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

# Type I-A Modification to Solid Waste Management Facility and Waiver Applications North Country Environmental Services Landfill Response to NHDES Comments – 5/22/14

**581 Trudeau Road**
**Bethlehem, NH 03574**
**NHDES Site #: 198704033**
**Project Type: (SW-LNDFILL)**
**Project Number: 0021939**

Prepared For:
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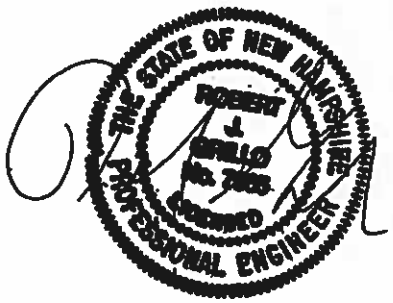


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Date of Report: June 26, 2014

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June 26, 2014

Mr. Paul M. Gildersleeve, P.E.
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**RE: NCES – North Country Environmental Services, Trudeau Rd, Bethlehem, NH**
**Type IA Permit Modification Application for Solid Waste Landfill Facility**
**Stage V Expansion**
**DES-SW-SP-03-002, WMD Doc Log # 13337, 13390, 13419, 13423, 13477**
**Response to NHDES Comments dated May 22, 2014**
**CMA #833-A**

Dear Mr. Gildersleeve:

On behalf of North Country Environmental Services (NCES), CMA Engineers, Inc. has prepared this letter to provide information requested by the New Hampshire Department of Environmental Services (NHDES) in your correspondence dated May 22, 2014. Our responses to NHDES's comments are presented in roman type, following the corresponding NHDES comment in ***bold italic*** type. As your letter requested, we have enclosed one copy of the requested information and we are also uploading an electronic copy to the NHDES One Stop database. A revision date is provided on each revised page and sheet.

**Waiver- Leachate Collection and Removal System Design Standards**

1. ***In Section VIII of the Application, please address individually and separately the requirements of Env-Sw 202.04(a-b)(1-3), which address the criteria for waiver, as they relate to the waivers sought for Env-Sw 805.07(a)(1) and Env-Sw 805.07(b)(1).***

Please see the attached Enclosure 1 located in Appendix A. Also provided in Appendix A is Table 1 to the Waiver, entitled "Secondary Leachate Flows" which was inadvertently left out of the original application. Table 1 and the secondary leachate calculations have been updated with new secondary flow data recorded since the February submission of the application.

**Public Benefit**

2. ***In Section 5.2.1, on page 20, a Figure 5 is referenced; however, no Figure 5 can be found. We believe it's actually Figure 4. Please confirm.***

There is no Figure 5 to the public benefit demonstration and Figure 4 should have been referenced in its place. A revised double sided replacement page incorporating this change is located in Appendix B.

**Operating Plan**

Enclosed as Appendix C is an updated copy of the Facility Operating Plan that incorporates the revisions

described below. Also enclosed is an updated copy of the NCES Rules and Regulations for Facility Use document, included with this submittal as Appendix C.1

3. ***In the Operating Plan, Section 2.1, Env-Wm 502 is referenced. Please update this rule reference using the newest Rules nomenclature.***

This reference has been removed from the text.

4. ***In Appendix I, the asbestos locations shown on the Asbestos Disposal Location Site Plan, Stage V, do not match the locations in the existing Operating Plan for Stage IV Phase II. Please explain.***

We have reviewed the historical sketches for each asbestos disposal location provided in Appendix I of the Stage V application. It should be noted that these sketches identify disposal locations by measuring from prominent site features, rather than by using standard survey techniques and the site coordinate system. Our review of the documentation identified 13 asbestos locations, not 12 as was depicted on the original plan. In addition, a few of the points were plotted to be in slightly different locations from those shown on the original plan. We also note that there was a discrepancy with the plan in the original application between the points in the "Asbestos Location Overall Site Plan" view and the "Asbestos Location Plan" view. A corrected version of the plan is located in Appendix C.2.

5. ***In Section 2.1, "NHDES-approved certified waste derived products" are listed as authorized wastes. These certified waste derived products (CWDPs) need to be approved for the facility by DES before they can be considered authorized. Please explain. Also, please list individually the CWDPs that are authorized to use at the NCES LF.***

Section 2.1 has been revised to reflect only those certified waste derived products that NCES has obtained approval for. Also, please note that NCES has revised Sections 2.1, 2.2, 3.3.2 (including its subsections), 6.6, and 8.0 and the Appendix A cover page of the operating plan and added a Special Waste Characterization Profile (SWCP) form to Appendix A to make NCES's special waste acceptance procedures conform with the prevailing procedures at other landfills in New Hampshire. NCES has also submitted replacement pages for Section III(3) of its pending application for a Type I-A modification to effectuate a corresponding revision of Conditions 7(d) and (e) of the Stage IV standard permit regarding special waste acceptance procedures. A copy of the replacement Section III(3) is enclosed as Appendix D.

6. ***Gas monitoring sections located in Section 3.11, "Controls," of the current Operation and Maintenance Manual, Appendix C, are missing. Please explain. Please state in this proposed section that if the flare is not operating, DES will be notified.***

The "Controls" section is now included in Section 3.8, "Open Flare and Control System" of the proposed Operation and Maintenance Manual, Gas Management System. A sentence was added to Section 3.8 to indicate that DES will be notified in the event the flare system is not operable (e.g., during a GCCS malfunction event). A copy of the revised Gas Management System Operations and Maintenance Plan is enclosed as Appendix C.3.

7. ***In Section 7.0, please update the Solid Waste Operator Training requirements to incorporate the rules in http://des.nh.gov/organization/commissioner/legal/rulemaking/documents/envsw1600-fp-annot.pdf.***

Section 7 has been revised accordingly.

8. ***In Appendix C, Operation and Maintenance Manual, Gas Management System, Section 3.8, the frequency of the open flare inspections is not included. Please explain.***

A sentence was added to Section 3.8 of the proposed Operation and Maintenance Manual, Gas Management System to indicate the frequency of the open flare inspections.

9. ***In the Operation and Maintenance Manual, Gas Management System, Appendix A, Section 1.0, please revise rule Env-Wm 2506.07 (c) to the current Rule nomenclature.***

The text in Section 1.0 of the Gas Monitoring Plan in Appendix A of the proposed Operation and Maintenance Manual, Gas Management System was revised to reference the current Rule nomenclature (i.e., Env-Sw 806.07).

10. ***In the Operation and Maintenance Manual, Gas Management System, Appendix B, the Gas Probe Monitoring Data Sheet does not include the probe IDs like the existing Gas Probes data sheet. Please explain.***

The probe IDs have been added to the Gas Probe Monitoring Data Sheet in Appendix B of the proposed Operation and Maintenance Manual, Gas Management System.

11. ***In the existing Operation and Maintenance Manual, Gas Management System, Appendix D, the "March 24 and April 30, 2010 Memoranda" is missing from the proposed Operation and Maintenance Manual, Gas Management System. Please include it and add it to the Appendix.***

The "March 24 and April 30, 2010 Memoranda" have been added as Appendix C of the proposed Operation and Maintenance Manual, Gas Management System.

12. ***In Appendix I, Asbestos Disposal Location Site Plan, the location of the northern most asbestos burial spots are different than on the existing Asbestos Disposal Location Site Plan. Please explain.***

See response to Comment #4.

13. ***The primary pumps mentioned in Part VI, Design Report, page 3, last paragraph, weren't included in Part III, Technical Specifications, Section 11312. Please explain.***

The new primary pump was not included in the construction specification as NCES is not intending to have the Stage V contractor procure and install the new pump. Rather, the pump will be procured and installed by NCES operations staff. The calculations provided in Section 7 of Appendix A-1 of the Design Report indicate that a pump capable of pumping a minimum 105 gpm is required to remove leachate generated by the 100 year storm for Stage V. Bench testing of the current primary leachate pump for Stage IV Phase I concluded a flow rate of only 67 gpm.

We are specifying an EPG Companies Series 18 SurePump Model WSDPT 18-2 for the Stage IV Phase I primary leachate sump, or equivalent approved by the Engineer.

**<u>Design Report</u>**

14. ***In Section 8, HELP model page 1, layer 2 contains a thickness of 72 inches. Please explain. Please provide a profile of the different layers for this model.***

Two scenerios were run in the HELP Model assuming different waste depths. The first model assumes a waste depth of 72", the second assumes a waste depth of 90'. Below is a summary of the 5 layers of the model, with Layer 1 being on top and Layer 5 being on the bottom of the model:

Layer 1: 6" Daily Cover
Layer 2: Waste (Model 1 = 72", Model 2 = 90')
Layer 3: 18" Stone
Layer 4: Primary Drainage Geocomposite
Layer 5: Primary HDPE liner

***15. In the Design Report, page 15, under Env-Sw 1003.07, the 500-year floodplain is not provided. To meet the intent of RSA 483:9-a VII(c), which states:***

***"Expansion of existing solid waste landfills shall not occur within the 500 year floodplain of a designated rural river or segment, and any expansion of such a landfill shall be set back a minimum of 100 feet from the landward extent of the 500 year floodplain and shall be screened from the river with a vegetative or other natural barrier to minimize visual impact;"***

***A delineation of the 500 year flood plain shall be conducted along that stretch of the river that is located nearest the landfill. DES notes that there is a gauging station adjacent to the landfill, as shown on the attached aerial photograph. Data from the station may be used in the analysis.***

CMA Engineers has estimated the limits of the 500-year flood plain of the Ammonoosuc River in the vicinity of the landfill and calculations are provided in Appendix E. Available data from the Ammonoosuc River USGS Gaging Station 01137500 was reviewed for this calculation including measurements of gage height and flow with data reported as far back as 1940. The gaging station is located at the Ammonoosuc River approximately 2,000 feet north of the closest proposed limit of the landfill (Stage V), as shown on Figures 1 and 2 in Appendix E. The river levels recorded at the gage range from a low of 1.92 feet in October of 2009 to a high of 12.09 feet measured in October of 1959. These gage heights are above the Gage Datum of 1,180.74 feet NGVD29. The landfill perimeter elevation is 1,340 feet NGVD29, or higher.

Flood return intervals were calculated utilizing the Weibull Equation and methodology provided by *North Dakota State Department of Geosciences Flood Frequency Analysis and Determination of 100-year and 500-year Floods* (http://www.ndsu.edu/pubweb/~sainieid/group/100-year.htm). The return interval calculations are enclosed as part of the 500-year Flood Plain Calculation in Appendix E.

The return intervals for each data point were then plotted on a semi-logarithmic scale against its corresponding flow, and a best fit curve was generated. The equation generated by the best fit curve was used to estimate flow for the 100-year and 500-year storm events (15,754 and 77,910 cfs respectively). Utilizing the watershed characteristics represented by the Gage Height vs. Discharge chart provided by the USGS for the gaging station, included in Appendix D, a gage height of 30' was estimated for a discharge rate of 80,000 cfs. It is noted that the USGS line needed to be extrapolated to estimate the gage height for the 500-year storm. This gage height of 30' is added to the reference datum of 1,181 ft NVGD29 to estimate a 500-year flood elevation of 1,211 ft NVGD29. The 500-year flood plain limit is plotted on Figure 1.

Note that the USGS plan labels contours in meters and the calculated 500-year flood plain elevation is therefore converted to 369 meters. Conservatively, the 372 meter contour (1,220 feet NVGD29) was used

to depict the limit of the 500-year flood plain (note that the contour intervals on the USGS map are 6 meters).

Using these conservative assumptions, at its closest point the landfill's footprint will be 780 feet from the limit of the 500-year flood plain, and the landfill is situated 120 feet above the flood plain.

***16. In Section 8, Figure 6-3, data from Technical Paper Number 40 was included. Please explain if the Cornell Northeast Regional Climate Center model was used.***

Cornell Northeast Regional Climate Center model was used for the stormwater calculations per NHDES Alteration of Terrain Bureau guidance. Figure 6-3 was used in the leachate calculations.

***17. In Appendix A.2, Landfill Stability Analysis, in the 10% probability of exceedance in 250 years section, the calculations for the seismic safety factors 1.008, 1.742, and 1.732 could not be found. Please explain.***

The factor of safety equaling 1.008 was the result of step 2 in the seismic evaluation evaluating liner displacement from the design earthquake as described in the design report. The intent of this calculation is to determine the magnitude of the earthquake required to cause displacement, or failure, of the liner interface. That failure, or yield acceleration was calculated to be 0.32g by varying the acceleration value until a factor of safety of 1.0 was achieved.

The 1.742 and 1.732 factors of safety were the result of an analysis check on the pseudo-static static stability of a shallow embankment failure and a deeper foundation failure into the wetland area at the toe of the natural slope, using the design earthquake of 0.18g provided by the United States Geologic Survey. Factor of safety values of 1.1 are generally considered to be acceptable for this type of analysis.

***18. In Appendix A.3, Pre Development Conditions Site Plan, neither the existing surveyed landfill contours nor the detention ponds are shown. Please explain.***

The Pre-Development Conditions model estimates stormwater flow conditions at the site prior to the existence of NCES landfill and associated ponds and is based on USGS mapping.

***19. In Appendix A.3, on the Post Development Conditions Site Plan, pond 3 described in the "Project Description" cannot be found. Please explain.***

Detention Pond 3 is located to the north of the current landfill footprint and within the footprint of the proposed Stage V. Detention Pond 3 is eliminated when Stage V is constructed so it is not modeled in the Post Development Conditions stormwater model.

***20. In Appendix E, the design of the site swales is not provided. Please explain.***

The Pre-Development Conditions model that was included in Appendix E of the application models site conditions prior to the existence of the landfill which included no designed stormwater swales.

**<u>Closure Plan</u>**

***21. In the post-closure cost estimate, please include calculations showing how the "Leachate Collection/Monitoring" amount in Task IV is determined.***

Supporting documentation for Stage V post-closure costs were provided in the pages following the Post-Closure Cost Estimate form. The supporting documentation includes a cost breakdown for all items listed in Task IV (Leachate Collection/Monitoring).

***22. In Section 6.0, April and November were removed from the existing Operating Plan as inspection months. While it states that formal inspections will be done twice a year, please explain how those date will be determined.***

Specific months were removed from the post-closure requirements to allow operations staff more flexibility in scheduling inspections. We would expect that inspections would occur in the early spring and either after the cap has been mowed in the summer or in late fall.

***23. Please show how the closure and post-closure acreages of 40.66 and 46.46 acres, respectively, were calculated.***

The 40.66 acre area to be closed does not include the 5.8 acre eastern slope cap that will be completed in 2014.

***31. In the supporting documentation for the post-closure cost estimate, under Item IV-C, the amounts decreased from $6300 to $6000 in years 11-20, and from $5000 to $4800 in years 21-30. Please explain.***

When preparing the Stage V post closure cost estimate, we reviewed the approved Stage IV Phase II post closure cost estimate. A calculation error was identified in the Stage IV Phase II post closure cost estimate for the pump station electricity costs for years 11-20 and 21-30. These costs were corrected in the Stage V cost estimate and should be $6,000/year and $4,800/year, respectively. Since the error in the approved Stage IV Phase II financial assurance conservatively estimates post closure costs, we request that the corrected pump station electricity costs be reflected in the next financial assurance submittal.

**Hydrogeologic Report**

***32. In Section 2.2.4, MW-402 Area Monitoring, there is a typo in the second paragraph regarding the data of installation of monitoring wells B-922U/L. The date of installation should read January 2012 versus January 2013. Please revise.***

Comment acknowledged. The text has been revised to indicate the January 2012 date. A double sided-replacement page has been included with this submittal in Appendix F.

***33. In Section 5.0, Proposed Stage V Area Groundwater Monitoring Results, the preoperational sampling did not include analysis for the semi-volatile organic compounds (SVOCs). Please explain. Two "pre-operational" SVOCs sampling rounds will need to be performed for the 12 monitoring wells in the vicinity of the proposed Stage V expansion. The wells to be sampled shall include B-909/B-917U/D, B-916U/M/D, B-915U/M/D, and B-918U/M/D. In a recent phone conversation with Sanborn, Head & Associates, they indicated that the first round of this sampling will be incorporated into the regular April 2014 Groundwater Management and Release Detection sampling event. It is anticipated that the second round can be completed at the time of the regular July 2014 Groundwater Management and Release Detection sampling event. Please concur and revise this section.***

We concur: NCES will collect a second set of samples for SVOC analysis from the Stage V wells in July 2014. No text revisions to Section 5 were needed to address this comment; the April 2014 SVOC results were submitted to NHDES in the Stage V Water Quality Data Supplement, dated May 5, 2014. Similar to the May 5, 2014 Stage V Water Quality Data Supplement, results from the July 2014 SVOC sampling of the Stage V wells will be incorporated in a transmittal to NHDES.

***34. Appendix A.3 - Field Sampling Forms – The gallons purged information was not listed on the Groundwater Quality Field Sampling Summary forms. While this information is not a required reporting element per the Groundwater Management and Release Detection Permit and Env-Or 600 and Env-Or 700, for consistency of data collection at this site, SHA has agreed to include this on all Field Sampling Forms. SHA indicated that this was an inadvertent omission and this data will be supplied in a subsequent submission. Please concur.***

To confirm: The omission of the "gallons purged" values from the field forms was inadvertent. The field forms with gallons purged values shown for the Stage V monitoring wells, including the June and September 2012 sampling events, were included in NCES' May 5, 2014 Stage V Water Quality Data Supplement.

***35. In Section 6.0, Proposed Modifications to Groundwater Management and Release Detection Permit Monitoring, should Stage V be permitted and constructed, we concur with the plan to decommission Groundwater Management and Release Detection Permit (Permit) wells MW-403U/L, B-913U/M/L, B-920U/M/D and B-922U/L. Additionally, as recommended, any other wells not included in the Permit monitoring program, but within the footprint of the proposed Stage V area, should be properly decommissioned prior to any approved construction. Additionally, should Stage V be permitted and constructed, we also concur that the following proposed wells be incorporated in the Permit monitoring program: B-909/B-917U/D; B-916U/M/D; B-915U/M/D; and B-918U/M/D. Note that no decommissioning should occur until, and if, Stage V is permitted and construction approved. Please concur.***

We concur.

***In regards to the request to decommission wells B-922U/L, we note that a more detailed rationale for the decommissioning has been provided in the Corrective Action Plan Amendment report by Sanborn, Head & Associates, Inc., dated February 27, 2014, submitted on behalf of NCES per the request of the Department at our December 19, 2013 meeting. This additional information has been evaluated and forms the basis for our approval to decommission wells B-922U/L should Stage V be permitted. A response responding directly to any recommendations contained within the Corrective Action Plan Amendment report will be issued by the Hazardous Waste Remediation Bureau under separate cover.***

Comment Acknowledged.

**Design Drawings (Revised Plans Bound Seperately)**

Revised design drawings are bound separately. For additional clarity the detail references have been renumbered sequentially such that there are no repeat detail numbers. In the original submission, detail numeration started at "1" on each detail sheet. The detail references below reflect the new designations on the updated design drawings.

***36. Sheet 5 requires the Contractor to connect new force main and underground electric to existing Stage IV, Phase II pump station, but no detail is provided. Please explain.***

The new Stage V forcemain will replace the existing dual walled forcemain that extends from Pump Station I through the northern limits of Stage IV, and terminates at the leachate load-out area. The new forcemain will connect to the existing forcemain outside of Pump Station 1 when the existing forcemain is decommissioned. The connection of the existing dual wall forcemain to the proposed forcemain is not detailed. This is a standard pipe-to-pipe weld that does not require a detail.

***37. Sheet 6 shows an air relief valve without a detail reference. Please explain.***

An air relief valve detail (forcemain air relief chamber) has been added to Sheet 15 (Detail 43) and is called out in plan view on Sheets 5 and 6.

***38. Sheet 7 contains a detail for pond 4 that is not referenced on the plan views. Please explain.***

A plan reference for Pond 4 has been added to Sheet 4.

***39. On Sheet 9, Section A-A, please include proposed pond 6. Also, please include detention pond 4 in a cross section.***

Section A-A' has been expanded to include Pond 6. Section C-C' has been added to Sheet 9 to provide a cross section of Pond 4

***40. Details 4, 6, 7, 8, and 9 on Sheet 10 lists " 18" of 1½" crushed stone or 4" diameter washed bank run stone" in the leachate collection layer. This specification is different than that approved on Detail 20, Sheet C-11 of the Stage IV Phase II Application dated March 2010. Please explain.***

Detail 20 on Sheet C-11 of the Stage IV Phase II plans depict 18" of select sand above the primary drainage geocomposite on the side slopes. For Stage V NCES is proposing to extend the stone fill section depicted in the "base areas" detail (Detail 19 on Sheet C-11) throughout the entire limits of liner.

Note that Details 4, 6, 7, 8 and 9 on Sheet 10 have been redesignated as Details 8, 10, 11, 12 and 13 respectively.

***41. Detail 6 on Sheet 10; Detail 6 on Sheet 13; Detail 1 on Sheet 14; and Details 1, 2, 4, 6, and 8 on Sheet 15 cannot be found in plan view. Please explain.***

Detail references for the above have been added to the following plan sheets:

- A reference for Detail 6 (redesignated as Detail 10) on Sheet 10 has been added to Sheets 5 and 6
- A reference for Detail 6 (redesignated as Detail 26) on Sheet 13 has been added to Sheets 5 and 6
- A reference for Detail 1 (redesignated as Detail 29) on Sheet 14 has been added to Sheets 5 and 6
- References for Details 1, 2, 4, 6, and 8 (redesignated as Details 34, 35, 36, 39 and 41, respectively) on Sheet 15 have been added to Sheets 5 and 6.

***42. Detail 4 on Sheet 12 is called out on Sheet 6 with a leader to the Proposed Secondary Pump. However, Detail 4 shows alterations to the Stage IV Side Riser Building, not the Secondary Pipe. Please explain.***

The Secondary Pump Manhole references have been changed to Details 16 and 17 (formerly designated as Details 1 and 2, respectively) on Sheet 5. Previously the references were Details 1, 3 and 4. Details 3 and 4 were incorrectly referenced.

***43. Detail 3 on Sheet 12 is leadering to the proposed secondary sump on Sheet 6. However, shouldn't it be referenced on Detail 1, Sheet 11?***

Detail 3 (Redesignated as Detail 18) on Sheet 12 should be shown at near the toe of slope in the sump area not at the top near the secondary leachate pump station. The Detail 18 Sheet 12 reference is moved to the sump area on Sheet 5. The Detail 18 Sheet 12 reference was removed from Sheet 6 as it is the primary liner grading plan.

***44. Detail 2 on Sheet 13 includes a reference to Section Detail 2 on Sheet 5 in its title. Please explain.***

The plan reference in the title on Detail 2 on Sheet 13 is not necessary and has been removed.

***45. A callout stating "Tie Proposed 3x6 Dual Containment Forcemain into Existing Forcemain" is shown on Sheet 6; however, it does not reference a detail for this tie in. Please explain.***

The connection of the existing dual wall forcemain to the proposed forcemain is not detailed. This is a standard pipe-to-pipe weld that does not require a detail.

***46. Detail 8 on Sheet 13 is titled "Masonry Rubble Headwall;" however, the callout for this detail located on Sheet 6 is MRM Headwall. Please explain the meaning of the second "m." Please also include this material in the Technical Specifications.***

The terms "Masonry Rubble Headwall" and "MRM Headwall" are interchangeable. The term "MRM" stands for mortar rubble masonry. The term "MRM" has been added to the title of Detail 8 (redesignated as Detail 28) on Sheet 13.

***47. On Sheet 4, the callout for Detail 9 on Sheet 15 is for a temporary gas collection tarp. The construction for the Stage I Sump excavation also used a temporary gas collection tarp; however, odors were still noticed periodically at the landfill and by Bethlehem residents. Please explain how this tarp will control these fugitive odors.***

The premise of this comment appears to be that the temporary gas collection tarp was not effective in controlling odor associated with the Stage IV Phase II waste excavation. Although there were some episodes of onsite and offsite odors during the project, we believe that those odors resulted from other sources, not from any deficiency in the performance of the temporary tarp.

The temporary gas collection tarp was installed in 2013 over the exposed waste slope that remained after Stage I waste was excavated and relocated from the Stage IV Phase II sump construction area. The tarp panels were anchored above the excavation limits, draped down over the exposed waste down to the cell liner, and welded to create a barrier for gas and odor migration. Collection piping connected to the landfill gas piping network was installed underneath the tarp and operated to collect any gas from the underlying waste slope.

The waste excavation ended on June 21, 2013 and the tarp was fully installed and operational on July 13. The tarp remained in place through November 2013, when landfilling began in this area. Since November, the tarp has been cut back from the bottom as the level of waste in the adjacent cell has risen

with time. A portion of the tarp is still in place. It has been our observation that the gas collection tarp has operated as intended. We noted no odors from the waste slope during our full-time observation of the construction work conducted throughout 2013. On a few occasions the tarp had been damaged by wind or other mechanisms, but it was quickly repaired and brought back into service.

The Stage I waste slope beneath the tarp is a potential odor source. A figure plotting the occurrence of odor complaints versus time and potential odor producing activities at the landfill is provided as Appendix G. A cluster of 4 complaints was made near the end of waste excavation when the deepest, oldest (circa 1980s), and likely most odiferous waste was removed from Stage I in the third week of June. Strong odors were noted on site during excavation of this particular waste, during its transport to the disposal area, and when the waste was spread out at the top of the landfill. Release of odors may have occurred after the eastern slope was stripped of its soil cover in preparation for cap construction. The gas collection system was turned off in this section of the landfill in anticipation of cap construction. The eastern slope waste was essentially uncovered from the third week in August until the third week in October, after which the installation of the geomembrane cap was completed. The work also included excavating trenches in the waste to install gas collection laterals. There were three odor complaints during this period. At least two other odor complaints reported septage-like odors that correlated to treatment plant sludge disposal at the site. Lastly, wind and atmospheric conditions could periodically transport off-site the odor of fresh waste being landfilled at the working face. On several occasions, odor complaints could not be justified and confirmed by the landfill.

In summary, our observations and available evidence indicate the gas collection tarp functioned as intended during the 2013 construction season, and was effective in limiting odor migration from the waste excavation slope. For this reason, we are not proposing any significant design changes to the gas collection tarp proposed for Stage V construction. The volume of waste to be excavated is much smaller for Stage V than Stage IV Phase II, and the waste is newer having been placed only since 2006. Both of these factors will limit the potential for odor migration off-site. A water misting machine and odor-neutralizing pellets owned by NCES will be deployed as needed to control odors during Stage V waste excavation.

***48. A callout on Sheet 4 states "Protect and Extend to Provide 3' Stickup" for GMW B-402. Please provide a detail concerning how monitoring wells will be protected.***

Monitoring wells within the work area will be protected using appropriate physical barriers provided by the contractor and approved by the on-site engineer. The following note has been added to Sheet 4:

"Contractor shall protect all site monitoring wells throughout construction. Repair to damage to 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."

***49. A callout on Sheet 5 states "Proposed 3"x6" Forcemain Reducer Dual Containment Pipe Outside Anchor Trench to Drain into Anchor Trench." Please provide a detail of the reducer and dual containment pipe. Please explain how the dual containment pipe will drain into the anchor trench.***

The 6" containment portion of the forcemain will end inside the anchor trench and will be left open to drain. The term "reducer" has been removed from the callout on Sheets 5 and 6.

***50. Sheet 5 states the Stage V sump liners are to be connected to the Stage IV Phase I sump liners. Please provide a detail showing this connection. Please also show the connection point of the existing and proposed liners on Detail 9 Sheet 10.***

The connection of the existing Stage IV Phase I liner to the new Stage V liner in the sump area is depicted on the Interim Stormwater Management Detail (Detail 34 on Sheet 15). The 60-mil HDPE containment wall flap will be extrusion welded to the new Stage V liner. The connection point of the new liner to the existing liner will be just outside of the stormwater containment wall – the location of which has been added to Sheets 5 and 6. Additionally, stormwater management construction sequence notes have been added to Sheet 5.

***51. A callout on Sheet 5 states "Top of Leachate Collection Trench." Please provide a detail showing this callout description.***

The top of leachate collection trench is reflected as Detail 7 (redesignated as Detail 11) on Sheet 10.

***52. Detail 1 on Sheet 7 mentions a 4" CPP Perforated Underdrain Pipe. This pipe could not be found in Part III of the Technical Specifications. Please explain.***

A 4" ADS Single Wall corrugated HDPE perforated pipe or an approved equivalent is now specified on Detail 3 (formerly Detail 2) of Sheet 7.

***53. Detail 1 on Sheet 10 shows 12" select secondary subgrade fill; however, this material cannot be found in Section 02223 of the Technical Specifications. Please explain.***

To be consistent with specification section 02223, the details on Sheet 10 have been replaced with "12" screened till."

***54. On Sheets 5 and 6 the outgoing forcemain from the existing Stage IV Phase I pump building is not shown. Please explain.***

The outgoing forcemain from the pump building has been added to the design drawings.

***55. On Sheet 6, an elevation of 1340' on the gravel road is adjacent to an existing elevation of 1330' north and adjacent to the gravel road; however, no wall or wall grading is shown. Please explain.***

NCES personnel are currently borrowing soil above the proposed Stage V subgrade and processing/screening till and boulder stockpiles in this area. After NCES has completed this work, the grades in this area will be roughly at grade with the road grades shown. Final construction drawings will incorporate surveyed existing conditions.

***56. On Sheet 8 and 9, the Baseline A Stations 6+00 and 12+00 Details and Section A-A Detail, show a zig zag line with a note "Existing Vertical Expansion" leadered to it. Please explain why this line is zig zagged.***

The zig-zag line is depicting the existing "zig-zag" vertical expansion of the Stage III anchor trench.

***57. Sheet 4 of the Stage V Drawings shows the existing flare being decommissioned. However, the Type II Flare Applications dated September 16, 2013, Section III(1.0), 3rd paragraph states the existing flare station will remain in place as a backup facility and be decommissioned at a later time. Please explain when this flare will be decommissioned.***

NCES will decommission any items that remain of the existing flare station as part of the Stage V work.

**Filling and Interim Closure Plan**

***58. On the Design Drawings, Filling and Interim Closure Plan, and the Closure Plan drawing sets, please show slope designations along contour lines.***

Slope designations have been added for additional clarity on the Design Drawings, Filling and Interim Closure Plan and the Closure Plan drawing sets.

***59. Please provide a profile detail of the "previously deployed HDPE cover," the "proposed temporary HDPE cover," and the "Proposed Final Capping System" shown of Sheet 1 of 5. Please better differentiate the hatching of these areas from the roadway and pavement hatching.***

The temporary HDPE cover system design is currently being developed with the intent of reducing stormwater infiltration and landfill gas emission. A Type II application to NHDES is forthcoming and will include the design of the HDPE cover and stormwater upgrades.

***60. The proposed contours are confusing, with disconnecting contour lines and lines crossing contours in the Stage IV Phase I sump area. Please clarify these proposed contours.***

The disconnecting lines in Stage V are in the location of the leachate collection trench, depicted on the project Design Drawings. The gaps in the contours have been removed on the revised plans.

For clarity, the existing contours have been removed behind the waste excavation contours in the sump area.

**Closure Plan Drawings**

***61. Detail 12 on Sheet C5 is titled "Pipe Trench Within Landfill;" however, the callout for this detail on Sheet C2 calls the detail "Proposed Gas Header." Please explain.***

The detail callout on Sheet C2 has been modified to read "Pipe Trench Within Landfill."

***62. Please state the highest elevation of the landfill in the notes section.***

Note 6 has been added to Sheet C2 and reads as follows:

"Final closure grades shall have a maximum elevation of 1483' above mean sea level".

***63. Sheet C3 shows a 6" layer of screened till while Section 02223-2 of the Technical Specifications requires a 12" layer. Please explain.***

The 12" layer of screened till refers to the "12" Select Secondary Subgrade Fill" under the secondary liner and not the 6" closure layer. We have enclosed preliminary closure specifications with this submittal in

Appendix H.

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/ams

Enclosures

*Appendix A/Enclosure 1 (Response to DES Comment No. 1 Re: Waiver Application)/with Supporting Table 1 and Supporting Calculations*
*Appendix B – Public Benefit Replacement Page (19 & 20)*
*Appendix C – Revised Operating Plan*
*Appendix C.1 – Revision to NCES Rules and Regulations for Facility Use*
*Appendix C.2 – Asbestos Disposal Location Site Plan*
*Appendix C.3 – Revised Gas Management System O&M Manual*
*Appendix D – Revised Section III (3) to Type I-A Permit Modification*
*Appendix E – 500-year Flood Plain Plan and Calculations*
*Appendix F – Hydrogeologic Report Double-Sided Replacement Page (5 & 6)*
*Appendix G – Odor Complaint Summary Chart*
*Appendix H – Preliminary Closure Specifications*
*Appendix I - Reduced Size (8.5x11) Revised Design Drawings, Closure Plan Drawings and Filling & Interim Closure Plan Drawings (Full Size Drawings Bound Separately)*

cc: NHDES Onestop
John Gay, NCES
Kevin Roy, NCES
Bryan Gould, Cleveland, Waters and Bass, P.A.
April Hibberd, Town of Bethlehem – Administrative Assistant
Sandy Laleme, Town of Bethlehem - Selectboard Chairwoman (w/o full size plans)

# *List of Appendices*

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**<u>Enclosure 1</u>**

**Response to DES Comment #1**

1. *In Section VIII of the Application, please address individually and separately the requirements of Env-Sw 202.04(a-b)(1-3)*[1]*, which address the criteria for waiver, as they relate to the waivers sought for Env-Sw 805.07(a)(1) and Env-Sw 805.07(b)(1).*

## I. Introduction

Section VIII of the waiver application (Part VIII of NCES's submission uploaded to DES's One Stop database on February 11, 2014, as updated by NCES's submission of revised pages and drawings on or about March 10, 2014 (the "Waiver Application")), is substantively identical to the waiver application DES granted on March 1, 2013, in connection with the development of Stage IV, Phase 2, of the landfill. Section VIII of the Waiver Application addresses and satisfies each of the criteria of Env-Sw 202.04(a)(1) and one of the criteria of Env-Sw 202.04(a)(2) as required by those rules.

As NCES understands DES's Comment #1, DES has asked NCES to supplement Section VIII of the Waiver Application with a criterion-by-criterion treatment of each of the two rules for which NCES has requested a waiver. While this approach results in considerable redundancy, NCES provides below the analysis in the form requested by DES.

Accompanying this response are a replacement set of calculations and a Table 1 in support of Section V of the Waiver Application. NCES inadvertently omitted a Table 1 (providing secondary leachate flows in Stage I, Phases I-III, since January of 1995) from the original Waiver Application. The replacement calculations provide more comprehensive support for the conclusions in the Waiver Application regarding the amount of head on the primary liner of Stage I, Phases I-III, given the assumptions discussed in Section V of the Waiver Application. Finally, since submitting the Waiver Application, CMA Engineers has revised its estimate of the cost of an overlay liner from approximately $4 million to approximately $3 million. This revision was made in recognition of the fact that Stage V waste will be placed over a smaller portion of Stage I, Phases I-III, than originally anticipated. All of the additional and updated information identified in this paragraph is reflected in the discussion set forth in this response.

With the exception of the new and updated information described above, this response is submitted in addition to Section VIII of the Waiver Application, and is not intended to replace or supersede any of the content of the Waiver Application. By submission of this response NCES does not imply or concede that the Waiver Application is insufficient to entitle NCES to the requested waivers.

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[1] Based on a phone call with Paul Gildersleeve on May 27, 2014, NCES understands that the citation is intended to refer to Env-Sw 202.04(a)(1) and (2) and 202.04(b).

## II. Individual and Separate Application of Criteria of Env-Sw 202.04

A. Waiver of Env-Sw 805.07(a)(1)

Env-Sw 805.07(a)(1) provides that a leak detection and location system is not required where "the potential for leakage through the bottom most liner is reduced" by incorporation of geonet "throughout" the leachate collection and removal system "to rapidly convey leachate off the liner and thereby limit the potential for hydraulic head to develop on the liner." The secondary liner of Stage I, Phases I-III does not incorporate geonet over its entire surface, and NCES has therefore applied for a waiver of the requirement that geonet be incorporated "throughout." All of the applicable criteria for such a waiver are satisfied in this case.

1. Env-Sw 202.04(a)(1)a

The first criterion of Env-Sw 202.04(a)(1) is that "[e]xemption from complying with the rule will . . . [n]ot result in an adverse effect to the environment or natural resources of the state, public health or to public safety." Env-Sw 202.04(a)(1)a. That criterion is satisfied in this case because there is no material difference between the protection that the liner system of Stage I, Phases I-III now provides to the environment or natural resources of the state, public health and public safety, and the protection that would be provided by an overlay liner. As discussed in more detail in the Waiver Application:

(a) The requirement for incorporation of geonet is intended to reduce the potential for leakage of leachate by reducing the buildup of hydraulic head. *See* Env-Sw 805.07(a)(1). All of the areas of the liner with relatively high hydraulic head (i.e., header pipe trenches and sumps) are already lined with geonet.

(b) With respect to the sand-drained areas of the liner, calculated average head, conservatively based on ALR, is only 0.33 inches, exceeding performance criteria for hydraulic head by at least a factor of forty. Thus, hydraulic heads in these areas are already so low that, as a practical matter, the potential for leakage of any consequence does not exist.

(c) The potential for leachate leakage in the sand-drained areas is further reduced because there is a negligible ongoing supply of leachate to leak through any imperfection in the liner because of dispersed leachate flow (sheet flow).

(d) The potential for leachate leakage in the sand-drained areas is also reduced because the low to moderately permeable screened till subgrade layer limits leakage through the secondary liner and promotes lateral flow and containment of the leachate within the secondary collection and containment systems.

There is therefore no material difference between the protection that the liner system of Stage I, Phases I-III now provides to the environment or natural resources of the state, public health and public safety and the protection that would be provided by an overlay liner. The first requirement of Env-Sw 202.04(a)(1) is therefore satisfied.

2. Env-Sw 202.04(a)(1)b

The second criterion of Env-Sw 202.04(a)(1) is that "[e]xemption from complying with the rule will . . . [n]ot result in an impact on abutting properties that is more significant than that which would result from complying with the rule." The second criterion is satisfied in this case because there is no material difference between the protection that the liner system of Stage I, Phases I-III now provides abutting properties, and the protection that would be provided by an overlay liner. As discussed in more detail in the Waiver Application:

(a) The requirement for incorporation of geonet is intended to reduce the potential for leakage of leachate by reducing the buildup of hydraulic head. *See* Env-Sw 805.07(a)(1). All of the areas of the liner with relatively high hydraulic head (i.e., header pipe trenches and sumps) are already lined with geonet.

(b) With respect to the sand-drained areas of the liner, calculated average head, conservatively based on ALR, is only 0.33 inches, exceeding performance criteria for hydraulic head by at least a factor of forty. Thus, hydraulic heads in these areas are already so low that, as a practical matter, the potential for leakage of any consequence does not exist.

(c) The potential for leachate leakage in the sand-drained areas is further reduced because there is a negligible ongoing supply of leachate to leak through any imperfection in the liner because of dispersed leachate flow (sheet flow).

(d) The potential for leachate leakage in the sand-drained areas is also reduced because the low to moderately permeable screened till subgrade layer limits leakage through the secondary liner and promotes lateral flow and containment of the leachate within the secondary collection and containment systems.

There is therefore no material difference between the protection that the liner system of Stage I, Phases I-III now provides to abutting properties and the protection that would be provided by an overlay liner. As a result, a waiver will not result in a more significant impact on such properties. The second criterion of Env-Sw 202.04(a)(1) is therefore satisfied.

3. Env-Sw 202.04(a)(1)c.

The third criterion of Env-Sw 202.04 is that "[e]xemption from complying with the rule will . . . [b]e in keeping with the intent and purpose of the rule being waived."

The express purpose for requiring geonet throughout the secondary liner is to rapidly convey leachate off the liner and thereby limit the potential for hydraulic head to develop on the liner. Env-Sw 805.07(a)(1). The express purpose for limiting the potential for hydraulic head to develop on the liner is to reduce the potential for leakage. Env-Sw 805.07(a).

As discussed in more detail in the Waiver Application, a waiver of Env-Sw 805.07(a)(1) under the circumstances presented here would be consistent with the intent and purpose of the rule for the following reasons:

(a) All of the areas of the liner with comparatively high hydraulic head (i.e., header pipe trenches and sumps) are already lined with geonet.

(b) With respect to the sand-drained areas of the liner, calculated average head, conservatively based on ALR, is only 0.33 inches, exceeding performance criteria for hydraulic head by at least a factor of forty. Thus, hydraulic heads in these areas are already so low that, as a practical matter, the potential for leakage of any consequence does not exist.

(c) The potential for leachate leakage in the sand-drained areas is further reduced because there is a negligible ongoing supply of leachate to leak through any imperfection in the liner because of dispersed leachate flow (sheet flow).

(d) The potential for leachate leakage in the sand-drained areas is also reduced because the low to moderately permeable screened till subgrade layer limits leakage through the secondary liner and promotes lateral flow and containment of the leachate within the secondary collection and containment systems.

The intent and purpose of the rule is to reduce the potential buildup of hydraulic head and, as a consequence, the potential for leakage of leachate. That intent and purpose is already satisfied without requiring an overlay liner. Waiver of Env-Sw 805.07(a)(1) is therefore in keeping with the intent and purpose of the rule.

4. Env-Sw 202.04(a)(2)c.

In addition to the three criteria of Env-Sw 202.04(a)(1), to obtain a waiver requires that one of the three criteria of Env-Sw 202.04(a)(2) must be satisfied as well. In this case, the relevant criterion is set forth in subsection c: "[s]trict compliance with the rule will provide no benefit to the public and will cause an operational or economic hardship to the applicant." In this instance, "strict compliance" from NHDES's

standpoint would require construction of an overlay liner. As discussed in more detail in the Waiver Application, strict compliance would provide no benefit to the public and would cause operational or economic hardship to NCES for the following reasons:

(a) There is no deficiency in the performance of the liner of Stage I, Phases I-III:

1. The requirement for incorporation of geonet is intended to reduce the potential for leakage of leachate by reducing the buildup of hydraulic head. *See* Env-Sw 805.07(a)(1). All of the areas of the liner with relatively high hydraulic head (i.e., header pipe trenches and sumps) are already lined with geonet.

2. With respect to the sand-drained areas of the liner, calculated average head, conservatively based on ALR only, is 0.33 inches, exceeding performance criteria for hydraulic head by at least a factor of forty. Thus, hydraulic heads in these areas are already so low that, as a practical matter, the potential for leakage of any consequence does not exist.

3. The potential for leachate leakage in the sand-drained areas is further reduced because there is a negligible ongoing supply of leachate to leak through any imperfection in the liner because of dispersed leachate flow (sheet flow).

4. The potential for leachate leakage in the sand-drained areas is also reduced because the low to moderately permeable screened till subgrade layer limits leakage through the secondary liner and promotes lateral flow and containment of the leachate within the secondary collection and containment systems.

As a result, there is no rational basis – beyond mere redundancy – to conclude that an overlay liner would provide any greater protection to the public than the existing liners do. Absent some demonstration that the state-approved design of the Stage I, Phases I-III, secondary liners is inherently dangerous to the public or that the actual performance of the liners poses a risk to the public, there is no ground for the conclusion that an overlay liner will provide a benefit to the public.

(b) One purpose of a double-liner system is to provide redundancy. The performance of the Stage I, Phases I-III, liners establish that they are meeting that purpose. Requiring NCES to spend $3 million or more on an overlay liner merely to add two more layers of redundancy imposes an economic hardship on NCES for no demonstrable improvement in environmental protection.

(c) An overlay liner would create operational challenges for NCES. Env-Sw 1103.01(b)(1) and (2) specify that where options exist relative to design concepts, preference shall be given to the option providing the least complex alternative for facility construction, operation and maintenance, and exhibiting the required performance standards. An overlay liner would unnecessarily complicate management of the landfill, landfill gas, and leachate:

1. Such a liner would restrict future access to Stage I waste and to the Stage I landfill gas collection systems for replacement or repair purposes.

2. With an overlay liner in place, the relatively thin layer of Stage V waste would create greater opportunity for both ambient air intrusion into, and fugitive emissions from, the operation of the shallow gas collection system.

3. Any overlay liner would have to include several new redundant systems, such as horizontal collectors beneath the overlay liner and additional vertical wells along the perimeter of the overlay liner.

4. The control of the vacuum to existing Stage I gas wells and collectors would have to be extended laterally to access points outside of the overlay liner limits.

5. Any overlay liner design would have to include a secondary leachate collection system separate from the base liner secondary system. This separate leak detection system would require additional and unnecessary flow pumping, volume measurement, laboratory testing and reporting.

Because requiring an overlay liner will provide no benefit to the public and will engender both operational and economic hardships, NCES has satisfied the criterion set forth in Env-Sw 202.04(a)(2)c.

5. Env-Sw 202.04(b)

Env-Sw 202.04(b) requires that economic, technological, practical application and safety issues be considered in evaluating a demonstration of the criteria of Env-Sw 202.04(a). Cost alone is not to be determinative, however. As discussed in more detail in the Waiver Application, the following factors satisfy this requirement:

(a) It would cost $3 million or more to install an overlay liner.

(b) An overlay liner would unnecessarily complicate landfill gas management of the underlying Stage I waste because such a liner would restrict future

access to Stage I waste and to the Stage I landfill gas collection systems for replacement or repair purposes.

(c) With an overlay liner in place, the relatively thin layer of Stage V waste would create greater opportunity for both ambient air intrusion into, and fugitive emissions from, the operation of the shallow gas collection system.

(d) An overlay liner would need several new redundant systems, such as horizontal collectors beneath the overlay liner, and additional vertical wells along the perimeter of the overlay liner.

(e) The control of the vacuum to existing Stage I gas wells and collectors would need to be extended laterally to access points outside of the overlay liner limits.

(f) Any overlay liner design would have to include a secondary leachate collection system separate from the base liner secondary system. This separate leak detection system would require additional and unnecessary flow pumping, volume measurement, laboratory testing and reporting.

When viewed in light of the factors enumerated in Env-Sw 202.04(b), the waiver criteria of Env-Sw 202.04(a) are satisfied in this case, and NCES is entitled to a waiver of the requirements of Env-Sw 805.07(a)(1).

B. Waiver of Env-Sw 805.07(b)(1)

Env-Sw 805.07(b)(1) provides that "[l]eak detection and location systems shall be designed to . . . [c]onvey liquids to an observation point for detection, based on a maximum time of concentration equal to 24-hours under saturated hydraulic conditions." The 24-hour response time requirement exists so that a leak can be detected, located, and repaired within a short period after it is created. As discussed in more detail in the Waiver Application, the purpose of the 24-hour response time is no longer applicable to the Stage I, Phases I-III, liner systems.

Accordingly, NCES has applied for a waiver of the requirements of Env-Sw 805.07(b)(1). All of the requirements for such a waiver are satisfied in this case.

1. Env-Sw 202.04(a)(1)a

The first criterion of Env-Sw 202.04(a)(1) is that "[e]xemption from complying with the rule will . . . [n]ot result in an adverse effect to the environment or natural resources of the state, public health or to public safety." Env-Sw 202.04(a)(1)a. That criterion is satisfied in this case, because there is no material difference between the protection that the liner system of Stage I, Phases I-III now provides to the environment or natural resources of the state, public health and public safety, and the protection that

would be provided by a 24-hour response time. As discussed in more detail in the Waiver Application:

(a) The premise of the rule is that, with rapid leak detection, damage to any particular area of the liner can be identified based on the location of active work within the previous 24 hours of leak detection.

(b) A very substantial layer of waste now overlies the Stage I liner, and construction and other operations in Stage V cannot damage that liner. Nor will construction of Stage V require exposure of the Stage I primary liner. Thus, it is not possible for any punctures or defects in the Stage I primary liner to be caused by Stage V construction activities or operations in these areas such that 24-hour leak detection would permit a correlation between the leak and any activity conducted in Stage V. Without such a correlation, increased secondary flows provide no reliable information about the location of a leak.

(c) In the very remote event of catastrophic (e.g., earthquake) damage or spontaneous development of a new leak in the primary liner, the purpose of detection of a leak would not be to isolate the location of the leak and repair it. Rather, the only feasible response would be to cap the pertinent section of the landfill.

(d) Where the only feasible response to a leak would be to cap the pertinent section of the landfill, there would be no benefit or utility to detecting a leak in the primary liner within 24 hours because the closure design and construction would take many months. Nor would the remedy be finding and repairing the leak, because removal of thousands of tons of waste in the landfill to expose the liner for inspection is not feasible.

There is therefore no material difference between the protection that the liner system of Stage I, Phases I-III now provides to the environment or natural resources of the state, public health and public safety, and the protection that would be provided by a 24-hour response time. The first criterion of Env-Sw 202.04(a)(1) is therefore satisfied.

2. Env-Sw 202.04(a)(1)b

The second criterion of Env-Sw 202.04(a)(1) is that "[e]xemption from complying with the rule will . . . [n]ot result in an impact on abutting properties that is more significant than that which would result from complying with the rule." The second criterion is satisfied in this case, because there is no material difference between the protection that the liner system of Stage I, Phases I-III now provides to abutting properties and the protection that would be provided by a 24-hour response time. As discussed in more detail in the Waiver Application:

(a) The premise of the rule is that, with rapid leak detection, damage to any particular area of the liner can be identified based on the location of active work within the previous 24 hours of leak detection.

(b) A very substantial layer of waste now overlies the Stage I liner, and construction and other operations in Stage V cannot damage that liner. Nor will construction of Stage V require exposure of the Stage I primary liner. Thus, it is not possible for any punctures or defects in the Stage I primary liner to be caused by Stage V construction activities or operations in these areas such that 24-hour leak detection would permit a correlation between the leak and any activity conducted in Stage V. Without such a correlation, increased secondary flows provide no reliable information about the location of a leak.

(c) In the very remote event of catastrophic (e.g., earthquake) damage or spontaneous development of a new leak in the primary liner, the purpose of detection of a leak would not be to isolate the location of the leak and repair it. Rather, the only feasible response would be to cap the pertinent section of the landfill.

(d) Where the only feasible response to a leak would be to cap the pertinent section of the landfill, there would be no benefit or utility to detecting a leak in the primary liner within 24 hours because the closure design and construction would take many months. Nor would the remedy be finding and repairing the leak, because removal of thousands of tons of waste in the landfill to expose the liner for inspection is not feasible.

There is therefore no material difference between the protection that the liner system of Stage I, Phases I-III now provides to abutting properties, and the protection that would be provided by a 24-hour response time. As a result, a waiver will not result in a more significant impact on such properties. The second criterion of Env-Sw 202.04(a)(1) is therefore satisfied.

3. Env-Sw 202.04(a)(1)c.

The third criterion of Env-Sw 202.04 is that "[e]xemption from complying with the rule will . . . [b]e in keeping with the intent and purpose of the rule being waived."

The purpose of the 24-hour response time requirement is to isolate the location of a leak quickly and then repair it by correlating the time of the leak with construction or other activity at a particular location at the landfill. That rationale does not apply in this case for the following reasons:

(a) The premise of the rule is that, with rapid leak detection, damage to any particular area of the liner can be identified based on the location of active work within the previous 24 hours of leak detection.

(b) A very substantial layer of waste now overlies the Stage I liner, and construction and other operations in Stage V cannot damage that liner. Nor will construction of Stage V require exposure of the Stage I primary liner. Thus, it is not possible for any punctures or defects in the Stage I primary liner to be caused by Stage V construction activities or operations in these areas such that 24-hour leak detection would permit a correlation between the leak and any activity conducted in Stage V. Without such a correlation, increased secondary flows provide no reliable information about the location of a leak.

(c) In the very remote event of catastrophic (e.g., earthquake) damage or spontaneous development of a new leak in the primary liner, the purpose of detection of a leak would not be to isolate the location of the leak and repair it. Rather, the only feasible response would be to cap the pertinent section of the landfill.

(d) Where the only feasible response to a leak would be to cap the pertinent section of the landfill, there would be no benefit or utility to detecting a leak in the primary liner within 24 hours because the closure design and construction would take many months. Nor would the remedy be finding and repairing the leak, because removal of thousands of tons of waste in the landfill to expose the liner for inspection is not feasible.

Because compliance with the rule would not further the objectives of the rule in this particular case, waiver of the rule is in keeping with its intent and purpose. The third criterion of Env-Sw 202.04(a)(1) is therefore satisfied with respect to Env-Sw 805.07(b)(1).

4. Env-Sw 202.04(a)(2)c.

In addition to the three criteria of Env-Sw 202.04(a)(1), to obtain a waiver one of the three criteria of Env-Sw 202.04(a)(2) must be satisfied as well. In this case, the relevant criterion is set forth in subsection c: "[s]trict compliance with the rule will provide no benefit to the public and will cause an operational or economic hardship to the applicant." In this instance, "strict compliance" from NHDES's standpoint would require NCES to construct an overlay liner to meet the 24-hour response time requirement. As discussed in more detail in the Waiver Application, strict compliance would provide no benefit to the public and would cause operational or economic hardship to NCES for the following reasons:

(a) The purpose of the 24-hour response time does not apply to the secondary liner of Stage I, Phases I-III under current circumstances:

1. The premise of the 24-hour response time rule is that, with rapid leak detection, damage to any particular area of the liner can be identified based on the location of active work within the previous 24 hours of leak detection.

2. A very substantial layer of waste now overlies the Stage I liner, and construction and other operations in Stage V cannot damage that liner. Nor will construction of Stage V require exposure of the Stage I primary liner. Thus, it is not possible for any punctures or defects in the Stage I primary liner to be caused by Stage V construction activities or operations in these areas such that 24-hour leak detection would permit a correlation between the leak and any activity conducted in Stage V. Without such a correlation, increased secondary flows provide no reliable information about the location of a leak.

3. In the very remote event of catastrophic (e.g., earthquake) damage or spontaneous development of a new leak in the primary liner, the purpose of detection of a leak would not be to isolate the location of the leak and repair it. Rather, the only feasible response would be to cap the pertinent section of the landfill.

4. Where the only feasible response to a leak would be to cap the pertinent section of the landfill, there would be no benefit or utility to detecting a leak in the primary liner within 24 hours because the closure design and construction would take many months. Nor would the remedy be finding and repairing the leak, because removal of thousands of tons of waste in the landfill to expose the liner for inspection is not feasible.

There would therefore be no benefit to the public if a 24-hour response time were required under the circumstances of this case.

(b) Requiring NCES to spend $3 million or more on an overlay liner to satisfy a 24-hour response time requirement when meeting that requirement would not assist in isolating or repairing a leak imposes an economic hardship on NCES for no demonstrable improvement in environmental protection.

(c) An overlay liner would create operational challenges for NCES. Env-Sw 1103.01(b)(1) and (2) specify that where options exist relative to design concepts, preference shall be given to the option providing the least complex alternative for facility construction, operation and maintenance, and exhibiting the required performance standards. An overlay liner would unnecessarily complicate the management of the landfill, landfill gas, and leachate:

1. Such a liner would restrict future access to Stage I waste and to the Stage I landfill gas collection systems for replacement or repair purposes.

2. With an overlay liner in place, the relatively thin layer of Stage V waste would create greater opportunity for both ambient air intrusion into, and fugitive emissions from, the operation of the shallow gas collection system.

3. The control of the vacuum to existing Stage I gas wells and collectors would have to be extended laterally to access points outside of the overlay liner limits.

4. Any overlay liner design would have to include a secondary leachate collection system separate from the base liner secondary system. This separate leak detection system would require additional and unnecessary flow pumping, volume measurement, laboratory testing and reporting.

Because requiring an overlay liner will provide no benefit to the public and will engender both operational and economic hardships, NCES has satisfied the criterion set forth in Env-Sw 202.04(a)(2)c.

5. Env-Sw 202.04(b)

Env-Sw 202.04(b) requires that economic, technological, practical application and safety issues be considered in evaluating a demonstration of the criteria of Env-Sw 202.04(a). Cost alone is not to be determinative, however. As discussed in more detail in the Waiver Application, the following factors satisfy this requirement:

(a) It would cost $3 million or more to install a new liner.

(b) An overlay liner would unnecessarily complicate landfill gas management of the underlying Stage I waste as it would restrict future access to that waste and to the Stage I landfill gas collection systems.

(c) With an overlay liner in place, the relatively thin layer of Stage V waste would create greater opportunity for both ambient air intrusion into, and fugitive emissions from, the operation of the shallow gas collection system.

(d) Any overlay liner would need several new redundant systems, such as horizontal collectors beneath the overlay liner, and additional vertical wells along the perimeter of the overlay liner.

(e) The control of the vacuum to existing Stage I gas wells and collectors would need to be extended laterally to access points outside of the overlay liner limits.

(f) Any overlay liner design would have to include a secondary leachate collection system separate from the base liner secondary system. This separate leak detection system would require additional and unnecessary flow pumping, volume measurement, laboratory testing and reporting.

When viewed in light of the factors enumerated in Env-Sw 202.04(b), the waiver criteria of Env-Sw 202.04(a) are satisfied in this case, and NCES is entitled to a waiver of the requirements of Env-Sw 805.07(b)(1).

**North Country Environmental Services**
**Table 1 - Secondary Leachate Flows**

| | Stage I | | |
|---|---|---|---|
| **Monthly Average** | **Phase I** | **Phase II** | **Phase III** |
| | Gal/Ac/Day | Gal/Ac/Day | Gal/Ac/Day |
| January-95 | 0.00 | 0.00 | 2.17 |
| February-95 | 0.00 | 0.07 | 0.90 |
| March-95 | 0.00 | 0.02 | 5.22 |
| April-95 | 0.00 | 0.00 | 1.36 |
| May-95 | 0.00 | 0.00 | 0.62 |
| June-95 | 0.00 | 0.00 | 0.33 |
| July-95 | 0.00 | 0.00 | 0.30 |
| August-95 | 0.00 | 0.02 | 0.25 |
| September-95 | 0.00 | 0.00 | 6.69 |
| October-95 | 15.11 | 16.97 | 14.85 |
| November-95 | 12.68 | 1.77 | 0.00 |
| December-95 | 7.32 | 0.53 | 4.95 |
| January-96 | 60.16 | 0.00 | 4.60 |
| February-96 | 6.64 | 1.82 | 8.46 |
| March-96 | 3.82 | 1.22 | 3.99 |
| April-96 | 2.99 | 17.73 | 15.78 |
| May-96 | 1.88 | 12.80 | 9.40 |
| June-96 | 0.89 | 1.93 | 1.61 |
| July-96 | 8.04 | 0.94 | 5.54 |
| August-96 | 4.92 | 1.04 | 14.25 |
| September-96 | 3.64 | 0.00 | 3.48 |
| October-96 | 5.16 | 0.00 | 4.33 |
| November-96 | 4.51 | 0.00 | 4.39 |
| December-96 | 8.50 | 7.66 | 34.25 |
| January-97 | 1.05 | 0.66 | 8.57 |
| February-97 | 0.00 | 0.75 | 14.43 |
| March-97 | 0.00 | 0.00 | 0.00 |
| April-97 | 0.00 | 0.00 | 4.28 |
| May-97 | 0.49 | 0.00 | 5.14 |
| June-97 | 0.00 | 0.00 | 0.00 |
| July-97 | 0.00 | 0.00 | 0.87 |
| August-97 | 0.00 | 18.85 | 39.01 |
| September-97 | 8.73 | 9.42 | 55.11 |
| October-97 | 98.44 | 18.14 | 20.56 |
| November-97 | 7.23 | 23.97 | 149.31 |
| December-97 | 0.00 | 1.20 | 60.97 |
| January-98 | 0.00 | 64.92 | 249.87 |
| February-98 | 0.00 | 0.00 | 20.34 |
| March-98 | 0.00 | 43.47 | 39.54 |
| April-98 | 0.00 | 10.81 | 78.11 |
| May-98 | 0.00 | 0.00 | 33.85 |
| June-98 | 0.00 | 9.91 | 49.53 |
| July-98 | 0.00 | 26.56 | 73.51 |
| August-98 | 0.00 | 10.81 | 16.12 |
| September-98 | 4.71 | 12.16 | 23.06 |
| October-98 | 0.20 | 3.20 | 7.10 |

**North Country Environmental Services**
**Table 1 - Secondary Leachate Flows**

| | Stage I | | |
|---|---|---|---|
| **Monthly Average** | **Phase I** | **Phase II** | **Phase III** |
| | Gal/Ac/Day | Gal/Ac/Day | Gal/Ac/Day |
| November-98 | 0.00 | 6.20 | 4.90 |
| December-98 | 0.00 | 20.40 | 7.00 |
| January-99 | 0.00 | 40.90 | 7.29 |
| February-99 | 0.00 | 4.46 | 25.44 |
| March-99 | 0.00 | 3.59 | 24.23 |
| April-99 | 0.00 | 9.09 | 41.07 |
| May-99 | 0.00 | 0.00 | 11.79 |
| June-99 | 0.00 | 0.00 | 11.53 |
| July-99 | 0.00 | 14.78 | 6.24 |
| August-99 | 0.00 | 0.00 | 11.66 |
| September-99 | 0.00 | 11.46 | 11.41 |
| October-99 | 0.00 | 1.82 | 18.38 |
| November-99 | 0.00 | 15.30 | 9.63 |
| December-99 | 0.00 | 36.60 | 17.36 |
| January-00 | 0.00 | 4.89 | 6.96 |
| February-00 | 0.00 | 2.86 | 13.38 |
| March-00 | 0.00 | 18.71 | 8.74 |
| April-00 | 2.83 | 162.61 | 100.76 |
| May-00 | 0.00 | 170.80 | 58.29 |
| June-00 | 0.00 | 33.82 | 14.57 |
| July-00 | 0.00 | 0.61 | 12.77 |
| August-00 | 0.00 | 0.00 | 17.16 |
| September-00 | 0.00 | 0.21 | 0.00 |
| October-00 | 0.10 | 5.59 | 18.60 |
| November-00 | 3.30 | 0.00 | 6.60 |
| December-00 | 0.00 | 39.68 | 18.89 |
| January-01 | 0.00 | 0.45 | 0.79 |
| February-01 | 0.00 | 0.00 | 17.77 |
| March-01 | 0.00 | 0.98 | 18.22 |
| April-01 | 0.00 | 223.41 | 149.28 |
| May-01 | 4.28 | 64.00 | 45.78 |
| June-01 | 0.00 | 15.59 | 12.66 |
| July-01 | 0.00 | 0.00 | 10.17 |
| August-01 | 0.00 | 0.80 | 8.74 |
| September-01 | 0.00 | 0.51 | 7.06 |
| October-01 | 0.00 | 0.00 | 5.18 |
| November-01 | 0.00 | 0.00 | 12.54 |
| December-01 | 0.00 | 0.10 | 12.81 |
| January-02 | 0.00 | 28.09 | 16.03 |
| February-02 | 0.00 | 42.16 | 39.25 |
| March-02 | 0.00 | 197.72 | 39.07 |
| April-02 | 0.00 | 63.86 | 49.40 |
| May-02 | 0.00 | 119.35 | 61.39 |
| June-02 | 0.00 | 76.32 | 33.41 |
| July-02 | 0.47 | 19.89 | 28.30 |
| August-02 | 0.00 | 12.32 | 14.58 |

**North Country Environmental Services**
**Table 1 - Secondary Leachate Flows**

| | Stage I | | |
|---|---|---|---|
| **Monthly Average** | **Phase I** | **Phase II** | **Phase III** |
| | Gal/Ac/Day | Gal/Ac/Day | Gal/Ac/Day |
| September-02 | 0.00 | 3.38 | 2.59 |
| October-02 | 0.00 | 0.32 | 1.04 |
| November-02 | 0.00 | 0.00 | 21.32 |
| December-02 | 0.00 | 0.00 | 18.36 |
| January-03 | 0.00 | 0.04 | 9.30 |
| February-03 | 0.00 | 0.00 | 8.46 |
| March-03 | 0.11 | 13.11 | 10.95 |
| April-03 | 0.00 | 0.94 | 7.55 |
| May-03 | 0.00 | 9.04 | 7.47 |
| June-03 | 0.00 | 0.00 | 3.31 |
| July-03 | 0.00 | 0.37 | 1.91 |
| August-03 | 0.00 | 0.00 | 0.56 |
| September-03 | 0.00 | 0.00 | 0.00 |
| October-03 | 0.00 | 0.00 | 0.00 |
| November-03 | 0.00 | 0.00 | 0.00 |
| December-03 | 0.00 | 0.00 | 0.00 |
| January-04 | 0.00 | 17.44 | 0.00 |
| February-04 | 0.00 | 0.00 | 0.00 |
| March-04 | 0.00 | 5.22 | 2.17 |
| April-04 | 0.00 | 0.58 | 6.03 |
| May-04 | 0.00 | 14.57 | 6.21 |
| June-04 | 0.00 | 0.00 | 10.13 |
| July-04 | 0.00 | 0.00 | 22.08 |
| August-04 | 0.00 | 0.00 | 14.83 |
| September-04 | 0.00 | 0.02 | 4.67 |
| October-04 | 0.00 | 4.58 | 5.40 |
| November-04 | 0.00 | 0.54 | 0.00 |
| December-04 | 0.00 | 14.73 | 1.97 |
| January-05 | 0.00 | 8.69 | 0.00 |
| February-05 | 0.00 | 1.16 | 1.83 |
| March-05 | 0.00 | 0.96 | 21.57 |
| April-05 | 0.00 | 13.47 | 1.46 |
| May-05 | 0.00 | 0.42 | 0.00 |
| June-05 | 0.00 | 0.06 | 0.00 |
| July-05 | 0.00 | 0.00 | 0.00 |
| August-05 | 0.00 | 0.00 | 0.02 |
| September-05 | 0.00 | 10.48 | 8.46 |
| October-05 | 0.00 | 4.05 | 3.88 |
| November-05 | 0.00 | 0.54 | 0.00 |
| December-05 | 0.00 | 0.00 | 0.00 |
| January-06 | 0.00 | 43.50 | 29.18 |
| February-06 | 0.00 | 25.71 | 31.77 |
| March-06 | 0.00 | 2.61 | 16.84 |
| April-06 | 0.00 | 1.82 | 13.23 |
| May-06 | 14.40 | 7.14 | 18.43 |
| June-06 | 11.43 | 12.04 | 7.42 |

**North Country Environmental Services**
**Table 1 - Secondary Leachate Flows**

| | Stage I | | |
|---|---|---|---|
| **Monthly Average** | **Phase I** | **Phase II** | **Phase III** |
| | Gal/Ac/Day | Gal/Ac/Day | Gal/Ac/Day |
| July-06 | 17.00 | 2.65 | 17.01 |
| August-06 | 14.78 | 4.22 | 4.91 |
| September-06 | 3.09 | 0.89 | 24.62 |
| October-06 | 6.25 | 11.70 | 20.17 |
| November-06 | 17.38 | 12.57 | 19.11 |
| December-06 | 18.13 | 4.47 | 22.03 |
| January-07 | 91.02 | 6.25 | 20.24 |
| February-07 | 23.62 | 0.98 | 15.81 |
| March-07 | 90.67 | 34.15 | 30.28 |
| April-07 | 108.88 | 32.01 | 36.13 |
| May-07 | 17.73 | 3.00 | 20.67 |
| June-07 | 15.01 | 1.61 | 19.98 |
| July-07 | 7.64 | 1.59 | 21.12 |
| August-07 | 8.32 | 5.79 | 17.08 |
| September-07 | 6.09 | 0.89 | 15.71 |
| October-07 | 8.46 | 3.45 | 16.90 |
| November-07 | 4.61 | 4.54 | 28.47 |
| December-07 | 3.63 | 11.66 | 23.38 |
| January-08 | 4.43 | 11.63 | 25.34 |
| February-08 | 4.03 | 18.69 | 21.78 |
| March-08 | 2.61 | 2.17 | 38.91 |
| April-08 | 7.92 | 16.57 | 31.96 |
| May-08 | 12.02 | 7.69 | 18.79 |
| June-08 | 14.44 | 2.73 | 19.11 |
| July-08 | 11.17 | 11.64 | 24.08 |
| August-08 | 33.00 | 24.13 | 28.93 |
| September-08 | 17.60 | 6.18 | 16.66 |
| October-08 | 7.11 | 0.87 | 19.75 |
| November-08 | 13.13 | 0.47 | 45.86 |
| December-08 | 24.62 | 0.48 | 24.92 |
| January-09 | 23.57 | 0.02 | 70.31 |
| February-09 | 12.70 | 0.00 | 23.62 |
| March-09 | 57.31 | 0.00 | 50.90 |
| April-09 | 33.84 | 0.00 | 30.11 |
| May-09 | 13.74 | 0.00 | 13.23 |
| June-09 | 11.32 | 13.87 | 15.46 |
| July-09 | 11.11 | 22.53 | 10.10 |
| August-09 | 16.02 | 4.67 | 18.43 |
| September-09 | 6.86 | 3.63 | 14.01 |
| October-09 | 7.16 | 1.86 | 13.33 |
| November-09 | 6.95 | 6.04 | 9.44 |
| December-09 | 20.69 | 14.87 | 20.73 |
| January-10 | 17.33 | 0.00 | 0.00 |
| February-10 | 19.25 | 0.00 | 4.19 |
| March-10 | 13.77 | 0.03 | 0.68 |
| April-10 | 22.39 | 0.00 | 0.00 |

**North Country Environmental Services**
**Table 1 - Secondary Leachate Flows**

| | Stage I | | |
|---|---|---|---|
| **Monthly Average** | **Phase I** | **Phase II** | **Phase III** |
| | Gal/Ac/Day | Gal/Ac/Day | Gal/Ac/Day |
| May-10 | 65.82 | 0.00 | 0.00 |
| June-10 | 6.65 | 0.00 | 16.52 |
| July-10 | 5.41 | 0.00 | 0.00 |
| August-10 | 16.08 | 0.00 | 14.32 |
| September-10 | 0.00 | 0.00 | 14.45 |
| October-10 | 5.21 | 0.00 | 14.56 |
| November-10 | 5.14 | 19.25 | 42.19 |
| December-10 | 5.20 | 13.74 | 18.95 |
| January-11 | 12.08 | 0.00 | 18.79 |
| February-11 | 5.64 | 0.00 | 19.73 |
| March-11 | 16.88 | 0.00 | 29.11 |
| April-11 | 10.52 | 6.27 | 28.47 |
| May-11 | 9.49 | 0.01 | 27.21 |
| June-11 | 4.74 | 0.00 | 19.18 |
| July-11 | 2.34 | 0.00 | 15.29 |
| August-11 | 4.26 | 0.00 | 43.96 |
| September-11 | 2.57 | 12.84 | 92.68 |
| October-11 | 4.57 | 12.17 | 42.46 |
| November-11 | 1.94 | 0.00 | 31.68 |
| December-11 | 4.91 | 12.78 | 62.28 |
| January-12 | 7.29 | 0.00 | 35.32 |
| February-12 | 4.18 | 0.00 | 20.33 |
| March-12 | 6.11 | 11.96 | 40.17 |
| April-12 | 4.96 | 0.00 | 36.66 |
| May-12 | 10.00 | 13.00 | 49.00 |
| June-12 | 6.00 | 0.00 | 38.00 |
| July-12 | 5.00 | 12.00 | 31.00 |
| August-12 | 2.71 | 10.08 | 36.65 |
| September-12 | 3.00 | 0.00 | 24.00 |
| October-12 | 5.00 | 12.00 | 27.00 |
| November-12 | 3.00 | 24.00 | 26.00 |
| December-12 | 9.00 | 12.00 | 32.00 |
| January-13 | 10.00 | 11.00 | 26.00 |
| February-13 | 9.00 | 13.00 | 23.00 |
| March-13 | 10.00 | 10.00 | 24.00 |
| April-13 | *15.00* | *0.00* | *58.00* |
| May-13 | *12.00* | *0.00* | *58.00* |
| June-13 | *16.00* | *0.00* | *131.00* |
| July-13 | *279.00* | *92.00* | *113.00* |
| August-13 | - | - | - |
| September-13 | - | - | - |
| October-13 | - | - | - |
| November-13 | - | - | - |
| December-13 | - | - | - |
| January-14 | - | - | - |
| February-14 | - | - | - |

| **Stage IV** |
|---|
| **Phase II** |
| Gal/Ac/Day |
| *360* |
| *16* |
| *284* |
| *28* |
| 16 |
| 9 |
| 10 |
| 6 |

**North Country Environmental Services**
**Table 1 - Secondary Leachate Flows**

| | Stage I | | | |
|---|---|---|---|---|
| **Monthly Average** | **Phase I** | **Phase II** | **Phase III** | |
| | Gal/Ac/Day | Gal/Ac/Day | Gal/Ac/Day | |
| March-14 | - | - | - | 5 |
| April-14 | - | - | - | 6 |
| **Average** | **6.8** | **11** | **21** | **8.7** |

Notes

*Italics* indicate secondary flow is not included in the historical average. Flows reported during this time are not reflective of normal operations, as the secondary leachate collection system was open to precipitation and clean water runoff during construction of Stage IV Phase 2.

**CMA ENGINEERS, Inc.**

Civil/Environmental Engineers
35 Bow Street
Portsmouth, NH 03801

NCES Stage V
CMA #833
June 9, 2014
By: BWS Check: RJG

Flow Capacity through Select Drainage Sand

| Q=K*i* A (Darcy Equation) | | | Notes |
|---|---|---|---|
| K | 5.00E-03 | cm/s | Drainage sand permeability estimated based on specified grain size and limited fines |
| | 14.17 | ft/day | |
| *i* | 0.02 | | Slope of cell floor |
| A | 1 | $ft^2$ | 12" Drainage sand per foot width |
| Q | 0.283 | $ft^3$/day | Flow capacity per foot width |

| Head on Secondary Liner | Action Level | Historical S1P1-3 | S1P1-3 with new S4P2 Sump | Units | Notes |
|---|---|---|---|---|---|
| Secondary Leachate Flow Rates | 25 | 13 | 8.7 | gal/acre/day | |
| Area | 200 | 200 | 200 | $ft^2$ | Contributory area of longest drainage path per foot width |
| Flow Rate x Area | 0.015 | 0.008 | 0.005 | $ft^3$/day | Max flow at low end of cell |
| | 0.11 | 0.06 | 0.04 | gal/day | |
| Max Head on Liner | 0.65 | 0.34 | 0.23 | inches of head | Max head at low end of cell |
| Average Head on Liner[2] | 0.33 | 0.17 | 0.12 | inches of head | Head at mid-point of cell |

Flow Through Till Subgrade (Potential Leak Through 12"x12" Hole)

| Q=K*i* A (Darcy Equation) | Action Level | Historical S1P1-3 | S1P1-3 with new S4P2 Sump | Units | Notes |
|---|---|---|---|---|---|
| Secondary Leachate Flow Rates | 25 | 13 | 8.7 | gal/acre/day | |
| K | 1.00E-04 | 1.00E-04 | 1.00E-04 | cm/s | Screened till liner subbase |
| | 0.283 | 0.283 | 0.283 | ft/day | |
| *i* | 0.0541 | 0.0282 | 0.0188 | | Head on liner/12" thick till |
| A | 1 | 1 | 1 | $ft^2$ | |
| Q | 0.015345 | 0.007980 | 0.005340 | $ft^3$/day | Flow through defect |
| | 0.11478 | 0.05969 | 0.0399 | gal/day | |

Notes:

1. Onsite screened till permeability is for default values for USCS SM soil as determined by Terracon from sieve analysis performed on 9/27/11, as presented in the Stage IV, Phase II-A Construction Quality Assurance report.

2. Average head on liner calculation assumes average of max head on liner at sump and no head on liner at the high end of the cell.

*Appendix B – Public Benefit Replacement Page (19 & 20)*

CWS operates a series of six transfer stations serving broad regions of New Hampshire. These facilities recycle about 15,000 tons of other solid wastes per year. A summary of recycling tonnages and types at the transfer stations is included in Table 10.

#### 5.1.4 Goal 4: Assure Disposal Capacity for New Hampshire

The capacity analysis presented in Section 3.0 of this public benefit demonstration identifies a shortfall in disposal capacity for New Hampshire waste. For the 20-year planning period, permitted disposal capacity totals from about 15,500,000 to as little as 5,000,000 tons. Table 3. Projected quantities of New Hampshire waste total nearly 22,000,000 tons over the same period. Table 2. Permitting NCES Stage V will add about 1,558,440 tons of capacity during the planning period and assist the state in ensuring adequate disposal capacity for New Hampshire waste. Indeed, even with the Stage V capacity approved, New Hampshire is facing a shortfall of *at least* 4,802,904 tons over the 20-year planning period.[14] If DES takes into account only the capacity for which operating approval has been granted and assumes waste imports at the average rate in the state for 2010-2012 and closure of the Wheelabrator facility in Concord at the end of 2019, the shortfall over the 20-year period, even *with* the Stage V capacity, would be about 27,854,314 tons.[15] Given that the state will confront a shortfall over the next twenty years of modest to massive proportions, DES should approve Stage V because it mitigates the shortfall and therefore contributes to ensuring disposal capacity for New Hampshire waste.

#### 5.1.5 Goal 5: Assure that Solid Waste Management Activities are Conducted in a Manner Protective of Human Health and the Environment

The proposed Stage V Landfill is designed to meet or exceed regulatory requirements, to be operated responsibly by trained personnel, and to be monitored in accordance with relevant regulations. Moreover, Casella's commitment to operating all of its facilities in a safe and environmentally sound manner was recently recognized by the EPA.

In 2012, Casella received the EPA's Climate Leadership Award for Excellence in Greenhouse Gas Management – the only resource management company in the country to receive this distinction. CWS's ongoing commitment to greenhouse gas reduction is integral to a broader vision of sustainable waste management.[16] CWS reduced its carbon footprint by 45% in just five years by installing landfill gas collection and capping systems, installing three landfill gas-to-energy power plants, and investing in improved fleet routing.

#### 5.2.1 District Solid Waste Plans

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[14] 4,802,904 tons is the remainder after Stage V capacity (1,558,440 tons) is deducted from the low end of the range of capacity shortfall (6,361,344 tons). See section 3.4 *ante*.

[15] 27,854,314 tons is the remainder after Stage V capacity (1,558,440 tons) is deducted from the high end of the range of capacity shortfall (29,412,754 tons). See Section 3.5.1 *ante*.

[16] EPA 2012 Climate Leadership Award Winners (Feb. 5, 2014, 11:14AM), http://www.epa.gov/climateleadership/awards/2012winners.html#casella

The formation of solid waste districts in New Hampshire was prompted by the federal Resource Conservation and Recovery Act (RCRA). Among other things, RCRA required states to encourage regional efforts to manage solid waste.[17] One of the ways New Hampshire responded to this requirement was by enacting what is now RSA 149-M:24 and :25. Those sections of the solid waste act provide for the formation of single- or multi-member solid waste districts, and require each town or district to adopt a solid waste management plan approved by the department.

While numerous solid waste districts were formed in the 1980s, strict adherence to RSA 149-M:24 and :25 has waned. In fact, there are currently no approved district solid waste plans on file with NHDES.[18] Notwithstanding the lack of approved plans, municipalities are nonetheless making careful planning decisions about solid waste issues. These plans are sometimes reduced to writing and contained in, for example, municipal master plans.[19] Whether contained in a formal document or not, however, the conduct of many municipalities evidences that they are planning ahead for the solid waste disposal needs of their citizens with an emphasis on recycling and on the economical disposal of waste that is not recycled. For example, nineteen municipalities now belong to one of the largest and most active solid waste districts, the Pemi-Baker Solid Waste District (P-BSWD), the principal purpose of which has been to take advantage of economies of scale to provide cost-effective waste management for its member municipalities, including negotiation of contracts for long-term services. Whether through a multi-member solid waste district or as individual municipalities, however, many New Hampshire cities and towns have entered into long-term contracts for disposal of their solid waste, evidencing that they have planned how to manage their solid waste disposal needs.

The importance of NCES's landfill in Bethlehem to the solid waste management planning of New Hampshire municipalities and solid waste districts is evidenced in at least two ways. First, whether pursuant to a long-term contract or not, NCES receives solid waste originating in a large majority of New Hampshire's municipalities, showing that the facility is important to the management of solid waste statewide. Some of the waste is transported directly by municipal sanitation departments (See Table 7 and Figure 1), some through the waste-hauling and transfer station operations of NCES's affiliates (see Tables 4 and 5 and Figure 3), and some through unaffiliated third parties (see Table 6 and Figure 4). The full geographic breadth of the New Hampshire wasteshed served by NCES is shown on Figure 4.

Many New Hampshire municipalities, moreover, have entered into long-term contracts, either directly or through a multi-member solid waste district to provide for the disposal of their

[17] 42 U.S.C.A. § 6946

[18] NCES contacted NHDES to obtain waste management plans submitted to and approved by the department, but the department reported that no approved plans could be found on file. E-mail from W. Wheeler (1/17/14). NCES contacted nearly fifty cities and towns in an effort to obtain solid waste management plans of multiple or single town districts. None of the municipalities NCES contacted were able to provide a solid waste plan adopted in compliance with RSA ch. 149-M.

[19] See, e.g., Rumney Master Plan (2012) at 48 and Monroe Master Plan (2011) at 35, both of which provide for the disposal of solid waste at NCES's landfill in Bethlehem.

*Appendix C – Revised Operating Plan*

# FACILITY OPERATING PLAN

**North Country Environmental Services, Inc.**

**Bethlehem, New Hampshire**

*Prepared by:*

**CMA Engineers, Inc.**

**~~July 10, 2012~~ ~~February 2014~~June 2014**

# FACILITY OPERATING PLAN

**North Country Environmental Services, Inc.**

**Bethlehem, New Hampshire**

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## FACILITY OPERATING PLAN

This Facility Operating Plan (Plan) is for the North Country Environmental Services, Inc. (NCES) landfill facility located on Trudeau Road in Bethlehem, New Hampshire. The purpose of this Plan is to describe the operating requirements for the facility in accordance with the New Hampshire Solid Waste Rules. A copy of this Plan is to be maintained at the facility.

## 1.0 FACILITY IDENTIFICATION

The facility is owned and operated by NCES. The current mailing address and telephone number for the facility are:

North Country Environmental Services, Inc.
581 Trudeau Road, PO Box 9
Bethlehem, NH 03574
Telephone (603) 869-3366
Facsimile (603) 869-2152

The facility is a lined landfill comprised of four Stages. Stages I, II~~ and~~, III and IV were permitted by the New Hampshire Department of Environmental Services (NHDES) in 1987, 1989~~ and,~~ 2000 and 2003 (Permit Nos. DES-SW-87-022, DES-SW-89-009, ~~and~~ DES-SW-SP-00-003 and DES-SW-SP-03-002), respectively. ~~As part of the development of Stage II, an unlined landfill located in the general vicinity of the Stage II footprint was excavated and relocated to the Stage I landfill area. Phase I of Stage IV was constructed in 2006. Phase II-A of Stage IV was constructed in 2011.~~

The facility is a commercial disposal facility and has no restricted service area. The facility receives waste from commercial and residential sources.

## 2.0 AUTHORIZED AND PROHIBITED WASTES

### 2.1 Authorized Wastes

Wastes which may be accepted at the facility include:

- Municipal solid waste (MSW) as defined in State of New Hampshire Solid Waste rules.
- Construction and demolition (C&D) waste which includes non-putrescible building material waste and rubble. Examples of such waste include, but are not limited to, bricks, concrete, and other masonry materials, wood, wall coverings, plaster, dry wall, plumbing,

fixtures, non-asbestos insulation or roofing shingles, asphaltic pavement, glass, plastics, electrical wiring and components containing no hazardous liquids and/or metals that are incidental to any of the above.

- ~~NHDES-approved certified waste derived products~~
- ~~Special solid wastes which is~~are ~~not hazardous or otherwise a prohibited waste that is a solid waste~~ and ~~meets the conditions for disposal consistent with the NCES Special Waste Characterization Profile.~~~~Solid~~Non-liquid Special Waste, as defined in Section 3.3.2, which has received prior approval of NCES, in accordance with Section 3.3.2.1. Special Waste may include but is not limited to the following:~~which have received prior approval of the NHDES before being accepted. Requests for approval are to be accompanied by sufficient waste profile and generation information to facilitate NHDES' review and decision making process. Special wastes may include but are not limited to the following:~~

- Waste from industrial processes;
- Waste from pollution control processes including but not limited to water and wastewater treatment ~~plant~~ sludges and air pollution control residues;
- Residue from a spill of a ~~non-hazardous~~ chemical substance or commercial chemical product or a waste listed above;
- Commercial products which are off-specification, outdated, or unused;
- Waste produced during the demolition or dismantling of industrial process equipment;
- Waste produced during the demolition or dismantling of automobiles (auto fluff);
- Ash ~~which has been determined to be nonhazardous under the provisions of Env-Hw 502 which is~~ managed in accordance with the requirements of Env-Sw 902;
- Contaminated soils and media managed in accordance with Env-Sw 903; ~~and~~
- Contaminated residuals from the clean-up of a facility generating, storing, treating, recycling, or disposing wastes, chemical substances or commercial products listed above;
- Treated infectious waste which has been autoclaved, or otherwise treated and disinfected in accordance with the requirements of Env-Sw 904; and
- Other non-hazardous solid waste that requires special handling prior to disposal or acceptance in accordance with Section 3.3.2, such as wastes with excessive moisture content, fine particulate (i.e., dusty) wastes, and any waste that is not identifiable prior to analytical characterization.

- NHDES Certified Waste Derived Products as follows;
  - CWDP #14 - Auto Shredder ADC
  - CWDP #13 – Biosolids Incinerator Ash ADC
  - CWDP #10 Bottom Ash from Wood Fired Boilers ADC
  - CWDP #6 - C&D & Soil Mixture ADC
  - CWDP Merrimack Coal Fly Ash
  - CWDP Processed C&D (Refer to Appendix H)
  - Any other Certified Waste Derived Products approved by NHDES

- ~~**Waste from industrial processes;**~~
- ~~**Waste from pollution control processes including water and wastewater treatment plant sludge;**~~
- ~~**Residue from a spill of a non-hazardous chemical substance or commercial product or a waste listed above;**~~
- ~~**Commercial products which are off-specification, outdated, or unused;**~~
- ~~**Waste produced during the demolition or dismantling of industrial process equipment;**~~
- ~~**Waste produced during the demolition or dismantling of automobiles (auto fluff) or;**~~
- ~~**Ash which has been determined to be nonhazardous under the provisions of Env-Wm 502 which is managed in accordance with the requirements of Env-Sw 902.**~~

## 2.2 Prohibited Wastes

Wastes which are prohibited from disposal at the facility include the following:

- Those wastes prohibited by state and federal law;
- Hazardous wastes (as defined by the federal and New Hampshire Hazardous Waste Rules);
- Infectious waste;
- Asbestos waste including solid waste containing more than 1 percent asbestos by weight;

- Liquid wastes (that is waste containing free liquids as defined by Method 9095 Paint Filter Liquids Test as described in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods" [USEPA Pub. No. SW-846]);
- Contained gaseous wastes;
- White goods;
- Leaf and yard waste;
- Whole tires;
- S~~Non-approved s~~pecial wastes not ~~explicitly~~ approved by NCES;
- Mercury added products;
- Video Display Devices;
- Wet cell/M-Cad/Rechargeable Batteries; and
- Radioactive materials as defined by He-P 4000.

The definition of hazardous waste used at the NCES facility is as defined in the State of New Hampshire Hazardous Waste Rules. Customers are required to execute a Certificate of Acceptable Waste, and this form is included in Appendix A.

Incoming waste is to be monitored in accordance with the procedures outlined in Section 3.3. Those materials which are specified as unacceptable for disposal are to be rejected as described in Section 6.6.

# 3.0 ROUTINE OPERATIONS PLAN

## 3.1 Hours of Operation

Facility operating hours are generally from 7:00 a.m. to 3:00 p.m. Monday through Friday, and the facility may be open from 7:00 a.m. to 12:00 p.m. on Saturday. The facility may be closed on Sundays and the following holidays: New Years Day, Thanksgiving Day and Christmas Day. Additionally, the facility may be closed on Memorial Day, Independence Day and Labor Day. Operating hours are expanded as necessary to meet actual disposal requirements of facility users but are restricted to the hours of 6:00 a.m. and 6:00 p.m. All routine landfill operations and inspections, maintenance, repairs, and monitoring under non-emergency circumstances is to be conducted between the hours of 6:00 a.m. and 6:00 p.m. unless otherwise approved by NHDES.

The facility serves as a dispatch location for over the road waste collection vehicles (hauling division), vehicles associated with this operation may leave the facility prior to 6:00 am to service required early morning accounts. These vehicles may not tip waste at the landfill until 6:00 am.

Leachate is generally removed from the facility during routine operating hours; however, from time to time (i.e., such as during the spring snow melt season) it may be necessary to remove leachate from the facility during the hours from 6:00 p.m. to 6:00 a.m.

### 3.2 Access Control and On-Site Traffic Patterns

Access to the facility is restricted by an electronically operated locking gate located on the access road to the scale house from Trudeau Road. Another potential access point to the facility is via Muchmore Road located north of the landfill area. This abandoned access location has been blocked by a locked gate and boulders prohibiting vehicular access. ~~NCES also has additional security measures such as motion activated video surveillance and alarm systems.~~

Signs are to be posted and maintained at the entrance road, gate and scale house indicating:

1. The facility name and permit number;
2. The name, address, and telephone number of the Permitee;
3. The hours of operation;
4. The types of wastes accepted; and
5. A statement that unlawful dumping shall be subject to fine and prosecution.

The scale house is occupied by NCES personnel during daily operating hours. The scale house operator is also responsible for monitoring traffic flow at the facility gate. The gate is to be locked at night and when the landfill is closed.

The scale house is located near the entrance. Incoming vehicles stop at the scale and are weighed, then proceed to the landfill tipping area. The scale operator and equipment operators on the working face use a CB and/or a two-way radio to communicate. When appropriate, the scale operator will inform the operators at the working face that a truck has been cleared to proceed to the tipping area and provide any specifics on the load or special handling criteria. Operators use a CB radio to communicate with drivers and provide instructions as to where waste is to be discharged. After discharging loads, drivers return to the scale and are weighed to determine the net weight for the waste disposed. A weight ticket is then printed by the scale house operator and signed by the vehicle driver and the scale operator.

An access road is located around the facility. The location of access roadways to the active disposal area vary depending upon the location of the active disposal area. The landfill compactor operator has a CB radio and can contact waste haulers to provide instruction as to where waste is to be discharged.

## 3.3 Waste Review, Unloading and Inspection Procedures

### 3.3.1 Waste Review

NCES implements measures to restrict acceptance of prohibited wastes at this facility. Loads identified as having prohibited wastes (as listed in Section 2.2) are to be rejected as described in Section 6.6.

All waste delivery vehicles stop at the scale prior to proceeding into the landfill. The scale operator identifies the customer and queries the customer's account in the facility's computer system or manually enters a customer's information. The driver of the vehicle identifies the type and origin of waste which is entered into the facility's computer system by the scale house operator prior to allowing the vehicle to proceed to the active working area. Only waste authorized for disposal at the facility and identified as such by the waste hauler is allowed to proceed beyond the scale location. The driver must sign a scale ticket for every load delivered which includes a certification statement:

*"I certify under penalty of perjury that I am familiar with wastes authorized at this facility and that to the best of my knowledge all waste contained in this load is authorized for disposal at this facility".*

Loads of C&D materials delivered to the s~~S~~ite are to be visually inspected. Loads that are predominantly materials suitable for processing to produce alternative daily cover (ADC) (i.e., wood, cardboard, paper and other miscellaneous solid C&D debris), may be stockpiled within the active landfill. Loads of C&D materials that do not appear suitable for processing will be directed to the active face of the landfill and not stockpiled. In the event unsuitable materials (i.e., excessive trash or metals) are found in stockpiled materials they are to be removed by hand sorting or using a front loader or excavator. Metals may be recycled; trash and other debris are to be hauled to the working face for disposal.

In addition, trucks delivering Non-Hazardous Special Waste are not allowed beyond the scale area unless written approval has been issued by NCES, please~~received from the NHDES. R~~refer to section 3.3.2 for Special Waste Program for more detail.

The likelihood of unacceptable wastes being delivered to this facility will be minimized by:

1. Customer education;
2. Training landfill operations staff;
3. Signs posted at the facility; and
4. Inspections of incoming waste loads.

### 3.3.2 Special Waste Program

The facility has a comprehensive program for management and handling of Special Waste. This program is in addition to the procedures for unloading and inspection in Sections 3.3.5 and 3.3.6. Special Waste is defined as:

> *A non-hazardous waste, as defined by the New Hampshire Hazardous Waste Rules, which because of the process generating the waste or its physical, chemical and/or biological characteristics potentially requires special testing and/or handling.*

#### 3.3.2.1 Special Waste Acceptance

The evaluation of ~~waste generated by s~~Special ~~w~~Waste ~~customers~~ is conducted by an NCES technical representative(s) and includes the following.

- ~~—~~After the initial waste evaluation, the Special Waste Generator must complete a ~~Special Waste Profile Form~~ Special Waste Characterization Profile Form (included in Appendix A), which characterizes the waste to be disposed and includes a certification statement declaring the waste is not hazardous.
- ~~The completed and signed Special Waste Profile Form is initially reviewed by an NCES representative. If necessary, additional information and testing is requested of the generator or customer, to sufficiently ensure the wastes are non-hazardous and can be accepted at the Facility.~~Requests for the approval of Special Waste ~~is~~ are to be reviewed by the Special Waste ~~T~~technical ~~Manager~~staff to ensure that the wastes are non-hazardous and may be accepted under the facility permit. Waste streams are either approved by NCES, with or without special conditions for management of the material, or approval is denied.
- Odor generating potential will be assessed when Special Waste streams such as sludges are considered for disposal at the facility. NCES will impose as a condition of approval for special wastes (including wastewater treatment plant sludge) delivered to the facility that the generator shall provide odor control measures as necessary. NCES will also include as a condition of special waste approval that

loads with unacceptable odors may be rejected at the discretion of landfill operating staff.

- In addition to evaluating new waste streams, the waste streams of existing customers are also to be reviewed periodically. This review may involve site visits, review of Material Safety Data Sheets (MSDS), waste stream analysis, load inspections, or the re-evaluation of special waste management decisions.

- ~~Upon review and approval of the waste stream data by a company technical representative, the waste stream data is submitted to the NHDES for review and written approval. A special waste is not to be accepted until written approval has been received by the NHDES.~~

- ~~Upon NHDES approval, t~~The ~~waste profile~~ Special Waste Characterization Profile Form and approval documentation is maintained on file at the landfill. If the approval is conditional on tonnage or testing, the approval limitations are entered into the scale system at the scale house and tracked with each incoming load.

- Each ~~customer of s~~Special ~~w~~Waste delivery ~~generated by a one-time disposal event~~ will be required to have a waste tracking document (i.e., non-hazardous manifest~~,~~ or bill of lading~~, etc.~~) used to track the waste from the point of generation through transportation, to disposal. The waste tracking document contains the customer / generator information, a description of the waste, the transporter information, and the approved disposal facility (destination). ~~Customers of continuous special waste generation (as a part of a business concern) will not be required to utilize a waste tracking document.~~

- A copy of the waste tracking document is attached to the scale ticket and maintained on file at the Facility.

#### 3.3.2.2 Special Waste Handling

- Upon arrival at the ~~Facility~~facility, the d~~D~~river will present the required waste tracking document ~~(If if one-time event generated waste)~~ to the ~~Scale~~ scale ~~Attendant~~attendant. The s~~S~~cale a~~A~~ttendant will review the documentation and verify the waste approval number and all limitations (e.g. tonnage, ~~testing~~handling requirements, etc.) have been satisfied. Once all the paperwork has been checked and verified, the ~~Scale~~ scale o~~O~~perator will notify the Operations Manager or his designee that the ~~s~~Special ~~w~~Waste load is proceeding to the working face.

- The NCES staff will visually inspect the ~~s~~Special ~~w~~Waste for consistency with the description provided by the generator on the ~~Generator Special Waste Profile~~ Special Waste Characterization Profile Form as the material is unloaded. This confirmation will include comparing the physical state of the waste with those characteristics as described in the ~~Special Waste Profile Form~~Special Waste Characterization Profile Form and the waste tracking document.

  **NOTE:** If a discrepancy is found during the visual inspection, the Landfill Manager or his designee can reject the load. Procedures for rejecting a load are outlined in Section 6.6.

- After the visual inspection is performed and the load is verified, if applicable, ~~the~~ NCES staff must sign the waste tracking document for the approved acceptable (if one-time event generated waste) load and return a copy of the signed document to the Transporter.

- The completed documentation will be filed at the facility office.

### 3.3.3 Customer Education

NCES staff will inform customers of the services provided at the Bethlehem landfill facility and to educate them as to what wastes are acceptable and unacceptable for disposal. All customers approved to bring acceptable solid waste to the NCES facility must follow standard Rules and Regulations for Facility Use. They are required to accept and sign a copy of the Rules and Regulations and to execute a Certificate of Acceptable Waste form. Copies of these forms are provided in Appendix A.

Customers are also provided with informational packets. The information packet includes:

- NHDES Construction & Demolition Waste Management Outreach Effort information
- NHDES Asbestos Abatement Inspection and Notification Requirements
- NHDES Asbestos Demolition/Renovation Notification Form & Instructions
- NHDES Certified Asbestos Consultant List
- USEPA Asbestos Containing Materials Sample List and Table

NCES will provide updated information to new and existing customers on acceptable and prohibited wastes with any changes in the prohibited list in the regulations via mail

or distributed at the scale house. NCES staff encourages customers to contact the facility with any questions they may have on acceptable wastes.

### 3.3.4 Facility Signs

A sign is posted at the entrance of the facility. Additional signs adjacent to the scales clearly identify acceptable and unacceptable wastes.

### 3.3.5 Waste Unloading & Routine Inspection

Once vehicles are in the disposal area, compactor operators visually inspect the waste as the vehicles discharge their load onto the working face. As refuse is spread at the working face, operators continue to visually inspect for unacceptable materials.

### 3.3.6 Random Load Inspection

In addition to the routine visual inspection of the waste as it is discharged at the working face, 5% of loads are chosen to be inspected more thoroughly on random basis. Consideration for random inspection is given based on the type of waste, accounts serviced, and whether the hauler has a record of disposing unauthorized wastes at the facility.

Random load inspections are performed by NCES personnel with NHDES Solid Waste Operator Certification training.

Random Load Inspection:

A. An NCES representative will randomly select a hauler at the scale or the working face;

B. The NCES Representative will notify the hauler of the random load inspection program that he/she has been selected for an inspection;

C. If the hauler will not allow the inspection, they will not be permitted to unload at the site and may be banned from future use of the facility;

D. If the hauler will allow the inspection the scale house will notify operators at the working face and the truck will be directed to the designated random load

inspection area and met by NCES representative(s);

E. The load will be discharged in an area where it can be spread and visually inspected for unauthorized waste. The NCES representative shall not handle the waste. A Load Inspection Form will be completed;

F. Any unauthorized waste as identified in Section 2.2 of this document will be handled in accordance with Section 6.6 Receipt of Prohibited Waste and will be noted on the Load Inspection Form. The hauler will be given a copy of the inspection form if they request it. A copy of the Waste Inspection Form is included in Appendix A;

G. Photographs may be taken of the unauthorized waste, truck or its contents;

H. Unauthorized waste will be segregated and handled according to Section 6.6 of the Facility Operating Plan;

I. Any load identified as having a confirmable or suspected unauthorized waste will be documented on the Load Inspection Form. The hauler shall be sent a letter and may include photographs and an invoice for expenses associated with the management and proper disposal of any confirmed unauthorized waste. The hauler may be banned from future use of the facility;

J. Site personnel will file the report at the site where it will be available for NHDES review and will consist of:

1) The completed Load Inspection Form
2) Any photos
3) A copy of the scale ticket

K. Records are kept in accordance with procedures outlined in Section 8.0.

Please refer to the contingency section (Section 6) for management of an unauthorized waste.

### 3.3.6.1 Personal Protective Equipment for Random Load Inspections

Personal Protective Equipment appropriate for the specific job will be provided by NCES.

## 3.4 Method for Tracking Waste Quantities

As indicated in Section 3.2, haulers bringing waste to the facility are required to stop at the facility scale for weighing. They then proceed into the landfill. After off-loading, trucks return to the scale for re-weighing to determine the weight of the delivered waste. A scale ticket is generated and signed by the scale house operator and the driver of the vehicle. One part of the weight ticket is given to the truck driver while the other part is used for billing and record keeping purposes by the facility.

Waste quantity tracking records are to be maintained at the facility until such time as approval to move or destroy the records is granted by NHDES.

## 3.5 Method of Tracking Outgoing Waste or Certified Waste-Derived Products

The facility is a disposal facility and should not generate solid waste requiring off-site disposal. Leachate is collected at the facility and transported off-site for disposal in accordance with the procedures outlined in Section 4.0. Any vehicle hauling leachate off-site is weighed prior to and after loading to determine the volume removed. Trucks hauling C&D debris which is segregated for off-site transport will be weighed before and after loading to track the quantity leaving the site.

## 3.6 Waste Storage Time and Capacity Limits

Authorized waste materials delivered to the facility will be disposed within the lined landfill. C&D debris suitable for processing to produce alternative daily cover ("ADC") occurs in accordance with the procedures identified in Appendix H. The volume of C&D stockpiled on-~~Site~~ site for processing is not to exceed 3,000 cubic yards. Processed C&D material may also be stockpiled within the active landfill and used by the facility as ADC. As indicated in Section 3.3, prohibited waste delivered to the facility may be stored temporarily on-site until such time as the hauler or qualified disposal company removes the waste.

## 3.7 Waste Management Following Receipt (Fill Sequence Plan)

An objective of the design and development of Stage ~~I~~V is to limit leachate generation by limiting the amount of precipitation that contacts waste.

A minimum of 4 feet of cover is to be provided over the anchor trench and the landfill liner system in other areas where temporary access roads are to be constructed. Swales may be constructed on slopes above the active fill area to divert stormwater runoff away from the landfill.

The filling of the landfill will be under the supervision of the landfill manager.

### 3.7.1 Initial Lift in Base Areas and Above Overlay Liner

An initial +/- 5-foot lift of select refuse (typically household trash) is to be placed above the liner system. Care is to be taken during initial refuse placement in these areas to remove items from the waste that could damage the liner system. During placement of the initial lift in the base areas, a full-time spotter is to observe the placement of refuse onto the base area of the landfill and remove items such as poles, pipes, and steel rods. Compaction of the initial lift in the base area will be performed with a bulldozer or similar equipment to limit the potential for damage to the liner system.

### 3.7.2 Subsequent Lifts

Once the initial lift is placed, additional waste is spread and compacted in shallow layers generally about 2 feet thick with a landfill compactor. Following placement of the initial lift, fill placement is to proceed in daily cells built in successive compacted layers to a height typically between 6 and 12 feet depending upon the incoming refuse volume. Once filling proceeds above perimeter anchor trench grades, lifts will be graded to drain to the perimeter slopes to promote run-off to the perimeter swale. Grading of the top of each daily cell is to slope away from the active face to direct run-off away from the operating area.

It is noted that actual day-to-day operations are left to the discretion of the Landfill Manager, and the fill sequencing and lift development outlined above may be adjusted based on actual operating conditions including waste volumes and weather conditions.

### 3.7.3 Landfill Cover[1]

Daily cover consisting of soil or a NHDES approved Alternative Daily Cover (ADC) material is to be applied to the working face at the conclusion of each working day.

---

[1] ~~Section 3.7.3 revised; 5/24/12~~

Twelve inches of intermediate cover soil or NHDES approved alternative is to be applied in areas where active filling will not occur for a period of one month or more.

The purpose of the daily and intermediate cover is to limit odors from the ~~Site~~site, limit the potential to attract vectors, promote drainage of surface water, limit windblown litter, reduce the potential for fire, provide stability, and to serve as subgrade for the capping system. Soil cover material is to be applied and graded to direct runoff away from the filled area and limit leachate production. Silt fences and/or hay bales, or stone check dams are to be used as necessary to filter suspended soil particles from within the runoff from areas which have received soil cover.

ADC is often superior to soil covers as they eliminate the use of natural resources. ADC must serve all the cover material functions identified above and may be used only after gaining approval from the NHDES.

Leachate recirculation operations will be performed in the active Stage IV Phase IIA, and inactive Stage IV Phase I under the conditions of a Type IB Permit Modification granted by NHDES. During the active filling of the Stage IV Phase IIA area, approved temporary tarpaulins will be used for daily cover, when practical. Daily cover soil materials may be used in lieu of tarpaulins; however, any soil cover material of low permeability such as till used as daily cover must be removed prior to resumption of daily landfill operations. Sand or permeable alternative daily cover materials that will not restrict leachate flow may be utilized and left in place when resuming landfill operations. For more information on leachate recirculation operations, see Section 4.3.

# 4.0 RESIDUAL WASTE MANAGEMENT

## 4.1 Leachate Management Plan

The leachate collection system for the NCES facility consists of a double liner system with primary and secondary liquid collection. The collection, pumping and handling system is designed so that liquids are removed from the landfill as rapidly as possible.

### 4.1.1 Anticipated Leachate Generation Quantities

The quantity of leachate generated varies and is a function of weather conditions, (temperature and precipitation); the amount of waste in place, how long the cell has been

open, whether the fill has progressed above grade so that runoff may occur, and the landfill cover condition.

Based on operating experience at the facility, the long-term average leachate generation during operation ranges from about ~~300~~ 250 to ~~500~~ 650 gallons per acre per day (g/a/d). Following construction of final cover, leachate generation rates gradually diminish with time.

### 4.1.2 Phasing and Cell Development

To limit leachate quantities, the NCES facility has been developed in phases.

### 4.1.3 Pumping/Removal Schedule

Leachate is automatically pumped from collection sumps through piping to two underground storage tanks using dedicated submersible pumps. Leachate consolidated in the underground storage tanks may be pumped to a reserve 150,000 gallon above ground storage tank. Leachate is pumped to a leachate loading facility where leachate tankers will be loaded.

Primary leachate levels are monitored with a supervisory control and data acquisition (SCADA) system. The pump controls are designed to activate the pumps when the leachate level is equivalent to the liner grade adjacent to the sump. The pump controls can be monitored on a daily basis remotely to determine that the system is operating properly.

Liquids collected from the secondary systems of all stages will be pumped automatically, measured, and consolidated with primary leachate. Quantities pumped are measured to about 90% accuracy using flow meters.

A leachate loadout facility is located adjacent to the above ground storage tank.

Facility staff calculates the leakage rates into the secondary detection system. If it is determined that the calculated monthly rate exceeds 25 gallons per contributory acre per day, it is to be reported to NHDES within one week of the rate identification except for flow which the NHDES agrees is the result of dewatering or a construction project. If the rate exceeds 100 gallons per contributory acre per day, NCES is to file an

investigative report consistent with Env-Sw 806.09 unless the NHDES agrees the rate is the result of a dewatering activity or a construction related project.

Leachate which is pumped into tankers for off-site disposal will be disposed of at one or more of the facilities listed below.

| FACILITY |
|---|
| Concord, New Hampshire |
| Montpelier, Vermont |
| Essex Junction , Vermont |
| Burlington (North), Vermont |
| Barre, Vermont |
| Plattsburgh, New York |

Current ~~Letters of Agreement~~ permits for the Concord, Plattsburgh and four Vermont facilities indicating the facilities will accept leachate from NCES are kept on file at the site in the ~~Permit~~ permit b~~B~~inder.

~~NCES may enter into agreements with other facilities but must maintain agreements with at least two facilities to manage the quantity of leachate generated by the facility.~~

A supervisory control and data acquisition (SCADA) system shall control the process of transferring liquids from the sumps to the underground storage tanks. The SCADA system is configured such that pumps will not be activated if the leachate underground storage tanks are full. Furthermore, an alarm will be activated if the underground storage tanks are full.

While the leachate sump to storage tank transfer system is designed to operate automatically, it may also be operated manually. Pumping leachate to a tanker truck at the leachate loadout facility is ~~to be initiated manually~~ a manual operation.

### 4.1.4 Leachate Contingency Considerations

In the event of an extended power outage, NCES is to institute alternative power supply contingencies. A generator of adequate capacity is available for use as an alternative power supply. The generator is to be connected at transfer switches around the site, individually.

Should the contingency or other large storm occur and the leachate exceeds the capacity available in the facility's leachate storage tanks, additional storage is available on the liner system. As discussed in Section 6.1, operations staff is to take steps to remove leachate to increase storage capacity when severe weather is predicted. NCES is to implement measures to remove the additional leachate from the ~~Site~~ site in an expeditious manner using additional tank trucks to haul the excess leachate to the treatment plants indicated in Section 4.1.3. Under no circumstances is temporary storage on the liner to last for more than seven days.

### 4.1.5 Record Keeping and Monitoring

The facility is to maintain records for each load of leachate shipped, identifying the quantity of leachate shipped, the date shipped, and the name of the wastewater treatment facility receiving the leachate.

NCES is to sample the leachate consistent with the requirements of the NHDES Rules, the facility permit, and the requirements of the various disposal facilities.

## 4.2 Landfill Gas Condensate Management

Condensate generated between the landfill and the gas management system blower is collected and pumped into the leachate collection system. Samples of condensate are to be collected at least once per year and analyzed. If the condensate is determined to be nonhazardous, it may continue to be mixed with leachate.

## 4.3 Leachate Recirculation System[2]

Leachate recirculation operations will be performed in permitted landfill cells to accelerate the degradation and stabilization of waste, enhance gas production, and improve leachate quality. The following sections describe the leachate system design and operating guidelines.

### 4.3.1 Design Description

The leachate recirculation system is comprised of Pump Station I, leachate forcemains, and horizontal leachate injection wells which are located in Stage IV Phase I & II-A.

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[2] ~~Section 4.3 added; 5/24/12~~

The Phase II-A recirculation area is confined to the landfilled waste area that is connected to the Stage I Phase IV liner and its leachate collection system, and does not extend into Stage I Phases III, II or I.

During normal operations, leachate collected at the Stage IV Phase II sump is pumped from Pump Station I through the forcemain which runs along the Stage IV Phase I anchor trench to the leachate management area east of Stage IV Phase I, where it is temporarily stored and then offloaded into tanker trucks for delivery to waste water treatment facilities for disposal. During leachate recirculation operations, leachate collected in the Stage IV Phase II sump will be transmitted via Pump Station I to the horizontal leachate injection wells in either Stage IV Phase I or Stage IV Phase II-A.

Leachate recirculation in Stage IV Phase I is accomplished by opening each of the leachate lateral control valves at the leachate forcemain to direct flow to the horizontal landfill gas collection wells. The horizontal gas collection wells were installed during waste placement and were connected to the landfill gas collection system in 2009. The horizontal gas collection wells have been modified with valving to allow operation either for gas collection or leachate injection by isolating the connection to the landfill gas or leachate lateral. The flow of leachate to each injection well is balanced using the lateral control valve and installed flow meter to evenly distribute the recirculated leachate to each of the selected horizontal wells.

Leachate recirculation in Stage IV Phase II-A will require manual operation of the leachate recirculation valve within the pump station to activate the recirculation forcemain and shut off flow to the leachate storage system. The leachate forcemain from Pump Station I is located in a common trench with the 14-inch landfill gas header pipe which runs along the western Stage IV, Phase II anchor trench. As land-filling progresses in Stage IV Phase II-A, NCES will construct landfill gas collection wells and leachate injection wells in a combined trench. The combined trenches are ~~be~~ spaced approximately 160 feet horizontally from each other, and separated 20 feet vertically from the stages above and below that are offset 80 feet horizontally to increase coverage. The flow from the recirculation forcemain into each lateral and injection well will be balanced using the control valve and installed flow meter to evenly distribute the recirculated leachate to each of the selected horizontal injection wells.

### 4.3.2 Recirculation Operations

In order to appropriately monitor the leachate recirculation system, leachate will ~~only~~ be recirculated to wells in either Stage IV, Phase I or Phase II-A and not both simultaneously. Only leachate collected in the Stage IV, Phase II sump will be available for leachate recirculation via Pump Station I.

Operators shall utilize each lateral's flow meter and control valve to distribute leachate evenly to the desired injection wells. Typically recirculation will be completed using 5 to 7 injection wells at a time. Once the leachate recirculation system is balanced for a particular configuration, it should remain balanced as the hydraulic pumping conditions will not vary.

During prolonged recirculation operation in an area, the flows in each lateral will be monitored on a monthly basis and adjusted if necessary to maintain balanced flow.

Recirculation flow rates to Stage IV Phase I are estimated to be 70 gpm, while flow to Stage IV Phase II-A is estimated to be 65 gpm for the lower and middle stages (LR-201 – LR 210) and approximately 60 gpm for the upper stage (LR 211-217)

Leachate recirculation operations will cease for a given landfill phase when:

- primary leachate flow rate increases above the following threshold flow rates:
    - Stage IV Phase I = 14,800 gpd
    - Stage IV Phase II-A = 21,000 gpd
- Leachate flow rates indicate that field capacity has been reached by comparing recirculation flows to historical base flows while accounting for precipitation, snow melt and seasonal effects.
- leachate outbreaks occur;
- secondary flow is greater than 25 gal/acre/day.

When the primary leachate flow rates approach twice the historic baseline flow rate, the refuse influenced by recirculation is likely to be at or near its field capacity. Field capacity is the moisture content of the waste at which the maximum amount of liquid is held in the voids. Field capacity can vary but is anticipated to be approximately 40 to 50% by weight depending on waste composition, age, density, and porosity. When at field capacity, refuse will no longer have the ability to absorb additional liquid and recirculation short circuiting may occur, or the waste will leach out an equivalent weight of water added. When field capacity is attained in the waste mass influenced by the injection well, recirculation at this location will be discontinued.

Leachate injection and gas collection in the Stage IV Phase II-A recirculation areas can be performed at the same time, provided that the daily discharge rate does not exceed the capacity of the waste to accept the leachate or the amount that can be stored within the recirculation trench below the gas collection header. If simultaneous operation is desired or necessary to control gas emissions or odor, then the injection rates shall be monitored and adjusted to prevent leachate from fouling the gas collection system. Ordinarily, the horizontal gas collection system would be operated at alternate times from the recirculation.

### 4.3.3 Leachate Recirculation Permit Renewal, Record Keeping, and Reporting

NCES is permitted to conduct leachate recirculation operations in the approved landfill cells Stage IV Phase I and Stage IV Phase II-A as an innovative leachate management method. Per Env-Sw 806.04 (j), the leachate recirculation operations permit is valid for three years from the date of issuance, and is renewable ~~as not to exceed~~ up to 12 years of operations.

Record keeping should conform to all other record keeping procedures. The dates of operation of each well and the total and average daily volume of leachate recirculated will be recorded by operators. Leachate primary flow totals will be compared to recirculation flow totals to monitor for refuse field capacity and for leachate short circuiting. Maintenance performed on the leachate recirculation system will be recorded and an inventory of replacement parts incorporated into the recirculation system will also be kept to evaluate performance of the system. The settlement/consolidation of the landfill waste in the recirculation areas will also be tracked to quantify positive impacts from the recirculation on the stabilization of waste. Waste filling operations atop recirculation areas will also influence settlement, and will need to be factored into the settlement analyses.

Quarterly surveys of the recirculation areas will be completed concurrent with the quarterly survey of active filling areas. Surveys will also locate the leachate injection wells at the penetration of intermediate cover soils to track any horizontal and vertical movement of the trenches, as the waste degrades and settles.

Monthly visual inspection will be performed in areas where recirculation is performed. Operators shall note:

- differential settlement
- leachate outbreaks

- leaks in piping

## 5.0 FACILITY MAINTENANCE, INSPECTION, AND MONITORING PLAN

The areas in and around the vicinity of the landfill are to be maintained in a neat and orderly manner. The access roads are to be graded when necessary and maintained in a serviceable condition.

Closed portions of the facility will also be visually inspected. The purpose of inspecting the closed portions of the ~~Site~~ site is to evaluate the integrity of the final capping system, the stormwater management system, erosion control measures, and leachate collection systems.

### 5.1 Spontaneous Combustion and Other Fire Hazards

Fire protection controls on-site consist of cover soils, fire extinguishers and the ~~Site~~ site water truck. Gas ~~Management~~ management ~~System~~ system records are to be periodically reviewed to observe that system monitoring is being performed and that the concentrations of the various gases within the landfill gas collection system are within expected ranges. (Operation and ~~Maintenance~~ maintenance provisions for the ~~Gas~~ gas ~~Management~~ management ~~System~~ system are included in Appendix C.)

### 5.2 Vector Production

Compaction and the use of cover material limits vector access to the waste. If necessary, appropriate measures such as use of a professional exterminator would be employed.

### 5.3 Gas Monitoring and Control

An active landfill gas system has been constructed at the NCES facility and will be expanded as necessary. The system consists of drilled gas extraction wells and lateral extraction trenches which are connected to gas collection piping. Blowers are used to extract the landfill gas and control devices are utilized to ~~destruct~~ destroy the gas.

A written plan for confined space entry is maintained on site.

Monitoring for landfill gas outside the limits of the landfill will involve sampling gas monitoring probes as described in the Gas Monitoring Plan in Appendix C. These probes are to be monitored for explosive gas, using a dual-range natural gas indicator such as a Gas Tech Model NP-204 or equivalent.

The following steps are to be implemented in the event that monitoring results indicate combustible gas concentrations in the soil exceed 50 percent of the lower explosive limit (LEL) at the property line or 25 percent of the LEL in on-Site structures excluding leachate collection and gas recovery components (note that the LEL defined above corresponds to 5 percent methane by volume in air):

- Take all necessary steps to ensure protection of human health and notify NHDES [This notification shall be deemed to have taken place when the Department's Project Manager in the Solid Waste Compliance Section 603-271-2925 is notified.];
- Within seven (7) days of detection, place in the operating record the methane gas levels detected and a description of the steps taken to protect human health; and
- Within sixty (60) days of detection, implement a remediation plan for the methane gas release, place a copy of the plan in the operating record, and notify the ~~Director~~ NHDES that the plan has been implemented. The plan shall describe the nature and extent of the problem and the proposed remedy.

Locations where gas concentrations exceed 50 percent of the LEL at the property line are to be identified in a separate report which is to be forwarded to NHDES.

Should the combustible gas concentrations be determined to exceed 50 percent of the LEL at any permanent probe location, an evaluation is to be made to determine whether the frequency of monitoring should be increased, and whether the monitoring network and type of monitoring should be modified to enhance detection. If continued monitoring indicates elevated levels of landfill gas at the property line, an appropriate plan to control gas concentrations, such as further expansion of the active gas system, is to be developed and submitted to NHDES for review.

If monitoring indicates that additional control measures are necessary, they are to be installed so that:

1. Gas concentrations at the property boundaries will be less than 50 percent of the LEL; and
2. Gas concentrations at any structure will be less than 25 percent of the LEL.

## 5.4 Odors

The application of daily cover in conjunction with the active gas management system should provide effective odor control. The final cover system has been designed with a synthetic membrane. This membrane will further minimize odors by constraining gas to the active system.

Other measures to control odors which may be considered include deployment of odor control products. An odor-neutralizing chemical may also be applied as a mist in areas where odors are noted.

If waste streams are identified which routinely exhibit unacceptable odor, the generator will be informed and required to take measures to reduce odor. If this cannot be accomplished, the generator's waste stream will not be accepted at the facility.

Items to check during routine inspections include:

- The active gas collection system records to observe that gas is being extracted effectively from the various collection locations~~.~~;
- That there is adequate daily or intermediate cover on the waste; and
- If necessary, solid odor neutralizing products or misting agents be deployed.

When the facility receives an odor complaint, the facility is to implement an odor inspection to confirm the odors at the alleged source and if necessary to identify the source of the odor. For those persons who may be calling during hours when the facility is not open, the call is automatically forwarded to an answering service which will contact an NCES representative. The NCES representative will follow the procedures outlined above.

The facility is to maintain a log of odor complaints using the form included in Appendix D. The completed form provides a log of the time and place odors are noted and are to identify the response implemented by the facility.

## 5.5 Dust Control

Dust control procedures include proper maintenance of vegetated areas and gravel service roads. Dust is to be controlled on the facility access roads by the application of gravel as needed and by watering. Water is available from stormwater detention ponds or with the Town's permission, the hydrant located near the northern end of the ~~Site~~site.

## 5.6 Windblown Litter

Blowing litter is to be minimized by limiting the active working face, applying daily cover to the active fill areas and fencing. Other methods, such as the utilization of litter pickers and portable fencing, are employed. Any windblown litter must be collected promptly and taken to the active disposal area.~~.~~

Litter will also be collected along the entrance area and roadways. Refuse hauling trucks are required to have their loads tarped or use closed containers/truck bodies which reduces windblown litter.

## 5.7 Leachate

The leachate systems are monitored through the SCADA system. The quantity of liquid pumped from the primary and secondary collection systems is recorded and provided to the NHDES. Leachate manholes are equipped with leak detection features for monitoring of subsurface leachate for leaks.

## 5.8 Spills

NCES has a spill prevention and countermeasure control plan (SPCC Plan). Spills will be managed in accordance with this plan.

## 5.9 Stormwater Management Systems[3]

The surface water management systems are inspected and managed in accordance with the s~~S~~ite's Stormwater Pollution Prevention Plan (SWPPP). ~~Catch basins and swales on the reinforced earth berm are to be maintained to be free of snow, ice, sediment and debris.~~

~~In addition to the ditches~~ Ditches and detention ponds, sideslopes and surfaces of the exterior landfill berms are to be inspected for erosion. All sideslopes should have well-established vegetation or be in the process to be vegetated.

[3] Section 5.9 revised; 7/14/10

## 5.10 Groundwater Monitoring

Sampling and analyses of groundwater is performed in accordance with the current NHDES Groundwater Management and Release Detection Permit.

Permanent groundwater monitoring wells are installed to monitor groundwater quality at the ~~Site~~site. The monitoring wells are typically constructed using polyvinyl chloride (PVC) well screen and riser piping. The well screen for the monitoring wells is surrounded by a sand filter. A bentonite seal and cement/bentonite grout surrounds the riser pipe from the sand filter to the ground surface. Monitoring wells are provided with protective casings and locking caps.

## 5.11 Leachate Breakouts

Inspections are to include observations of landfill sideslopes for evidence of leachate breakouts. Breakouts are to be repaired promptly. Methods to repair breakouts may include excavation of the breakout and backfill with free draining material to promote drainage into the landfill. Leachate breakout locations are recorded on a field sketch and submitted with the monthly facility report. A copy of the repair log form and field sketch are provided in Appendix E.

## 5.12 Bird Control

The facility is to take steps to limit the number of birds present and foraging at the landfill. Steps to discourage birds from visiting the site are identified in the Bird Control Plan provided in Appendix G.

## ~~5.13 Liner Settlement Monitoring~~

~~In accordance with Condition 5(b) of the Stage IV permit, settlement of the liner system is to be monitored and liner strain evaluated. Settlement monitoring is to be performed in accordance with the Liner Settlement Monitoring Plan provided in Appendix H. This portion of the liner system over Phase I of Stage I was constructed in 2008.~~

## 5.~~14~~ 13 Asbestos Records and Plan[4]

[4] ~~Section 5.14 added; 8/9/10~~

~~As part of the construction of Stage IV, Phase 2. of the landfill, NCES will excavate waste in Stage I to expose the leachate collection sumps to build a new sump and connect the new leachate collection system to it. The area where the excavation will take place, Stage I, was permitted to accept asbestos.~~ The NH Solid Waste Rules require that the asbestos disposal locations be documented, which was done for Stage IV. These records are maintained at the site, and are included as Appendix I.

Construction and demolition debris from the Mountain View Grand Hotel renovation project, which the DES alleged to have contained asbestos, was received between October 1999 and May 2002, while NCES was operating Stages II and III. As noted above, the excavation of waste required for the construction of Stage ~~IV, Phase 2~~V will take place entirely within Stage IV. Therefore, C&D waste from the Mountain View Hotel will not be encountered in this project.

Nevertheless, in any waste excavation project unexpected wastes, including asbestos, may be encountered. Therefore, for these types of projects, the contractors are required to implement a DES-approved Site Safety and Contingency Work Plan to control and monitor the work, including procedures for safely handling asbestos waste and assuring no releases occur.

## 6.0 CONTINGENCY PLAN[~~5~~]

Specific actions to be taken in the event of severe storm, fire, operator injury, spills and receipt of prohibited wastes are described in the following section. A list of emergency phone numbers is provided below. For police, fire and medical emergencies, 911 may be dialed.

| List of Emergency ~~Organizations~~[~~6~~]Organizations[1] | | |
|---|---|---|
| **Type of Service** | **Name of Organization** | **Telephone Number** |
| Fire | Bethlehem Fire Department | (603) 869-2232<br>In Emergency: Dial 911 |
| Poison Center | Northern New England Poison Center | 1-800-222-1222 |
| Hospital | Littleton Regional Hospital | (603) 444-9000 |
| Spill Notification | NHDES (M-F, 8AM-4PM) | (603) 271-3899 |

[~~5~~] ~~Section 6.0 revised; 7/14/10~~

[~~6~~] [1] List of Emergency Organizations revised; ~~8/16/10~~2/4/14

| | | |
|---|---|---|
| Spill Notification | NH State Police<br>(Nights – Weekends – Holidays) | (800) 346-4009<br><br>Out of State<br>(603) 271-3636 |

## 6.1 Severe Storm

If severe weather is predicted including the potential for a large amount of precipitation or high winds, operating staff are to evaluate if the facility should be closed temporarily.

A preemptive closure may allow operating staff more time to cover the refuse, secure equipment, and secure the facility.

## 6.2 Fire and Explosions

The Bethlehem Fire Department (869-2232) will be contacted in the event of a fire at the facility.

Loads of refuse which are suspected to be burning will not be disposed in the active disposal area. Instead, such loads will be dumped in the hot load area. If an incoming load of refuse is suspected of being on fire, the haul vehicle will be directed immediately to the hot load area. The hot load will be monitored, allowed to cool and possibly quenched with water (if necessary) prior to disposal in the active area.

Soil may also be used to smother fires in support of the Fire Department at the working face.

Appropriate fire extinguishers are carried on the facility's heavy equipment at all times and used to control small fires that may occur. Fire fighting will not be done at the risk of personal injury.

## 6.3 Injury

In the event of personal injury, first aid should be administered and an assessment should be made as to whether emergency (ambulance) care is required.

## 6.4 Petroleum Spills[6]

Please refer to the SPCC (Spill Prevention Control & Countermeasures Plan) and SWPPP (Stormwater Pollution and Prevention Plan) plans.

## 6.5 Leachate Spills

When a leachate release or spill occurs a determination is to be made as to:

- Location of the release, or spill;
- Source of the leachate;
- An estimate of any quantity released;
- The direction in which any spill or release is heading; and/or
- The possibility of fire and/or explosion.

There are three major steps that can be taken in the event of a release or spill. These include:

- Control
- Transfer
- Disposal

The following are general procedures that are to be followed in the event of a spill at the facility:

**Control –** The first task should be to stop the release of leachate, if possible, by such actions as shutting off pumps, placing soil against a leak, or diverting flow to a collection point. If the release of leachate cannot be controlled, begin the second step (transfer) immediately.

If a spill occurs on the ground surface, use absorbents if the spill is relatively small. Otherwise, use dirt, sand, or other relatively impervious material to dam the spill and

[6] ~~Section 6.4 revised; 7/14/10~~

prevent flow. Plug any drains in the area of the spill as soon as possible after a spill has occurred.

If the spill has reached a body of water the entire body of water must be considered leachate until such time analytical testing can suggest that impact has been remediated.

**Transfer –** Once a spill is contained, the spilled material must be transferred to appropriate storage containers before disposal. If a spill is small and absorbents are used, they may be manually placed in waste containers and transported to the landfill workface for disposal at the facility. Collected liquids are to be transported off-Site for disposal at an appropriate wastewater treatment facility or discharged back to the landfill.
Leachate should be pumped into an appropriate bulk tank truck or to a container or tank suitable for storage of the material. Handling of spilled material is not to be done at the risk of personal injury.

**Disposal –** The disposal methods would be the landfill or a permitted wastewater treatment facility.

## 6.6 Receipt of Prohibited Waste[7]

When a prohibited waste stream is discovered, the procedure outlined below is to be followed:

- ~~An unapproved special waste~~Special Waste that has not been approved in accordance with Section 3.3.2.1 or other prohibited waste which is deposited on the working face and which does not appear to NCES personnel to be an immediate threat to health or safety (e.g., whole tires, white goods, etc.) is to be isolated by the landfill equipment operator~~the compactor operator~~. The customer is to be identified, and requested to remove the waste. If the source of the waste or hauler cannot be identified, NCES will evaluate the situation and implement appropriate procedures for the management of the waste. NCES staff will notify the ~~Landfill~~ landfill ~~Manager~~ manager and/or ~~PCE~~ Permits, Compliance and Engineering personnel immediately. The unauthorized waste will be separated and if appropriate, placed in a secure container. The unauthorized waste will be evaluated by trained personnel and characterized for

[7] ~~Section 6.6 revised; 7/14/10~~

proper disposal. If the waste is identified to be potentially hazardous, NCES staff will contact an authorized hazardous waste company as identified in Section 2.2. NCES would utilize one of the following companies (or similar qualified firms) for removal and disposal of unauthorized waste:

CYN Environmental
8 Progress Drive
Dover, NH 03820
1-800-417-7455

Clean Harbors Environmental Services, Inc.
20 Dunklee Road
Bow, NH
1-603-~~644-3633~~224-6626

- In the event a waste disposed on the working face is believed to present an immediate threat to health and safety (e.g., reactive chemicals, ruptured drums containing liquids), the waste is to be left in place undisturbed and NCES staff will immediately notify the ~~Landfill~~ landfill ~~Manager~~manager. The NHDES will also be notified. The waste is to be evaluated and characterized for proper handling and transportation. Such waste is to be weighed and promptly transferred using licensed waste transporters and transported to a licensed disposal facility.

- The following table describes management of specified prohibited wastes. This list is not intended to be all inclusive, but a general tabulation of typical materials. The "Disposal/Transfer" vendor information is intended for reference only and may be modified by the Facility.

| MATERIAL | TEMPORARY STORAGE LOCATION | WASTE CONTAINER TYPE | MAXIMUM DURATION ON-SITE STORAGE | DISPOSAL / TRANSFER |
|---|---|---|---|---|
| Anti-Freeze | Maintenance Garage | Drum | < 1 year per Universal Waste Rules | Recycler |
| Asbestos | Near Working Face -Secure location determined at the time of incident. | Covered Dumpster / Roll-off or Trailer | Removed upon testing and proper management arrangements. | Alternate Disposal Facility |
| Batteries (Wet Cell) | Maintenance Garage | Storage Rack or Plastic Bin | < 1 year per Universal Waste Rules | Universal Waste Recycler |
| Batteries | Electronics Storage Shed | Drum | < 1 year per Universal Waste Rules | Universal Waste Recycler |

| | | | | |
|---|---|---|---|---|
| Cathode Ray Tubes (CRT's) | Electronics Storage Shed | Labeled Cardboard Box | < 1 year per Universal Waste Rules | Universal Waste Recycler |
| CFC Containing Appliances | Designated Area | Roll-off | 3-6 Months | Certified Technician removes CFCs. Recycler |
| Contained Gaseous (Propane Tanks) | Designated Area | Roll-off | 3-6 Months | Littleton Town Transfer Station |
| Fluorescent Bulbs and Lighting Ballasts | Electronics Storage Shed | Labeled Cardboard Box | < 1 year per Universal Waste Rules | Universal Waste Recycler |
| Medical Waste (Untreated) | Near Working Face -Secure location determined at the time of incident. | Container it was shipped in / Dumpster / Roll-off | Removed upon testing and proper management arrangements. | Alternate Disposal Facility |
| Mercury Containing Devices | Electronics Storage Shed | Drum | < 1 year per Universal Waste Rules | Universal Waste Recycler |
| Motor Oil | Maintenance Garage | Drum | Removed upon testing and proper management arrangements. | Licensed Hazardous Waste Contractor |
| Tires - whole | Designated Area | Roll-off | 3-6 Months | Recycler or Alternate Disposal Facility |
| Unidentified Waste that may be Hazardous | Where off-loaded, until identified. Secured storage per NHDES Solid and Hazardous Waste Division(s). | Container as recommended by DES and Contractor. Substance Dependant* | Removed upon testing and proper management arrangements. | Licensed Hazardous Waste Contractor |
| White Goods | Designated Area | Roll-off | 3-6 Months | Recycler |

## 7.0 EMPLOYEE TRAINING PROGRAM

NCES Operations Supervision ~~The operations~~~~Operations management functions~~ must have a certified NHDES ~~at the facility~~ ~~is~~ ~~are~~ ~~to be provided by persons who are certified by NHDES for the level of responsibilities~~~~performance of their assigned responsibilities~~. ~~At least one person on-site shall be a certified~~ Level IV Operator Certification consistent with Env-Sw 1600.~~. For every five operators (person directly involved in solid waste management activities), there is to be at least one Level III or Level IV Operator.~~

NCES provides training to staff on job responsibilities, human resource matters, operations/equipment, health and safety, and environmental compliance. Training is primarily done by qualified internal staff, however third-party consultants/experts, or certificate programs and seminars may be incorporated. Necessary job-related training is provided to new-hire employees. Training related to landfill operations staff includes:

### 1. Health and Safety

Training on a variety of ~~Health~~ health and ~~Safety~~ safety related topics is provided primarily by on-site management. Generally training occurs once per month and ranges from ½ hour to 1 hour sessions depending on the topic.

**2. Specific Technical Training on Operating Equipment and Procedures**

The ~~Landfill~~ landfill ~~Manager~~ manager will ensure employees are technically trained in proper equipment use prior to operation. On-site and off-site training is provided for staff and management on specific equipment from suppliers.

**3. Facility Operating Plan**

The Facility Operating Plan is reviewed annually by the ~~Landfill~~ landfill ~~Manager~~ manager and/or Compliance Staff. Facility operations staff is trained annually on the Facility Operating Plan or more frequently if changes are made subsequent to the most prior training.

Within thirty days of NHDES approval of any changes to the Facility Operating Plan, each employee will receive training with respect to any change related to the employee's responsibilities. Each training session will require attendees to sign a log specifying the sections of the Facility Operating Plan on which the operator received training. Employee familiarity with the Facility Operating Plan is monitored through interaction with the instructor during training.

**a. Identification of Acceptable and Unacceptable Waste**

Annual training is provided to equipment/compactor operators in identification of acceptable and unacceptable waste (Hazardous waste, CFC's, asbestos, etc.). Training topics may include: definitions, what is unacceptable, identification practices, load inspection, handling procedures, and procedures for unapproved or unacceptable deliveries~~,~~ and contact information.

**b. Special Waste Training**

Annual training is provided to the ~~Landfill~~ landfill ~~Manager~~manager, sales representative, and equipment/compactor operators, involved in the management

of ~~s~~Special ~~w~~Wastes, as applicable to their related duties. Additional training may be required when there are new handling requirements, new rules or policies, or new waste streams. Training topics may include: definitions, examples of ~~s~~Special ~~w~~Wastes, identification of ~~s~~Special ~~w~~Waste, ~~s~~Special ~~w~~Waste approval process, load inspection, handling procedures, and procedures for unapproved or unacceptable deliveries~~,~~ and contact information.

**c. Emergency and Contingency Plan Procedures**

The ~~Emergency~~ emergency and ~~Contingency~~ contingency ~~Plan~~ plan ~~Procedures~~ procedures are reviewed annually by the ~~Landfill~~ landfill ~~Manager~~manager. Facility ~~Operations~~ operations ~~Staff~~ staff are trained regularly and as necessary on various components of the Plan.

**4. Spill Prevention Control and Countermeasures (SPCC)**

~~Provided~~ T~~t~~he ~~Facility~~ facility is required to have a SPCC Plan ~~by~~ under 40 CFR 112~~,~~ ~~annually,~~ Annual training ~~will~~ is ~~be~~ held for employees on the SPCC Plan and emergency response procedures. In addition, the training includes a review of the NHDES criteria for reporting petroleum discharges and emergency contact information.

**5. Storm Water Pollution Prevention Plan (SWPPP)**

~~Provided~~ T~~t~~he Facility is required to have a SWPPP by the US EPA National Pollution Discharge Elimination System (NPDES) Program~~,~~ ~~annually,~~ S~~s~~torm water pollution prevention training ~~will be~~is conducted for operational employees annually.

## 8.0 RECORD KEEPING AND REPORTING

The following records are to be maintained at the facility as well as the NCES's Permitting and Compliance office:

- Copies of facility permits and approvals;
- Quantity, type, and origin of all waste received by the facility;
- Quantity and destination of leachate generated by the facility;

- Quantity, type and destination of all certified waste-derived products used or produced by the facility, if any;
- Record of inspections, maintenance, and repairs;
- Record of accidents, violations, remedial and emergency event response actions;
- Record of complaints received and related response actions;
- Data from all environmental monitoring performed at or for the facility, whether required by the Solid Waste Rules or the permit or undertaken voluntarily;
- Documentation of contact with the waste management district(s) served by the facility as required by Env-Sw 1105.06 (11);
- The facility design reports;
- Hydrogeologic reports;
- Special Waste profile documentation and analysis, as applicable, for all Special Waste delivered to the site;
- Other record keeping information and documentation required by the Solid Waste Rules; and
- Other information and documentation as required by the terms and conditions of the facility permits and approvals.

The operating records identified above are to be maintained at the facility at all times during the active life of the facility, unless approval is granted ~~pursuant to a Type V Permit Modification or a Waiver is granted~~ to relocate or destroy the records pursuant to a Type V permit modification or a waiver. Operating records are to be made available for NHDES inspection and copies provided to the department pursuant to Env-Sw 2000. Following closure of the facility, the operating records are to be maintained at a location approved by NHDES in the Closure Plan, unless destruction of the records is approved pursuant to a Type V ~~Permit~~ permit ~~Modification~~modification.

~~The Permitee is to~~NCES will notify the ~~Department~~ department in writing within thirty (30) calendar days of any change in the facility address, telephone number, key operators or contact person(s).

An annual facility report is to be filed by March 31 each year for the prior calendar year and include the information required by Env-Sw 1105.13.

*Appendix C.1 – Revision to NCES Rules and Regulations for Facility Use*

Revised June 2014

# NORTH COUNTRY ENVIRONMENTAL SERVICES, INC.

## RULES AND REGULATIONS FOR FACILITY USE

- These Rules For Facility Use ("Rules") shall be issued to each hauler using this facility. The Certificate of acceptable waste shall be completed to verify conformance with these rules.
- A Certificate of Insurance for all vehicles (used to deliver Acceptable Waste to the Facility) of such HAULER shall accompany the signed Rules. It is the responsibility of each HAULER/SUPPLIER to make sure that all insurance certificates are kept current and forwarded to the landfill. The minimum required liability coverage will be one million dollars.
- All waste haulers shall check in with the Scale Attendant before entering the disposal area. This check in shall take place at the Scale and will include:
    a. Inspection to ensure the waste load is contained and covered.
    b. Verification that adequate comprehensive general liability insurance is in force with regard to said vehicle. The adequacy of said liability insurance is at the sole discretion of the OPERATOR.
    c. Issuance of a Permit Number which is to be permanently affixed to the vehicle in such a manner as to be seen clearly from the scale office.
    d. Disclosure of origins and constituents of the waste contained in each truck.
- All vehicles arriving and departing from the landfill, except those servicing the local area, are to use the Route 3 access onto Trudeau Road.
- The Facility is typically operated from the hours of 7:00 a.m. to 3:00 p.m. on non-holiday weekdays. No vehicle will be admitted on a non-holiday weekday after 3:00 p.m. unless prior notification, such as a truck running late, has been given. No vehicle shall arrive at the Facility prior to 6:30 a.m. Under no circumstances will any vehicle park upon Trudeau Road, while awaiting admission to the Facility. The Facility may be closed on the following holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving, and Christmas. North Country Environmental Services, Inc. shall determine the date of these holidays when the State, Federal, and/or traditional holidays conflict.
- The quantity of waste delivered to the Facility will be measured by the Scale Attendant on its certified scales and the weights recorded. At the SUPPLIER'S request, the Scale Attendant shall make available appropriate scale certification documents.
- After weighing, the driver shall proceed to a point in the Facility as directed and discharge the load.

- Upon discharging the load, the driver will return to the scales for reweighing and the determination of the net weight. The driver will sign and receive a copy of the weight slip for each load.
- Upon receipt of the weight slip, the driver shall immediately vacate the scale.
- Only Acceptable Waste, as defined by the NH DES Approved Operating Plan, shall be disposed at the Facility. A Certificate of Acceptable Waste must be executed by the SUPPLIER, or its designated HAULER, and forwarded to the Facility prior to disposal. It is the affirmative obligation of each and every authorized HAULER and SUPPLIER to disclose the presence or suspected presence of any non-acceptable waste. The presence of any non-acceptable waste may result in a denial of access to the Facility at the sole discretion of the OPERATOR.
- The OPERATOR retains the right to inspect any load presented at the gate prior to its admission to the Facility.
- All damage to the Facility caused by a driver or vehicle shall be reported immediately to the Facility Supervisor. All drivers have the ultimate responsibility to maintain and operate their vehicles in a safe and proper fashion.
- The vehicle registration form (Section A, 4) required by these Rules must be renewed annually (at a minimum) or at any time a vehicle is added or deleted. Any vehicle not registered will NOT be admitted to the Facility.
- Refusal of any driver of any vehicle to register upon arrival at the gate of the Facility will result in denial of access, with such denial being considered rejected waste.
- All vehicles entering the Facility for disposal purposes must be able to discharge or tip their loads by mechanical or hydraulic means without assistance from the OPERATOR's equipment. Should the vehicle experience problems in discharging its load due to mechanical breakdown, frozen conditions, or jammed loads, then OPERATOR may render assistance, pending the availability of equipment, and assess charges for any equipment and labor time rendered. This assistance and the charges will be made at the OPERATOR's sole discretion and will be based on rates charged for comparable services and equipment in the construction industry.
- All vehicles entering the Facility will be equipped with suitable tow hooks for the purpose of assisting the vehicle to the working face during inclement weather conditions. Any towing of vehicles will be done at the sole risk of the vehicle owner or driver. The OPERATOR will be held harmless for any damage done to vehicles while providing towing assistance, but will use due caution when providing this service. CB radios are required to provide communication between the drivers and the Landfill Facility personnel.

- ACCEPTABLE WASTE . Wastes which may be accepted at the facility include:
    a. Municipal solid waste (MSW) as defined in State of New Hampshire Solid Waste rules.
    b. Construction and demolition (C&D) waste which includes non-putrescible building material waste and rubble. Examples of such waste include, but are not limited to, bricks, concrete, and other masonry materials, wood, wall coverings, plaster, dry wall, plumbing, fixtures, non-asbestos insulation or roofing shingles, asphaltic pavement, glass, plastics, electrical wiring and components containing no hazardous liquids and/or metals that are incidental to any of the above.
    c. Special solid waste which is not hazardous or otherwise a prohibited waste that is a solid waste and met the conditions for disposal consistent with the NCES Special Waste Characterization Profile. **For more information regarding Special Waste please contact the NCES Special Waste Technical Advisor at (802) 772-2217.**
- Wastes which are prohibited from disposal at the facility include the following:
    a. Those wastes prohibited by state and federal law;
    b. Hazardous wastes (as defined by the federal and New Hampshire Hazardous Waste Rules);
    c. Infectious waste;
    d. Asbestos waste including solid waste containing more than 1 percent asbestos by weight;
    e. Liquid wastes (that is waste containing free liquids as defined by Method 9095 Paint Filter Liquids Test as described in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods" [USEPA Pub. No. SW-846]);
    f. Contained gaseous wastes;
    g. White goods;
    h. Leaf and yard waste;
    i. Whole tires;
    j. Non-approved special wastes;
    k. Mercury added products;
    l. Video Display Devices;
    m. Wet cell/M-Cad/Rechargeable Batteries; and
    n. Radioactive materials as defined by He-P 4000.

Revised June 2014

# NORTH COUNTRY ENVIRONMENTAL SERVICES, INC.

## CERTIFICATE OF ACCEPTABLE WASTE

The undersigned hereby certifies that, to the best of their knowledge and belief, the materials which are delivered for disposal at the North Country Environmental Services, Inc. solid waste facility are Acceptable Wastes as defined by these Rules & Regulations and incorporated herein by reference.

_____

Company Name

_____

Address

_____

Business and after-hours telephone contact number and name

_____ _____

**Date** **Customer Signature**

| FOR STATE USE ONLY | | |
|---|---|---|
| SITE NO. | APPLICATION NO. | DATE RECEIVED |
| DEPARTMENT ACTION ☐ Approved ☐ Disapproved | | DATE |

## *SPECIAL WASTE CHARACTERIZATION PROFILE*

### *Disposal Facility Location (Choose All That Apply)*

| Hyland Landfill | Chemung Cty LF | Ontario Cty LF | Clinton Cty LF | Waste USA LF | NCES Landfill |
|---|---|---|---|---|---|
| 6653 Herdman Rd | 1488 Cty Rte. 60 | 1879 Rt. 5&20 | 286 Sand Road | 21 Landfill Lane | 581 Trudeau Road |
| Angelica, NY 14709 | Lowman, NY 14861 | Stanley, NY 14561 | Morrisonville, NY 12962 | Coventry, VT 05825 | Bethlehem, NH 03574 |
| Tel: 585.466.7271 | Tel: 607.737.2980 | Tel: 585.526.4420 | Tel: 518.563.5514 | Tel: 802.334-5796 | Tel: 603.869.3366 |
| Fax: 585.466.3206 | Fax: 607.737.2967 | Fax: 585.526.5459 | Fax: 518.563.5598 | Fax: 802.334.2476 | Fax: 603.869.2152 |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

### *Disposal Option:*

**Waste Profile is destined for:** ☐ **Disposal as waste** ☐ **BUD:** _____ ☐ **Other (describe)** _____

**Drill Cuttings Only:** ☐ **Raw Cuttings for Solidification** ☐ **Bulked Cuttings For Disposal** **MUST CHECK ONE:** ☐ **Air/Water** ☐ **Oil-based**

### *Waste Characterization Data :*

| 1) Company Generating Waste | Address of Facility Generating Waste (Street, City, State, Zip) | | County of Origin |
|---|---|---|---|
| 2) Representative of Generator (same as generator's signature) | Mailing Address of Representative | Telephone No. | Fax No. |

**3) Description of Facility/Process Generating Waste**

**4) Description of waste (debris-containing, composition, uniform or mixture, etc.)**

**5) Is Waste Considered Hazardous by Federal or State Hazardous Waste Regulations?** ☐ **Yes** ☐ **No**

| 6) Expected Annual Amount of Waste To Be Delivered | Approximate Density of Waste |
|---|---|
| _____ tons/year _____ cubic yards/year | _____ pounds/cubic yard |

**7) Expected Frequency of Delivery**

_____ one-time

_____ daily _____ weekly _____ monthly _____ other (specify, if known)

| 8) Hauler Name | Address | Transporter Permit No. | Telephone No. |
|---|---|---|---|
| | | Exp. Date: | |

**9) Method of Delivery. If other, specify.**

_____ roll-off _____ packer truck _____ tractor trailer _____ other

| 10) Previous Disposal Location | Address | Phone | Contact Person |
|---|---|---|---|
| | | | |

| *Waste Characterization Data (Cont'd)* | |
|---|---|
| **11) Is the waste classified as a "listed" or "characteristic" hazardous waste as defined by USEPA, or State of origin, or State where disposed? (If yes, explain.)** | |
| **12) Describe all hazardous or nuisance properties associated with the waste.** | |
| **13) Does the waste require any special handling or disposal procedures? If so, explain.** | |
| **14) Analytical Data Submitted (TCLP/Other).** | **Type of Samples (indicate No. of each type in space provided)**<br>**_____ grab _____ composite** |
| ***Casella requires, at a minimum, the submittal of full TCLP (Metals-RCRA 8, VOC, SVOC, PCBs, Pesticides/Herbicides), pH, Reactivity, Ignitibility, and % solids testing results for any special waste submitted for landfill acceptance unless the applicant can provide an acceptable justification for submittal of less comprehensive data. The generator is responsible for proper waste characterization.*** | |
| **15) Justification for not submitting full TCLP data.** | |

***GENERATOR CERTIFICATION***

I hereby certify that (1) all information submitted on this form and on supplemental materials is complete and accurate to the best of my knowledge and ability to determine; (2) the information provided herein, including any supplemental information, such as laboratory analytical, MSDS, etc., accurately describes the waste stream to be delivered to the facility and that all known or suspected hazards have been disclosed. I understand that, once the waste stream is approved by Casella based on this information, any deviation in the source, composition, constituents or characteristics of the waste stream from the information described herein, may render the waste stream unacceptable for disposal, at the sole discretion of Casella. I further understand that any deviation from the information contained herein will require immediate notification to the disposal facility and cessation of disposal.

| **Generator's Authorized Representative - Signature:** | **Print name:** | **Print Title:** | **Date:** |
|---|---|---|---|

| ***DISPOSITION (to be completed by Casella Waste Systems, Inc.)*** | | | |
|---|---|---|---|
| **Received by:** | | **Date Received:** | **Date Logged In:** |
| **Approved by:** | | **Project Name:** | |
| **Title:** | | | |
| **Submitted to Casella PC&E** | **Date:** | **Casella PC&E Approval** | **Date:** |
| **Submitted to State Agency** | **Date:** | **Agency Approval** | **Date:** |

**SUBMIT ALL DATA TO:**

**Ann Santell** / ann.santell@casella.com

Casella Waste Services

25 Greens Hill Road

Rutland, VT 05701

**Telephone #802-772-2217 ♦ Facsimile #802-419-3736**

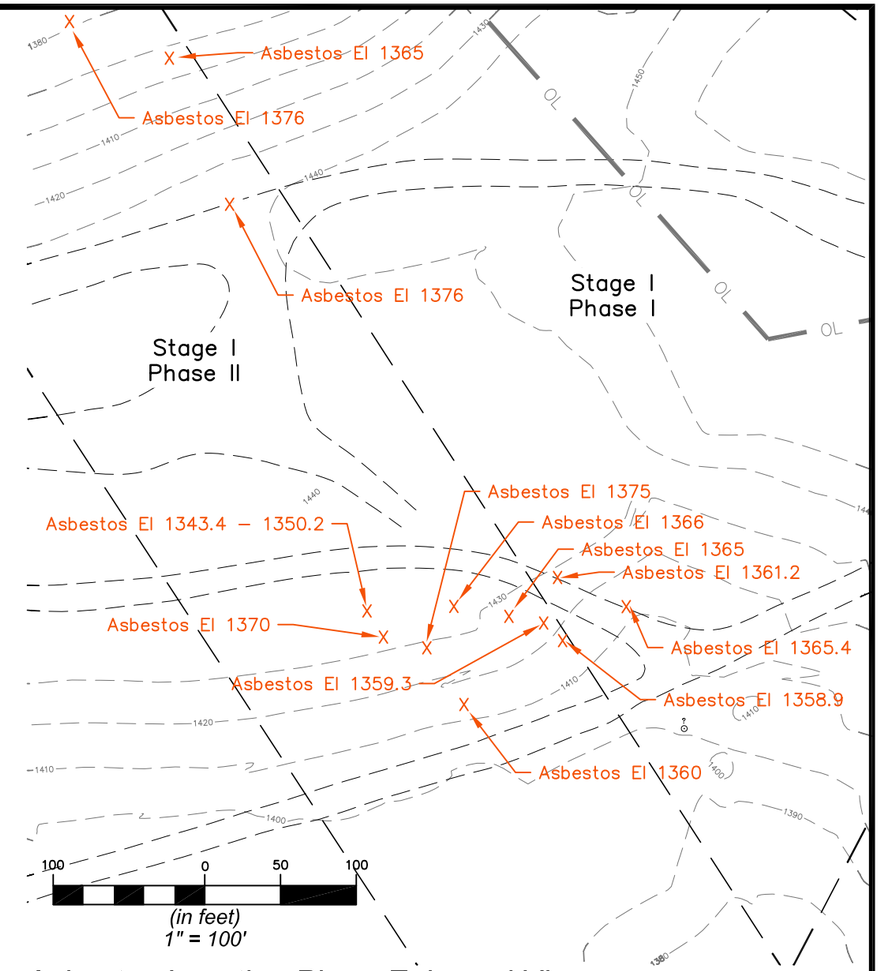
*Appendix C.2 – Asbestos Disposal Location Site Plan*

Revised June 2014

## Asbestos Location Overall Site Plan

Scale: 1" = 200'

200 0 100 200
(in feet)
1" = 200'




100 0 50 100
(in feet)
1" = 100'

## Asbestos Location Plan - Enlarged View

Scale: 1" = 100'


CMA ENGINEERS
CIVIL/ENVIRONMENTAL ENGINEERS

35 Bow Street
Portsmouth, New Hampshire
03801-3819
Phone: 603/431-6196
Fax: 603/431-5376

Lafayette Center
Storer Street Building, Suite 208
Kennebunk, Maine 04043
Phone: 207/985-8717
Fax: 207/985-5520

E-mail: info@cmaengineers.com


North Country Environmental Services, Inc.
Bethlehem, NH
Stage V
Facility Operating Plan

- Asbestos Disposal Location Site Plan -

Scale: As Shown

*Appendix C.3 – Revised Gas Management System O&M Manual*

SANBORN HEAD

*Building Trust. Engineering Success.*

# OPERATION AND MAINTENANCE MANUAL

## GAS MANAGEMENT SYSTEM

*North Country Environmental Services, Inc.*
*Bethlehem, New Hampshire*

*Prepared for North Country Environmental Services, Inc.*
*File No. File 1003.07*
*~~February~~May 2014*

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# 1.0 INTRODUCTION

This manual describes procedures for operation and maintenance of the gas management system at the North Country Environmental Services, Inc. (NCES) landfill in Bethlehem, New Hampshire. The objective of the gas management system is to help to assure that the concentrations of methane and other explosive gases do not exceed:

- 25 percent of the lower explosive limit (LEL) for gases in structures on- or off-site excluding leachate collection and gas recovery and control structures; and
- 50 percent of the LEL for gases at and beyond the property boundary within soil.

Further objectives are to limit greenhouse gas emissions by capturing methane and other compounds, and to provide for control of odors emanating from the landfill.

Before operating a landfill gas (LFG) collection and control system and related process equipment, individuals should be properly trained in the potential hazards and proper operating procedures for such operation. This manual is a general guide and is not intended to be a substitute for proper hands on training in process operations, regulatory requirements, or special safety activities, which may be required by various local, state, or federal regulations.

# 2.0 CHARACTERISTICS OF LANDFILL GAS AND POTENTIAL HAZARDS TO PERSONNEL

## 2.1 Characteristics

LFG is primarily composed of methane and carbon dioxide and is produced by anaerobic bacteria which consume organic matter. Other major gases that may be present include oxygen, nitrogen, and water vapor. LFG usually contains traces of hydrogen, ethane, and many other gases, including volatile organic compounds (VOCs). Oxygen and nitrogen are usually present because of air entrained in the landfill (air is approximately 21 percent oxygen and 79 percent nitrogen), either during placement of refuse, from atmospheric weather effects, because of LFG system operations, or by diffusion of air into the landfill.

Important characteristics of LFG are as follows:

- Consists primarily of methane and carbon dioxide;
- LFG has a relatively high moisture content; cooling almost always results in the formation of condensate;
- LFG is flammable (i.e., potentially explosive);
- LFG may migrate through surrounding soils, within open conduits, and trench backfill;
- LFG may accumulate in confined spaces;
- The weight (specific density) of LFG is usually close to the weight of air;
- Typical temperature range is 16 degrees Celsius ($^{o}$C) to 55$^{o}$C (60 degrees Fahrenheit [$^{o}$F] to 130$^{o}$F) within the landfill;
- Component gases (methane, carbon dioxide, water vapor and others) tend to stay together but may separate through soil and liquid contact; and

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- Secondary constituents (trace gases) may cause nuisance odors, environmental pollution, and may create a health risk.

The flammable range of methane is approximately 5 to 15 percent (by volume) in air. The lower limit of 5 percent is referred to as the Lower Explosive Limit (LEL); the upper limit of 15 percent is referred to as the Upper Explosive Limit (UEL). The auto-ignition temperature of methane is 540 $^{o}$C (1004 $^{o}$F). The specific density of methane and carbon dioxide are 0.55 and 1.52, respectively; however, the specific density of LFG is close to that of air. It should not be assumed that LFG will rise. The LFG mixture may be lighter or heavier than air and the specific density of LFG will be dictated by the LFG's overall composition.

LFG has its own characteristic odor due to trace compounds in the gas. Some of the most significant examples of the classes of odor-causing trace constituents include esters, phenols, organic acids, solvents, and sulfur compounds (including mercaptans); however, LFG may not always exhibit an identifiable odor since the odor carrying trace components may be stripped off as a result of movement through cover or adjacent soil.

LFG concentrations can be monitored using various meters. At a minimum, the percent LEL, percent oxygen, and percent hydrogen sulfide ($H_2S$) should be measured at any location where there is potential for LFG to be present where personnel will be working.

According to Occupational Safety and Health Administration (OSHA) guidance, personnel should either not enter a space, or should immediately leave the space if already present and monitoring results indicate:

- The percent LEL is 50 percent or higher;
- The concentration of oxygen is lower than 19.5 percent; or
- The concentration of hydrogen sulfide is more than 10 parts per million (ppm).[1]

## 2.2 Potential Hazards to Personnel

Landfill operations staff should be made familiar with the following types of hazards related to the presence of LFG and gas condensate and the appropriate and safe procedures to identify and avoid them:

- Fire hazards;
- Explosive hazards;
- Confined space, toxic exposure, and asphyxiation hazards; and
- Condensate.

Methane is colorless, odorless, flammable, and potentially explosive gas that may be emitted into the atmosphere; Carbon dioxide is colorless, odorless, and non-combustible. LFG that contains other volatile gases may migrate through the soil into surrounding areas

[1] American Conference of Industrial Hygienists (ACGIH) recommends a threshold limit value (TLV) of 1 ppm as an 8-hour time weighted average (TWA) and a short-term exposure limit (STEL) of 5 ppm.

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or contact groundwater and may adversely impact the environment. LFG may travel long distances underground and may accumulate underneath and in structures and confined or enclosed spaces creating a potential explosion hazard.

### *2.2.1 Asphyxiation*

Methane and carbon dioxide are asphyxiates. Oxygen deficiency is a serious hazard and may cause death by asphyxiation. If LFG is present in an unventilated area, it can displace air and lead to an oxygen deficient environment. According to OSHA standards, an oxygen deficient atmosphere exists when the oxygen concentration is 19.5 percent or less. It is imperative that confined space regulations and procedures be followed before personnel enter any confined spaces or any location where oxygen deficiency could occur. Under certain circumstances special "permitted entry" requirements apply.

Potentially lethal concentrations of $H_2S$ may be present at landfills. Personnel must always be alert for the hazards presented by $H_2S$. $H_2S$ is a colorless, toxic, flammable gas, which in low concentration has an offensive odor similar to that of rotten eggs. A person's sense of smell can be lost within 2 to 15 minutes of exposure to $H_2S$. If $H_2S$ is detected or suspected, consult the site Health and Safety Officer, an industrial hygienist, or other qualified person.

### *2.2.2 Explosive Atmosphere*

LFG tends to migrate and accumulate in confined spaces. The occurrence and accumulation of methane is sometimes transient. The presence of slight amounts of methane, less than the LEL, is an indication that more may accumulate under other conditions if corrective action is not taken. If methane is detected in concentrations greater than 15 percent (100 percent of the UEL) by volume, there is always the potential for an explosive methane-air "front" that could be formed nearby by dilution.

- Avoid any possible source of ignition when working on the gas management system. Smoking when working on the LFG system components is prohibited.
- Synthetic clothing such as polyester is extremely flammable. Wearing synthetic clothing can be fatal in a methane gas flash fire.

### *2.2.3 Potential for Landfill Fire*

If large quantities of air are introduced into the landfill in a localized area, either through natural occurrence or overly aggressive operation of the LFG system, poorly supported combustion of the buried municipal solid waste (MSW) may occur and carbon monoxide may be detected. Subsurface fires produce temperatures of several hundred degrees Fahrenheit within the landfill and typically result from air intrusion into:

- The landfill/cover soil interface;
- Cracks, breaks, or buried imperfections in the cover/cap;
- Breaks in buried collection piping and extraction wells; and/or

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- Backfill surrounding collection system components (e.g., from the filter or gravel pack of an extraction well or the gravel backfill around a sump).

To limit the potential for a landfill fire, the landfill operator should limit the introduction of air into the landfill by good operation of the collection system and maintenance of the landfill cover.

### *2.2.4 LFG Condensate*

LFG condensate may contain trace chemicals. Appropriate protective gloves and splash protection equipment should be used when working with LFG condensate. Operating personnel should avoid direct skin contact.

Condensate is odorous, and may release VOCs. Condensate also usually contains a high concentration of iron which causes the condensate to stain concrete orange. Careful control of condensate handling, treatment and disposal is necessary to limit release of odors.

The vapors emanating from condensate tanks may be flammable.

## 3.0 SYSTEM COMPONENTS AND MONITORING PROGRAM

The gas management system includes perimeter gas monitoring probes, sub-liner gas wells, horizontal collection trenches, gas extraction wells and associated wellheads, gas collection from the leachate collection system, transmission piping, blowers, and flares. A description of the individual gas management system components is provided below.

The LFG collection system should be operated in a manner which maintains anaerobic conditions within the landfill limiting the intrusion of air into the waste. To assure the objectives are met, the system components should be monitored on a routine basis. A discussion of the monitoring requirements for the various components is provided below and summarized in Table 1.

### 3.1 Gas Probes

Monitoring of the perimeter gas probes and sub-liner gas wells will be performed as outlined in the Gas Monitoring Plan (GMP) provided as Appendix A.

### *3.1.1 Perimeter Gas Probes*

Twelve gas probes are monitored on a quarterly basis including: GP-1, GP-2, GP-4, GP-5, GP-6, GP-7, GP-8A, GP-11, GP-12, GP-13, GP-14, and GP-15. The perimeter gas probes are installed beyond the perimeter of the landfill and are used to monitor for the presence of LFG migrating through the soil away from the landfill.

The atmosphere within each perimeter gas probe will be monitored for combustible gas concentrations using a combustible gas meter or equivalent device. In the event that combustible gas concentrations exceed 50 percent of the LEL, an evaluation will be made in accordance with the requirements outlined in the GMP.

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### 3.1.2 Sub-liner Gas Wells

There are six sub-liner gas wells located east of the Stage I/II and Stage III delineation line. These wells are designated SGW-1 through SGW-6. The wells were installed with the base slightly into groundwater. Monitoring of the sub-liner gas wells will be performed at the same frequency and for the same parameters as the perimeter gas probes.

## 3.2 Horizontal Collection Trenches

The horizontal collection trenches typically consist of perforated, high-density polyethylene (HDPE) pipe bedded in crushed stone installed in trenches excavated in the refuse. The collection trenches are connected to gas transmission piping and gas extraction is controlled at a wellhead as described in Section 3.5.

## 3.3 Gas Extraction Wells

Gas extraction wells, typically constructed of 8-inch diameter schedule 80 PVC pipe (or similar) have been installed in boreholes drilled with a 30-inch diameter (typical) bucket auger to various depths within the refuse. Typically, the wells are slotted from depths of approximately 15 feet below intermediate cover grades to the base of the well. The slotted sections of the wells are backfilled with crushed stone.

## 3.4 Wellhead Assemblies

The wellhead assemblies are located between each gas extraction point (e.g., collection trench, well, or leachate collection cleanout pipe) and the gas transmission system piping. Using various hose, fittings, and taps, the wellhead assemblies allow for:

- Differential settlement between the tie-in header and the well;
- Sampling of the gas in the well head;
- Measurement of the gas flow rate;
- Measurement of the gas temperature;
- Measurement of the available vacuum;
- Control of the gas flow rate; and
- Access to the well from the top for equipment or measurements.

The wellheads are to be monitored on a regular basis to observe their general condition, with particular attention to the condition of the flexible hose between the wellhead and the transmission piping. Additional data to be gathered includes:

- Valve position (percent open);
- Gas flow rate;
- Available vacuum;
- Static pressure;
- Percent methane;
- Percent carbon dioxide;
- Percent oxygen; and
- Gas temperature.

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## 3.5 Transmission Piping

LFG from the wellhead assemblies at the extraction points passes through the transmission piping to the blower and flare system. Condensate formed in the transmission piping is directed to condensate traps for removal.

The transmission piping shall be monitored on a semiannual basis. The visible portions of the gas transmission piping shall be monitored for general condition, evidence of ground movement from frost or settlement, signs of deterioration, and integrity of the pipe supports.

## 3.6 Valves

Gate valves are located between each wellhead assembly and the transmission piping, and butterfly valves have also been provided at several locations along the transmission piping. The valves at wellhead assemblies are used to control the gas flow rate from the extraction points. The valves located along the transmission piping are used to isolate sections of the gas collection system for maintenance.

The valves installed in the headers shall be inspected on a quarterly basis and exercised to confirm they are operable; the valve position (percent open) shall be noted.

## 3.7 Blower

The facility is equipped with a primary and a backup blower, each with a dedicated variable frequency drive. The piping on the vacuum side of the blower includes a manually controlled butterfly valve and a vacuum transducer to assist with controlling LFG flow to the system.

The piping on the discharge side of the blower includes an in-line thermal flow meter to measure the LFG flow rate, and a pneumatically actuated butterfly valve to automatically shut off LFG flow through the system in the event of a system failure.

The valve actuator for the automatic shutoff valve is powered by a high-pressure, nitrogen cylinder with a regulator to step the nitrogen pressure down to about 80 pounds per square inch (psi). The nitrogen is supplied to the actuator through an electrically actuated solenoid valve which is controlled by the flare system's electrical control panel.

The blowers shall be visually inspected for evidence of leakage anywhere on the assembly and abnormal noises in the motor or blower.

## 3.8 Open Flare and Control System

The flare is a self-supported open (candlestick) type, designed to operate in accordance with U.S. Environmental Protection Agency (USEPA) 40 CFR 60.18, and provide greater than 98 percent destruction efficiency of non-methane organic compounds (NMOCs).

The flare system is designed to operate automatically and is controlled via a Supervisory Control and Data Acquisition (SCADA) system. The SCADA system monitors and controls

flare, blower, and condensate pump operations and is equipped with operator controls, status indicators, and alarm lights. In addition, the SCADA system monitors and records various analog and discrete inputs from the flare station equipment including condensate levels, header vacuum, landfill gas flow rate, landfill gas auto-block valve position, and flare thermocouple temperatures.

The following is a description of the SCADA system design intent with respect to flare system startup and shutdown. If specific alarm conditions occur,~~If an alarm condition occurs,~~ the SCADA system automatically stops landfill gas flow to the flare. In addition, the SCADA system will notify the flare system operator of the nature of the alarm condition. Thermocouples monitor the pilot flame, main flame, and flame arrestor to prevent damage to the equipment.

The flare system includes an automatic ignition system and fail-safe controls. During flare system start-up, the pilot gas solenoid valve opens and allows propane gas to flow to the flare pilot assembly where the ignitor generates a spark and ignites the pilot tip. Once the pilot ignition is proved by the pilot thermocouple, the SCADA system opens the landfill gas auto-block valve and starts the landfill gas blower. After the main flame ignition is proved via the main flame thermocouple, the pilot gas solenoid valve closes to limit propane usage. If the main flame thermocouple indicates that the flame has extinguished, the auto-block valve automatically closes and the landfill gas blower shuts off. The SCADA system will automatically initiate the system startup sequence to resume flare operation. If the main flame does not prove within a specified period of time, after the third attempt, the flare will shut down and an automatic callout will notify the system operator of a shutdown. NCES will notify the New Hampshire Department of Environmental Services in the event the flare system is not operable (e.g., during a GCCS malfunction event).

The flare station shall be inspected on a weekly basis for:

- General conditions;
- Nitrogen supply for the control valve;
- Propane supply for the ignition system;
- Condition of the ignition system; and
- Back pressure at the flame arrestor.

Appendix B includes a Routine Inspection Report for Gas Extraction System that should be completed during each inspection.

### 3.9 Condensate Handling Components

The LFG condensate handling system is designed to remove condensate that forms within the piping of the gas extraction system by allowing it to drain back into the leachate collection system through traps, or collecting it and pumping to the condensate storage tank. Condensate traps are incorporated in the piping system to collect and remove LFG condensate. Condensate traps are located at low points in the LFG transmission piping system. The traps typically consist of a U-shaped tube filled with condensate to provide a seal for the vacuum in the system. To maintain a seal, the liquid column maintained in the

trap must be at least as high as the maximum vacuum obtainable in that portion of the system. Condensate collected in traps located in the landfill flows out the liquid discharge side into the leachate collection system.

Gas condensate knockout structures are located in the LFG header piping near the blower flare assembly. Each of the condensate knockouts include pumps to pump the collected condensate directly into the leachate storage tank (Tank A) located to the east of Stage IV Phase I landfill for management with the collected leachate. Level switches are installed in the knockout structures to monitor the liquid level. The level switches and pump system control the pump operation to manage the collected condensate and also sound low and high level alarms if there are operational issues.

The condensate knockout structures will be routinely monitored to note:

- Depth of condensate in the knockout structure; and
- Whether liquids are present in the interstitial space between the walls of the condensate knockout, as applicable.

### 3.10 Ancillary Observations

In the course of monitoring system components, observations of the condition of the landfill cover system should also be made including indications of settlement, stressed vegetation, and condition of cover soils. Further, the presence of odors should also be noted.

## 4.0 OPERATING AND ADJUSTING THE LFG COLLECTION SYSTEM

### 4.1 Well System Tuning

The adjustment or "tuning" of the LFG extraction system involves monitoring various parameters and making adjustments to optimize the extraction of LFG from each extraction point in the system. The objective of the tuning is to provide for a negative pressure at each extraction point without causing the intrusion of air into the landfill. Tuning is an iterative process, as adjustments to any portion of the system have the potential to affect the entire system. A discussion of the monitoring and tuning procedures is provided below. A summary of the steps to be taken and data to be gathered is presented in Table 2.

The instrumentation used to monitor LFG flow rates, pressures, and composition is a landfill gas analyzer (e.g., Landtec GEM-2000 instrument). Like most analytical instrumentation, it is important to field calibrate the LFG analyzer (meter) prior to using it to collect LFG data. The instrument requires calibration with methane, carbon dioxide, and oxygen span gases. The meter shall be field checked with calibration gas and, if necessary, calibrated in accordance with the manufacturer's recommendations at least once each day that it is used. A log of the calibration should be kept with the instrument. Vibration, shock, and large temperature changes can affect the calibration of the instrument. Use care when transporting and handling.

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### 4.1.1 Indicator Parameters

The composition of LFG with respect to methane, carbon dioxide, and oxygen contents is measured using the landfill gas analyzer (meter). The meter draws in a sample of LFG from the wellhead static pressure port and provides percentages for methane, carbon dioxide, oxygen, and balance gas.

The tuning of the system should be performed based on gas composition and gas temperature. Typically, as the methane and carbon dioxide concentrations decrease, oxygen and nitrogen concentrations will increase; such a trend indicates adjustments should be made to reduce the gas extraction rate. Alternatively, if the methane and carbon dioxide concentrations are consistently high, then the gas extraction rate could be increased.

Elevated gas temperatures (e.g., greater than 131°F) can be an indication of aerobic activity in the landfill, which if left unchecked, may lead to a landfill fire. Sanborn Head prepared memoranda dated March 24 and April 30, 2010 (see Appendix C) discussing balancing a wellfield considering aerobic activity concerns. NCES' wellfield technician and/or engineer should review the memoranda if there is reason to believe that the landfill is operating under aerobic conditions that might lead to a landfill fire. As indicated in the memoranda, ~~T~~the following parameters should be closely monitored to assess whether aerobic activity may be occurring:

- Wellhead temperature;
- LFG Flow Rate;
- Residual Nitrogen; and
- Carbon Dioxide/Methane Ratio.

### 4.1.2 Flow Rates

The gas extraction flow rates will be different at each extraction point and will vary with changes in atmospheric pressure as well as landfill cover condition (i.e., geomembrane cap or intermediate cover). Likewise, the cumulative extraction rate at the blower will vary with time. The flow rates should be adjusted based on the concentrations of the various constituents as described above. As the operating record of the system becomes established over time, "normal" flow ranges for the individual extraction points as well as the system will become established.

The LFG flow rate is determined by reading the differential pressure. The meter can be programmed to directly correlate differential pressure to flow rate.

### 4.1.3 Pressures

The pressure of the LFG will vary throughout the system at any given time, and will also vary as a function of gas flow rate. The pressures at the extraction points should be negative (vacuum) to provide active extraction from that point. If the pressure is positive, adjustments should be made to increase the flow rate, provided the gas constituent concentrations are within the normal ranges as discussed above.

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The static pressure at various ports in the piping at the gas extraction points and along the transmission piping is read using the meter. Tubing is provided with an external filter/water trap assembly to connect between the static pressure port on the meter and the static pressure ports on the LFG system.

#### *4.1.4 Temperature*

The temperature of the LFG at the extraction points is read directly from thermometers installed on the wellhead assemblies or by temperature probes connected to the meter.

## 5.0 MAINTENANCE AND TROUBLESHOOTING

### 5.1 Wellfield and Collection System Maintenance

Wellfield maintenance involves the following:

- Repairs to the collection piping due to damage caused by accident, settlement, environmental factors, and aging;
- Repair or replacement of system components (e.g., wellheads, access ports, flex hoses, valves, road crossings, condensate traps, etc.);
- Removal or capping of system components (horizontal collection trenches, gas extraction wells and associated wellheads, leachate collection system components) that are not operating properly or are no longer productive, based on wellfield tuning data;
- Excavation for repair of damaged piping and components;
- Repairing and re-adjusting piping supports and anchors; and
- Re-sloping or re-leveling piping support earth berms and the landfill surface.

In many instances, repairing the collection system may require shutting down the blower-flare facility. The duration of the shutdown should be kept to a minimum; when possible, the work should be scheduled to coincide with scheduled blower/compressor and flare shutdowns.

### 5.2 Landfill Surface

The cover and cap are an integral part of the system. Good landfill cover and cap maintenance practices are important for effective operation and performance of the LFG management system. Experience has shown that in most cases, good cap and cover maintenance will solve most landfill odor problems. A visual inspection is helpful in identifying cracks, fissures or bare spots in cover. Damaged areas should be investigated and repaired.

### 5.3 Transmission Piping

Over time, the collection piping may develop air leaks. Air leakage should be kept as low as possible and it is recommended that oxygen in LFG not exceed 3.5 percent by volume in the collection piping.

Leaks can occur in above-grade piping systems due to piping separations caused by thermal contraction. Separations or damage can occur to below-grade piping due to differential settlement. Buried pipe is also subject to expansion and contraction, but to a lesser degree because of a more uniform temperature and the anchoring effect of the soil support within the trench.

The transmission piping should be installed at a minimum slope of 3 percent to limit the potential for condensate accumulation in the pipe due to differential settlement; however, condensate blockages in main and lateral headers may occur. These blockages can be evaluated by installing access ports for monitoring. With buried systems, it may be necessary to "pot hole" (i.e., perform exploratory excavation) with a backhoe to install access ports and conduct the monitoring. If the main header becomes blocked or restricted with condensate, it should be corrected by re-leveling the line or installing an additional drain trap.

## 5.4 Blower-Flare Facility Maintenance

A brief discussion of general maintenance requirements for specific equipment follows. For more detailed information refer to applicable manufacturer's information.

### *5.4.1 Pipe and Fittings*

Process plant pipe and fittings commonly consist of steel and thermoplastic. Both are durable long-lived materials, however, thermoplastic piping can be subject to damage from shock, strain, or heat. Thermoplastic piping should not be used near sources of extreme heat such as the flare. Carbon steel piping can erode and corrode. Stainless steel, cast iron, and aluminum piping have all been used successfully.

LFG and condensate exhibit corrosive properties due in part to the presence of oxygen, carbon dioxide, and organic acids in the LFG condensate. Steel piping may be corroded when exposed to LFG condensate. The pipe should be inspected for evidence of corrosion (e.g., leakage, particularly at fittings) and ultrasonic thickness testing may be performed to check pipe integrity.

### *5.4.2 Valves*

Valve seats and stem seals may wear and eventually require replacement. Butterfly, gate, and ball valves filled with elastomer seals, such as Buna-N or EPDM, may be affected by LFG. In such cases, it may be necessary to try other elastomer types to find a material more suitable to the service. Viton or filled Teflon™ valve seats in butterfly and ball valves respectively have had reasonably good wear performance.

### *5.4.3 Blower Maintenance*

Consult the manufacturer's literature for detailed information on the maintenance of the blower.

Routine maintenance for blowers and motors consists of listening for signs of abnormal operating conditions, monitoring for excessive vibration or temperature, and draining

condensate from blower housing periodically and before startup (if not automatically drained). On direct drive machines, flexible coupling alignment should be checked on initial setup and periodically as recommended by the manufacturer (typically quarterly to annually). Bearings should be oiled, greased, or repacked according to the manufacturers' recommendations (typically quarterly to annually). The electric drive motor, if not equipped with sealed bearings, should also be greased. Blower seals and packing should be checked periodically for leakage. If blower seals continually leak or will not last, consult the manufacturer or try another type of seal or seal material.

### *5.4.4 Automatic Block Valve*

An automatic block valve shuts off the flow of LFG to the flare when the flare is not operating or when a fault or shutdown is initiated. This is a butterfly type valve and should be serviced only when a need is indicated. The valve is pneumatically operated using a high-pressure nitrogen cylinder with a pressure-reducing regulator to supply the driving gas. For the pneumatic actuator to function properly, the supplied drive gas must be clean, dry, and at the specified pressure. The pneumatic actuator should open and close the valve fully without sticking. The piping to the air motor and valve should not leak. The automatic block valve seat should maintain a gas tight seal whenever the valve is in the closed position. Refer to the manufacturer's literature for information on service.

### *5.4.5 Flame Arrestor*

A flame arrestor is located at the inlet to the flare. A flame arrestor is designed to prevent the migration of burning LFG from the flare backwards into the process piping. This condition can cause what is known as "detonation" (an explosion) or "flashback" within the piping. This is a dangerous condition, particularly in the case of high oxygen content. A flame arrestor will only work properly if the velocity and pressure of the "flashback" in the pipe is within the allowable range and the flame arrestor is properly assembled.

The pressure at the blower outlet should be checked during weekly monitoring. If the differential between inlet and outlet pressures is greater than 2 to 3 inches of water column, the flame arrestor should be serviced. To service a flame arrestor, shut down the facility and block in the flame arrestor upstream using the manual and automatic block valve (verify the valves do not leak.). Closely follow the directions in the manufacturer's literature for maintenance and re-assembly of the flame arrestor element. It is important to note that a flame arrestor's effectiveness is based upon a design spacing or gap in the flame arrestor element. During maintenance and re-assembly, this spacing must be maintained according to the manufacturer's original specifications if the flame arrestor is to function as designed. Ensure that all parts are returned and in the proper orientation when re-assembling the flame arrestor.

### *5.4.6 Open Flare*

Operation and maintenance of the candlestick flare includes maintaining proper fuel pressure, maintaining the ignitor system, and keeping the flare drained of any condensate build-up. Gas velocity, quality, mixing, and flame condition can affect performance.

Problems with flame stability in a candlestick flare are usually caused by poor LFG methane quality and/or excessive wind.

The primary wear on flares is due to thermal stress. If the flare is operated in an imbalanced condition or at excessively high temperature, it will exhibit signs of accelerated thermal stress. This may be indicated by wear and deformation of the burner.

The flare may require burner adjustment or modification to achieve and maintain proper combustion performance. Adjustment of the flare may involve changing an orifice or burner ring, or moving or changing a plate. Consult the manufacturer or seek qualified assistance.

Gas velocity to the flare is adjusted at the blower-flare facility inlet. This is accomplished by balancing the distribution of the blower's total pressure so that there is sufficient fuel pressure at the flare. In severe cases where adjustment will not work, the flare burner or the blower may need to be modified or replaced. **Never modify the flame arrestor to increase gas velocity.**

The flame safeguard sensor system consists of an electronic controller mounted in the control panel and a thermocouple mounted on the flare tip. At least one spare thermocouple should be kept on site.

A thermocouple can be checked independently with a voltmeter and thermocouple tables or with a digital thermocouple test meter or digital thermometer. Proper polarity must be observed when installing and monitoring a thermocouple. If the thermocouple is subjected to flame impingement, its life may be considerably shortened. Thermocouples can be mounted in protective sheathing, however, this will cause some delay in response to temperature changes. See the flare manufacturer's literature for specific component operation, maintenance, and troubleshooting information.

The open flare spark ignitor is similar in appearance and function to an automotive spark plug. Monthly, or when the ignitor exhibits excessive wear, the spark ignitor should be inspected for cracking of the ceramic insulator, wear of the ignitor ground rod, short circuiting in the high voltage lead wire, and accumulation of moisture that may short out the ignitor causing it to fail to perform. It is important that a proper gap be maintained for a good spark between the spark ignitor ground rod and the burner head. As the spark ignitor is used the gap will increase and eventually may result in failure to spark. From time to time the gap may need to be adjusted. Spare spark ignitors should be kept on site.

The spark ignition wire will also wear due to heat stress and UV exposure. If this wire shows cracks, deterioration or signs of excessive wear due to thermal stress, it should be replaced. Spark ignitor wire may also be damaged from heat when routed in conduit mounted on the flare body if not properly cooled or insulated. Another common problem with spark ignitors is moisture, which will cause short-circuiting to ground and malfunctioning of the ignition system. If moisture is detected, check the ignition components and clean and dry all connections.

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### 5.4.7 Electrical Equipment Controls and Instrumentation

Dust may accumulate in cabinets absorbing moisture from the air. Over sufficient time a conductive path can be created that can cause a failure. Connections may also become loose due to thermal expansion and contraction. Electrical service and control cabinets should be cleaned on an annual basis. Wire connections should be checked and tightened throughout the cabinets annually. Calibration and verification of instrumentation gages and thermocouples should be performed annually. Shutdown alarms and devices should be tested. Thermocouples for sensing flare stack temperature should be maintained, and replaced when they no longer perform properly. This is normally evident by failure of the temperature controller to properly read or control the flare stack temperature (usually due to an open junction) or by loose or corroded connection terminals at the temperature transmitter, connector block, or temperature controller.

Test and recalibrate instruments, fault protection and shutdown devices. Large breakers or fused disconnects should be disconnected under load. Ensure high voltage breakers or disconnects are "locked out" in accordance with 29 CFR 1910.147 and 1910.333 Subpart S before working on equipment associated with them. Fuses should be physically pulled to isolate equipment. When the facility will be down for major maintenance or stand down, large breakers should be locked out (i.e., physically separated and disconnected) and the fuses should be pulled.

### 5.4.8 Lubrication - General

Follow the manufacturer's recommendations for specific types and brands of lubricants. It is important to use the recommended type of grease and not to mix types or brands of grease. Do not over lubricate. Personnel who perform lubrication services should be knowledgeable in lubrication practices and should follow the manufacturer's instructions for lubrication requirements.

Establish an initial lubrication frequency based upon the equipment manufacturer's recommendation. It may be necessary to adjust the lubrication frequency interval based upon experience with the equipment.

### 5.4.9 Other Equipment Maintenance and Operating Tips

The system operator should be proactive, remain alert, and develop a habit of observing equipment.

Equipment noises (such as bearings) may be monitored by using an equipment stethoscope or using a wrench or similar tool by placing it on the equipment and placing the opposite end of the tool against the bone in front of the ear to listen. It is important to develop a sense of what baseline conditions are for comparison. The smell of leaking LFG or burned lubricant can indicate a seal, component, or lubricant failure.

When checking motors or other electrical devices for temperature by infrared thermometer, the back of the hand should be used. Approach the equipment slowly and

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feel for radiant heat which would indicate a very high temperature. If the equipment is too hot to maintain hand contact, it is at or above a threshold of about 60 to 63°C (140 to 145°F) and may be considered excessive in many cases depending upon the equipment and service. The reason for using the back of the hand is that it is more heat sensitive and in the case of electrical fault to the casing, the natural reaction will be for the muscles of the arm to contract away from the device. This can prevent electrocution.

Operating personnel should wear all cotton clothing which provides some degree of protection in gas flash fires. Some synthetics such as polyester blends will melt readily, which can be fatal. Ties or loose items (e.g. identification badges hanging from or work around the neck, etc.) should never be worn around rotating or belt-driven equipment. Remove all watches, rings, identification bracelets, etc., when performing electrical testing or troubleshooting.

It is important that maintenance supplies, lubricants, and spare parts be inventoried on a frequent basis to ensure that adequate stocks are maintained for when they will be needed. Supplies should be reordered and restocked as used.

### *5.4.10 Condensate Handling Systems*

The blower-flare facility is fitted with various traps, drains, and pumps for handling condensate. Condensate can be corrosive and the equipment will need to be checked carefully and frequently for the effects of corrosion. Seals, o-rings, slide valves, and check valves are usually high maintenance items. Refer to the manufacturer's information for maintenance of individual equipment or components.

## 6.0 COLD WEATHER OPERATIONAL CONSIDERATIONS

Operation of the LFG system under cold weather conditions may cause freezing of condensate in exposed pipes and equipment or in below-grade pipes without adequate soil cover. Care must be taken to limit the amount of condensate allowed to collect in the LFG system at any time. The LFG is a source of heat for the system. If the system shuts down for a short period of time during winter months, condensate in the exposed portions of the system may freeze.

If freezing of condensate under normal operating conditions becomes a regular problem, heat trace and insulate the affected areas.

## 7.0 DATA COLLECTION

Data will be collected routinely using reading sheets from the blower-flare facility, the wellfield, migration monitoring probes, structures, etc. These "readings" become part of the facility operating record.

### 7.1 Data Assessment

During the initial start-up and operation of the LFG system, baseline data should be acquired. The data should be representative of normal (not unusual, imbalanced, or

irregular) conditions. These baseline data may be used in the future for comparison with current data. Parameters to be monitored include pressure, differential pressure, temperature, and flow, at various locations within the LFG system.

Pressure will change with changes in gas flow. Similarly, the temperature rise across a blower will change based on the flow through it.

With the above caveat in mind, equipment performance may be compared with past or baseline performance under similar operating conditions. Persons assessing the data should be aware of the normal operating range for each parameter and note any changes and assess the reasons for that change. Equipment deterioration that can be either sudden or very gradual may be indicated by an abnormal monitoring result. Such indications should be promptly investigated or reported. Facility data should fall within established parameters for normal operating ranges for that equipment based upon service conditions. Manufacturers' information and equipment operating experience along with judgment are required to assess facility data and determine these ranges.

A number of data assessment techniques for LFG wellfields have been developed including:

1. Comparing current performance data with baseline data;
2. Comparing data with tables of acceptable ranges and conditions cross-referenced with recommended adjustments;
3. Directly comparing monitoring data with target criteria (e.g., methane, oxygen, nitrogen residual, wellhead vacuum, flow, etc.);
4. Assessing individual well data parameters with subjective judgment (no specific analytical or mathematical method used);
5. Performing a summation of total wellfield flow and comparing with predicted or prior demonstrated acceptable wellfield flow. This may be used to develop a compensation factor to calculate individual well flow targets and readjust the wells;
6. Differentiating between air intrusion through landfill cover and waste mass, and collection piping leakage, and compensating accordingly (see No. 9 below);
7. Evaluating nitrogen residual by measuring nitrogen with a gas chromatograph or calculate nitrogen as a balance gas;
8. Comparing a summation of individual well data with total composite wellfield flow, while accounting for piping leakage and flow measurement error;
9. Performing a special analysis of the extraction well, monitoring probe, and waste mass boundary; and
10. Presenting data trends in graphical and tabular formats.

These techniques should be used in conjunction with target criteria and established acceptable performance ranges for each extraction well.

## 7.2 Facility LFG Field Book

Whenever the system is monitored for any reason, staff should make appropriate entries in the Field Book that will be stored at the landfill office. Log entries could include:

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- Name of person making the entry;
- Date and time;
- Reason for the monitoring (e.g., routine, shutdown, specific monitoring or maintenance activity, etc.);
- Reason for any shutdown. Any LFG system shut down whether for normal maintenance or system failure is to be recorded on the NCES LFG Extraction System Log which is kept inside the control panel within the LFG utilization facility;
- Actions taken or adjustments made;
- Equipment status upon leaving; and
- Unusual observations made.

The log is used as a record of events regarding the facility and to communicate between operating personnel. The log entry also becomes part of the daily facility readings.

## 7.3 ~~Facility LFG Field Book~~The Data Collection Routine

Data are collected manually in the field at the individual data points (i.e., at wells on the landfill, at migration monitoring probes surrounding the landfills, etc.). Data will be recorded electronically and/or on paper reading sheets.

The data collection routine involves walking or driving around the landfill from point to point.

Equipment used for data collection includes:

- Landfill Gas Monitor;
- Calibration gases (use before going into the field);
- Data reading sheets;
- Clipboard and writing implement;
- Pocket calculator;
- Site map of the data points;
- Carrying tray, toolbox, or backpack, etc.;
- Tools needed to access the system components; and
- Spare parts for maintenance such as access ports, plugs, etc.

# TABLES

## TABLE 1
## MONITORING SCHEDULE

| ITEM | FREQUENCY | PARAMETER |
|---|---|---|
| Well Heads | Monthly | • Condition of flex hose, sample ports, and wellheads;<br>• Valve position;<br>• Gas flow rate;<br>• Static Pressure;<br>• Percent methane;<br>• Percent carbon dioxide;<br>• Percent oxygen; and<br>• Temperature of gas. |
| Blower | Weekly | • Throttling valve position (percent open);<br>• Actuator solenoid valve gas pressure; (high pressure in the bottle and low pressure in the supply line);<br>• Evidence of leakage anywhere on the assembly;<br>• Amount of condensate removed from the fan housing drain;<br>• Gas flow rate through the blower;<br>• Percent methane;<br>• Percent carbon dioxide;<br>• Percent oxygen;<br>• Gas temperature;<br>• Abnormal noises or vibration in the motor or blower; and<br>• Maintenance required. |
| Flare | Monthly | • Condition of ignitor system; and<br>• Plumbness of stack. |
| Controls | Monthly | • Thermocouple and temperature control module;<br>• Solenoid valve;<br>• Actuated valve; and<br>• Liquid level sensors. |
| Flame Arrester | Weekly | • Pressure at blower outlet. |
| Valves | Quarterly | • Exercised to confirm satisfactory operation. |
| Gas Probes and Gas Vents | Quarterly | • Presence of explosive gases. |
| Transmission Piping | Bi-Annual | • General condition of exposed pipe. |
| Electrical Cabinet and Controls | Annual | • Tightness of connections;<br>• Calibration of gauges;<br>• Thermocouple and alarms. |

Note: The above-indicated frequency represents a minimum time period between events; NCES may elect to monitor parameters more often than the indicated frequency. In addition to the monitoring schedule outlined above, mechanical components such as the blower and flare should also be monitored and serviced in accordance with the manufacturers' instructions.

# TABLE 2

## GAS EXTRACTION SYSTEM MONITORING CHECKLIST
## GAS EXTRACTION POINTS

**A. <u>Prior to going out onto the landfill.</u>**

1. Calibrate the landfill gas monitor (meter) using methane, carbon dioxide, and oxygen in accordance with the manufacturer's recommendations.

2. Calibrate the pressure transducers by performing the "Zero Pressure" function.

3. Record the calibration procedure on the meter calibration data sheet contained in Appendix B.

4. Record the ambient weather conditions including:

   - Temperature;
   - Barometric pressure;
   - Wind speed and direction;
   - Precipitation amounts; and
   - Current observations (i.e., drizzling, raining, snowing).

**B. <u>At each gas extraction well head assembly.</u>**

1. Connect the Tygon tube with the external filter/water trap assembly from the static pressure/sampling port on the meter to the static pressure port on the well head assembly.

2. Connect the Tygon tubing between the impact pressure port on the meter and the impact pressure port on the wellhead assembly.

3. Perform the "Read Gas Levels" function on the meter. Follow instructions on the meter.

4. Record the following data on the data sheets or in the meter memory:

   - Station identification;
   - Percent methane;
   - Percent carbon dioxide;
   - Percent oxygen;
   - Percent balance;
   - The temperature of the gas stream;
   - Available vacuum;
   - Static pressure;
   - Differential pressure; and
   - Gas flow rate.

5. Make adjustments to the flow rate by adjusting the wellhead control valve, if required.

# TABLE 3

## GAS EXTRACTION SYSTEM MONITORING CHECKLIST

## BLOWER/FLARE ASSEMBLIES

**A. <u>Prior to going out onto the landfill.</u>**

1. Field check with calibration gas and, if necessary, calibrate the landfill gas monitor (meter) using methane, carbon dioxide, and oxygen in accordance with the manufacturer's recommendations.

2. Calibrate the pressure transducers by performing the "Zero Pressure" function.

3. Record the calibration procedure on the meter calibration data sheet contained in Appendix B.

4. Record the ambient weather conditions including:

- Temperature;
- Barometric pressure;
- Wind speed and direction;
- Precipitation amounts; and
- Current observations (i.e., drizzling, raining, snowing).

**B. <u>At the blower assembly.</u>**

1. Drain condensate from the blower fan housing and other drain points in the system.

2. Read the gas flow rate using the in-line flow meter.

3. Perform the "Read Gas Levels" function on the meter. Follow instructions on the meter.

4. Record the following data on the data sheets or in the meter memory:

- Station identification;
- Percent methane;
- Percent carbon dioxide;
- Percent oxygen;
- Percent balance;
- The temperature of the gas stream;
- Available vacuum;
- Static pressure;
- Differential pressure;
- Gas flow rate; and
- Manual control valve percent open.

(The manual control valve will normally be 100 percent open. The flow rate is adjusted using the control valves at the individual gas extraction points.)

5. Monitor the digital meter which indicates the current draw of the blower motor.

6. Grease or oil blower and motor components as required by the manufacturer's recommendations.

7. Check manufacturer's literature for other maintenance items to be performed on the blower, motor, and valve components.

**C. <u>At the flare assembly.</u>**

1. Check for signs of corrosion on the flare stack and other sections of steel pipe.

2. Measure and record the differential pressure across the flame arrester.

3. Check the gas flame color and opacity of flare emissions and note any irregularities.

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# APPENDIX A

# GAS MONITORING PLAN

Revised May 2014

# GAS MONITORING PLAN

## North Country Environmental Services

## Bethlehem, New Hampshire

## 1.0 INTRODUCTION

This gas monitoring plan has been developed per ~~Env-Wm 2506.07 (c)~~ Env-Sw 806.07 (c), to monitor for the presence of landfill gas between the limit of refuse and site property lines. The overall objective of this monitoring plan is to monitor the site so that the site remains within applicable regulatory and safety guidelines regarding control of gas migration.

## 2.0 MONITORING PROGRAM

The monitoring program described in this plan is directed toward monitoring methane levels around the perimeter of waste containment. This monitoring includes measuring methane levels between the limit of refuse and adjacent property lines. If the on-site monitoring indicates the possibility of off-site migration, additional monitoring will be performed to assess the extent of migration and also the potential for accumulation within nearby structures.

Routine gas monitoring at the facility will consist of monitoring:

- Perimeter gas probes GP-1, GP-2, GP-4, GP-5, GP-6, GP-7, GP-8A, GP-11, GP-12, GP-13, GP-14, and GP-15; and
- Subliner gas wells SGW-1, SGW-2, SGW-3, SGW-4, SGW-5, and SGW-6.

Monitoring is to be performed on a quarterly basis by facility staff or more frequently if required by NHDES or determined necessary by NCES.

The gas probes were installed in boreholes typically drilled to a depth corresponding to an elevation which is approximately at the base grade of the landfill or to groundwater. The gas probes consist of 1-inch slotted PVC pipe, installed from the bottom of the borehole to about 3 feet below the ground surface, and 1-inch solid pipe installed from the top of the slotted pipe to 2.5 to 3.0 feet above the ground surface. The annulus between the borehole wall and well screen is backfilled with 3/8-inch pea gravel or coarse sand. A granular filter layer was placed above the pea gravel and cement/bentonite grout was placed from the top of the granular layer to the ground surface. Vented locking protective casings have been installed over the probes. A detail of a probe is attached.

The subliner gas wells were installed during construction of Stage III and consist of high density polyethylene (HDPE) pipe installed in borings drilled to a depth corresponding approximately to the groundwater table. The lower section of the wells were perforated while the upper portion of the well is solid pipe which was installed in a trench extending to just beyond the north corner of Stage III.

Format
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The gas probes and subliner gas wells will be monitored for combustible gas concentrations using a dual range combustible gas monitor that measures concentration as percent by volume of methane equivalence or the facility's landfill gas monitor. In addition to monitoring the composition of the gas at the gas vents, the gas pressure is also to be recorded.

## 3.0 DATA REPORTING AND EVALUATION

Monitoring results and observations will be recorded and copies of these monitoring records will be maintained at the facility. Where combustible gas concentrations exceed 50 percent of the lower explosive limit (LEL) at the property line:

- Take all necessary steps to ensure protection of human health and notify the Director of the Department's Waste Management Division ([WMD] Director) [This notification shall be deemed to have taken place when the Department's Project Manager in the Solid Waste Compliance Section 603-271-2925 is notified.];

- Notify the affected property owner of the results;

- Within seven (7) days of detection, place in the operating record the methane gas levels detected and a description of the steps taken to protect human health; and

- Within sixty (60) days of detection, implement a remediation plan for the methane gas releases, place a copy of the plan in the operating record, and notify the Director that the plan has been implemented. The plan shall describe the nature and extent of the problem and the proposed remedy.

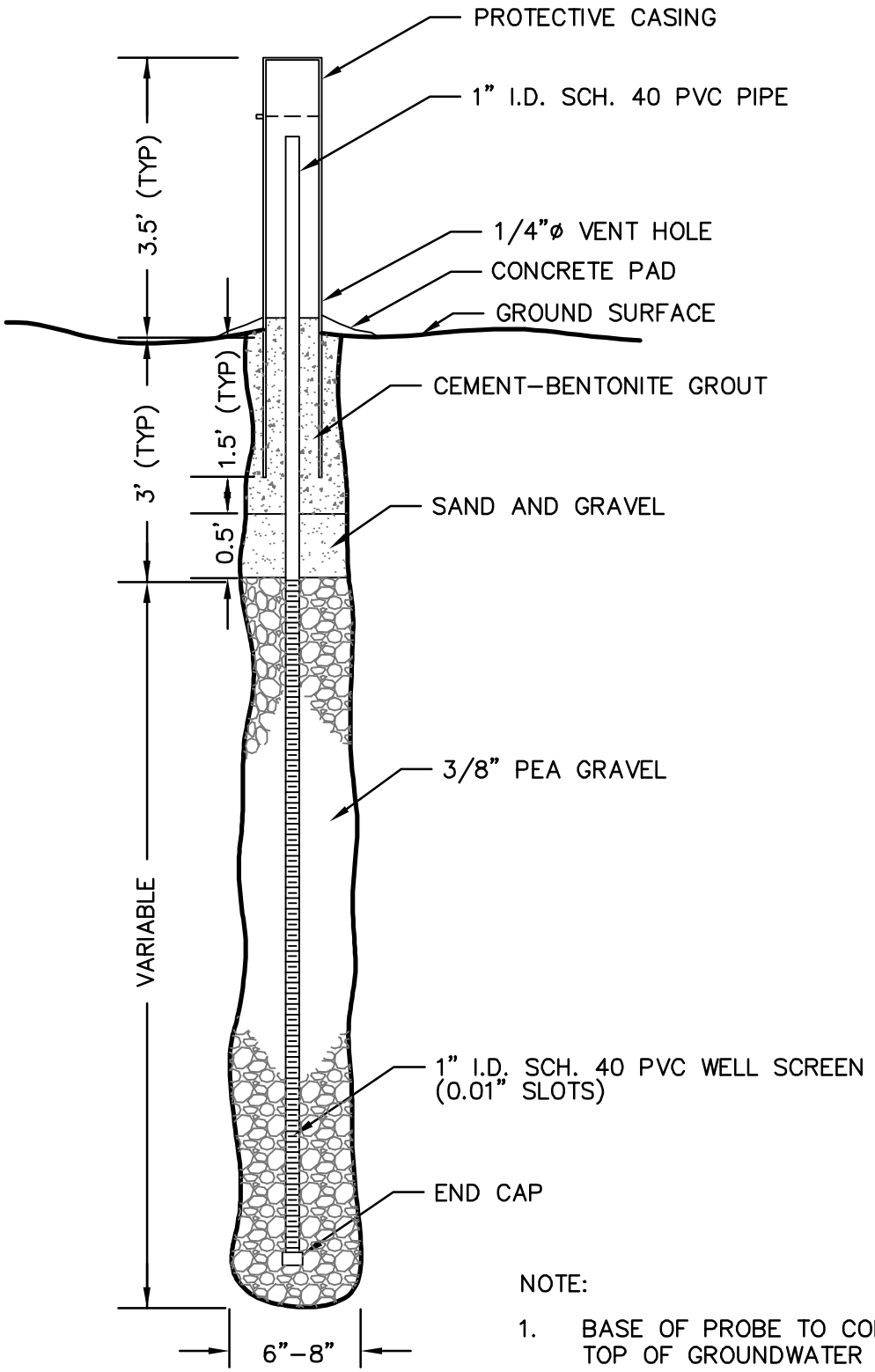
Locations where gas concentrations exceed 50 percent of the LEL at the property line will be identified in a separate report which will be forwarded to WMD.

Should the combustible gas concentrations be found to exceed 50 percent of the LEL at any permanent probe location, an evaluation will be made to assess whether the frequency of monitoring should be increased, and whether the monitoring network and type of monitoring should be modified to enhance detection. If continued monitoring indicates elevated levels of landfill gas at the property line, an appropriate plan to control gas concentrations, such as further expansion of the gas venting system, will be developed and submitted to the WMD for review.

If monitoring indicates that additional control measures are necessary, they will be installed so that:

1. Gas concentrations at the property boundaries will be less than 50 percent of the LEL; and

2. Gas concentrations at any structure will be less than 25 percent of the LEL.




NOTE:

1. BASE OF PROBE TO COINCIDE WITH TOP OF GROUNDWATER

# TYPICAL GAS PROBE

| NORTH COUNTRY ENVIRONMENTAL SERVICES, INC. BETHLEHEM, NEW HAMPSHIRE | TYPICAL GAS PROBE DETAIL | | |
|---|---|---|---|
| SHA IMPROVING EARTH | SCALE: NTS | DRAWN BY: DJD | FILE NO.1003.07 |
| | DATE: JUL 10 | CHECKED BY: HHL | FIGURE NO. 1 |

© 2010 SANBORN, HEAD & ASSOCIATES, INC.

IMAGES: Q:\Program Files\Autodesk Land Desktop 2008\Template\SHA-IE Color Logo.bmp

FILE: Q:\CONCORD\1003.07\dwg\Gas Probe Detail\Gas Probe Detail.dwg
LAYOUT: fig 1
CTB FILE: SHA Standard.ctb
PLOT DATE: 7-12-10

# APPENDIX B

# DATA COLLECTION SHEETS AND INSPECTION REPORTS

## WELL BALANCING CALIBRATION LOG

## North Country Environmental Services, Inc. Landfill
## Bethlehem, New Hampshire

### LANDTEC GEM-2000

| Date | Technician | Pre-Monitoring Calibration | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | %$CH_4$ | | %$CO_2$ | | %$O_2$ | | Ambient Temperature (deg F) | Barometric Pressure (inHg) |
| | | Standard % | Calibration % | Standard % | Calibration % | Standard % | Calibration % | | |
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# NCES LFG EXTRACTION SYSTEM LOG

| SYSTEM DOWN TIME | DATE | TIME | BLOWER CONFIGURATIION | FLARES OPERATING | REASON FOR FAILURE |
|---|---|---|---|---|---|
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# Routine Inspection Report for Gas Extraction System

**Date/Time:** **Technician:**
**Weather:**

Indicate that inspection has or has not been completed for each item. Indicate if repairs are or are not needed. If repairs are needed, describe in the Summary of Landfill Cover and Gas Collection System Improvements table.

| **Items to be inspected weekly unless otherwise indicated** | Inspection completed | Repairs needed |
|---|---|---|
| **Landfill gas collection system** | | |
| A. Measure and record (at least monthly) | | |
| 1. Gas flow rate, composition, temperature, and pressure at wellheads | | |
| B. Wellfield components inspection (at least monthly) | | |
| 1. Well head and dust cap in good condition | | |
| 2. Sample ports in good condition | | |
| 3. Ferncos fittings - no cracks or loose clamps | | |
| 4. Kanaflex hose in good condition | | |
| 5. Well casing in good condition - no cracks or other damage | | |
| C. Remedial actions | | |
| 1. Adjustments and minor repairs (as needed) | | |
| 2. Re-balance the collection system (as needed) | | |
| **The condensate management system** | | |
| A. General inspection of: | | |
| 1. Condensate drip legs, collection points, pump stations, storage tanks | | |
| 2. Knockout pot pump | | |
| B. Remedial actions | | |
| 1. Drain condensate | | |
| 2. Adjustments and minor repairs(as needed) | | |
| **Blower station** | | |
| A. General inspection of: | | |
| 1. Blower, flow meter, and related piping, wiring and controls | | |
| B. Measure and record: | | |
| 1.Gas flow rate, composition, temperature, and pressure at blowers | | |
| 2. Differential pressure at moisture separator | | |
| C. Remedial actions: | | |
| 1. Inspect and repair components (as needed) | | |
| 2. Check blower bearing oil level - add or replace as needed | | |
| 3. Exercise manual gas and condensate control valves (at least monthly) | | |
| 4. Check blower alignment, foundation, and isolation pads | | |
| 5. Check pipe supports and adjust if necessary | | |
| 6. Remove and clean flow meter element (as needed) | | |
| **Flare assemblies** | | |
| A. General inspection of: | | |
| 1. Flare, flame arrestor, and block valve | | |
| B. Measure and record: | | |
| 1. Differential pressure at flame arrestor | | |
| 2. Control valve nitrogen pressure | | |
| 3. Pilot system propane pressure | | |
| A. Remedial actions: | | |
| 1. Adjust, replace, and repair (as needed) | | |
| 2. Remove and clean flame arrestor (as needed) | | |

**Comments:**

**Summary of Landfill Cover and Gas Collection System Improvements**
**North Country Environmental Services, Inc.**
**Bethlehem, New Hampshire**

| Improvement # | Recommended Improvements | Date Recommended | Anticipated Completion Date | Status | Date Completed | Performed By |
|---|---|---|---|---|---|---|
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## WELL BALANCING DATA SHEET

## North Country Environmental Services, Inc. Landfill
## Bethlehem, New Hampshire

Site: NCES Landfill
Date:
Temp: °F
Barometric Pressure: "Hg
Totalizer:
Weather:

Flare temp: °F
Positive pressure: "$H_2O$

| Control Device Name | Date/Time | $CH_4$ (%) | $CO_2$ (%) | $O_2$ (%) | Bal. (%) | Pres ("$H_2O$) | Flow (scfm) | Adj. Flow (scfm) | Gas Temp. (°F) |
|---|---|---|---|---|---|---|---|---|---|
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**Comments:**

North Country Environmental Services
Sump and Tank Levels

Prior Date: _____

| | Primary Sump ( Inches ) | Secondary Sump ( Inches ) |
|---|---|---|
| Stage 3 | | |
| Stage 4 | | |
| S4 P2 PRI 1 | | |
| S4 P2 PRI 2 | | |
| S4 P2 SEC OVER | | |

( Feet )

| | |
|---|---|
| Tank A | |
| Tank B | |
| AST Tank | |
| Condensate | |

(Meter)

| | |
|---|---|
| S3 PRI Meter | |
| S3 SEC Meter | |
| S4 PRI Meter | |
| S4 SEC Meter | |
| S4 P2 PRI | |
| S4 P2 SEC | |
| S4 P2 SEC OVER | |

Todays Date: _____

| | Primary Sump ( Inches ) | Secondary Sump ( Inches ) |
|---|---|---|
| Stage 3 | | |
| Stage 4 | | |
| S4 P2 PRI 1 | | |
| S4 P2 PRI 2 | | |
| S4 P2 SEC OVER | | |

( Feet )

| | |
|---|---|
| Tank A | |
| Tank B | |
| AST Tank | |
| Condensate | |

(Meter)

| | |
|---|---|
| S3 PRI Meter | |
| S3 SEC Meter | |
| S4 PRI Meter | |
| S4 SEC Meter | |
| S4 P2 PRI | |
| S4 P2 SEC | |
| S4 P2 SEC OVER | |

# GAS PROBE MONITORING DATA SHEET

## North Country Environmental Services, Inc. Landfill
## Bethlehem, New Hampshire

Date:
Temp: °F
Barometric Pressure: "Hg Weather:

| Gas Monitoring Device Name | Date/Time | $CH_4$ (%) | $CO_2$ (%) | $O_2$ (%) | Bal. (%) | %LEL (%) | Baro. Press. inches Hg |
|---|---|---|---|---|---|---|---|
| GP-2 | | | | | | | |
| GP-2 | | | | | | | |
| GP-4 | | | | | | | |
| GP-4 | | | | | | | |
| GP-7 | | | | | | | |
| GP-7 | | | | | | | |
| GP-8A | | | | | | | |
| GP-8A | | | | | | | |
| GP-11 | | | | | | | |
| GP-11 | | | | | | | |
| GP-12 | | | | | | | |
| GP-12 | | | | | | | |
| GP-13 | | | | | | | |
| GP-13 | | | | | | | |
| GP-14 | | | | | | | |
| GP-14 | | | | | | | |
| GP-15 | | | | | | | |
| GP-15 | | | | | | | |
| MW-102D | | | | | | | |
| MW-102D | | | | | | | |
| MW-401 | | | | | | | |
| MW-401 | | | | | | | |
| MW-603 | | | | | | | |
| MW-603 | | | | | | | |
| SGW-1 | | | | | | | |
| SGW-1 | | | | | | | |
| SGW-2 | | | | | | | |
| SGW-2 | | | | | | | |
| SGW-3 | | | | | | | |
| SGW-3 | | | | | | | |
| SGW-4 | | | | | | | |
| SGW-4 | | | | | | | |
| SGW-5 | | | | | | | |
| SGW-5 | | | | | | | |
| SGW-6 | | | | | | | |
| SGW-6 | | | | | | | |

Notes:
1. Each gas probe was monitored for $CO_2$, $O_2$, and $CH_4$ using a Landtec GEM-2000 Gas Extraction Monitor (or equivalent). Calibration was checked daily. Monitoring procedures consisted of recording any gas levels during the first 1 to 2 minutes that the well/probe was opened and a second reading after a minimum of 20 minutes open venting.

# APPENDIX C

# MARCH 24 AND APRIL 30, 2010 MEMORANDA

**North Country Environmental Services, Inc.**

3 Pitkin Court
Montpelier, Vermont 05602

(802) 223-7221
(802) 223-7128 Fax

March 24, 2010

Michael E, Guilfoy, P.E., Administrator
New Hampshire Department of Environmental Services
Waste Management Division
29 Hazen Drive, P.O. Box 95
Concord, New Hampshire 03302-0095

**RE: North Country Environmental Services, Inc.**
**Landfill Facility - Bethlehem, NH**
**Landfill Gas System Operations**

Dear Mike:

NCES (North Country Environmental Services, Inc.) writes to formally respond to your March 1, 2010 correspondence regarding the operation of the GCCS (landfill gas collection and control system) at our landfill in Bethlehem, New Hampshire. This response follows a March 18, 2010 meeting that was held at the NHDES (New Hampshire Department of Environmental Conservation) offices in Concord, New Hampshire.

This response includes an attachment that was prepared by SHA (Sanborn, Head & Associates, Inc.) of Essex Junction, Vermont titled GCCS – Assessment of Aerobic Activity and includes discussion on wellfield balancing and an aerobic activity evaluation.

Should you have any questions or require additional information, please contact David Adams of SHA at (802) 288-9119 or me at (802) 224 – 0106.

Sincerely,

**NORTH COUNTRY ENVIRONMENTAL SERVICES, INC.**

John Gay, E.I.
Engineering, Permitting, Compliance & Construction

Enclosures

c. Pam Monroe, NHDES Waste Management Division (w/o encl.)
Kevin Roy, North Country Environmental Services, Inc. (via email, w/o encl.)
John Schwalbe, North Country Environmental Services, Inc. (via email, w/o encl.)
Dave Adams, SHA (via email, w/o encl.)
Heather Little, SHA (via email, w/o encl.)

*printed on recycled paper*

SANBORN, HEAD & ASSOCIATES, INC.
11 Pearl Street, Suite 102 ■ Essex Junction, VT 05452
P (802) 288-9119 ■ F (802) 288-9779
www.sanbornhead.com

# MEMORANDUM

**To:** John Gay, North Country Environmental Services, Inc.

**From:** Heather H. Little
David E. Adams, P.E.

**File:** 2493.04

**Date:** March 24, 2010

**Re:** GCCS – Assessment of Aerobic Activity
North Country Environmental Services, Inc. Landfill
Bethlehem, New Hampshire

**cc:** Kevin Roy, NCES
Larry Lackey, NCES, by e-mail
Karen Flanders, NCES, by e-mail
John Schwalbe, NCES, by e-mail

---

At your request, Sanborn, Head & Associates, Inc. (SHA) prepared this memorandum in response to a March 1, 2010 letter to North Country Environmental Services, Inc. (NCES) from the New Hampshire Department of Environmental Services (NHDES) regarding "North Country Environmental Services (NCES) Landfill Gas System Operation."

A meeting was held at NHDES on March 18, 2010 to discuss the concerns raised by Mr. Michael Guilfoy in his March 1, 2010 letter, with the objective of addressing those concerns with finality. Attendees of the meeting included NHDES, NCES, and SHA representatives. During the meeting, Mr. Guilfoy requested that NCES provide a written response to his March 1, 2010 letter by March 25, 2010.

This memorandum and the attached historic wellfield data provide a re-assessment of the 46 landfill gas (LFG) extraction locations to which Mr. Guilfoy's letter referred. Information pertaining to those 46 LFG extraction locations was requested by NHDES in the March 1, 2010 letter. Review of the data concerning the 46 LFG extraction locations is provided herein.

## WELLFIELD BALANCING

In order to minimize the risk of ambient air infiltration while balancing the need to minimize odors and fugitive LFG emissions from the surface of the landfill, NCES performs wellfield

balancing typically twice per month. Wellfield balancing is a continuous process and data collected with each wellfield balancing event is evaluated in conjunction with historic data to assess trends and to assist with making operations decisions regarding the wellfield.

## AEROBIC ACTIVITY EVALUATION

There are several parameters that should be evaluated when assessing LFG wellfield data for the possibility of ambient air infiltration and/or aerobic decomposition occurring within the waste mass. The following is a discussion of information presented on March 18, 2010 during the meeting at NHDES' offices.

### Wellhead Temperature

As identified in the New Source Performance Standards (NSPS) for Municipal Solid Waste (MSW) Landfills (40 CFR Part 60, Subpart WWW), the U.S. Environmental Protection Agency (USEPA) set an upper gas temperature threshold of 55ºC (131ºF) for subject landfills. Landfills that are subject to the NSPS must take corrective actions to reduce the gas temperature if the gas temperature at an extraction point exceeds the NSPS threshold. Although the NCES Landfill is not subject to the NSPS, NCES' Standard Operating Procedures (SOP) references the same wellhead temperature threshold. As indicated in the SOP, if temperatures greater than 131°F were to be observed at a wellhead, corrective actions would be taken to decrease the temperature or reduce the LFG flow rate at that location.

Based on data provided by the USEPA in *Air Emissions from Municipal Solid Waste Landfills – Background Information for Proposed Standards and Guidelines*, dated March 1991, "optimum temperature for anaerobic digestion of refuse is 29°C (84°F) to 38°C (100°F) for mesophilic operation and 49°C (120°F) to 57°C (135°F) for thermophilic operation." Temperatures greater than 131°F generally inhibit anaerobic decomposition.

It should be noted that of the more than 1,200 gas temperature readings at gas extraction points from August 2009 through January 2010, there were no recorded temperatures above the NSPS threshold of 131°F.

### LFG Flow Rate

Low LFG flow rates (e.g., 10 scfm or less) at individual gas extraction points indicate that little LFG is being extracted from the waste mass and limited ambient air infiltration is occurring in the vicinity of the extraction point. Under low flow conditions, the "stagnant" gas present in an extraction point does not provide useful concentration information for assessing whether a landfill is under aerobic conditions.

### Residual Nitrogen

An important parameter in our evaluation of the level of aerobic activity at the NCES Landfill is residual nitrogen. The following are excerpts from the SWANA O&M Manual relative to residual nitrogen:

> *The residual nitrogen concept differentiates between the nitrogen associated with air leakage (in a ratio of 3.76:1) and the nitrogen associated with aerobic activity (or residual nitrogen).*[1]
>
> *Air entering a landfill gas collection system that is not subject to aerobic consumption by bacteria is not of concern for refuse fires. If oxygen is not being consumed, it is likely that this air, commonly called leakage, is a result of short circuiting into the upper well casing or collection pipe.*[2]

Residual nitrogen is defined by Richard W. Prosser, P.E. of GC Environmental, Inc. in "Reviewing and Interpreting Landfill Gas Monitoring Data" as:

> *the excess nitrogen (balance gas) measured in LFG (i.e., the volume of nitrogen greater than the corresponding volume of oxygen).*

Residual nitrogen may be calculated as: Nitrogen % - (Oxygen % x 3.76).

Prosser defines 20 percent residual nitrogen as the threshold of concern for increased fire risk and the threshold above which levels of residual nitrogen should be avoided, if possible, except for purposes of aggressive emission control.

### Carbon Dioxide / Methane Ratio

Anaerobic decomposition of MSW occurs through the process of methanogenesis, during which microorganisms produce methane by the fermentation of simple organic compounds.[3] We expect methane to be the primary constituent resulting from anaerobic waste decomposition, resulting in a carbon dioxide to methane ratio of less than one.

## SUMMARY OF FINDINGS

We assessed each of the four parameters described above, in addition to historic wellfield data from January 1, 2008 through March 18, 2010, to evaluate the potential for aerobic activity within the landfill; specifically at the 46 LFG extraction locations which are the subject of NHDES' March 1, 2010 letter.

---

[1] Landfill Gas Operation and Maintenance Manual of Practice by the Solid Waste Association of North America (SWANA), 1998.
[2] Landfill Gas Operation and Maintenance Manual of Practice by SWANA, 1998.
[3] http://toxics.usgs.gov/definitions/methanogenesis.html

Relative to an assessment of the four parameters discussed above, as presented during the March 18, 2010 meeting at NHDES, we believe that the majority of the 46 locations were not under aerobic conditions during August 2009 through January 2010. Furthermore, it is important to stress the dynamic nature of a landfill, and that wellfield balancing is an on-going process wherein adjustments are continually made to the gas collection and control system (GCCS).

Due to the changeable conditions within a landfill, we believe it is useful to assess historic wellfield data for each of the 46 LFG extraction locations in order to evaluate trends in landfill gas composition data. Graphs which include LFG composition, LFG temperature, LFG flow rate, and applied pressure (vacuum) at each of the 46 LFG extraction locations are attached. The graphs include data from January 1, 2008 through March 18, 2010. (Note that for LFG extraction locations that were installed during that time period, the earliest date of available data is dependent on the date of installation.)

Based on the historic data shown in the attached graphs and assessment of the four parameters described above, LFG compositions measured on January 6 and 7, 2010 at the 46 selected LFG extraction locations do not indicate changes in LFG composition that raise concerns of ambient air infiltration or aerobic decomposition within the waste mass.

## GCCS MAINTENANCE AND IMPROVEMENTS

Operations decisions to install additional GCCS components or remove non-productive components of the GCCS are based, in part, on historic wellfield balancing data trends. NCES regularly augments the landfill cover system and inspects GCCS components as part of a comprehensive approach to maintaining the GCCS and complying with air and solid waste regulations.

As an example of the GCCS assessments performed by NCES on a regular basis, during October 2009, NCES performed an evaluation of liquid levels in vertical gas extraction wells. The evaluation showed that some wells were partially "flooded" (e.g., a low percentage of screen was available for LFG collection) and that there was a need for additional vertical gas extraction wells in Stage I of the landfill. Therefore, during November and December 2009, NCES installed eight additional vertical gas wells in Stage I of the landfill. The eight additional vertical wells aid in preventing LFG migration from the northern portion of the landfill in addition to increasing LFG collection from Stage I.

## CONCLUSION

NCES regularly conducts wellfield balancing and GCCS maintenance according to industry standards. Since the January wellfield balancing event referenced in NHDES' March 1, 2010 letter, NCES re-monitored and made necessary adjustments to the 46 identified gas extraction locations on the following dates:

- January 28/29, 2010;
- February 8/9, 2010;
- February 22/23, 2010;
- March 9/10, 2010; and
- March 22/23, 2010.

Notable improvements in gas quality have been documented for several gas extraction points and the GCCS continues to function properly (i.e., without indications of unsafe levels of ambient air infiltration or aerobic decomposition).

Based on the information described above and attached to this memorandum, we do not believe there was excessive ambient air infiltration into the landfill or that oxygen was being consumed by aerobic decomposition within the waste mass on or leading up to January 6/7, 2010. We also believe that appropriate adjustments have been made to the wellfield since the January 6/7 wellfield balancing event.

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Encl. *Landfill Gas Management Suite™* Graphs for 46 Gas Extraction Locations

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North Country Environmental Services, Inc.

3 Pitkin Court
Montpelier, Vermont 05602

(802) 223-7221
(802) 223-7128 Fax

April 30, 2010

Michael E, Guilfoy, P.E., Administrator
New Hampshire Department of Environmental Services
Waste Management Division
29 Hazen Drive, P.O. Box 95
Concord, New Hampshire 03302-0095

**RE: North Country Environmental Services, Inc.**
**Landfill Facility - Bethlehem, NH**
**Landfill Gas System Operations**

Dear Mike:

NCES (North Country Environmental Services, Inc.) writes to respond to your April 21, 2010 correspondence regarding the operation of the landfill gas collection and control system at our landfill in Bethlehem, New Hampshire.

The responses to your questions have been addressed in the enclosed memorandum prepared by SHA (Sanborn, Head & Associates, Inc.) of Essex Junction, Vermont. Please note that the response to your first question is necessarily generic. That question calls for a discussion of how NCES's operation of the landfill gas system conforms to the currently approved facility operating plan. We believe we are in full compliance with our approved facility operating plan, and we could not be more specific in our response without knowing which, if any, provisions contained in the plan are of particular concern to the department. If there are provisions of particular concern not addressed in the enclosed memorandum, please identify those areas of concern so we may provide a more targeted response.

Should you have any questions or require additional information, please contact David Adams of SHA at (802) 288-9119 or me at (802) 224 – 0106.

Sincerely,

**NORTH COUNTRY ENVIRONMENTAL SERVICES, INC.**

J. Gay

John Gay, E.I.
Engineering, Permitting, Compliance & Construction

Enclosures

c. Pam Monroe, NHDES Waste Management Division (w/o encl.)
Kevin Roy, North Country Environmental Services, Inc. (via email, w/o encl.)
John Schwalbe, North Country Environmental Services, Inc. (via email, w/o encl.)
Dave Adams, SHA (via email, w/o encl.)
Heather Little, SHA (via email, w/o encl.)

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SANBORN, HEAD & ASSOCIATES, INC.
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P (802) 288-9119 ■ F (802) 288-9779
www.sanbornhead.com

IMPROVING EARTH

# MEMORANDUM

**To:** John Gay, North Country Environmental Services, Inc.

**From:** Heather H. Little
David E. Adams, P.E.

**File:** 2493.04

**Date:** April 30, 2010

**Re:** North Country Environmental Services, Inc. Landfill Gas System Operation
Bethlehem, New Hampshire

**cc:** Kevin Roy, NCES
Larry Lackey, NCES, by e-mail
Karen Flanders, NCES, by e-mail
John Schwalbe, NCES, by e-mail

---

At your request, Sanborn, Head & Associates, Inc. (SHA) prepared this memorandum in response to an April 21, 2010 letter to North Country Environmental Services, Inc. (NCES) from Mr. Michael Guilfoy of the New Hampshire Department of Environmental Services (NHDES) regarding "North Country Environmental Services (NCES) Landfill Gas System Operation."

In his letter, Mr. Guilfoy asked three questions which we address below.

> ***Question 1*** *- The NCES response did not include a discussion of how the operation of the landfill gas system conforms to the currently approved facility operating plan.*

The current Facility Operating Plan (Plan) states that records are to be periodically reviewed to observe "that the concentrations of the various gases within the landfill gas (LFG) collection system are within expected ranges."

Table 1 of the Operations and Maintenance Manual (O&M Manual) provides typical characteristics of LFG; differences between the characteristics of LFG from the NCES facility and the values shown in Table 1 do not in and of themselves, signify a condition requiring correction. The ranges shown in Table 1 are not intended to be rigid standards but are more to be used as a "rule of thumb" for ranges in LFG concentrations. The O&M Manual also indicates that normal values of LFG for the NCES facility will be established using data collected during operation. These values are a far more reliable measure of the performance of the gas collection

and control system (GCCS) than is Table 1. Using these values, we believe that NCES is in conformance with the currently approved Plan.

Based on the historical LFG concentrations measured at the NCES landfill, NCES revised the O&M Manual to be more reflective of the site-specific data. A revised O&M Manual has been submitted to the NHDES.

> ***Question 2*** *- The NCES response did not include a discussion of whether or not more gas extraction wells are needed.*

As stated during the meeting with NHDES, NCES, and SHA representatives on March 18, 2010, NCES routinely investigates the need for augmentation of the GCCS. Based on data collected during wellfield balancing events, surface emissions monitoring, and the presence of odors that may be due to fugitive LFG emissions, NCES carefully considers whether additional gas extraction components should be added to the GCCS.

While additional wells are not needed to remain in compliance, NCES' current plans include installation of additional gas extraction components, as approved by the NHDES. In addition to expanding the GCCS, NCES also intends to remove gas extraction components that are not productive (i.e., low gas quality and/or quantity). We are currently reviewing wellfield balancing data to assess which extraction points should be removed from service.

> ***Question 3*** *- The Department accepts the explanation of the importance of determining residual nitrogen, the carbon dioxide to methane ratio, flow rate and temperature. The Department notes that three of the four parameters were within the range of concern for 7 of the 46 gas extraction wells referenced in the Department's March 1, 2010 letter. These parameters were residual nitrogen over 20%, CO2/CH4 ratio 1 or greater and flow greater that 10 scfm. An explanation was not provided in the NCES response whether or not these wells were adjusted or that any well operating in this manner is routinely adjusted.*

NCES regularly conducts wellfield balancing at a frequency of approximately twice per month. During wellfield balancing events, any gas extraction point where LFG concentrations indicate low gas quality (low methane with high oxygen and/or balance gas) is routinely adjusted. Since the January 6/7, 2010 wellfield balancing event, NCES re-monitored and made necessary adjustments to the 46 identified gas extraction locations on the following dates:

- January 28/29, 2010
- February 8/9, 2010;
- February 22/23, 2010;
- March 9/10, 2010;
- March 22/23, 2010;
- April 5/6, 2010; and
- April 22/23, 2010.

Since the January 6/7, 2010 wellfield balancing event, appropriate adjustments have been made to the 7 gas extraction points which had residual nitrogen greater than 20 percent, carbon dioxide to methane ratio greater than 1, and flow rates greater than 10 standard cubic feet per minute (scfm) on the dates referenced above.

With the exception of NCHCT201, between the January 6/7, 2010 wellfield balancing event and the most recent (April 22/23, 2010) wellfield balancing event, improvements in gas quality (increase in methane concentration and decrease in balance gas concentration) have been documented at the 7 referenced gas extraction points. For extraction point NCHCT201 (see attached graph), gas quality has not improved since the January 6/7 wellfield balancing event and NCES has adjusted the flow rate to less than 10 scfm accordingly.

HHL\DEA:hhl

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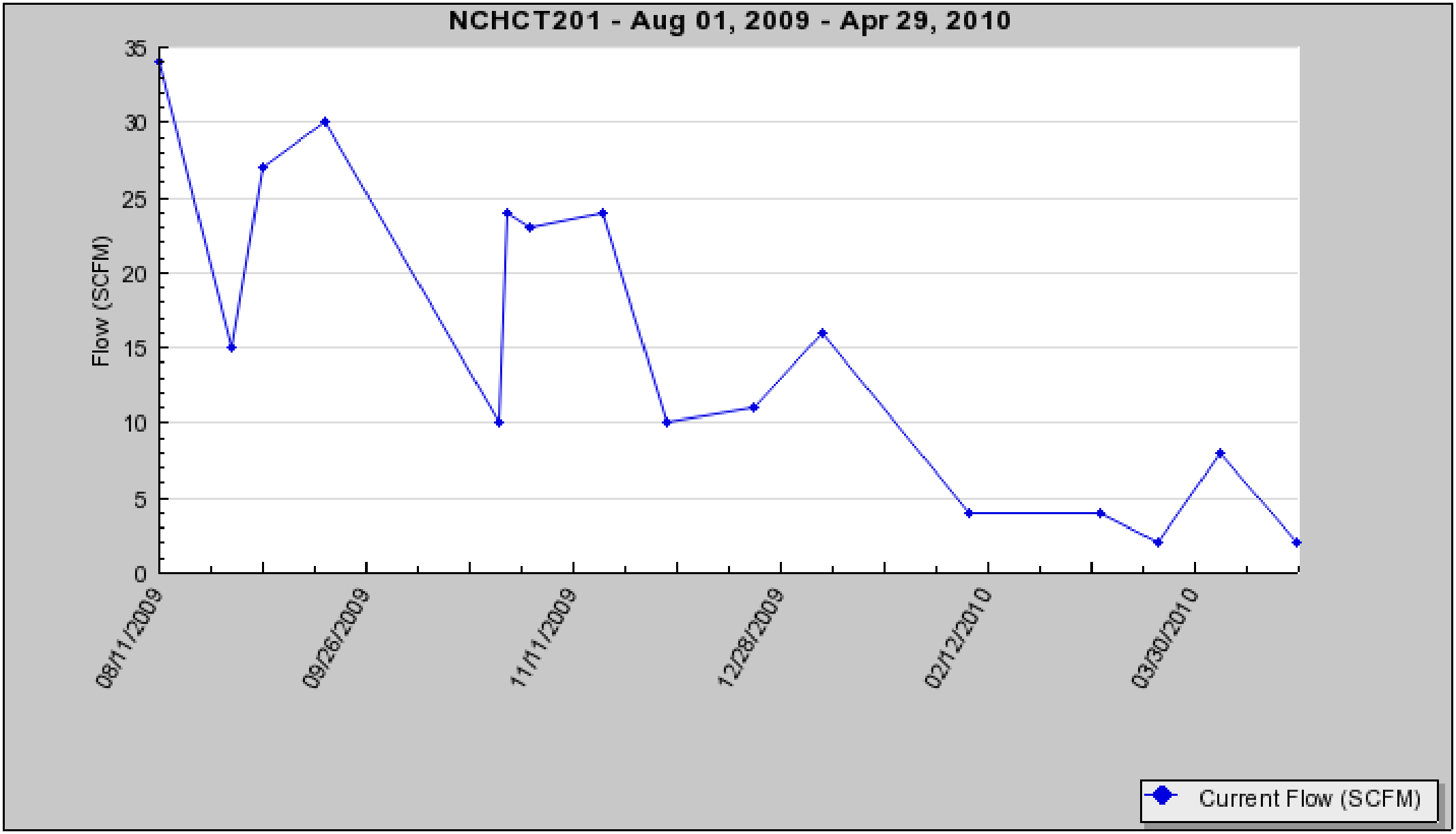
SHA IMPROVING EARTH
Landfill Gas Management Suite

casella waste systems inc.



*Appendix D – Revised Section III(3) to Type I-A Permit Modification*

## Section III (3) Permit Conditions Requiring Amendment

To give effect to this Type I-A modification, the following terms and conditions of the Stage IV Landfill Permit (DES-SW-SP-03-002) should be amended or new terms and conditions should be included with the approval of the Type I-A modification. In accordance with the instructions found in Section III (3), draft language for each proposed amendment (or proposed new term and condition) is set forth below.

**Section 1, "Citations and Definitions,"** should be amended or a new term and condition should be appended to the approval of the Type I-A modification by adding the following:

> Subsequent modifications of this permit have been prepared based on the rules and other authorities cited in the notice of approval for each such modification. With respect to the Type I-A modification approving Stage V the applicant submitted a completed standard permit application form with its Type I-A modification application. The department determined that the requirements for both a Type I-A modification and a standard permit were satisfied and NCES was therefore entitled to either a standard permit or a Type I-A modification for Stage V. The department elected, pursuant to its rules, to approve Stage V through a Type I-A modification to Permit No. DES-SW-SP-03-002 for reasons of administrative convenience and simplification of internal recordkeeping only.

**Section 3, "Basis of Approval/Supporting Documentation,"** should be revised to add the following new subsection (f):

> (f) All information identified in the notice of approval for each modification of this permit.

**Section 7(d), "Authorized Wastes,"** should be revised to read as follows:
This facility is authorized to accept the following types of solid waste only, except if restricted by Condition 7(e) below:

(1) Municipal solid waste, as defined by Env-Sw 103.46;
(2) Construction and demolition debris, as defined by Env-Sw 102.42; and
(3) Other solid wastes, as listed below, which the permittee has determined to be non-hazardous based on generator knowledge/certification and/or representative sampling and analysis in accordance with Env-Hw 502 and

Section 3.3.2 (Special Waste Program) of the facility's Operating Plan, including the recordkeeping requirements set forth therein. The permittee shall not rely on generator knowledge alone to determine that a waste is not hazardous unless the generator is able to demonstrate to the permittee's reasonable satisfaction that the waste was generated in circumstances that are unlikely to result in making the waste hazardous, for example, when the generator is able to demonstrate that the waste results from a process not involving any hazardous materials or waste.

a. Waste from industrial processes;
b. Waste from pollution control processes including but not limited to water and wastewater treatment sludges and air pollution control residues;
c. Residue from a spill of a chemical substance or commercial chemical product or a waste listed above;
d. Commercial products which are off-specification, outdated, or unused;
e. Waste produced during the demolition or dismantling of industrial process equipment;
f. Waste produced during the demolition or dismantling of automobiles (auto fluff);
g. Ash managed in accordance with Env-Sw 902;
h. Contaminated soils and media managed in accordance with Env-Sw 903;
i. Contaminated residuals from the clean-up of a facility generating, storing, treating, recycling, or disposing wastes, chemical substances or commercial products listed above;
j. Treated infectious waste which has been autoclaved, or otherwise treated and disinfected in accordance with the requirements of Env-Sw 904; and
k. Other non-hazardous solid waste not specifically identified above that requires special handling prior to disposal or acceptance in accordance with Section 3.3.2 (Special Waste Program) of the Facility Operating Plan. For example, wastes with excessive moisture content, fine particulate (i.e., dusty) wastes, and any waste that is not identifiable prior to analytical characterization.

**Section 7(e)(11), "Prohibited Wastes,"** should be revised to read as follows:

Solid wastes identified in Condition 7(d)(3), subsections a through h, which have not been determined to be non-hazardous as provided in Condition 7(d)(3).

**Section 7(f), "Determination of Public Benefit,"** should be amended after subsections (1) through (7), or a new term and condition should be appended to the approval of the Type I-A modification, by adding the following:

With respect to Stage V, the department's determination that the facility can provide a substantial public benefit specifically includes, without limitation, determinations that there is a substantial capacity shortfall over the applicable twenty-year planning period for the reasons set forth in NCES's public benefit determination (Attachment VII to its application), and that closing the facility in 2016 will disrupt existing arrangements of New Hampshire municipalities that rely on the facility for disposal of some or all of their waste, accelerate the depletion of the capacity of other disposal facilities in the state, and diminish competition among providers of waste disposal, thereby increasing disposal costs to New Hampshire citizens.

## Section III (4). Approved Plans of Record Amended by the Modification

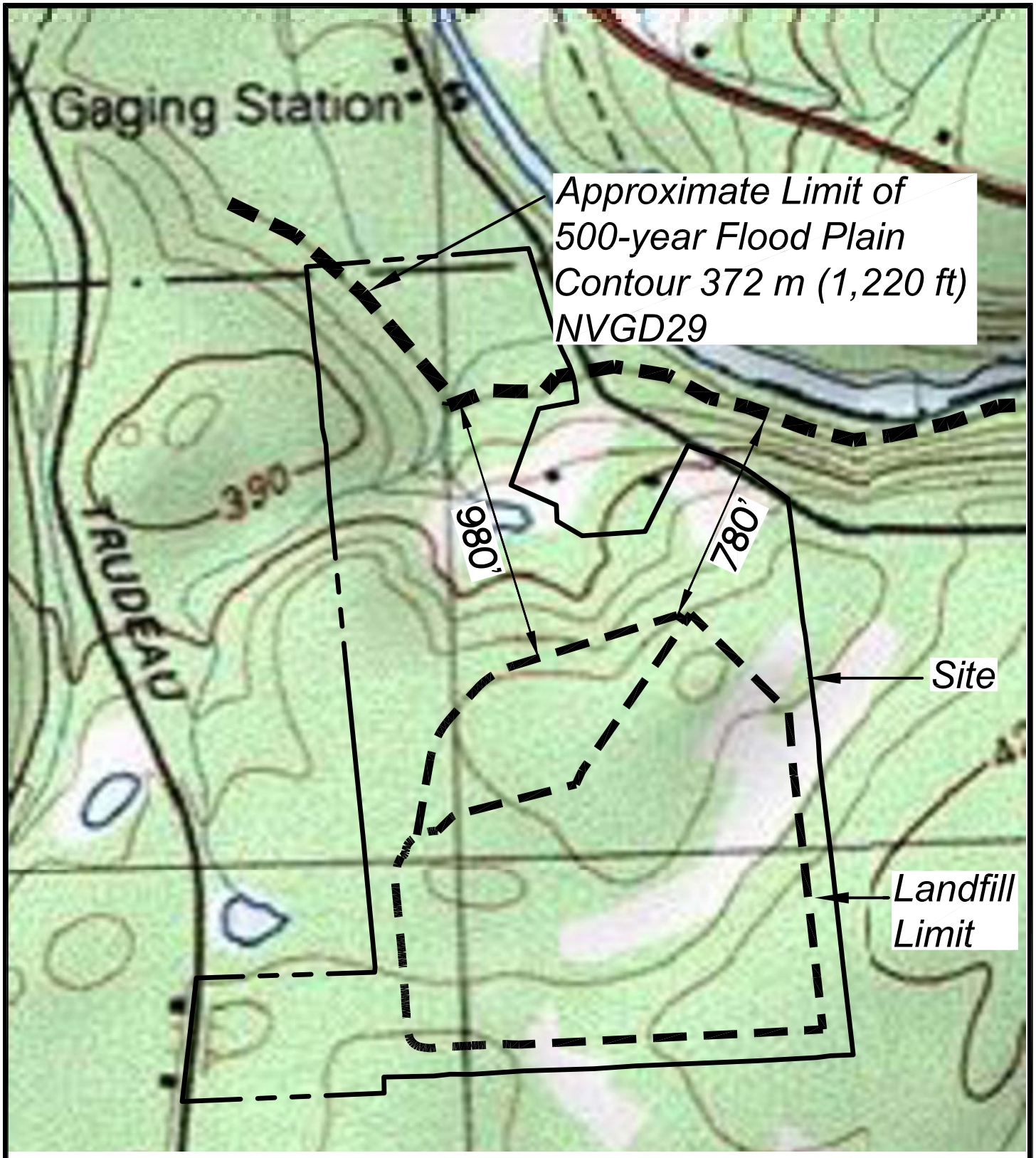
Revisions to these documents submitted herewith, including:

- Modified Design Drawings
- Modified Technical Specifications
- Modified Operating Plan
- Modified Closure Plan
- Modified Financial Assurance

*Appendix E – 500-year Flood Plain Plan and Calculations*

Summary of 500-Year Flood Plain Calculations

1. Figures 1 and 2 depict Gaging Station 01137500 used in this analysis in relation to the NCES Landfill.
2. Table 1 includes a summary of data from Gaging Station 01137500 including flow (in cubic feet/second (cfs)) and gage height (in feet) and the date of each measurement. The data range is from 1940 to 2013 (73 years).
3. The data is sorted by highest flow measurement to lowest flow measurement in Table 1 and a return interval (RI) for each data point is calculated using the Weibull Equation RI = (n+1)/m where n = the data span (73 years) and m = the ranking of the data point in terms of highest flow.
4. The flow data is plotted against the return interval (RI) on Figure 3 and a best fit line is generated as y = 155.39x +214.99, where y = flow and x = RI.
5. Using the equation in bullet #4 above, the flow for the 100 year storm event is 15,753.99 cfs and the flow for the 500-year storm event is 77,909.99 cfs.
6. The 100-year storm event flow is conservative and in line with data summarized in the USGS Publication *Estimation of Flood Discharges at Selected Recurrence Intervals for Streams in New Hampshire* (http://pubs.usgs.gov/sir/2008/5206/) of 12,200 cfs (1940 – 2007) and 10,800 cfs (1988 – 2007). See Table 2 for this data.
7. The 500-year flow is plotted against the Gage Height vs. Discharge Table for Gaging Station 01137500 provided by USGS and enclosed as Figure 4. For conservatism, a flow of 80,000 cfs was used on the table for a corresponding gage height of 30'.
8. 30' is added to the gage datum of Station 01137500 of 1,181 feet above NGVD 29 for a 500-year flood plain elevation estimate of 1,211 feet.
9. The 500-year flood plain limit is plotted on Figure 1. The USGS plan available for the site lists contour elevations in meters with contour intervals at 6 meters. The 1,211 foot elevation convert to meters is 369 m. The closest contour on the plan is 372 m (1,220 ft). The 372 m contour us used to estimate the limit of the 500-year flood plain.
10. Stage V of the landfill is 780' from the estimated limit of the 500-year flood plain at its closest point. The elevation of the perimeter of the landfill at this point is approximately 1340'.

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NCES Solid Waste Landfill
Stage V Landfill Expansion
Est. of 500-year Flood Plain Limit

Figure 1

Scale: 1" = 500'

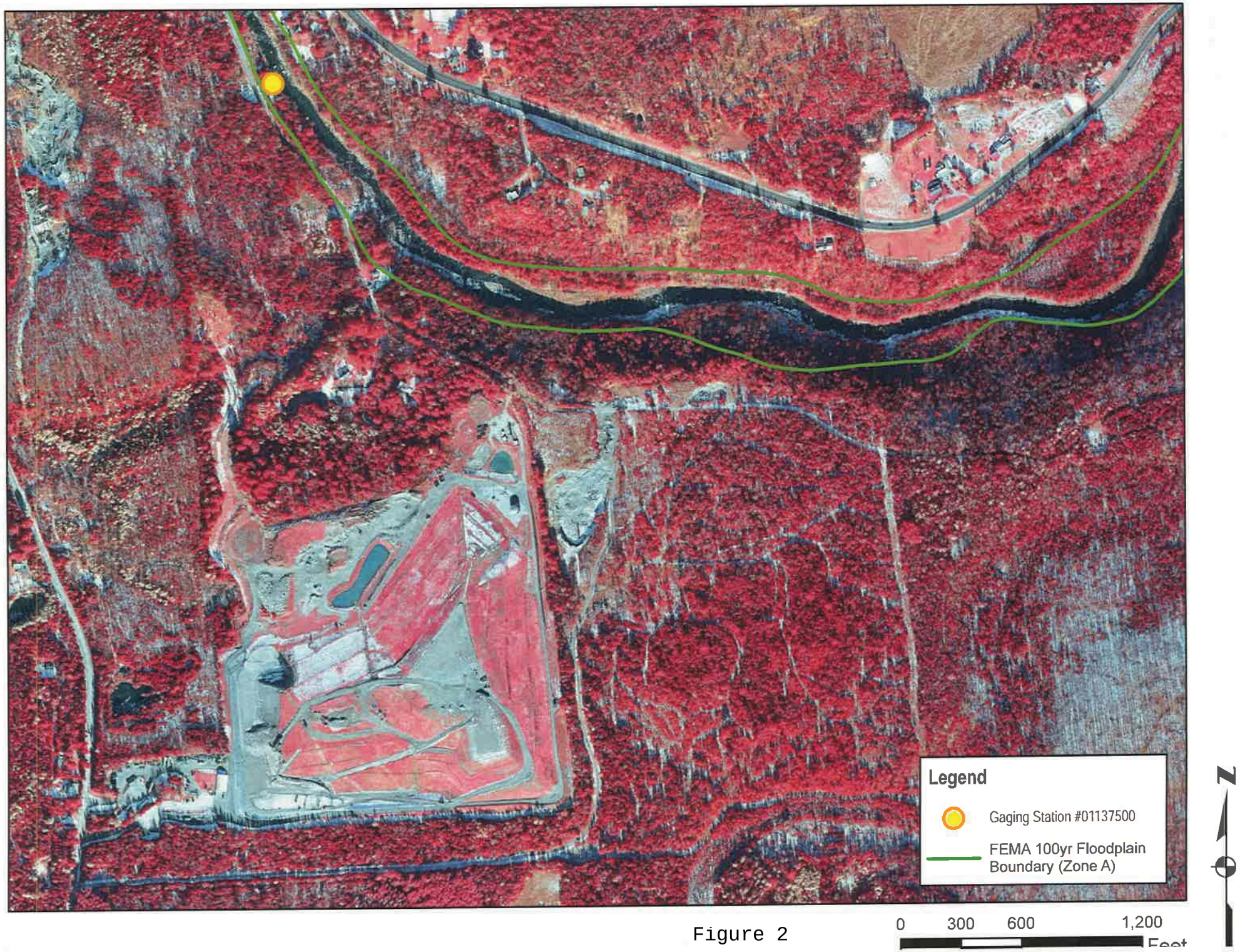

Legend
Gaging Station #01137500
FEMA 100yr Floodplain Boundary (Zone A)
0
300
600
1,200
Feet
N

Figure 2

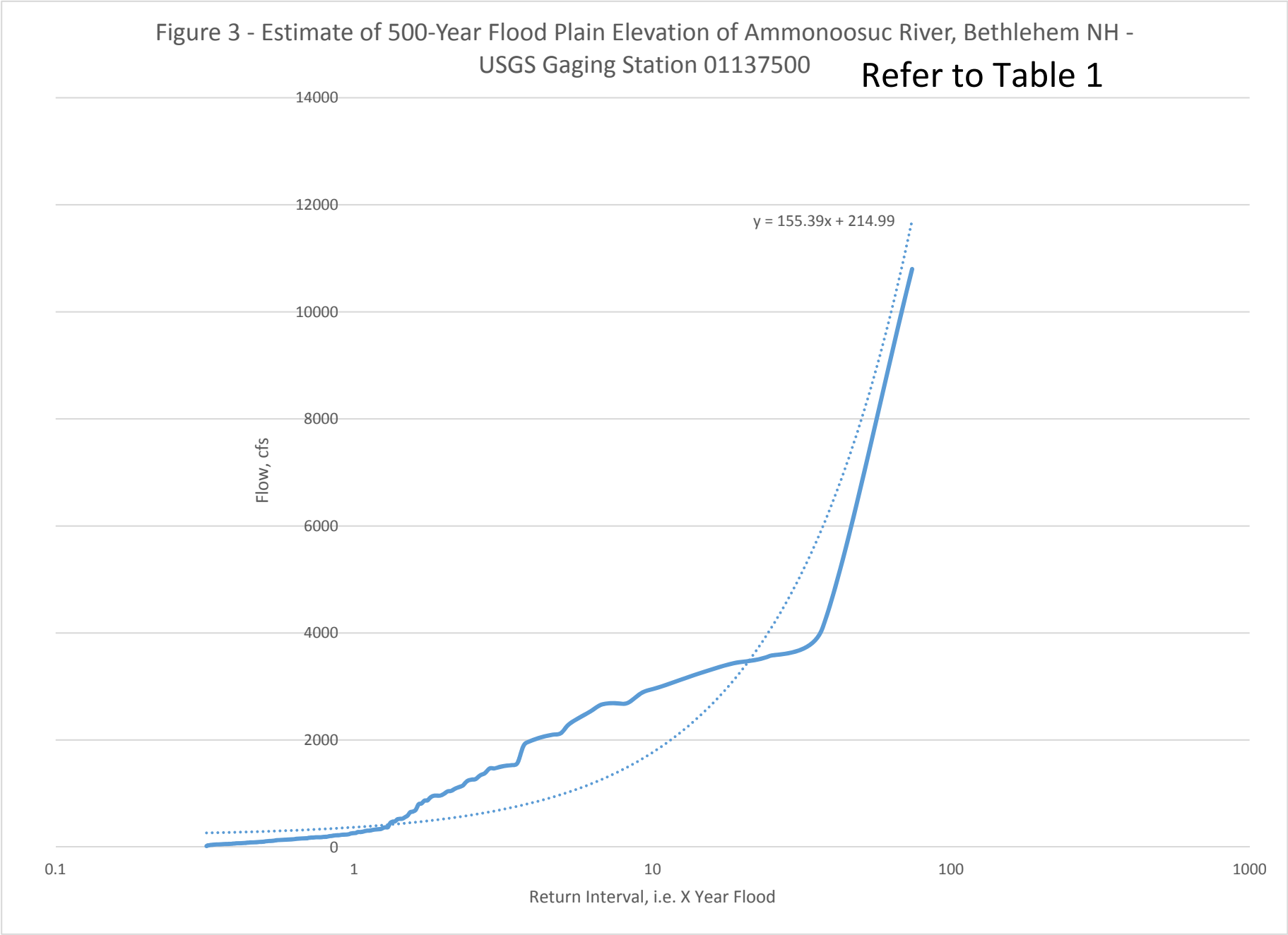
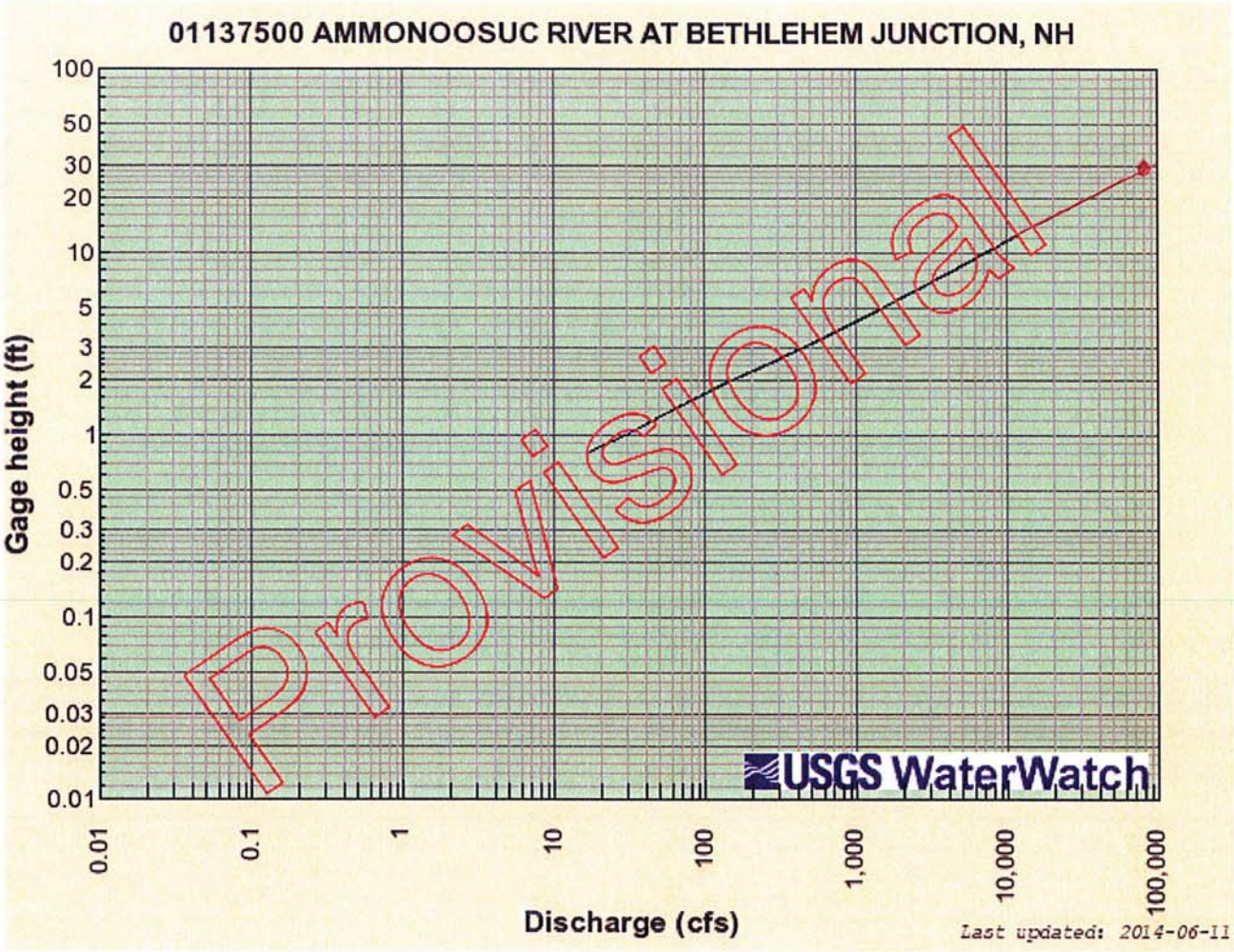


Figure 3 - Estimate of 500-Year Flood Plain Elevation of Ammonoosuc River, Bethlehem NH - USGS Gaging Station 01137500
Refer to Table 1
y = 155.39x + 214.99
Flow, cfs
14000
12000
10000
8000
6000
4000
2000
0
0.1
1
10
100
1000
Return Interval, i.e. X Year Flood

Figure 4


01137500 AMMONOOSUC RIVER AT BETHLEHEM JUNCTION, NH
Gage height (ft)
100
50
30
20
10
5
3
2
1
0.5
0.3
0.2
0.1
0.05
0.03
0.02
0.01
0.01
0.1
1
10
100
1,000
10,000
100,000
Discharge (cfs)
Provisional
USGS WaterWatch
Last updated: 2014-06-11

North Country Environmental Services Landfill
Bethlehem, NH
Stage V Landfill Expansion
Type I-A Permit Modification
Prepared by CMA Engineers

Table 1 - Determination of 500 year Floodplain Utilizing USGS Gaging Station 01137500

Gage Datum 1,180.74 ft above NGVD29

Ammonoosuc River at Bethlehem Junction, NH

| Weibull Distribution | |
|---|---|
| RI = | (n+1)/m |
| n = | 73 years |

| Flow (cfs) | Gage Ht (ft) | # | Date | m | RI |
|---|---|---|---|---|---|
| 10800 | 12.09 | 287 | 1959-10-24 -- -- | 1 | 74 |
| 4080 | 7.75 | 11 | 1940-05-03 -- -- | 2 | 37 |
| 3570 | 7.24 | 101 | 1947-06-03 -- -- | 3 | 24.666667 |
| 3430 | 7.26 | 10 | 1940-05-02 -- -- | 4 | 18.5 |
| 3270 | 6.95 | 100 | 1947-05-06 -- -- | 5 | 14.8 |
| 3120 | 6.78 | 730 | 4/23/2012 16:15 | 6 | 12.333333 |
| 2990 | 6.66 | 719 | 12/13/2010 11:32 | 7 | 10.571429 |
| 2890 | 6.58 | 693 | 11/17/2006 9:49 | 8 | 9.25 |
| 2690 | 6.32 | 642 | 4/4/2000 14:20 | 9 | 8.2222222 |
| 2690 | 6.66 | 163 | 1951-04-03 -- -- | 10 | 7.4 |
| 2660 | 6.45 | 552 | 1988-04-29 -- -- | 11 | 6.7272727 |
| 2530 | 6.41 | 12 | 1940-05-05 -- -- | 12 | 6.1666667 |
| 2310 | 6.31 | 293 | 1960-03-31 -- -- | 14 | 5.2857143 |
| 2130 | 6 | 473 | 1977-03-14 -- -- | 15 | 4.9333333 |
| 2100 | 5.99 | 282 | 1959-06-15 -- -- | 16 | 4.625 |
| 2070 | 5.96 | 403 | 1969-04-19 -- -- | 17 | 4.3529412 |
| 2030 | 5.74 | 665 | 10/29/2003 13:54 | 18 | 4.1111111 |
| 1980 | 5.7 | 750 | 4/15/2014 9:28 | 19 | 3.8947368 |
| 1900 | 5.32 | 724 | 8/29/2011 10:55 | 20 | 3.7 |
| 1570 | 5.34 | 242 | 1956-05-28 -- -- | 21 | 3.5238095 |
| 1530 | 5.38 | 63 | 1944-05-04 -- -- | 22 | 3.3636364 |
| 1520 | 4.92 | 705 | 4/24/2008 10:50 | 23 | 3.2173913 |
| 1500 | 5.11 | 643 | 5/10/2000 8:55 | 24 | 3.0833333 |
| 1470 | 4.97 | 725 | 8/29/2011 13:15 | 25 | 2.96 |
| 1470 | 5.18 | 197 | 1953-03-28 -- -- | 26 | 2.8461538 |
| 1380 | 4.82 | 683 | 4/25/2005 10:51 | 27 | 2.7407407 |
| 1340 | 5.06 | 367 | 1966-05-17 -- -- | 28 | 2.6428571 |
| 1270 | 5.04 | 305 | 1961-05-15 -- -- | 29 | 2.5517241 |
| 1260 | 4.87 | 413 | 1970-05-18 -- -- | 30 | 2.4666667 |
| 1230 | 4.94 | 51 | 1943-05-13 -- -- | 31 | 2.3870968 |
| 1150 | 4.71 | 164 | 1951-04-10 -- -- | 32 | 2.3125 |
| 1120 | 4.52 | 733 | 9/19/2012 11:12 | 33 | 2.2424242 |
| 1090 | 4.71 | 13 | 1940-05-06 -- -- | 34 | 2.1764706 |
| 1050 | 4.55 | 37 | 1942-04-07 -- -- | 35 | 2.1142857 |
| 1040 | 4.33 | 676 | 12/2/2004 7:35 | 36 | 2.0555556 |
| 995 | 4.48 | 198 | 1953-04-27 -- -- | 37 | 2 |
| 963 | 4.4 | 213 | 1954-05-02 -- -- | 38 | 1.9473684 |

North Country Environmental Services Landfill
Bethlehem, NH
Stage V Landfill Expansion
Type I-A Permit Modification
Prepared by CMA Engineers

Table 1 - Determination of 500 year Floodplain Utilizing USGS Gaging Station 01137500

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Ammonoosuc River at Bethlehem Junction, NH

| Weibull Distribution | |
|---|---|
| RI = | (n+1)/m |
| n = | 73 years |

| Flow (cfs) | Gage Ht (ft) | # | Date | m | RI |
|---|---|---|---|---|---|
| 961 | 4.38 | 520 | 1984-04-18 -- -- | 39 | 1.8974359 |
| 960 | 4.29 | 635 | 5/6/1999 14:45 | 40 | 1.85 |
| 932 | 4.35 | 99 | 1947-04-13 -- -- | 41 | 1.804878 |
| 873 | 4.19 | 443 | 1973-03-12 -- -- | 42 | 1.7619048 |
| 868 | 4.28 | 212 | 1954-04-17 -- -- | 43 | 1.7209302 |
| 815 | 4.02 | 636 | 5/7/1999 7:05 | 44 | 1.6818182 |
| 800 | 3.74 | 721 | 4/18/2011 11:23 | 45 | 1.6444444 |
| 697 | 3.84 | 558 | 1989-04-05 -- -- | 46 | 1.6086957 |
| 664 | 3.73 | 612 | 5/14/1996 7:00 | 47 | 1.5744681 |
| 651 | 3.61 | 670 | 4/15/2004 13:08 | 48 | 1.5416667 |
| 589 | 3.32 | 681 | 4/7/2005 10:01 | 49 | 1.5102041 |
| 558 | 3.25 | 749 | 4/9/2014 13:42 | 50 | 1.48 |
| 530 | 3.27 | 743 | 6/24/2013 12:35 | 51 | 1.4509804 |
| 528 | 3.38 | 594 | 5/17/1994 8:15 | 52 | 1.4230769 |
| 519 | 3.24 | 744 | 6/24/2013 13:07 | 53 | 1.3962264 |
| 480 | 3.14 | 740 | 4/30/2013 11:38 | 54 | 1.3703704 |
| 476 | 3.1 | 682 | 4/11/2005 9:40 | 55 | 1.3454545 |
| 450 | 3.22 | 619 | 5/13/1997 10:30 | 56 | 1.3214286 |
| 373 | 2.94 | 617 | 12/19/1996 8:15 | 57 | 1.2982456 |
| 371 | 2.86 | 667 | 12/30/2003 12:38 | 58 | 1.2758621 |
| 361 | 2.85 | 698 | 5/23/2007 10:05 | 59 | 1.2542373 |
| 340 | 2.67 | 710 | 5/28/2009 12:10 | 60 | 1.2333333 |
| 335 | 2.74 | 565 | 1990-06-12 -- -- | 61 | 1.2131148 |
| 330 | 2.71 | 716 | 5/12/2010 18:25 | 62 | 1.1935484 |
| 329 | 2.81 | 564 | 1990-04-25 -- -- | 63 | 1.1746032 |
| 321 | 2.65 | 751 | 5/22/2014 8:32 | 64 | 1.15625 |
| 312 | 2.72 | 557 | 1988-11-17 -- -- | 65 | 1.1384615 |
| 307 | 2.68 | 659 | 10/17/2002 11:30 | 66 | 1.1212121 |
| 307 | 2.75 | 628 | 4/7/1998 8:45 | 67 | 1.1044776 |
| 300 | 2.6 | 689 | 4/27/2006 8:09 | 68 | 1.0882353 |
| 289 | 2.59 | 713 | 12/7/2009 15:55 | 69 | 1.0724638 |
| 282 | 2.6 | 671 | 6/3/2004 8:51 | 70 | 1.0571429 |
| 282 | 2.58 | 588 | 7/30/1993 8:05 | 71 | 1.0422535 |
| 281 | 2.61 | 611 | 3/26/1996 13:40 | 72 | 1.0277778 |
| 264 | 2.53 | 640 | 11/30/1999 16:00 | 73 | 1.0136986 |
| 261 | 2.5 | 727 | 12/22/2011 9:46 | 74 | 1 |
| 258 | 2.54 | 620 | 6/12/1997 11:05 | 75 | 0.9866667 |
| 254 | 2.45 | 572 | 5/10/1991 9:40 | 76 | 0.9736842 |
| 241 | 2.41 | 690 | 6/8/2006 8:43 | 77 | 0.961039 |
| 236 | 2.41 | 697 | 4/3/2007 7:45 | 78 | 0.9487179 |
| 233 | 2.31 | 741 | 6/17/2013 9:25 | 79 | 0.9367089 |
| 233 | 2.35 | 718 | 10/15/2010 8:45 | 80 | 0.925 |

North Country Environmental Services Landfill
Bethlehem, NH
Stage V Landfill Expansion
Type I-A Permit Modification
Prepared by CMA Engineers

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Gage Datum 1,180.74 ft above NGVD29

Ammonoosuc River at Bethlehem Junction, NH

| Weibull Distribution | |
|---|---|
| RI = | (n+1)/m |
| n = | 73 years |

| Flow (cfs) | Gage Ht (ft) | # | Date | m | RI |
|---|---|---|---|---|---|
| 231 | 2.25 | 735 | 11/16/2012 13:18 | 81 | 0.9135802 |
| 228 | 2.4 | 601 | 3/15/1995 11:00 | 82 | 0.902439 |
| 222 | 2.3 | 742 | 6/17/2013 11:03 | 83 | 0.8915663 |
| 222 | 2.31 | 734 | 10/1/2012 11:44 | 84 | 0.8809524 |
| 220 | 2.34 | 662 | 5/20/2003 10:00 | 85 | 0.8705882 |
| 217 | 2.37 | 632 | 12/9/1998 15:15 | 86 | 0.8604651 |
| 214 | 2.34 | 709 | 3/11/2009 14:22 | 87 | 0.8505747 |
| 208 | 2.29 | 634 | 4/16/1999 8:30 | 88 | 0.8409091 |
| 206 | 2.31 | 551 | 1988-04-21 -- -- | 89 | 0.8314607 |
| 202 | 2.32 | 576 | 12/16/1991 11:30 | 90 | 0.8222222 |
| 194 | 2.2 | 633 | 2/3/1999 8:15 | 91 | 0.8131868 |
| 193 | 2.18 | 656 | 7/18/2002 10:52 | 92 | 0.8043478 |
| 191 | 2.17 | 602 | 4/27/1995 6:40 | 93 | 0.7956989 |
| 189 | 2.14 | 603 | 6/15/1995 13:30 | 94 | 0.787234 |
| 185 | 2.23 | 720 | 1/4/2011 11:27 | 95 | 0.7789474 |
| 184 | 2.16 | 666 | 12/8/2003 8:55 | 96 | 0.7708333 |
| 183 | 2.13 | 694 | 12/6/2006 8:20 | 97 | 0.7628866 |
| 183 | 2.24 | 649 | 4/11/2001 9:20 | 98 | 0.755102 |
| 183 | 2.19 | 560 | 1989-10-26 -- -- | 99 | 0.7474747 |
| 182 | 2.18 | 655 | 4/8/2002 13:25 | 100 | 0.74 |
| 179 | 2.15 | 629 | 6/9/1998 9:20 | 101 | 0.7326733 |
| 178 | 2.1 | 691 | 8/11/2006 11:34 | 102 | 0.7254902 |
| 178 | 2.12 | 591 | 12/2/1993 11:34 | 103 | 0.7184466 |
| 174 | 2.08 | 717 | 8/10/2010 15:50 | 104 | 0.7115385 |
| 174 | 2.12 | 569 | 1990-12-20 -- -- | 105 | 0.7047619 |
| 166 | 2.13 | 608 | 11/28/1995 11:00 | 106 | 0.6981132 |
| 165 | 2.15 | 726 | 10/24/2011 10:30 | 107 | 0.6915888 |
| 165 | 2.07 | 684 | 6/14/2005 15:40 | 108 | 0.6851852 |
| 164 | 2.05 | 584 | 12/1/1992 8:00 | 109 | 0.6788991 |
| 162 | 2.01 | 575 | 1991-10-31 -- -- | 110 | 0.6727273 |
| 160 | 2.08 | 568 | 1990-11-09 -- -- | 111 | 0.6666667 |
| 159 | 1.96 | 677 | 12/30/2004 11:40 | 112 | 0.6607143 |
| 158 | 2.21 | 563 | 1990-02-28 -- -- | 113 | 0.6548673 |
| 157 | 1.99 | 722 | 6/14/2011 11:30 | 114 | 0.6491228 |
| 155 | 1.98 | 704 | 2/21/2008 12:45 | 115 | 0.6434783 |
| 154 | 2.05 | 553 | 1988-06-02 -- -- | 116 | 0.637931 |
| 149 | 1.95 | 639 | 10/8/1999 8:25 | 117 | 0.6324786 |
| 145 | 1.93 | 644 | 6/8/2000 13:00 | 118 | 0.6271186 |
| 144 | 1.96 | 637 | 6/4/1999 8:30 | 119 | 0.6218487 |
| 144 | 1.97 | 616 | 11/21/1996 8:30 | 120 | 0.6166667 |
| 144 | 1.98 | 578 | 5/27/1992 13:30 | 121 | 0.6115702 |
| 142 | 1.92 | 712 | 10/14/2009 13:45 | 122 | 0.6065574 |

North Country Environmental Services Landfill
Bethlehem, NH
Stage V Landfill Expansion
Type I-A Permit Modification
Prepared by CMA Engineers

Table 1 - Determination of 500 year Floodplain Utilizing USGS Gaging Station 01137500

Gage Datum 1,180.74 ft above NGVD29

Ammonoosuc River at Bethlehem Junction, NH

| Weibull Distribution | |
|---|---|
| RI = | (n+1)/m |
| n = | 73 years |

| Flow (cfs) | Gage Ht (ft) | # | Date | m | RI |
|---|---|---|---|---|---|
| 142 | 1.94 | 547 | 1987-11-05 -- -- | 123 | 0.601626 |
| 141 | 1.88 | 706 | 7/2/2008 11:10 | 124 | 0.5967742 |
| 139 | 1.94 | 600 | 2/1/1995 12:00 | 125 | 0.592 |
| 138 | 1.9 | 582 | 9/24/1992 9:35 | 126 | 0.5873016 |
| 137 | 1.93 | 556 | 1988-10-11 -- -- | 127 | 0.5826772 |
| 136 | 1.9 | 587 | 6/16/1993 8:00 | 128 | 0.578125 |
| 134 | 1.96 | 731 | 6/12/2012 19:17 | 129 | 0.5736434 |
| 134 | 1.91 | 729 | 4/13/2012 9:12 | 130 | 0.5692308 |
| 132 | 1.92 | 687 | 12/13/2005 8:30 | 131 | 0.5648855 |
| 131 | 1.81 | 715 | 3/11/2010 14:50 | 132 | 0.5606061 |
| 130 | 1.93 | 703 | 1/31/2008 14:05 | 133 | 0.556391 |
| 130 | 1.87 | 613 | 6/20/1996 6:35 | 134 | 0.5522388 |
| 126 | 1.8 | 590 | 11/9/1993 14:21 | 135 | 0.5481481 |
| 125 | 1.79 | 664 | 10/8/2003 12:12 | 136 | 0.5441176 |
| 121 | 2.5 | 561 | 1989-12-06 -- -- | 137 | 0.540146 |
| 118 | 1.73 | 711 | 8/19/2009 14:15 | 138 | 0.5362319 |
| 118 | 1.76 | 707 | 10/16/2008 15:05 | 139 | 0.5323741 |
| 115 | 2.41 | 708 | 1/13/2009 10:25 | 140 | 0.5285714 |
| 114 | 1.79 | 736 | 1/11/2013 12:08 | 141 | 0.5248227 |
| 114 | 1.88 | 695 | 1/23/2007 9:15 | 142 | 0.5211268 |
| 113 | 1.68 | 674 | 8/4/2004 13:18 | 143 | 0.5174825 |
| 112 | 1.72 | 714 | 1/6/2010 8:15 | 144 | 0.5138889 |
| 110 | 1.98 | 562 | 1990-01-23 -- -- | 145 | 0.5103448 |
| 109 | 2.28 | 747 | 12/16/2013 8:51 | 146 | 0.5068493 |
| 106 | 1.73 | 548 | 1987-12-17 -- -- | 147 | 0.5034014 |
| 101 | 1.7 | 571 | 1991-03-27 -- -- | 148 | 0.5 |
| 100 | 1.93 | 668 | 1/22/2004 10:08 | 149 | 0.4966443 |
| 98.3 | 1.59 | 739 | 2/26/2013 15:32 | 150 | 0.4933333 |
| 97.7 | 1.63 | 737 | 2/25/2013 9:30 | 151 | 0.4900662 |
| 97.4 | 1.69 | 688 | 2/21/2006 8:25 | 152 | 0.4868421 |
| 97.1 | 1.62 | 647 | 1/9/2001 14:35 | 153 | 0.4836601 |
| 96.9 | 1.77 | 624 | 10/28/1997 7:50 | 154 | 0.4805195 |
| 93.9 | 1.62 | 648 | 2/14/2001 13:15 | 155 | 0.4774194 |
| 91.7 | 1.63 | 746 | 10/21/2013 10:52 | 156 | 0.474359 |
| 91.6 | 1.62 | 573 | 1991-06-19 -- -- | 157 | 0.4713376 |
| 90.5 | 1.62 | 699 | 6/26/2007 15:20 | 158 | 0.4683544 |
| 90.2 | 2.04 | 618 | 1/29/1997 11:30 | 159 | 0.4654088 |
| 88.6 | 1.53 | 589 | 9/13/1993 9:25 | 160 | 0.4625 |
| 88.1 | 1.59 | 574 | 1991-08-27 -- -- | 161 | 0.4596273 |
| 87.7 | 1.59 | 567 | 10/4/1990 10:00 | 162 | 0.4567901 |
| 87.2 | 1.53 | 678 | 2/1/2005 11:00 | 163 | 0.4539877 |
| 87 | 1.58 | 579 | 1992-07-06 -- -- | 164 | 0.4512195 |

North Country Environmental Services Landfill
Bethlehem, NH
Stage V Landfill Expansion
Type I-A Permit Modification
Prepared by CMA Engineers

Table 1 - Determination of 500 year Floodplain Utilizing USGS Gaging Station 01137500

Gage Datum 1,180.74 ft above NGVD29

Ammonoosuc River at Bethlehem Junction, NH

| Weibull Distribution | |
|---|---|
| RI = | (n+1)/m |
| n = | 73 years |

| Flow (cfs) | Gage Ht (ft) | # | Date | m | RI |
|---|---|---|---|---|---|
| 86.6 | 1.6 | 692 | 10/10/2006 8:47 | 165 | 0.4484848 |
| 86.3 | 1.59 | 631 | 10/8/1998 15:25 | 166 | 0.4457831 |
| 83.6 | 1.76 | 626 | 1/29/1998 9:55 | 167 | 0.4431138 |
| 83.3 | 1.51 | 597 | 9/21/1994 7:15 | 168 | 0.4404762 |
| 83.2 | 1.52 | 660 | 1/9/2003 11:15 | 169 | 0.4378698 |
| 78.5 | 1.53 | 748 | 2/7/2014 9:45 | 170 | 0.4352941 |
| 78.5 | 1.48 | 599 | 12/21/1994 12:00 | 171 | 0.4327485 |
| 77 | 1.45 | 605 | 7/25/1995 7:00 | 172 | 0.4302326 |
| 76.1 | 1.53 | 686 | 10/4/2005 8:24 | 173 | 0.4277457 |
| 75.9 | 1.5 | 621 | 7/30/1997 11:00 | 174 | 0.4252874 |
| 74.3 | 1.43 | 673 | 7/19/2004 10:23 | 175 | 0.4228571 |
| 73.8 | 1.54 | 641 | 1/24/2000 14:15 | 176 | 0.4204545 |
| 73.4 | 1.44 | 595 | 6/27/1994 11:30 | 177 | 0.4180791 |
| 72.5 | 1.44 | 627 | 2/10/1998 14:15 | 178 | 0.4157303 |
| 72.3 | 1.66 | 702 | 12/13/2007 13:40 | 179 | 0.4134078 |
| 71.8 | 1.42 | 696 | 2/12/2007 8:35 | 180 | 0.4111111 |
| 71.7 | 1.61 | 585 | 12/29/1992 14:35 | 181 | 0.4088398 |
| 71.5 | 1.44 | 653 | 10/25/2001 12:15 | 182 | 0.4065934 |
| 71.5 | 1.43 | 598 | 11/15/1994 11:10 | 183 | 0.4043716 |
| 70.8 | 1.46 | 685 | 8/3/2005 10:42 | 184 | 0.4021739 |
| 67.7 | 1.64 | 610 | 2/13/1996 9:30 | 185 | 0.4 |
| 66.5 | 1.46 | 728 | 2/10/2012 8:11 | 186 | 0.3978495 |
| 66 | 1.45 | 745 | 8/28/2013 9:17 | 187 | 0.3957219 |
| 64.6 | 1.39 | 646 | 10/26/2000 8:00 | 188 | 0.393617 |
| 64.4 | 1.35 | 638 | 7/28/1999 14:40 | 189 | 0.3915344 |
| 61.9 | 1.46 | 592 | 1/20/1994 11:00 | 190 | 0.3894737 |
| 61.1 | 1.36 | 596 | 8/3/1994 10:15 | 191 | 0.3874346 |
| 61 | 1.32 | 675 | 10/4/2004 8:30 | 192 | 0.3854167 |
| 60.9 | 1.23 | 669 | 2/26/2004 11:35 | 193 | 0.3834197 |
| 59.9 | 1.33 | 566 | 1990-08-03 -- -- | 194 | 0.3814433 |
| 59.5 | 1.29 | 679 | 2/28/2005 8:08 | 195 | 0.3794872 |
| 58.8 | 1.32 | 630 | 8/4/1998 12:45 | 196 | 0.377551 |
| 58 | 1.3 | 650 | 7/17/2001 14:17 | 197 | 0.3756345 |
| 57.8 | 1.35 | 680 | 3/23/2005 7:45 | 198 | 0.3737374 |
| 57.7 | 1.36 | 732 | 8/1/2012 10:18 | 199 | 0.3718593 |
| 57.6 | 1.38 | 623 | 10/27/1997 15:35 | 200 | 0.37 |
| 56.8 | 1.48 | 593 | 2/28/1994 10:05 | 201 | 0.3681592 |
| 56.7 | 1.25 | 654 | 2/19/2002 10:30 | 202 | 0.3663366 |
| 56.4 | 1.32 | 554 | 1988-07-08 -- -- | 203 | 0.364532 |
| 53.9 | 1.27 | 583 | 10/6/1992 10:15 | 204 | 0.3627451 |
| 53.4 | 1.63 | 625 | 12/12/1997 9:15 | 205 | 0.3609756 |
| 52.8 | 1.24 | 580 | 1992-09-01 -- -- | 206 | 0.3592233 |

North Country Environmental Services Landfill
Bethlehem, NH
Stage V Landfill Expansion
Type I-A Permit Modification
Prepared by CMA Engineers

Table 1 - Determination of 500 year Floodplain Utilizing USGS Gaging Station 01137500

Gage Datum 1,180.74 ft above NGVD29

Ammonoosuc River at Bethlehem Junction, NH

| Weibull Distribution | |
|---|---|
| RI = | (n+1)/m |
| n = | 73 years |

| Flow (cfs) | Gage Ht (ft) | # | Date | m | RI |
|---|---|---|---|---|---|
| 52.6 | 1.39 | 672 | 7/6/2004 14:33 | 207 | 0.3574879 |
| 51.8 | 1.26 | 622 | 9/17/1997 10:00 | 208 | 0.3557692 |
| 51.3 | 1.27 | 607 | 10/5/1995 9:20 | 209 | 0.354067 |
| 50.7 | 1.24 | 645 | 8/23/2000 7:50 | 210 | 0.352381 |
| 50.6 | 1.21 | 581 | 1992-09-02 -- -- | 211 | 0.3507109 |
| 50.1 | 1.3 | 614 | 9/11/1996 6:25 | 212 | 0.3490566 |
| 49.9 | 1.49 | 609 | 1/10/1996 8:00 | 213 | 0.3474178 |
| 49.9 | 1.32 | 549 | 1988-01-28 -- -- | 214 | 0.3457944 |
| 48.4 | 1.28 | 550 | 1988-03-09 -- -- | 215 | 0.344186 |
| 48.2 | 1.23 | 615 | 10/2/1996 9:20 | 216 | 0.3425926 |
| 47 | 1.19 | 701 | 10/3/2007 8:50 | 217 | 0.3410138 |
| 45.6 | 1.14 | 663 | 7/17/2003 14:15 | 218 | 0.3394495 |
| 45 | 1.32 | 570 | 1991-02-12 -- -- | 219 | 0.3378995 |
| 44.6 | 1.19 | 723 | 8/8/2011 10:13 | 220 | 0.3363636 |
| 42.2 | 1.19 | 555 | 1988-08-12 -- -- | 221 | 0.3348416 |
| 41.8 | 1.19 | 559 | 1989-09-14 -- -- | 222 | 0.3333333 |
| 39.5 | 1.4 | 661 | 3/6/2003 10:40 | 223 | 0.3318386 |
| 39.5 | 1.08 | 604 | 7/6/1995 13:30 | 224 | 0.3303571 |
| 38.2 | 1.11 | 700 | 8/29/2007 11:57 | 225 | 0.3288889 |
| 34 | 1.1 | 658 | 8/25/2002 14:50 | 226 | 0.3274336 |
| 32.8 | 1.1 | 657 | 8/25/2002 12:50 | 227 | 0.3259912 |
| 32.2 | 1.02 | 606 | 8/29/1995 11:30 | 228 | 0.3245614 |
| 32.1 | 1.2 | 586 | 2/18/1993 11:15 | 229 | 0.3231441 |
| 23.7 | 0.91 | 652 | 8/28/2001 13:10 | 230 | 0.3217391 |
| 19.5 | 0.85 | 651 | 8/27/2001 12:30 | 231 | 0.3203463 |

Equation from "Est 500 yr Flood Plain" Chart: y = 155.39x+214.99
y = flow (cfs)
x = Return Interval

| | | |
|---|---|---|
| 100 year flood Estimate = | 15753.99 | cfs |
| 500 year flood Estimate = | 77909.99 | cfs |
| Gage Height assuming 80,000 cfs using USGS Gage Height vs. Discharge Chart for Gage Station 01137500 = | 30 | feet |
| **Elevation of 500 year flood =** | **1,210.74** | **ft above NGVD29** |
| Convert to Meters for USGS Plan = | 369.03 | m |

**Table 2.** Differences between the 100-year flood discharge computed from the period of record and from the period 1988–2007 for selected streamgages in and adjacent to New Hampshire.

[Locations of streamgages are shown in figure 2. ft³/s, cubic feet per second]

| USGS streamgage station number | Station name | Years | Flood discharge at a 100-year recurrence interval (ft³/s) | Change in the 100-year flood discharge computed from the period of record to the period 1988–2007 |
|---|---|---|---|---|
| 01052500 | Diamond River near Wentworth Location, NH | 1942–2007 | 10,400 | Increase by 15 percent |
| | | 1988–2007 | 12,000 | |
| 01064500 | Saco River near Conway, NH | 1904–09, 1930–2007 | 52,800 | Decrease by 26 percent |
| | | 1988–2007 | 38,900 | |
| 01073000 | Oyster River near Durham, NH | 1935–2007 | 1,200 | Increase by 56 percent |
| | | 1988–2007 | 1,870 | |
| 01073500 | Lamprey River near Newmarket, NH | 1935–2007 | 9,270 | Increase by 53 percent |
| | | 1988–2007 | 14,200 | |
| 01076500 | Pemigewassett River at Plymouth, NH | 1904–2007 | 57,700 | Decrease by 29 percent |
| | | 1988–2007 | 40,800 | |
| 01078000 | Smith River near Bristol, NH | 1919–2007 | 5,740 | Decrease by 8 percent |
| | | 1988–2007 | 5,290 | |
| 01094000 | Souhegan River at Merrimack, NH | 1910–76, 1982–2007 | 12,200 | No change[1] |
| | | 1988–2007 | 12,100 | |
| 01134500 | Moose River at Victory, VT | 1947–2007 | 4,740 | Decrease by 6 percent |
| | | 1988–2007 | 4,440 | |
| 01135500 | Passumpsic River at Passumpsic, VT | 1929–2007 | 17,000 | No change[1] |
| | | 1988–2007 | 17,000 | |
| 01137500 | Ammoonoosuc River at Bethlehem Junction, NH | 1940–2007 | 12,200 | Decrease by 11 percent |
| | | 1988–2007 | 10,800 | |
| 01139000 | Wells River at Wells River, VT | 1941–2007 | 5,170 | Decrease by 5 percent |
| | | 1988–2007 | 4,900 | |
| 01142500 | Ayers Brook at Randolph, VT | 1940–2007 | 2,820 | Increase by 29 percent |
| | | 1988–2007 | 3,640 | |
| 01144000 | White River at West Hartford, VT | 1916–2007 | 61,800 | Decrease by 31 percent |
| | | 1988–2007 | 42,800 | |
| 01152500 | Sugar River at West Claremont, NH | 1929–2007 | 12,800 | Decrease by 10 percent |
| | | 1988–2007 | 11,500 | |

[1]Less than 3-percent change in discharge is reported as no change.

*Appendix F – Hydrogeologic Report Double-Sided Replacement Page (5 & 6)*

### *2.2.3 Results of Additional Soil Excavation*

As described in the February 2010 CAP, the presence of diethyl ether and 1,1-dichloroethane (1,1-DCA) in groundwater in this area is attributed to historical LFG presence in vadose zone soils to the north of the Stage I landfill. As such, a limited area of remaining vadose zone soils in the vicinity of MW-402U (which had not been removed as part of prior soil excavation work in this area) were suspected to represent a potential source of residual LFG-related impacts. Accordingly, these remaining soils were removed in April 2011 as part of the overall corrective action process to restore groundwater quality at MW-402U to the background conditions defined in the site CAP.

The Stage IV/Phase II construction project (completed separately, but at approximately the same time as the excavation of vadose zone soil near MW-402U) provided an opportunity to assess soil quality beneath a portion of the Stage I landfill, in an area generally upgradient from MW-402U.

The findings from these soil excavation and testing activities were provided in Sanborn Head's June 21, 2011 letter to NHDES, and are summarized below.

#### 2.2.3.1 Soil Excavation – MW-402U Area

Vadose zone soils in the area of MW-402U (and nearby couplet well, MW-402LR) were excavated by NCES in April 2011. The excavation activities completed by NCES were observed and documented by a Sanborn Head representative, who collected samples of in-place and excavated soils for characterization, field screening and laboratory analysis. Excavation proceeded to a depth of approximately 8 to 10 feet below pre-excavation ground surface grades in the area. The excavated soils exhibited apparent iron staining in some of the uppermost depth intervals, but did not display evidence of (non-iron) staining or odors suggestive of potential LFG- or other VOC-related impacts. PID field-screening readings for in-place and excavated soils were all non-detect[8]; VOCs were not detected in either of the two soil samples submitted for laboratory analysis.

#### 2.2.3.2 Stage I Subliner Soil Sampling and Analysis

The Stage IV/Phase II construction project provided an opportunity to assess soil quality beneath a portion of the Stage I landfill, in an area generally upgradient from MW-402U. Based on information provided by NCES, re-construction of the Stage I/Phase IV leachate sump was completed in early 2011, as an approved element of the Stage IV/Phase II construction project. As part of this work, the Stage I liner system and underlying soils in the area of the sump were temporarily exposed, allowing the in-place soils underlying the liner system to be observed. Soil samples were collected by CMA Engineers (CMA) of Portsmouth, New Hampshire, on behalf of NCES, and analyzed VOCs, bromide, and chloride to assess for the potential presence of a VOC source in the subliner soils in this area.

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[8] Representative soil samples for field screening were collected from intervals within both the shallow soils and the deeper, glacial till soils; from locations proximate to well MW-402U. In consideration of the absence of visual/olfactory observations or PID responses suggestive of the presence of contaminated soils, only two soil samples were submitted for laboratory analysis.

CMA's observations of the soils underlying the Stage I secondary liner in the area of the (re-built) Stage I/Phase IV secondary leachate sump revealed some limited areas with possible iron and manganese staining, which did not appear to persist below a depth of approximately 1 to 2 inches. Also, odors suggestive of the possible presence of VOCs or LFG were not apparent from the exposed soils in this area. Two soil samples were collected by CMA and submitted for analysis of VOCs, bromide, and chloride. Neither VOCs nor bromide were detected in the soil samples. Chloride concentrations in the samples were suggestive of background concentrations, and not suggestive of impacts related to the presence of leachate or LFG in these soils.

### *2.2.4 MW-402 Area Monitoring*

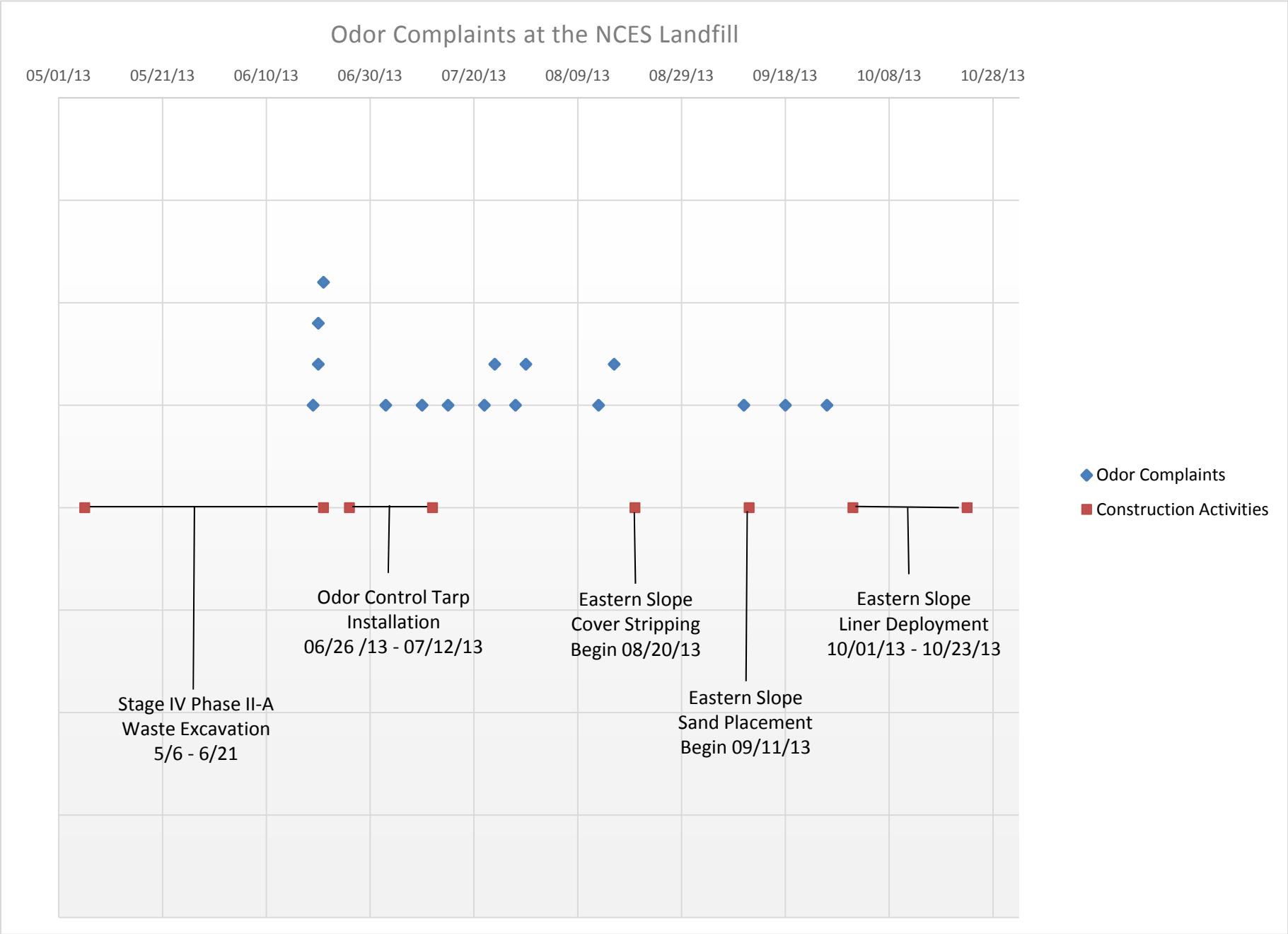
As discussed in the February 2010 CAP, the presence of diethyl ether and 1,1-DCA has been concluded to be a consequence of historical LFG presence in the area sourced from the Stage I Landfill. Although corrective actions undertaken by NCES, as described in the CAP and subsequent communications with NHDES, have been effective at addressing historical LFG sources, as evidenced by non-detects in soil vapor in the area between the Stage I Landfill and MW-402U; diethyl ether and 1,1-DCA continue to be detected in groundwater at MW-402U. As a result, NHDES required that NCES undertake additional investigations to further assess whether there are other potential source(s) for these VOCs.

On November 22, 2011, NCES submitted a Work Plan for installation of a new monitoring well couplet (B-922U/L) at a location closer to the Stage I Landfill, to evaluate the potential presence of VOCs in this area. Monitoring wells B-922U/L were installed in January 2012. As indicated in monitoring reports submitted to NHDES, and discussed in Section 4.1, diethyl ether and 1,1-DCA are detected in monitoring well B-922U at similar, but slightly higher concentrations than detected at MW-402U.

In addition to groundwater monitoring, as described in the February 2010 CAP, Sanborn Head installed soil vapor probes GP-16 and GP-17 in an area to the north of the Stage I Landfill to collect and analyze soil vapor samples for VOCs. The purpose of these soil vapor probes located in an area generally upgradient of monitoring well MW-402U, was to assess whether the VOCs observed in the groundwater samples collected from MW-402U may be the result of an active LFG source (i.e., LFG migration through the landfill liner system) in this part of the site.

As indicated in Sanborn Head's March 14, 2013 letter to NHDES, soil vapor monitoring results from the MW-402U area have consistently indicated low or non-detectable concentrations of VOCs, and none of the VOCs detected in groundwater at MW-402U have been detected in the soil vapor samples from probe GP-17 (and the four rounds that included the former location GP-16). These findings demonstrated that no active LFG source for the low-level VOCs detected in groundwater at well MW-402U is present in the vadose zone in the area of the soil vapor sampling. This is consistent with our site conceptual model, in that the low concentrations of diethyl ether and 1,1-DCA detected in the groundwater samples from monitoring well MW-402U are indicative of residual, low-level contamination associated with an older release of LFG along a pathway in the area upgradient of MW-402U, where both the source and the pathway have since been removed. NHDES concurred with

*Appendix G – Odor Complaint Summary Chart*


Odor Complaints at the NCES Landfill
05/01/13
05/21/13
06/10/13
06/30/13
07/20/13
08/09/13
08/29/13
09/18/13
10/08/13
10/28/13
Odor Complaints
Construction Activities
Stage IV Phase II-A
Waste Excavation
5/6 - 6/21
Odor Control Tarp
Installation
06/26 /13 - 07/12/13
Eastern Slope
Cover Stripping
Begin 08/20/13
Eastern Slope
Sand Placement
Begin 09/11/13
Eastern Slope
Liner Deployment
10/01/13 - 10/23/13

*Appendix H – Preliminary Closure Specifications*

| | |
|---|---|
| 02222 | Excavation |
| 02223 | Filling |
| 02232 | Stone Fill |
| 02234 | Select Sand |
| 02236 | Articulating Concrete Block Revetment System |
| 02270 | Erosion Control |
| 02273 | Drainage Composite |
| 02275 | Non-Woven Geotextile Filter Fabric |
| 02276 | Linear Low Density Polyethylene (LLDPE) Liner |
| 02619 | High Density Polyethylene Pipe and Fittings |
| 02930 | Loaming and Seeding |

# 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 uncovering existing anchor trench and for landfill gas header, lateral pipe and horizontal gas collector installation, and connections.
D. Excavation and disposal of unsuitable and excess materials.

### 1.02 RELATED REQUIREMENTS

A. Section 02223 - Filling
B. Section 02270 - Erosion Control

### 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.

1.04 JOB CONDITIONS

A. SITE CONDITIONS: Existing capping system and landfill gas system details depicted may vary slightly from what will be encountered during the progress of the work. The existing information is made available for the Convenience of the Contractor and the Owner will not be responsible for minor deviations such as changes in depth of less than 2-feet, or fitting or pipe size discrepancies of less than or equal to 4-inches.

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. Existing Vegetation and Cover Materials: Existing grass vegetation and cover soil materials contained within the root mass of the intermediate cover shall be excavated and segregated from the underlying intermediate cover materials by the Contractor and stockpiled in the borrow area.

2. Common Borrow: Soil to be excavated outside of the anchor trench for the installation of the gas lines, drainage swale, and capping system termination and utilized as common borrow fill shall have all rocks and material greater than eight (8) inches in diameter removed. 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.

3. Rock and Boulders: Existing stone, rock and boulders installed on the intermediate cover or within existing drainage swales shall be excavated and removed as required for installation of the capping system and stormwater management system. Existing angular rip rap stone may be processed to provide a clean stone, and re-used in conformance with the Drawings and Specifications. Existing non-angular

stone (un-processed) shall be relocated to the borrow area at a location designated by the Owner.

4. Unclassified Waste: Waste materials including soil cover and cover to be excavated from areas adjacent to the existing liner system anchor trench and for horizontal gas collection trenches as indicated on the Drawings. May include refuse, wood chips, metal, masonry, concrete, boulders, or debris and other unclassified waste.

5. 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 for construction or decommissioning of landfill gas collectors 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.

## 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. Compaction equipment in open areas shall consist of vibratory rollers, or other equivalent compaction equipment reviewed by the Engineer.

C. 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.

## 3.04 STOCKPILING

1. Suitable fill excavated from the capping system including vegetation and sand materials shall be stockpiled for use by the Owner. 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 common borrow fill.
B. Furnishing, placing and compaction of screened till for moisture retention layer.
C. Coordination with the Engineer for completion of all required tests.

### 1.02 RELATED REQUIREMENTS

A. Section 02222 - Excavation
B. Section 02232 - Stone Fill
C. Section 02234 - Select Sand
D. Section 02270 - Erosion Control
E. 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.
General.

C. Screened Till

Screened Till for use as the 6 inches of screened till fill (moisture retention layer) shall consist of inorganic mineral soil free of organic material, loam, trash, snow, ice, frozen soil, or other unsuitable materials have a permeability of $1x10^{-4}$cm/s or less as determined by ASTM D 5084, 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 |

D. For other fill materials see Section 02234 – Select Sand 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 one (1) 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 (at 95% MDD), 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 $ft^3$ installed
2. Screened Till: 1 test per 10,000 $ft^3$ 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 are 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 within utility trenches outside the landfill 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" | 95 |

F. Compaction of screened till materials above the select sand layer as a moisture retention layer shall be accomplished by passage of the dozers and low ground pressure machinery only. Compaction of screened till to shape the intermediate drainage benches shall be completed by tamping with the excavator bucket or plate compactor to provide stable and firm subgrade for the construction of the bench.

3.03 BACKFILLING OF UTILITES AND PIPING

A. After pipes and joints have been inspected and approved by the Engineer, Select sand (see Section 02234) 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 Select 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 95% 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 02232
STONE FILL

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Procurement of select gravel, 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 landfill gas 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 Stabilization of Drainage Swales, and Toe Drains:

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. 3/4" Crushed Stone

1. 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.

2. 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 | 0 - 20 |
| #20 | 0 - 5 |

C. Select Gravel

1. The select gravel shall be composed of hard, durable stone and coarse to fine sand, free from loam and clay and undesirable organic matter.

2. The gravel shall be well-graded and contain no stone greater than one and one half inches (1½") and meet the requirements of NHDOT 304.4 (Crushed Stone Fine),including the modified gradation below.

| Square Opening Sieve | % Passing by Weight |
|---|---|
| 2” | 100 |
| 1½” | 85 - 100 |
| ¾” | 45 - 75 |
| #4 | 10 - 45 |
| #40 | 0 - 10 |
| #200 | 0 - 5 |

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 select gravel materials as shown on the Drawings.

B. Stone fill within the gas collection trenches shall be placed beneath the pipe to form the bedding and then surround the pipe as shown on the Drawings.

C. Stone fill and Select Gravel in drainage benches and swales shall be placed directly over a 10 oz. non-woven geotextile fabric or drainage geocomposite (as shown on the Drawings) 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.

D. 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.

E. 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.

F. 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.

G. 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.

H. 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 six (6) inches as the gas transmission layer and landfill gas pipe bedding and backfill and twelve (12) inch layers of select sand as part of the landfill capping system, and at greater thicknesses as shown on the Drawings.

### 1.02 RELATED REQUIREMENTS

A. Section 02223 - Filling
B. 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 and proposed geomembrane 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 | 85-100 |
| #10 | 60-90 |
| #40 | 20-50 |
| #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 $1 \times 10^{-3}$ cm/sec as determined by ASTM D 2434.

D. The interface shear strength testing requirements for the select sand and drainage geocomposite are specified in Section 02273, 2.04.E.

E. The interface shear strength testing requirements for the select sand and geomembrane are specified below.

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 28°

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, 2 and 3 psi, all under inundated conditions. The strain rate shall not exceed 0.04 inches per minute. The 40-mil textured LLDPE 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.

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. Select sand shall be placed on side slopes steeper than 4:1 starting from the bottom of the slope and proceeding in an upward direction. The Contractor shall exercise caution when operating on side slopes and shall limit turning and braking.

E. 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.

F. 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.

G. The select sand layers 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 02236
ARTICULATING CONCRETE BLOCK REVETMENT SYSTEM

## PART 1 GENERAL

### 1.01 REQUIREMENTS INCLUDED

A. The work covered by this section consist of furnishing all labor, materials, equipment and incidentals required and performing all operations in connection with the installation of articulating concrete revetment blocks as shown on the Drawings and in accordance with these specifications.

### 1.02 RELATED REQUIREMENTS

A. Section 02275 - Non-Woven Geotextile Fabric

B. Section 02223 – Stone Fill

### 1.03 SUBMITTALS

A. The Contractor shall submit to the Engineer all manufacturers' hydraulic testing and calculations in support of the proposed cellular concrete mat system.

1. Full-scale laboratory test results and associated engineered calculations quantifying the hydraulic capacity of the proposed cellular concrete mat system in similar conditions to the specific project.

B. The Contractor shall furnish the manufacturer's certificates of compliance for cellular concrete blocks/mats, revetment cable, and any revetment cable fittings and connectors as specified in this document. The Contractor shall also furnish the manufacturer's specifications, literature, shop drawings for the layout of the mats, and any recommendations, if applicable, that are specifically related to the project.

C. The revetment block system is comprised of tapered articulated interlocking concrete blocks placed on a 6-inch bed crushed, clean, washed NHDOT D stone followed by a layer of Tensar geogrid.

D. Provide a list of 5 comparable projects, in terms of size and applications, utilizing tapered blocks, in the United States, where the results of the specific alternate revetment system use can be verified after a minimum of five (5) years of service life.

## PART 2 PRODUCTS

## 2.01 MATERIALS

### A. Acceptable Manufacturers

1. Articulated Concrete Block System shall be ArmorFlex® 40T by Contech Engineered Solutions, or equal.

### B. General

1. All cellular concrete mats shall be prefabricated as an assembly of concrete blocks, with specific hydraulic capacities, laced with revetment cables. Cellular concrete mats may be assembled on-site by hand-placing the individual units with the subsequent insertion of cables.

2. Individual units in the system shall be staggered and interlocked for enhanced stability. The mats shall be constructed of open cell units only as shown on the contract drawings. The open cell units have two (2) vertical openings of rectangular cross section with sufficient wall thickness to resist breakage during shipping and installation. The open cell units have an open area of 18-23% as measured from the base of the mat. Parallel strands of cable shall extend through two (2) cable ducts in each block allowing for longitudinal binding of the units within the mat and subsequent ability of the blocks to move freely along the cable. Each row of units shall be laterally offset by one-half of a block width from the adjacent row so that any given block is cabled to four other blocks (two in the row above and two in the row below).

3. All blocks in any given mat must be secured with a minimum of two (2) cables each.

4. The cellular concrete blocks, cables and fittings shall be fabricated at the manufacturer or another approved location into mats with a width of up to eight (8) feet and a length up to forty (40) feet, which is approved by the Engineer**.**

5. Each block shall incorporate interlocking surfaces that minimize lateral displacement of the blocks within the mats when they are lifted by the longitudinal revetment cables. The interlocking surfaces must not protrude beyond the perimeter of the blocks to such an extent that they reduce the flexibility or articulation capability of the cellular mats or become damaged or broken when the mats are lifted during shipment or placement. Once the mats are in place, the interlocking surfaces shall minimize the lateral displacement of the blocks even if the cables should become damaged or removed. The mats must be able to flex a minimum of 18° between any given row or column of blocks in the uplift direction and a minimum of 45° in the downward direction.

6. The cables inserted into the mats shall form lifting loops at one end of the mat with the corresponding cable ends spliced together to form a lifting loop at the

other end of the mat. The Engineer shall approve appropriate sleeves for use in order to splice the lifting loop. The cables shall be inserted after sufficient time has been allowed for the concrete to complete the curing process.

7. Certification (Overtopping Flow): Cellular concrete mats will only be accepted when accompanied by documented hydraulic performance characteristics that are derived from tests under controlled flow conditions. Testing guidelines should conform to U.S. Federal Highway Administration and U.S. Bureau of Reclamation Testing Protocol as documented in "Minimizing Embankment Damage During Overtopping Flow", Report No. FHWA-RD-88-181 and all hydraulic performance testing shall be performed in a 2H:1V flume. The testing shall be conducted including an aggregate drainage layer as specified for field installation. Hydraulic jump test results should also be included in this submission.

8. Performance (Overtopping Flow): The design of the cellular concrete mats shall be in accordance with the Factor-of-Safety design methodology as described in "Erosion and Sedimentation" by Pierre Julien, Cambridge University Press, 1995. The minimum designed safety factor shall be 1.5 by utilizing the following equation.

$$\mathbf{SF = ((\vartheta_2 / \vartheta_1)\, \alpha_\theta) / ((1 - \alpha_\theta^2)^{0.5} \cos \beta + \eta\, (\vartheta_2 / \vartheta_1) + (\vartheta_3 F_d' \cos \delta + \vartheta_4 F_l') / \vartheta_1 W_s) = 1.5}$$

The analysis shall be performed based upon the stability of the mat due to gravity forces alone, neglecting conservative forces added by cabling, mechanical anchorage, contact with adjacent blocks, or other restraints not attributable to gravity based forces. The analysis must account for a 0.0-inch block projection**.** Hydraulic jump analysis based on the correlation between energy ratio and Froude ratio shall also be performed.

*All design calculations submitted must be based upon the smallest block utilized in the mats. Partial "half blocks" must be analyzed separately.*

In order to analyze the performance of the unit, the hydraulic information listed below is required:

**TABLE 1. ACB HYDRAULIC INFORMATION**

| | |
|---|---|
| Velocity (ft/sec) | 15 |
| Flow Rate ($ft^3$/sec) | 40 |
| Depth of Flow (in) | 12 |
| Friction or Bed Slope (ft/ft) | 0.33 |
| Side Slope (_H:1V) | 3:1 |
| Allowable Unit Protrusion (in) | 0.0 |

C. Cellular Concrete Blocks

1. The blocks shall be cementitious materials that conform to the following applicable ASTM specifications:

a. Portland Cements - Specification C 150, for Portland Cement.
b. Blended Cements - Specification C 595, for Blended Hydraulic Cements.
c. Hydrated Lime Types - Specification C 207, for Hydrated Lime Types.
d. Pozzolans - Specification C 618, for Fly Ash and Raw or Calcined Natural Pozzolans for use in Portland Cement Concrete.
e. Aggregates shall conform to the following ASTM specifications, except that grading requirements shall not necessarily apply:
f. Normal Weight - Specification C 33, for Concrete Aggregates.

2. Casting

a. The concrete units shall be produced by a dry cast method. The dry cast units obtain strength in a shorter duration as well as an increase in the durability and overall quality of product.

3. Physical Requirements

a. At the time of delivery to the work site, the units shall conform to the physical requirements prescribed in Table 2 listed below.

**TABLE 2. PHYSICAL REQUIREMENTS**

| **Compressive Strength Net Area Min. p.s.i (mPa)** | | **Water Absorption Max. lb/ft$^3$ (kg/m$^3$)** | |
|---|---|---|---|
| Avg. of 3 units | Individual Unit | Avg. of 3 units | Individual Unit |
| 4,000 (27.6) | 3,500 (24.1) | 9.1 (160) | 11.7(192) |

b. Units will be sampled and tested in accordance with *ASTM D 6684-04, Standard Specification for Materials and Manufacture of Articulating Concrete Block (ACB) Revetment Systems.*

c. Units shall be sampled and tested in accordance with ASTM D 6684-04, Standard Specification for Materials and Manufacture of Articulating Concrete Block (ACB) Revetment Systems.

4. Visual Inspection

a. All units shall be sound and free of defects that would interfere with either the proper placement of the unit or impair the performance of the system. Surface cracks incidental to the usual methods of

manufacture, or surface chipping resulting from customary methods of handling in shipment and delivery, shall not be deemed grounds for rejection.

b. Cracks exceeding 0.25 inches (.635 cm) in width and/or 1.0 inch (2.54 cm) in depth shall be deemed grounds for rejection.

c. Chipping resulting in a weight loss exceeding 10% of the average weight of a concrete unit shall be deemed grounds for rejection.

d. Blocks rejected prior to delivery from the point of manufacture shall be replaced at the manufacturer's expense. Blocks rejected at the job site shall be repaired with structural grout or replaced at the expense of the contractor.

5. Sampling and Testing

a. The purchaser or their authorized representative shall be accorded proper access to facilities to inspect and sample the units at the place of manufacture from lots ready for delivery.

b. Field installation procedures shall comply with the procedures utilized during the hydraulic testing procedures of the recommended system. All system restraints and ancillary components (such as synthetic drainage mediums) shall be employed as they were during testing. For example, if the hydraulic testing installations utilize a drainage layer then the field installation must utilize a drainage layer; an installation without the drainage layer would not be permitted.

c. The theoretical force-balance equation used for performance extrapolation tends for conservative performance values of thicker concrete units based on actual hydraulic testing of thinner units. When establishing performance values of thinner units based on actual hydraulic testing of thicker units, there is a tendency to overestimate the hydraulic performance values of the thinner units. Therefore, all performance extrapolation must be based on actual hydraulic testing of a thinner unit then relating the values to the thicker units in the same “family” of blocks.

d. Additional testing, other than that provided by the manufacturer, shall be borne by the purchaser.

D. Revetment Cable and Fittings

1. Polyester Revetment Cable and Fittings. Revetment cable shall be constructed of high tenacity, low elongating, and continuous filament polyester fibers. Cable shall consist of a core construction comprised of parallel fibers contained within an outer jacket or cover. The weight of the parallel core shall be between 65% to 70% of the total weight of the cable. The revetment cable shall have the following physical properties:

| Polyester Cable | | | | |
|---|---|---|---|---|
| Nominal Cable Diameter | Approximate Average Strength | | Weight per Length | |
| (in) | Lbs | kN | Lbs/100 ft | Kg/m |
| 1/4 | 3,000 | 13.3 | 2.2 | 0.03 |
| 5/16 | 7,000 | 31.1 | 4.4 | 0.07 |
| 3/8 | 10,000 | 44.5 | 5.5 | 0.08 |
| 1/2 | 15,000 | 66.7 | 9.7 | 0.14 |

2. Elongation requirements specified below are based upon stabilized new, dry cable. Stabilization refers to a process in which the cable is cycled fifty (50) times between a load corresponding to 200D2 and a load equal to 10%, 20% or 30% of the cable's approximate average breaking strength. Relevant elongation values are as shown in the table below. The tolerance on these values is + 5%.

| ELASTIC ELONGATION at Percentage of Break Strength | | |
|---|---|---|
| 10% | 20% | 30% |
| 0.6 | 1.4 | 2.2 |

3. The revetment cable shall exhibit resistance to most concentrated acids, alkalis and solvents. Cable shall be impervious to rot, mildew and degradation associated with marine organisms. The materials used in the construction of the cable shall not be affected by continuous immersion in fresh or salt water.

4. Selection of cable and fittings shall be made in a manner that insures a safe design factor for mats being lifted from both ends, thereby forming a catenary. Consideration shall be taken for the bending of the cables around hooks or pins during lifting. Revetment cable splicing fittings shall be selected so that the resultant splice shall provide a minimum of 60% of the minimum rated cable strength. Fittings such as sleeves and stops shall be aluminum and washers shall be galvanized steel unless otherwise shown on the Contract Drawings.

E. Geogrid

1. The geogrid shall be Tensar BX1100 or an approved equal.

   The geogrid shall be a regular grid structure of polymeric material and shall have aperture geometry, rib and junction cross-sections sufficient to permit significant mechanical interlock and retain the underlying material. The geogrid shall impart a) high resistance to loss of load capacity or structural integrity when the geogrid is subjected to mechanical stress during installation, b) high resistance to deformation when the geogrid is subjected

to applied force in use, and c) high resistance to loss of load capacity or structural integrity when the geogrid is subjected to all forms of ultraviolet, biological or chemical degradation normally encountered in earthwork construction.

2.02 STORAGE AND HANDLING

A. Unload the mats according to the manufacturer instructions, using proper equipment.

B. In handling, lower, do not drop from trucks or excavator. Avoid severe impact blows.

C. Blocks damaged during handling, transportation, or storage will be rejected and must be replaced by new blocks meeting the requirements of these specifications.

PART 3 EXECUTION

3.01 SITE PREPARATION

A. The blocks are to be installed atop a prepared 6-inch subgrade of NHDOT D Stone and Geogrid. The subgrade shall be free from obstructions and be shaped smoothly to accept blocks. Hand dressing where necessary shall be required. Areas on which the articulated concrete block revetment system is to be placed shall be inspected immediately prior to placing, and no material shall be placed thereon until that area has been approved.

B. No holes, "pockmarks", slope board teeth marks, footprints, or other voids greater than 1.0 inch in depth normal to the local slope face shall be permitted. No grooves or depressions greater than 0.5 inches in depth normal to the local slope face with a dimension exceeding 1.0 foot in any direction shall be permitted. Where such areas are evident, they shall be brought to grade by placing compacted homogeneous material. The slope and slope face shall be uniformly compacted, and the depth of layers, homogeneity of soil, and amount of compaction shall be as required by the Engineer.

C. Excavation and preparation for anchor trenches, flanking trenches, and toe trenches or aprons shall be done in accordance to the lines, grades and dimensions shown in the Contract Drawings. The anchor trench hinge-point at the top of the slope shall be uniformly graded so that no dips or bumps greater than 0.5 inches over or under the local grade occur. The width of the anchor trench hinge-point shall also be graded uniformly to assure intimate contact between all cellular concrete blocks and the underlying grade at the hinge-point.

D. Geogrid materials shall be installed in accordance with manufacturer’s recommendations.

## 3.02 INSTALLATION

A. The Contractor shall provide the services of the articulated concrete block system manufacturer's factory representative to train the Contractor's personnel (on site) in the installation of the concrete block revetment system and shall oversee the initial installation of the concrete block revetment system, and shall make periodic inspections as the work progresses. The concrete block revetment system manufacturer's factory representative shall immediately notify the Contractor and Engineer of any improperly installed blocks. Such areas shall be corrected as recommended by the concrete block revetment system manufacturer and at no additional cost to the Owner.

B. The articulated concrete block revetment system shall be installed in accordance with the manufacturer's recommendations as approved by the Engineer to the lines and grades indicated on the Drawings. Any damage to the underlying drainage geocomposite or geogrid during placement of the concrete block system shall be repaired before proceeding with the work. The Contractor shall furnish a certificate from the manufacturer or authorized representative thereof stating that the blocks were installed correctly. Final acceptance and approval of the installation will be made by the Engineer.

C. Equipment used to install the mat shall be off of the geomembrane capping system or sitting atop additional sand thickness such that the pressure 12-inches above the geomembrane liner is no more than 4.7 psi

D. The Placement of the Cellular Concrete Blocks/Mats shall be performed in accordance with *ASTM D6884-03, Standard Practice for Installation of Articulating Concrete Block (ACB) Revetment Systems*.

E. The cellular concrete blocks shall be placed on a minimum 6-inch NHDOT Stone drainage layer. No individual block within the plane of placed cellular concrete blocks shall protrude more than one-half inch or as otherwise specified by the Engineer.

F. If assembled and placed as large mattresses, the cellular concrete mats shall be attached to a spreader bar or other approved device to aid in the lifting and placing of the mats in their proper position by the use of a crane or other approved equipment. The equipment used should have adequate capacity to place the mats without bumping, dragging, tearing or otherwise damaging the drainage layer or underlying fabric. The mats shall be placed side-by-side and/or end-to-end, so that the mats abut each other. Mat seams or openings between mats greater than two (2) inches and less than the dimensions of a full block as used in the mat shall be filled with 4000 psi non-shrink grout, concrete or approved equal. Backfilling of staggered half-blocks will not be allowed. Whether placed by hand or in large mattresses, distinct changes in grade that results in a discontinuous revetment

surface in the direction of flow shall require a grout seam at the grade change location so as to produce a continuous surface.

G. Termination trenches shall be backfilled and flush with the top of the blocks. The integrity of the trench backfill must be maintained so as to ensure a surface that is flush with the top surface of the cellular concrete blocks for its entire service life. Toe trenches shall be backfilled as shown on the Contract Drawings. Backfilling of trenches shall be completed in a timely fashion. No more than 500 linear feet of placed cellular concrete blocks with non-completed anchor and/or toe trenches shall be permitted at any time.

## 3.03 FILLING OF VOIDS

A. After the concrete block revetment system has been place, the Contractor shall fill in the open areas with ¾ Crushed Stone per Section 02232.

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 Alteration of Terrain Permit, and NPDES Construction General Permit conditions for this project.

### 1.02 RELATED REQUIREMENTS

A. Section 02222 - Excavation
B. Section 02223 - Filling
C. Section 02232 - Stone Fill

### 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 for stone check dams 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 4:1. 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 4:1 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 drainage net bonded on both sides to non-woven polypropylene geotextile fabrics.

1.02 RELATED REQUIREMENTS

A. Section 02223 - Filling
B. Section 02234 - Select Sand
C. Section 02276 – Linear Low Density Polyethylene (LLDPE) Liner

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 shear strength testing per Part 2.04 of this section.

D. Requirements for testing of interface shear strength between the drainage geocomposite and the textured LLDPE 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. GSE Fabrinet HF Geocomposite
B. 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 |
| 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 |
|---|---|---|---|
| Polymer Density | ASTM D1505 | 1/50,000 SF | 0.94 g/cm$^3$ |
| Carbon Black Content | ASTM D4218 | 1/50,000 SF | 2% |
| Nominal Thickness | ASTM D5199 | 1/50,000 SF | 250 mil |
| Tensile Strength MD | ASTM D5035 | 1/50,000 SF | 50 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 and secondary drainage geocomposite shall have a minimum transmissivity of $5.0 \times 10^{-4}$ m$^2$/s when tested with ASTM D4716 between select sand and textured LLDPE liner at a normal load of 300 psf and a gradient of 0.33 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 200,000 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.

F. 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 $28^0$ between the following surfaces:

   a. The double-sided drainage geocomposite and the proposed 40-mil textured LLDPE geomembrane.

1. 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, 2 and 3 psi, all under inundated conditions. The strain rate shall not exceed 0.04 inches per minute. The drainage geocomposite and the 40-mil textured LLDPE 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" LLDPE 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. Installation of select sand directly above the geomembrane and geocomposite shall be completed with LGP equipment (See Section 02276).

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 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
LINER LOW DENSITY POLYETHYLENE (LLDPE) LINER

## PART 1 GENERAL

### 1.01 REQUIREMENTS INCLUDED

A. Furnishing of Textured 40-mil LLDPE liner
B. Quality Control for liner materials
C. Field installation of the liner
D. Leak location survey

### 1.02 RELATED REQUIREMENTS

A. Section 02223 - Filling
B. Section 02232 - Stone Fill
C. Section 02234 - Select Sand
D. Section 02273 - Drainage Geocomposite

### 1.03 APPLICABLE STANDARDS, CODES, AND REGULATIONS

A. ASTM Standards for Linear Low 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 LLDPE geomembrane rolls and/or experience totaling 10,000,000 sq. ft. of manufactured LLDPE 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 LLDPE 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 LLDPE 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 LLDPE 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. 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 LLDPE 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 LLDPE welding rod to be used on the project shall be submitted.

5. Shop Drawings showing the following:

   a. Proposed layout of the LLDPE membrane system.

   b. Details of jointing the LLDPE 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. The Contractor shall provide representative samples of the proposed geomembrane to the Engineer to complete direct shear box testing of the proposed 40-mil textured LLDPE geomembrane and select sand to demonstrate compliance of interface friction as required in Section 02234 (Select Sand).

12. The Engineer shall complete direct shear box testing of the proposed 40-mil textured LLDPE geomembrane and drainage geocomposite 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, and QC representative. 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.

## 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. Alternative standard company language may be acceptable, but the period, notification time, and legal jurisdictions shall remain as stated in the Exhibits.

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 LLDPE 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. Review of Contractor Personnel - Roles and Responsibilities
8. Reports and Record Drawing Information
9. 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 | .915 |
| 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 | 38 mils |
| | | lowest for 8 of 10 | 36 mils |
| | | lowest for 2 of 10 | 34 mils |
| Asperity Height | GRI GM12 | | 10 mils |
| Tensile Strength (Yield) (lbs/in.) | ASTM D6693 Type IV | | |
| Tensile Strength (Break) (lbs/in.) | ASTM D6693 Type IV | | 60 |
| Elongation at Yield (%) | ASTM D6693 Type IV (1.3" gauge) | | |
| Elongation at Break (%) | ASTM D6693 Type IV (2.0" gauge) | | 250% |
| Tear Resistance (lbs) | ASTM D1004 Die C | | 22 |
| Puncture Resistance (lbs) | ASTM D4833 | | 44 |
| Carbon Black Content | ASTM D1603/4218 | | 2 to 3% by weight |
| Oven Aging at 85°C<br>High Pressure OIT | ASTM D5721<br>ASTM D5885 | % retained after 90 days | 80% |
| UV Resistance<br>High Pressure OIT | GRI-GM11<br>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 40-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 |

LLDPE 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 40-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.

B. Each panel of LLDPE 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 LLDPE 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 LLDPE 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 LLDPE 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 40-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.

   The survey shall be certified by the surveyor and submitted to the Engineer as an AutoCAD 2009, 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.

5. 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 40-mil liner shall be evaluated using vacuum box testing. The seams of the 40-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.

C. 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.

D. Drainage Geocomposite and Select Sand 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 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 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 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 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. Select sand, screened till and topsoil materials shall be placed upslope or laterally on slopes greater than 4:1.

## 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 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 02222 - Excavation
B. Section 02223 - Filling
C. Section 02276 – Linear Low Density Polyethylene (LLDPE) 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. Pipe shall meet the requirements of ASTM D3350 and meet or exceed the cell classification of 345464C and be 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 Elast. | ASTM D638 | 130,000 psi |
| Flexural Modulus | ASTM D790 | 120,000 psi |
| Melt Index | ASTM D1238 | 0.10 gm/10 min (max) |

### 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 LLDPE 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 LLDPE 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 02930
# LOAMING AND SEEDING

## PART 1 GENERAL

### 1.01 REQUIREMENTS INCLUDED

A. Procure loam materials, 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.

D. Owner's Representatives inspection shall determine if the seeded areas are acceptable and whether maintenance shall continue in any part.

E. 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. Topsoil materials 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.

D. 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.

2.04 BONDED FIBER MATRIX

A. Bonded fiber matrix stabilizer and fiber mulch mix shall be installed on all vegetated areas. Acceptable manufacturers include:
   1. Terra Novo (Earthguard Fiber Matrix)
   2. Approved equal.

B. Application rates of the stabilizer and fiber mulch shall be in accordance with manufacturer's recommendations.

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. Prior to seeding, Contractor shall track the topsoil slope areas with a dozer in a direction parallel to the slope, to provide water bars and reduce erosion potential and promote see catch.

D. Care must be taken by the Contractor to see that excessive 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 FIBER MULCHING

A. MULCH:

Immediately after the area has been seeded or during application of seed, it shall be uniformly covered by fiber mulch at the rate recommended by the manufacturer of the fiber matrix.

## 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. 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.

E. 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.

F. 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

*Appendix I - Reduced Size (8.5x11) Revised Design Drawings, Closure Plan Drawings and Filling & Interim Closure Plan Drawings*

*(Full Size Drawings Bound Separately)*

# NORTH COUNTRY ENVIRONMENTAL SERVICES, INC.
# STAGE V LANDFILL EXPANSION

## Bethlehem, New Hampshire

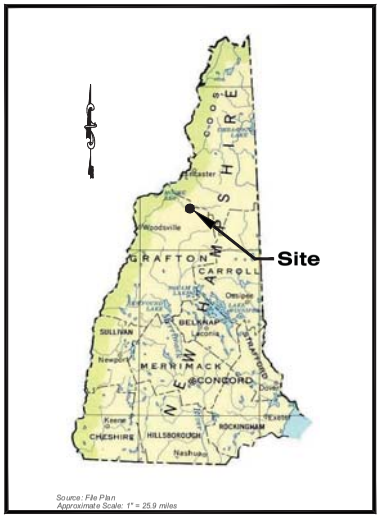
## Design Drawings

***Issued for NHDES Review - February 2014***

***Issued For NHDES Review- June 2014***
***Response to May 22, 2014 NHDES Comments***

## Sheet Index


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


***Locus Plan***


*Prepared By:*

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CIVIL /ENVIRONMENTAL ENGINEERS

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*Prepared For:*

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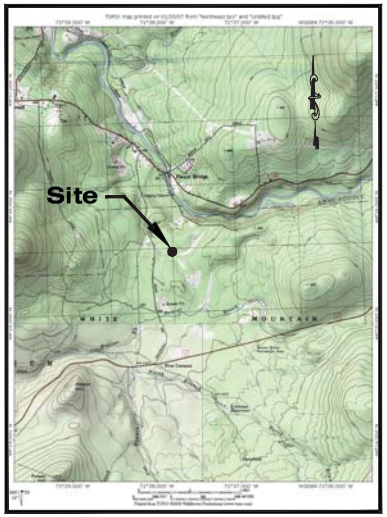
Bethlehem, New Hampshire 03574


***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)

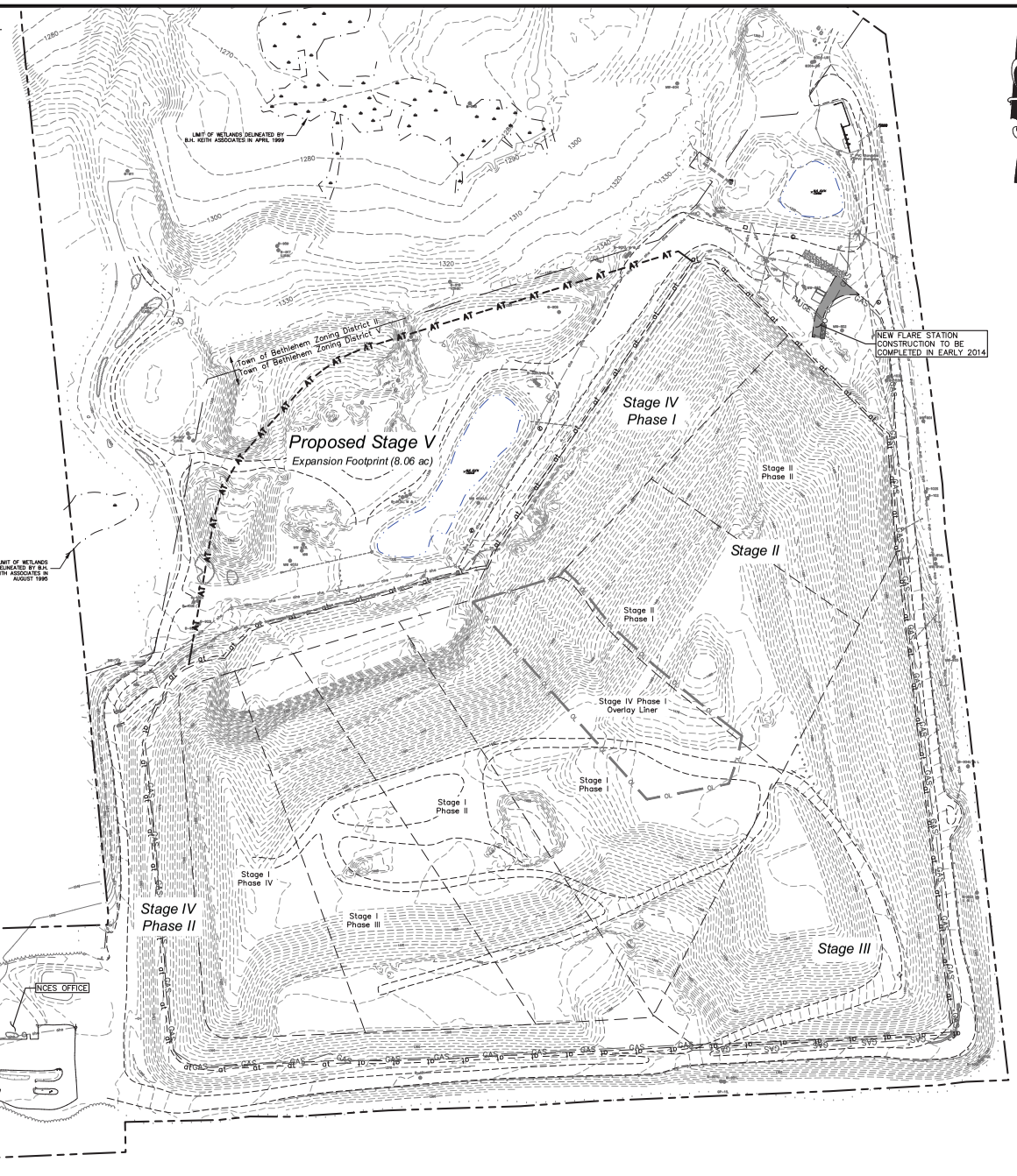
I. "2007 Landfill Gas Improvements Record Drawings" prepared for North Country Environmental Services, Inc. by CMA Engineers, Inc. of Portsmouth, New Hampshire dated April 2008.

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.




## 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 October 9, 2013 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.

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

## Legend:

- Existing 2' Contour
- 1440 Existing 10' Contour
- Existing Property Line
- Town of Bethlehem Zoning Line
- Existing Tree Line
- 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
- AT Proposed Anchor Trench

| no. | revision | date | by |
|---|---|---|---|
| 1 | Issued for NHDES Review | 2/7/14 | RJG |
| 2 | Issued for NHDES Review: May 22, 2014 Comments | 6/19/14 | RJG |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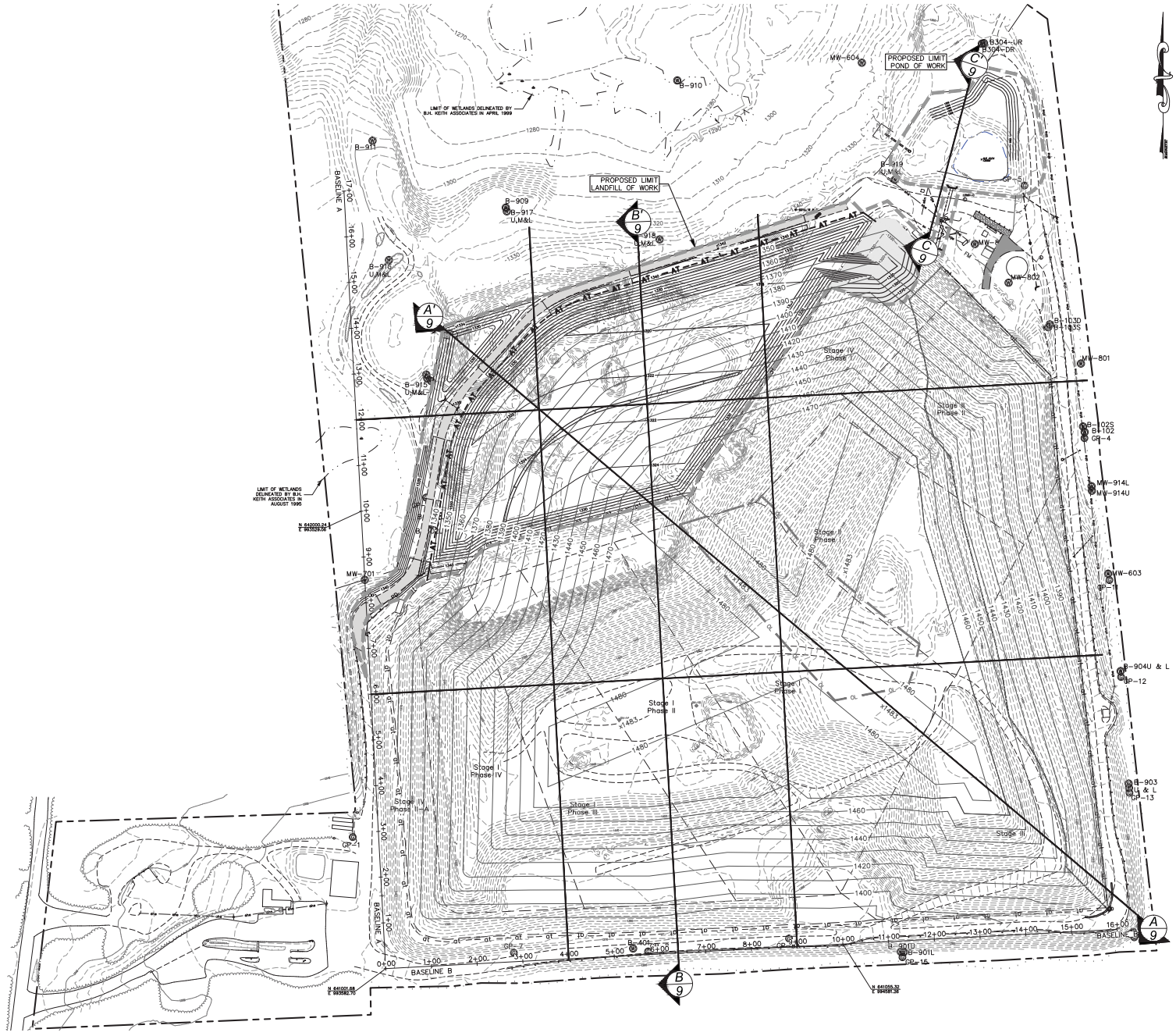
designed by: RJG/BWS
drawn by: BWS
approved by: RJG
date: February 2014
project no: 833
file name: 833-OVSP1406.dwg
scale: 1" = 100'

# North Country Environmental Services
## Bethlehem, NH
## Stage V Landfill Expansion
## Type I-A Permit Modification
## Existing Conditions & Overall Site Plan

drawing no. 2

sheet: 2 of 15

Drawing file: F:\CADD\PROJECTS\833–NCES Stage V\dwg\DES Comments 1406\Design Drawings\833–OVSP1406.dwg 6/18/2014 9:46am




## Notes:

1. Existing topography shown within the treeline is developed from the October 9, 2013 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.

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

3. Proposed topography shown within the proposed Stage V landfill expansion on this plan are top of secondary liner.

4. Closure grades shown are top of cap. Top of waste is approximately 3.83' below top of cap grades. See the Closure Plan for addition detail.

5. Construction baselines and section alignments shown on this sheet are used for landfill cross sections on Sheets 8 & 9.

## Legend:

- Existing 2' Contour
- 1440 Existing 10' Contour
- Existing Property Line
- Town of Bethlehem Zoning 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
- Existing Anchor Trench
- Existing Limit of Waste
- AT Proposed Anchor Trench
- Proposed Limit of Work
- 1440 Proposed 10' Contour
- Proposed 2' Contour
- Proposed Gravel Road
- PD Proposed Drainage Pipe
- Proposed Waste Excavation
- 1440 Proposed Stage V Top of Cap 10' Contour

| no. | revision | date | by |
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drawn by: BWS
approved by: RJG
date: February 2014
project no: 833
file name: 833-OVSP1-Base.dwg
scale: 1" = 100' (in feet)

# North Country Environmental Services
## Bethlehem, NH
## Stage V Landfill Expansion
## Type I-A Permit Modification
## Proposed Overall Site Plan

drawing no. 3

sheet: 3 of 15

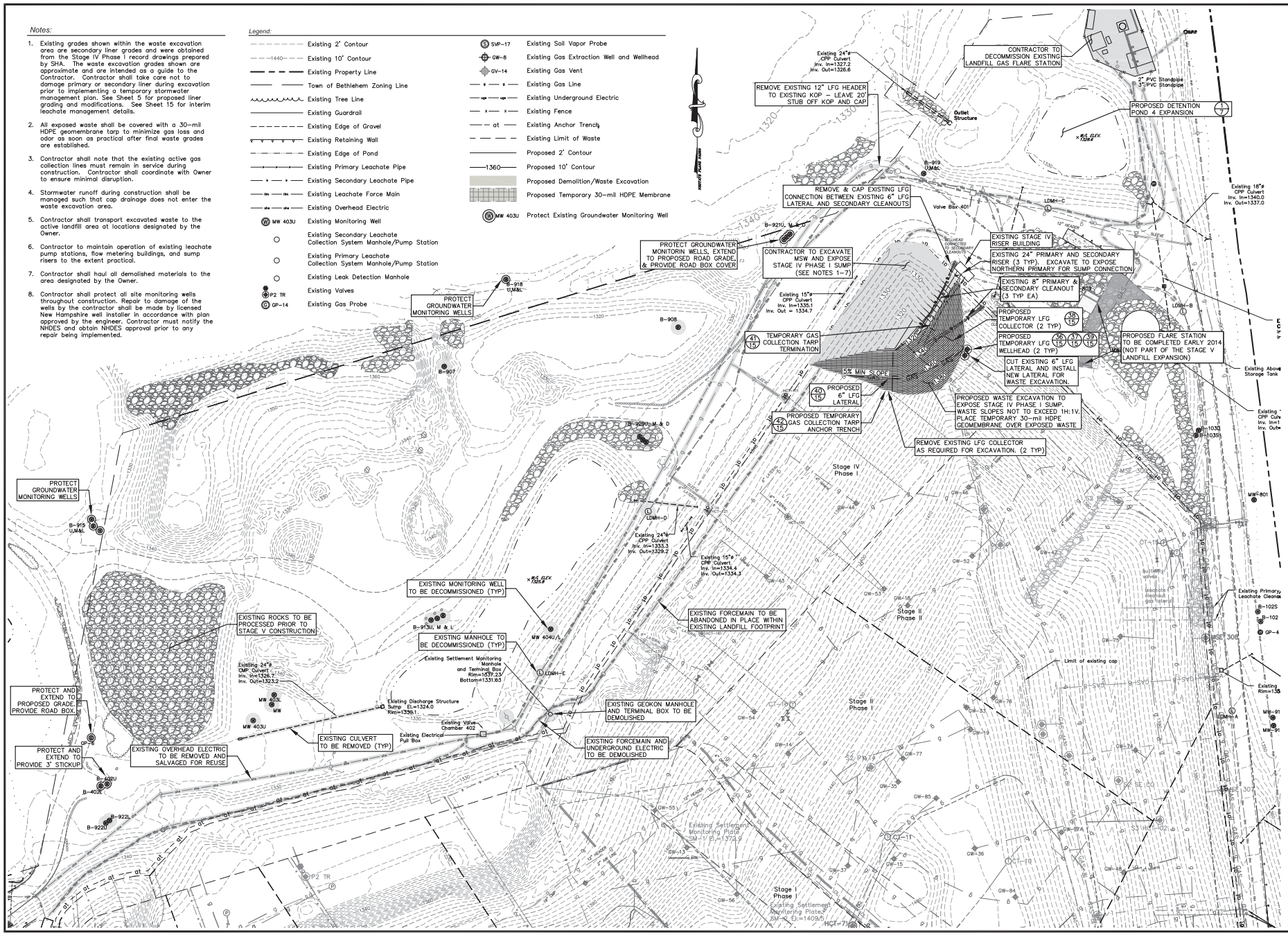
Drawing file: F:\CADD\PROJECTS\833-NCES Stage V\dwg\DES Comments 1406\Design Drawings\833-OVSP1406.dwg 6/18/2014 9:46am

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 5 for proposed liner grading and modifications. See Sheet 15 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.

Legend:

- Existing 2' Contour
- Existing 10' Contour
- Existing Property Line
- Town of Bethlehem Zoning 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
- Existing Anchor Trench
- Existing Limit of Waste
- Proposed 2' Contour
- Proposed 10' Contour
- Proposed Demolition/Waste Excavation
- Proposed Temporary 30-mil HDPE Membrane
- MW 403U Protect Existing Groundwater Monitoring Well

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designed by: RJG/BWS
drawn by: BWS
approved by: RJG
date: February 2014
project no: 833
file name: 833-Waste Excavation1406.dwg
scale: 1" = 50' (in feet) 1:600

North Country Environmental Services
Bethlehem, NH

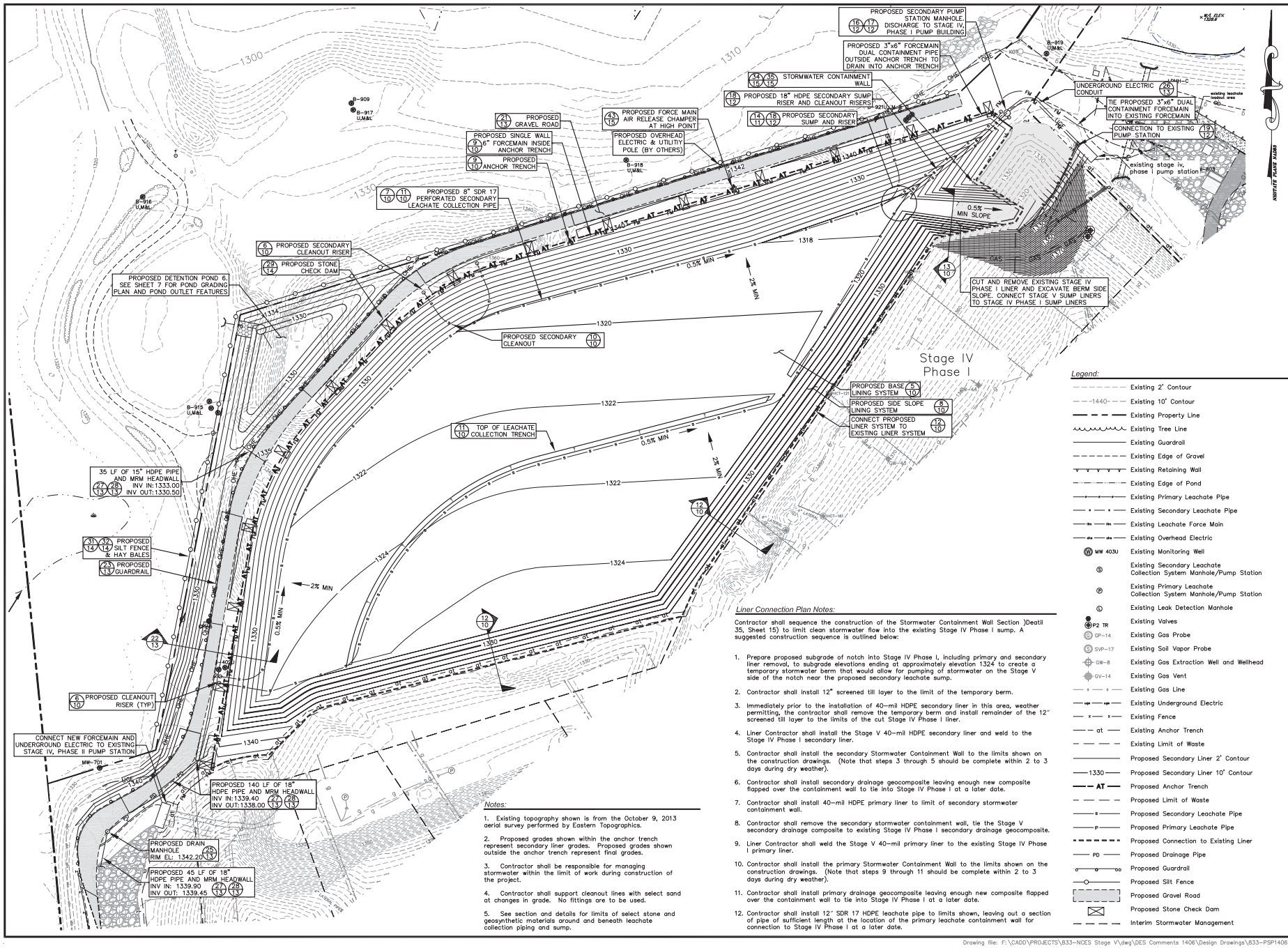
Stage V Landfill Expansion
Type I-A Permit Modification

Existing Conditions, Waste Excavation & Demolition Plan

drawing no. 4

sheet: 4 of 15

Drawing file: \\fs2011\sys\CADD\PROJECTS\833-NCES Stage V\dwg\DES Comments 1406\Design Drawings\833-Waste Excavation1406.dwg 6/18/2014 10:12am




## Notes:

1. Existing topography shown is from the October 9, 2013 aerial survey performed by Eastern Topographics.
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 )Deatil 35, Sheet 15) to limit clean stormwater flow into the existing Stage IV Phase I sump. A suggested construction sequence is outlined below:

1. 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.
2. Contractor shall install 12" screened till layer to the limit of the temporary berm.
3. Immediately prior to the installation of 40-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.
4. Liner Contractor shall install the Stage V 40-mil HDPE secondary liner and weld to the Stage IV Phase I secondary liner.
5. Contractor shall install the secondary Stormwater Containment Wall to the limits shown on the construction drawings. (Note that steps 3 through 5 should be complete within 2 to 3 days during dry weather).
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 40-mil HDPE primary liner to limit of secondary stormwater containment wall.
8. Contractor shall remove the secondary stormwater containment wall, tie the Stage V secondary drainage composite to existing Stage IV Phase I secondary drainage geocomposite.
9. Liner Contractor shall weld the Stage V 40-mil primary liner to the existing Stage IV Phase I primary liner.
10. Contractor shall install the primary Stormwater Containment Wall to the limits shown on the construction drawings. (Note that steps 9 through 11 should be complete within 2 to 3 days during dry weather).
11. 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.
12. 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.

## 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
- Existing Anchor Trench
- Existing Limit of Waste
- Proposed Secondary Liner 2' Contour
- 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
- Proposed Drainage Pipe
- Proposed Guardrail
- Proposed Silt Fence
- Proposed Gravel Road
- Proposed Stone Check Dam
- Interim Stormwater Management

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STATE OF NEW HAMPSHIRE
ROGER B. SCHMIDT
No. 9234
LICENSED PROFESSIONAL ENGINEER

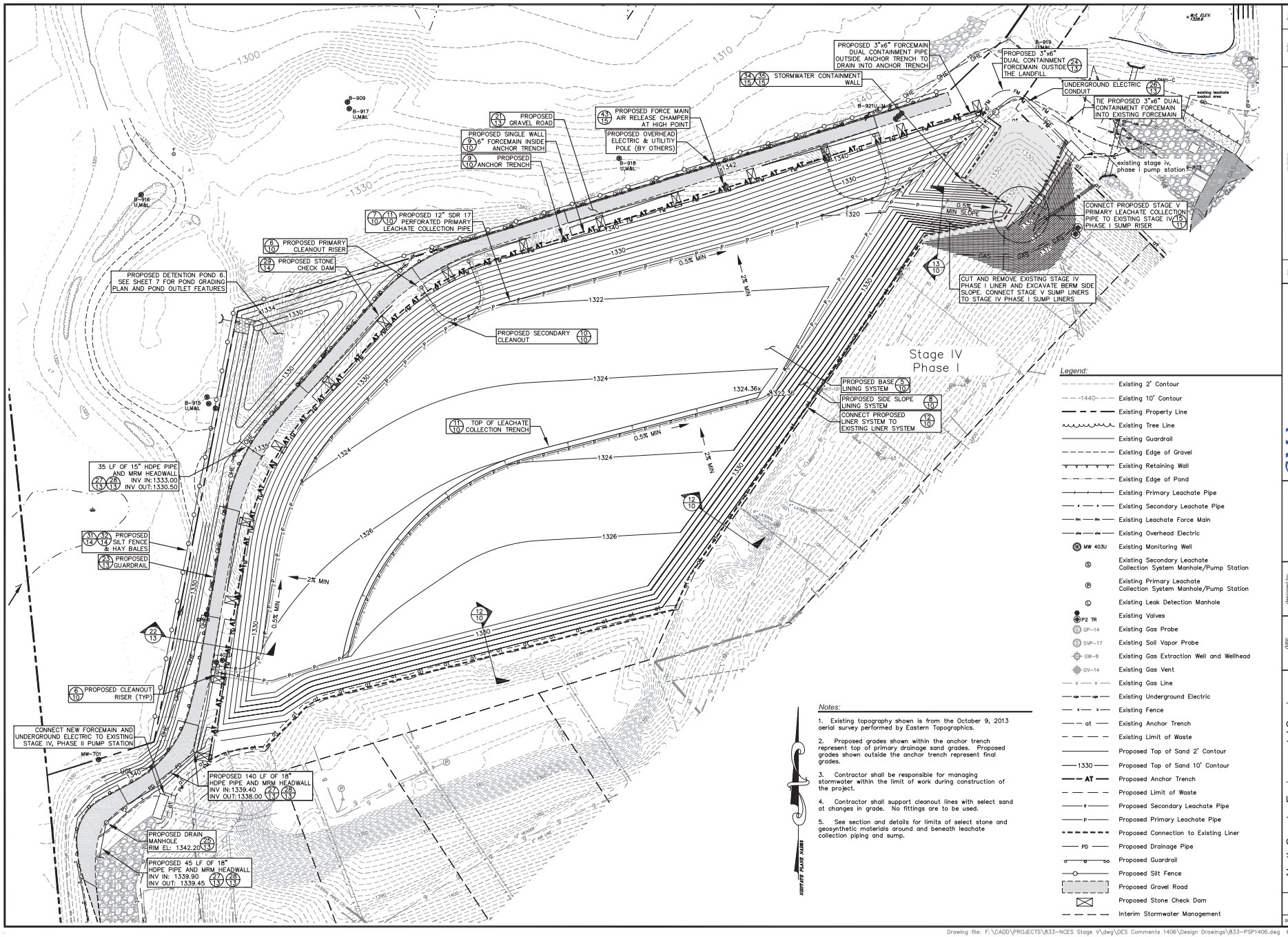
designed by: RJG/BWS
drawn by: BWS
approved by: RJG
date: February 2014
project no: 833
file name: 833-PSP1406.dwg
scale: 50 25 0 50 (in feet) 1" = 50'

# North Country Environmental Services
## Bethlehem, NH
## Stage V Landfill Expansion
## Type I-A Permit Modification
## Proposed Secondary Liner Grading Plan

drawing no. 5

sheet: 5 of 15

Drawing file: F:\CADD\PROJECTS\833-NCES Stage V\dwg\DES Comments 1406\Design Drawings\833-PSP1406.dwg 6/18/2014 11:28am




*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
- Existing Valves
- P2 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 Top of Sand 2' Contour
- 1330 Proposed Top of Sand 10' Contour
- AT Proposed Anchor Trench
- Proposed Limit of Waste
- Proposed Secondary Leachate Pipe
- Proposed Primary Leachate Pipe
- Proposed Connection to Existing Liner
- Proposed Drainage Pipe
- Proposed Guardrail
- Proposed Silt Fence
- Proposed Gravel Road
- Proposed Stone Check Dam
- Interim Stormwater Management

*Notes:*

1. Existing topography shown is from the October 9, 2013 aerial survey performed by Eastern Topographics.
2. Proposed grades shown within the anchor trench represent top of primary drainage sand 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.

| no. | revision | date | by |
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STATE OF NEW HAMPSHIRE
ROBERT J. GUERETTE
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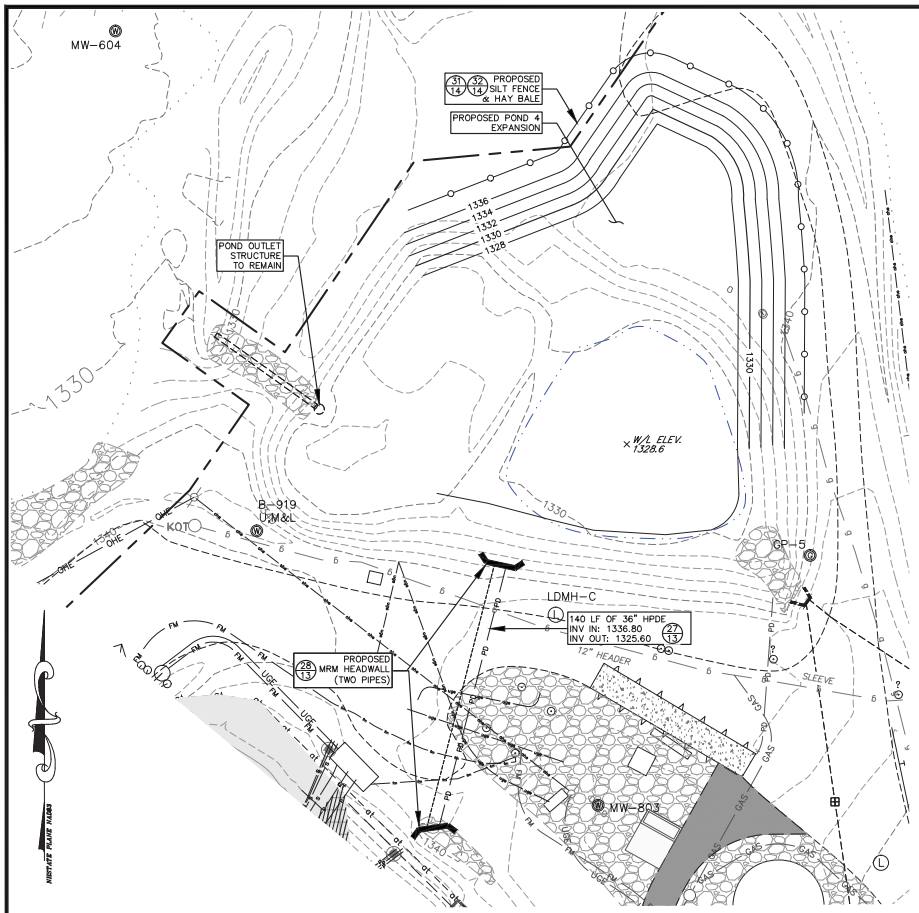
designed by: JSM/BWS
drawn by: BWS
approved by: RJG
date: February 2014
project no: 833
file name: 833-PSP1406.dwg
scale: 0 25 50 (in feet) 1" = 50'

# North Country Environmental Services
## Bethlehem, NH
## Stage V Landfill Expansion
## Type I-A Permit Modification
## Proposed Primary Drainage Sand Grading Plan

drawing no. 6

sheet: 6 of 15

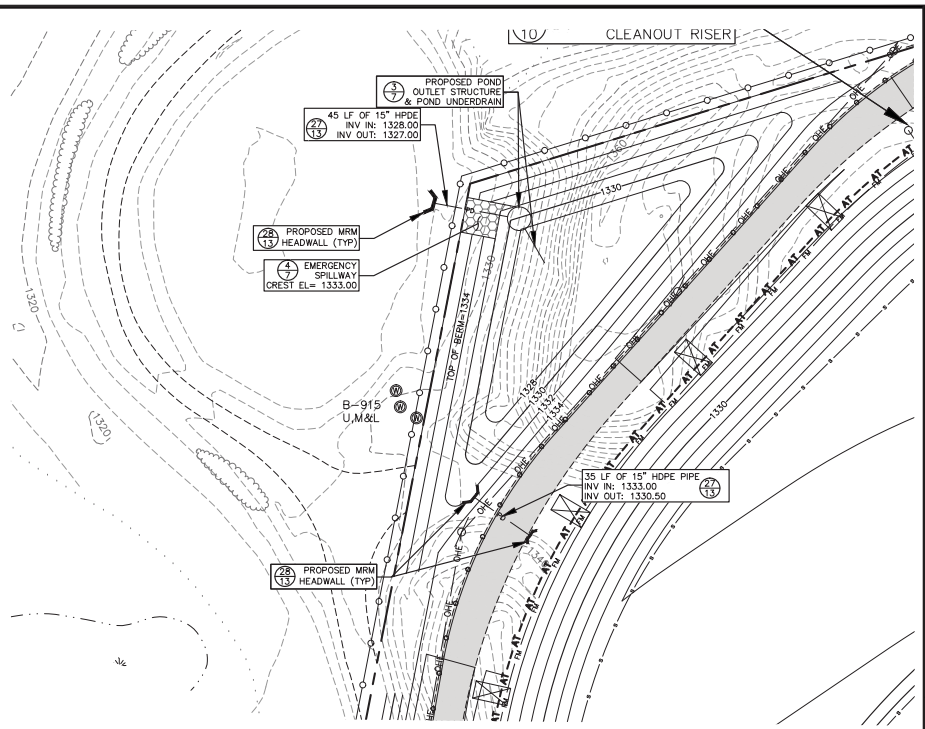
Drawing file: F:\CADD\PROJECTS\833-NCES Stage V\dwg\DES Comments 1406\Design Drawings\833-PSP1406.dwg 6/18/2014 11:27am




## Proposed Detention Pond 4 Grading Modification

Scale: 1" = 30'

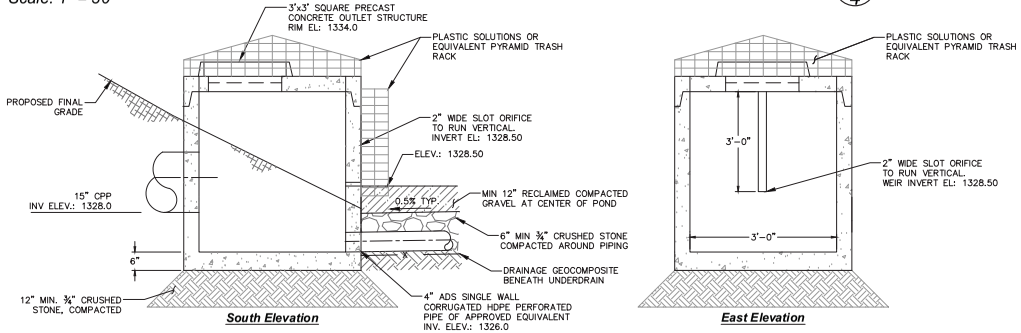
1/4




## Proposed Detention Pond 6 Grading Plan

Scale: 1" = 30'

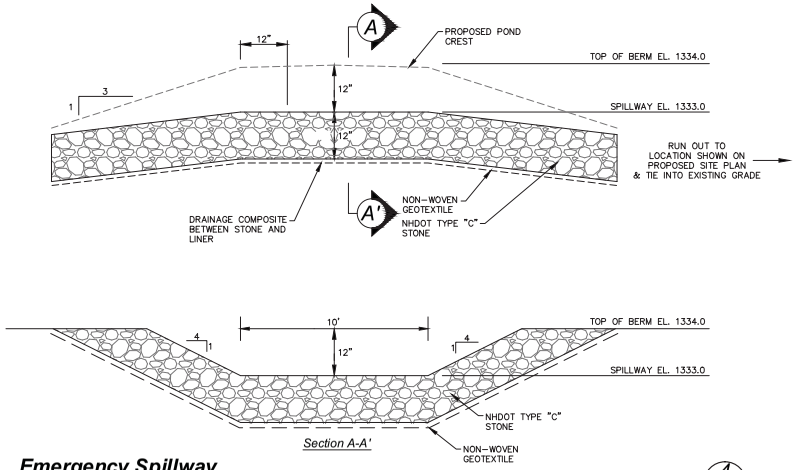
2/5 2/6




## Outlet Structure Detail

Not to Scale

3/7




## Emergency Spillway

Not to Scale

4/7

| no. | revision | date | by |
|---|---|---|---|
| 1 | Issued for NHDES Review | 2/7/14 | RJG |
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designed by: RJG/EWS
drawn by: BWS
approved by: RJG
date: February 2014
project no: 833
file name: 833-PSP1406.dwg
scale: 30 15 30 (in feet) 1" = 30'

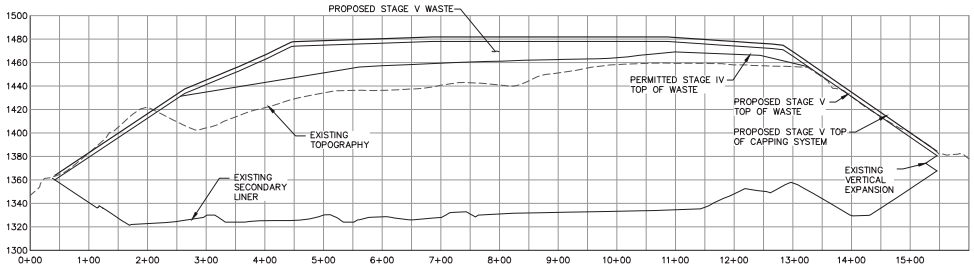
North Country Environmental Services
Bethlehem, NH
Stage V Landfill Expansion
Type I-A Permit Modification
Proposed Detention Pond 4 & 6 Grading Plan

drawing no. 7
sheet: 7 of 15

Drawing file: F:\CADD\PROJECTS\833-NCES Stage V\dwg\DES Comments 1406\Design Drawings\833-PSP1406.dwg 6/18/2014 9:43am

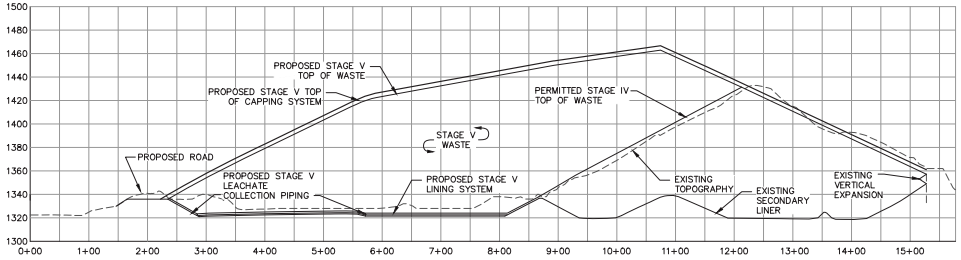
*Notes:*

1. Section Lines are shown on Sheet 3



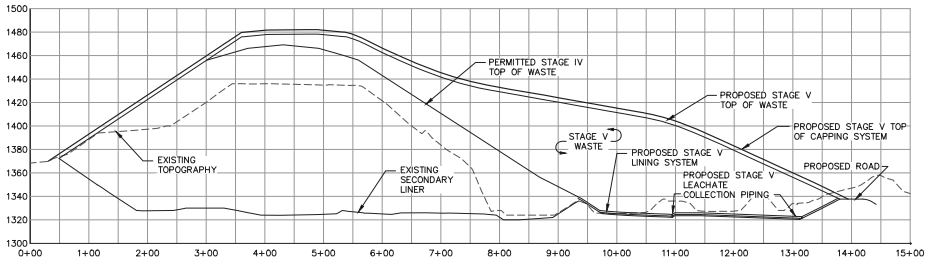

*Baseline A Station 6+00*

Horizontal: 1" = 100'
Vertical: 1" = 50'



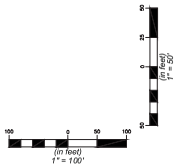

*Baseline A Station 12+00*

Horizontal: 1" = 100'
Vertical: 1" = 50'




*Baseline B Station 4+00*

Horizontal: 1" = 100'
Vertical: 1" = 50'




| no. | revision | date | by |
|---|---|---|---|
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date: February 2014
designed by: RJG/BWS
drawn by: LBK/BWS
approved by: RJG
project no: 833
file name: 833-Sections1406.dwg
scale:

North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Type I-A Permit Modification

Landfill Cross Sections

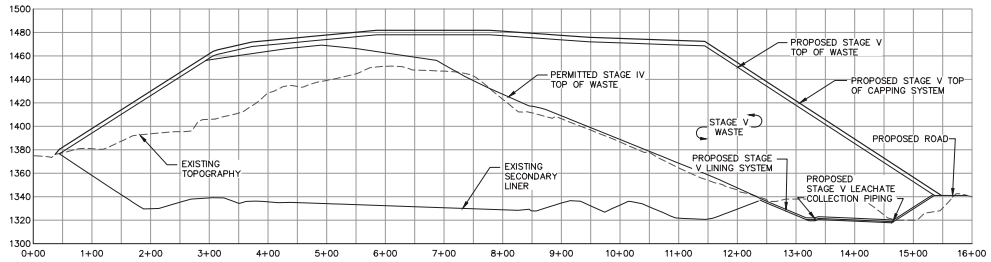
drawing no. 8

sheet: 8 of 15

Drawing file: F:\CADD\PROJECTS\833-NCES Stage V\dwg\DES Comments 1406\Design Drawings\833-XSections1406.dwg 6/18/2014 9:45am

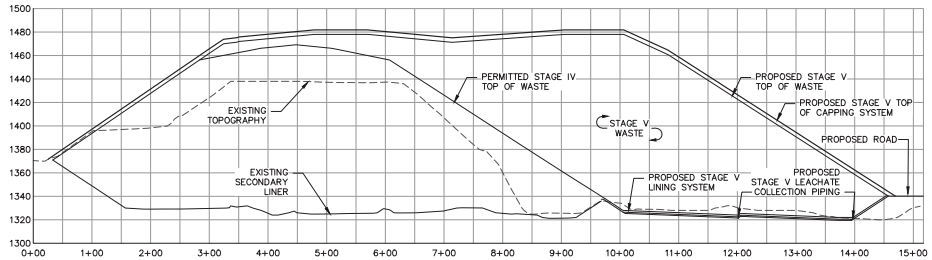
*Notes:*

1. Section Lines are shown on Sheet 3




## Baseline B Station 9+00

Horizontal: 1" = 100'
Vertical: 1" = 50'

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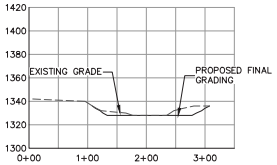
Vertical: 1" = 50'




## Section C-C'

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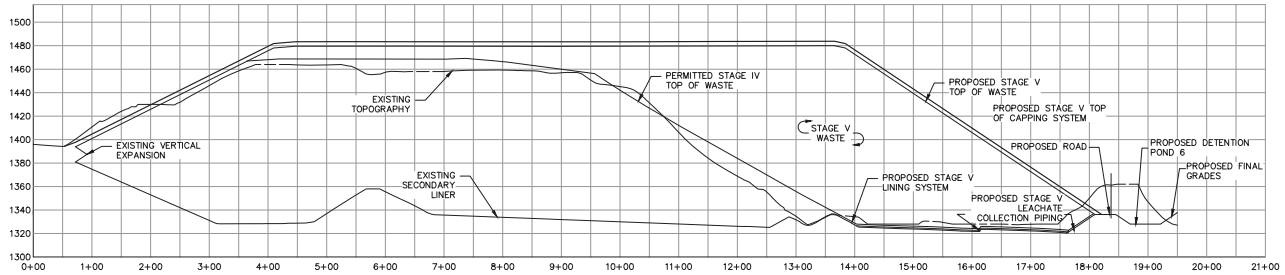
Vertical: 1" = 50'




## Section A-A'

Horizontal: 1" = 100'
Vertical: 1" = 50'

(in feet) 1" = 50'

(in feet) 1" = 100'

| no. | revision | date | by |
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designed by: RJG/BWS
drawn by: LBK/BWS
approved by: RJG
date: February 2014
project no: 833
file name: 833-Sections1406.dwg
scale:

North Country Environmental Services
Bethlehem, NH

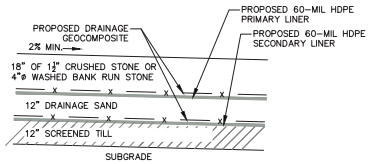
Stage V Landfill Expansion
Type I-A Permit Modification

Landfill Cross Sections

drawing no. 9

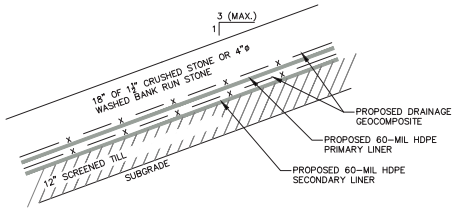
sheet: 9 of 15

Drawing file: F:\CADD\PROJECTS\833-NCES Stage V\dwg\DES Comments 1406\Design Drawings\833-XSections1406.dwg 6/18/2014 9:45am



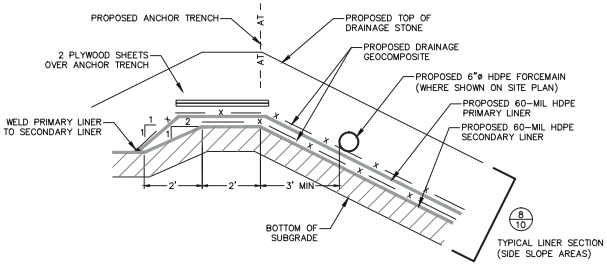

## Typical Liner Section (Base Areas)

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



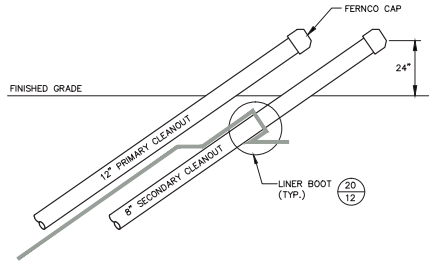

## Typical Liner Section (Side Slope Areas)

**Not to Scale** (8/5) (8/6) (8/13)



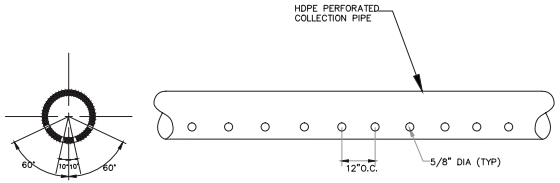

## Typical Anchor Trench

**Not to Scale** (9/5) (9/6) (9/13)




## Primary & Secondary Cleanout Riser

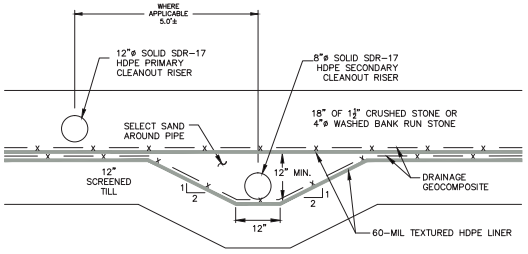
**Not to Scale** (6/5) (6/6)




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

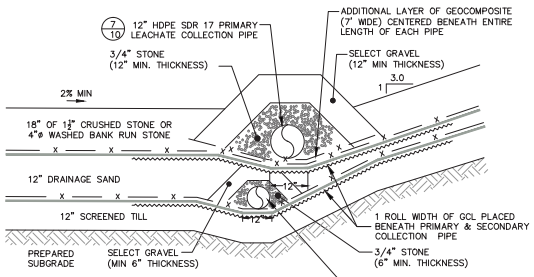
**Not to Scale** (7/5) (7/6)




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

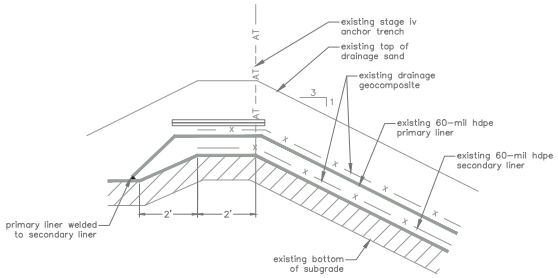
**Not to Scale** (10/5) (10/6)



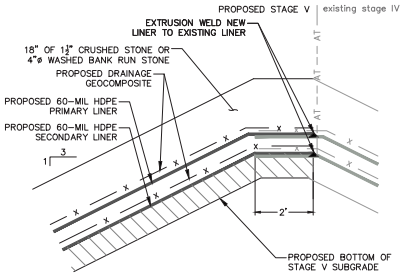

NOTES:
1. MATERIALS AROUND PIPES TYPICAL FOR ALL LOCATIONS
2. PIPES ARE PERFORATED

## Leachate Collector Pipe

**Not to Scale** (11/5) (11/6)



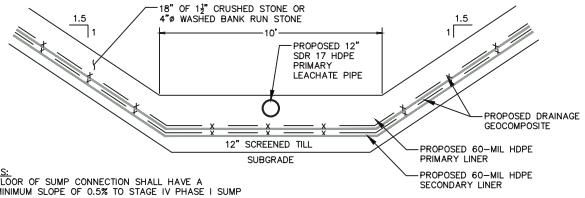

EXISTING




PROPOSED

## Liner Connection to Stage IV

**Not to Scale** (12/5) (12/6)




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** (13/5) (13/6)

| no. | revision | date | by |
|---|---|---|---|
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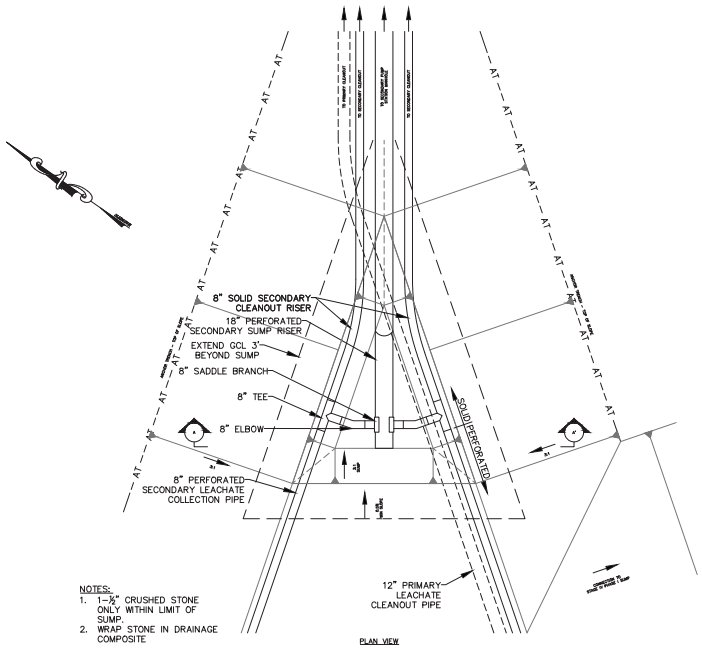
date: February 2014
project no: 833
file name: 833-Details1406.dwg
designed by: RJG/BWS
drawn by: BWS/LBK
approved by: RJG
scale:

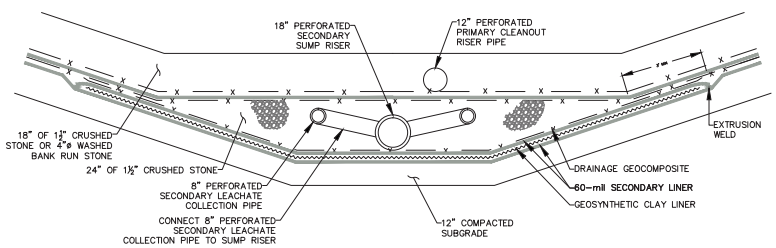
North Country Environmental Services
Bethlehem, NH
Stage V Landfill Expansion
Type I-A Permit Modification
Details - Landfill

drawing no. 10
sheet: 10 of 15

Drawing file: F:\CADD\PROJECTS\833-NCES Stage V\dwg\DES Comments 1406\Design Drawings\833-Details1406.dwg 6/18/2014 9:44am




PLAN VIEW

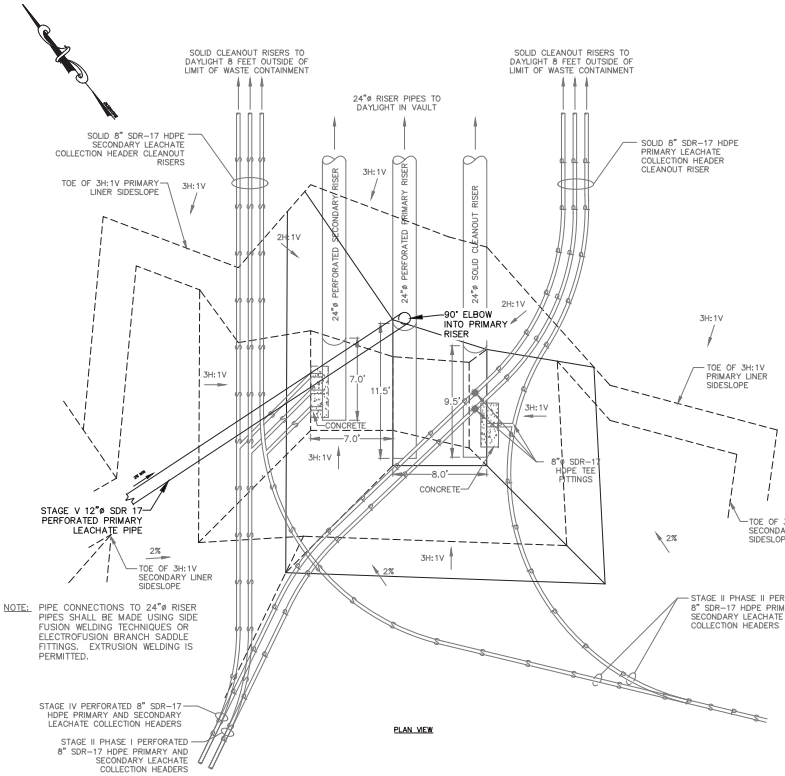



SECTION A-A'

## Stage V Secondary Sump

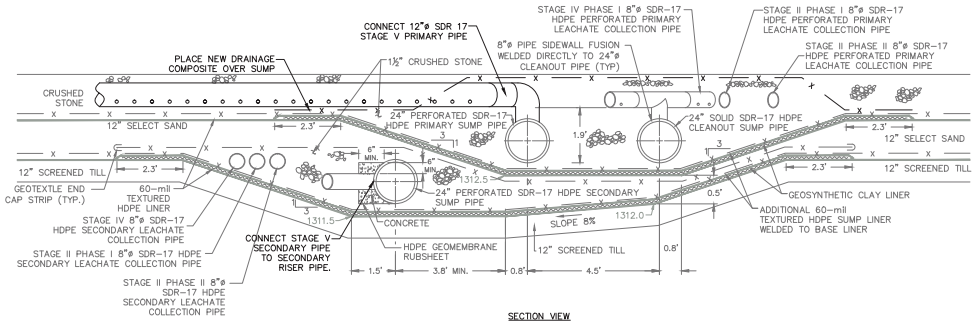
Not to Scale

14
5




NOTE: PIPE CONNECTIONS TO 24"ø RISER PIPES SHALL BE MADE USING SIDE FUSION WELDING TECHNIQUES OR ELECTROFUSION BRANCH SADDLE FITTINGS. EXTRUSION WELDING IS PERMITTED.

PLAN VIEW




SECTION VIEW

## Connection to Stage IV, Phase I Sump

Not to Scale

15
6

| no. | revision | date | by |
|---|---|---|---|
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date: February 2014
designed by: RJG/BWS
project no: 833
drawn by: BWS/LBK
file name: 833-Details1406.dwg
approved by: RJG
scale:

North Country Environmental Services
Bethlehem, NH

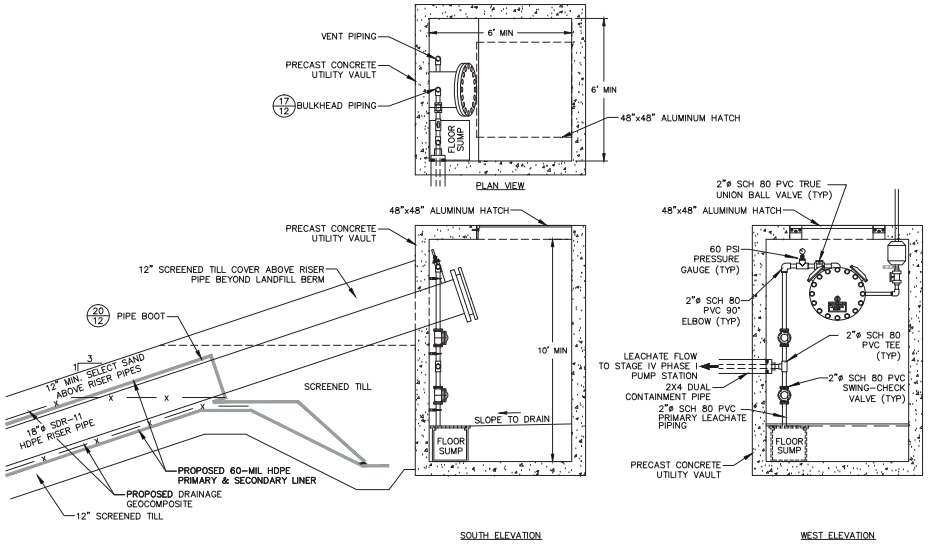
Stage V Landfill Expansion
Type I-A Permit Modification

Details
Sump Modification & Construction

drawing no. 11

sheet: 11 of 15

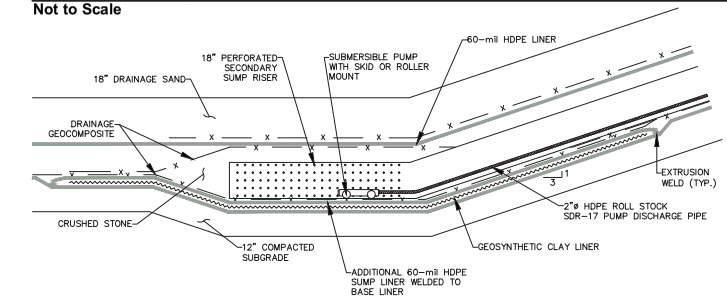
Drawing file: F:\CADD\PROJECTS\833-NCES Stage V\dwg\DES Comments 1406\Design Drawings\833-Details1406.dwg 6/18/2014 9:44am




## Secondary Pump Station Manhole

**Not to Scale**

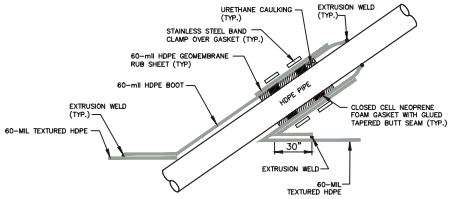
16/5




## Proposed Secondary Sump Riser to Manhole Pump Station

**Not to Scale**

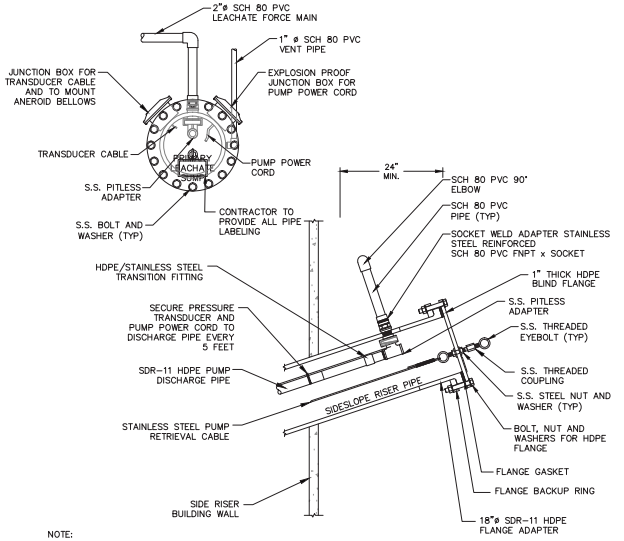
18/5




## Typical Boot Detail

**Not to Scale**

20/10 20/12




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, 6-1/2" 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.

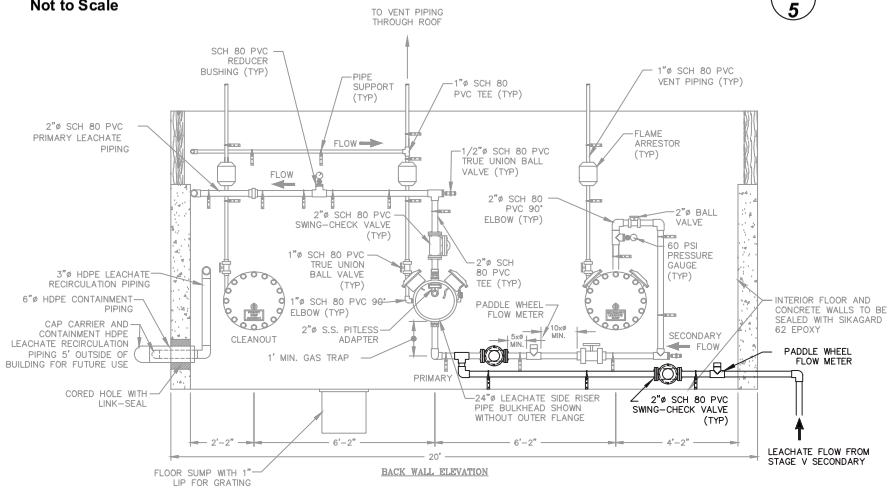
PROVIDE PASS-THROUGH SINGLE TIER TERMINAL BLOCKS FOR PUMP POWER AND TRANSDUCER CONDUCTORS. PROVIDE LABELS FOR EACH TERMINAL.

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**

17/5




## Proposed Alterations To Stage IV Side Riser Building Piping

**Not to Scale**

19/5

| no. | revision | date | by |
|---|---|---|---|
| 1 | Issued for NHDES Review | 2/7/14 | RJG |
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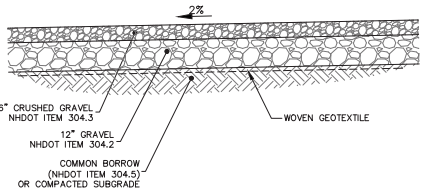
drawn by: BWS/LBK
approved by: ATR
date: February 2014
project no: 833
file name: 833-Details1406.dwg
scale:

North Country Environmental Services
Bethlehem, NH
Stage V Landfill Expansion
Type I-A Permit Modification
Details
Riser Modification & Construction

drawing no. 12

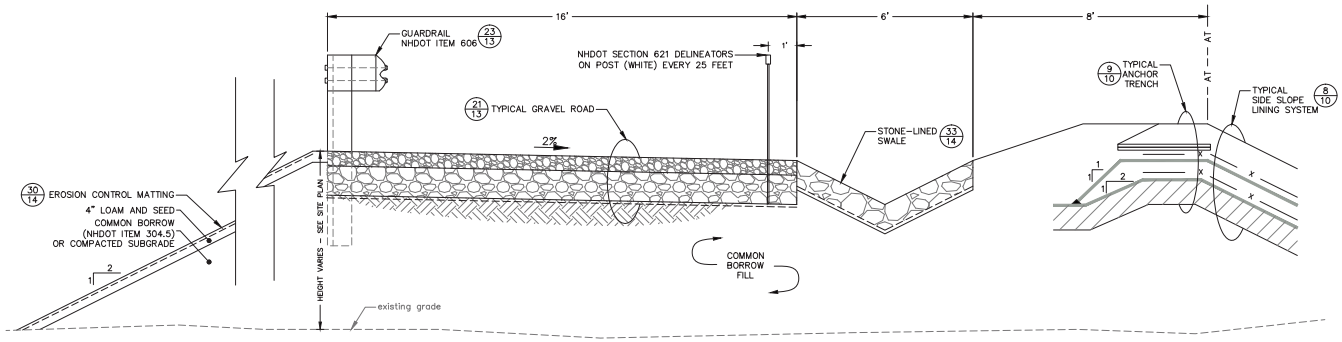


Drawing file: F:\CADD\PROJECTS\833-NCES Stage V\dwg\DES Comments 1406\Design Drawings\833-Details1406.dwg 6/18/2014 9:44am



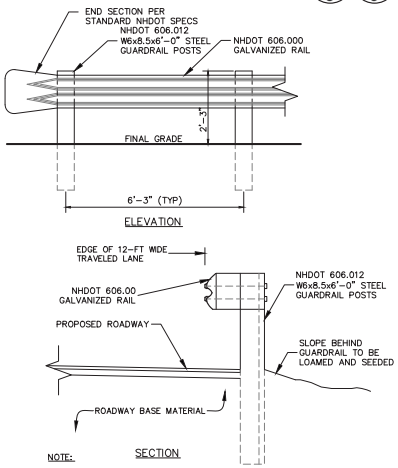

## Typical Gravel Road Section (21/5) (21/6) (21/13)

**Not to Scale**




## Landfill Berm & Roadway (22/5) (22/6)

**Not to Scale**

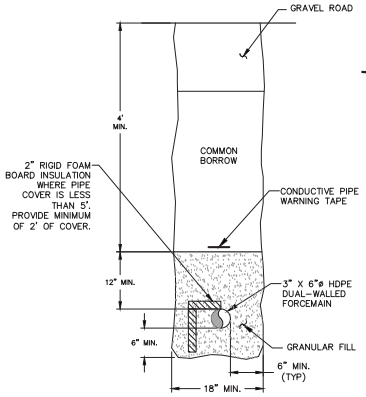



NOTE:

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

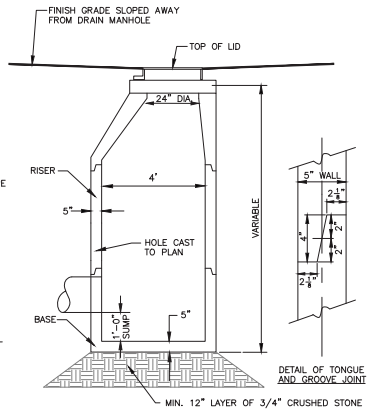
## Typical Guardrail Detail (23/5) (23/6) (23/13)

**Not to Scale**




## Leachate Forcemain Outside Anchor Trench (24/5) (24/6)

**Not to Scale**




NOTES:

1. HORIZONTAL JOINTS BETWEEN SECTIONS OF PRECAST CONCRETE BARRELS SHALL BE OF A TYPE APPROVED BY THE ENGINEER, WHICH SHALL, IN GENERAL, DEPEND FOR WATERTIGHTNESS UPON AN ELASTOMERIC OR MASTIC-LIKE GASKET.

2. PIPE-TO-MANHOLE JOINTS SHALL BE ONLY AS APPROVED BY THE ENGINEER AND IN GENERAL WILL DEPEND FOR WATERTIGHTNESS UPON EITHER AN APPROVED NON-SHRINKING MORTAR OR ELASTOMERIC SEALANT.

3. FOR BITUMASTIC TYPE JOINTS, THE AMOUNT OF SEALANT SHALL BE SUFFICIENT TO FILL AT LEAST 75% OF THE JOINT CAVITY. APPROVED BITUMASTIC SEALANTS INCLUDE RAM-NEK, KENT SEAL NO. 2, EZ OR EQUAL.

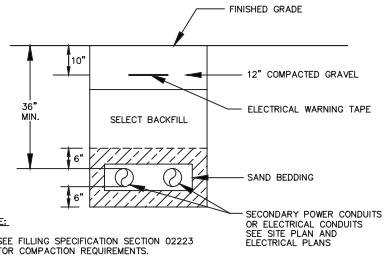
4. THE TONGUE OR THE GROOVE OF THE JOINT OF THE WALL. SHALL CONTAIN ONE LINE OF CIRCUMFERENTIAL REINFORCEMENT EQUAL TO 0.12 SQ.IN. PER LINEAR FOOT.

5. ECCENTRIC CONES SHALL BE USED WHEN DEPTH TO CROWN OF SHALLOWEST PIPE EXCEEDS 30". RISERS OF 12", 36" AND 48" CAN BE USED TO REACH THE DESIRED DEPTH.

6. CATCH BASIN LID TO BE NHDOT TYPE B GRAY IRON. FRAME SHALL BE 3 FLANGE TYPE.

## Drain Manhole (25/5) (25/6)

**Not to Scale**

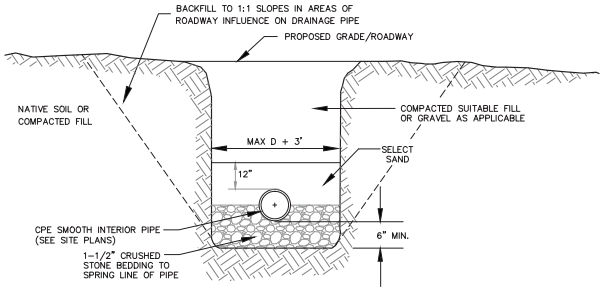



NOTE:

1. SEE FILLING SPECIFICATION SECTION 02223 FOR COMPACTION REQUIREMENTS.

## Underground Electric Conduit Detail (26/5) (26/6)

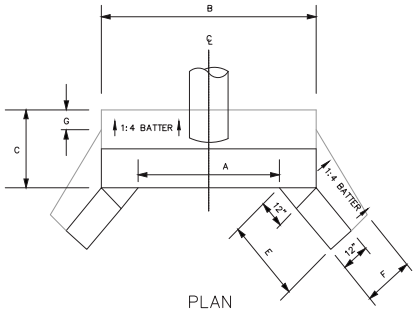
**Not to Scale**



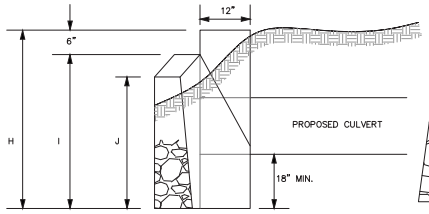

## Typical Drainage Pipe Trench (27/5) (27/6) (27/7)

**Not to Scale**

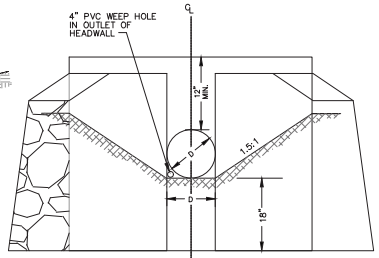
| DIAMETER D | A | B | C | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|
| 15" | 23" | 54" | 24" | 20" | 22" | 7" | 43" | 36" | 36" |
| 18" | 25" | 54" | 25" | 24" | 22" | 7" | 48" | 42" | 38" |
| 24" | 27" | 60" | 26" | 28" | 23" | 7" | 53" | 47" | 41" |
| 30" | 32" | 66" | 27" | 34" | 23" | 6" | 59" | 53" | 45" |
| 36" | 38" | 72" | 29" | 42" | 24" | 6" | 65" | 59" | 48" |




PLAN




SIDE ELEVATION




ELEVATION

## Masonry Rubble (MRM) Headwall (28/5) (28/6) (28/7)

**Not to Scale**

| no. | revision | date | by |
|---|---|---|---|
| 1 | Issued for NHDES Review | 2/7/14 | RJG |
| 2 | Issued for NHDES Review- May 22, 2014 Comments | 6/19/14 | RJG |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designed by: RJG/BWS
drawn by: BWS/LBK
approved by: RJG
date: February 2014
project no: 833
file name: 833-Details1406.dwg
scale:

North Country Environmental Services
Bethlehem, NH

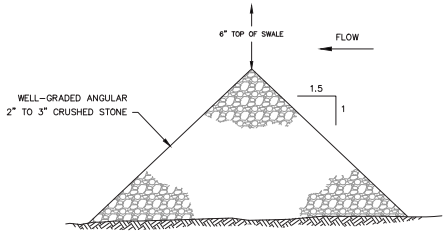
Stage V Landfill Expansion
Type I-A Permit Modification

Details - Site Work

drawing no. 13

sheet: 13 of 15

Drawing file: F:\CADD\PROJECTS\833-NCES Stage V\dwg\DES Comments 1406\Design Drawings\833-Details1406.dwg 6/18/2014 9:44am



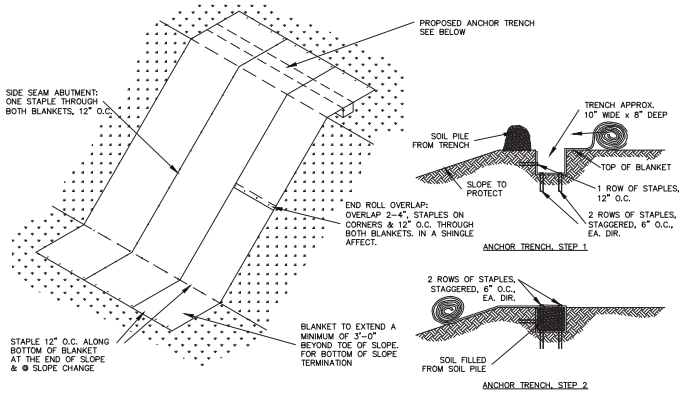

NOTES:

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

29/5 29/6

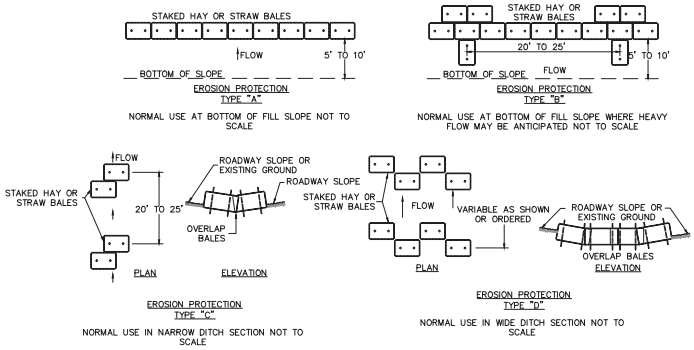
**Not to Scale**




## Erosion Control Blanket Slope Detail

30/13

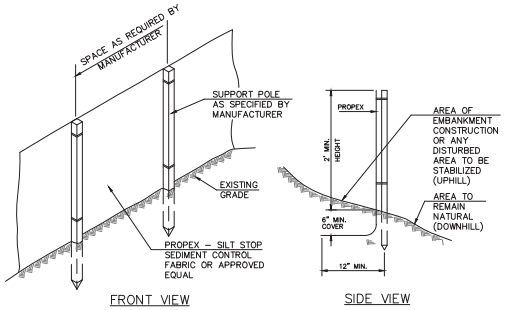
**Not to Scale**




## Hay Bales

31/5 31/6 31/7

**Not to Scale**



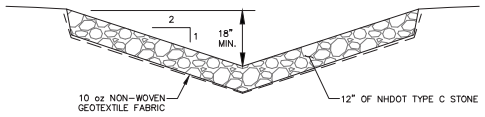

NOTE:

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

32/5 32/6 32/7

**Not to Scale**




## Stone-Lined Swale

33/13

**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 slide 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.

| no. | revision | date | by |
|---|---|---|---|
| 1 | Issued for NHDES Review | 2/7/14 | 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 |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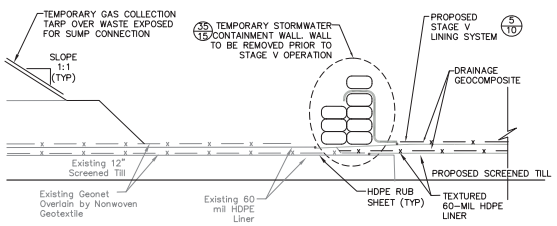
drawn by: BWS/LBK
approved by: RJG
scale:
date: February 2014
project no: 833
file name: 833-Details1406.dwg

North Country Environmental Services
Bethlehem, NH
Stage V Landfill Expansion
Type I-A Permit Modification
Details - Erosion Control

drawing no. 14



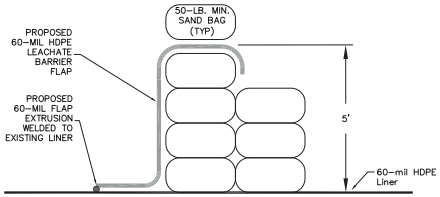
Drawing file: F:\CADD\PROJECTS\833-NCES Stage V\dwg\DES Comments 1406\Design Drawings\833-Details1406.dwg 6/18/2014 9:44am




## Interim Stormwater Management Detail

Not to Scale

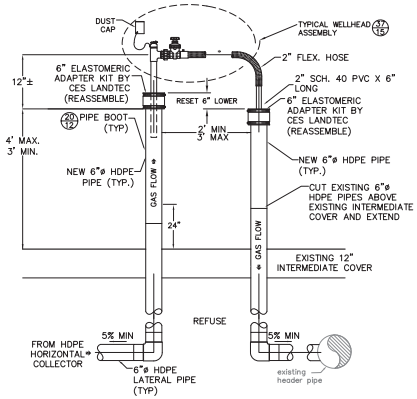
34/5 34/6




## Typical Stormwater Containment Wall Section

Not to Scale

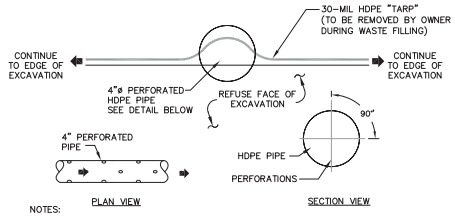
35/5 35/6




## Horizontal Gas Collection Wellhead

Not to Scale

36/4



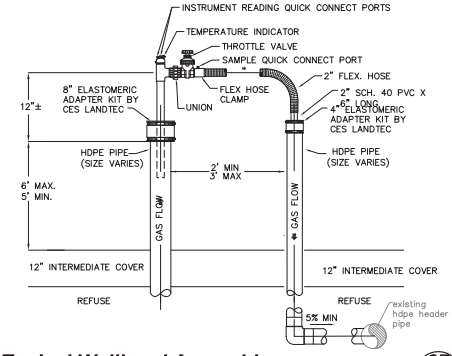

NOTES:

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

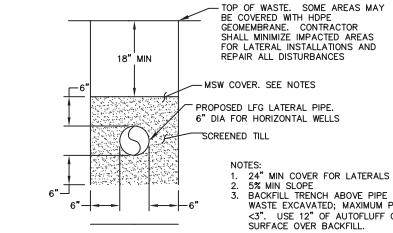
38/4 38/15




## Typical Wellhead Assembly

Not to Scale

37/4 37/15



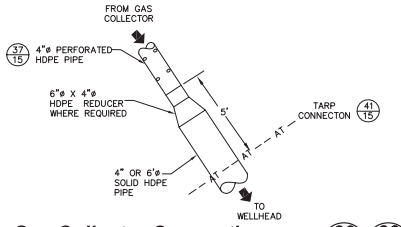

NOTES:

1. 24" MIN COVER FOR LATERALS
2. 5% MIN SLOPE
3. BACKFILL TRENCH ABOVE PIPE BEDDING WITH WASTE EXCAVATED; MAXIMUM PARTICLE SIZE <3". USE 12" OF AUTOFLUFF COVER AT SURFACE OVER BACKFILL.

## Landfill Gas Lateral

Not to Scale

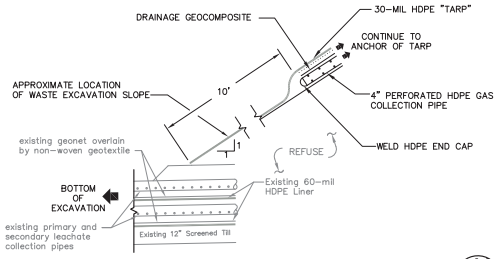
40/4




## Gas Collector Connection

Not to Scale

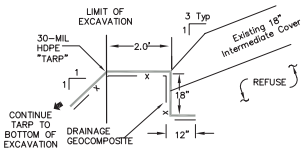
39/4 39/15




## Temporary Gas Collection Tarp Termination

Not to Scale

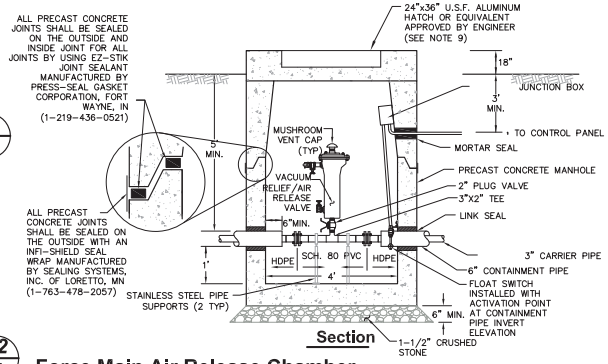
41/4 41/15

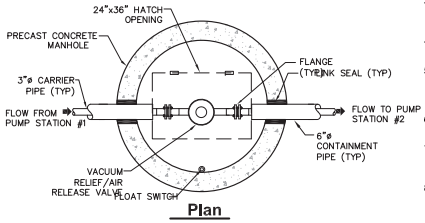



## Temporary Gas Collection Tarp Anchor Trench

Not to Scale

42/4




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 1/4"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

Not to Scale

43/5 43/6

| no. | revision | date | by |
|---|---|---|---|
| 1 | Issued for NHDES Review | 2/7/14 | RJG |
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designed by: RJG/BWS
drawn by: BWS/LBK
approved by: RJG
date: February 2014
project no: 833
file name: 833-Details1406.dwg
scale:

North Country Environmental Services
Bethlehem, NH
Stage V Landfill Expansion
Type I-A Permit Modification
Details
Temporary Environmental Controls

drawing no. 15

sheet: 15 of 15

Drawing file: F:\CADD\PROJECTS\833-NCES Stage V\dwg\DES Comments 1406\Design Drawings\833-Details1406.dwg 6/18/2014 11:31am

# NORTH COUNTRY ENVIRONMENTAL SERVICES, INC.
# STAGE IV PHASE II & STAGE V
# FILLING & INTERIM CLOSURE PLAN

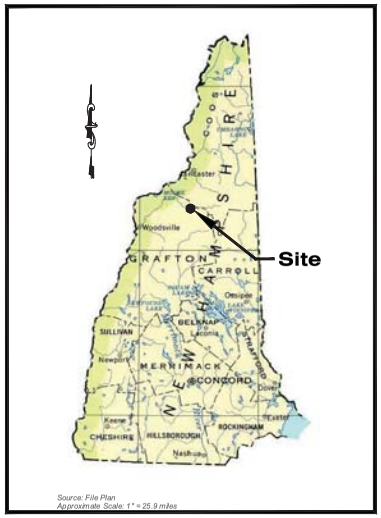
## Bethlehem, New Hampshire

**February 2014**

**Issued For NHDES Review - June 2014**
**Response to May 22, 2014 NHDES Comments**

## Sheet Index


| | |
|---|---|
| 1 | Sequence 1 |
| 2 | Sequence 2 |
| 3 | Sequence 3 |
| 4 | Sequence 4 |
| 5 | Sequence 5 |


**Locus Plan**


Prepared By:

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Prepared For:

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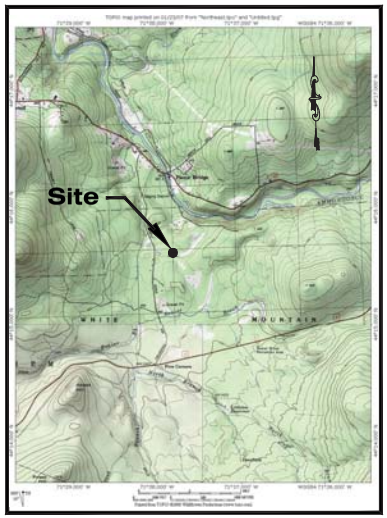


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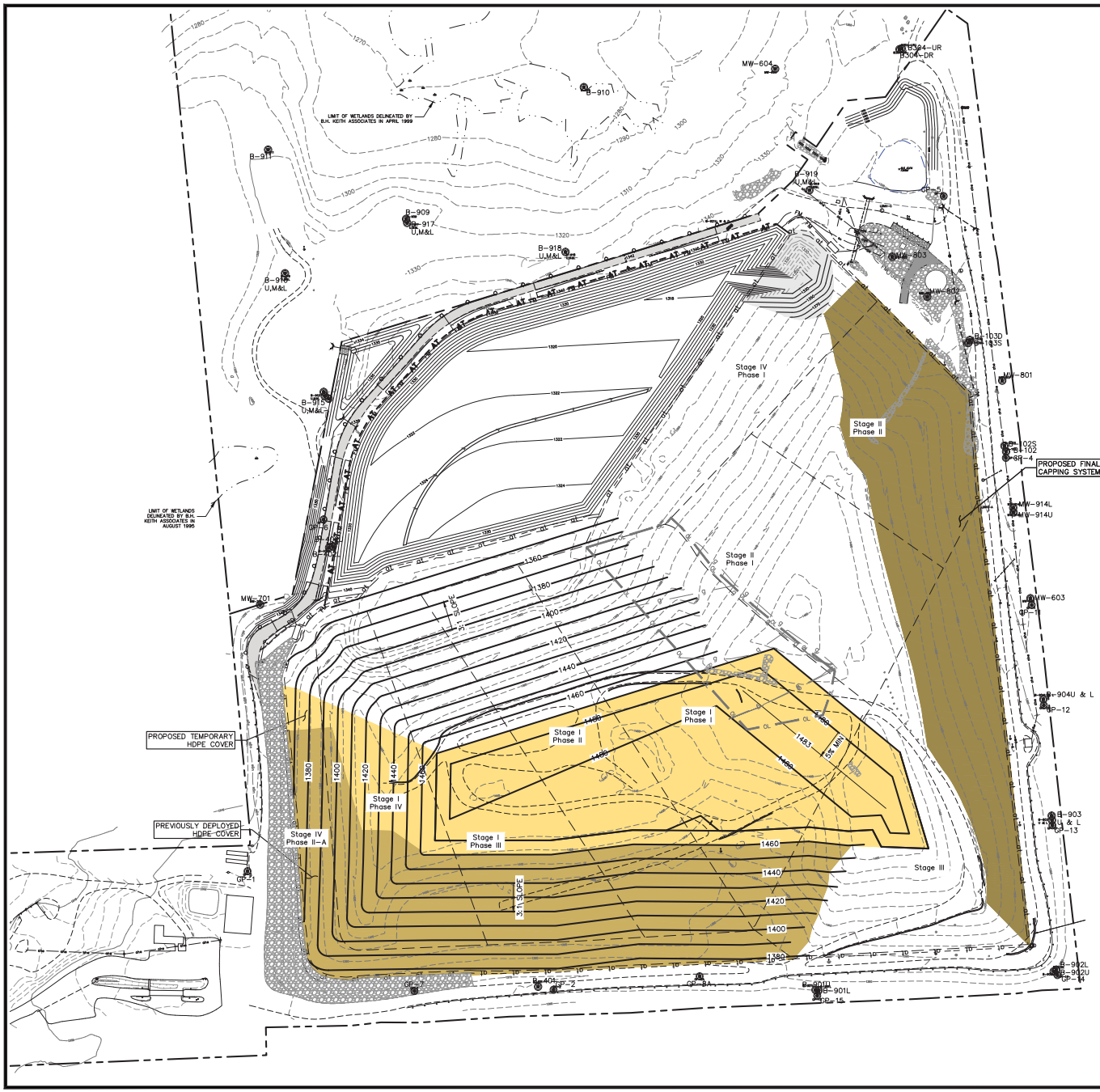


*Legend:*

- 1380 — Existing 10' Contour
- at — at — Existing Anchor Trench
- Existing Gravel Road
- AT — AT — Proposed Anchor Trench
- 1380 — Proposed Liner 2' Contour
- 1380 — Proposed Liner 10' Contour
- 1380 — Proposed 10' Contour
- Proposed Temporary HDPE Cover
- Previously Deployed HDPE Cover
- Proposed Final Capping System

NORTH STATE PLANE FEET

*Notes:*

1. Existing topography shown is from the October 9, 2013 aerial survey performed by Eastern Topographics.
2. Proposed exterior 3:1 waste grades shown are top of landfill capping system. Top of waste grades are 46" lower than top of capping system. Proposed unfinished interior slopes are top of waste grades.
3. Estimated fill volume is a comparison of the existing top of waste and proposed top of waste grades and/or top of drainage sand grades. Volume assumes the Stage 1 capping system is removed and filled with waste.
4. Filling schedule assumes a utilization rate of 290,000 tons per year at an in-place density of 0.81 tons per cubic yard.
5. Proposed temporary HDPE cover to be installed within 6 months of the actual sequence fill date, or during the next construction season if the 6 month period extends into the winter months.
6. A temporary stormwater collection berm shall be constructed and the western portion of Stage V shall be covered with temporary HDPE cover prior to operation as shown on this sheet. Stormwater shall be collected in this area and managed by pumping.

*Sequence 1 Volume = 734,900 CY*
*Cumulative Volume = 734,900 CY*
*Anticipated Duration = 2.1 Years*
*Anticipated Fill Date = October 2015*

| no. | revision | date | by |
|---|---|---|---|
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drawn by: BWS
approved by: RJG
date: February 2014
project no: 833
file name: 833-Fill Sequence1406.dwg
scale: 1" = 100' (in feet) 1" = 30m (in meters)

North Country Environmental Services
Bethlehem, NH

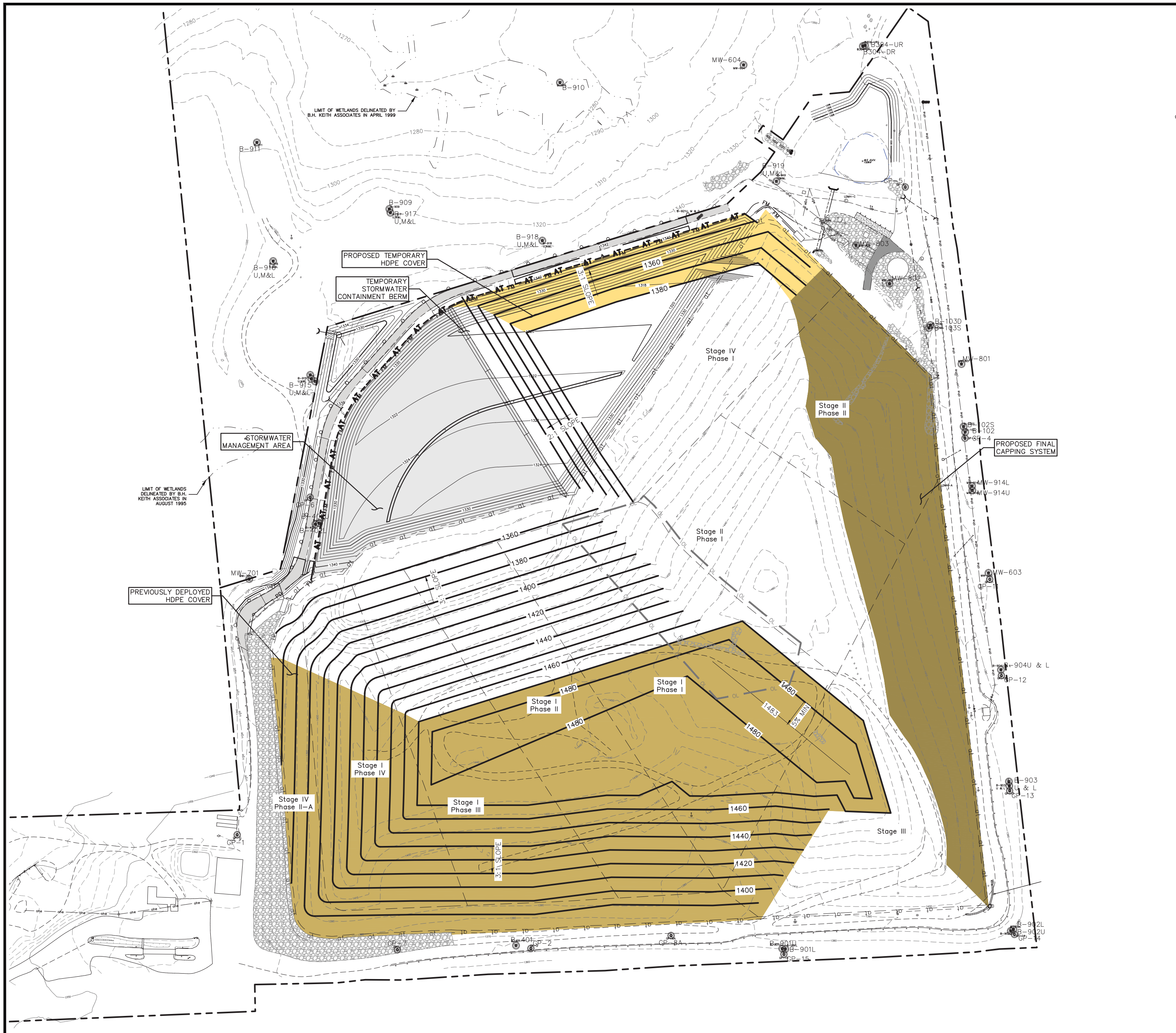
Stage IV Phase II & Stage V
Filling & Interim Closure Plan

Sequence 1

drawing no. 1

sheet: 1 of 5

Drawing file: F:\CADD\PROJECTS\833-NCES Stage V\dwg\DES Comments 1406\Fill Sequence\833-Fill Sequence1406.dwg 6/18/2014 9:48am




**Legend:**

| | |
|---|---|
| 1380 | Existing 10' Contour |
| at — at | Existing Anchor Trench |
| | Existing Gravel Road |
| AT — AT | Proposed Anchor Trench |
| 1380 | Proposed Liner 2' Contour |
| 1380 | Proposed Liner 10' Contour |
| 1380 | Proposed 10' Contour |
| | Proposed Temporary HDPE Cover |
| | Previously Deployed HDPE Cover |
| | Proposed Final Capping System |
| | Temporary HDPE Cover for Stormwater Containment |

**Notes:**

1. Existing topography shown is from the October 9, 2013 aerial survey performed by Eastern Topographics.
2. Proposed exterior 3:1 waste grades shown are top of landfill capping system. Top of waste grades are 46" lower than top of capping system. Proposed unfinished interior slopes are top of waste grades.
3. Estimated fill volume is a comparison of the existing top of waste and proposed top of waste grades and/or top of drainage sand grades. Volume assumes the Stage 1 capping system is removed and filled with waste.
4. Filling schedule assumes a utilization rate of 290,000 tons per year at an in-place density of 0.81 tons per cubic yard.
5. Proposed temporary HDPE cover to be installed within 6 months of the actual sequence fill date, or during the next construction season if the 6 month period extends into the winter months.
6. A temporary stormwater collection berm shall be constructed and the western portion of Stage V shall be covered with temporary HDPE cover prior to operation as shown on this sheet. Stormwater shall be collected in this area and managed by pumping.

Sequence 2 Volume = 361,100 CY
Cumulative Volume = 1,096,000 CY
Anticipated Duration = 1.0 Years
Anticipated Fill Date = October 2016

| no. | revision | date | by |
|---|---|---|---|
| 1 | Issued for NHDES Review - Supplemental Submittal | 3/7/14 | RJG |
| 2 | Issued for NHDES Review- May 22, 2014 Comments | 6/19/14 | RJG |

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| | |
|---|---|
| date: February 2014 | designed by: RJG/BWS |
| project no: 833 | drawn by: BWS |
| file name: 833-Fill Sequence1406.dwg | approved by: RJG |

scale: 100 0 50 100 (in feet) 1" = 100'

## North Country Environmental Services
## Bethlehem, NH

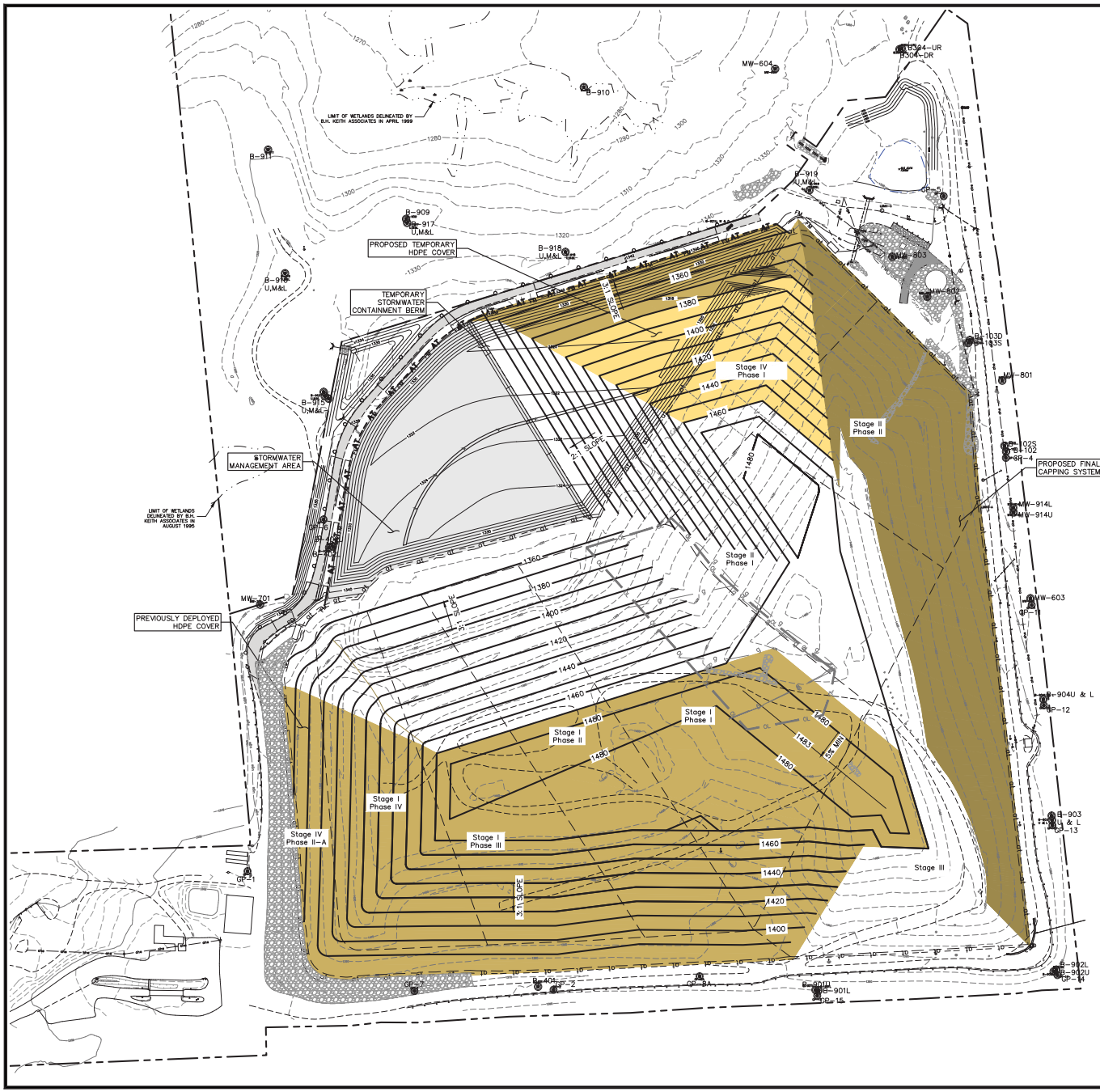
## Stage IV Phase II & Stage V Filling & Interim Closure Plan

## Sequence 2

drawing no. 2

sheet: 2 of 5

Drawing file: F:\CADD\PROJECTS\833-NCES Stage V\dwg\DES Comments 1406\Fill Sequence\833-Fill Sequence1406.dwg 6/18/2014 9:48am




*Legend:*

- 1380 — Existing 10' Contour
- at — at — Existing Anchor Trench
- Existing Gravel Road
- AT — AT — Proposed Anchor Trench
- 1380 — Proposed Liner 2' Contour
- 1380 — Proposed Liner 10' Contour
- 1380 — Proposed 10' Contour
- Proposed Temporary HDPE Cover
- Previously Deployed HDPE Cover
- Proposed Final Capping System
- Temporary HDPE Cover for Stormwater Containment

NH STATE PLANE BLDGS

*Notes:*

1. Existing topography shown is from the October 9, 2013 aerial survey performed by Eastern Topographics.
2. Proposed exterior 3:1 waste grades shown are top of landfill capping system. Top of waste grades are 46" lower than top of capping system. Proposed unfinished interior slopes are top of waste grades.
3. Estimated fill volume is a comparison of the existing top of waste and proposed top of waste grades and/or top of drainage sand grades. Volume assumes the Stage 1 capping system is removed and filled with waste.
4. Filling schedule assumes a utilization rate of 290,000 tons per year at an in-place density of 0.81 tons per cubic yard.
5. Proposed temporary HDPE cover to be installed within 6 months of the actual sequence fill date, or during the next construction season if the 6 month period extends into the winter months.
6. A temporary stormwater collection berm shall be constructed and the western portion of Stage V shall be covered with temporary HDPE cover prior to operation as shown on this sheet. Stormwater shall be collected in this area and managed by pumping.

*Sequence 3 Volume = 216,700 CY*
*Cumulative Volume = 1,312,700 CY*
*Anticipated Duration = 0.6 Years*
*Anticipated Fill Date = June 2017*

| no. | revision | date | by |
|---|---|---|---|
| 1 | Issued for NHDES Review - Supplemental Submittal | 3/7/14 | RJG |
| 2 | Issued for NHDES Review. May 22, 2014 Comments | 6/19/14 | RJG |

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designed by: R.J.GEWS
drawn by: BWS
approved by: RJG
date: February 2014
project no: 833
file name: 833-Fill Sequence1406.dwg
scale: 1" = 100' (in feet) 1" = 30m (in meters)

North Country Environmental Services
Bethlehem, NH

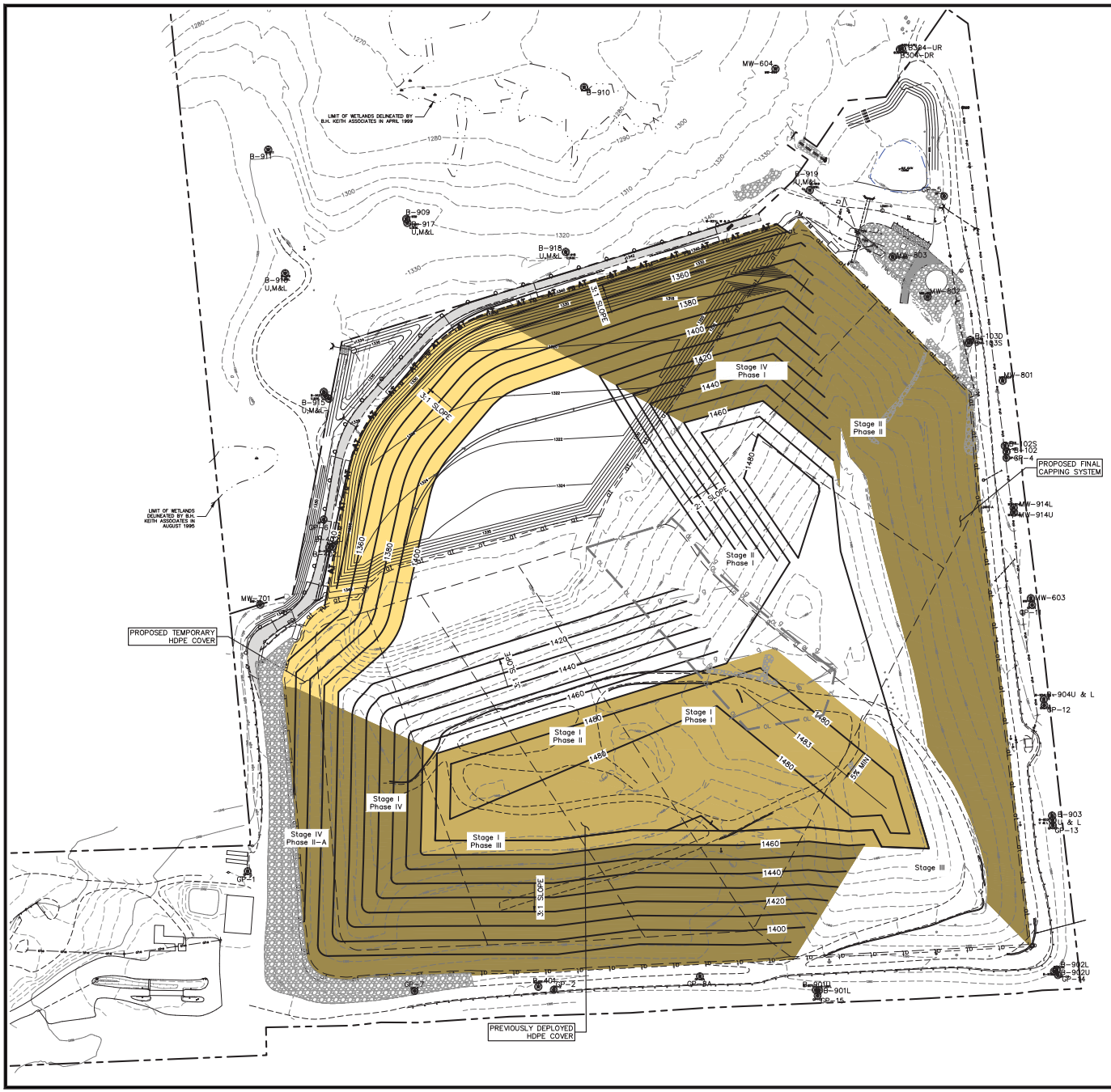
Stage IV Phase II & Stage V
Filling & Interim Closure Plan

Sequence 3

drawing no. 3

sheet: 3 of 5

Drawing file: F:\CADD\PROJECTS\833-NCES Stage V\dwg\DES Comments 1406\Fill Sequence\833-Fill Sequence1406.dwg 6/18/2014 9:48am




*Legend:*

- 1380 — Existing 10' Contour
- at — at — Existing Anchor Trench
- Existing Gravel Road
- AT — AT — Proposed Anchor Trench
- 1380 — Proposed Liner 2' Contour
- 1380 — Proposed Liner 10' Contour
- 1380 — Proposed 10' Contour
- Proposed Temporary HDPE Cover
- Previously Deployed HDPE Cover
- Proposed Final Capping System

NH STATE PLANE NAD83

*Notes:*

1. Existing topography shown is from the October 9, 2013 aerial survey performed by Eastern Topographics.
2. Proposed exterior 3:1 waste grades shown are top of landfill capping system. Top of waste grades are 46" lower than top of capping system. Proposed unfinished interior slopes are top of waste grades.
3. Estimated fill volume is a comparison of the existing top of waste and proposed top of waste grades and/or top of drainage sand grades. Volume assumes the Stage 1 capping system is removed and filled with waste.
4. Filling schedule assumes a utilization rate of 290,000 tons per year at an in-place density of 0.81 tons per cubic yard.
5. Proposed temporary HDPE cover to be installed within 6 months of the actual sequence fill date, or during the next construction season if the 6 month period extends into the winter months.

*Sequence 4 Volume = 581,200 CY*
*Cumulative Volume = 1,893,900 CY*
*Anticipated Duration = 1.6 Years*
*Anticipated Fill Date = January 2019*

| no. | revision | date | by |
|---|---|---|---|
| 1 | Issued for NHDES Review - Supplemental Submittal | 3/7/14 | RJG |
| 2 | Issued for NHDES Review. May 22, 2014 Comments | 6/19/14 | RJG |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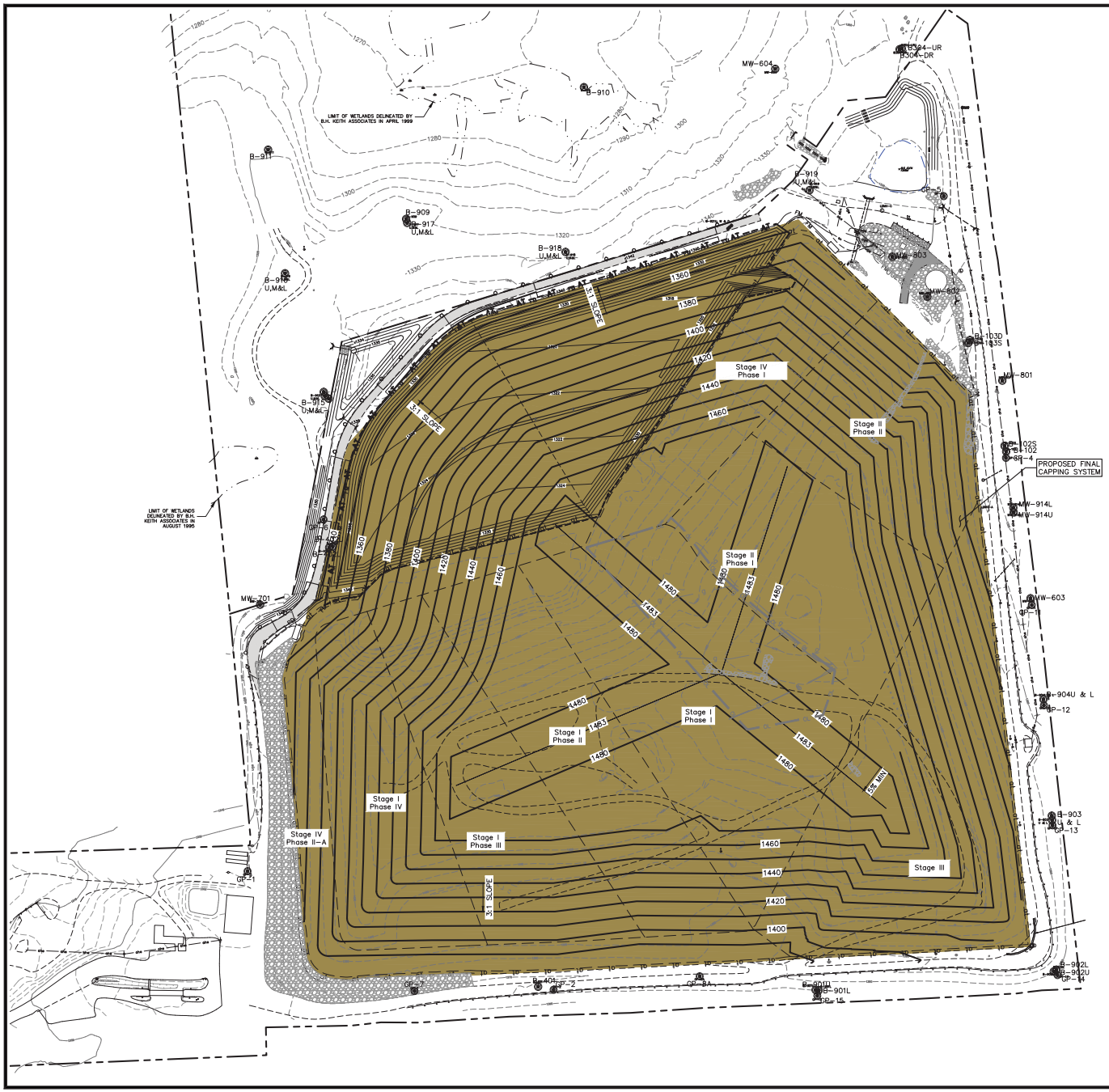
designed by: RJG/BWS
drawn by: BWS
approved by: RJG
date: February 2014
project no: 833
file name: 833-04 Sequence1406.dwg
scale: 1" = 100'

# North Country Environmental Services
## Bethlehem, NH
## Stage IV Phase II & Stage V Filling & Interim Closure Plan
## Sequence 4

drawing no. 4
sheet: 4 of 5

Drawing file: F:\CADD\PROJECTS\833-NCES Stage V\dwg\DES Comments 1406\Fill Sequence\833-Fill Sequence1406.dwg 6/18/2014 9:48am




*Legend:*

- 1380 — Existing 10' Contour
- at — at — Existing Anchor Trench
- Existing Gravel Road
- AT — AT — Proposed Anchor Trench
- 1380 — Proposed Liner 2' Contour
- 1380 — Proposed Liner 10' Contour
- 1380 — Proposed 10' Contour
- Proposed Temporary HDPE Cover
- Previously Deployed HDPE Cover
- Proposed Final Capping System

NORTH
NHSPLANE NAD83

*Notes:*

1. Existing topography shown is from the October 9, 2013 aerial survey performed by Eastern Topographics.
2. Proposed exterior 3:1 waste grades shown are top of landfill capping system. Top of waste grades are 46" lower than top of capping system. Proposed unfinished interior slopes are top of waste grades.
3. Estimated fill volume is a comparison of the existing top of waste and proposed top of waste grades and/or top of drainage sand grades. Volume assumes the Stage 1 capping system is removed and filled with waste.
4. Filling schedule assumes a utilization rate of 290,000 tons per year at an in-place density of 0.81 tons per cubic yard.
5. Proposed temporary HDPE cover to be installed within 6 months of the actual sequence fill date, or during the next construction season if the 6 month period extends into the winter months.

*Sequence 5 Volume = 931,100 CY*
*Cumulative Volume = 2,825,000 CY*
*Anticipated Duration = 2.6 Years*
*Anticipated Fill Date = August 2021*

| no. | revision | date | by |
|---|---|---|---|
| 1 | Issued for NHDES Review - Supplemental Submittal | 3/7/14 | RJG |
| 2 | Issued for NHDES Review. May 22, 2014 Comments | 6/19/14 | RJG |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designed by: RJG/BWS
drawn by: BWS
approved by: RJG
date: February 2014
project no: 833
file name: 833-04 Sequence1405.dwg
scale: 1" = 100' (in feet) 1" = 30m (in meters)

North Country Environmental Services
Bethlehem, NH

Stage IV Phase II & Stage V
Filling & Interim Closure Plan

Sequence 5

drawing no. 5
sheet: 5 of 5

Drawing file: F:\CADD\PROJECTS\833-NCES Stage V\dwg\DES Comments 1406\Fill Sequence\833-Fill Sequence1406.dwg 6/18/2014 9:48am

# NORTH COUNTRY ENVIRONMENTAL SERVICES, INC.
# PROPOSED STAGE V EXPANSION

**Bethlehem, New Hampshire**

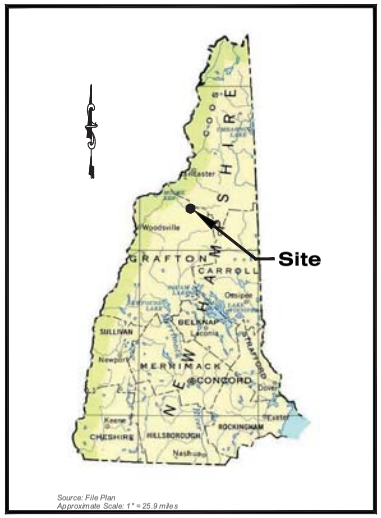
# Closure Plan Drawings

**February 2014**

**Issued For NHDES Review- June 2014**
**Response to May 22, 2014 NHDES Comments**

## Sheet Index


C-1 Closure Plan
C-2 Final Grading Plan
C-3 Closure Details
C-4 Gas System Details
C-5 Gas System Details


**Locus Plan**


Prepared By:

CMA ENGINEERS
CIVIL /ENVIRONMENTAL ENGINEERS

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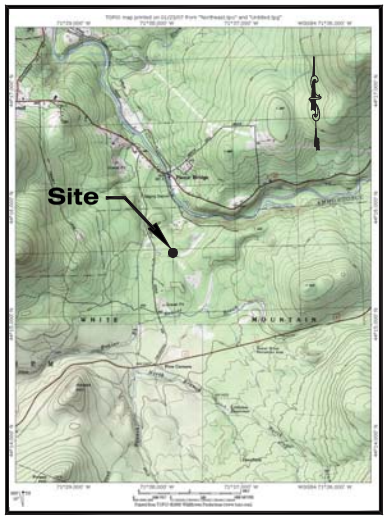
Prepared For:

north country ENVIRONMENTAL SERVICES
Bethlehem, New Hampshire 03574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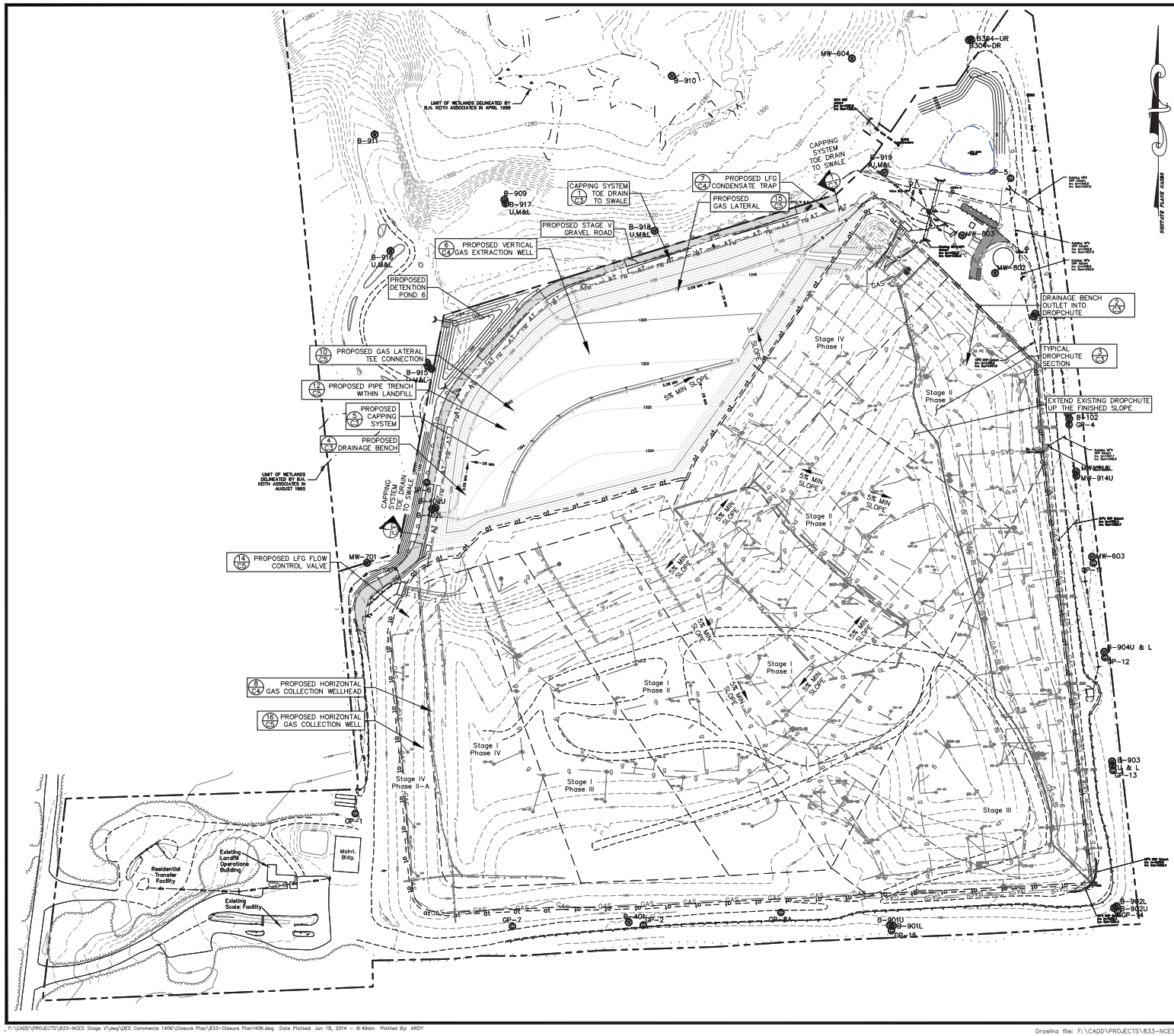


*Notes:*

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
- 1440 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 |


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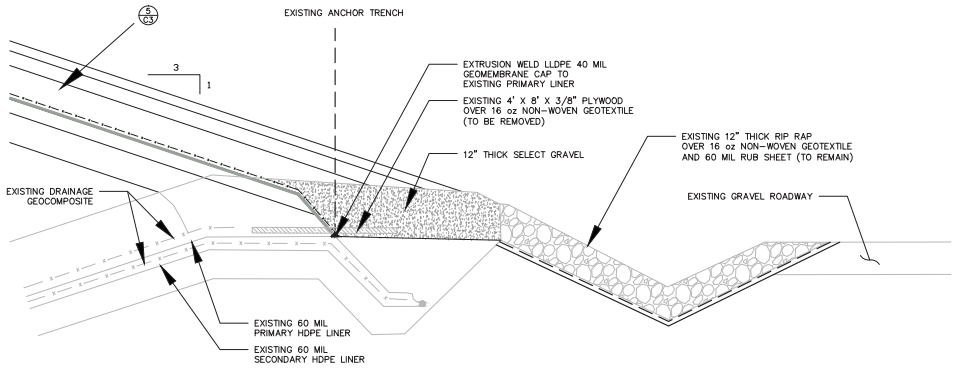
date: February 2014
project no: 833
file name: 833-Closure Plan1406.dwg
designed by: RJG/BWS
drawn by: BWS/LBK
approved by: RJG
scale: 1" (in feet) 1" = 100'

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

drawing no. C2

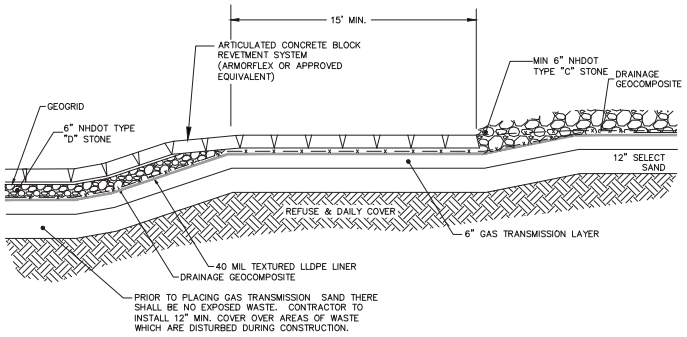
sheet: 2 of 5




## Capping System Toe Drain to Swale

**Not to Scale**

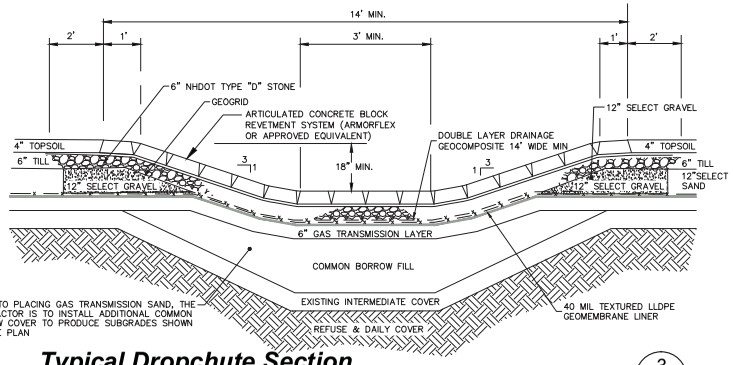
1 / C2




## Drainage Bench Outlet Into Dropchute

**Not to Scale**

2 / C2



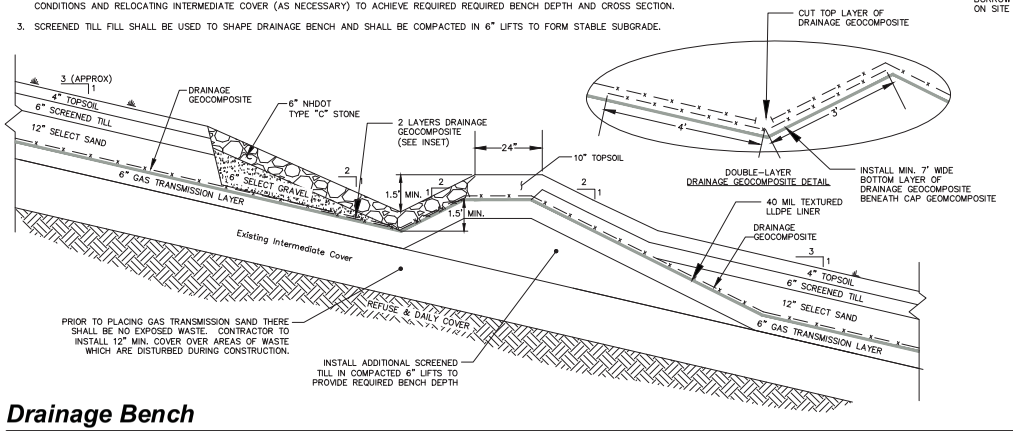

## Typical Dropchute Section

**Not to Scale**

3 / C2

NOTES:

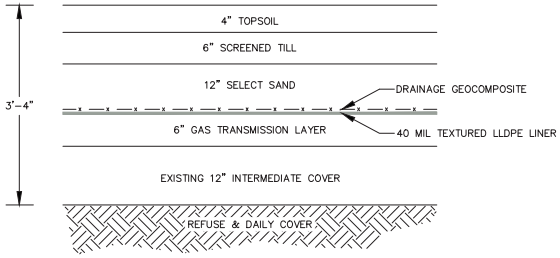
1. DRAINAGE BENCHES SHALL BE NEWLY CONSTRUCTED AT THE SPACING SHOWN ON THE PLANS AT A MINIMUM 2% SLOPE.
2. EXISTING INTERMEDIATE COVER THICKNESS AT SWALES ARE APPROXIMATE AND NOT VERIFIED. CONTRACTOR IS RESPONSIBLE FOR VERIFYING EXISTING CONDITIONS AND RELOCATING INTERMEDIATE COVER (AS NECESSARY) TO 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 |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designed by: RJG/BWS
drawn by: BWS
approved by: ATR
date: February 2014
project no: 833
file name: 833-Closure Details.dwg
scale:

North Country Environmental Services
Bethlehem, NH

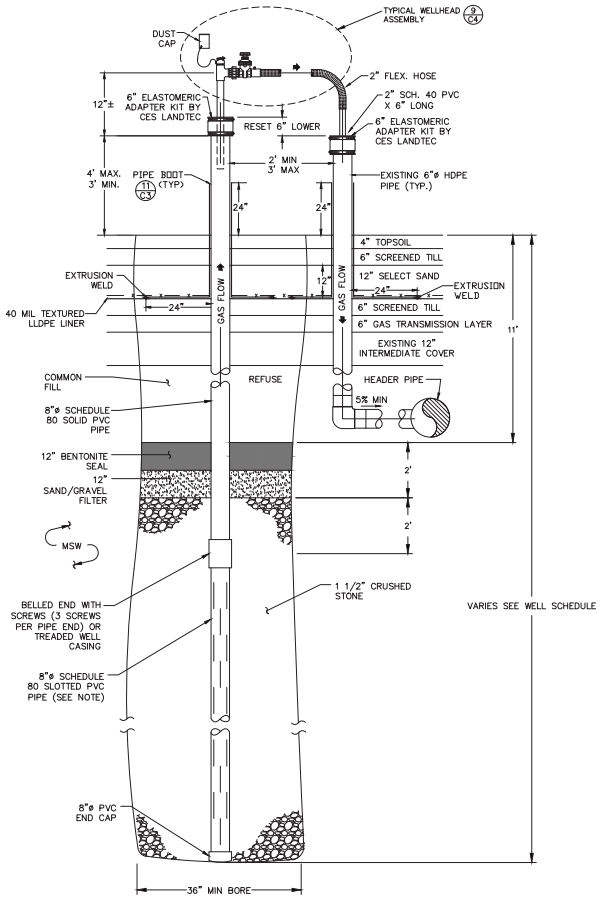
Stage V Landfill Expansion
Type I-A Permit Modification

Closure Details

drawing no. C3

sheet: 3 of 5

Drawing file: F:\CADD\PROJECTS\833-NCES Stage V\dwg\DES Comments 1406\Closure Plan\833-Closure Details1406.dwg 6/18/2014 9:48am



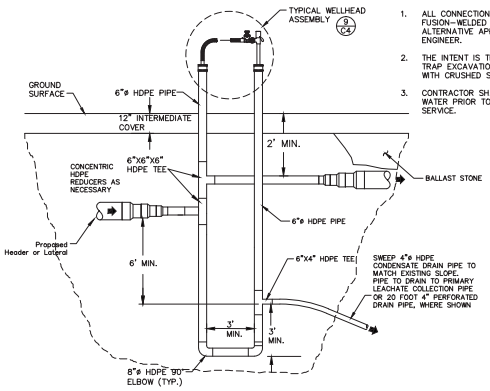

NOTE:

1. PIPE PERFORATED WITH SLOTS ⅛" TO ¼" WIDE BY 8" LONG. FOUR SLOTS PER ROW SPACED 90° APART, WITH ADJACENT ROWS OFFSET BY 45°.

## Vertical Gas Extraction Well

**Not to Scale**

6 / C2



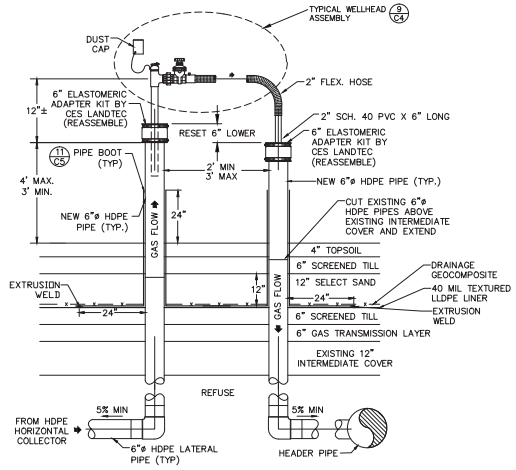

NOTES:

1. ALL CONNECTIONS ARE TO BE BUTT FUSION-WELDED UNLESS ALTERNATIVE APPROVED BY THE ENGINEER.
2. THE INTENT IS THAT THE ENTIRE TRAP EXCAVATION BE BACKFILLED WITH CRUSHED STONE.
3. CONTRACTOR SHALL FILL TRAP WITH WATER PRIOR TO PLACING TRAP IN SERVICE.

## Condensate Trap

**Not to Scale**

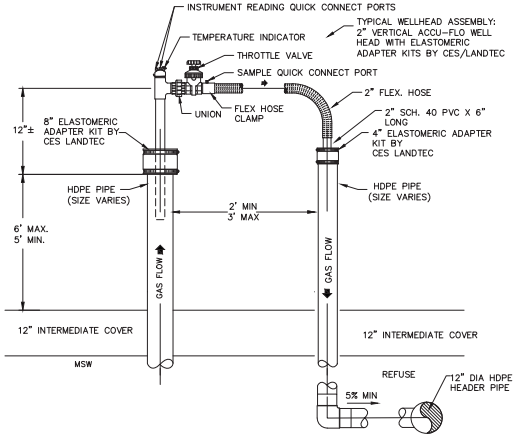
7 / C2




## Horizontal Gas Collection Wellhead

**Not to Scale**

8 / C2




## Typical Wellhead Assembly

**Not to Scale**

9 / C4

| no. | revision | date | by |
|---|---|---|---|
| 1 | Issued for NHDES Comments | 2/7/13 | RJG |
| 2 | Issued for NHDES Review, May 22, 2014 Comments | 6/19/14 | RJG |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designed by: RJG/BWS
drawn by: BWS
approved by: RJG
date: February 2014
project no: 833
file name: 833-Closure Details-rev2.dwg
scale:

North Country Environmental Services
Bethlehem, NH

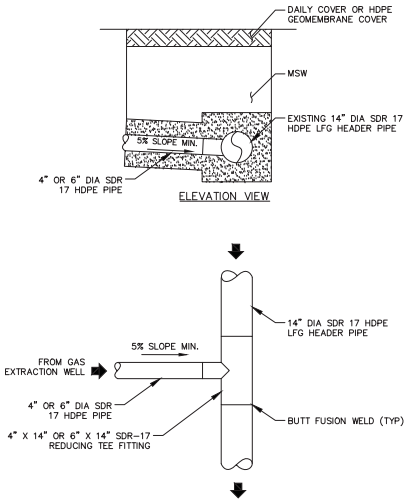
Stage V Landfill Expansion
Type I-A Permit Modification

Gas System Details

drawing no. C4

sheet: 4 of 5

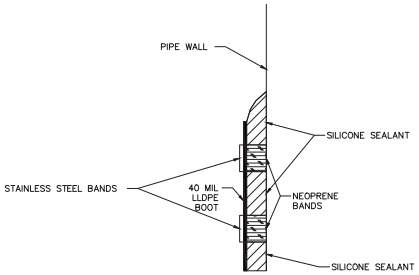
Drawing file: F:\CADD\PROJECTS\833-NCES Stage V\dwg\DES Comments 1406\Closure Plan\833-Closure Details1406.dwg 6/18/2014 9:48am




## Gas Lateral Tee Connection

**Not to Scale**

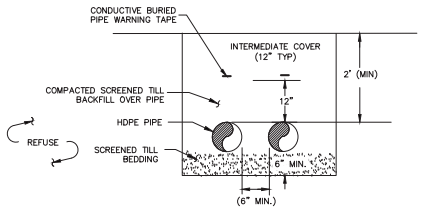
10 / C2




## Pipe Boot

**Not to Scale**

11 / C4



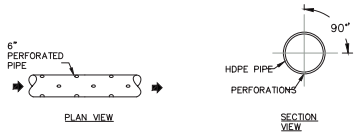

NOTES:

1. SCREENED TILL SHALL BE ON-SITE SOIL SCREENED TO 1" MINUS.
2. ALL HEADER AND LATERAL PIPING SHALL BE INSTALLED WITH A MINIMUM PITCH OF 5 PERCENT.
3. PROVIDE 2" RIGID INSULATION OVER AND ON SIDES OF PIPE, IF COVER IS LESS THAN 2-FEET.

## Pipe Trench Within Landfill

**Not to Scale**

12 / C2




NOTES:

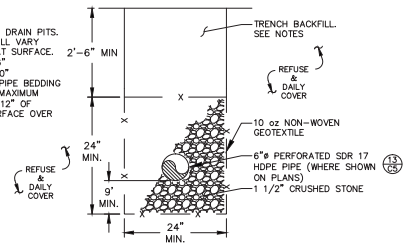
1. HOLES SHALL BE 1/2"ø DRILLED HOLES SPACED 12" APART IN 4 ROWS ALONG THE LENGTH OF THE PIPE. ROWS SHALL BE LOCATED 90°APART OFFSET 6" ALONG THE AXIS OF THE PIPE.

## Typical Perforated Pipe

**Not to Scale**

13 / C5

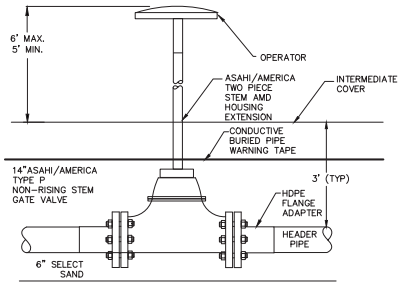
NOTES:
1. 2% MIN SLOPE TO TRENCH DRAIN PITS.
2. ACTUAL TRENCH DEPTH WILL VARY BASED ON TOPOGRAPHY AT SURFACE.
   -MINIMUM DEPTH = 4'-6"
   -MAXIMUM DEPTH = 9'-0"
3. BACKFILL TRENCH ABOVE PIPE BEDDING WITH WASTE EXCAVATED; MAXIMUM PARTICLE SIZE <3". USE 12" OF AUTOFLUFF COVER AT SURFACE OVER BACKFILL.




## Horizontal Gas Collection Well

**Not to Scale**

16 / C2



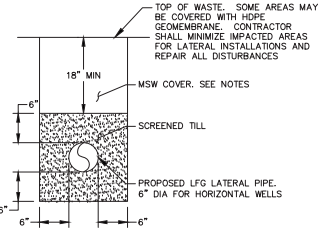

NOTES:

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.

## LFG Flow Control Valve

**Not to Scale**

14 / C2

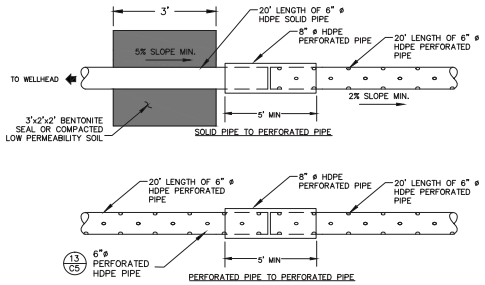



NOTES:
1. 24" MIN COVER FOR LATERALS
2. 5% MIN SLOPE
3. BACKFILL TRENCH ABOVE PIPE BEDDING WITH WASTE EXCAVATED; MAXIMUM PARTICLE SIZE <3". USE 12" OF AUTOFLUFF COVER AT SURFACE OVER BACKFILL.

## Gas Lateral

**Not to Scale**

15 / C2

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North Country Environmental Services
Bethlehem, NH

Stage V Landfill Expansion
Type I-A Permit Modification

Gas System Details

drawing no. C5

sheet: 5 of 5

Drawing file: F:\CADD\PROJECTS\833-NCES Stage V\dwg\DES Comments 1406\Closure Plan\833-Closure Details1406.dwg 6/18/2014 9:48am