:55	15.15'	Top of PVC	N/A	Well Installed	~4 hours
01/25/12	07:20	15.22'	Top of PVC	N/A	Well Installed	~22 hours

Depth (ft)	Sample Information: Sample No.	Depth (ft)	Pen/ Rec (ft)	Field Testing Data	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
-2									4" Dia. Protective Steel Casing with Locking Cap and Expansion Plug Set in Concrete (-3 to 2')
0	S-1	0 - 5	5.0/ 4.0			-----0'-----	S-1 (0 to 5'): Olive brown, fine to medium SAND, little Silt, trace Gravel, trace Organic Material. Moist. FILL.		Concrete Surface Pad (0 to 2')
2									
4									
6	S-2	5 - 10	5.0/ 5.0				S-2 (5 to 10'): Olive brown, fine to medium SAND, little Silt, trace Organic Material. Moist. FILL.		Bentonite/Cement Grout (2 to 48')
8						FILL			
10	S-3	10 - 14	4.0/ 3.0				S-3 (10 to 14'): Olive brown, fine to medium SAND, some Silt. Wet. FILL.		
12									
14	S-4	14 - 17	3.0/ 3.0			---14'---	S-4 (14 to 17'): Olive brown, fine to coarse SAND, some Silt, little Gravel, trace Cobbles. Dry. TILL.		2" Dia. Sch. 40 PVC Riser (-2 to 55.3')
16									
18	S-5	17 - 20	3.0/ 3.0			UPPER TILL	S-5 (17 to 20'): Olive grading to gray, fine to coarse SAND, some Silt, little Gravel, trace Cobbles. Dry. TILL.		
20	S-6	20 - 25	5.0/ 5.0				S-6 (20 to 25'): Gray, fine to coarse SAND and Silt, little Cobbles, little Gravel. Dry. TILL.		
22									

BORING LOG S:\CONDATA\1000S\1003.07\LOGS\100307 NCES B-922U & L.GPJ 2010 SANBORN HEAD V1.GLB 2010 SANBORN HEAD V1.GDT 4/20/12

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: North Country Environmental Services, Inc.
Location: Bethlehem, New Hampshire
Project No.: 1003.07

Log of Monitoring Well B-922L

Ground Elevation: Not Available

Drilling Method: Mini Sonic Model 1421 Track Rig with 6" Casing

Sampling Method: 4" ID Core Barrel

Drilling Company: Boart Longyear
Foreman: K. Regan
Date Started: 01/23/12 **Date Finished: 01/25/12**
Logged By: D. Porter **Checked By: P. Rydel**

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
01/23/12	15:45	6.5'	Ground Surface	40'	40'	~5 minutes
01/24/12	07:50	12.8'	Ground Surface	40'	40'	~18 hours
01/24/12	13:55	15.15'	Top of PVC	N/A	Well Installed	~4 hours
01/25/12	07:20	15.22'	Top of PVC	N/A	Well Installed	~22 hours

Depth (ft)	Sample Information: Sample No.	Depth (ft)	Pen/ Rec (ft)	Field Testing Data	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
22									
24									
	S-7	25 - 30	5.0/ 5.0			UPPER TILL	S-7A (25 to 28'): Gray, fine to coarse SAND, some Silt, little Gravel. Dry. TILL.		
26									
28						-----28'-----	S-7B (28 to 29'): Gray, SILT, some fine Sand. Stratified seams throughout. Moist. STRATIFIED DRIFT.		2" Dia. Sch. 40 PVC Riser (-2 to 55.3')
						SILT			
						-----29'-----	S-7C (29 to 30'): Gray, fine to medium SAND, little Silt, trace Gravel. Moist. STRATIFIED DRIFT.		
30	S-8	30 - 35	5.0/ 4.0				S-8 (30 to 35'): Brown, fine to coarse SAND and Gravel, little Silt, trace Cobbles. Wet. STRATIFIED DRIFT.		
32									
34									
	S-9	35 - 40	5.0/ 2.5				S-9 (35 to 40'): Brown, fine to coarse SAND and Gravel, some Cobbles, little Silt. Wet. STRATIFIED DRIFT.		
36									
38						STRATIFIED DRIFT			Bentonite/Cement Grout (2 to 48')
40	S-10	40 - 45	5.0/ 4.0				S-10 (40 to 45'): Brown, GRAVEL and fine to coarse Sand, trace Silt, trace Cobbles. Wet. STRATIFIED DRIFT.		
42									
44									
	S-11	45 - 50	5.0/ 3.0				S-11 (45 to 50'): Brown, fine to coarse SAND and Gravel, little Silt, trace Cobbles. Wet. STRATIFIED DRIFT.		
46									

BORING LOG S:\CONDATA\1000S\1003.07\LOGS\100307 NCES B-922U & L.GPJ 2010 SANBORN HEAD V1.GLB 2010 SANBORN HEAD V1.GDT 4/20/12

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: North Country Environmental Services, Inc.
Location: Bethlehem, New Hampshire
Project No.: 1003.07

Log of Monitoring Well B-922L

Ground Elevation: Not Available

Drilling Method: Mini Sonic Model 1421 Track Rig with 6" Casing

Sampling Method: 4" ID Core Barrel

Drilling Company: Boart Longyear
Foreman: K. Regan
Date Started: 01/23/12 **Date Finished: 01/25/12**
Logged By: D. Porter **Checked By: P. Rydel**

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
01/23/12	15:45	6.5'	Ground Surface	40'	40'	~5 minutes
01/24/12	07:50	12.8'	Ground Surface	40'	40'	~18 hours
01/24/12	13:55	15.15'	Top of PVC	N/A	Well Installed	~4 hours
01/25/12	07:20	15.22'	Top of PVC	N/A	Well Installed	~22 hours

Depth (ft)	Sample Information: Sample No.	Depth (ft)	Pen/ Rec (ft)	Field Testing Data	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
48									Bentonite/Cement Grout (2 to 48')
									2" Dia. Sch. 40 PVC Riser (-2 to 55.3')
50	S-12	50 - 55	5.0/ 4.0				S-12 (50 to 55'): Brown, fine to coarse SAND and Gravel, little Cobbles, little Silt. Wet. STRATIFIED DRIFT.		Bentonite Chips (48 to 53')
52									
54									
56	S-13	55 - 60	5.0/ 4.0				S-13 (55 to 60'): Brown, fine to coarse SAND, some Gravel, trace Cobbles, trace Silt. Wet. STRATIFIED DRIFT.		2" Dia. Sch. 40 PVC Well Screen (0.010" Slots) (55.3 to 65.3')
58						STRATIFIED DRIFT			
									Filter Sand (53 to 65.6')
60	S-14	60 - 65	5.0/ 3.0				S-14 (60 to 65'): Brown, fine to coarse SAND, some Gravel, trace Cobbles, trace Silt. Wet. STRATIFIED DRIFT.		
62									
64									
66	S-15	65 - 70	5.0/ 4.0				S-15A (65 to 69.3'): Brown, fine to coarse SAND, some Gravel, trace Cobbles, trace Silt. Wet. STRATIFIED DRIFT.		
68									Formation Material (65.6 to 70')
						-----69.3'-----	S-15B (69.3 to 70'): Gray, fine to coarse SAND, some Silt, little Gravel. Moist. TILL.		
70						LOWER TILL -----70'-----	Boring terminated at 70'. No refusal encountered.		
72									

NOTES:

1. Stratification of stratified drift was not apparent in most

BORING LOG S:\CONDATA\1000S\1003.07\LOGS\100307 NCES B-922U & L.GPJ 2010 SANBORN HEAD V1.GLB 2010 SANBORN HEAD V1.GDT 4/20/12

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: North Country Environmental Services, Inc.
Location: Bethlehem, New Hampshire
Project No.: 1003.07

Log of Monitoring Well B-922L

Ground Elevation: Not Available

Drilling Method: Mini Sonic Model 1421 Track Rig with 6" Casing

Sampling Method: 4" ID Core Barrel

Drilling Company: Boart Longyear
Foreman: K. Regan
Date Started: 01/23/12 Date Finished: 01/25/12
Logged By: D. Porter Checked By: P. Rydel

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
01/23/12	15:45	6.5'	Ground Surface	40'	40'	~5 minutes
01/24/12	07:50	12.8'	Ground Surface	40'	40'	~18 hours
01/24/12	13:55	15.15'	Top of PVC	N/A	Well Installed	~4 hours
01/25/12	07:20	15.22'	Top of PVC	N/A	Well Installed	~22 hours

Depth (ft)	Sample Information: Sample No.	Depth (ft)	Pen/Rec (ft)	Field Testing Data	Stratum: Log	Description	Geologic Description	Well Diagram	Well Description
72							samples because of the rotosonic drilling technique. 2. Approximately 320 gallons of potable water was used during drilling operations.		
74									
76									
78									
80									
82									
84									
86									
88									
90									
92									
94									
96									

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NORTH COUNTRY ENVIRONMENTAL SERVICES, INC.
STAGE V LANDFILL EXPANSION

Bethlehem, New Hampshire

Construction Drawings

January 2015

Sheet Index

1. Cover Sheet
2. Existing Conditions & Overall Site Plan
3. Proposed Overall Site Plan
4. Existing Conditions, Waste Excavation, & Demolition Plan
5. 2015 Work Plan
6. Proposed Secondary Liner Grading Plan
7. Proposed Primary Drainage Stone Grading Plan
8. Proposed Detention Pond 5 & 6 Grading Plan
9. Erosion Control and Site Layout Plan
10. Landfill Cross Sections
11. Details - Landfill
12. Details - Sump Modification & Construction
13. Details - Riser Modification & Construction
14. Details - Site Work
15. Details - Erosion Control
16. Details - Temporary Environmental Controls

Locus Plan

Prepared By:

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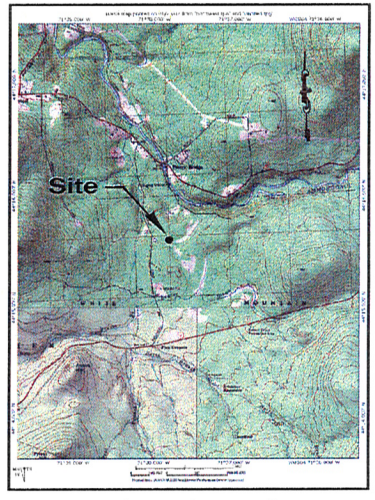
Prepared For:

north country ENVIRONMENTAL SERVICES
Bethlehem, New Hampshire 03574



Project Location

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Plan References:

The horizontal and vertical locations of all underground/buried features including, but not limited to leachate collection pipes, liner location, forcemain, culverts, tanks, sumps, and utilities were obtained from the following plans:

A. "Record Drawings, 1987 Construction Sanco Landfill Expansion, Phase I Construction" prepared for Sanco, Inc. by Kimball Chase Company, Inc. of Portsmouth, New Hampshire dated March 25, 1988. (Stage I Phase I)

B. "Record Drawings 1988/1989 Construction" prepared for Consumat Sanco, Inc. by Goldberg–Zoino & Associates, Inc. dated March 1990. (Stage I Phase II and Stage I Phase III)

C. "Phase IV – Record Drawings" prepared for Consumat Sanco, Inc. by Goldberg–Zoino & Associates, Inc. dated January 1993. (Stage I Phase IV)

D. "Stage II Phase II Record Drawings" prepared for North Country Environmental Services, Inc. by Sanborn, Head & Associates of Concord, New Hampshire dated March 1999. (Stage II Phase II)

E. "Stage III Construction Record Drawings" prepared for North Country Environmental Services, Inc. by Sanborn, Head & Associates of Concord, New Hampshire dated December 2000. (Stage III)

F. "Record Drawings, Stage III Gas System Modifications" prepared for North Country Environmental Services, Inc. by Sanborn, Head & Associates of Concord, New Hampshire dated July 2005.

G. "Stage IV Phase I Construction Drawings" prepared for North Country Environmental Services, Inc. by Sanborn, Head & Associates, Inc. of Concord, New Hampshire dated July 2005 and revised April 2006. (Stage IV Phase I)

H. "Interim Stage IV Phase I Construction Record Drawings" prepared for North Country Environmental Services, Inc. by Sanborn, Head & Associates of Concord, New Hampshire dated August 2006. (Stage IV Phase I)

I. "2007 Landfill Gas Improvements Record Drawings" prepared for North Country Environmental Services, Inc. by CMA Engineers, Inc. of Portsmouth, New Hampshire dated April 2008.

J. "Stage IV Phase I Overlay Liner Construction Record Drawings" prepared for North Country Environmental Services, Inc. by CMA Engineers, Inc. of Portsmouth, New Hampshire dated August 2008.

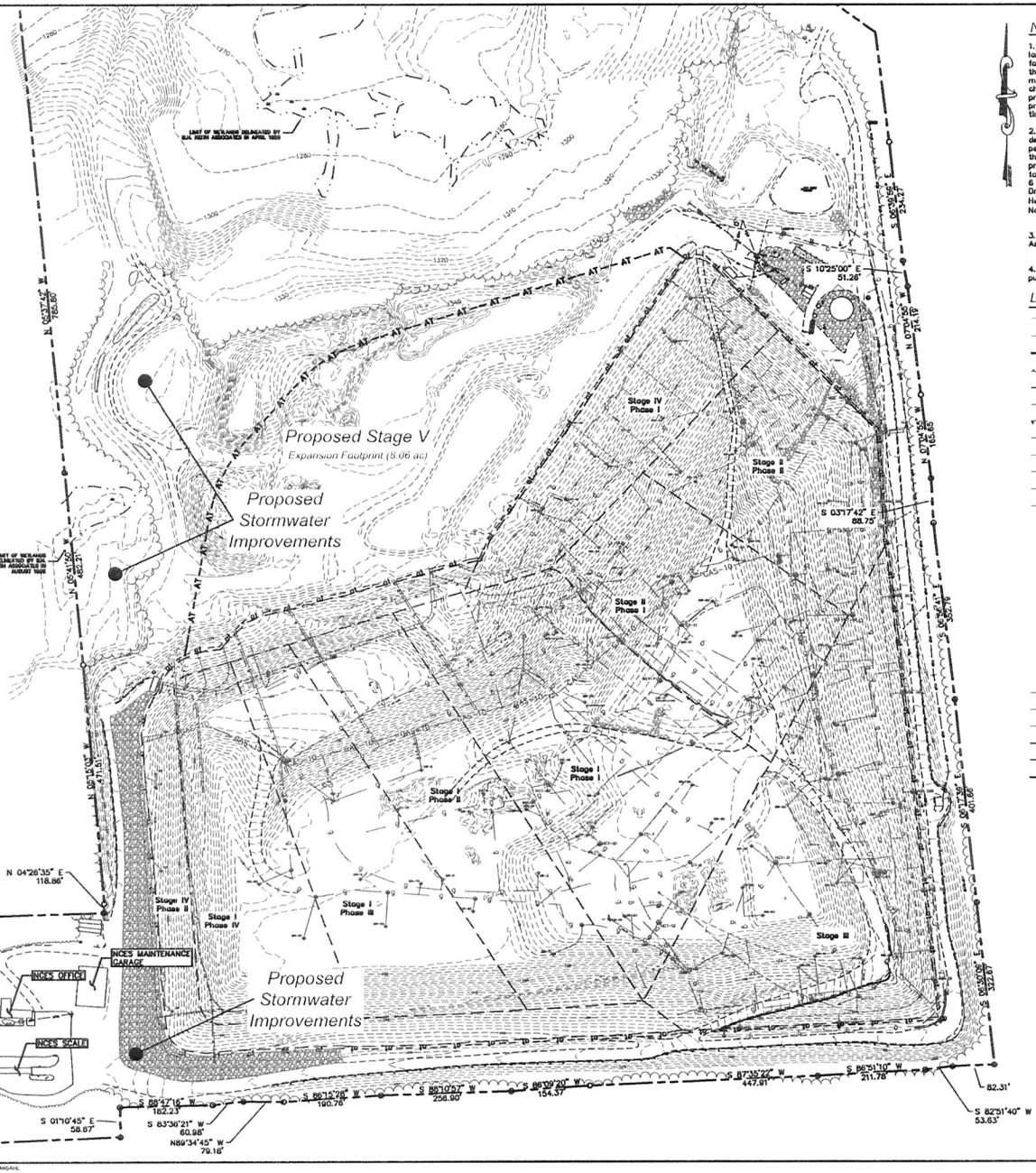
K. "Leachate Management Improvements Record Drawings" prepared for North Country Environmental Services, Inc. by CMA Engineers, Inc. of Portsmouth, New Hampshire dated February 2009.

L. "Stage IV Phase II–A Construction Record Drawings" prepared for North Country Environmental Services, Inc. by CMA Engineers, Inc. of Portsmouth, New Hampshire dated February 2012.

M. "Property Boundary Plan" by Horizons Engineering of Littleton, New Hampshire dated April 2012.

N. Boundary line information taken from Horizons Engineering, Inc. plan titled "A Minor Lot Line Adjustment Plan for North Country Environmental Services, Inc. Between Tax Map 419 Lots 21 & 22" dated February 2012.

O. "Stage IV Phase II–B Construction Record Drawings" prepared for North Country Environmental Services, Inc. by CMA Engineers, Inc. of Portsmouth, New Hampshire dated November 2013.



Notes:

1. This facility is an active landfill. Grades within the landfill footprint will change as filling progresses. The footprint of proposed Stage V is located in the vicinity of the common borrow pit containing virgin and stockpiled materials. Grades within the common borrow pit will change due to material use and stockpiles will be relocated prior to landfill construction. Proposed grades outside the proposed anchor trench will change based on topography at time of construction.

2. Existing topography shown within the treeline is developed from the August 19, 2014 aerial photogrammetry performed by Eastern Topographics. Topography north of the treeline is taken from the Stage IV Design Drawings prepared by SHA and dated March 2002. Existing topography shown in the area of Proposed Detention Pond 6 is approximate and based on Sheet 1A of the Record Drawings for Stage I of the landfill prepared by Sanborn, Head and Associates, Inc. dated December 1998 (Revised November 1999).

3. Existing limit of wetlands were delineated by B.H Keith Associates in August 1995 and April 1999.

4. Proposed features on this plan are for reference purposes only. See following sheets for additional detail.

Legend:

- Existing 2' Contour
- Existing 10' Contour
- Existing Property Line
- Existing Tree Line
- Existing Limit of Wetland
- Existing Edge of Gravel
- Existing Retaining Wall
- Existing Edge of Pond
- Existing Primary Leachate Pipe
- Existing Secondary Leachate Pipe
- Existing Leachate Force Main
- Existing Overhead Electric
- MW 403U Existing Monitoring Well
- Existing Secondary Leachate Collection System Manhole/Pump Station
- Existing Primary Leachate Collection System Manhole/Pump Station
- Existing Leak Detection Manhole
- P2 TH Existing Valves
- GP-14 Existing Gas Probe
- SVP-17 Existing Soil Vapor Probe
- GW-8 Existing Gas Extraction Well and Wellhead
- GV-14 Existing Gas Vent
- Existing Gas Line
- Existing Underground Electric
- Existing Fence
- AT Existing Anchor Trench
- Existing Limit of Waste
- AT Proposed Anchor Trench

1	Issued for NHDES Type I Perm. Modification	JAN. 2015

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DATE JAN. 2015	DESIGNED RJG/BWS/AJS		
PROJECT NO. E33	DRAWN BY BWS/AJS		
FILE NAME E33P14-1 Dwg.	REVIEWED BY RJG		

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Existing Conditions & Overall Site Plan

Drawing no. 2

of sheets 2 of 10

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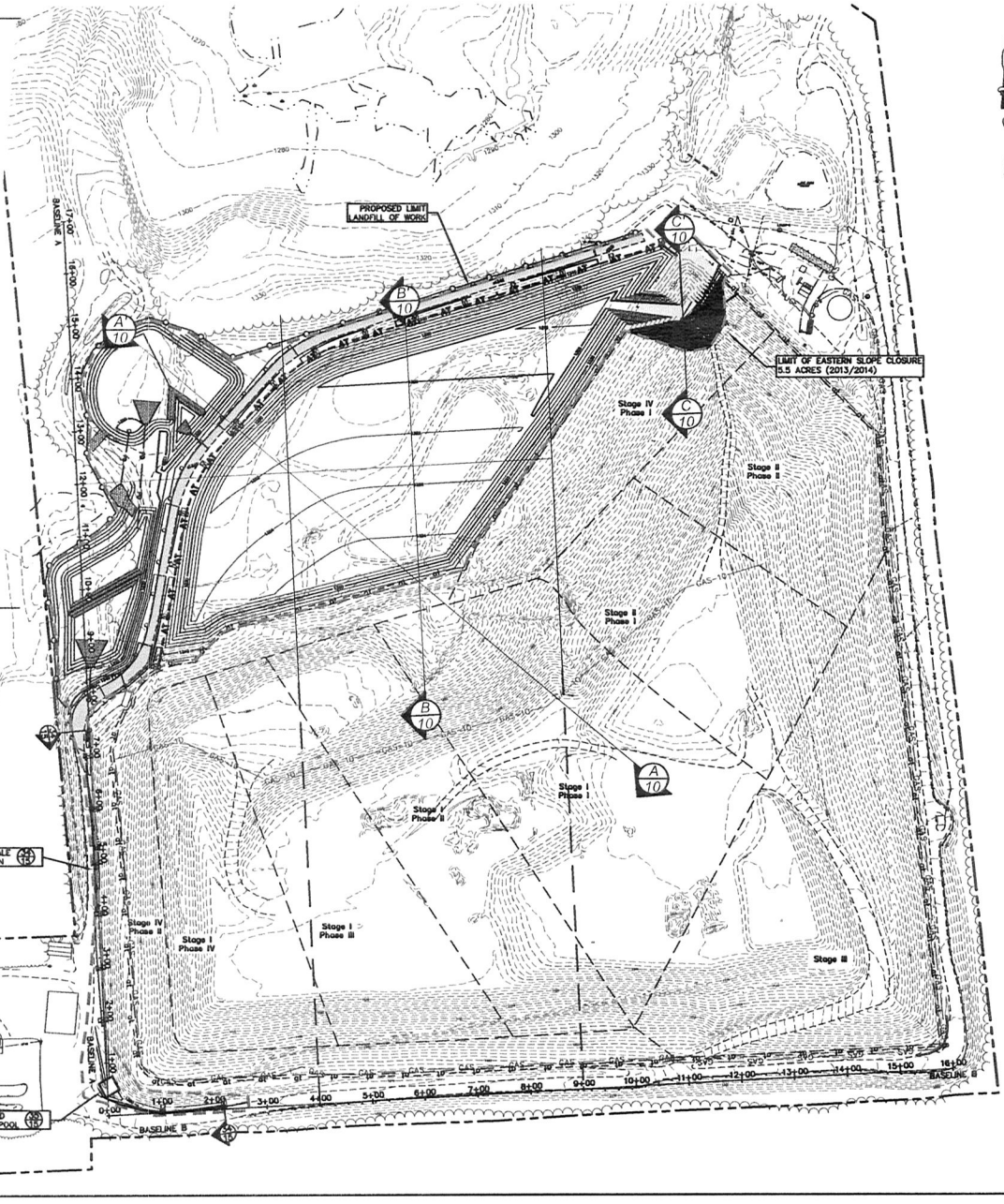
2015 Construction Sequence Notes

1. Establish vertical and horizontal control.
2. Install and maintain sedimentation and erosion controls as specified and as shown on Sheet 9.
3. Install new gas header condensate loop over Stage VI Phase I (See Sheet 4).
4. Decommission existing monitoring wells, gas header pipe, culverts and overhead electric per specifications.
5. Clear and grub and remove existing topsoil from limits of work to area designated by owner.
7. Install temporary forcemain as depicted on Sheet 4.
8. Complete excavation to proposed Stage V subgrade elevation and stockpile excavated soils at location determined by Owner (not more than 1 mile one-way). Construct silt fence perimeter around stockpiles.
9. Excavate and relocate waste (area designated by owner not more than 1 mile one-way) in Stage IV Phase I to access Stage IV Phase I sump area.
10. Construct secondary stormwater containment wall after primary liner demo in waste excavation area (weld flap to existing Stage IV Phase I liner.
11. Construct perimeter berm.
12. Construct stormwater improvements including Detention Ponds 5 and 6, expansion of the western swale and plunge pool.
13. Construct gas header modifications in waste relocation area and install temporary LFG collectors and temporary gas collection tarp.
14. Install 12" screened till layer to the limit shown on Sheet 5.
15. Install GCL layer where secondary leachate piping is to be installed (base areas only) and in sump area.
16. Install 60-mil HDPE secondary liner to the limit shown on Sheet 5 and weld to existing Stage IV secondary liner.
17. Install secondary drainage geocomposite layer to limit of secondary stormwater containment wall and the limit shown on Sheet 5.
18. Install secondary leachate piping to the limit shown on Sheet 5 – including second layer of drainage geocomposite, secondary pump station manhole and tie in secondary forcemain to Stage IV Phase I Side Riser Building.
19. Install 3/4" stone and gravel layers over secondary leachate piping.
20. Install 12" drainage sand layer to limit of secondary stormwater containment wall and the limit shown on Sheet 5.
21. Install GCL layer where primary leachate piping is to be installed (base areas only).
22. Install 60-mil HDPE primary liner to limit of secondary stormwater containment wall and the limit shown on Sheet 5.
23. Remove secondary stormwater containment wall and connect Stage V secondary drainage geocomposite to Stage IV Phase I secondary drainage geocomposite.
24. Construct primary stormwater containment wall.
25. Weld Stage V primary liner to Stage IV primary liner.
26. Install primary drainage geocomposite to limit of primary stormwater containment wall and the limit shown on Sheet 5.
27. Install phase separation berm.
28. Install sump in northeast corner of Phase II cell to pump accumulated stormwater.
29. Install primary leachate piping, including second layer of drainage geocomposite, to the limit shown on Sheet 5 and connect Stage V leachate collection pipe to Stage IV Phase I sump riser.
30. Install 3/4" stone over primary leachate piping.
29 Install 3" HDPE forcemain, 14" HDPE gas header pipe, condensate trap, valve and riser to Phase I Project limit. Provide end caps for future Phase II tie in.
30. Install 18" stone layer over primary drainage geocomposite to the limit shown on Sheet 5.
31. Loam and seed disturbed areas outside of anchor trench.
32. Site cleanup and demobilization.

2016 Construction Sequence Notes

1. Establish vertical and horizontal control.
2. Install and maintain sedimentation and erosion controls as specified and as shown on Sheet 9.
3. Pump any accumulated stormwater from the Stage V excavation area and discharge to existing sediment forebay of Detention Ponds 4, 5 or 6.
4. Inspect 2015 construction work and make repairs as necessary.
5. Demolish existing Geokon Unit.
6. Install 12" screened till layer.
7. Install GCL layer where secondary leachate piping is to be installed (base areas only).
8. Install 60-mil HDPE secondary liner and weld to existing Stage IV secondary liner.
9. Install secondary drainage geocomposite layer
10. Install secondary leachate piping including second layer of drainage geocomposite.
11. Install 3/4" stone and gravel layers over secondary leachate piping.
12. Install 12" drainage sand layer.
13. Install GCL layer where primary leachate piping is to be installed (base areas only).
14. Install 60-mil HDPE primary liner and weld to existing Phase IV primary liner.
15. Install primary drainage geocomposite and tie into existing Stage IV drainage geocomposite.
16. Install primary leachate piping.
17. Install perimeter 3" leachate forcemain and 14" HDPE LFG header pipe, condensate trap, valves and risers.
18. Demolish existing leachate forcemain and associated structures.
19. Install 18" stone layer over primary drainage geocomposite.
20. Loam and seed disturbed areas.
21. Site cleanup and demobilization.



Notes:

1. Existing topography shown within the treeline is developed from the August 19, 2014 aerial photogrammetry performed by Eastern Topographics. The topography has been modified to depict approximate post-stockpile surface grades on this plan. Topography north of the treeline is taken from the Stage IV Design Drawings prepared by SHA and dated March 2002. Existing topography shown in the area of Proposed Detention Pond 5 is approximate and based on Sheet 1A of the Record Drawings for Stage I of the landfill prepared by Sanborn, Head and Associates, Inc. dated December 1996 (Revised November 1999).
2. Existing limit of wetlands were delineated by B.H Keith Associates in August 1995 and April 1999.
3. Proposed features on this plan are for reference purposes only. See following sheets for additional detail.
4. Proposed topography shown within the proposed Stage V landfill expansion on this plan are top of secondary liner.
5. Construction baselines and section alignments shown on this sheet are used for landfill cross sections on Sheet 10.

Legend:

- Existing 2' Contour
- Existing 10' Contour
- Existing Property Line
- Existing Tree Line
- Existing Limit of Wetland
- Existing Guardrail
- Existing Edge of Gravel
- Existing Retaining Wall
- Existing Edge of Pond
- Existing Primary Leachate Pipe
- Existing Secondary Leachate Pipe
- Existing Leachate Force Main
- Existing Overhead Electric
- MW 403U Existing Monitoring Well
- Existing Secondary Leachate Collection System Manhole/Pump Station
- Existing Primary Leachate Collection System Manhole/Pump Station
- Existing Leak Detection Manhole
- Existing Valves
- PZ TR
- GP-14 Existing Gas Probe
- SVP-17 Existing Soil Vapor Probe
- GW-8 Existing Gas Extraction Well and Wellhead
- GV-14 Existing Gas Vent
- Existing Gas Line
- Existing Underground Electric
- Existing Fence
- Existing Anchor Trench
- Existing Limit of Waste
- Proposed Anchor Trench
- Proposed Limit of Work
- Proposed 10' Contour
- Proposed 2' Contour
- Proposed Gravel Road
- Proposed Drainage Pipe
- Proposed Waste Excavation
- Proposed Silt Fence
- Proposed Stone Check Dam

1	Revised to NHDES Tier I Permit Modification	JAN 2015	RJG

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DATE JAN 2015	DESIGNED RJG & BKS & AJS	DRAWN BY BKS & AJS	
PROJECT NO. 833		APPROVED RJG	
FILE NO. 833-01-01-01			SCALE 1" = 100'

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Proposed Overall Site Plan

drawing no. 3
sheet 1 of 16

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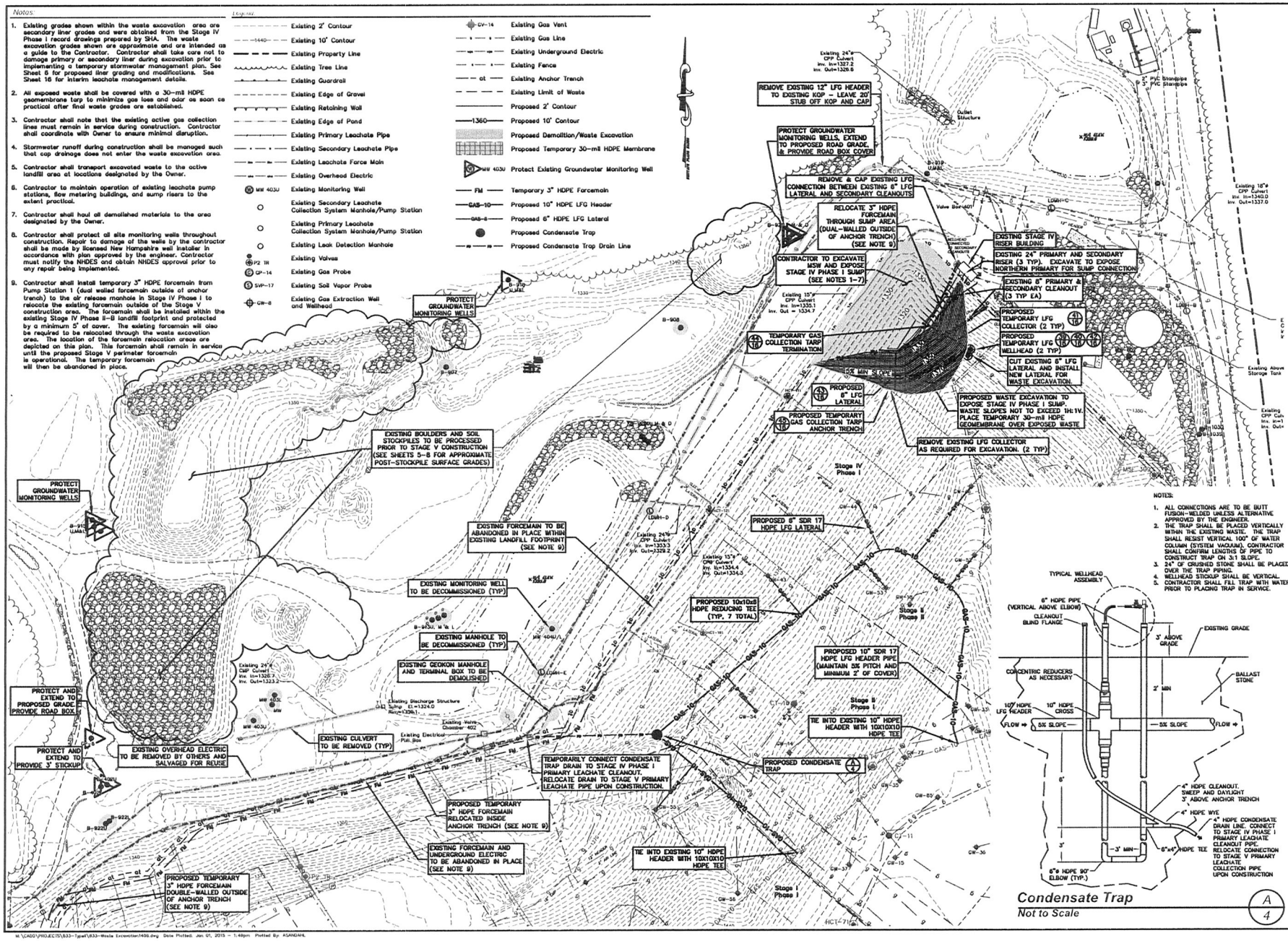
Notes:

1. Existing grades shown within the waste excavation area are secondary liner grades and were obtained from the Stage IV Phase I record drawings prepared by SHA. The waste excavation grades shown are approximate and are intended as a guide to the Contractor. Contractor shall take care not to damage primary or secondary liner during excavation prior to implementing a temporary stormwater management plan. See Sheet 6 for proposed liner grading and modifications. See Sheet 16 for interim leachate management details.
2. All exposed waste shall be covered with a 30-mil HDPE geomembrane tarp to minimize gas loss and odor as soon as practical after final waste grades are established.
3. Contractor shall note that the existing active gas collection lines must remain in service during construction. Contractor shall coordinate with Owner to ensure minimal disruption.
4. Stormwater runoff during construction shall be managed such that cap drainage does not enter the waste excavation area.
5. Contractor shall transport excavated waste to the active landfill area at locations designated by the Owner.
6. Contractor to maintain operation of existing leachate pump stations, flow metering buildings, and sump risers to the extent practical.
7. Contractor shall haul all demolished materials to the area designated by the Owner.
8. Contractor shall protect all site monitoring wells throughout construction. Repair to damage of the wells by the contractor shall be made by licensed New Hampshire well installer in accordance with plan approved by the engineer. Contractor must notify the NHDES and obtain NHDES approval prior to any repair being implemented.
9. Contractor shall install temporary 3" HDPE forcemain from Pump Station 1 (dual walled forcemain outside of anchor trench) to the air release manhole in Stage IV Phase I to relocate the existing forcemain outside of the Stage V construction area. The forcemain shall be installed within the existing Stage IV Phase II-B landfill footprint and protected by a minimum 5' of cover. The existing forcemain will also be required to be relocated through the waste excavation area. The location of the forcemain relocation areas are depicted on this plan. This forcemain shall remain in service until the proposed Stage V perimeter forcemain is operational. The temporary forcemain will then be abandoned in place.

Legend:

- Existing 2' Contour
- Existing 10' Contour
- Existing Property Line
- Existing Tree Line
- Existing Guardrail
- Existing Edge of Gravel
- Existing Retaining Wall
- Existing Edge of Pond
- Existing Primary Leachate Pipe
- Existing Secondary Leachate Pipe
- Existing Leachate Force Main
- Existing Overhead Electric
- MW 403U Existing Monitoring Well
- Existing Secondary Leachate Collection System Manhole/Pump Station
- Existing Primary Leachate Collection System Manhole/Pump Station
- Existing Leak Detection Manhole
- P2 TR Existing Valves
- GP-14 Existing Gas Probe
- SVP-17 Existing Soil Vapor Probe
- GW-8 Existing Gas Extraction Well and Wellhead
- GV-14 Existing Gas Vent
- Existing Gas Line
- Existing Underground Electric
- Existing Fence
- at Existing Anchor Trench
- Existing Limit of Waste
- Proposed 2' Contour
- 1360 Proposed 10' Contour
- Proposed Demolition/Waste Excavation
- Proposed Temporary 30-mil HDPE Membrane
- MW 403U Protect Existing Groundwater Monitoring Well
- FM Temporary 3" HDPE Forcemain
- GAS-10 Proposed 10" HDPE LFG Header
- GAS-6 Proposed 6" HDPE LFG Lateral
- Proposed Condensate Trap
- Proposed Condensate Trap Drain Line



NOTES:

1. ALL CONNECTIONS ARE TO BE BUTT FUSION-WELDED UNLESS ALTERNATIVE APPROVED BY THE ENGINEER.
2. THE TRAP SHALL BE PLACED VERTICALLY WITHIN THE EXISTING WASTE. THE TRAP SHALL RESIST VERTICAL 100" OF WATER COLUMN (SYSTEM VACUUM). CONTRACTOR SHALL CONFIRM LENGTHS OF PIPE TO CONSTRUCT TRAP ON 3:1 SLOPE.
3. 24" OF CRUSHED STONE SHALL BE PLACED OVER THE TRAP PIPING.
4. WELLHEAD STICKUP SHALL BE VERTICAL.
5. CONTRACTOR SHALL FILL TRAP WITH WATER PRIOR TO PLACING TRAP IN SERVICE.

Condensate Trap

Not to Scale

A/4

CMA ENGINEERS
CIVIL/ENVIRONMENTAL ENGINEERS

No.	Revisions/UNDES Tier I Permit Modification	Date	By
1		JAN 2015	RJG

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Existing Conditions, Waste Excavation & Demolition Plan

Drawing no. 4

Sheet 4 of 16

Date JAN 2015 | Designed by RJG/EWS/AJS | Drawn by EWS/AJS | Approved by RJG | Scale 1" = 50'

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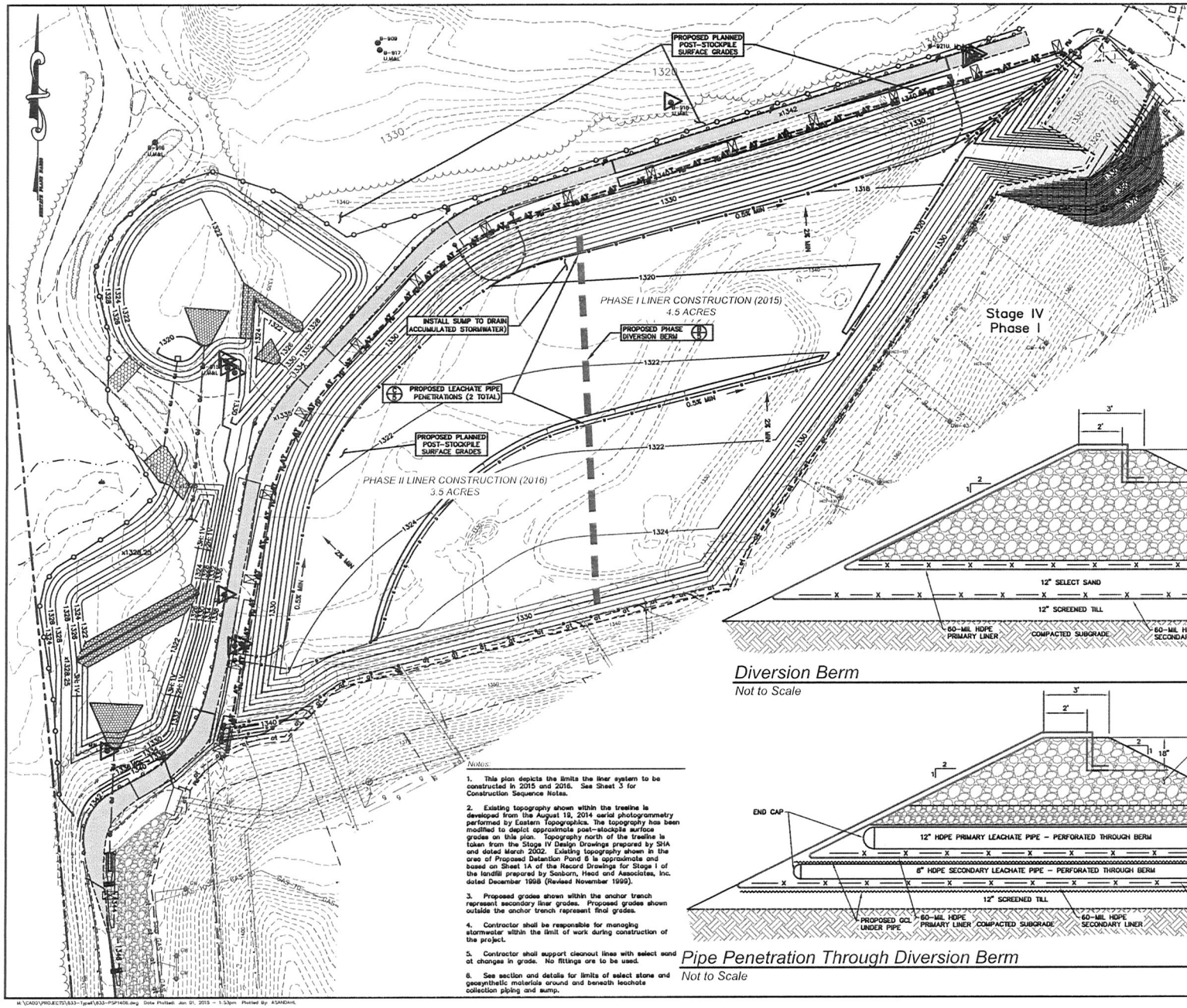
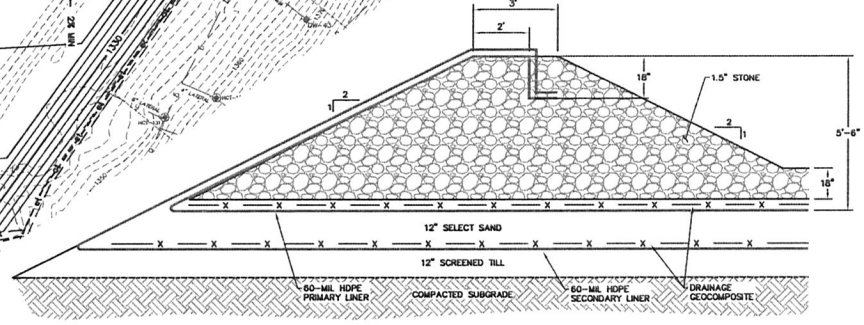
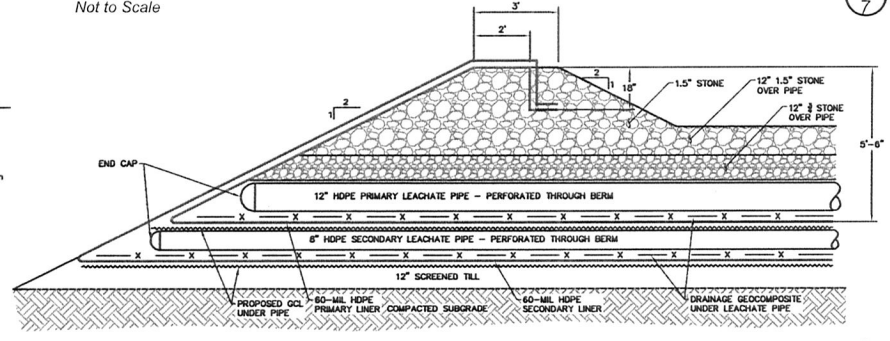




Diversion Berm

Not to Scale

B/7



Pipe Penetration Through Diversion Berm

Not to Scale

C/7

Notes:

1. This plan depicts the limits the liner system to be constructed in 2015 and 2016. See Sheet 3 for Construction Sequence Notes.
2. Existing topography shown within the treeline is developed from the August 19, 2014 aerial photogrammetry performed by Eastern Topographics. The topography has been modified to depict approximate post-stockpile surface grades on this plan. Topography north of the treeline is taken from the Stage IV Design Drawings prepared by SHA and dated March 2002. Existing topography shown in the area of Proposed Detention Pond 8 is approximate and based on Sheet 1A of the Record Drawings for Stage I of the landfill prepared by Sanborn, Head and Associates, Inc. dated December 1998 (Revised November 1999).
3. Proposed grades shown within the anchor trench represent secondary liner grades. Proposed grades shown outside the anchor trench represent final grades.
4. Contractor shall be responsible for managing stormwater within the limit of work during construction of the project.
5. Contractor shall support cleanout lines with select sand at changes in grade. No fittings are to be used.
6. See section and details for limits of select stone and geosynthetic materials around and beneath leachate collection piping and sump.

Issued for/Rev.	Date	By
1 Issued for NHDES Typ.II Permit Modification	JAN 2015	RJG

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STATE OF NEW HAMPSHIRE
RICHARD J. GUERIN
No. 9346
PROFESSIONAL ENGINEER

Designed by: KJB/BMS/AJS
Drawn by: BMS/AJS
Approved by: RJG
Date: JAN 2015
Project No.: 633
Filename: 1633-PSP1406.dwg

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings
2015 Work Plan

drawing no. 5
sheet 5 of 16

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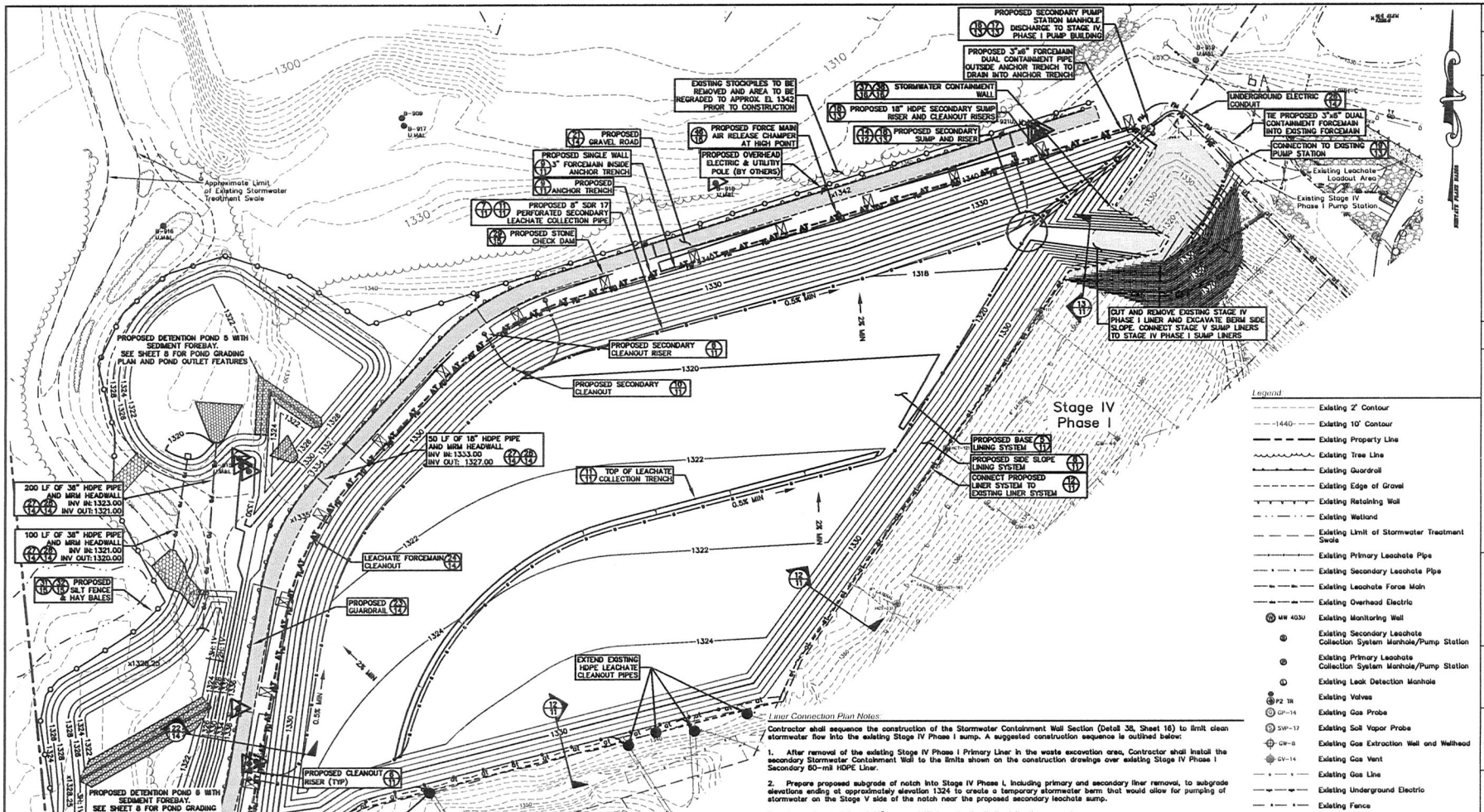

Legend:

- Existing 2' Contour
- Existing 10' Contour
- Existing Property Line
- Existing Tree Line
- Existing Guardrail
- Existing Edge of Gravel
- Existing Retaining Wall
- Existing Wetland
- Existing Limit of Stormwater Treatment Swale
- Existing Primary Leachate Pipe
- Existing Secondary Leachate Pipe
- Existing Leachate Force Main
- Existing Overhead Electric
- MW 403U Existing Monitoring Well
- Existing Secondary Leachate Collection System Manhole/Pump Station
- Existing Primary Leachate Collection System Manhole/Pump Station
- Existing Leak Detection Manhole
- PZ TR Existing Valves
- GP-14 Existing Gas Probe
- SVP-17 Existing Soil Vapor Probe
- GW-8 Existing Gas Extraction Well and Wellhead
- GV-14 Existing Gas Vent
- Existing Gas Line
- Existing Underground Electric
- Existing Fence
- Existing Anchor Trench
- Existing Limit of Waste
- Proposed Secondary Liner 2' Contour
- 1330 Proposed Secondary Liner 10' Contour
- Proposed Anchor Trench
- Proposed Limit of Waste
- Proposed Secondary Leachate Pipe
- Proposed Primary Leachate Pipe
- Proposed Connection to Existing Liner
- PD Proposed Drainage Pipe
- Proposed Guardrail
- Proposed Silt Fence
- Proposed Gravel Road
- Proposed Stone Check Dam
- Interim Stormwater Management
- Proposed Well Protection

Notes:

1. Existing topography shown within the treeline is developed from the August 19, 2014 aerial photogrammetry performed by Eastern Topographics. The topography has been modified to depict approximate post-stockpile surface grades on this plan. Topography north of the treeline is taken from the Stage IV Design Drawings prepared by SHA and dated March 2002. Existing topography shown in the area of Proposed Detention Pond 6 is approximate and based on Sheet 1A of the Record Drawings for Stage I of the landfill prepared by Sanborn, Head and Associates, Inc. dated December 1998 (Revised November 1999).

2. Proposed grades shown within the anchor trench represent secondary liner grades. Proposed grades shown outside the anchor trench represent final grades.

3. Contractor shall be responsible for managing stormwater within the limit of work during construction of the project.

4. Contractor shall support cleanout lines with select sand at changes in grade. No fittings are to be used.

5. See section and details for limits of select stone and geosynthetic materials around and beneath leachate collection piping and sump.

Liner Connection Plan Notes:

Contractor shall sequence the construction of the Stormwater Containment Wall Section (Detail 3B, Sheet 16) to limit clean stormwater flow into the existing Stage IV Phase I sump. A suggested construction sequence is outlined below:

1. After removal of the existing Stage IV Phase I Primary Liner in the waste excavation area, Contractor shall install the secondary Stormwater Containment Wall to the limits shown on the construction drawings over existing Stage IV Phase I Secondary 60-mil HDPE Liner.

2. Prepare proposed subgrade of notch into Stage IV Phase I, including primary and secondary liner removal, to subgrade elevations ending at approximately elevation 1324 to create a temporary stormwater berm that would allow for pumping of stormwater on the Stage V side of the notch near the proposed secondary leachate sump.

3. Contractor shall install 12" screened till layer to the limit of the temporary berm.

4. Immediately prior to the installation of 60-mil HDPE secondary liner in this area, weather permitting, the contractor shall remove the temporary berm and install remainder of the 12" screened till layer to the limits of the cut Stage IV Phase I liner.

5. Liner Contractor shall install the Stage V 60-mil HDPE secondary liner and weld to the Stage IV Phase I secondary liner.

6. Contractor shall install secondary drainage geocomposite leaving enough new composite flapped over the containment wall to tie into Stage IV Phase I at a later date.

7. Contractor shall install 8" SDR 17 HDPE Secondary Leachate Piping.

8. Contractor shall install 12" Drainage Sand Layer over secondary drainage geocomposite to limit of secondary stormwater containment wall.

9. Contractor shall install 60-mil HDPE primary liner to limit of secondary stormwater containment wall.

10. Contractor shall remove the secondary stormwater containment wall, tie the Stage V secondary drainage composite to existing Stage IV Phase I secondary drainage geocomposite and fill remaining 12" Drainage Sand Layer.

11. Contractor shall install the Primary Stormwater Containment Wall to the limits shown on the construction drawings. Steps 10 and 11 shall be completed during dry weather over 1 to 3 days.

12. Liner Contractor shall install Stage V 60-mil primary liner and weld to the existing Stage IV Phase I primary liner.

13. Contractor shall install primary drainage geocomposite leaving enough new composite flapped over the containment wall to tie into Stage IV Phase I at a later date.

14. Contractor shall install 12" SDR 17 HDPE leachate pipe to limits shown, leaving out a section of pipe of sufficient length at the location of the primary leachate containment wall for connection to Stage IV Phase I at a later date.

15. Contractor shall install 18" 1.5" stone layer over Primary Drainage Geocomposite.

No.	Revision	Date	By
1	Issued for PDES Type I Permit Modification	JAN 2015	RJG

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Lowell Office: 50 Cambridge Street, Suite 1100, Lowell, MA 01852
Manchester, NH 03101
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info@cmaengineers.com www.cmaengineers.com

Date: JAN 2015
Designed by: RJG/BWS/AJS
Drawn by: BWS/AJS
Approved by: RJG
Scale: 1" = 100'

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Proposed Secondary Liner Grading Plan

Drawing no. 6
Sheet 6 of 15

M:\CADD\PROJECTS\633-Tjpa4\633-PSP1406.dwg Date Plotted: Jan 01, 2015 - 2:21pm Plotted By: ASANDAHL

Notes:

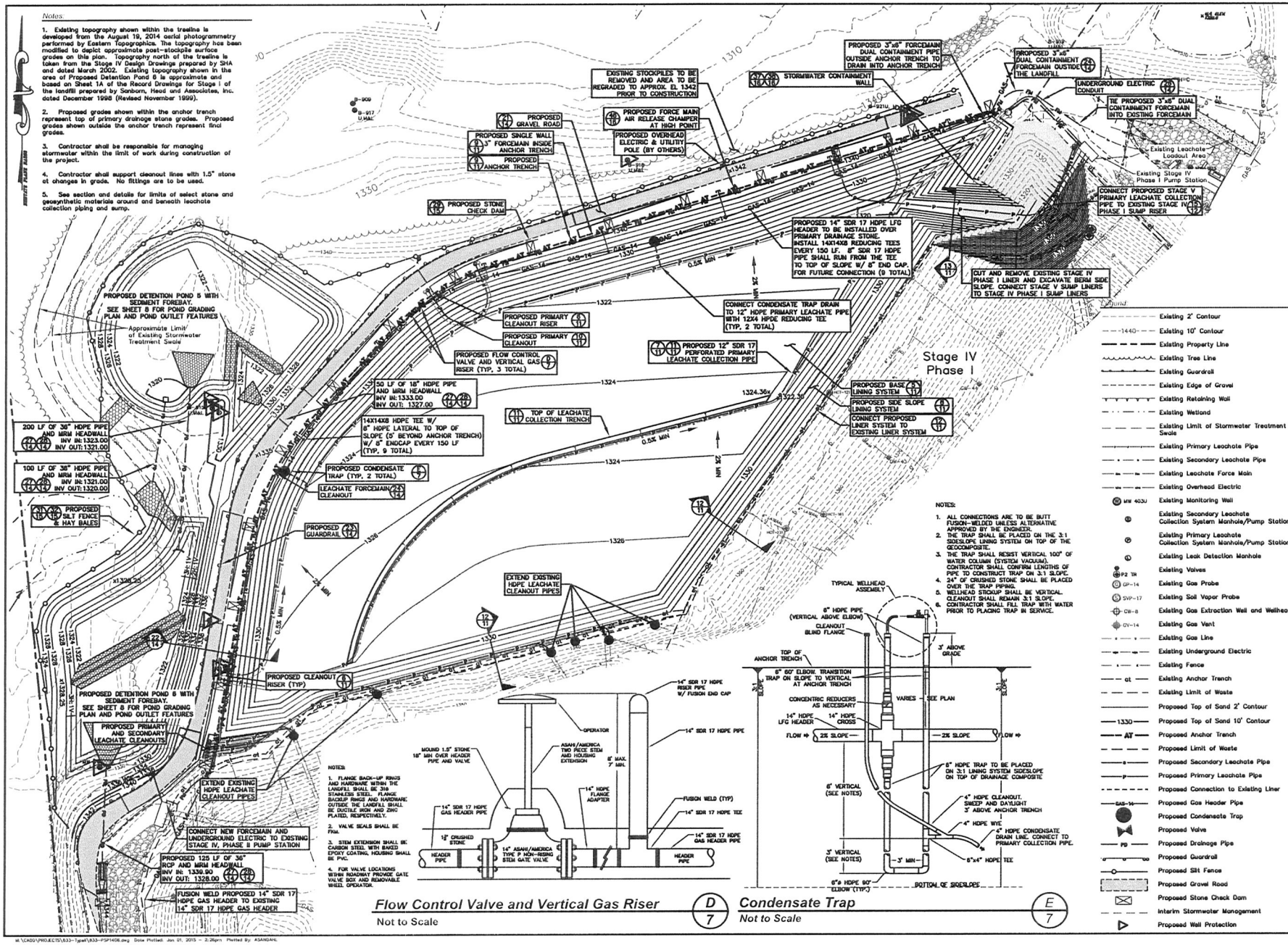
1. Existing topography shown within the treeline is developed from the August 19, 2014 aerial photogrammetry performed by Eastern Topographics. The topography has been modified to depict approximate post-stockpile surface grades on this plan. Topography north of the treeline is taken from the Stage IV Design Drawings prepared by SHA and dated March 2002. Existing topography shown in the area of Proposed Detention Pond 6 is approximate and based on Sheet 1A of the Record Drawings for Stage I of the landfill prepared by Sanborn, Head and Associates, Inc. dated December 1998 (Revised November 1999).

2. Proposed grades shown within the anchor trench represent top of primary drainage stone grades. Proposed grades shown outside the anchor trench represent final grades.

3. Contractor shall be responsible for managing stormwater within the limit of work during construction of the project.

4. Contractor shall support cleanout lines with 1.5" stone at changes in grade. No fittings are to be used.

5. See section and details for limits of select stone and geosynthetic materials around and beneath leachate collection piping and sump.



NOTES:

1. FLANGE BACK-UP RINGS AND HARDWARE WITHIN THE LANDFILL SHALL BE 316 STAINLESS STEEL. FLANGE BACKUP RINGS AND HARDWARE OUTSIDE THE LANDFILL SHALL BE DUCTILE IRON AND ZINC PLATED, RESPECTIVELY.
2. VALVE SEALS SHALL BE FKM.
3. STEM EXTENSION SHALL BE CARBON STEEL WITH BAKED EPOXY COATING. HOUSING SHALL BE PVC.
4. FOR VALVE LOCATIONS WITHIN ROADWAY PROVIDE GATE VALVE BOX AND REMOVABLE WHEEL OPERATOR.

Flow Control Valve and Vertical Gas Riser

Not to Scale

D / 7

NOTES:

1. ALL CONNECTIONS ARE TO BE BUTT FUSION-WELDED UNLESS ALTERNATIVE APPROVED BY THE ENGINEER.
2. THE TRAP SHALL BE PLACED ON THE 3:1 SIDESLOPE LINING SYSTEM ON TOP OF THE GEOCOMPOSITE.
3. THE TRAP SHALL RESIST VERTICAL 100" OF WATER COLUMN (SYSTEM VACUUM). CONTRACTOR SHALL CONFIRM LENGTHS OF PIPE TO CONSTRUCT TRAP ON 3:1 SLOPE.
4. 24" OF CRUSHED STONE SHALL BE PLACED OVER THE TRAP PIPING.
5. WELLHEAD STICKUP SHALL BE VERTICAL. CLEANOUT SHALL REMAIN 3:1 SLOPE.
6. CONTRACTOR SHALL FILL TRAP WITH WATER PRIOR TO PLACING TRAP IN SERVICE.

Condensate Trap

Not to Scale

E / 7

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THE STATE OF NEW HAMPSHIRE REGISTERED PROFESSIONAL ENGINEER

date	JAN 2015
project no.	E25
file name	11-PSP-4D-Rev.
designed by	RJG & BWS/AJS
drawn by	BWS/AJS
approved by	RJG
scale	1" = 50' (H) 1" = 5' (V)

1	Issued for NHDES Type I Permit Modification	JAN 2015	RJG

North Country Environmental Services
Bethlehem, NH

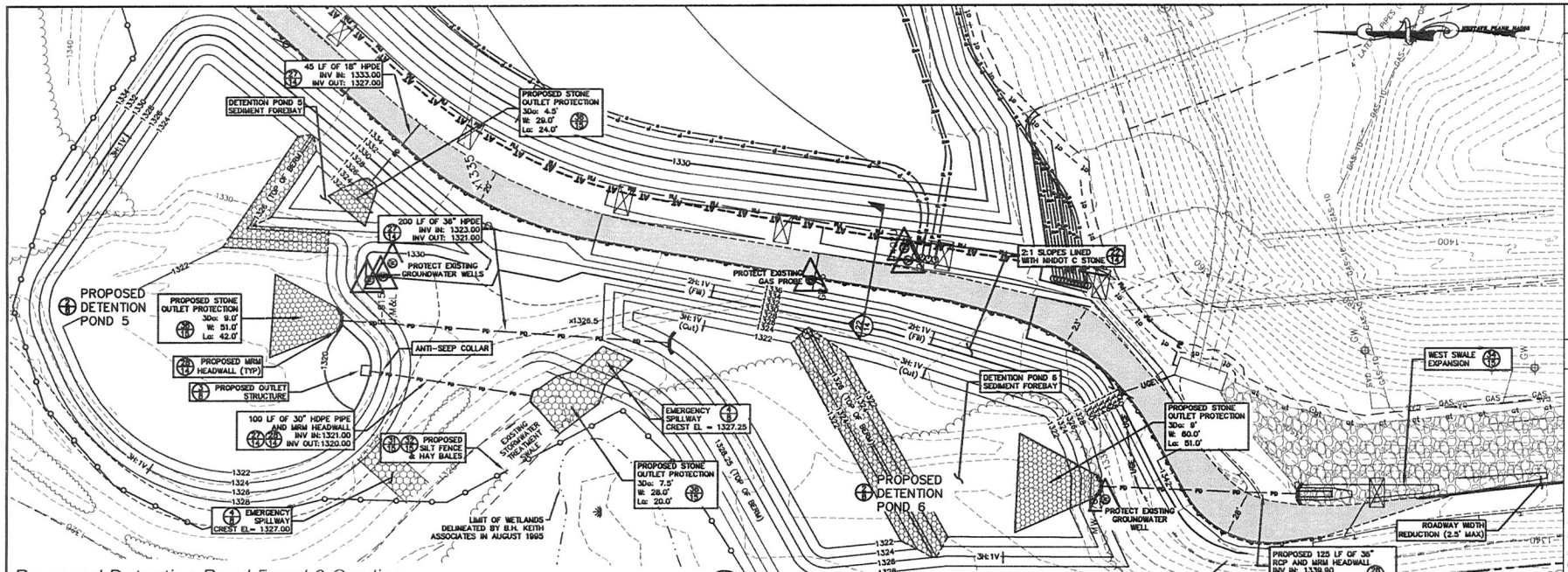
Stage V Landfill Expansion
Construction Drawings

Proposed Primary Drainage Stone Grading Plan

drawing no. 7

sheet 7 of 75

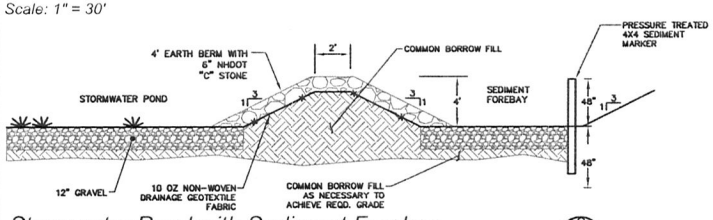
M:\CADD\PROJECTS\E33-Type4\E33-PSP140E.dwg Date Plotted: Jan 01, 2015 - 2:26pm Plotted By: ASANDAHL



Proposed Detention Pond 5 and 6 Grading

Scale: 1" = 30'

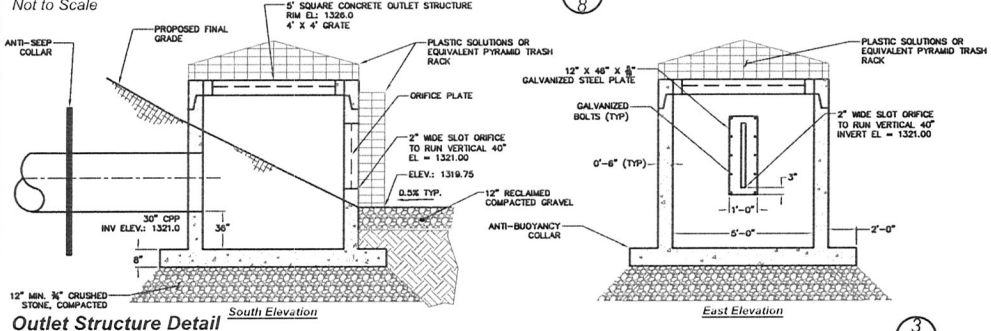
1/8



Stormwater Pond with Sediment Forebay

Not to Scale

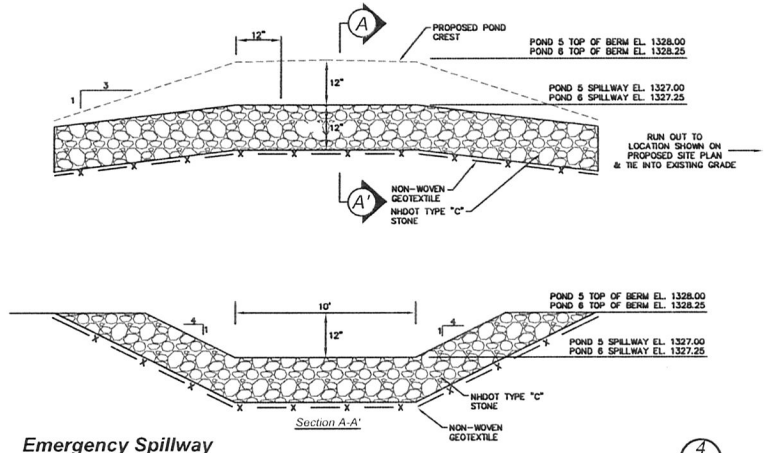
2/8



Outlet Structure Detail

Not to Scale

3/8



Emergency Spillway

Not to Scale

4/8

CMA ENGINEERS
CIVIL/ENVIRONMENTAL ENGINEERS

JAN. 2012 R.J.C.

designed by R.J.C./B.W.S./A.J.S.
drawn by B.W.S./A.J.S.
approved by R.J.C.
date JAN. 2012
project no. 833
file name 11-pgs-4-5.dwg
scale 1" = 30'

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Proposed Detention Pond 5 & 6 Grading Plan

drawing no. 8
sheet 8 of 15

M:\CADD\PROJECTS\833-1gpwt\833-PSP140E.dwg Date Plotted: Jan 01, 2013 – 2:32pm Plotted By: ASANDAHL

Erosion Control Notes:

1. Prior to construction and thereafter erosion control measures are to be implemented as noted. The smallest practical area of land should be exposed at any one time during development. When land is exposed during development, the exposure should be kept to the shortest practical period of time. Land should not be left exposed during the winter months.

2. Hay bale barriers shall be installed and maintained along limits of work where shown. Additional hay bales shall be added as required by the Engineer. Hay bales will be staked and maintained prior to and during construction until disturbed areas are covered with crushed gravel or have a healthy stand of grass.

3. All disturbed areas and side slopes which are finish graded with no further construction to take place shall be seeded and mulched within 72 hours. All seed, lime and fertilizer programs shall conform to all applicable sections of the specifications.

4. Any disturbed areas which are to be left temporarily, or longer than two weeks and which will be regraded later during construction, shall be machine hay mulched and seeded at the rate of 2 tons per acre. The smallest practical area shall be disturbed during construction, but in no case shall exceed 5-acres at any one time before disturbed areas are stabilized.

5. Avoid use of undisturbed areas whenever possible during construction. Construction traffic shall travel the roadbeds of existing and future roads.

6. Silt fence shall be installed & maintained where shown and additional silt fence added as required by the Engineer prior to any on-site grading or disturbance of existing surface materials. It should be maintained during and after development to remove sediment from runoff water and from land undergoing development. Where possible natural drainage ways should be utilized and left open to remove clean excess surface water. The silt fence is to be maintained and cleaned until all slopes have a healthy stand of grass.

7. Erosion control devices shall be inspected weekly and after every 0.5-in of rainfall.

8. All disturbed areas shall have a minimum of 4 inches of loam placed, before being seeded and mulched unless otherwise shown. Erosion control matting shall be placed on all slopes steeper than 3:1 and within grass lined swales as shown.

9. After all disturbed areas have been stabilized, the temporary erosion control measures are to be removed and accumulated sediment disposed of in an on site location designated by the Owner.

10. Baled hay and mulch shall be mowings of acceptable herbaceous growth, free from noxious weeds or woody stems, and shall be dry.

11. Silt fences shall be minimum of 36 inches high with the bottom of the fabric keyed into the ground (see detail). Posts shall be of wood or steel.

12. The erosion control devices shown on the Drawings and as specified in the specifications represent the minimum required for erosion control. The Contractor shall add to these devices any and all measures as required by the Engineer to effectively prevent migration of sediment from the work area.

13. All slopes and disturbed areas to be seeded shall comply with the NHDES Section 644 WF Seed Type 45.

14. Lime shall conform to NHDOT specifications, Div. 600, sec. 642 "Limestone". Limestone shall be applied by either the dry or hydraulic method as described in NHDOT Div 600, sec. 644.2.5. The amount of limestone applied should be based on evaluation of soil tests conducted by the contractor. The minimum rate of 2 tons per acre or 100 lbs per sq. ft. shall be applied if required.

15. Fertilizer to be used must be the equivalent of a 15-15-15 mixture and shall be reviewed by the Engineer. Fertilizer shall conform to NHDOT specifications Div. 600, Sec. 643 "Fertilizer for Grasses." Kinds and amounts of fertilizer should be based on evaluation of soil tests conducted by the contractor. The minimum amounts applied shall be as follows:

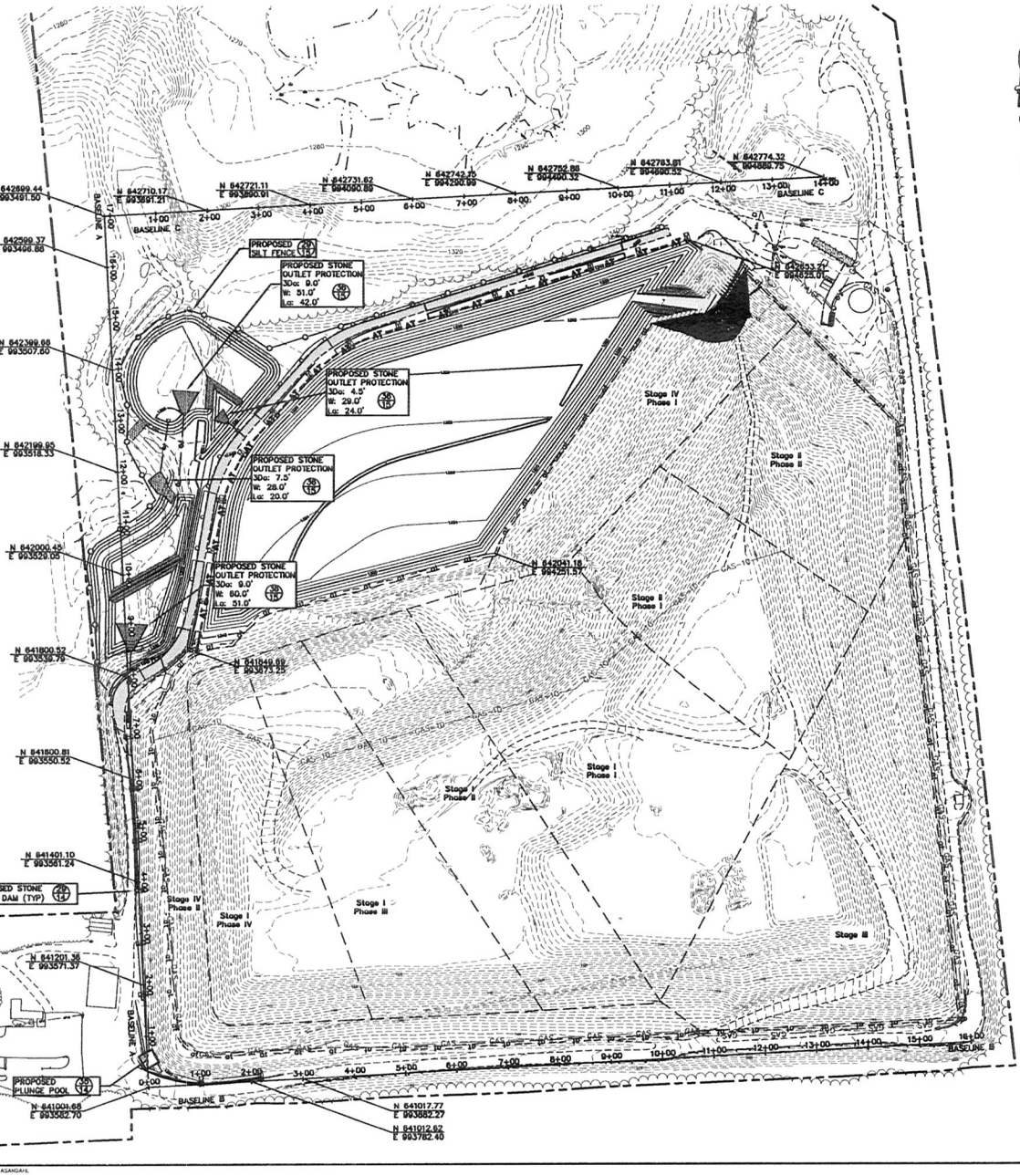
Nitrogen (N) 150 lbs per acre or 1.1 lbs per 1000 s.f.
Phosphate (P O) 100 lbs per acre or 2.2 lbs per 1000 s.f.
Potash (K O) 100 lbs per acre or 2.2 lbs per 1000 s.f.

(Note: This is the equivalent of 500 lbs per acre of 10-20-20 fertilizer or 1000 lbs per acre of 5-10-10)

16. All proposed swales must be stabilized prior to directing runoff to them.

17. All roadways to be stabilized within 72 hours of achieving finished grade.

18. All areas shall be stabilized within 45 days of initial disturbance. An area shall be considered stable if one of the following has occurred:
- Base course gravels have been installed in areas to be paved;
- A minimum of 85% vegetated growth has been established;
- A minimum of 3-in of non-erosive material such as stone or rip rap has been installed; or
- Erosion control blankets have been properly installed.



Winter Construction Notes:

Winter Construction notes prepared in accordance with Rule Env-Wq 1505.05

1. All proposed vegetated areas which do not exhibit a minimum of 85% vegetative growth by November 30th, or which are disturbed after November 30th, shall be stabilized by seeding and installing bonded fiber matrix and soil stabilizer at a rate of 3,000 lb/acre and 10 gallons/acre respectively for stabilization over winter. The seeding and mulching shall not occur over accumulated snow or on frozen ground and shall be completed in advance of thaw or spring melt events;

2. All ditches or swales which do not exhibit a minimum of 85% vegetative growth by November 30th, shall be stabilized temporarily with stone or erosion control blankets appropriate for the design flow conditions; and

3. After November 30th, incomplete road or parking surfaces, where work has stopped for the winter season, shall be protected with a minimum of 3 inches of crushed gravel per NHDOT Item 304.3.

Legend:

- Existing 2' Contour
- Existing 10' Contour
- Existing Property Line
- Existing Tree Line
- Existing Limit of Wetland
- Existing Guardrail
- Existing Edge of Gravel
- Existing Retaining Wall
- Existing Edge of Pond
- Existing Primary Leachate Pipe
- Existing Secondary Leachate Pipe
- Existing Leachate Force Main
- Existing Overhead Electric
- MW 403U — Existing Monitoring Well
- Existing Secondary Leachate Collection System Manhole/Pump Station
- Existing Primary Leachate Collection System Manhole/Pump Station
- Existing Leak Detection Manhole
- PZ TR — Existing Valves
- GP-14 — Existing Gas Probe
- SVP-17 — Existing Soil Vapor Probe
- GW-8 — Existing Gas Extraction Well and Wellhead
- GV-14 — Existing Gas Vent
- Existing Gas Line
- Existing Underground Electric
- Existing Fence
- Existing Anchor Trench
- Existing Limit of Waste
- Proposed Anchor Trench
- Proposed Limit of Work
- 1440 — Proposed 10' Contour
- Proposed 2' Contour
- Proposed Gravel Road
- PD — Proposed Drainage Pipe
- Proposed Waste Excavation
- Proposed Stone Check Dam
- Proposed Silt Fence

	JAN. 2013	RJG
Issued for NHDES Type I Permit Modification		

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Date	JAN. 2013
Project No.	833
Reviewed by	RJG
Drawn by	BWS/AJS
Approved by	RJG
Scale	1" = 100'

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

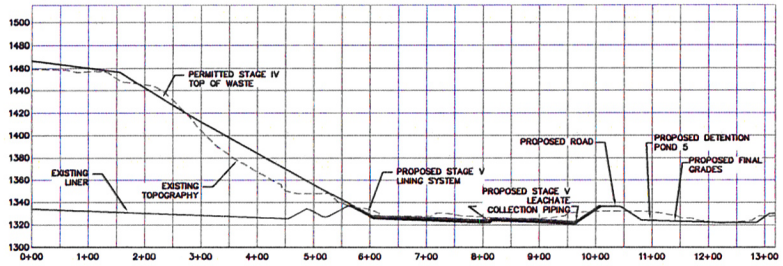
Erosion Control and
Site Layout Plan

Drawing No. 9

Sheet 9 of 16

Notes:

1. Section Lines are shown on Sheet 3



Section A-A'
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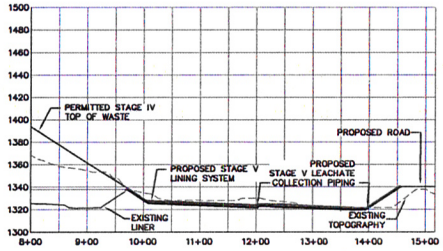
Vertical: 1" = 50'



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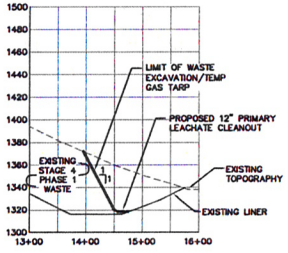

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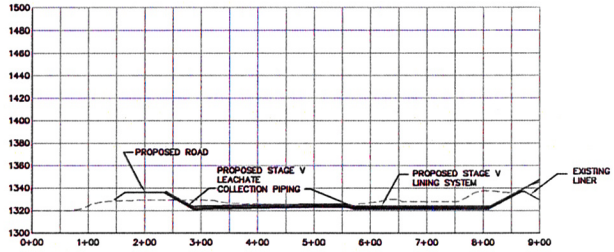

Baseline A Station 12+00
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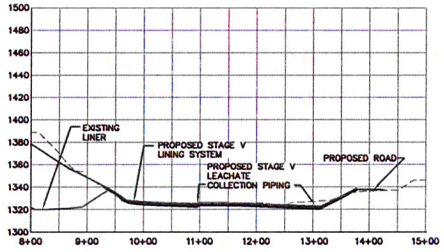
Vertical: 1" = 50'



Baseline B Station 4+00
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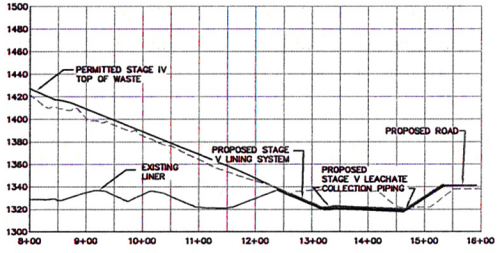
Vertical: 1" = 50'



Baseline B Station 9+00
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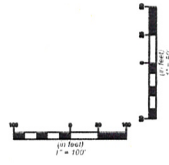
Vertical: 1" = 50'



1	Issued for NHDES Type I Permit Modification	JAN. 2015	RJG
No.	revision	date	By

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date JAN. 2015
project no. 833
file name
CTY-Xsections1408-A19.dwg
designed by RJG/BWS/AJS
drawn by BWS/AJS
approved by RJG
scale NONE

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Landfill Cross Sections

drawing no.
10

sheet 10 of 15

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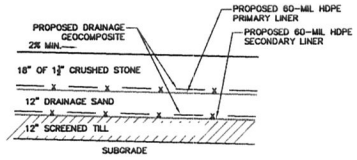
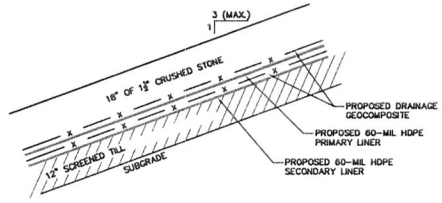


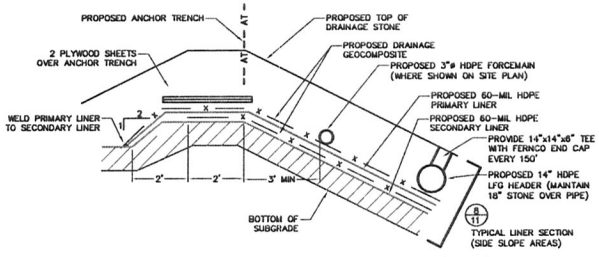
Typical Liner Section (Base Areas)

Not to Scale (5/6) (5/7)



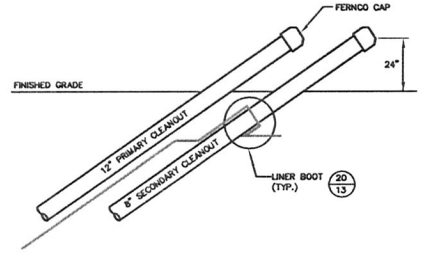
Typical Liner Section (Side Slope Areas)

Not to Scale (8/6) (8/7) (8/14)



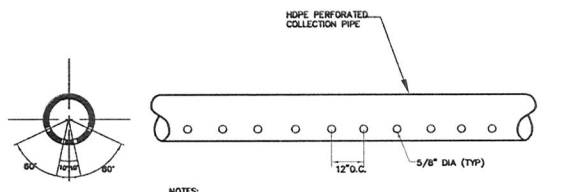
Typical Anchor Trench

Not to Scale (9/6) (9/7) (9/14)



Primary & Secondary Cleanout Riser

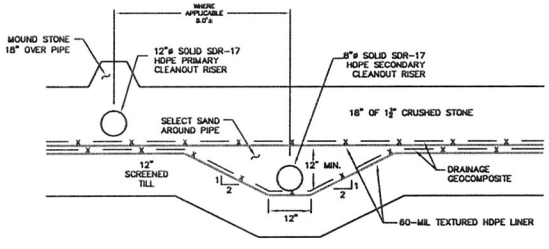
Not to Scale (6/6) (6/7)



NOTES:
1. PRIMARY LEACHATE COLLECTION PIPE INSIDE LANDFILL SHALL BE 12" DIA. HDPE SDR 17
2. SECONDARY LEAK DETECTION PIPE INSIDE LANDFILL SHALL BE 8" DIA. HDPE SDR 17
3. PRIMARY & SECONDARY PIPES ARE NON-PERFORATED WHEN PASSING THROUGH FLAPS, PHASE SEPARATION, AND INTERMEDIATE BERMS. SEE APPROPRIATE SECTIONS AND DETAILS.
4. PRIMARY AND SECONDARY CLEANOUT/VENT PIPES ARE NON-PERFORATED.

Perforated Collection Pipe

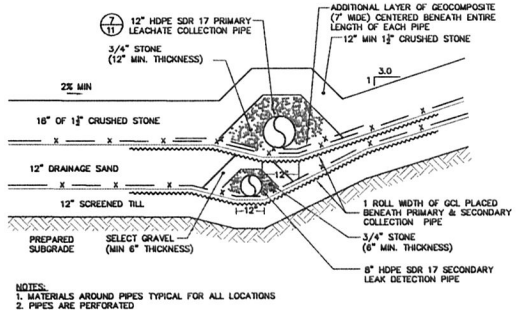
Not to Scale (7/6) (7/7)



NOTES:
1. SEE BOOT REQUIREMENTS FOR SECONDARY CLEANOUT AT ANCHOR TRENCH THIS SHEET.
2. CLEANOUTS SHALL EXTEND 24" ABOVE FINISHED GRADE AND PROVIDED WITH FERNCO CAP.

Primary & Secondary Cleanout Cross Section

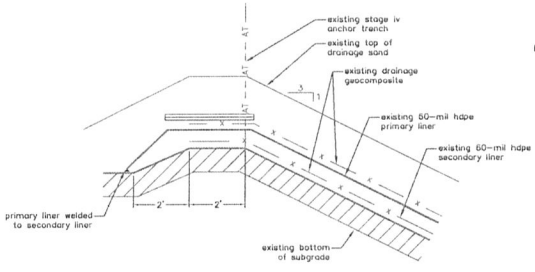
Not to Scale (10/6) (10/7)



NOTES:
1. MATERIALS AROUND PIPES TYPICAL FOR ALL LOCATIONS
2. PIPES ARE PERFORATED

Leachate Collection Pipe

Not to Scale (11/6) (11/7)



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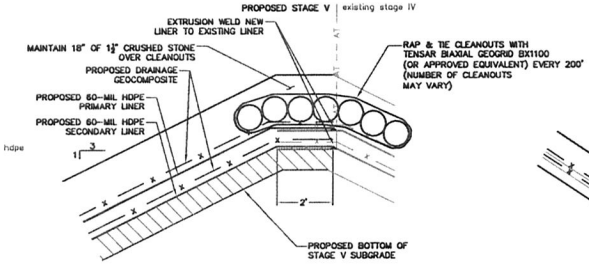
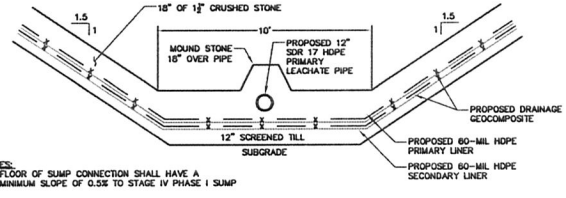


PROPOSED

Liner Connection to Stage IV

Not to Scale (12/6) (12/7)



NOTES:
1. FLOOR OF SUMP CONNECTION SHALL HAVE A MINIMUM SLOPE OF 0.5% TO STAGE IV PHASE I SUMP

Connection to Stage IV Phase I Sump

Not to Scale (13/6) (13/7)

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Issued for NHDES Type II Permit Modification	JAN 2015	RJG

DATE JAN 2015 | DESIGNED 5.AS.BWS.AJS | DRAWN BWS.AJS | REVIEWED RJG

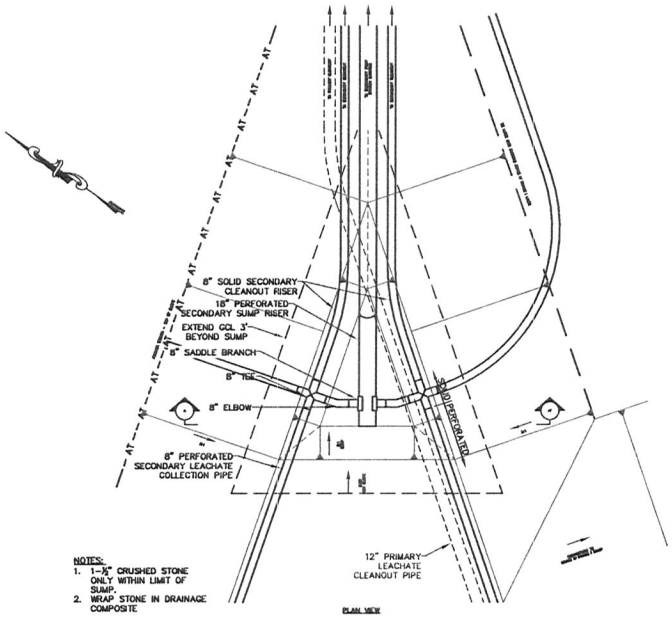
North Country Environmental Services
Bethlehem, NH

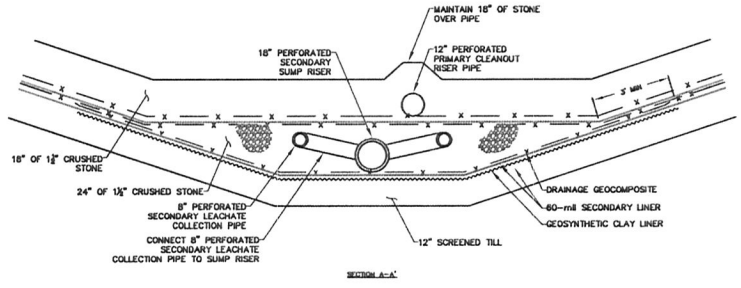
Stage V Landfill Expansion
Construction Drawings

Details - Landfill

Drawing no. 11

M:\CADD\PROJECTS\633-Type4\633-Details1408.dwg Date Plotted: Jan 01, 2015 – 2:40pm Plotted By: ASANGARI

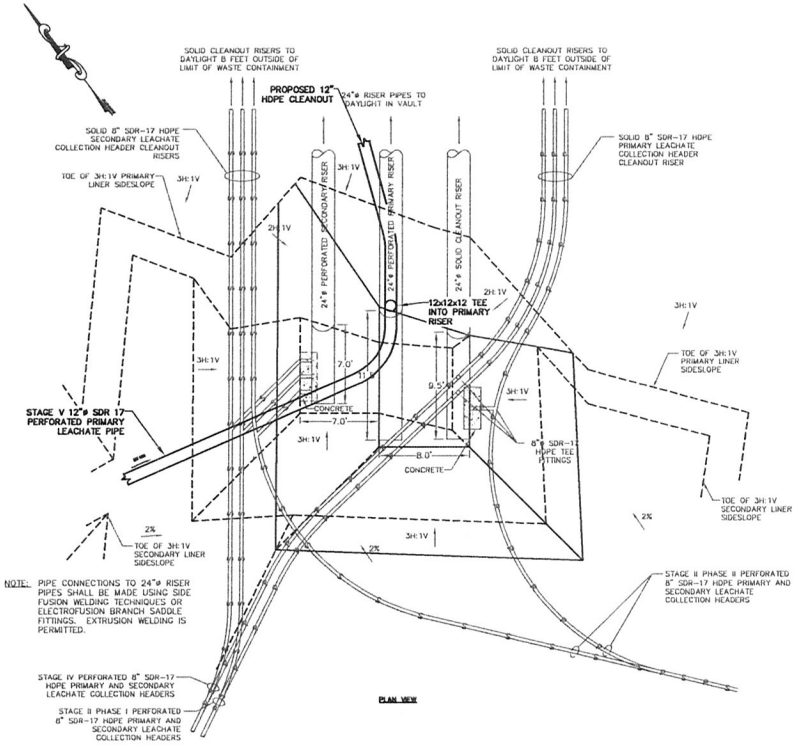


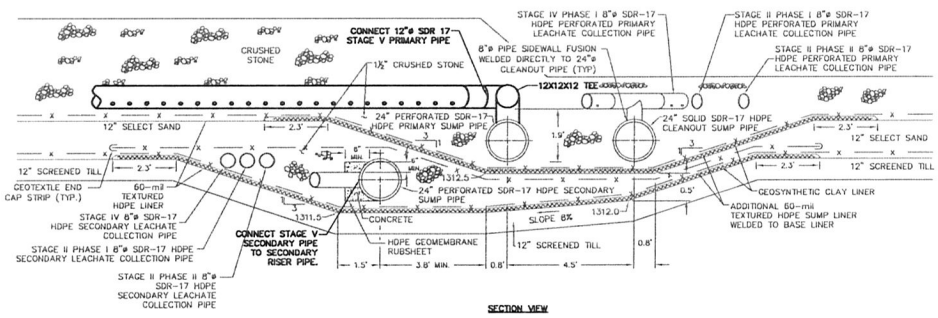


Stage V Secondary Sump

Not to Scale

14
6





Connection to Stage IV, Phase I Sump

Not to Scale

15
7

JAN 2012	R.J.G.

ISSUED FOR NHDES Type I Permit Modification

CMA ENGINEERS
Civil Environmental Engineers

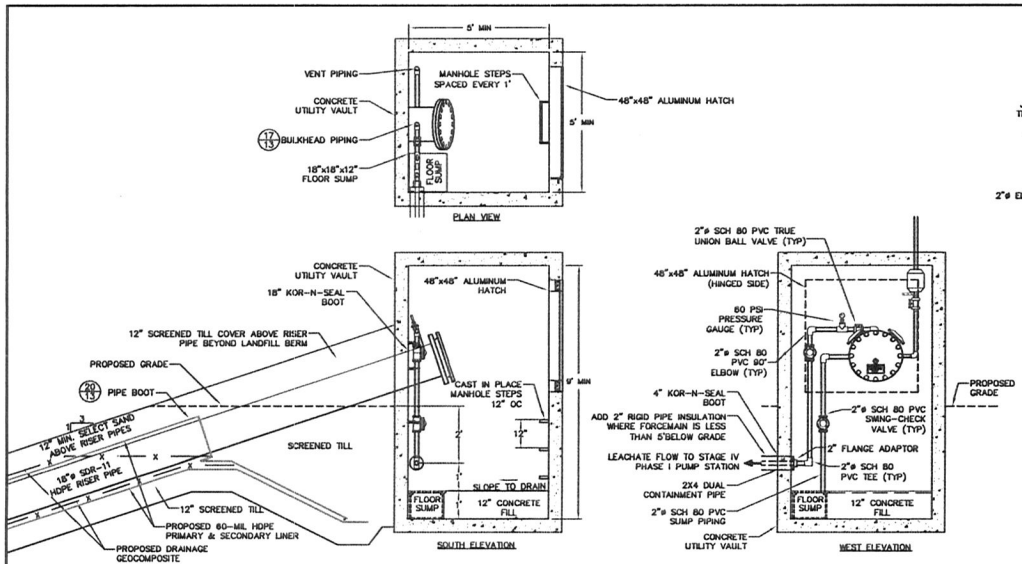
North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Details
Sump Modification & Construction

Drawing No. 12

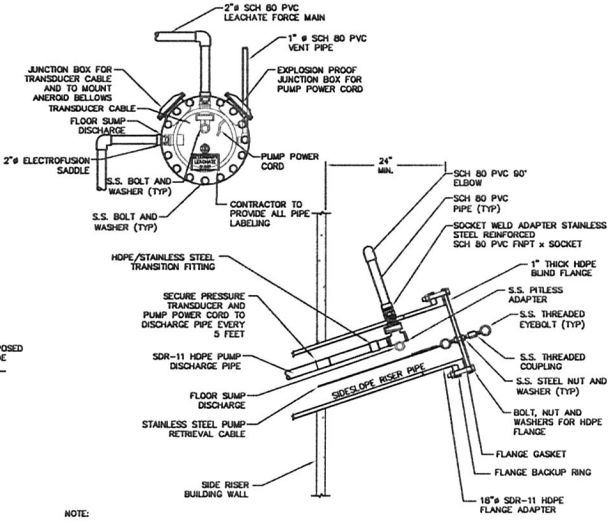
M:\CADD\PROJECTS\833-Type8\833-Details1408.dwg Date Plotted: Jan 01, 2015 – 2:34pm Plotted By: ASANDAHL



Secondary Pump Station Manhole

Not to Scale

16/6



NOTE:

1. CONTRACTOR SHALL PROVIDE AN ENGRAVED STAINLESS STEEL LABEL ON THE TOP OF EACH RISER THAT SHOWS THE TOTAL LENGTH OF THE SIDE RISER PIPE ALONG THE INVERT.

EQUIPMENT LIST

PITLESS ADAPTER – MODEL NW STAINLESS STEEL DISCHARGE ADAPTER, EPG COMPANIES, INC., MAPLE GROVE, MN, (800)443-7526.

FLANGE BACKUP RING – DUCTILE IRON FLANGE BACKUP RING WITH POWDERCOAT EPOXY COATING.

BOLTS FOR FLANGE (16 PER FLANGE)– GRADE 8 PLAIN STEEL HEX-HEAD CAP SCREWS, 1-1/8"-7 STANDARD THREAD, 8-1/2" LONG.

HEX NUTS FOR FLANGE (16 PER FLANGE)–PLAIN STEEL HEX FULL NUT, 1-1/8"-7.

WASHERS FOR FLANGE (32 PER FLANGE)– PLAIN STEEL SAE STANDARD FLAT WASHER, 1-1/8" SCREW SIZE, 2-1/4" O.D., 9/64" THICK.

FLANGE GASKETS – 1/8-INCH THICK VITON FULL FACE FLANGE GASKET.

PUMP CORD JUNCTION BOX – EXPLOSION PROOF JUNCTION BOX, 4" x 4" MINIMUM INTERIOR DIMENSIONS.

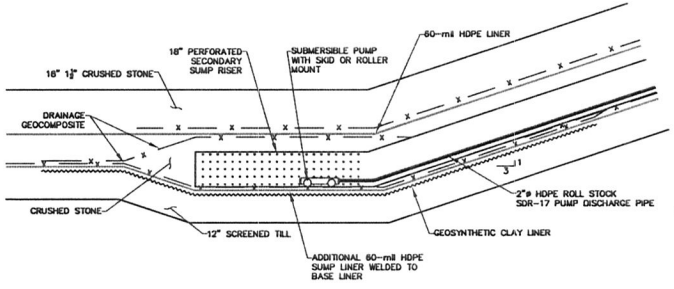
PROVIDE PASS-THROUGH SINGLE TIER TERMINAL BLOCKS FOR PUMP POWER AND TRANSDUCER CONDUCTORS. PROVIDE LABELS FOR EACH TERMINAL.

EXTEND PRESSURE TRANSDUCER CABLE VENT TUBE TO ANEROID BELLOWS MOUNTED IN THE TRANSDUCER CABLE JUNCTION BOX ON THE WALL OF THE SIDESLOPE RISER PIPE.

Bulkhead Piping Detail

Not to Scale

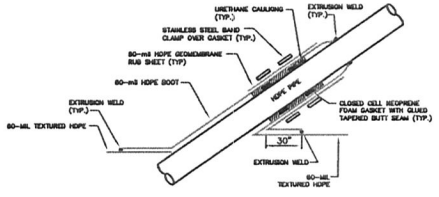
17/6



Proposed Secondary Sump Riser to Manhole Pump Station

Not to Scale

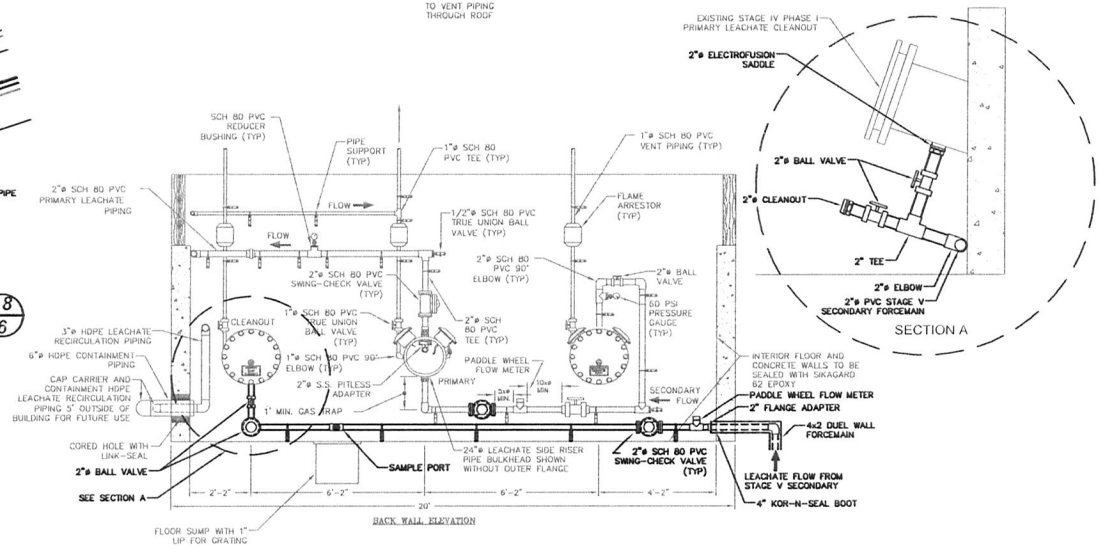
18/6



Typical Boot Detail

Not to Scale

20/11 20/13



Proposed Alterations To Stage IV Side Riser Building Piping

Not to Scale

19/6

CMA ENGINEERS
CIVIL ENVIRONMENTAL ENGINEERS

DATE	DESCRIPTION	BY	CK
JAN 2015	Issued for NHDES Type I Permit Modification	RJC	

DATE: JAN 2015
DESIGNED: EJS
DRAWN: BMS/AJS
CHECKED: RJC
APPROVED: RJC

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Details
Riser Modification & Construction

drawing no. 13

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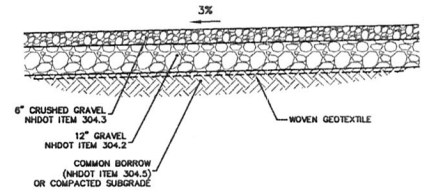
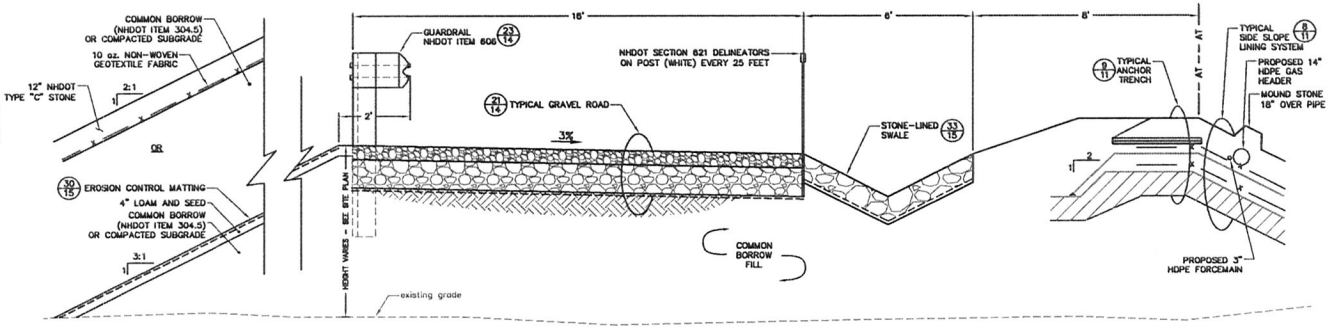


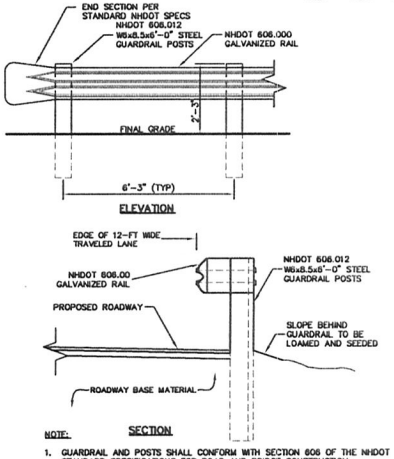
Typical Gravel Road Section (21/6) (21/7) (21/14)

Not to Scale



Landfill Berm & Roadway (22/6) (22/7) (22/8)

Not to Scale

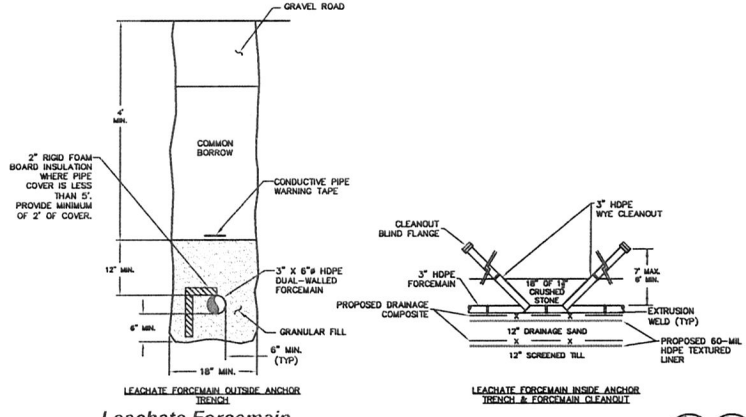


NOTE:

1. GUARDRAIL AND POSTS SHALL CONFORM WITH SECTION 606 OF THE NHDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION.

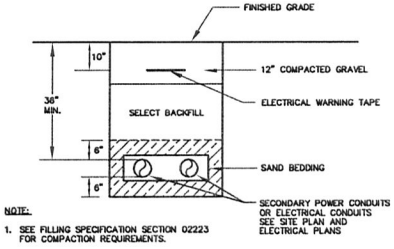
Typical Guardrail Detail (23/6) (23/7) (23/14)

Not to Scale



Leachate Forcemain (24/6) (24/7)

Not to Scale

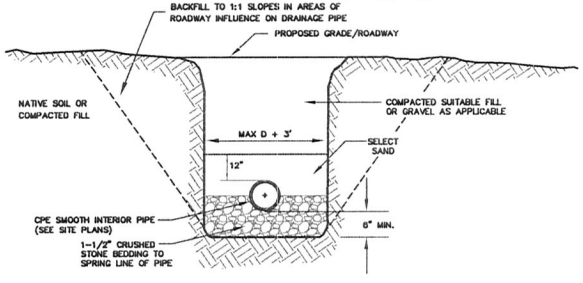


NOTE:

1. SEE FILLING SPECIFICATION SECTION 02223 FOR COMPACTION REQUIREMENTS.

Underground Electric Conduit Detail (26/6) (26/7)

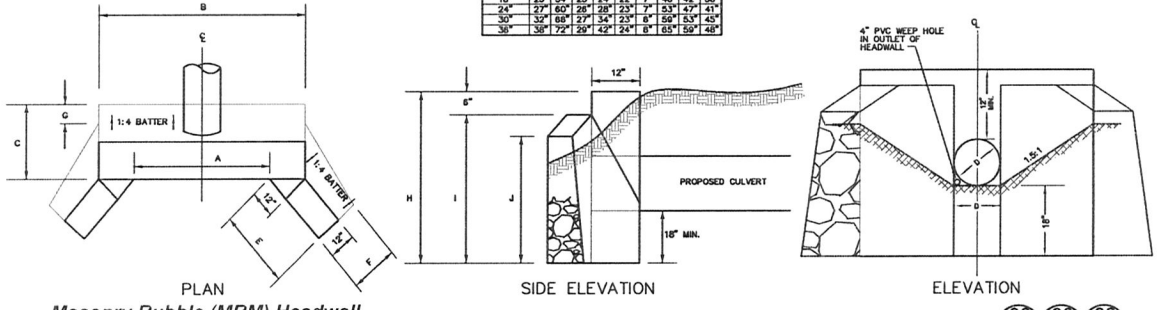
Not to Scale



Typical Drainage Pipe Trench (27/6) (27/7) (27/8)

Not to Scale

DIAMETER D	A	B	C	E	F	G	H	I	J
15"	23"	54"	24"	20"	22"	7"	43"	36"	36"
18"	25"	54"	25"	24"	22"	7"	48"	42"	38"
24"	27"	60"	26"	28"	23"	7"	53"	47"	41"
30"	32"	66"	27"	34"	23"	8"	59"	53"	45"
36"	38"	72"	29"	42"	24"	8"	65"	59"	48"



Masonry Rubble (MRM) Headwall (28/6) (28/7) (28/8)

Not to Scale

CMA ENGINEERS
CIVIL ENVIRONMENTAL LANDUSE

Large Plots
22 Bow Street
Concord, NH 03301
603-410-1195

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Portsmouth, NH 03801
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STATE OF NEW HAMPSHIRE
ALAN BINSALE
No. 9811
LICENSED PROFESSIONAL ENGINEER

DATE	JAN 2016
PROJECT NO.	833
DRAWN BY	BMS
CHECKED BY	ASB
APPROVED BY	ASB
SCALE	

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Details - Site Work

Drawing No.
14

Issued for NHDES Type I Permit Modification

1	JAN 2016	ASB

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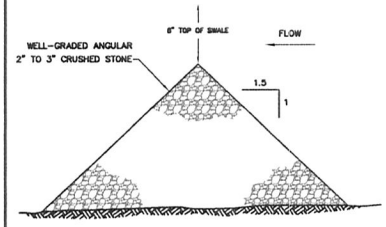


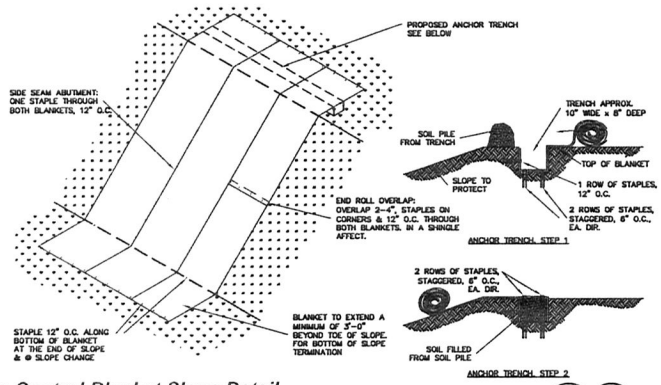
NOTES:

1. PLACE CRUSHED STONE TO WITHIN 6" OF TOP OF DRAINAGE WAY.
2. FOR ACTIVE DRAINAGE OUTFLOW CHECK DAMS SHALL BE PLACED IN SERIES ALONG FLOW LINE TO RETAIN SEDIMENTS.

Stone Check Dam

29/6 29/7 29/9

Not to Scale



Erosion Control Blanket Slope Detail

30/9 30/14

Not to Scale

Erosion Control Notes

1. Prior to construction and thereafter erosion control measures are to be implemented as noted. The smallest practical area of land should be exposed at any one time during development. When land is exposed during development, the exposure should be kept to the shortest practical period of time. Land should not be left exposed during the winter months.

2. Hay bale barriers shall be installed and maintained along limits of work where shown. Additional hay bales shall be added as required by the Engineer. Hay bales will be staked and maintained prior to and during construction until disturbed areas are covered with crushed gravel or have a healthy stand of grass.

3. All disturbed areas and side slopes which are finish graded with no further construction to take place shall be seeded and mulched within 72 hours. All seed, lime and fertilizer programs shall conform to all applicable sections of the specifications.

4. Any disturbed areas which are to be left temporarily, or longer than two weeks and which will be regraded later during construction, shall be machine hay mulched and seeded at the rate of 2 tons per acre. The smallest practical area shall be disturbed during construction, but in no case shall exceed 5-acres at any one time before disturbed areas are stabilized.

5. Avoid use of undisturbed areas whenever possible during construction. Construction traffic shall travel the roadbeds of existing and future roads.

6. Silt fence shall be installed & maintained where shown and additional silt fence added as required by the Engineer prior to any on-site grading or disturbance of existing surface material. It should be maintained during and after development to remove sediment from runoff water and from land undergoing development. Where possible natural drainage ways should be utilized and left open to remove clean excess surface water. The silt fence is to be maintained and cleaned until all slopes have a healthy stand of grass.

7. Erosion control devices shall be inspected weekly and after every 0.5-in of rainfall.

8. All disturbed areas shall have a minimum of 4 inches of loam placed, before being seeded and mulched unless otherwise shown. Erosion control matting shall be placed on all slopes steeper than 3:1 and within grass lined swales as shown.

9. After all disturbed areas have been stabilized, the temporary erosion control measures are to be removed and accumulated sediment disposed of in an on site location designated by the Owner.

10. Baled hay and mulch shall be mowings of acceptable herbaceous growth, free from noxious weeds or woody stems, and shall be dry.

11. Silt fences shall be minimum of 36 inches high with the bottom of the fabric keyed into the ground (see detail). Posts shall be of wood or steel.

12. The erosion control devices shown on the Drawings and as specified in the specifications represent the minimum required for erosion control. The Contractor shall add to these devices any and all measures as required by the Engineer to effectively prevent migration of sediment from the work area.

13. All slopes and disturbed areas to be seeded shall comply with the NHDES Section 644 WF Seed Type 45.

14. Lime shall conform to NHDOT specifications, Div. 600, sec. 642 "Limestone". Limestone shall be applied by either the dry or hydraulic method as described in NHDOT Div 600, sec. 644.2.5. The amount of limestone applied should be based on evaluation of soil tests conducted by the contractor. The minimum rate of 2 tons per acre or 100 lbs per sq. ft. shall be applied if required.

15. Fertilizer to be used must be the equivalent of a 15-15-15 mixture and shall be reviewed by the Engineer. Fertilizer shall conform to NHDOT specifications Div. 600, Sec. 643 "Fertilizer for Grasses." Kinds and amounts of fertilizer should be based on evaluation of soil tests conducted by the contractor. The minimum amounts applied shall be as follows:

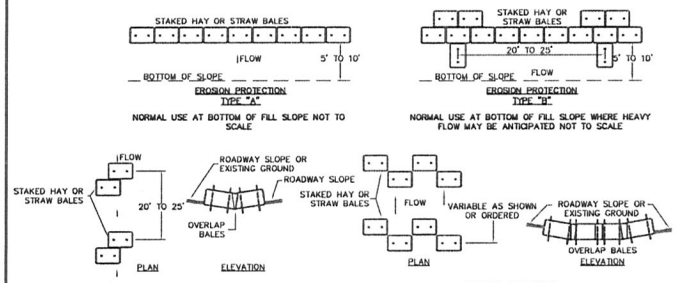
Nitrogen (N) 150 lbs per acre or 1.1 lbs per 1000 s.f.
Phosphate (P O) 100 lbs per acre or 2.2 lbs per 1000 s.f.
Potash (K O) 100 lbs per acre or 2.2 lbs per 1000 s.f.

(Note: This is the equivalent of 500 lbs per acre of 10-20-20 fertilizer or 1000 lbs per acre of 5-10-10)

16. All proposed swales must be stabilized prior to directing runoff to them.

17. All roadways to be stabilized within 72 hours of achieving finished grade.

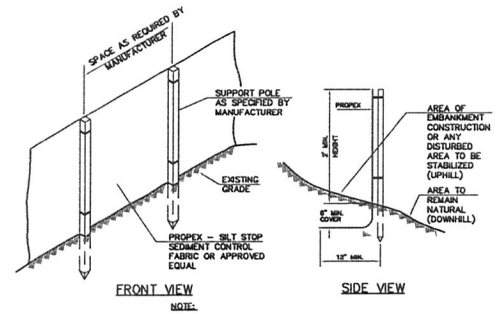
18. All areas shall be stabilized within 45 days of initial disturbance. An area shall be considered stable if one of the following has occurred:
- Base course gravels have been installed in areas to be paved;
- A minimum of 85% vegetated growth has been established;
- A minimum of 3-in of non-erosive material such as stone or rip rap has been installed; or
- Erosion control blankets have been properly installed.



Hay Bales

31/6 31/7 31/8 31/9

Not to Scale



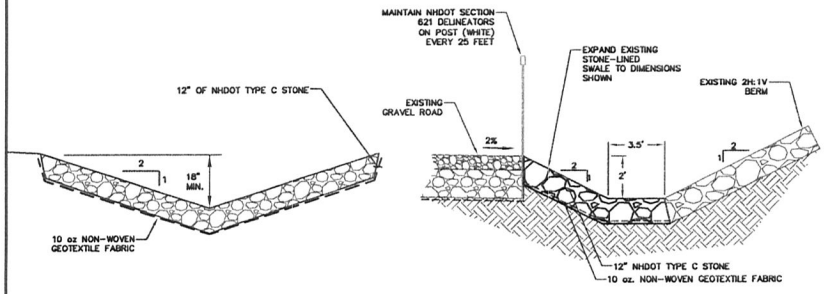
NOTE:

1. AT A MINIMUM, SILT FENCE IS TO BE INSTALLED TO PROTECT WETLAND AREAS, WATERWAYS, EXISTING AND PROPOSED DRAINAGE FEATURES, SLOPES, LAWNS AND PLANTINGS ADJACENT TO THE WORK.

Silt Fence

32/6 32/7 32/8 31/9

Not to Scale



Stone-Lined Swale

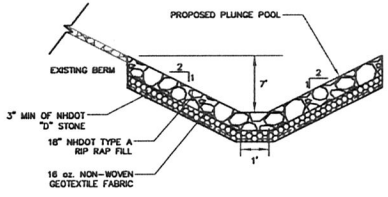
33/14

Not to Scale

West Swale Expansion Section

34/6 34/7 34/8

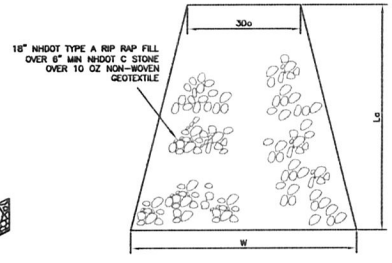
Not to Scale



Plunge Pool Detail

35/3 35/9

Not to Scale



NOTE:

1) STONE TO BE A MINIMUM OF 24" DEEP.

2) CONTRACTOR RESPONSIBLE FOR REMOVING DEBRIS OR SEDIMENT WHICH ENTERS STONE PRIOR TO STABILIZATION.

3) SEE DRAWINGS FOR REQUIRED DIMENSIONS.

Typical Culvert Outlet Protection

36/8 36/9

Not to Scale

No.	Issued for NHDES Type I Permit Modification	JAN 2015	RJG
1			

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STATE OF NEW HAMPSHIRE
RICHARD J. GUERIN
No. 9404
PROFESSIONAL ENGINEER

DESIGNED BY RJG/BMS/AJS
DRAWN BY BMS/AJS
REVIEWED BY RJG
DATE JAN 2015
PROJECT NO. 8211
FILE NO. 14-1014
FILENAME 14-1014.DWG
SCALE NONE

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Details - Erosion Control

DRAWING NO. 15

SHEET 15 OF 16

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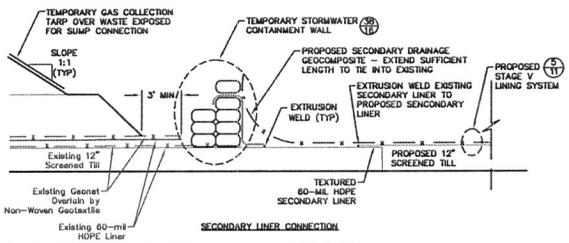
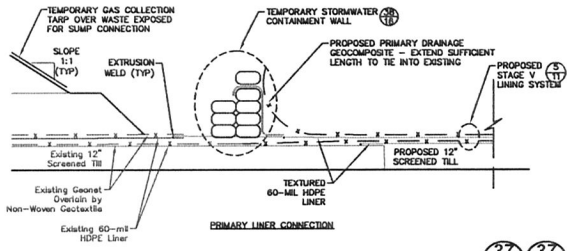
NOTE: CONTRACTOR SHALL TAKE ALL MEASURES AND PRECAUTIONS NECESSARY TO PROPERLY CONTROL THE TEMPORARY STORMWATER MANAGEMENT SYSTEM AND CONTAINMENT BERM REQUIRED FOR THE CONNECTION TO THE EXISTING STAGE IV PHASE I PRIMARY AND SECONDARY LINER SYSTEMS AND CONSTRUCTION OF THE NEW STAGE V SUMP. CONTRACTOR SHALL PREVENT ANY STORMWATER FROM ESCAPING FROM THE CONTAINMENT AREA TO THE LEACHATE COLLECTION SYSTEM. CONTRACTOR SHALL OPERATE AND MAINTAIN THE CONTAINMENT SYSTEM AND PUMPS 24 HOURS PER DAY FOR THE DURATION THAT THE CONTAINMENT SYSTEM IS OPERATIONAL, AND TO HAVE ON-SITE BACK UP PUMPS AND BACK-UP GAS/DIESEL POWERED GENERATORS IN THE EVENT EXISTING ELECTRICAL CONNECTIONS OR GENERATOR CEASE TO FUNCTION.

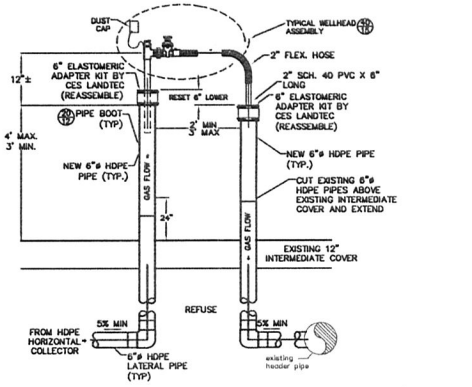


Interim Stormwater Management Detail

Not to Scale

37/6 37/7

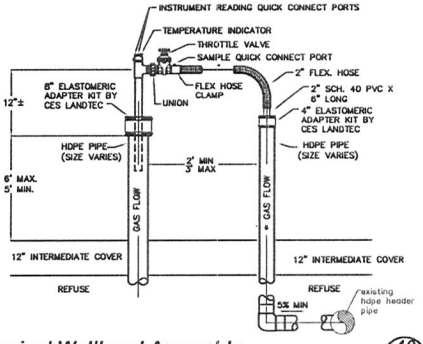




Horizontal Gas Collection Wellhead

Not to Scale

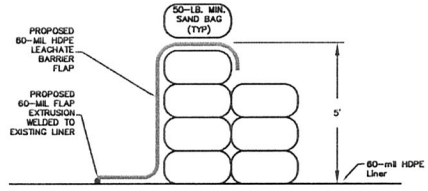
39/4



Typical Wellhead Assembly

Not to Scale

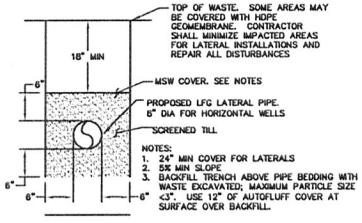
40/4 40/16



Typical Stormwater Containment Wall Section

Not to Scale

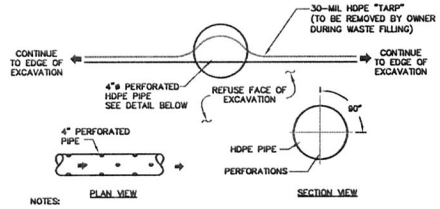
38/6 38/7



Landfill Gas Lateral

Not to Scale

43/4



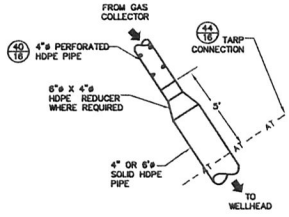
NOTES:

1. HOLES SHALL BE 1/2"ø DRILLED HOLES SPACED 12" APART IN 4 ROWS ALONG THE LENGTH OF THE PIPE. ROWS SHALL BE LOCATED 90° APART OFFSET 6" ALONG THE AXIS OF THE PIPE.

Temporary Horizontal Collector

Not to Scale

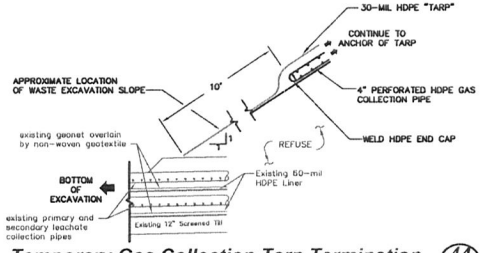
41/4 41/16



Gas Collector Connection

Not to Scale

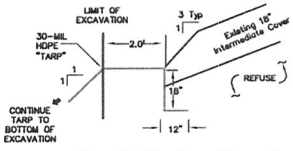
42/4 42/16



Temporary Gas Collection Tarp Termination

Not to Scale

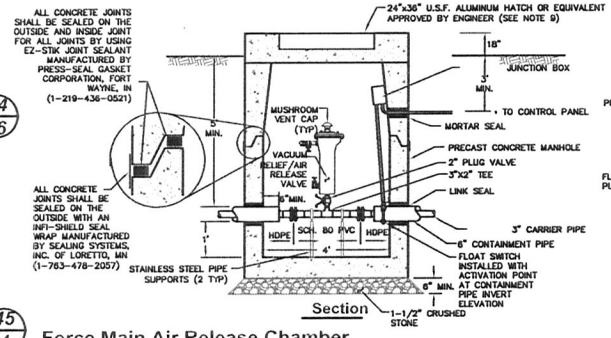
44/4 44/16

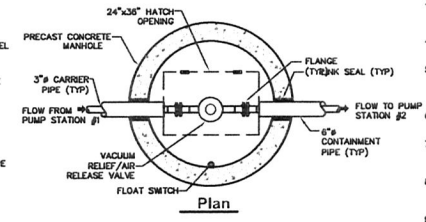


Temporary Gas Collection Tarp Anchor Trench

Not to Scale

45/4





Force Main Air Release Chamber

Not to Scale

46/6 46/7

GENERAL LEAK DETECTION AND AIR RELEASE CHAMBER NOTES:

1. ASSUME CLASS 1 DIVISION 1 GROUP D ATMOSPHERE IN ALL BELOW-GRADE STRUCTURES, INCLUDING MANHOLES AND VALVE BOXES.
2. TWO COATS OF SIKAGARD 62 SHALL BE APPLIED TO THE FLOOR AND WALLS OF ALL THE MANHOLES INCLUDING ACROSS ALL BARREL SECTION JOINT SURFACES. CONCRETE SURFACE TO BE COATED SHALL BE DRY, FREE OF SURFACE VOIDS, HONEYCOMBED CONCRETE, CRACKS, MORTAR SMEARS, DIRT, AND FORM RELEASE AGENTS. SURFACE DEFECTS SUCH AS CRACKS, HOLES, OR CAVITIES SHALL BE FILLED AND FINISHED FLUSH WITH A PORTLAND CEMENT GROUT OR CONCRETE. VOIDS IN SURFACES ARE TO BE FILLED TO CREATE A SMOOTH, SLIGHTLY POROUS SURFACE. CLEAN ALL SURFACES TO REMOVE DIRT, MUD, DEBRIS, DUST, LAITANCE, ETC.
3. DRAIN PIPE PERFORATIONS SHALL BE ¼"ø HOLES SPACED 120° RADIALLY AND 6" ALONG AXIS OF PIPE.
4. FLOAT SWITCH CIRCUITS SHALL BE INTRINSICALLY SAFE.
5. PIPE SUPPORT NOT SHOWN. CONTRACTOR SHALL PROVIDE SUPPORTS AND RESTRAINTS AS REQUIRED TO SECURE THE PIPE SYSTEM IN THE MANHOLES.
6. PROVIDE FULL-FACE VITON GASKET FOR ALL FLANGE CONNECTIONS.
7. CONTAINMENT PIPES ARE TO BE LEFT OPEN-ENDED IN MANHOLES UNLESS OTHERWISE NOTED.
8. FORCE MAIN PIPING SHALL BE SDR-17 CARRIER PIPE WITHIN SDR-17 CONTAINMENT PIPE UNLESS OTHERWISE NOTED.
9. ALUMINUM HATCH SHALL BE U.S.F. FABRICATION TYPE WAPS (FLOODTIGHT/GASTIGHT) WITH STAPLE FOR PADLOCK. HATCH SHALL BE CAST INTO CHAMBER COVER.

Issue	Date	Initials
1	Issued for NHDES Tank Permit Modification	JAN 2015	RJG

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designed by RJG/BWS/AJS
drawn by BWS/AJS
approved by RJG
date JAN 2015
project no. 833
scale NONE

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Construction Drawings

Details
Temporary Environmental Controls

drawing no. 16

sheet 16 of 16

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