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

Type I-A Permit Modification to Solid Waste Management Facility Permit and Waiver Request for Additional Information #2
Application No. 2020-50565
Phase IV – Four Hills Landfill
Nashua, New Hampshire

NHDES Site #: 198403099
Project Number: 4905

Prepared For:
City of Nashua
Nashua Division of Public Works,
Solid Waste Division
840 West Hollis Street
Nashua, NH 03062
Phone Number (603) 589-3410
RP Contact Name: Darrin Santos
RP Contact Email: santosd@nashuanh.gov

Cynthia L Roberts

Digitally signed by Cynthia L Roberts
Date: 2022.02.11 15:09:53 -05'00'

Prepared By:
Sanborn, Head & Associates, Inc.
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Contact Email: egalvin@sanbornhead.com

Date of Report: February 11, 2022

SANBORN HEAD
Building Trust. Engineering Success.

20 Foundry Street
Concord, NH 03301

Jamie Colby
Waste Management Division
NH Department of Environmental Services (NHDES)
29 Hazen Drive
Concord, NH 03302-0095

February 11, 2022
File No. 3066.11

Re: Request for Additional Information (December 3, 2021)
Applications for Type I-A Modification to Solid Waste Management Facility Permit and Waiver (2020-50565)
Phase IV Landfill Expansion, Four Hills Landfill
Nashua, New Hampshire
Permit No. DES-SW-SP-95-002

Dear Jaime:

On the behalf of the City of Nashua (City), Sanborn, Head & Associates, Inc. (Sanborn Head) prepared this letter to respond to the New Hampshire Department of Environmental Services (NHDES) December 3, 2021 comment letter regarding the completeness of the Phase IV Type I-A Modification to Solid Waste Management Facility Permit (Type I-A PMA) and Application for Waiver. The comment letter is in response to the additional information submitted to the NHDES on July 16, 2021, which was originally requested in NHDES's first request for additional information, dated November 20, 2020.

We understand that the NHDES still deems the applications incomplete and is requesting additional information to continue reviewing the applications. For convenience, the remainder of this letter addresses each of the comments, reproduced in *italics*, followed by our response. Additional information is enclosed to support our responses.

1. *NHDES understands that the City is proposing to monitor the quantity and analytical characteristics of liquid from a tertiary layer[1] beneath the Phase IV double-liner system and above the unlined landfill geomembrane cap. As discussed during our meeting on November 10, 2021, provide preliminary design plans and specifications as required by Env-Sw 315.05(c)(4)a, and any proposed changes to the facility's operating, closure and financial assurance plans as required by Env-Sw 315.05(c)(4)b, c, and d, needed to accommodate the proposed design.*

Sheets 13, 14, 16, and 17 of the Phase IV Design Drawings were revised to include the preliminary above-cap monitoring system design details. The above-cap monitoring system will function similarly to that of the proposed leachate collection and detection systems, whereas liquid captured within the existing Unlined Landfill capping system will be conveyed downslope to a 6-inch diameter perforated pipe that will direct the liquid to the

[1] In the remainder of this response letter and the revised plans, the term "above-cap monitoring system" is used in lieu of "tertiary layer" to refer to the layer between the Unlined Landfill capping system and the proposed Phase IV secondary liner system.

proposed 18-inch diameter sump riser location. The proposed leachate collection sump was modified to incorporate a separate third chamber specific to the liquid captured by the above-cap monitoring system (e.g., separate from the leachate collection system). The above-cap monitoring sump riser will be equipped with similar features as the primary and secondary risers that will allow liquid detection, pumping, and sampling/collection. These specific details will be prepared and included as part of the Type II Permit Modifications Application Construction Drawings.

The operating, closure, and financial assurance plans were revised to incorporate the proposed Phase IV above-cap monitoring system. For clarity, the previously proposed changes to the plans (proposed as part of the original application, and/or our first response letter) were accepted and the new proposed changes associated with the above-cap monitoring system are shown in "track changes."

2. *Provide the proposed "approved design capacity" of Phases I through IV as defined in Env-Sw 102.09, and identify by showing on a grading plan the proposed vertical and lateral limits of waste used to determine the Phases I through IV design capacity so as to provide a complete description of the proposed modification in accordance with Env-Sw 315.05(c).*

To address Env-Sw 102.09(a), the average weekly tonnage to be received at the facility during the quarter in which the most waste is anticipated to be received is estimated to be 2,100 tons/week, which assumes the City's typical six (6) day collection cycle per week.

To address Env-Sw 102.09(c), the proposed "approved design volume" (defined in Env-Sw 102.10) is included in the Facility's Operating Plan and are repeated below. Also, to address Env-Sw 315.05(c), Sheet 10A (enclosed) was added to the Phase IV Design Drawings to clarify the volume calculation boundaries (i.e., top on intermediate cover).

Phase/ Stage	Capacity (CY)	Cumulative Capacity (inclusive of cover material) (CY)
I/I	174,000	174,000
I/II	288,000	462,000
I/III	395,000	857,000
II/I	680,000	680,000
II/II	989,000	1,669,000
III/I*	1,056,000	1,056,000
IV/I	1,499,000	1,499,000
IV/II	862,000	2,361,000
IV/III	730,000	3,091,000
IV/IV	809,000	3,900,000

*Additional volume associated with Phase III Stage II is not included because its capacity has yet to be approved by the NHDES.

3. Based on the information provided and as discussed during our meeting on November 10, 2021, Phase IV may settle by up to about 20 feet. To provide a complete proposed design with supporting calculations as required by Env-Sw 315.05(c)(4)a, and to allow further evaluation of the requirements in Env-Sw 805.03(c) and (g) as well as Env-Sw 805.09(c):

We understand that the NHDES is interested in understanding the engineering calculations that support the proposed Phase IV design. Therefore, to address the apparent concern relative to Env-Sw 805.03(c) and (g) (both regarding landfill subgrade) and Env-Sw 805.09(c) (regarding stormwater), please consider the responses below that follow each comment item.

a. Provide supporting documentation for the primary and secondary compression ratios, including the surveys used to estimate settlement over time and the resulting compression index ratios.

A settlement calculation was provided as an enclosure to Sanborn Head's July 16, 2021 response to Comment #6 of the NHDES' November 20, 2020 comment letter. While the calculation focused on our understanding of the then NHDES concern regarding strain in the liner system over the Unlined Landfill, the calculation results also demonstrate that the anticipated settlement would not detrimentally impact the Phase IV design relative to liner system support, leachate management, nor stormwater management.

Based on the above comment, we understand that the NHDES now requests documentation as to the selection of the engineering parameters used in the calculation. To that end, please consider the following:

- The values for the primary and secondary compression ratios presented in the July 2021 response were obtained from the following source, which was referenced in the calculation – Babu, G. L. S., Reddy, K. R., Chouskey, S. K., and Kulkarni, H. S., "Prediction of Long-Term Municipal Solid Landfill Settlement Using Constitutive Model," in Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management, ASCE, 2010, p. 140.
- Due to the age of the existing waste within the Unlined Landfill (initial waste placement began approximately 50 years ago) and that it has already experienced primary settlement and is well into its secondary settlement phase, Sanborn Head selected a primary compression ratio value lower than the typical published range of 0.163 and 0.205. Using primary compressions ratios within this range result in settlements from primary consolidation that are unrealistic for the age of waste locate within the Unlined Landfill.
- Sanborn Head verified the secondary compression ratio based on an analysis of the following survey data:
    1. *Final Closure Grades* – Attachment A presents excerpts from the Unlined Landfill Closure Record Drawings, prepared by CMA Engineers, Inc. (CMA), dated March 2005, that depict the Unlined Landfill final closure grades. Electronic AutoCAD files of this plan set were not available, so Sanborn Head digitized the final grade contours from the PDF.
    2. *Landfill Grades from June 2010* – Sheet 2 of the Phase IV Design Drawings (Overall Site Plan) includes a base map that was obtained from drawings prepared by CMA

that reference a survey of the Unlined Landfill that occurred in June 2010. This 2010 topography was used to determine the secondary compression ratio included in the July 2021 response document.

3. *Landfill Grades from December 2021* – Attachment B presents the Existing Conditions Survey of the Unlined Landfill that was prepared by WSP USA, Inc., which includes survey data captured on December 14, 2021.

The calculation, which is enclosed, confirms the selection of a secondary compression ratio of 0.07.

> *b. Identify if differential settlement of the existing waste mass of the unlined landfill has occurred, and if so, show such on a site plan. Address whether such differential settlement is anticipated to continue under the new loading condition.*

The City retained WSP USA, Inc. (WSP) of Merrimack, New Hampshire to survey the Unlined Landfill in order to identify, if present, differential settlement of the existing waste mass. The survey was performed using a combination of aerial mapping and on the ground Real Time Kinematic GPS field survey techniques. Enclosed is a drawing titled "Existing Conditions Survey" prepared by WSP that includes topography, spot elevations, edge of roads, and other relevant site features. Based on the 2-foot contours, it is clear that there are no signs of differential settlement (i.e., depressions, changes in stormwater flow direction, ponding water within the capped area, etc.). Also, in accordance with the City's closure plan, City staff inspect the Unlined Landfill cap for differential settlement as part of their post-closure monitoring requirements. No standing water is present, and no differential settlement has been noticed or reported as part of their annual post-closure reporting requirements.

> *c. Provide an explanation and supporting calculations to demonstrate that the proposed Phase IV systems can accommodate anticipated settlement, including whether the leachate collection and removal systems will function effectively during both the active life and closure and post-closure periods of the landfill in accordance with Env-Sw 805.06(d). NHDES anticipates that leachate removal calculations will be performed for both the pre- and post-settlement conditions to capture the full extent of the system's performance over time.*

The calculations that were prepared and included in the City's original application considered various phases of the Phase IV develop and considered only pre-settlement conditions of the liner system over the Unlined Landfill. Of the calculations prepared for Phase IV, there are two (2) in which the liner system's slope can impact the leachate collection and removal system – primary drainage geocomposite and secondary travel time.

The primary drainage geocomposite calculation (Calculation B.1 enclosed) considers the flow capacity of the geocomposite during initial operation, active operation, and full buildout of Phase IV. Because of the variable slope of the liner system across the Phase IV liner area, the calculation is further divided to consider the following three (3) subgrade areas: (i) base area; (ii) overlay area with slopes <5%; and (iii) overlay area with slope greater than 5%. Because there is no waste located beneath the base area of Phase IV, only the overlay areas were evaluated using post-settlement slopes. Similar to how the settled Phase IV liner surface was calculated (see above comment response), the settled surface was profiled along

the critical path as depicted on the enclosed Primary Geocomposite Critical Path Profile Worksheet. As depicted on the profile, the slope of the "top deck" drops from 5.0% to approximately 4.8% and the sideslope average slope drops from 22.6% to 17.0%. The enclosed Table 1 was modified to include these post-settled slopes and the resulting calculated required transmissivities. As noted on Table 1, the performance requirement for the primary drainage geocomposite does not change as the maximum required transmissivity still occurs within the Phase IV base during initial operations (i.e., 1.69×10^{-3} m^2/sec).

For the original secondary travel time calculation (Calculation B.5 enclosed), the travel time is based on the conservative assumption that the shallowest slope of the critical path is used for the entire critical path length. The calculation presented in the original application used a slope of 2.4%, which occurs within the base of Phase IV. Similar to how the settled Phase IV liner surface was calculated (see above comment response), the settled surface was profiled along the critical path as depicted on the enclosed Secondary Travel Time Critical Path Profile Worksheet. As depicted on the profile, the lowest slope of the post-settled Phase IV liner grades, occur on the top deck and are labeled. The shallowest slope is 2.6%, which is greater than that used in the original secondary travel time calculation; therefore, accounting for the settlement of Phase IV liner system does not affect the original results.

4. *As discussed during our meeting on November 10, 2021 and to ensure the design meets the requirements of Env-Sw 805.06(h)(1), demonstrate that the existing leachate discharge system downstream of Phases I-IV and upstream of the City sewer system is adequately sized to handle leachate flows from routine operations and the contingency event, or propose design changes accordingly. Provide calculations, drawings and details as appropriate.*

The proposed leachate management system meets the requirements of Env-Sw 805.06(h). The enclosed calculation concludes that the existing gravity main has sufficient capacity to handle the anticipated leachate flows from the contingency storm event (i.e., 100-year, 24-hour storm).

5. *Provide preliminary design plans for expanding the decomposition gas monitoring network to ensure the requirements of Env-Sw 806.07 will be met. NHDES notes that there are no gas monitoring points positioned to monitor for migration along the westerly boundaries of the facility beyond which lie residential developments.*

A revised Gas Monitoring Well Location Plan is enclosed that depicts the existing gas monitoring network and proposed locations along the northern and eastern boundary of the facility. The proposed monitoring point spacing is limited by access constraints but is consistent with that of the existing monitoring locations (i.e., up to approximately 500 feet between locations).

6. *Address the feasibility of meeting the requirements in Env-Sw 1003.01 relative to providing proper post-closure inspection, monitoring and maintenance, including repair, of the closed, unlined landfill if the expansion is approved; and Env-Sw 1004.04 relative to protection of the unlined landfill's closure system if the expansion is approved. NHDES notes that a permit modification for the unlined landfill may be required if the proposed expansion is approved.*

Env-Sw 1003.01 requires that a "facility or practice" "not interfere with the proper operation or closure of" another "facility," and Env-Sw 1004.04 requires that "the design of a facility" "include measures of features to avoid damage during construction and operation of the facility to any component of a landfill closure system." The proposed Phase IV, as described in the application narratives and as depicted on the Drawings, complies with these regulations as described below:

- A portion of Phase IV will overlay a portion of the Unlined Landfill as allowed by Env-Sw 805.17. Considering that Phase IV liner system will be constructed in stages over many years, portions of the closed Unlined Landfill will need to be re-permitted so that they are no longer part of the operation of a closed landfill. The mechanism to accomplish this change would be through the Type II Modification to Solid Waste Management Facility Permit (Type II PMA) for each specific Phase IV liner system construction project, as applicable. The Phase IV liner system construction Type II PMA would be supplemented with a revised Operating Plan and Closure Plan, as appropriate.
- Upon construction of the Phase IV liner system over the Unlined Landfill, post-closure care/monitoring of the closure system within the affected area would cease.
- Ground Control Markers (Env-Sw 1004.04 (a)), if any, would be replaced in kind beyond the limits of the Phase IV liner system construction.
- The construction of the Phase IV liner system over the Unlined Landfill will not damage the Unlined Landfill closure system (Env-Sw 1004.04(b)). In fact, as depicted on the Drawings, maintaining the integrity of the closure system, sans the removal of the Topsoil and Moisture Retention layers, is integral to the overall Phase IV design.
- As demonstrated by our liner settlement calculation provided as part of the previous request for additional information, placement of waste within Phase IV will not create intolerable strains on the Unlined Landfill capping geosynthetics.
- The Unlined Landfill does not have a leachate collection system (Env-Sw 1004.04(c)), and as such there are no associated risers or cleanouts.
- The relocation of groundwater monitoring wells (Env-Sw 1004.04(d)) within the footprint of Phase IV to provide a monitoring network compliant with the Solid Waste Rules is addressed in the application. Additionally with the proposed above-cap monitoring system, a monitoring point for the entire Phase IV overlay area will be provided.
- As noted in the Application, decomposition gas control devices (Env-Sw 1004.04(e)) were purposely not installed in the area of the Unlined Landfill in anticipation of a future expansion.

7. *As discussed during our meeting on November 10, 2021, the goals in RSA 149-M:2 were recently revised due to the passage of House Bill 413 (2021). Per RSA 149-M:11, VIII, provide a description of how the facility will assist the state in achieving the*

implementation of the hierarchy and goals under RSA 149-M:2 and 3 as required by RSA 149-M:11, III(b)

Enclosed is the latest revision to the Public Benefit Demonstration, which was last revised to address the NHDES comment that there was pending legislation (HB 413). The enclosed version acknowledges the recently amended RSA 149-M, which also includes additional text on how the City is working toward assisting the State of New Hampshire achieve its recently updated solid waste disposal reduction goal.

8. Based on the information provided, areas of threatened and endangered species exist at the site and notification in accordance with Env-Sw 303.06 and Env-Sw 303.09 is required. Make the required notifications to the NH Natural Heritage Bureau and NH Fish & Game Department and provide proof of notifications as required by Env-Sw 315.05(k).

The New Hampshire Natural Heritage Bureau and the New Hampshire Fish & Game Department were heavily involved in the Alteration of Terrain permitting, which was fully approved on October 4, 2021 and hence both agencies are well aware of the project. Enclosed are certified mail receipts from both parties indicting their receipt of the Type I-A PMA.

We trust that the information provide herein satisfies your request for additional information. Please do not hesitate to contact Edward Galvin at (603) 415-6132 should you require additional information.

Very truly yours,
SANBORN, HEAD & ASSOCIATES, INC.

Edward A. Galvin, PE
Project Manager

Eric S. Steinhauser, PE, CPESC, CPSWQ
Senior Vice President

ESS/EAG:eag

Enclosures:

Comment #1 Revised Phase IV Design Drawings (Sheets 5, 6, 13, 14, 16, and 17)
Revised Operating Plan
Revised Closure Plan
Revised Financial Assurance Plan
Comment #2 Revised Phase IV Design Drawings (Sheet 10A)
Comment #3 Secondary Compression Ratio Demonstration
WSP USA, Inc. Existing Conditions Survey (December 2021)
Primary Drainage Geocomposite – Critical Path Profile Worksheet, Revised Table 1, Additional HELP Output

Secondary Travel Time Critical Path Profile Worksheet

Comment #4 Existing Leachate Discharge System Capacity Calculation

Comment #5 Revised Gas Monitoring Well Location Plan

Comment #7 Revised Public Benefit Statement

Comment #8 Certified Mail Receipts

Copies to: Lisa Fauteux, City of Nashua
Jeff Lafleur, City of Nashua
Darrin Santos, City of Nashua

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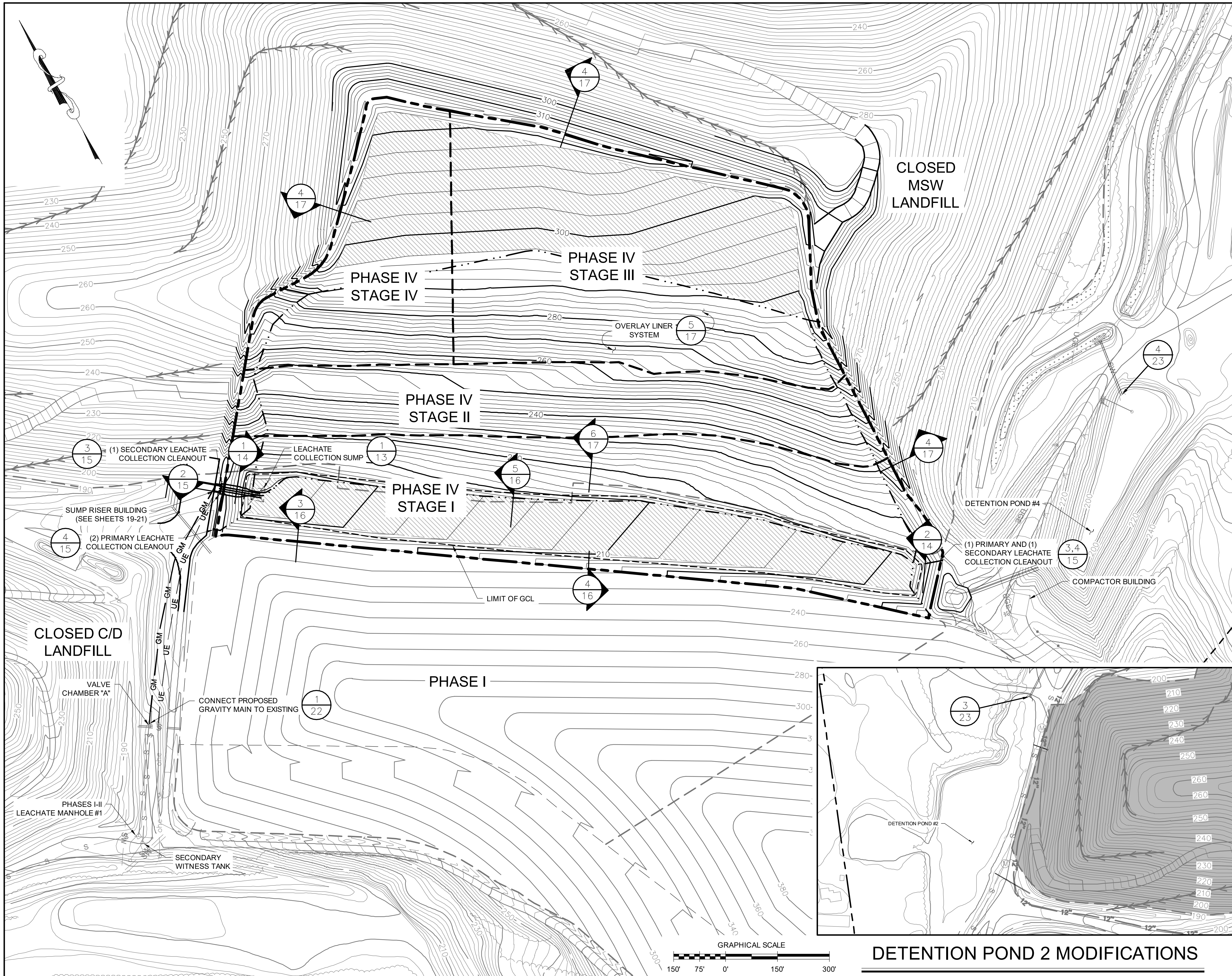
Comment #1

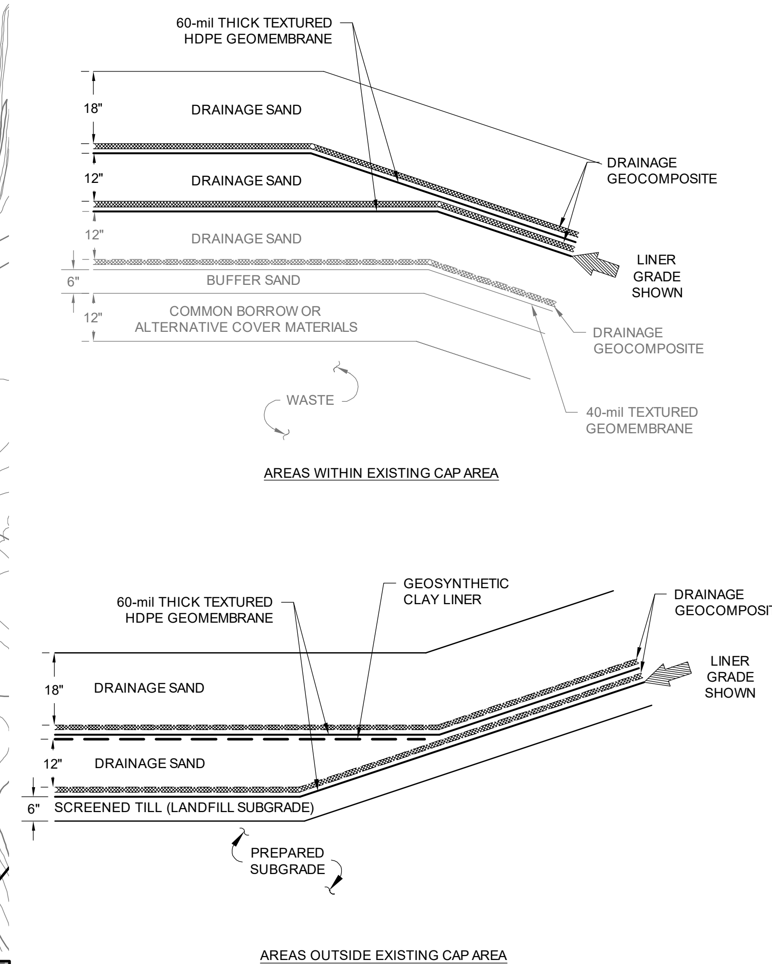
Revised Phase IV Design Drawings
(Sheets 5, 6, 13, 14, 16, and 17)
Revised Operating Plan
Revised Closure Plan
Revised Financial Assurance Plan

NOTES:

1. SEE SHEET 1 FOR ADDITIONAL NOTES AND LEGEND INFORMATION.
2. THE PROPOSED GRADES IN THE PROPOSED OVERLAY AREA ARE BASED ON HISTORICAL TOPOGRAPHIC DATA AND SHOULD BE CONSIDERED CONCEPTUAL ONLY. THE EXISTING GRADES AT THE TIME OF CONSTRUCTION MAY BE LOWER DUE TO WASTE SETTLEMENT. THEREFORE, THE OVERLAY AREA WILL BE SURVEYED PRIOR TO PREPARING THE CONSTRUCTION DRAWINGS AND THE PROPOSED GRADING WILL BE ADJUSTED ACCORDING TO THE PERMITTED LIMIT OF WASTE.
3. EXISTING GAS EXTRACTION WELLS AND COLLECTION TRENCHES NOT SHOWN FOR CLARITY.



DETENTION POND 2 MODIFICATIONS



GRADING KEY

LEGEND:

- AREA TO RECIEVE SECONDARY SAND
- LIMIT OF GEOSYNTHETIC CLAY LINER

- NOT FOR CONSTRUCTION -
FOR PERMITTING PURPOSES ONLY

SANBORN | HEAD

GRAPHICAL SCALE 100' 50' 0 100' 200'

STATE OF NEW HAMPSHIRE — ERIC SCOTT STEINHAUSER No. 11494 LICENSED PROFESSIONAL ENGINEER

NO.	DATE	DESCRIPTION	BY
△	10/28/2020	MODIFIED GRADING AND CULVERTS.	EAG

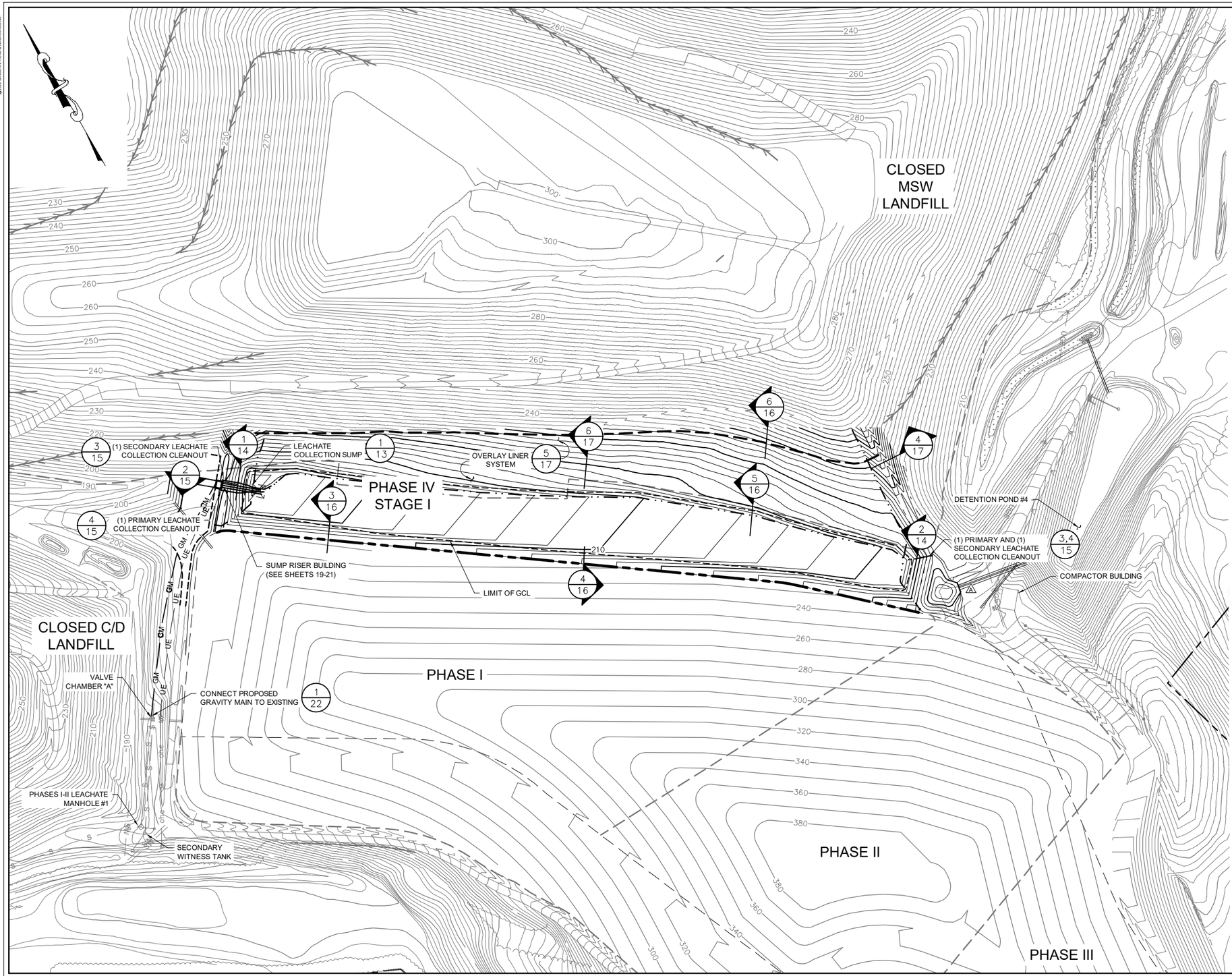
DRAWN BY: J. GRACE
DESIGNED BY: J. GRACE
REVIEWED BY: E. STEINHAUSER
PROJECT MGR: E. GALVIN
PIC: E. STEINHAUSER
DATE: JANUARY 2022

PHASE IV DESIGN DRAWINGS
TYPE I-A PERMIT MODIFICATION APPLICATION
FOUR HILLS LANDFILL
CITY OF NASHUA
NASHUA, NEW HAMPSHIRE

OVERALL SECONDARY BASE GRADING PLAN

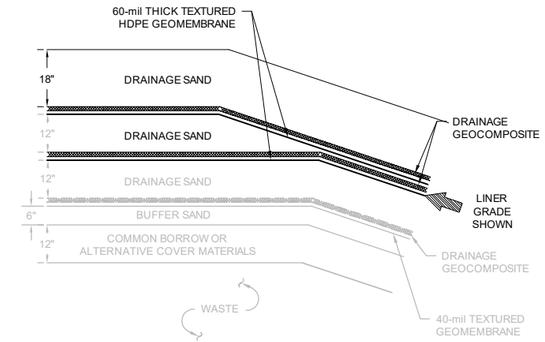
PROJECT NUMBER: 3066.11

SHEET NUMBER: 5 OF 30

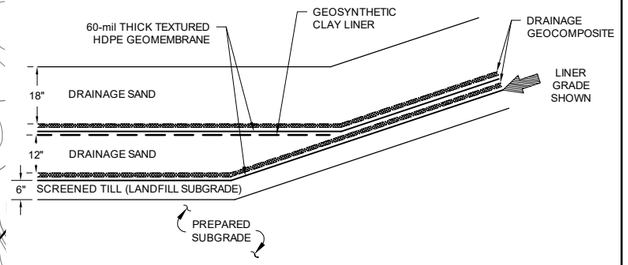


NOTES:

1. SEE SHEET 1 FOR ADDITIONAL NOTES AND LEGEND.
2. THE PROPOSED GRADES IN THE PROPOSED OVERLAY AREA ARE BASED ON HISTORICAL TOPOGRAPHY DATA AND SHOULD BE CONSIDERED CONCEPTUAL ONLY. THE EXISTING GRADES AT THE TIME OF CONSTRUCTION MAY BE LOWER DUE TO WASTE SETTLEMENT. THEREFORE, THE OVERLAY AREA WILL BE SURVEYED PRIOR TO PREPARING THE CONSTRUCTION DRAWINGS AND THE PROPOSED GRADING WILL BE ADJUSTED AS NECESSARY ACCORDING TO THE PERMITTED LIMIT OF WASTE.
3. EXISTING GAS EXTRACTION WELLS AND COLLECTION TRENCHES NOT SHOWN FOR CLARITY.



AREAS WITHIN EXISTING CAP AREA



AREAS OUTSIDE EXISTING CAP AREA

GRADING KEY

- NOT FOR CONSTRUCTION -
FOR PERMITTING PURPOSES ONLY

SANBORN HEAD

GRAPHICAL SCALE
100' 50' 0 100' 200'

STATE OF NEW HAMPSHIRE — ERIC SCOTT STEINHAUSER No. 11402 — LICENSED PROFESSIONAL ENGINEER

NO.	DATE	DESCRIPTION	BY
1	10/28/2020	ADJUSTED GRADING AND CULVERTS.	EAG

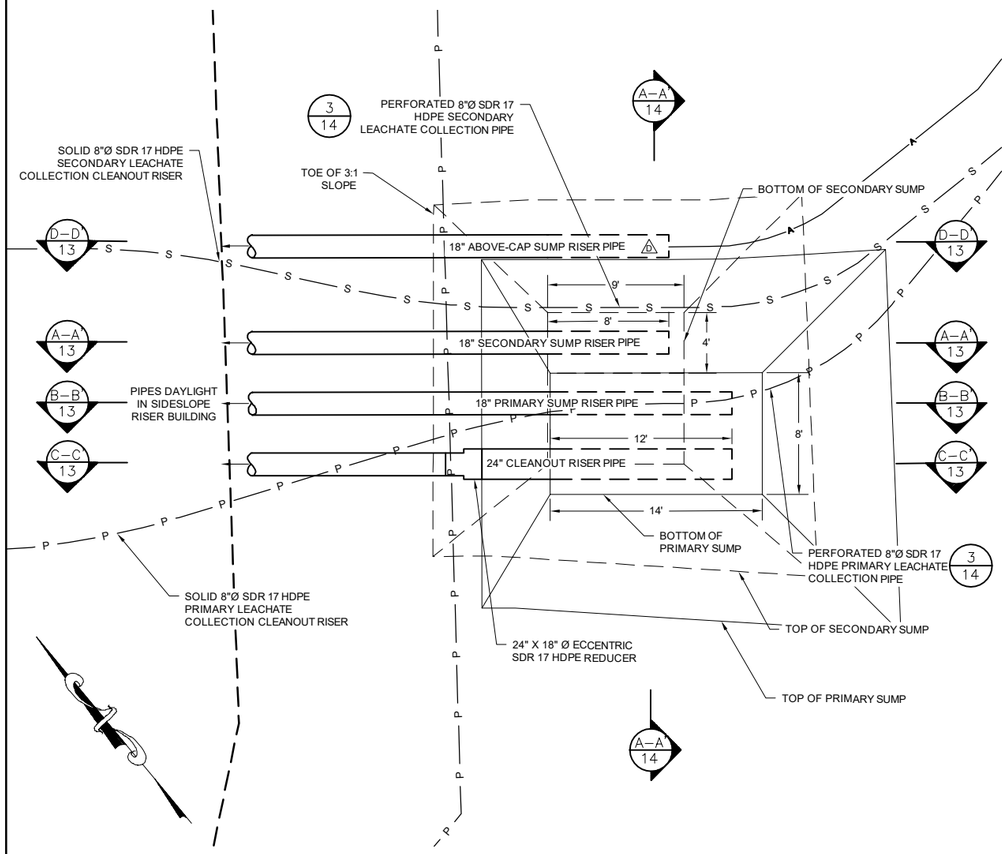
DRAWN BY: J. GRACE
DESIGNED BY: J. GRACE
REVIEWED BY: E. STEINHAUSER
PROJECT MGR: E. GALVIN
PIC: E. STEINHAUSER
DATE: JANUARY 2022

PHASE IV DESIGN DRAWINGS
TYPE I-A PERMIT MODIFICATION APPLICATION
FOUR HILLS LANDFILL
CITY OF NASHUA
NASHUA, NEW HAMPSHIRE

PROJECT NUMBER: 3066.11

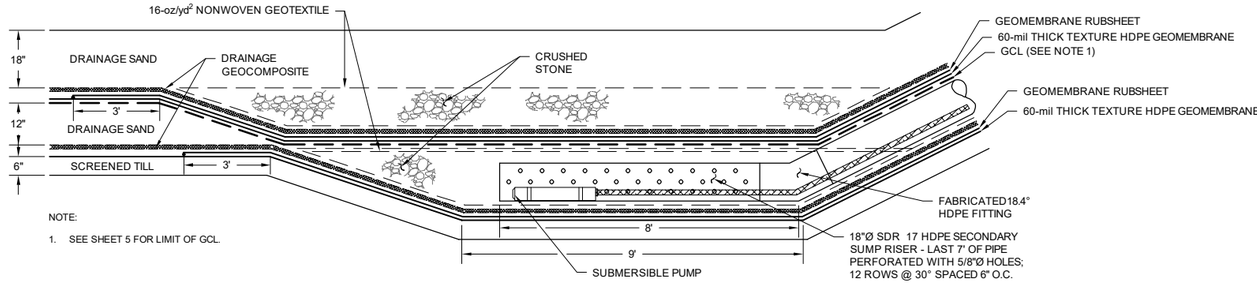
STAGE I SECONDARY BASE GRADING PLAN

SHEET NUMBER: 6 OF 30



1 LEACHATE COLLECTION SUMP

NOT TO SCALE

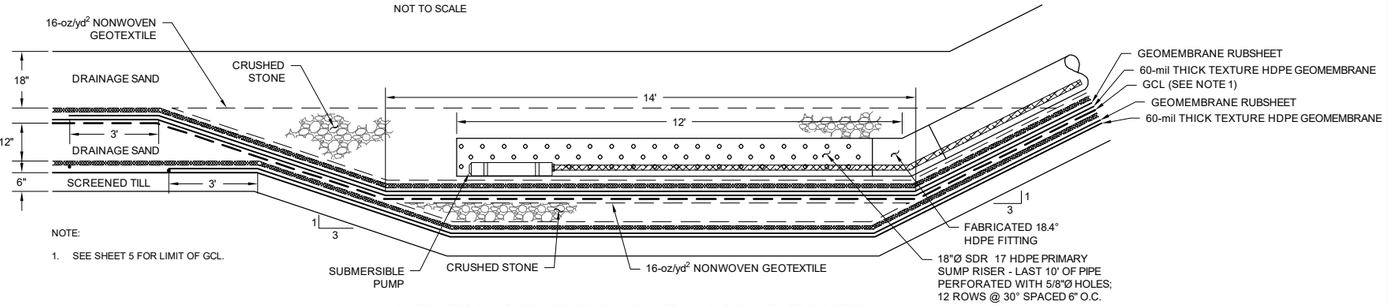


NOTE:

1. SEE SHEET 5 FOR LIMIT OF GCL.

SECTION A-A' SECONDARY SUMP RISER

NOT TO SCALE



NOTE:

1. SEE SHEET 5 FOR LIMIT OF GCL.

SECTION B-B' PRIMARY SUMP RISER

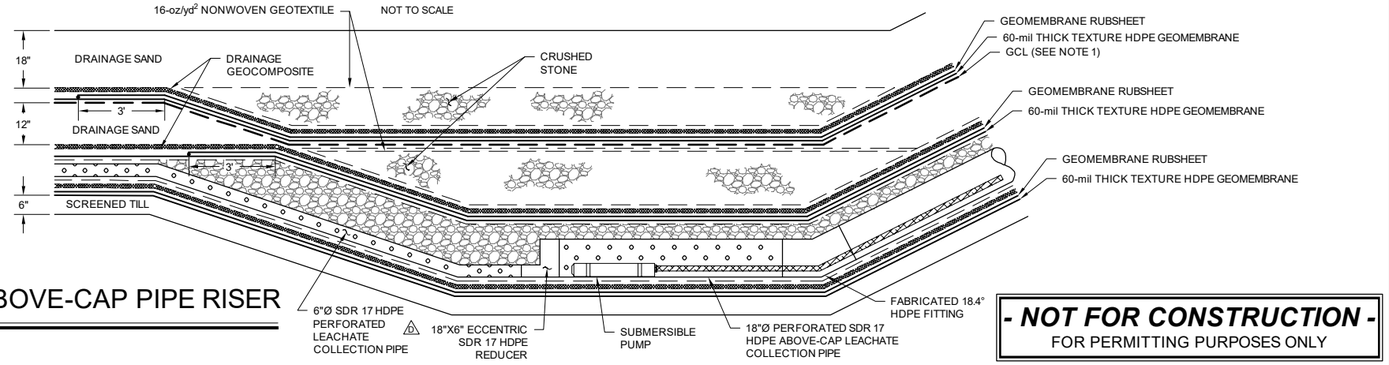
NOT TO SCALE

NOTE:

1. SEE SHEET 5 FOR LIMIT OF GCL.

SECTION C-C' CLEANOUT SUMP RISER

NOT TO SCALE



NOTE:

1. SEE SHEET 5 FOR LIMIT OF GCL.

SECTION D-D' ABOVE-CAP PIPE RISER

NOT TO SCALE

- NOT FOR CONSTRUCTION -
FOR PERMITTING PURPOSES ONLY

SANBORN HEAD

SCALE: AS NOTED

ERIC SCOTT STEINHAUSER No. 11490 LICENSED PROFESSIONAL ENGINEER STATE OF NEW HAMPSHIRE

NO.	DATE	DESCRIPTION	BY
C	01/04/2022	ADDED SECTION D-D' FOR ABOVE-CAP LCP	LMZ
B	01/31/2022	ABOVE-CAP PIPE MODIFIED	LMZ

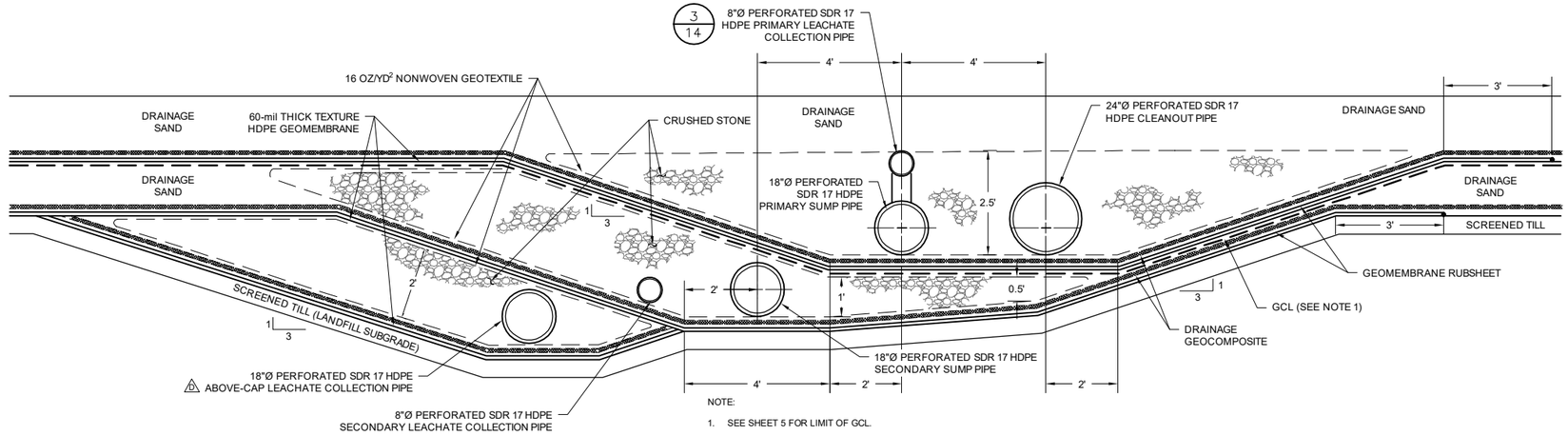
DRAWN BY: L. ZUCHOWSKI
DESIGNED BY: J. GRACE
REVIEWED BY: E. STEINHAUSER
PROJECT MGR: E. GALVIN
PIC: E. STEINHAUSER
DATE: JANUARY 2022

PHASE IV DESIGN DRAWINGS
TYPE I-A PERMIT MODIFICATION APPLICATION
FOUR HILLS LANDFILL
CITY OF NASHUA
NASHUA, NEW HAMPSHIRE

PROJECT NUMBER: 3066.11

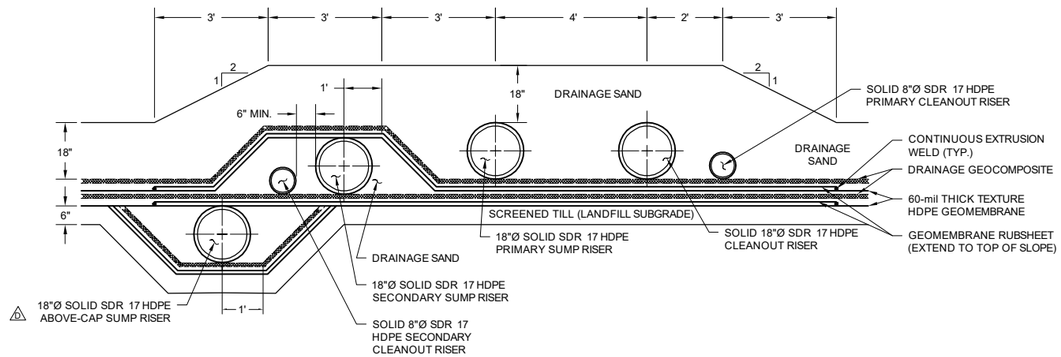
SUMP RISER / CLEANOUT DETAILS

SHEET NUMBER: 13 OF 30



SECTION A-A' PRIMARY AND SECONDARY LEACHATE SUMPS

NOT TO SCALE

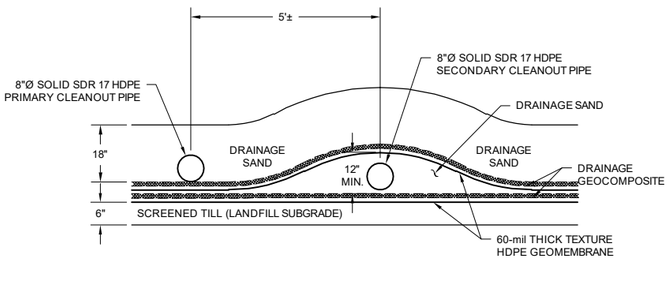


SECTION VIEW LOOKING DOWNSLOPE

SUMP RISER

1

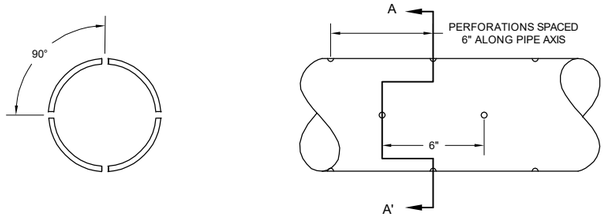
NOT TO SCALE



LEACHATE COLLECTION CLEANOUT RISERS

2

NOT TO SCALE



SECTION A-A'

ELEVATION

NOTE:

1. 8"Ø SDR 17 HDPE PIPE PERFORATED WITH 1/2"Ø HOLES SPACED 90° APART CIRCUMFERENTIALLY, AND 6 INCHES ON CENTER AXIALLY.

LEACHATE COLLECTION PIPE PERFORATION

3

NOT TO SCALE

- NOT FOR CONSTRUCTION -
FOR PERMITTING PURPOSES ONLY

SANBORN HEAD

SCALE: AS NOTED

ERIC SCOTT STEINHAUSER No. 11490 LICENSED PROFESSIONAL ENGINEER - STATE OF NEW HAMPSHIRE

NO.	DATE	DESCRIPTION	BY
2	01/04/2022	ADDED SECTION D-D' FOR ABOVE-CAP LCP	LMZ
1	01/31/2022	ABOVE-CAP PIPE MODIFIED	LMZ

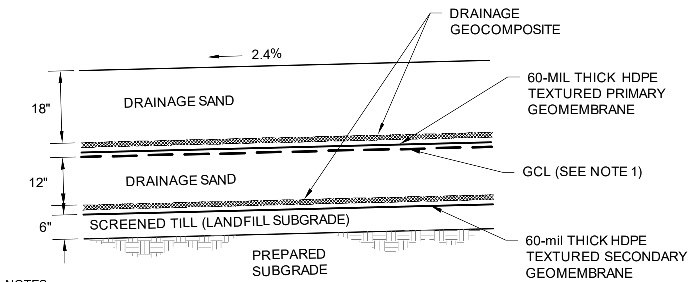
DRAWN BY: L. ZUCHOWSKI
DESIGNED BY: J. GRACE
REVIEWED BY: E. STEINHAUSER
PROJECT MGR: E. GALVIN
PIC: E. STEINHAUSER
DATE: JANUARY 2022

PHASE IV DESIGN DRAWINGS
TYPE I-A PERMIT MODIFICATION APPLICATION
FOUR HILLS LANDFILL
CITY OF NASHUA
NASHUA, NEW HAMPSHIRE

PROJECT NUMBER: 3066.11

SUMP RISER / CLEANOUT DETAILS

SHEET NUMBER: 14 OF 30

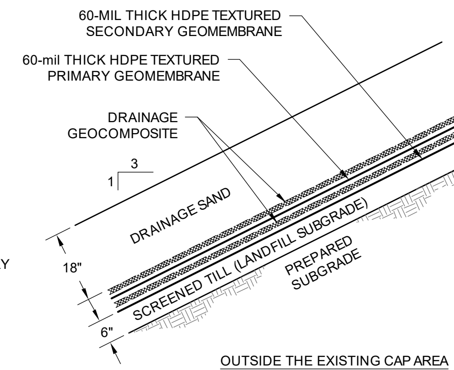


NOTES:

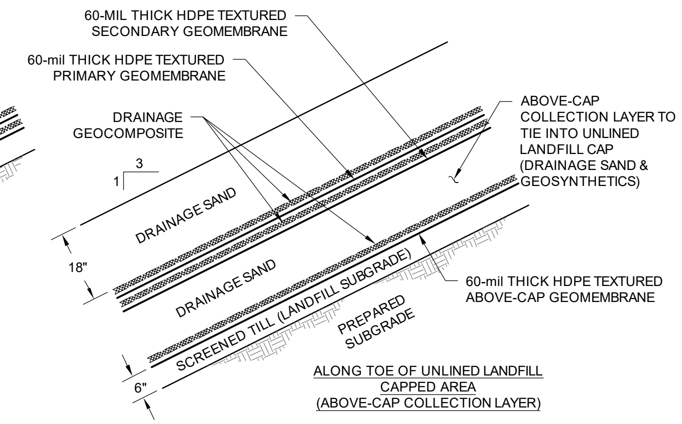
1. SEE SHEET 5 FOR LIMIT OF GCL. THE GCL SHALL BE PLACED BENEATH THE PRIMARY GEOMEMBRANE IN ALL BASE AREAS AND SHALL EXTEND 10 FEET UP SIDE SLOPES.
2. THE 6-INCH THICK SCREENED TILL (LANDFILL SUBGRADE) LAYER SERVES AS THE LANDFILL SUBGRADE IN ACCORDANCE WITH ENV-SW 805.03.
3. PREPARED SUBGRADE SHALL BE ESTABLISHED BY PROOF ROLLING NATURAL GROUND IN AREAS OF CUT OR BY COMPACTING STRUCTURAL FILL.

1 LINER SYSTEM (TYP)

NOT TO SCALE



OUTSIDE THE EXISTING CAP AREA



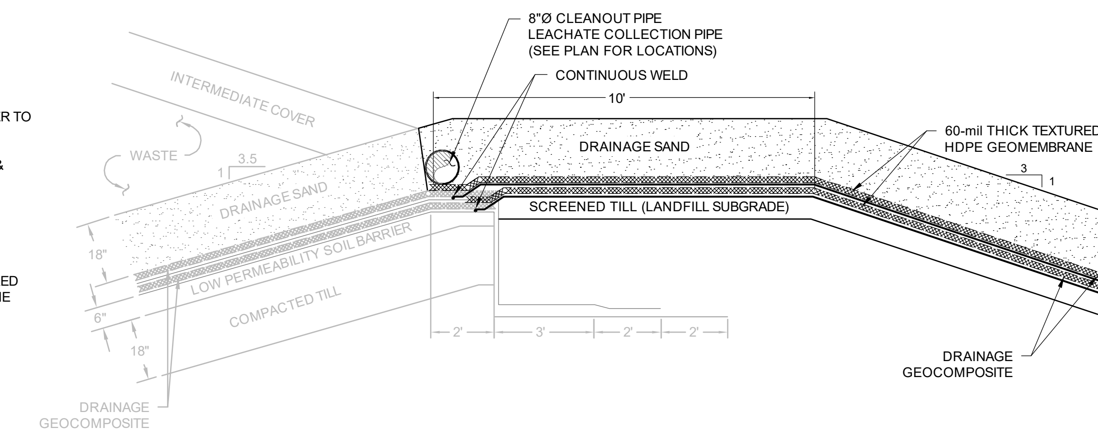
ALONG TOE OF UNLINED LANDFILL CAPPED AREA (ABOVE-CAP COLLECTION LAYER)

NOTES:

1. THE 6-INCH THICK SCREENED TILL (LANDFILL SUBGRADE) LAYER SERVES AS THE LANDFILL SUBGRADE IN ACCORDANCE WITH ENV-SW 805.03.
2. PREPARED SUBGRADE SHALL BE ESTABLISHED BY PROOF ROLLING NATURAL GROUND IN AREAS OF CUT OR BY COMPACTING STRUCTURAL FILL.

C 2 SLOPE LINER SYSTEM (TYP)

NOT TO SCALE

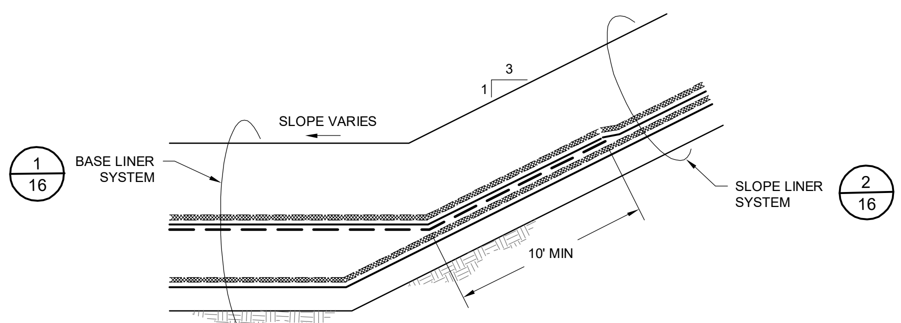


NOTE:

1. EXISTING PHASE I PRIMARY TO SECONDARY GEOMEMBRANE WELD AND ANCHOR TRENCH GEOSYNTHETICS TO BE REMOVED PRIOR TO INSTALLATION OF THE PHASE IV LINER SYSTEM.

3 LINER CONNECTION ALONG PHASE I

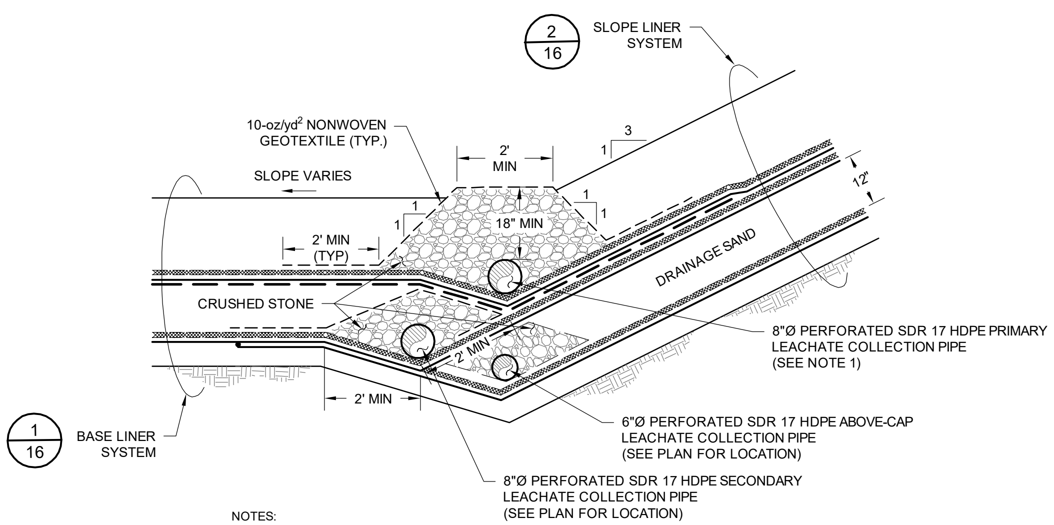
NOT TO SCALE



4 LINER SYSTEM AT TOE OF SLOPE

NOT TO SCALE

(WITHOUT LEACHATE COLLECTION PIPE)



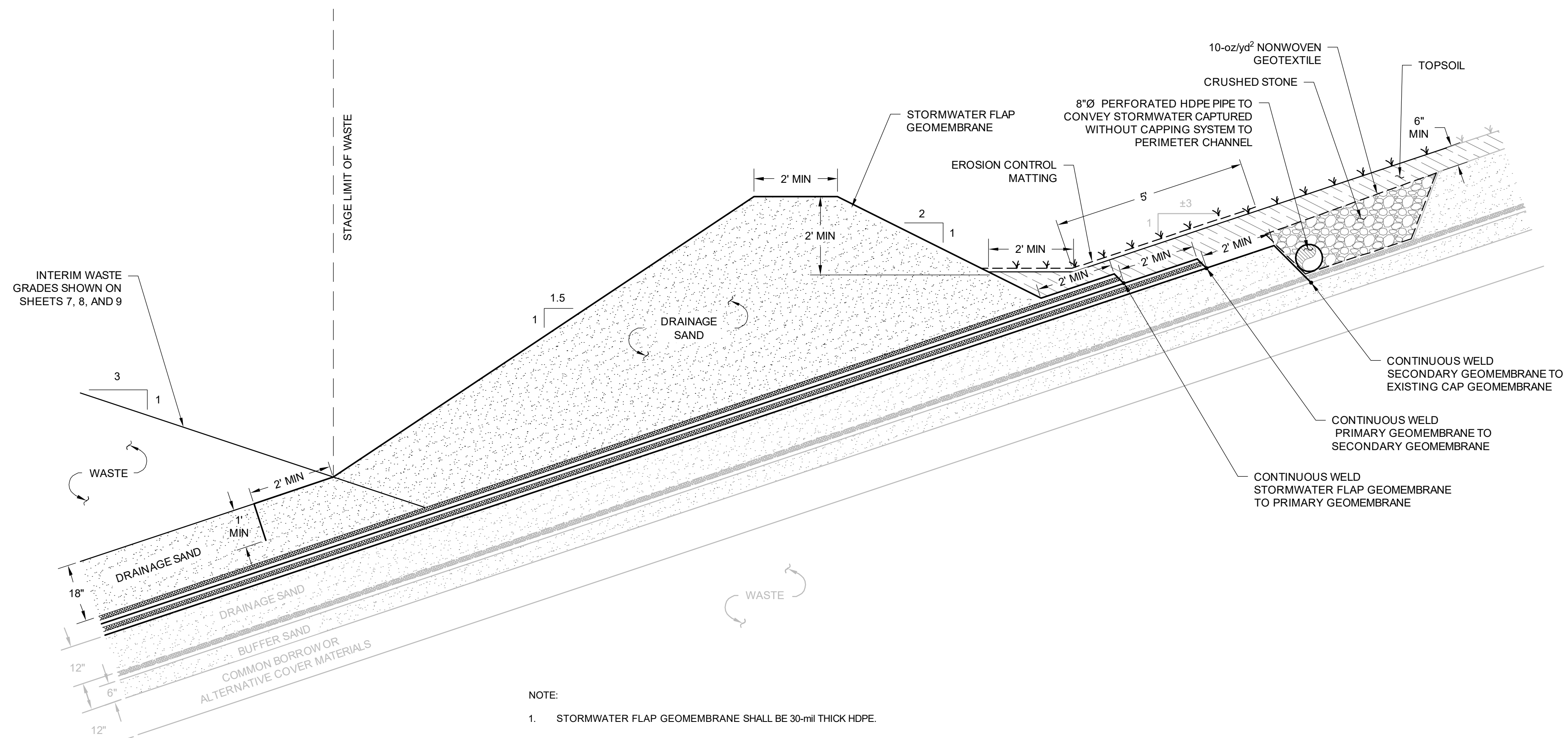
NOTES:

1. SEE DETAIL 3 ON SHEET 14 FOR PIPE PERFORATION INFORMATION.

C 5 LINER SYSTEM AT TOE OF SLOPE

NOT TO SCALE

(WITH LEACHATE COLLECTION PIPE)



NOTE:

1. STORMWATER FLAP GEOMEMBRANE SHALL BE 30-mil THICK HDPE.

6 TEMPORARY DIVISION BERM

NOT TO SCALE

- NOT FOR CONSTRUCTION -
FOR PERMITTING PURPOSES ONLY

SANBORN | HEAD

SCALE: AS NOTED

STATE OF NEW HAMPSHIRE — ERIC SCOTT STEINHAUSER No. 11494 — LICENSED PROFESSIONAL ENGINEER

NO.	DATE	DESCRIPTION	BY
C	01/04/2022	MODIFIED DETAILS TO INCLUDE ABOVE-CAP COLLECTION SYSTEM.	LMZ

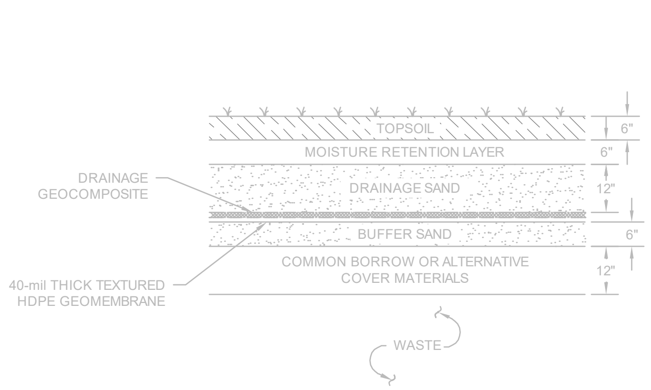
DRAWN BY: L.TRACY
DESIGNED BY: J. GRACE
REVIEWED BY: E. STEINHAUSER
PROJECT MGR: E. GALVIN
PIC: E. STEINHAUSER
DATE: JANUARY 2022

PHASE IV DESIGN DRAWINGS
TYPE I-A PERMIT MODIFICATION APPLICATION
FOUR HILLS LANDFILL
CITY OF NASHUA
NASHUA, NEW HAMPSHIRE

LINER SYSTEM DETAILS

PROJECT NUMBER: 3066.11

SHEET NUMBER: 16 OF 30



EXISTING TYPE A CAP AREA SECTION

1
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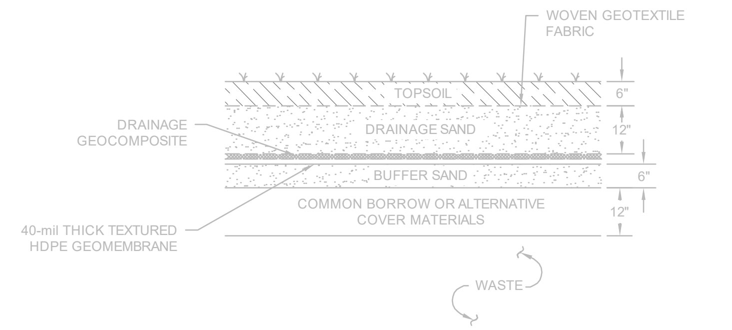
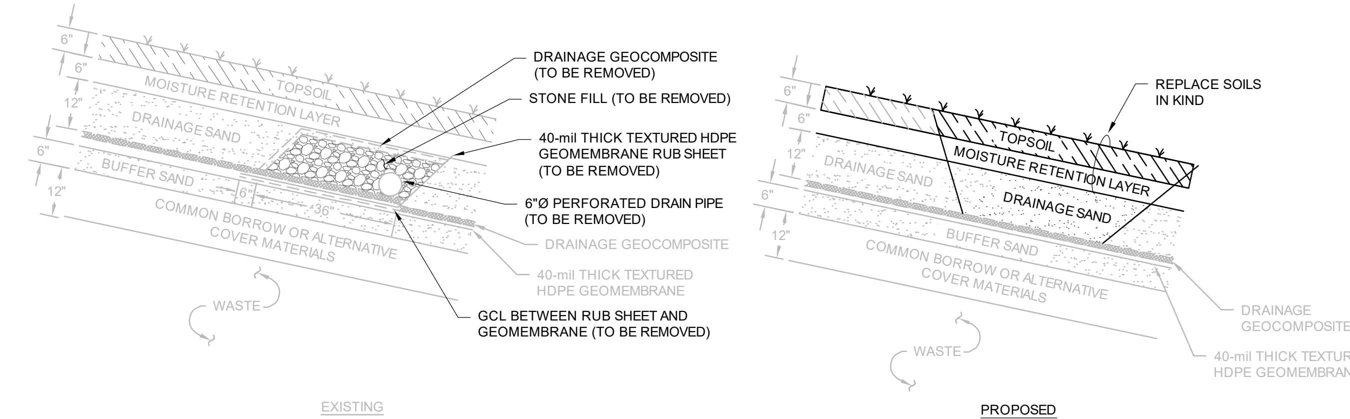


EXISTING TYPE B CAP AREA SECTION

2
NOT TO SCALE



SEEPAGE BENCH REMOVAL DETAIL

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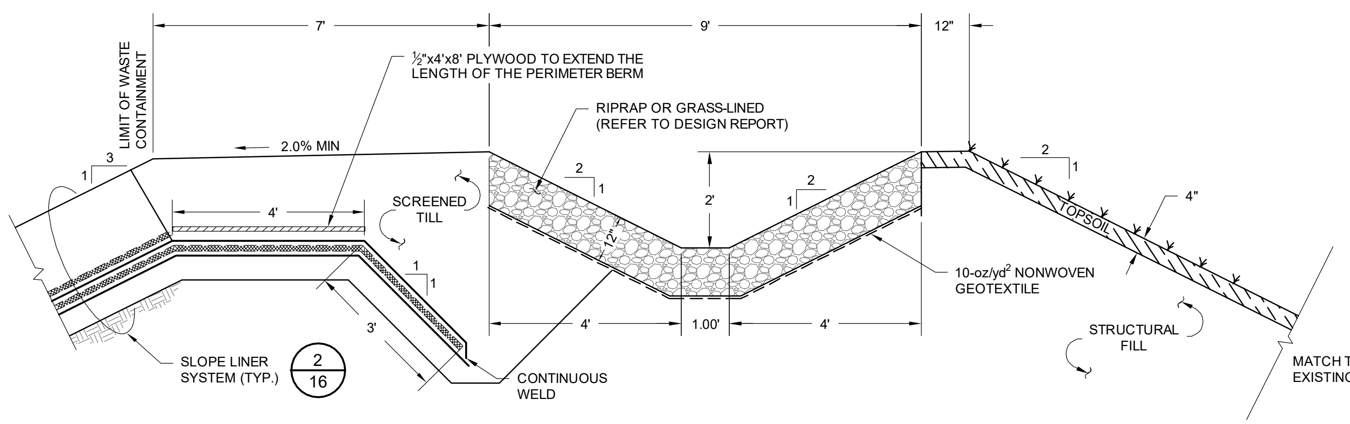
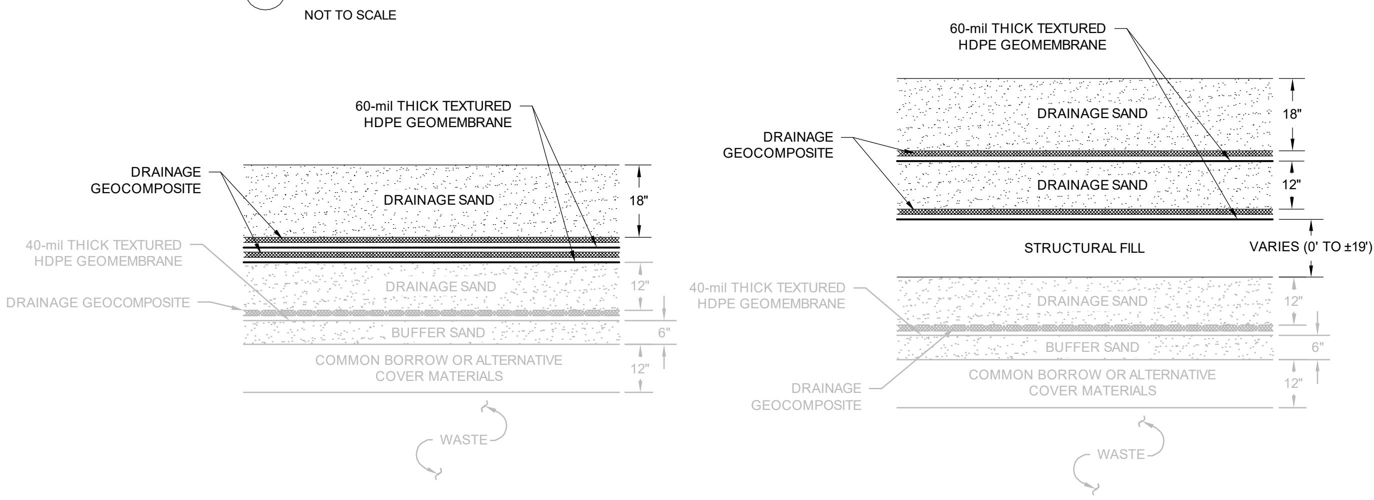
NOT TO SCALE



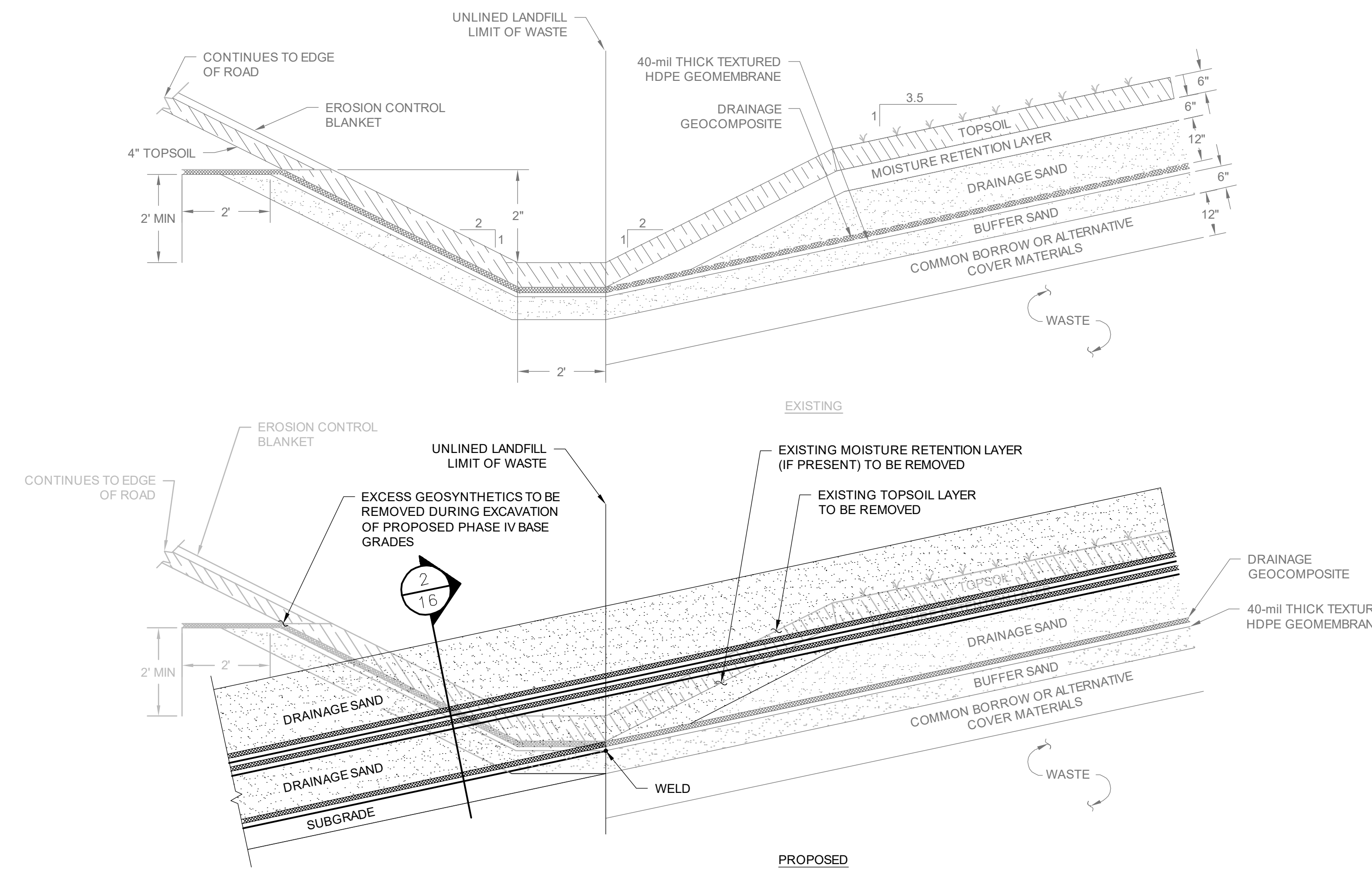
PERIMETER BERM (TYP.)

4
NOT TO SCALE



OVERLAY LINER SYSTEM BASE AREA SECTION

5
NOT TO SCALE



ABOVE-CAP MONITORING SYSTEM TIE-IN DETAIL

E 6
NOT TO SCALE

- NOT FOR CONSTRUCTION -
FOR PERMITTING PURPOSES ONLY

SANBORN HEAD

SCALE AS INDICATED

NO.	DATE	DESCRIPTION	BY
E	02/10/2022	ADDED ABOVE-CAP MONITORING SYSTEM TIE-IN DETAIL	

DRAWN BY: L. ZUCHOWSKI
DESIGNED BY: E. GALVIN
REVIEWED BY: E. STEINHAUSER
PROJECT MGR: E. GALVIN
PIC: E. STEINHAUSER
DATE: JANUARY 2022

PHASE IV DESIGN DRAWINGS
TYPE I-A PERMIT MODIFICATION APPLICATION
FOUR HILLS LANDFILL
CITY OF NASHUA
NASHUA, NEW HAMPSHIRE

LINER SYSTEM DETAILS

PROJECT NUMBER: 3066.11
SHEET NUMBER: 17 OF 30

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SANBORN HEAD

Building Trust. Engineering Success.

OPERATING PLAN

PHASE IV EXPANSION

Four Hills Landfill
Nashua, New Hampshire
Solid Waste Permit No. DES-SW-SP-95-002

Nashua
NEW HAMPSHIRE'S GATE CITY

Prepared for the City of Nashua
File No. 3066.11
~~*July 2020*~~*February 2022*

City of Nashua, New Hampshire

Four Hills Landfill

Operating Plan

Phase I/II/III/IV Secure Landfill Expansion

August 2007
Revised January 2008
Revised August 2008
Revised May 2011
Revised June 2012
Revised November 2012
Revised February 2013
Revised June 2013
Revised April 8, 2019
Revised January 6, 2020
Revised July 2020
Revised February 2022

Prepared For:

City of Nashua
Division of Public Works
9 Riverside Street
Nashua, NH 03062

City of Nashua, New Hampshire

Nashua Four Hills Landfill: Phase I/II/III/IV Secure Landfill Operating Plan

August 2007
Revised January 2008
Revised August 2008
Revised May 2011
Revised June 2012
Revised November 2012
Revised February 2013
Revised June 2013
Revised April 8, 2019
Revised January 6, 2020
Revised June 2020
Revised February 2022

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APPENDICES

Appendix A	Sequenced Filling Plans, Revised July 2020
Appendix B	Sequenced Gas Collection System Plans, Revised February 2013
Appendix C	Technical Specifications, Revised February 2013
Appendix D	Industrial Discharge Permit
Appendix E	Alternate Leachate Disposal Site
Appendix F	Removed May 2011
Appendix G	Locus Map – Four Hills Recycling Center

By Reference: Phase IV Type I-A Permit Modification Drawings, prepared by Sanborn, Head & Associates. Inc. of Concord, New Hampshire, dated July 2020; Phase III Construction Drawings, prepared by Sanborn, Head & Associates, Inc. of Concord, New Hampshire, dated December 2017, Revised ~~July 2019~~February 2022, and Phase I and Phase II Construction Drawings prepared by CMA Engineers of Portsmouth, New Hampshire.

Section 1

FACILITY IDENTIFICATION

Facility Name: Nashua Four Hills Landfill
Phase I/II/III/IV Secure Landfill Expansion

Mailing Address: City of Nashua
Division of Public Works
9 Riverside Street
Nashua, NH 03062
Phone: (603) 589-3140

Location: 840 West Hollis Street
Nashua, New Hampshire 03062

Permittee: City of Nashua, NH
Division of Public Works
9 Riverside Street
Nashua, NH 03062
Phone: (603) 589-3140

Permit No.: DES-SW-SP-95-002

Service Type: Limited

Operator: City of Nashua, NH
Division of Public Works, Solid Waste Department
9 Riverside Street
Nashua, NH 03062
Phone: (603) 589-3410

Capacity: The Phase I Expansion of the Nashua Four Hills Landfill is a lined landfill with a capacity of approximately 857,000 cubic yards (cy) of solid waste. The Phase I portion of the landfill consists of three stages with the volumes shown in Table 1.1.

The Phase II Expansion of the Nashua Four Hills Landfill is a lined landfill with a current capacity of 1,451,000 cubic yards of solid waste with an additional estimated 218,000 cy of soil for daily cover and intermediate cover requirements.

The Phase III Stage 1 expansion area volume is shown in Table 1.1. The estimated life of Phase III Stage 1 was estimated assuming a waste acceptance rate of 80,000 tons per year s, and a waste density of 1300 lb/cy (AUF of 0.65 tons/cy). Actual life will vary with tonnage, waste density, compaction, and cover soil use.

The Phase IV Expansion is a lined landfill will a proposed disposal capacity of 3.9 million cy. Actual life will vary with tonnage, waste density, compaction, and cover soil use.

TABLE 1.1: Capacity Summary

Phase / Stage	Capacity (CY)	Cumulative Capacity (inclusive of cover material) (CY)	Estimated Life (years)	Cumulative Life (years)
I/I	174,000	174,000	1.1	1.1
I/II	288,000	462,000	1.9	3.0
I/III	395,000	857,000	2.6	5.6
II/I	680,000	680,000	4.0	4.0
II/II	989,000	1,669,000	5.5	9.5
III/I	1,056,000	1,056,000	8.6	8.6
IV/I	1,499,000	1,499,000	12.2	12.2
IV/II	862,000	2,361,000	7.0	19.2
IV/III	730,000	3,091,000	5.9	25.1
IV/IV	809,000	3,900,000	6.6	31.7
			TOTAL PHASES I - IV LIFE	**55.4**

Section 2

ACCEPTABLE AND PROHIBITED WASTES

The secure expansion to the Nashua Four Hills landfill will be used for the disposal of mixed municipal solid waste from sources within the City of Nashua.

Acceptable wastes will include waste materials which are currently disposed at the existing landfill on the site, or otherwise are produced within the service area and meet state and federal restrictions for disposal in solid waste landfills, and may include:

- Mixed waste from residential, commercial, institutional, and industrial sources;
- Construction and demolition waste (C/D);
- Bulky waste;
- Street sweepings;
- Brush/Stumps (periodically);
- Digested wastewater sludge, grease, and grit from the Nashua WWTP (as a contingency and under a separate permit modification), and;
- Asbestos waste.

It is noted that the City will be voluntarily restricting C/D waste from the landfill as practicable.

Data from the landfill scales indicates that disposal of digested wastewater sludge, grease, and grit in the landfill averages approximately 320 tons per year. Increases to over 1,000 tons per year could occur due to operating, maintenance or equipment issues at the wastewater treatment plant.

Unacceptable wastes will include materials which may not be reasonably managed at the facility or which are not allowed for disposal by applicable regulations. Such materials will include, at a minimum:

- Hazardous waste as defined by Federal or State regulations which are in quantities and forms unsuitable for disposal in RCRA Subtitle D landfills;
- Polychlorinated biphenyls (PCBs) that are regulated under the Toxic Substances Control Act, as amended (ref. 40 CFR Part 761);
- Chlorofluorocarbons (CFCs), as prohibited by Title 6 of the Clean Air Act, as amended (ref. 40 CFR Part 82);
- Containerized liquids or drums;
- Explosive material;
- Highly flammable material;
- Untreated medical or pathological wastes;
- Whole tires;
- Bulky metals;
- Leaf and yard waste;
- Source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended, and;
- Other materials precluded by applicable regulations.

Recyclable wastes are accepted at the Four Hills facility from residential and commercial sources within Nashua. These materials are managed, collected, stored and transferred to off-site recycling facilities for processing. These wastes include:

- Mixed containers (glass, #1 plastic, #2 plastic, aluminum cans, and metal containers)
- Mixed paper (newspaper, cardboard, magazines, office paper, books, etc.)
- Scrap metal (ferrous and non-ferrous metals, and other incidental non-metal components, such as lawn mowers, household appliances, wire, cable, metal furniture, etc.)
- Used oil
- Lead acid batteries
- Tires

Universal wastes are accepted from residents of Nashua. These wastes are collected, stored and managed consistent with Chapter Env-Sw 1100 of the New Hampshire Solid Waste Rules, and are shipped off site for recycling. These wastes include:

- Video display devices
- Used anti-freeze
- Fluorescent lamps
- Mercury containing devices
- Rechargeable batteries (except lithium ion batteries)

To conserve landfill capacity, some C&D waste may be diverted from the landfill for off-site recycling. Loads containing 10% or more C&D waste may be diverted to a designated area at the Four Hills facility. Carpet and other undesirable materials will be removed and the remaining C&D (primarily wood, metal, masonry, plastic, and gypsum wall board) will be loaded into trailers and transferred to an off-site recycling facility.

Recyclable and universal wastes are collected and stored at the Four Hills Landfill Recycling Center. This area of the facility, as well as the scrap metal storage area and C&D diversion area are shown on the Locus Map in Appendix G.

Section 3

ROUTINE OPERATIONS

3.1 GENERAL

This facility operating plan provides an outline of the procedures for the operation of the proposed Nashua Secure Landfill Expansion. Operations are outlined to be environmentally sound, in accordance with the standards, regulations, and guidelines of the NHDES Waste Management Division (particularly Env-Sw 800, and related sections, including Env-Sw 1105).

Additional information with respect to operations is contained in the Phase IV Type I-A Permit Modification Drawings, dated July 2020, and revised in February 2022, the Phase III Construction Record Drawings, dated ~~December 2017~~April 2020, ~~Revised July 2019~~ and the Phase I/II Record Drawings. Specific information is presented herein on waste delivery, handling and placement, compaction, cover systems, staffing and general maintenance, site management, leachate management, contingencies, and other issues.

This plan addresses operations based on current expectations and the "state-of-the-practice." For operations to remain most effective, the operating history will be reviewed periodically and procedures adjusted as warranted. Any temporary or permanent departures of significance from the procedures outlined herein shall be coordinated with the NHDES, in accordance with provisions of permits obtained for the facility. Operations will remain flexible so that activities which would be adversely affected by inclement weather conditions or other temporary conditions will be avoided during those periods.

Copies of the facility's permits, and the approved operating plan, as may be updated from time to time, will be available at the facility at all times. The permit will be posted at a prominent location at the facility.

The landfill, at all times, is intended to be operated in full compliance with the applicable provisions of the New Hampshire Solid Waste Rules and other applicable state or federal regulations.

3.2 WASTE DELIVERY

Solid waste is anticipated to be delivered to the landfill primarily in packer trucks operated by the City of Nashua and commercial haulers, which will include mixed municipal waste from the City. Individual small deliveries will generally be excluded, being accepted only by special arrangement. Regular deliveries of small loads will be accepted in open-top containers to be provided at the residential drop-off facility, located near the entrance to the site.

C/D waste will be delivered in municipal and privately-owned vehicles, commonly dump trucks or open top roll on/roll off containers. C/D waste will be segregated from municipal solid waste and stockpiled at a designated area of the facility. Separation of C/D waste materials will occur as practical to recover scrap metal and clean wood, and remove mixed in municipal solid waste and other un-recyclable materials. In general, C/D material will be loaded out in bulk form to an approved C/D recycling facility. Un-recyclable C/D waste and mixed in municipal solid waste will be transported to the landfill for disposal.

Grease and grit from the Nashua Wastewater Treatment Plant will be accepted for disposal in the landfill. Digested wastewater sludge will generally be delivered only as a contingency to other off-site management options. Grease, grit, and/or sludge will be transported in enclosed containers having 18 to 24-cy capacity. Plant personnel will coordinate with landfill personnel so that the operators are aware of the delivery and can coordinate the delivery with other landfill operations. Deliveries will be weighed at the scales and then proceed to the landfill. Grease, grit, and/or sludge will be deposited within the landfill adjacent to the area of the working face for the operating day. This material will be covered with municipal solid waste, soil or other approved alternate daily cover (except tarps) in a timely manner to mitigate odors.

The landfill will accept deliveries up to six days per week during hours which will not typically exceed 7:00 a.m. to 5:00 p.m. on weekdays, and 8:00 a.m. and 1:00 p.m. on Saturdays. Operations will be generally limited to daylight hours between 6:00 a.m. and 6:00 p.m. On a normal basis, deliveries of waste will be scheduled such that the landfill will be open during a limited period; on the order of nine hours per day. In the event of the occurrence of extreme weather or emergency conditions, or other possible reasons, the City may, on a temporary basis, accept deliveries outside the normal delivery schedule. No deliveries of waste will be allowed when the landfill is not attended by City landfill personnel.

Deliveries to the landfill site shall be made as deliveries are currently being made via the City road network to West Hollis Street, to the existing landfill entrance road. The landfill entrance has a sign which identifies the facility, permit holder, emergency telephone number, operating hours, and a list of solid wastes banned or restricted. The landfill entrance gate shall be closed and locked when the landfill is not open for waste deliveries.

Upon entering the landfill site, waste delivery vehicles will proceed across the existing platform scale and scale house to be weighed and checked in. Records will be kept at the site of all deliveries including date, time, vehicle and/or container number, and weight of waste. From there, vehicles will be directed by appropriate signage and operating personnel along on-site access roadways to the active stage of the landfill. The vehicles will exit the site using the same route. Waste shall be delivered only to locations within the permitted vertical and horizontal limits of the landfill at which active operations are occurring.

3.3 PERSONNEL AND EQUIPMENT

The City intends to continue to operate the landfill with municipal employees under the Nashua Division of Public Works. At its option, the City may choose to contract with a private firm for portions of facility operations. The staffing description below is generally applicable to either option, in terms of on-site personnel and general management. It is recognized that contracting with a private entity for any functions will not relieve the City of all of its operational responsibilities as outlined herein and in appropriate permit conditions.

The landfill gas collection system in the existing unlined landfill and Phase I/II landfill expansion, and gas combustion flare are owned and operated by the City. A private firm, under a gas lease agreement with the City, operates the gas to energy facility on the site.

The landfill staff will generally consist of supervisory staff, a scale operator, equipment operators and

laborers and security personnel. In addition, other municipal employees will be available, under the direction of the Division of Public Works, for supplemental labor on an as-needed basis. The landfill supervisor will be responsible for operating and managing the landfill on a day-to-day basis. The landfill supervisor and equipment operators will have experience in the operation and maintenance of heavy equipment and have appropriate certifications pursuant to the requirements of the NH Solid Waste Rules. The City will continue to maintain adequate security during non operating hours by utilizing remote monitored cameras installed at the site. Staff will be on-site at all times during periods of waste delivery, to perform the duties described below, and other actions as required:

- Direct the deliveries of waste to the appropriate location at the active working face;
- Inspect the delivered wastes;
- Place and compact waste, and apply daily cover as required;
- Place and compact intermediate cover systems;
- Monitor and maintain leachate collection, piping, and storage systems;
- Maintain records of waste deliveries;
- Maintain on-site surface drainage facilities;
- Maintain equipment on a daily basis;
- Monitor and maintain the landfill gas collection and control system;
- Coordinate with the operators of the gas to energy facility as necessary; and,
- Monitor leachate discharge to the City sewerage system, in accordance with the leachate management plan.

Administrative and management support will be provided by the City through its Division of Public Works. Those personnel will be under the direction of the Solid Waste Department of the Division of Public Works. The Superintendent of the Department will be assisted by the Department's environmental engineering technician in landfill operations.

The landfill equipment will include steel-wheeled articulated landfill compaction machines equipped with a front end blade modified for trash placement, to be owned or leased by the City. The machines will be used for placement and compaction of waste, daily cover, and placement and compaction of intermediate cover systems. Other major equipment to be utilized includes a D-8 dozer (or equivalent), large capacity construction dump trucks, and water truck. Arrangements will be in-place for lease of key equipment during downtime. Other equipment will include auxiliary pumps, tools, and incidental equipment. A spare parts inventory will be maintained by the City for day-to-day maintenance. The City will establish arrangements for a watertight tank truck, to be City-owned or available on a contract basis, for the contingency pumping and hauling of leachate to off-site disposal locations, in the event discharge on-site to the City's sewerage system must be interrupted. Periodically, the landfill supervisor may arrange for additional equipment and personnel for significant operations of limited duration, which may include excavation and stockpiling of soil cover material, actions for establishment of intermediate or final cover systems, and any contingency actions.

All equipment should be maintained in accordance with the manufacturer's recommendations regarding daily and periodic maintenance.

3.4 LIFT CONSTRUCTION AND LANDFILL COVER

Lift construction will proceed in a manner generally consistent with the plans developed for the facility. Using survey equipment and control as necessary and appropriate, the City will maintain accurate elevation information as lifts are constructed to assure that sequenced development continues in accordance with the final landfill plans. The City will maintain boundary markers located at the bottom liner anchor trenches to assure that waste is not deposited outside of the bottom liners.

Survey control will be established for each lift to delineate the limits of the 500-foot residential setback included in the permit, as well as final grades above the anchor trench elevation. Survey control will be overseen by a qualified person, and reviewed by a licensed engineer.

The procedures outlined below describe the general actions and methods planned for filling of the landfill. Detailed lift sequencing design to guide the construction of lifts are shown in Appendix A.

3.4.1 Waste Handling and Placement

3.4.1.1 General

Waste delivered to the landfill will be directed to the working face where it will be deposited and compacted.

Wastes which may be accepted at the landfill include municipal solid waste, construction and demolition debris, non-recyclable residential bulky wastes, street sweepings, screenings, grit, scum and grease, digested sludge, and other non-hazardous municipal wastes as may be appropriately handled.

Wastes excluded will be containerized liquid waste, hazardous waste, non-treated medical/pathological waste, radioactive waste, whole tires, bulky metal wastes, leaf and yard waste, and wastes which are not to be accepted in accordance with applicable state or federal regulations.

Upon delivery to the landfill, waste will be deposited at the working face and compacted using several passes of the steel-wheeled landfill machine. In general, daily deposits of waste will be limited to the smallest practical area (generally 50' x 50'). Waste will be pushed to a final cell configuration with approximately a two horizontal to one vertical (2H:1V) side slope. In general, waste layers of two to three feet thickness will be placed with successive passes of the compacting machine. Placement of numerous layers will establish the total daily deposit. A minimum of four passes of the compacting equipment will be made over each 2 to 3-foot thick layer of waste. In-place waste densities are anticipated to be approximately 1,200 lb/cy, based on measurements and evaluations of existing operations.

3.4.1.2 Asbestos

The City, at its option, may accept wastes containing asbestos at the facility. Such wastes will generally be in small quantities. Deliveries of asbestos-containing waste will be by arrangement and will be received as previously packaged and labeled.

Prior to receiving asbestos-containing waste, the landfill operator will prepare a disposal area within the permitted area to allow the waste to be placed and covered without the release of asbestos fibers to the air and without direct contact between the asbestos waste and personnel and equipment. The containers of waste will be unloaded in such a manner as to prevent the release of asbestos fibers, personal exposure to asbestos fibers, and direct contact with asbestos fibers by personnel and equipment. Water will be used as necessary to maintain wet placement of asbestos waste. Following the placement of waste in the disposal area, asbestos waste shall be covered with at least a 3-foot thick layer of non-asbestos waste, or an 18-inch thick layer of soil. The Four Hills Landfill will compile records to include a map of the disposal area identifying the location, depth, area, and quantity of asbestos waste landfilled at the facility.

The co-disposal of asbestos waste will comply with the requirements of Env-Sw 901.04, and applicable Federal regulations.

3.4.1.3 Hot Loads

Hot loads may be caused by improper disposal of ashes and coals in trash, or chemical reactions caused by improper disposal of hazardous materials.

In the event that a vehicle with a hot load enters the facility, it will be diverted to the Nashua Fire Rescue training ground. The load will be dumped on pavement near the existing fire hydrant. Nashua Fire Rescue will be called and landfill personnel will assist fire crews in extinguishing the fire.

3.4.2 Waste Inspection

The equipment operator at the working face will provide continuous observation of discharging loads of waste. Observations will include assessing loads for the obvious presence of unacceptable waste. The level of observation will not provide for complete inspection of all parts of every load, although most loads will be observed.

Material which is identified as unacceptable for landfilling will be immediately removed from the fill. In general, the hauler bringing such material will be responsible for removal. In the event the hauler cannot be identified, the City will be responsible for removal and proper disposal. The removal of unacceptable material will be conducted such that the hauler, or anyone else involved with the removal of unacceptable material, is not put at personal risk.

Each incoming load of waste crosses the facility scales and is recorded with respect to amount, type, and generator. In the event that the delivered waste must be removed due to its unacceptability for landfilling, such waste will similarly be weighed, identified, and recorded. In general, unacceptable waste will be removed during the operating day in that it was identified. The storage capacity will be limited by a designated "set aside" area near the working face of the landfill. In general, this capacity will be limited to 10 to 20 cy. As soon as landfill operators determine that unacceptable waste is present, the operators will move the waste to the set-aside area. The operations manager will be notified and the transport and final disposal location will be determined. If the City directly disposes unacceptable waste at remote locations, the City will determine that the disposal/management facility is permitted for such use, the transportation method is acceptable, and record the amount of waste deposited. The City will keep records of any

contingency disposal which may occur.

3.4.3 Construction of Initial Lifts

Heavy equipment will be restricted from traveling directly on the 18-inch thick sand drainage layer directly over the primary liner. Operating equipment and vehicle deliveries will access new daily cells by traveling only on waste that was previously placed and compacted or, where that is not possible, on a 24 to 30-inch thick layer of compacted gravel installed above the 18-inch thick sand blanket.

The first landfill lift to be constructed above the 18-inch thick sand blanket will be a minimum of ten (10) feet thick throughout all areas of the landfill and shall be constructed carefully so as not to damage the geomembrane liner below. Prior to depositing waste on the sand, the load will be deposited over previously landfilled waste, when possible, and spread out. Any large metal objects such as rods or other potential items that may puncture the liner will be removed. The waste will then be placed on the sand layer and compacted using only one pass of the operating equipment.

For the initial lift over any stage, a single lift thickness will generally be ten (10) feet. If damage to the liner or leachate collection pipes is suspected in any way, waste shall not be placed and the liner and/or pipes shall be inspected and repaired.

3.4.4 Subsequent Lift Construction

Subsequent landfill lifts will be constructed with a total lift height of six (6) to eight (8) feet. The working face should have a width of about fifty (50) feet with a final slope at the face at the end of the day of about two horizontal to one vertical (2H:1V). Each two (2)-foot thick layer of waste should be compacted with four (4) passes of the steel-wheeled landfill machine. The lifts are to be constructed over a minimum horizontal area to the grades described in the drawings in Appendix A, to allow runoff over the perimeter berms, after the installation of intermediate or temporary cover.

3.4.5 Cover Systems

No less frequently than at the end of each working day, at least a six- (6-) inch thick layer of daily soil cover shall be applied on the active waste disposal areas utilizing soil or approved alternative daily cover materials. Sources of soil may be from excavations or stockpiles of previous excavations on-site, or from off-site sources. A working stockpile of a minimum of one to two weeks' capacity of daily cover material will be maintained on or near the landfill footprint at all times. Cover materials will be applied in a manner and at the frequency required to achieve the following performance objectives:

- Limit the dispersal of offensive odors;
- Limit the potential to attract and harbor vectors;
- Control drainage;
- Control unsightly conditions;
- Reduce the potential for fire;
- Provide stability; and,
- Assist in the proper development of final grades.

~~On-site soil (glacial till) is anticipated to be satisfactory for much of this daily cover requirement and to achieve the performance objectives listed above.~~ Material with ~~more~~ sand/gravel may be generated from

on-site sources or brought from off-site for areas of equipment movement and traffic, particularly during wet periods. The City also regularly uses sand, till, wood chips, or compost materials for daily cover.

The City currently uses approved alternative daily cover (ADC) from several sources and plans to continue to use ADC as sources become approved, and its use is effective. The use of ADC is subject to NHDES Solid Waste Management Bureau (SWMB) approval. Other materials, such as foam, wood chips, and contaminated soils meeting the requirements of Env-Sw 903.05 may also be used as appropriate, with approval of NHDES. The current list of approved ADC includes:

- Natural soil;
- Street Wastes (catch basin debris, roadside ditch soils, street sweepings, and asphalt grindings)
- Wood chips;
- Compost pursuant to Env-Sw 1503.10;
- Bottom ash from wood fired boilers (NHDES Certified Waste Derived Product No. 10);
- Synthetic tarps (Tarpomatic);
- C/D fines mixed with soil;
- C/D residuals mixed with soil (Certified Waste Derived Product No. 6);
- Non-hazardous, low level contaminated soil, and
- Aggregate for Construction Made with Crushed glass (Certified Waste-Derived Product No. 11).

The waste lifts will be constructed so as to maximize the area capable of discharging uncontaminated runoff over the berms to the stormwater system. For all areas so graded, intermediate cover shall consist of sheets of plastic over a 6-inch thick layer of daily cover, or a 12-inch thick layer of soil material cover. If soil only is to be used as intermediate cover, it shall:

- Be natural soil without contamination;
- Be applied and maintained in areas where active filling will not occur for at least one month or more;
- Be at least 12 inches thick over all waste;
- Be inspected for erosion and damage; and,
- Be promptly repaired.

A stockpile of intermediate cover will be maintained in a manner similar to the daily cover and will be covered by tarps to promote run-off. Contaminated soil meeting the requirements of Env-Sw 903.05 applied in a 12-inch thick layer may also be used for intermediate cover. Contaminated soil may only be stockpiled within the boundary of the landfill.

Certified waste derived products must be used and stored in accordance with their certification.

The use of plastic sheets may be used as a method to promote runoff. The sheets will be anchored using tires, sand bags, soil deposits, or similar means. The sheets will be placed over the 6-inch thick layer of daily cover material. The plastic will generally be fiber- reinforced high-density polyethylene of 10 to 20 mil thickness, or other suitable material. The plastic will be either perforated, or rolled up and reused elsewhere, when landfilling is reinitiated in the area covered by the plastic.

If plastic is used on slopes which are at final grade, it will be placed over the 12-inch thick layer of intermediate cover.

In general, the slope of the intermediate cover system will be between 4% and 15%. On temporary or permanent side slopes within a stage, slopes of 3H:1V to 3.5H:1V will receive cover systems as described above.

3.4.6 Solid Waste Footprint and Soil Fill

Due to the horizontal and vertical configuration of the Phase I and II landfill, liner systems in some areas on both the east and west sides of the landfill extend within 500-feet of residences existing at the time of permitting of this facility. However, placement of putrescible waste will not occur in areas closer than 500-feet to those residences. The Phase III landfill was designed and constructed with the liner system located entirely within 500-foot setback boundary. The Phase IV expansion was designed to be entirely within the 500-foot setback boundary.

This limitation of the landfill footprint and waste containment area will be accomplished by maintaining horizontal control of lifts in these areas. Lifts of waste will end at the 500-foot limit. The landfill operator will construct a concrete block wall lined with geomembrane at the 500-foot residential offset, the design of which was approved in 2013.

Within the 500-foot residential offset, each lift will be completed with soil or other NHDES approved fill materials. As sequential lifts are completed, a vertical separation between waste and soil/fill will be established within the liner system.

Operationally, the following specific considerations are part of the operating plan:

3.4.6.1 Horizontal Control

The landfill supervisor will be assisted by a qualified person, with review by a registered professional engineer. The required limit of waste which will become the landfill "footprint" will be clearly marked by grade stakes, flagging, or other monumentation. Each lift will have such control, in areas where the liner anchor trench is within 500-feet of pre-existing residences.

3.4.6.2 Concrete Block Wall

A. Completion of Lifts:

In areas where the concrete block wall is to be constructed the waste lift will be terminated about 10 feet from the 500-foot residential setback unless the preceding lift of the concrete block wall is present. Once the concrete block wall is constructed and lined, the waste fill may extend to the concrete block wall. The vertical elevation of the lift will be extended to the limit of the liner system (at that elevation) inside the 500-foot residential setback with common borrow fill or NHDES approved fill material that meets the filling specifications. The differential elevation on either side of the concrete block wall (i.e., waste or common borrow fill) should not exceed 5 feet.

B. Concrete Block Wall Footings:

- Footing above liner:
  In locations where the concrete block wall is to be constructed directly above the existing drainage sand, a screened till footing at least 8-feet wide will be constructed. Screened till for the footing will meet liner-quality permeability of $1x10^{-7}$ cm/sec. The requirements for placing and compacting the screened till are included in Section 02223 of Appendix C. A detail of the footing is provided on Figure FS-12 in Appendix A.
- Footing in existing soil wall:
  In locations where the concrete block wall will be constructed on top of the existing soil wall, a 12-inch deep trench will be excavated into the top of the soil wall to seat the concrete block. A detail of the footing is provided on Figure FS-12 in Appendix A.

C. Concrete Blocks:
Concrete blocks will be used to support and anchor the geosynthetic liner and non-woven geotextiles at the 500-foot residential setback. Details of the concrete blocks and installation are shown on Figure FS-11 in Appendix A.

D. Waste/Concrete Block Interface:
A nonwoven geotextile will be installed on both sides of a smooth 60-mil HDPE geomembrane at waste/concrete block interface. Details of the installation are shown on Figure FS-11 in Appendix A. Specification for the geotextile and geomembrane is included in Sections 02275 and 02550, respectively, of Appendix C.

E. Select Waste Near Waste/Concrete Block Interface:
The landfill operator will selectively place MSW within 10 feet of the waste/concrete block interface.

F. Common Borrow Fill Lifts:
When a common borrow fill lift intersects the select drainage sand, the common borrow fill will be graded to drain toward the waste at the footprint boundary. When a common borrow fill lift is vertically above the liner anchor trench, the lift will be graded to drain to the site stormwater system outside the liner area.

The Landfill operator will place common borrow fill or other NHDES approved fill materials in the fill area behind the 500-foot residential setback. The requirements for the common borrow fill or other NHDES approved fill materials to be used as fill behind the low permeable soil are described in Section 02223 of Appendix C.

G. Concrete Block Wall/Final Cover System Interface:
The concrete block wall will terminate 2-feet vertically below the intermediate cover component of the final cover system. A 12-foot wide section of geogrid will be installed along with a 2-foot thick layer of screened till. The final cover system will be installed above the Screened Till. Details of the concrete block wall/final cover system interface are shown on Figures FS-11 and FS-12 in Appendix A.

3.4.7 Landfill Gas (LFG) Collection System

The existing active landfill gas collection and conveyance system (GCCS) includes gas collection trenches, gas extraction wells, and associated well heads, conveyance pipe, and condensate handling components. A vacuum is applied to the GCCS conveyance pipe network from a blower station located within the landfill gas to energy (LFGTE) facility. A description of the individual GCCS components is provided below. Locations of existing GCCS components are shown in Figure LFG-2 in Appendix B.

As provided in the City's Additional Design Information letter to the NHDES, dated April 10, 2019, gas collection trenches will be installed within the waste mass at a horizontal spacing of approximately 100 feet and a vertical spacing of approximately 40 feet. Vertical gas extraction wells will be installed as the final waste grade is reached or as needed in both Phases I through III. Lateral pipe will be installed to connect the extraction features to the main header pipe as needed. Figures in Appendix B show the approximate layout and spacing of the LFG extraction features and piping.

3.4.7.1 Gas Collection Trenches

Gas collection trenches typically consist of perforated HDPE pipe installed in trenches excavated in the waste and bedded in aggregate. The extraction of gas from the trenches is controlled at a wellhead as described in Section 3.4.7.4.

3.4.7.2 Surface Collection Trenches

Surface collection trenches will be installed by the landfill operator on an as needed basis to control fugitive emissions and odors from the landfill surface. Surface collection trenches typically consist of perforated ADS pipe installed in trenches excavated in the waste, bedded in aggregate, and backfilled to the surface with intermediate cover. The extraction of gas from the trenches is controlled at a wellhead as described in Section 3.4.7.4.

3.4.7.3 Vertical Gas Extraction Wells

Gas extraction wells, constructed of schedule 80 PVC pipe, are installed in bore holes drilled to various depths within the waste. Gas extraction wells are typically drilled to a depth of about 15 feet above the liner system. The well screen is slotted to a depth of about 15 feet below the permitted intermediate cover grades to the base of the well. The slotted portion of the well is backfilled with large diameter aggregate.

3.4.7.4 Wellhead Assemblies

The wellhead assemblies are located between each gas extraction point (e.g., gas collection trench, well, or perimeter vent) and the gas conveyance system pipe. Using a valve, hose, fittings, sampling ports, and taps, the wellhead assemblies allow for:

- Differential settlement between the tie-in header and the well;
- Sampling of LFG;
- Measurement of the LFG extraction flow rate;
- Measurement of the LFG temperature; and
- Access to the well from the top for equipment or measurements.

The wellheads should be monitored on a regular basis to observe their general condition, with particular attention to the condition of the flexible hose between the well and the conveyance pipe. Additional data to be gathered includes:

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

3.4.7.5 Conveyance Pipe

LFG from the extraction points is conveyed through buried HDPE pipe to the LFGTE Facility. Condensate formed in the conveyance pipe is directed to a condensate trap or condensate knockout pot for removal.

3.4.7.6 Isolation Valves

Butterfly valves located at strategic locations along the conveyance pipe are to be used to isolate sections of the GCCS for maintenance. The valves should be monitored on a quarterly basis and exercised to confirm that they are operable. The valve position (percent open) shall be noted before and after the valve is exercised.

3.4.7.7 Condensate Management

LFG contains a high concentration of moisture that when cooled becomes condensate. The GCCS includes features designed to remove condensate that forms within the conveyance pipe network and discharge the liquid into the landfill's leachate management system using traps and condensate sumps.

Condensate management features are located at the low points in the landfill gas conveyance pipe network. 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 in the trap must be at least as high as the maximum vacuum obtainable in that portion of the system. Condensate sump manholes are structures located outside the landfill that drain by gravity or incorporate pumps to convey the liquid.

3.4.7.8 LFG Conveyance Pipe Manholes and Condensate Sumps

The Landfill operator will monitor and record the operation of condensate sumps #4 and #5 (located in Manholes #4 and #5 (MH-4 and MH-5), respectively) on a weekly basis. The sumps are located in the main LFG collection header from the Phase I/II landfill. (As part of the Phase IV Expansion, the LFG conveyance pipe network will be modified (see the Type I-A Permit Modification Drawings) and MH-4 and MH-5 will be eliminated. This Operating Plan will be revised again as part of a Type II Permit Modification Application associated with the initial construction of Phase IV.) The exterior of the sumps will be visually inspected for leaks and general condition of the pump and equipment. The pump counter readings will be recorded. The differential pressure

measurement across the manholes will be recorded based on the available vacuum readings taken from the LFG header pipe on either side of the manhole.

Interior inspections of the sumps and pumps are not possible while the LFG collection system is in operation. Interior inspections can occur only when the landfill gas to energy facility is shut down. Therefore, interior sump inspections are performed only if vacuum and gas flow readings indicate a problem. Replacement pumps are kept on site so they can be replaced quickly in the event of a failure.

Corrective action will be taken if there are indications that the header pipe is blocked based on the results of the weekly inspections. Interior inspection of the sumps will be performed and accumulated sediment or condensate will be removed from the sumps to allow optimum operation of the LFG collection system, as required. Sediment removed from the sumps will be disposed of within the active landfill; condensate will be discharged to the municipal sewer. A summary of corrective actions performed will be included in the quarterly operating report.

3.4.7.9 LFG Well Dewatering Pumps

Compressed air driven dewatering pumps are installed to operate automatically in select vertical gas wells within the Phase I/II landfill. The dewatering pumps discharge to a dedicated condensate main that conveys the liquid to the Phase I leachate collection system at leachate collection clean-out LP-04. To facilitate sustained performance, pump maintenance will be performed regularly, or as needed, in accordance with the pump manufacturers recommendations. Pump hoses and connections will be inspected at least monthly for audible detection of air leaks or blockages, and repaired if needed. The dewatering pumps may be deactivated, removed, or relocated to adjacent wells as site conditions change over time. In these cases, the compressed air lines will be capped or the air valve turned off. Discharge lines (condensate mains) will be maintained for as long as the pumps are operated. Pump cycle counter readings will be recorded during pump inspections.

3.4.8 Bromide Addition to Waste

The groundwater management permit issued for the site in April 2011 was renewed without the requirement to test groundwater samples for bromide. Therefore, bromide addition to the waste mass to create a "trace" in landfill leachate and groundwater is no longer necessary. The details of this requirement were contained in Appendix F, which was removed from the operating plan.

3.5 SURFACE WATER DRAINAGE CONTROL

3.5.1 General

The landfill was designed to prevent surface runoff from outside the secure landfill to enter the landfill area, control erosion and sedimentation due to surface runoff, and control the peak rate of runoff flow off the site. The temporary and permanent drainage facilities include drainage swales, detention basins, and treatment swales. Much of the site drainage system is integrated with the drainage system for the closure of the existing landfills. The operator will maintain the drainage structures to be free of debris and obstructions. The operator shall inspect the drainage structures at least weekly and/or during large storm events and take required steps to remove obstructions and repair any erosion that may occur.

Due to the reduced footprint of Phase III in comparison to Phases I and II, and the geometry of the base grades, Phase III is not divided into separate cells. The leachate management system was sized in order to manage the contingency storm event during the condition when Phase III is initially opened. A temporary slope diversion swale was constructed on the southern Phase II sideslope to divert stormwater runon from Phase II into the Phase III perimeter swale.

Because Phase IV is located between Phases I and II and the closed, unlined landfill, Phase IV was not divided into separate cells. The Phase IV leachate management system was sized in order to manage the contingency storm event during the condition when Phase IV is initially opened. Temporary slope diversion swales will be constructed on the northern slope of Phase I and on the southern slope of the closed, unlined landfill to divert stormwater runoff away from Phase IV.

3.5.2 Operational Conditions

Reserved for future expansions.

3.6 LANDFILL MAINTENANCE

3.6.1 General

Proper facility maintenance is essential to operations. The landfill supervisor shall make a walking tour of the site on at least a weekly basis to inspect the general repair of the drainage ditches and structures, the liner and leachate collection systems, and the access roadways.

Access roads will be maintained in order to promote safety and free flow of traffic. Any potholes or surface roughness in the access road will be repaired properly by regrading and/or addition of compacted gravel.

All landfill equipment and instrumentation will be regularly maintained in accordance with manufacturer's recommendations and as otherwise prudent.

3.6.2 Leachate Collection System

Primary leachate is collected within each phase of the Landfill with perforated collection piping and is ultimately combined at the HDPE manhole located west of Phase I. The existing HDPE manhole connects the primary leachate collection pipe from Phase I through III (and Phase IV once constructed) and discharges it out of the landfill through a single pipe penetration to the leachate pipe which flows to the Flow Control Building and eventually into the municipal sewer system via the Trestle Brook Pump Station as described in Section 4.0.

Similar to the primary leachate, secondary leachate is collected within each phase of the landfill with perforated collection piping located within the secondary liner system. Secondary leachate is discharged out of the landfill through a single pipe penetration located within Phase I where is flows by gravity to the Secondary Witness Tank. From this tank, the secondary leachate is pumped into Leachate Manhole #1 and combined with the primary leachate where it flows to the Flow Control Building as stated above.

Unique to the portion of Phase IV that overlays the Unlined Landfill, is a monitoring system that would collect liquid (if present) between the bottom of the secondary liner system and the geomembrane component of the final cover system (“above-cap monitoring system”). The collected liquid, if any, would

be conveyed to a sump via a perforated collection pipe located at the base of Unlined Landfill slope.

Primary and secondary leachate from Phase III is collected in a sump located in the southwest end of the phase. Pumps within the sump convey leachate to the Phase III Sump Riser Building located on the west perimeter of Phase III. Flow meters within in the building meter the flow of the primary and secondary leachate separately. Prior to exiting the building, the primary and secondary leachate is combined, and then flows through a 4-inch diameter force main to the gravity main that drains into the dedicated Phase III leachate conveyance pipe in Phase II.

For Phase IV, primary and secondary leachate, as well as the above cap liquid, if any, will be collected in ~~a~~ separate sumps located in the west end of the phase. Pumps within the sump will convey leachate to the Phase IV Sump Riser Building located on the west perimeter of Phase IV. Flow meters within in the building meter the flow of the primary and secondary leachate separately. Prior to exiting the building, the primary and secondary leachate, and Phase IV above cap liquid, is combined, and then flows through an 8-inch diameter gravity main that drains to the leachate manhole.

On a weekly basis, the landfill operator shall perform the following inspections:

- Check that the water level recorder in the manhole is functioning properly.
- Check and observe the instrumentation for recording leachate flow to the sewer, and that high-level alarms are functioning properly.
- Open the manhole containing the flow measurement flume, observe flow in primary pipe(s), and sample, analyze, and record data for pH and conductivity utilizing portable meters.
- Check that Phase III Sump Riser Building instrumentation is functioning properly.
- Check that Phase IV Sump Riser Building instrumentation is functioning properly.

If any unusual conditions are observed in the weekly inspections, the landfill operator shall take appropriate action.

If siltation or flow obstruction is observed, the leachate collection pipes should be flushed from the cleanouts by means of contracted hydraulic sewer pipe jetting equipment.

3.6.3 Litter and Vector Control

Vehicle unloading should be controlled such that waste is unloaded at the working face. Delivery vehicles will be covered when entering and leaving the site and daily cover will be applied to limit blowing of waste and to inhibit the attraction of birds, rodents, or other vectors. The operators of the landfill will inspect the landfill area and access road for litter and remove any litter on a regular basis.

A litter fence was installed as part of the Phase II and Phase III construction expansion and should be maintained on a regular basis. The fence is 20 feet high and is located along the western and southern perimeter of the landfill. Portable litter fencing is also utilized at the working face of the landfill. These fence sections are moved with heavy equipment as necessary to capture windblown litter at the working face.

The City has been contracting with the USDA to perform a gull harassment program at the existing facilities since 1995. This program has been effective in reducing the population of gulls and other birds at the

facility. This, or similar programs, will be evaluated on an annual basis to be included as part of operations.

Particular efforts will be extended to ensure that litter does not remain in inactive cells that are discharging to the site's stormwater management system. Measures will be taken to limit windblown litter with the constructed and portable litter fences. Litter will manually be picked up, if necessary. Effective use of daily and intermediate cover will minimize rodent, bird, or other vector problems.

3.6.4 Fire Control

The use of daily soil cover will inhibit or eliminate the potential for fires in the landfill. The potential for "hot loads" to be delivered to the landfill is small. In the event of a "hot load" delivery, the vehicle will be directed to an area outside the landfill, waste discharged, and extinguished by fire extinguishers or covered with soil. The Nashua Fire Department will also be notified. When the waste is confirmed to have no fire potential, all waste will be moved to the landfill. The ground will be scraped in the area of deposit to assure that all waste is moved.

A dry hydrant and wet well was installed at the location of Detention Pond #4 to aid in the fire protection management plan. The submersible screen was installed at elevation 194' and is connected to the dry hydrant by HDPE piping. The dry hydrant is fire truck pump ready to deliver 1250 gpm of fire flow to two hydrants near the active landfill area. See the Construction drawings dated July 2007.

The operator will have the ability to contact the Nashua Fire Department at all times by telephone and/or radio dispatch.

3.6.5 Dust Control

Dust control at the landfill will be achieved through the use of a water truck on landfill roadways. As conditions warrant, the water truck shall be operated to moisten the soils on the unpaved roadways to minimize dust production.

The existing, and all future areas with intermediate cover will be seeded to resist erosion from stormwater and wind.

3.6.6 Odor Control

3.6.6.1 General

LFG is made up of primarily methane and carbon dioxide, both of which are odorless. Landfill odors are generally associated with sulfuric compounds that may be present at relatively low concentrations within landfill gas, such as hydrogen sulfide and mercaptans. If fugitive LFG emissions occur, they may contain these compounds and under certain weather and atmospheric conditions, can cause potential nuisance odors at off site locations.

When such conditions exist, the source of odor-causing LFG emissions may come from any locations within the waste. Odors are associated more with atmospheric conditions than proximity to the landfill. For example odors are often noted at locations at greater distances from landfills than closely abutting properties; determined by migration patterns and not proximity.

Additionally, there may be odors associated with operations at the working face of waste disposal. At this point the anaerobic conditions which create methane, carbon dioxide, and sulfuric compounds are not active, and the potential odors are of a significantly different nature. Such odors typically do not migrate, and are local to the active face.

Atmospheric barometric pressure plays a role in the potential release of LFG, and associated potential for odors. When pressure is rising, gas emissions from landfills generally reduce. When barometric pressure is falling, there is a greater gradient for gas to migrate from within the landfill to the atmosphere. Rising barometer are often associated with clear conditions with atmospheric mixing that attenuates odors. Low pressure may be associated with moist conditions and less mixing under certain circumstances.

Among others, there are two primary approaches to management of LFG and associated odors:

1. Placement and maintenance of effective landfill cover systems that restrict and attenuate gas flow to the atmosphere, and

2. Effective LFG collection systems that collect and combust LFG thereby destroying odor causing compounds.

Additionally, the sulfate content of construction and demolition (C/D) waste is a contributing factor to hydrogen sulfide and reduced sulfur compounds in LFG. As a long-term odor control measure, the City is making plans to significantly reduce or eliminate C/D waste from disposal at the landfill, including any dirt fines received from C/D processing facilities. There is some C/D waste mixed with MSW in the landfilled waste to date. As C/D waste is eliminated over time, the reduced sulfur content of LFG should decline, reducing the odor potential of any fugitive LFG emissions.

Below is described the use of these and associated methods at the Four Hills Landfill.

3.6.6.2 Use of Cover Systems

A. Daily Cover

Daily cover is applied over waste deposits no less frequently than at the end of each working day. The primary material is soil placed over all exposed waste at least 6 inches thick. Alternative daily covers are possible as well, including deployable tarps such as the Tarpomatic system, and soil-like materials from other sources, including contaminated soils, street wastes, bottom ash from wood boilers, and construction residuals. It may also include approved applications of foams or other materials as approved by NHDES. A stockpile of daily cover material adequate for at least one week's worth of operations will be kept on or near the landfill footprint at all times. Daily cover materials will be applied in a manner to achieve the performance objectives of Env-Sw-806.03(a), which includes odor control.

B. Intermediate Cover over Completed Side Slopes

Intermediate cover will be placed over all finished side slopes that are filled to final grade, and over all areas where no additional waste will be placed for at least one month or more. Intermediate cover soil shall be at least 12 inches thick over all waste, be inspected for erosion

and damage, and promptly repaired.

3.6.6.3 Landfill Gas Collection

There is a comprehensive landfill gas (LFG) collection and combustion system at the landfill. The gas collection system in the closed MSW landfill and Phase I/II expansion landfill and combustion flare are owned and operated by the City. The landfill gas to energy facility is owned and operated by EPP Service Company. A gas lease (contract) is in place between the City and EPP Service Co. Headers extend vacuum to a system of laterals which connect to both horizontal and vertical LFG extraction wells. Engine/generator sets recover electric power (up to 2.4 MW), and a flare is also used to combust excess gas when the engines do not combust all LFG.

The NSPS & LFG Collection and Combustion Standards do not apply to this facility[1]. Accordingly, wells and laterals are periodically expanded as filling of waste continues in the expansion.

Performance of the system is measured periodically. Measurements of vacuum and gas quality at each collection well and valve adjustments are made to maintain as uniform a vacuum at all locations as possible. On a monthly or more frequent basis balancing of the collection system will be completed. If positive pressures are measured, that is indicative of more gas being produced that is being collected, or obstructions in laterals. Such conditions will be rectified immediately, to create consistent vacuum conditions throughout the landfill.

3.6.6.4 Expansion of LFG Collection System

The LFG collection system will be periodically expanded as new waste volumes are placed, and the potential for LFG generation and collection is present. A combination of horizontal and vertical collection wells will be placed.

In general, horizontal wells when used will be placed approximately every 40 feet of vertical landfill development, and every 100 feet laterally. Vertical wells, when used, will be on a spacing of approximately 160-180 feet between extraction wells.

The combustion capacity is projected to be sufficient for all four Phases of the landfill, in accordance with modeled total LFG production of both the capped unlined MSW Landfill and the progressive filling of the lined expansion.

3.6.6.5 Excavation of Waste

Construction activities are common at landfills and may involve the excavation or exposure of waste for the installation of pipes and structures within the landfill limits. During construction activities, care will be taken to limit the production of odors. Contractors that perform work at the site will be instructed on proper construction methods for waste excavations to reduce odors during construction events. The instruction on methods will include the following:

[1] Although the NSPS & LFG Collection and Combustion Standards do not apply to this facility, the City complies with the standards and provisions within the facility's Landfill Gas Collection System Enhanced Monitoring Protocol and Standard Operating Procedures (EMP/SOP).

1. Contractors will be required to implement odor control measures during construction activities that involve excavation, trenching, or drilling in landfilled waste.

2. The area of exposed waste as a result of the work will be limited to the degree practical. Trench excavations will be limited to the length of trench that may be backfilled in the same day.

3. Contractors will be required to apply odor neutralizing agent directly onto odorous spoils.

4. Excavated waste will be hauled promptly from the work area to the working face for disposal. Excavated waste must be hauled to the working face before the end of each working day. Work involving excavation in landfilled waste will cease when the working face is closed for the day unless other arrangements were made to have the refuse covered.

5. Contractors will be required to cover areas of exposed waste at the end of each day with approved daily cover, which may be obtained from on-site sources.

6. During the work, contractors will be required to regularly check for odors in the down-wind direction and employ additional odor neutralizing agent if odors are detected.

3.6.7 Health and Safety Requirements

Due to the nature of landfill operations in general, health and safety risks exist. All personnel shall be trained in the proper use of landfill equipment and all operating and safety equipment shall be maintained in good working order. The operating equipment shall be equipped with proper safety apparatus including fire extinguisher, under carriage protection, an enclosed cab, and a radio unit. A telephone, first aid station, and fire extinguishers will be provided in the maintenance building.

All structures that are associated with the landfill and are located below grade are considered confined spaces. These structures include the HDPE manhole, secondary witness tank, and valve chambers. Entrance to these facilities shall only be performed in accordance with procedures for confined space entry as set by applicable regulations and the operators of the landfill.

All personnel should be informed of the proper procedure for contacting appropriate help from off-site in the event of an emergency.

Section 4

BYPASS AND RESIDUAL MANAGEMENT PLAN

4.1 LEACHATE MANAGEMENT PLAN

Phase I/II/III/IV will be a lined, leachate controlled facility. The liner systems will limit precipitation or other moisture which has come in contact with waste in active landfill cells from migrating to the groundwater. Contaminated water that percolates through the landfilled waste, or that otherwise has the potential to contact waste, will be collected in the leachate collection system. Collected leachate will be managed as a wastewater and removed for treatment and disposal.

The plan for managing leachate from the Nashua Four Hills Secure landfill expansion has two basic components, as follows:

As final grades are achieved in portions of the landfill, the permanent, impermeable cap will be installed to preclude precipitation from infiltrating into as much surface area as possible. Low permeability glacial till (from on-site sources) or plastic sheets will be used as intermediate cover over areas brought to final grade prior to final capping systems being installed, as further described in Section 3.4.5. This cover system will direct the majority of precipitation (uncontaminated) from the completed areas to the stormwater management system.

Second, the leachate management plan allows for the discharge of leachate to the Nashua sewerage system for treatment and discharge at the Nashua WWTP, owned and operated by the City. The Nashua WWTP was expanded and upgraded to secondary treatment in 1989. The facility has a design capacity of 16 million gallons/day (MGD) and a current average flow in excess of 10 MGD. A 12" diameter gravity connection to the City's sewerage system was constructed in 1992, and leachate from the existing landfill is currently flowing to, and being treated by, the City's WWTP.

The 18-inch diameter leachate collection pipe exiting Phase I flows via gravity to the Leachate Flow Control Building. The flow through the 18-inch diameter pipe is limited to 0.34 cfs via a pinch valve and is measured in a flume downstream of the valve. A 12-inch diameter HDPE pipe connects the leachate flow from Phases I through III to the 12-inch diameter gravity connection to the City's sewerage system. An industrial discharge permit was approved by the Nashua WWTP and is included in Appendix D.

In the event that disposal of leachate to the City's WWTP becomes unavailable for any reason, arrangements will also be available for contingency disposal through commercial services at remote wastewater treatment facilities in Massachusetts. The remote commercial disposal option is readily available and will be arranged as a back-up to the local disposal option. Prior to commencement of operations, documentation of specific arrangements/commitments for remote disposal will be provided to NHDES SWMB.

The quality of the leachate is expected to vary depending upon rainfall patterns, the nature of the landfilled waste, and the status of operations. Based upon leachate quality data from other MSW landfills, it is anticipated that leachate will have a relatively high organic content (i.e., BOD/COD), compared to domestic

wastewater with concentrations of various volatile organic compounds (VOC's), semi-volatile compounds (A/B/N extractables), metals, and other inorganic contaminants. Review of the Nashua wastewater treatment plant, and the contaminant loading of the proposed discharge versus existing permitted discharge, it is not anticipated that pretreatment of leachate will be required prior to introduction of leachate to the sewerage system and treatment facility.

4.1.1 Description of Leachate Management Facilities

The following is a description of the various components of the leachate management system. Additional information is presented in the Phase IV Expansion Type I-A Permit Modification Application, dated July 2020, the Phase III Construction Drawings, dated December 2017, Revised July 2019, and the Phase I and II Construction Drawings.

4.1.1.1 Liners

The Phase I/II/III/IV landfill expansion consists of a dual liner system. The bottom (secondary) liner is proposed as a composite liner, consisting of a minimum ½-foot thick layer of low permeability select native glacial till (maximum $1x10^{-4}$ cm/sec permeability), directly overlain by a 60-mil thick textured HDPE liner. The bottom of the till layer was installed over a subgrade of native glacial tills which has a relatively low permeability. The 60-mil thick textured HDPE layer is located at least 6 feet above estimated seasonal high groundwater.

The primary liner is a 60-mil thick textured HDPE material overlying a geosynthetic clay liner (GCL) on the base lining system, resulting in a limited composite liner for the primary system. The secondary and primary liners are separated by a 12-inch thick layer of select drainage material within the base lining system limits, double sided drainage geocomposite on the bottom of the landfill, and by double sided drainage geocomposite on the side slopes. This dual liner system exceeds the current requirements of Env-Sw 800 and meets the current federal liner standards in CFR 258.

4.1.1.2 Sand Drainage Layer

A layer of drainage geocomposite and an 18-inch thick layer of select drainage sand with a permeability greater than 1×10^{-4} cm/sec is located over the primary liner to provide a mechanical buffer between the liner and the waste and to serve as a positive means of leachate drainage. The highly permeable sand layer and associated geosynthetic fabrics will serve as a primary hydraulic mechanism for leachate transport to the collection piping system. The hydraulic head on the system is predicted to be much less than 12 inches under normally expected conditions. Phases 1 through IV are equipped with level transducers that will monitor the buildup of leachate within the individual phases.

4.1.1.3 Leachate Collection System

The leachate collection system will consist of the sand drainage layer, leachate collection pipes, and associated select soil/stone and geosynthetic materials.

Three separate primary leachate collection pipes were installed as part of the Phase I construction, one for each of the first three phases of the landfill. Phase IV has its own leachate collection system. This provides for separate collection from each phase. These pipes join at the HDPE manhole at

the low end of Phase I-Stage 1.

Lateral leachate collection pipes were installed in each stage of the landfill. Cleanouts located at the upper end of each stage allow cleaning by means of conventional water jet sewer cleaning equipment.

The piping is HDPE perforated or solid wall pipe, as appropriate. Size of the leachate collection pipes were designed in accordance with the Solid Waste Rules. Piping is designed to convey leachate to the low point of the cell.

A separate collection and piping system was designed and installed for the Phase I and II secondary liner system. The select drainage sand and geosynthetic materials will provide rapid response time for the collection of a leak from the primary liner system meeting the requirements of the Solid Waste Rules. Phase III secondary leachate will be combined with Phase III primary leachate at the sump riser building after being collected and metered. ~~Phase IV secondary leachate will be combined with Phase IV primary leachate at the sump riser building after being collected and metered.~~

An above-cap monitoring system is present within the portion of Phase IV that overlays the Unlined Landfill. The existing Unlined Landfill final cover system materials (i.e., Drainage Sand, geocomposite, and geomembrane) will remain in place and will convey liquid present, if any, between the Unlined Landfill geomembrane cap and the Phase IV secondary liner downslope to a perforated pipe that will direct the liquid to a sump that is separate from the primary and secondary sumps. The above-cap liquid, if any, along with Phase IV secondary leachate will be combined with Phase IV primary leachate at the sump riser building after being collected and metered.

4.1.1.4 Leachate Vaults, Piping, and Storage Tanks

The design of Phase I included leachate flow control devices to limit the maximum rate of discharge to the Nashua sewerage system. Facilities included the following:

- Polyethylene leachate manhole within Phase I-Stage 1, with sump.
- Vault near Phase I, including valves or primary and secondary leachate collection.
- Secondary leachate collection manhole and pump; pump empties manhole into primary leachate pipe.
- Leachate control valving/throttle at flow control building.
- Leachate discharge measurement device downstream of control building.

The leachate flow rate is expected to be approximately 75,000 gallons/day for Phases I through IV. During the contingency storm and other design flow events, the anticipated total discharge rate is 250,000 gallons/day. At these times, the valves in the leachate control building will create hydraulic restrictions to limit flow to the maximum rate, and leachate will be stored in the 18-inch diameter piping between the flow control valve and the landfill, and landfill itself. Hydraulic head will increase temporarily within Phase I-Stage 1 of the landfill, and decrease over seven (7) days to routine levels (less than 12 inches). The landfill itself, and the piping between the landfill and the leachate flow control device, will act as a "tank" during these limited periods. The designed

storage in this system for Phase I is approximately 1 million gallons.

The flow control valve in the flow control building will be adjusted manually to limit flow to the 250,000 gpd maximum. During a combined sewer overflow event, or during an event when the Trestle Brook pumping station wet well level is exceeded, signals/alarms will be evident, and the operator will adjust the valve to store additional leachate within the landfill until the condition has passed.

There is instrumentation for the following, which must be monitored and recorded received by the operator on a daily basis:

- Leachate level in Phase I-Stage 1.
- Leachate level in Phase II-Stage 1.
- Leachate level in Phase III.
- Leachate level in Phase IV.
- Flow level in flume, and associated discharge rate.
- Phases III and IV primary and secondary leachate flow rates (Sump Riser Building Instrumentation).
- Above-cap liquid flow rates (Sump Riser Building Instrumentation)
- High level indicators in the vaults, manholes, leachate structures, and Phases III and IV sumps.

Readouts of these levels will be provided in the leachate control building, and some duplicated in the landfill operations building. The high level alarms will be indicated at the respective locations, and will also trigger an automatic dialer to alert identified responsible personnel. Data will also be made available and recorded through a leachate telemetry, internet-based database system. The following information will be recorded:

- Primary Leachate Flow Rate (gpm) from Siemens Ultrasonic Flow Meter;
- Primary Leachate Flow Totalizer (gallons) from Siemens Ultrasonic Flow Meter;
- Secondary Leachate Pump Flow Rate (gpm) from Foxboro flow meter;
- Secondary Leachate Flow Totalizer (gallons) from Foxboro flow meter;
- Phase III Primary Leachate Flow Rate (gpm);
- Phase III Primary Leachate Flow Totalizer (gallons);
- Phase III Secondary Leachate Pump Flow Rate (gpm);
- Phase III Secondary Leachate Flow Totalizer (gallons);
- Phase I Landfill Head on Liner (ft) from transducer;
- Phase II Landfill Head on Liner (ft) from transducer;
- Phase III Landfill Head on Liner (ft) from transducer;
- Phase IV Primary Leachate Flow Rate (gpm);
- Phase IV Primary Leachate Flow Totalizer (gallons);
- Phase IV Secondary Leachate Pump Flow Rate (gpm);
- Phase IV Secondary Leachate Flow Totalizer (gallons);
- Phase IV Above-cap Liquid Flow Rate (gpm);
- Phase IV Above-cap Liquid Flow Totalizer (gallons); and
- Phase IV Landfill Head on Liner (ft) from transducer.

4.1.2 Leachate Quantity

The anticipated average flow to the Nashua wastewater system is approximately 75,000 gallons a day. During certain operating scenarios, design flows of up to 250,000 gallons/day are estimated, for limited periods. During those periods, leachate concentrations are projected to be significantly diluted. With the recently completed modifications to the Trestle Brook pumping station, there is no hydraulic restriction to these flows in the Nashua sewerage system.

4.1.3 Leachate Disposal

The City of Nashua has a current Industrial Discharge Permit (Appendix D) for discharge of 288,000 gallons per day peak flow and 75,000 gallons per day average daily flow of leachate to the Nashua sewerage system for ultimate treatment at the Nashua wastewater treatment facility. Alternatively, arrangements discussed in this section at another wastewater treatment facility were established as a back-up in the unlikely event of the Nashua facility being unavailable.

Phase I through IV of the secure landfill is connected to the City sanitary sewer system via a gravity line. This gravity sewer serving the site flows to a collector sewer on West Hollis Street, and to the Trestle Brook pumping station. Flow after discharge from the pumping station includes several thousand feet of flow through large diameter collector and interceptor sewers, to the City's wastewater treatment plant.

The Nashua wastewater treatment plant has a design capacity of 16 MGD. The facility currently receives an average daily flow of over 10 MGD. The facility includes grit removal, primary sedimentation, secondary treatment, and disinfection. Combined primary and secondary sludge are dewatered by belt filter process to a solids content of approximately 20% - 25%. An anaerobic sludge digestion system was constructed. Effluent from the facility is discharged to the Merrimack River. Based on data provided by the plant staff, the present BOD_5 loading is estimated to be about 60 percent of the design conditions.

The characteristics of the leachate vary considerably depending upon waste characteristics and specific operating status and conditions, future recirculation practices, and age of the landfilled waste. The current leachate characteristics are presented in the following table, along with the current Nashua WWTP local limits:

TABLE 4.1: MSW Leachate Quality

Parameter	Mean Concentration (mg/l)	Current City of Nashua WWTP Local Limit (mg/L)
BOD_5	371.31	250
COD	640.08	N/A
Total Suspended Solids	100 - 200	300
Antimony	<0.006	N/A
Barium	0.023	N/A
Chloride	205.23	N/A
Sulfate	65	810
Arsenic	0.039	0.16
Cadmium	0.001	0.33
Chromium	0.024	1.85
Lead	0.004	1.20
Mercury	<0.001	0.006
Nickel	0.026	25.57
Selenium	0.026	0.11
Silver	<0.02	0.05
Iron	13.71	N/A
Manganese	3.96	N/A
pH	6.37	6 - 10.5
Specific Conductivity	1976.9	N/A
Bromide	8.491	N/A

The leachate characteristics meet the Nashua local limits, with the exception of BOD. The Nashua Wastewater Department has stated that there is capacity to treat the excess BOD at the plant.

It is noted that the closure plan for the existing landfill includes continued flow of leachate impacted groundwater to a collection pipe beneath the cap. This anticipated flow will be at a much lower flow rate, but possibly higher concentrations, than the existing flow.

In the unlikely event that the Nashua Wastewater Department is not able to accept leachate from the landfill expansion, a local transportation company will be contracted to transport leachate to a final disposal facility. Letters from the hauler and the final disposal facility are included in Appendix E. A pump will be installed in the leachate collection manhole within Phase I Stage 1 to pump leachate from the manhole and the sump area within Stage 1 to trucks waiting on the West Berm Road.

4.2 GAS MANAGEMENT PLAN

Phase I through ~~III~~ IV will generate landfill gas as the waste decomposes over time. As described in Section 3.4.7, the City proposes to expand the existing Phases I, ~~and~~ II, and III LFG collection system into Phase ~~III~~ IV as it is filled, which currently collects LFG from the landfilled waste. Collected gas is combusted in the system by the City owned flare or at the gas to energy facility operated by EPP Services Company.

Section 5

FACILITY MONITORING PLAN

5.1 GENERAL

In accordance with the general procedures outlined in this operating plan, and as are included in facility permits, all key landfill components will be regularly inspected. A general schedule of inspection is included in the following table. Daily, weekly, and monthly inspection forms will be prepared in advance of operations to facilitate the inspection and record keeping.

TABLE 5.1: Inspection and Maintenance Schedule

	Item	Recommended Frequency	Comments
x	Record head on liner	Daily and following storm events	Check head on the primary liner
x	Record leachate discharge rate (primary and secondary)		
x	Visually inspect the following components:	Daily and following storm events	
x	1) Stormwater standpipes		Remove any obstructions including ice/ snow
x	2) Leachate standpipes		Inspect for signs of leakage and overall condition of structure
x	3) Stormwater discharge outlet pipe		
x	4) Valve vault and manholes		
x	5) Drainage swales, culverts, ponds		Remove obstructions and repair eroded areas
x	6) Daily and intermediate cover areas		
x	7) Landfill drainage sand on side slopes and lateral diversion berms		Inspect for bare spots, uneven and eroded areas and repair as needed; and inspect and repair all damage caused by erosion
x	Litter	Daily	Inspect and remove litter from the landfill area and along access roadway
x	Instrumentation and Alarms	Daily	Check tank levels, probes, alarms, enunciator, chart recorder, autodialer
x	Sample and analyze flow at flume (primary flow) and secondary witness tank (secondary flow) and, if present, above-cap monitoring system flow (Phase IV overlay area only)	Weekly	Record the pH and conductivity
x	Operate all gate valves in the landfill and valve vaults	Monthly	Ensure the valves are functioning properly
x	Groundwater Monitoring Wells	Monthly	Inspect for damage
x	Gas Migration Wells	Monthly	Inspect for damage
x	Access Roadways	Bi-annual	Inspect and repair pot holes or surface roughness. Check grading on intermediate and perimeter berms.
x	Landfill Gas Well Dewatering Pumps	Monthly	Inspect for air leaks and or discharge line blockages, record pump cycle counter

X	Equipment (landfill compactor, loader, and pumps)	As required by manufacturer	Perform per manufacturers recommendations
X	Phase Sump Riser Building pumps and meters	As required by manufacturer	Perform per manufacturers recommendations

5.2 GROUNDWATER MONITORING

Groundwater monitoring will be conducted prior to initiating landfill operations, throughout the landfill life and during the post-closure period. The permanent groundwater monitoring wells will be sampled. These include well pairs at nine locations (see Appendix C of the Type I-A Permit Modification Application). Initially, wells will be sampled by a contracted field services/laboratory. In the future, the City may choose to complete these services with properly trained City personnel.

Results will be submitted to the NHDES SWMB in April and November each year. (Other wells on site will be sampled relative to the closure and post-closure monitoring of the existing landfills, on a separate tri-annual schedule.) At a minimum, wells will be sampled for the following parameters:

TABLE 5.2: Groundwater Monitoring Parameters

Specific Conductance @ 25C	Arsenic
pH	Barium
Temperature	Cadmium
BOD	Chromium
COD	Lead
VOCs by EPA Method 8260	
Chloride	Mercury
TKN	Selenium
Nitrate	Silver
Iron	Antimony
Manganese	Nickel
Sodium	Thallium
Sulfate	Beryllium

Water elevations will be recorded when samples are taken.

Samples will be obtained, and laboratory analyses completed in accordance with the requirements in Table 5.2 and of the Release Detection Permit (GWP-840399-N-00~~5~~6) for the project, and may be revised.

5.3 LEACHATE QUALITY MONITORING

At a minimum, in April, July, and November sampling of leachate will be done, with analyses obtained for pH, temperature, COD, BOD, specific conductance, iron, manganese, sulfates, chlorides, eight drinking water metals, antimony, beryllium, nickel, thallium, and VOCs. On a weekly basis, primary leachate will be analyzed with on-site portable equipment for pH and specific conductivity.

When future phases of the landfill are brought into service, separate collection pipes from both the primary and secondary liner systems of each phase will be used.

5.4 SECONDARY LEACHATE COLLECTION MONITORING

The secondary leachate collection system will be monitored regularly. On a weekly basis, the secondary collection system flow rate will be measured, and on-site analyses for pH and conductivity obtained.

Flow collected in the secondary leachate collection system will be analyzed at least weekly for pH and conductivity in the field. Tri-annually, along with primary leachate, composite secondary leachate samples will be obtained and analyzed for the full set of parameters outlined above for primary leachate.

Some secondary flow collection is anticipated. All secondary system flow will be managed as leachate regardless of flow rate or chemical quality. On a monthly basis the average flow rate for the secondary system will be evaluated, and the average gallons/day/acre of active phase of landfill calculated. If the average rate over 30 days exceeds 25 gallons/acre/day (gpapd), the NHDES SWMB will be notified, and evaluation of appropriate responses completed with respect to the Solid Waste Rules, Section Env. Sw 806.08(k).

5.5 ABOVE-CAP MONITORING SYSTEM

The above-cap monitoring system will be evaluated when liquid is present. Some liquid in the above-cap monitoring system is expected as construction water is squeezed out of the system. Although liquid collected in the monitoring system is not expected to be leachate, the collected liquid will be conservatively managed as leachate regardless of flow rate or chemical signature. On a quarterly basis the average flow rate for the tertiary system will be evaluated, which is anticipated to reduce substantially once the secondary liner is installed and welded to the Unlined Landfill cap as each stage is constructed. Laboratory analytical and field parameter testing (pH, specific conductance) data for liquid samples collected from the above-cap system will be evaluated temporally from initial Phase IV construction, through the post construction period when construction water is anticipated to be squeezed out of the system, and during initial Phase IV operation and will be compared with Phase IV primary and secondary leachate data.

5.~~5~~6 LANDFILL GAS MONITORING

Active gas extraction and management is planned for the long- term and will be expanded as gas production increases to collectible rates. This system will be implemented during the operation of the landfill, in advance of closure of the landfill, and be phased. The system will include a system of horizontal gas extraction wells and collection piping connected to the gas-to-energy system on-site. Energy recovery is a component of this system.

The potential for migration of gas through soil from the expansion is anticipated to be negligible. However, to monitor for landfill gas during operation of the landfill, the following measures will be taken:

- Quarterly gas sampling will be done at the existing soil gas monitoring wells for the unlined landfill and Phase I and II landfills, and also at the ~~two~~ nine proposed soil gas monitoring wells to be located along the ~~western~~ perimeter of Phases ~~II~~III and IV. In the unexpected event landfill gas is detected, the sampling locations will be adjusted to provide additional detail.

- Quarterly monitoring will include vaults and leachate control structures outside the landfills.

- If explosive gases are detected that exceed 25% of the lower explosive limits at locations outside the landfill periphery within the soil, the NHDES SWMB will be notified immediately. Appropriate steps necessary to evaluate the nature and mechanisms of the gas migration, and to ensure safety and health, will be taken.

Section 6

CONTINGENCY PLAN

6.1 GENERAL

In this section, specific contingency plans are presented to be followed in the event of the suspension of landfill operations, the appearance of landfill-based contaminants in the monitoring well network, and spillage of fuel or leachate from a tank or truck.

6.2 SUSPENSION OF LANDFILL OPERATIONS

In the unlikely event that landfill operations are suspended for an extended period for any reason, the City will have waste hauled to another approved location, as available on a temporary basis, such that disposal service may proceed. The City does not propose to establish formal arrangements for such back-up service. Rather, depending on the time and circumstances of such a suspension, arrangements through the "spot market" at permitted waste to energy facilities, secure landfills, or other facilities as may be available, will be made by the City and/or private haulers.

6.3 RELEASE OF CONTAMINANTS FROM LANDFILL

The general approach to actions in response to an occurrence of unanticipated contaminant release from the landfill includes the following:

- Establishment and regular monitoring of the primary system of facility monitoring wells.
- Future establishment of additional groundwater monitoring wells, if appropriate, to be placed in the event of a confirmed presence of a leachate leak.
- Assessment through hydrogeologic evaluations of the nature of the type and extent of contamination in groundwater, due to the secure landfill. Assessment of the need to take actions to control the release.
- Remedial action as may be required, in consideration of landfill performance.

6.4 LANDFILL BASED CONTAMINANTS DETECTED IN MONITORING WELLS OR THE ABOVE-CAP MONITORING SYSTEM

Sequential steps to be taken:

1. Notify the NHDES SWMB immediately, as provided for in facility permits. All subsequent actions are to be taken in coordination with the NHDES.

2. Initiate more frequent sampling and analysis for an appropriate period, to establish confirmation of results.

3. Compare historical leachate flow data in an effort to estimate the order of magnitude of leakage quantity.

4. Review all data on landfill operations to investigate occurrences which may have resulted in a leak from both liners, or other contaminant spills.

5. As appropriate, ~~P~~perform a~~n intensive~~ focused hydrogeological evaluation in the immediate area of contamination to determine the extent of the contaminant plume and to confirm flow directions and velocities. Assess the possibility of groundwater impacts from the existing unlined landfills and other sources other than the secure expansion.

6. Assess with the NHDES the need to intercept migrating contaminants with respect to anticipated impacts on surface and groundwater quality.

7. If required, develop a detailed work plan for remedial work to prevent or mitigate water quality impacts from migrating contamination. Appropriate actions may include diversion, interception, removal, and treatment of groundwater.

8. Evaluate the need for, and benefits from, modifying operations at the landfill to minimize or abate generation of leachate in the vicinity of the leak.

6.5 FUEL OR LEACHATE SPILL

In the event of an accidental fuel spill from a vehicle or the known leakage of leachate from pipes or tanks, the City will respond as follows:

1. Construct temporary earthen berms around the spill area to contain surface runoff from entering the area of the spill.

2. Notify the NHDES immediately. Coordinate all further activities with appropriate agencies of the Department.

3. Contract with an emergency spill management firm to assist in on-site cleanup.

4. If determined to be necessary, remove contaminated soil for proper disposal, or dispose within secure landfill.

5. Take other actions as deemed necessary by the NHDES to mitigate impacts of spill.

6.6 OTHER CONTINGENCY EVENTS

Good operations in accordance with this operating plan and "state of the practice" operations will limit the potential for emergency events involving fire, explosion, or personal safety. The operations staff at the landfill will, however, have the potential to be in immediate direct radio contact with the Nashua Public Works Dispatch. Public Works Dispatch has direct access to the Nashua Fire and Police Departments. During emergency events involving the personal safety of staff, other persons, or property, staff will coordinate all on-site activities with the Nashua Fire and Police departments.

6.6.1 Fire

In accordance with this plan, use of daily cover is anticipated to reduce or eliminate the potential for fire to occur in landfill operations. In the unlikely event of fire, a fire prevention system was installed as part of the Phase II landfill construction. The system consists of a wet well located within Detention Pond #4 connected to a water line and hydrant system adjacent to the landfill. If water is needed to extinguish a fire, a fire pumper truck can be utilized to pump water from the wet well to the hydrants. In the event of an occurrence of fire at the landfill, or anywhere on the site, the Nashua Fire Department will be notified immediately.

6.6.2 Explosion

Operations staff shall immediately contact the Nashua Fire Department and coordinate all subsequent actions with the Department. The landfill gas monitoring program is outlined in Section 5 of this plan. Risk of explosion is limited at the site and is primarily associated with use of equipment.

6.6.3 Operator Injury

Operations staff shall limit their direct intervention in the event of operator injury to removal of an individual from a location where additional injury may occur and administering immediate first aid. Immediately upon the event of injury, staff shall contact the Nashua Public Works Dispatch, inform dispatch of the location and nature of the injury, and coordinate all subsequent actions with Police/Fire personnel.

6.6.4 Backup Power Supply

The Phase III Sump Riser Building is equipped with a generator transfer switch to provide electricity to the pumping station and alarm systems. The site has emergency generators available that will be used to power the building components in the event of a power failure.

The Phase III Sump Riser Building is equipped with redundant equipment in the event of pump failure. Two pumps are available to pump primary leachate; a primary sump riser pump and a cleanout pump. The primary and secondary sump riser pumps are identical. In the event that the secondary pump fails, the primary sump riser pump can be transferred and operated within the secondary riser pipe while the cleanout pump is used to pump primary leachate until the pump repairs are made.

6.7 IDENTIFICATION OF EMERGENCY CONTACTS

In the event of an emergency event at the landfill, the following contacts will be made, as appropriate:

Nashua Police Department:	(603) 594-3500 or 911
Nashua Fire Department:	(603) 594-3651 or 911
Nashua Public Works Director:	(603) 589-3140
NHDES SWMB Compliance Section:	(603) 271-2925

Section 7

EMPLOYEE TRAINING PROGRAM

All landfill operations employees will receive appropriate training to implement the provisions of the latest approved operating plan. Employee training will be documented as to attendees, training content/subject, and the dates and length of training. The landfill operating plan, as finalized prior to commencement of operations, will be a key part in the training. Training will include the objectives and specific procedures associated with each element of the landfill operations, as relevant for that employee's responsibilities.

The landfill operators will be licensed through the NHDES Solid Waste Facility Operator Training and Certification program. The Four Hills Landfill is a Level IV facility per Env-Sw 1602.08 and therefore requires a certified Level IV operator/manager to be in responsible charge. The operators shall be required to be licensed in accordance with the State's Certification program and renew their operator certification annually. Prior to applying for certification renewal the operator must participate in an operator training update program organized by the State.

The supervisor and equipment operators will be familiar with all aspects of operations, including both routine and contingency actions, monitoring and inspections, and record keeping.

All employees, from the date of commencement of operations, or date of hire as appropriate, will receive specific training, under the supervisor of the Nashua Division of Public Works, and the supervisor. Such training will include review of operating objectives and procedures, and specific use of equipment.

The Nashua Division of Public Works, including Public Works Director, City Engineer, and staff will be available to assist as appropriate in resolving operational issues.

Section 8

RECORD KEEPING

8.1 OPERATING RECORDS

The City shall compile and maintain records at the facility which document all phases of facility operations, including the following information:

1. Identification of all facility operator(s) by name, address, certificate number, and date(s) of employment at the facility;
2. Quantity, type, and source of all waste received by the facility;
3. Quantity, type, and destination of all waste generated by the facility, if any, including bypass waste and residual waste;
4. Quantity and discharge of leachate, by location;
5. Quantity, type, and destination of all certified waste-derived products produced by the facility, if any;
6. Record of inspections, maintenance, and repairs;
7. Record of accidents, violations, remedial, and emergency event response actions;
8. Record of complaints received and related response actions;
9. Data from all environmental monitoring performed at or for the facility, whether required by the solid waste rules or the permit or undertaken voluntarily;
10. Documentation of contact with the waste management district(s) served by the facility as required to demonstrate that all operating requirements established by RSA 149-M:11, XI pertaining to the requirements of RSA 149-M:11,III~~(c)~~I and RSA 149-M:12,I(b) are being met and that the facility operations meet other relevant planning needs and requirements identified or established by the district to the extent allowed by the permit;
11. Cost estimates and financial assurance documentation; and
12. Other information and documentation as required by the terms and conditions of the permit.

The operating records identified above shall be maintained at the facility at all times during the active life of the facility, unless approval is granted pursuant to the provisions for a Type V permit modification in Env-Sw 315 to relocate or destroy the record.

Operating records shall be available for inspection by the department and copies provided to the department pursuant to Env-Sw 1105.06.

Following closure of the facility, the operating records shall be maintained at a location approved by the department in the closure plan.

8.2 REPORTING REQUIREMENTS

The City shall notify the department in writing within 30 calendar days of any change in the facility address, telephone number, key certified operators and contact person(s).

An annual facility report shall be submitted by March 31 for the prior calendar year for each year that the facility operates and for each year of the facility's post-closure monitoring and maintenance period (see below).

The City shall report all changes in operational and City control in accordance with the provisions for a Type III or Type IV permit modification, as applicable, pursuant to Env-Sw 315.

The City shall notify the NHDES in writing prior to conducting the following activities at the facility not specifically authorized in the permit:

1. Any activity not regulated by the solid waste rules but involving a waste listed in Env-Sw 101.03; and
2. Any activity that is permit-exempt in Env-Sw 302.03.

8.3 QUARTERLY REPORTS

Quarterly reports shall be submitted to the NHDES in duplicate no later than 30 days following the end of the quarterly reporting period. Each copy of the report shall be signed by the person duly authorized to sign for the City. The signature affirms that the material and information submitted is complete to the best of their knowledge and belief.

The report shall contain the following information:

1. Name and permit number of the reporting facility;
2. Landfill gas monitoring results, leachate, and leachate management system data, excluding the tri-annual monitoring of primary leachate;
3. Presence of liquid in the Phase IV above-cap monitoring system;
4. Quantity and type of wastes received by facility;
5. Data units for each type of data reported;
6. Reporting period and/or dates the data was collected, for each type of data recorded; and
7. Monthly and quarterly subtotals for each type of data reported.
8. Summary of LFG collection system condensate sumps: weekly inspection findings, operational data, and pump performance evaluation(s).
9. Description of corrective actions taken (if any) for the LFG collection system condensate sumps including quantities of sediment and condensate removed from the sumps, if any.
10. The location and description of leachate breakouts, if any, observed within the limits of the Phase I/II/III/IV landfill. Corrective actions taken to remediate the leachate breakouts shall also be described in the report.

8.4 ANNUAL REPORT

An annual report shall be submitted to the department in duplicate no later than March 31st after operations commence. Each copy of the annual report shall be signed by the person duly authorized to sign for the City. The signature affirms that the material and information submitted is complete to the best of their knowledge and belief.

The report shall contain the following information:

1. Facility name, location by street and municipality, and permit number;
2. Name, address, and telephone number of the permittee;

3. Name, address, certificate number and telephone number of all facility operators;
4. Facility status, including analysis of remaining capacity based on site survey which identifies the remaining facility capacity;
5. Quantity in tons, type, and source of all waste received by the facility;
6. Destination of all wastes received by the facility (i.e., Phase II A)
7. Quantity, type, and destination of all waste generated by the facility, including bypass and residual waste (leachate);
8. A summary and assessment of all monitoring performed at or for the facility, whether required by the solid waste rules or the permit or undertaken voluntarily, specifically including as applicable:

    a. A summary of the facility inspection and maintenance activities;
    b. Summary of leachate management system monitoring:
        1. head;
        2. primary and secondary flow;
        3. primary leachate quality;
    c. Summary of landfill gas monitoring;
    d. Summary of Phase IV above-cap system monitoring;
    ~~e~~d. Summary of groundwater and surface water quality monitoring; and
    ~~e~~f. A discussion, pursuant to RSA 149-M:11, XI, of how facility operations satisfied the public benefit requirements specified in the permit, if any.

    If monitoring information was already reported in writing to the department during the calendar reporting year, then it need not be submitted in the annual report if a written statement is provided which identifies:
    a. nature of information already submitted;
    b. date the information was submitted;
    c. title of document containing information; if applicable; and
    d. name of person who submitted information

    If monitoring information is unchanged from the previous calendar year reporting year, the City may mark the item "unchanged from last annual report" and cite the date of the last annual report that contained the information.

8.5 INCIDENT REPORT AND COMPLAINTS

8.5.1 Incident Involving Risk to Human Health, Safety or the Environment

In the event of an incident or situation at the facility which involves an imminent and substantial risk to human health, safety or the environment and/or which constitutes a violation of the NHDES Solid Waste Rules or the facility permit, the operator shall file a report to be placed in the operating record and submitted to NHDES as follows: (Also see section 7.0 - Contingency plan)

Provide a verbal report to the NHDES as soon as practicable.

Submit a written report to the NHDES and to be placed in the operating record within 5 working days to include the following information:

1. Facility name, location by street and municipality, and permit number;
2. Permittee name, mailing address, and telephone number;
3. Identification of all persons involved in the incident or situation, including name, title, and affiliation;
4. A description of the incident or situation, including:
    a. The date and time the incident or situation occurred
    b. The quantity and types of wastes and material(s) involved in the incident or situation and in the clean-up activities;
    c. Measures employed to contain releases caused by the incident or situation; and
    d. An assessment of actual or potential hazards to the environment, safety and human health related to incident; and
5. Measures the permittee has or intends to apply to reduce, eliminate, and prevent a recurrence of the incident or situation.

Leachate breakouts that occur and flow outside of the lined landfill foot print shall be considered an incident involving risk to human health, safety, and the environment and shall be reported to the Department as described above.

8.5.2 Complaints from Abutters or Third Parties

The operator shall maintain a record of all complaints occurring from abutters or other third parties with the operating record, and actions taken to respond to those complaints.

In the event of complaints made by abutters or other third parties which involve operating conditions or practices having the potential to adversely affect human health, safety or the environment or which involve a recurring or persistent situation such as noise, litter, odor, dust or vectors, the operator shall file a report to be placed in the operating record and submitted to the NHDES as follows:

The written report shall be made as soon as practicable and include the following information:

1. Facility name, location by street and municipality, and permit number;
2. Permittee name, mailing address, and telephone number;
3. Name, mailing address and, if available, telephone number of the complainant;
4. The nature of the complaint, date(s) of receipt by the permittee, and a complete description of the circumstances or situation giving rise to the complaint;
5. A description of the permittee's response action(s); and
6. Such other information as required in the section on incident reporting above if the circumstances or situation giving rise to the complaint require reporting under incident reporting above.

If the incident or complaint persists, the NHDES shall be notified and informed of corrective action to remedy the problem, and a periodic update shall be made regarding the incident or complaint as appropriate (such as in the quarterly or annual reports).

8.6 Landfill Gas Collection System Reporting

The landfill operator shall submit triannual reports to the NHDES in accordance with the Landfill Gas Collection System, Enhanced Monitoring Protocol and Standard Operating Procedures (EMP/SOP). The landfill operator will maintain all monitoring data sheets and calibration logs in accordance with the EMP/SOP.

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SANBORN HEAD

Building Trust. Engineering Success.

CLOSURE PLAN

PHASE IV EXPANSION

Four Hills Landfill
Nashua, New Hampshire
Solid Waste Permit No. DES-SW-SP-95-002

Nashua
NEW HAMPSHIRE'S GATE CITY

Prepared for the City of Nashua
File No. 3066.11
~~*July 2020*~~*February 2022*

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1.0 FACILITY IDENTIFICATION

Facility Name: Nashua Four Hills Landfill
Phase IV Secure Landfill Expansion

Facility Location: 840 West Hollis Street
Nashua, NH 03061

Mailing Address: Nashua Division of Public Works
9 Riverside Street
Nashua, NH 03062

Permit Number: DES-SW-SP-95-002

2.0 CLOSURE SCHEDULE

The proposed Phase IV expansion will be developed in four stages following filling in Phases I, II, and III. Intermediate closure of the landfill will occur progressively as final grades are achieved. The first closure construction will include the southern and western portions of the landfill once the Phase III final grades are achieved. The northern slopes of Phases I and II will remain as intermediate cover as they will be incorporated into Phase IV. The final closure of the remainder of the landfill will be constructed once all filling is completed. Total life of the Phase IV expansion) is approximately 30 years.

3.0 WASTE IDENTIFICATION

The Nashua Four Hills Landfill (Landfill) was established in 1971 for the disposal of municipal solid waste, construction and demolition waste, and wastewater sludge from the City of Nashua. Two separate closed landfills exist at the site: the approximately 60-acre closed, unlined municipal solid waste (MSW) landfill, and the approximately 15-acre closed, unlined construction and demolition debris (C/D) landfill. The lined Phase I expansion was permitted and constructed over several years and became operational in May 2000. The lined Phase II expansion became operational 2009 and the lined Phase III expansion became operational in 2020.

The Landfill is permitted to accept for the disposal only MSW generated from within the City of Nashua. Should the City elect to change wastes for disposal, appropriate permit modifications will be pursued, including modifications to this closure plan, if appropriate.

Acceptable wastes will include waste materials which are currently disposed at the existing landfill on the site, or otherwise are produced within the service area and meet state and federal restrictions for disposal in solid waste landfills, and may include:

- Mixed waste from residential, commercial, institutional, and industrial sources;
- Construction and demolition waste (C/D);
- Bulky waste;

- Street sweepings;
- Brush/Stumps (periodically);
- Digested wastewater sludge, grease, and grit from the Nashua WWTP (as a contingency and under a separate permit modification), and;
- Asbestos waste.

For additional information, refer to the Operating Plan. It is noted that the City will be voluntarily restricting C/D waste from the landfill as practicable.

4.0 NOTIFICATIONS

At least one year prior to ultimate closure of the Landfill, all users of the Landfill will be notified of the City's intentions to close the Landfill. Notification will be in writing with a specific closure date. Notification will also be placed as a Public Notice in a least one newspaper of general circulation. Signs identifying the closing date will be posted at the landfill as well as notices on bulletin boards in public meeting places.

The notice of an intent to close will be submitted to the New Hampshire Department of Environmental Services (NHDES) at least one year prior to the ultimate closure of the facility. The notice will include the following:

1. Facility identification;
2. Date the facility intends to stop receiving waste;
3. A copy of the approved closure plan or file reference thereto;
4. If the provisions of the last approved closure plan are no longer applicable or no longer conform to the closure requirements of the solid waste rules, identification of such provisions and revisions is required; and
5. The date the facility intends to commence closure activities.

Prior to the ultimate closure of the landfill, the City reserves the right to close the landfill at any time. In the event of such premature closure, the City will revise the Closure Plan and grade the landfill to the final closure shape presented in the revised Closure Plan.

5.0 CLOSURE REQUIREMENTS

The following tasks are required to implement and complete closure of the expansion:

1. Develop Final Design Plans and Specifications for Closure
2. Minor Regrading to Establish Closure Grades
3. Construct and Maintain Capping System
4. Construct and Maintain Stormwater Management System
5. Operate and Maintain Leachate Collection System
6. Operate and Maintain Above-Cap Monitoring System

~~6.~~7. Operate and Maintain Groundwater Monitoring System

~~7.~~8. Construct and Maintain Landfill Gas Management System

~~8.~~9. Initiate Settlement Monitoring Program

~~9.~~10. Provide Access Control to Site

A description of the procedures required to complete each of the closure tasks is provided below.

5.1 Final Design Plans and Specifications

The City will retain a qualified engineer to prepare the final design drawings and specifications for the closure of the Landfill. The final design will be developed prior to the landfill phases reaching capacity and should be based on current practices and applicable State and Federal rules. The preliminary closure design is presented in the Phase IV Expansion Type I-A Permit Modification Application, which are based on the preliminary closure design plans approved pursuant to the Type I-B and II permit modification issued by the NHDES on December 5, 2018.

5.2 Regrading of Waste

The Phase IV expansion will be constructed adjacent to Phase I and waste placement will extend over the Phase I final grades during Phase IV operations. Areas of Phases I, II, and III that are at final grade, will be covered with a 12-inch thick layer of intermediate soil cover and a vegetative stand established.

Closure of the lined landfill may require minor regrading of areas to establish appropriate slopes for landfill closure. The installation of intermediate drainage benches and perimeter swales may require some waste excavation and relocation. The Operating Plan of the landfill provides for placement of waste to appropriate closure grades so substantial regrading will not be necessary.

5.3 Capping System

The proposed capping system includes use of a single geomembrane (40-mil thick textured polyethylene geomembrane as the hydraulic barrier that prohibits infiltration of precipitation into the landfill and that limits leachate generation. The system will consist of a total of 3.5 feet of material over most of the phases, with specific additional materials at toe-drains, intermediate drainage benches, swales, and other locations. The capping system consists of the following materials that meet the minimum requirements of Env-Sw 805.10, listed from top to bottom:

- A 6-inch thick layer of topsoil with vegetation;
- A 6-inch thick layer of moisture retention soil;
- A 12-inch thick layer of drainage sand;
- A drainage geocomposite;

- A 40-mil thick textured geomembrane liner (barrier layer);
- A 6-inch thick layer of buffer sand; and
- A 12-inch thick layer (minimum) of common borrow (intermediate cover as required).

The existing active gas extraction system will be extended into Phase IV – both collection trenches and vertical wells. Additional vertical wells may be installed through the waste prior to closure. Gas collection well heads and control valves will require extension through the capping system for operational access.

In addition, numerous other select materials including geotextiles, geosynthetic drainage media, crushed stone, riprap, and other materials will be part of construction. Typical cross sections of the final capping system and other closure design information are presented in the Type I-A Permit Modification Application.

On areas that have not received the 12-inch thick layer of intermediate cover, a 12-inch thick layer of common borrow will be placed, compacted, and graded for the placement of overlying layers.

The buffer sand layer is intended to protect the geomembrane from underlying coarse soil materials. The sand will be constructed in accordance with the quality assurance/quality control as described in Env-Sw 805.16.

The barrier layer is intended to minimize the infiltration of water into the waste to eventually eliminate leachate production. Current practices utilize a 40-mil thick geomembrane installed pursuant to Env-Sw 805.16.

The drainage layer is intended to remove water that infiltrates through the topsoil and moisture retention layers. The drainage layer outlined herein consists of a drainage geocomposite overlain by a 12-inch thick layer of drainage sand. As an alternative, an 18-inch-thick layer of select drainage sand with a saturated hydraulic conductivity of no less than 1×10^{-3} cm/sec could be substituted if appropriate at the time of final closure.

The geocomposite drainage will consist of a single-sided or double-sided laminated composite of nonwoven geotextile and a geonet or perforated drain tubes. The selection of the drainage geocomposite will be based on applicable stability calculations. Water collected in the drainage geocomposite will be relieved at regular intervals based on the hydraulic capacity of the system and development of-head above the barrier layer.

The drainage sand layer will be comprised of a 12-inch thick layer of sand specified to meet the necessary hydraulic characteristics and constructed pursuant to Env-Sw 805.16.

The moisture retention soil will be comprised of a 6-inch thick layer of soil to support the vegetative.

The topsoil and vegetative layer will serve to stabilize the capping system against wind and water erosion. The layer will promote evapotranspiration while providing ease of visual inspection of the capping surface. Alternate or supplemental materials to the topsoil may be utilized if necessary, or advisable, with the concurrence of the NHDES.

5.4 Stormwater Management System

The stormwater management system will be designed to accommodate the peak flow from a 25-year, 24-hour storm for the drainage area being served. Peak surface runoff from the Landfill for the 25-year, 24-hour storm will be controlled and maintained through the use of detention ponds. The permanent sedimentation/detention ponds will be sized to handle the 25-year,24-hour storm event with no less than one foot of freeboard above the emergency spillway invert.

Stormwater runoff from the cap will be collected in intermediate drainage benches, spaced at intervals to limit surface erosion and necessary to convey the water. Intermediate benches will be constructed at a minimum slope of 4percent, while perimeter swales, outside the limit of waste will be constructed at a minimum slope of 1percent.

Prior to closure construction, an Alteration of Terrain Permit (AoT) will need to be obtained. The permit application will include appropriate drainage calculations used to design new and confirm existing sizes of drainage structures.

5.5 Leachate Collection System

Leachate collected within the primary and secondary leachate collection systems will be managed in accordance with the Residual Waste Management Plan as outlined in the Operating Plan. Leachate from Phases I, II, III, and IV is collected and discharged to the Nashua sewerage system for treatment at the Nashua Wastewater Treatment Plant. Alternative back-up arrangements for leachate discharge have been established through the Town of Palmer, Massachusetts, a combined industrial and municipal wastewater treatment facility.

Scheduled inspections and maintenance to the leachate management system will be completed in accordance with the post-closure requirements as outlined in Section 6.0

5.6 Above-Cap Monitoring System

Liquid collected within the above-cap monitoring system will be managed in accordance with the Residual Waste Management Plan as outlined in the Operating Plan. Above-cap liquid from Phase IV will be collected and discharged to the Nashua sewerage system for treatment at the Nashua Wastewater Treatment Plant. Alternative back-up arrangements for leachate discharge have been established through the Town of Palmer, Massachusetts, a combined industrial and municipal wastewater treatment facility.

Scheduled inspections and maintenance to the above-cap monitoring system will be completed in accordance with the post-closure requirements as outlined in Section 6.0

5.~~6~~7 Groundwater Monitoring System

Groundwater quality at the Landfill is currently monitored in accordance with a Groundwater Management and Release Detection Permit. Monitoring in accordance with the permit will continue following the closure of Phases I – IV and during the post-closure period. The monitoring program, including frequency and monitored parameters, will be reviewed at the time of closure and periodically based on data at that time. The monitoring program currently includes tri-annual monitoring of indicator compounds as well as heavy metals and VOCs.

5.~~7~~8 Landfill Gas Management System

Landfill gas will be generated from the proposed facility. The Operating Plan includes the installation of horizontal and vertical gas extraction wells to capture the generated landfill gas. The liner system will minimize migration of gases through the underlying soil. After closure, the landfill gas will continue to be managed through the active gas collection system, in compliance with applicable permits.

Gas migration monitoring will be accomplished by constructing a series of gas monitoring wells outside the footprint of Phases I, II, III, and IV. The concentration of methane and other explosive gases shall not exceed 25 percent of the lower explosive limit (LEL) in structures on or off-site, excluding leachate collection and gas control and recovery components or exceed 50 percent LEL at and beyond the property boundary in the soil. Monitoring of the gas wells and on-site structures will be performed quarterly as described in Section 6.4.

5.~~8~~9 Settlement Monitoring

Permanent landfill settlement monuments will be incorporated into the construction of the cap. Monuments will be installed adjacent to each of the active gas collection wells or at a typical spacing of 1 per acre. An instrument settlement survey will be completed following cap construction and will be performed initially on an annual basis until the landfill has achieved a decrease in the rate of settlement to that which has negligible impact on the capping system. The frequency of the instrument settlement survey should be reviewed periodically and may be reduced or eliminated if reviewed and approved by NHDES, upon which visual observations should be made.

The settlement monitoring program will include a survey of the settlement monuments, and the center lines of the drainage benches and swales located on the side slopes of the landfill at a 50-foot spacing. If settlement has occurred such that surface drainage is impeded, then the affected areas will be repaired to establish proper drainage. If differential settlement is detected such that affected areas must be mitigated, then excavations will be completed to expose the liner to allow for inspection. Appropriate repairs, if necessary, will be made. Significant remedial actions will be performed in conjunction with the notification and design review by the NHDES. A letter report summarizing the results of the settlement monitoring will be provided to the NHDES each year after completion of the survey.

5.~~9~~10 Access Control

Access to the Landfill is currently restricted by the entrance gate and a perimeter fence. After closure, the landfill may continue to serve as a transfer station/recycling facility, where vehicle access would be maintained through the existing gate and scale house. Security fence will be constructed as necessary to limit access to the Landfill.

6.0 POST-CLOSURE REQUIREMENTS

The post-closure period for the Landfill is proposed to be 30 years from the date the complete capping system is installed. The post-closure period will be subject to periodic adjustment by implementing a permit modification in the event that monitoring data indicate that the required performance standards are unlikely to be achieved during the 30-year period or that the data indicates that the performance standards of Env-Sw 807.04 are met for Phases I, II, III, and IV prior to the 30-year period:

6.1 Record Drawings

The City will file record drawings for the closed facility no later than 90 days following completion of construction of the capping system. The record drawings will explicitly identify the features different than the features provided in the approved plans and specifications. Written certification must also be provided that the facility, as-built, meets or exceeds the applicable requirements of the permit including the approved plans and specifications.

6.2 Property Deed Notification

The City will attach notification to the property deed that a landfill exists on the property and cause the notification to be recorded at the registry of deeds in Hillsborough County. Proof of notification to the property deed will be provided to the NHDES with the submission of the record drawings.

The notification will include the following information in accordance with Env-Sw 807.05(n:

1. A statement that a landfill exists on the property;
2. Identification of the registry of deeds, book and page numbers where the title to the property is located;
3. Identification of the property tax map and lot numbers in which the facility is located;
4. USGS coordinates for the site;
5. Description of facility, including size, type of waste received, type of liner and type of cap;
6. Description of closure implemented, and permit issued for closure by NHDES, including a statement that the permit might contain certain legal obligations regarding the site;

7. A statement that post-closure use of the property will not disturb the integrity of the final cover, liners, or any other components of the containment system or the function of the monitoring system unless approved by NHDES;
8. A statement that any future change in the use will be subject to review and approval by NHDES pursuant to a permit modification; and
9. A statement that access will be assured to department inspection personnel and the permittee for monitoring/maintenance purposes.

6.3 General Maintenance

The primary maintenance function for the closed site will be annual mowing of the landfill. This mowing is necessary to prevent growth of shrubs, trees, or other deep-rooted vegetation. Annual mowing of the cap is a critical maintenance responsibility.

The facility leachate collection systems and above-cap monitoring system will be inspected and maintained until generation of leachate/liquid has ceased.

During facility inspections, the drainage swales inside and outside the landfill footprint will be inspected and cleaned as necessary. Failure of vegetative cover, differential settlement, or erosion problems on the landfill surface will be identified and repaired.

6.4 Facility Inspections

Facility systems will be inspected in a manner that is initially the same as required in the Operating Plan. The City may request a decrease in the frequency of inspections based on favorable comparison of the performance expectations and actual performance, but in no case will the inspections occur less than semi-annually. Facility inspections will include, but may not be limited to, the following components, and will be monitored monthly initially. After the first year of post closure monitoring, the City anticipates requesting a reduction of the inspections to semi-annually.

1. roads;
2. berms;
3. pipes;
4. vaults;
5. valves;
6. tanks;
7. drainage benches and swales;
8. landfill surface;
9. sedimentation ponds;
10. equipment;
11. groundwater monitoring wells; and

12. gas management devices.

Repairs, cleaning, or remedial activities to facility components will be implemented as necessary to assure compliance with the above performance standards.

6.4.1 Inspection Reports

Inspection reports will be submitted in duplicate to the NHDES within 30 days of completing the inspection. Each copy of the inspection report will be signed by the person duly authorized to sign for the City.

6.5 Monitoring Requirements

Monitoring of the leachate management system, above-cap monitoring system, landfill gas collection and control, and the surrounding groundwater and surface water quality must continue to be monitored after closure. In accordance with State and Federal rules the following monitoring is required.

6.5.1 LeachateManagement System

After closure, the leachate management system will be monitored until leachate generation has ceased. At that time, the City may request a decrease in the frequency of monitoring to semi-annually for the duration of the post-closure monitoring period. The following will be initially monitored and recorded at the frequency indicated:

1. Hydraulic head at the low points in each Phase:
   a. Monthly.
   b. If the hydraulic head is found to be 12 inches or greater, then monitor daily until the hydraulic head is less than 12 inches.
2. Quantity of leachate collected and discharged to wastewater treatment facility, will be measured daily.
3. Flow in the secondary collection system:
   a. Weekly.
   b. More frequently as required to understand why the 30-day average exceeds 25 gallons per tributary acre per day.

   Average flow occurring during the 30-day operating period preceding the last measurement will be calculated and reported as follows:
   1) Rates less than or equal to 25 gallons per tributary acre per day will be reported to NHDES no less than quarterly;
   2) Rates that exceed 25 gallons per tributary acre per day will be reported to NHDES within one week of identification of the rate; and
   3) Rates that exceed 100 gallons per tributary acre per day will require the permittee to file an investigation report with the NHDES for the purpose of identifying the potential cause and appropriate response actions to be taken, which will be reported to the NHDES in writing in the form of a proposed response action plan.

The City will implement the approved response action plan to include the following actions as deemed necessary on the basis of the likely cause and remedy of the problem:

1) Increasing monitoring and reporting;
2) Instituting operational changes to limit head on the liner;
3) Locating and repairing leak(s);
4) Retrofitting the overlying liner; and/or
5) Closing part or all of the facility, if necessary, to protect human health and environment.

4. Quality of primary leachate will be evaluated by collecting representative samples taken in April, July, and November and analyzed for the following parameters:
   a. pH;
   b. temperature;
   c. Chemical oxygen demand (COD;
   d. Specific conductance;
   e. Iron;
   f. Manganese;
   g. Sulfates;
   h. Chlorides;
   i. Chromium;
   j. Lead;
   k. Cadmium; and
   l. Volatile organic compounds (VOCs;

   The results of the tri-annual monitoring will be submitted in duplicate to the NHDES within 30 days of receiving the results

6.5.2 Landfill GasMonitoring

Landfill gas monitoring wells will be installed around the perimeter of the landfill at locations approved by the NHDES during construction of the Phase II expansion. Landfill gas monitoring will be performed quarterly at each of the gas monitoring wells, in the ambient air at the property line, and inside the compactor building adjacent to the landfill. The Operating Plan incorporated the landfill gas monitoring of the lined and unlined landfill into a single site monitoring program.

Gas monitoring will be conducted with a combustible gas indicator, with the capability to detect the percent of the lower explosive limit (LEL or the actual concentrations of methane and other combustible gases. Representative samples taken from the gas monitoring wells will require that the volume of the gas well be evacuated prior to measurement of the equilibrated concentration.

Representative sampling within structure will be performed with the doors, windows, and other ventilation locations having been closed for at least an hour.

The concentration of methane and other explosive gases will not exceed 25percent LEL in structures on or off site, excluding leachate collection and gas control and recovery components, exceed 50percent LEL at and beyond the property boundary in the soil, or 10percent LEL in the ambient air (breathing zone at the property boundary.

If the above levels of gas are exceeded, then the City will notify the NHDES immediately and implement the contingency procedures outlined in the Operating Plan to ensure the protection of public health and safety. The contingency procedures include, subsequent monitoring, submittal of a remedial action plan to the NHDES and submitting an air emissions monitoring plan to the Air Resources Division in accordance with the NHDES Landfill Gas Policy.

6.5.3 Groundwater and Surface Water Monitoring

Monitoring in accordance with the Groundwater Management and Release Detection Permit will continue following closure.

The monitoring program currently requires bi-annual monitoring of indicator compounds as well as heavy metals and VOCs less frequently at locations which will adequately detect a leak in the secondary liner. A review of the appropriateness of the monitoring program will be completed annually for the first five years after closure, and recommendations made to the NHDES regarding suggested reduction, expansion, or consistency in the program. After five years, the review period may be modified. Reporting requirements are established in the permit by NHDES in accordance with RSA 485-A.

6.5.4 Above-Cap Monitoring

After closure, and if present, the Phase IV above-cap monitoring system will be monitored until the presence of liquid has ceased. At that time, the City may request a decrease in the frequency of monitoring for the duration of the post-closure monitoring period. The following will be initially monitored and recorded at the frequency indicated:

1. Quantity of liquid collected and discharged to wastewater treatment facility, will be measured daily.
2. Quality of liquid collected by the above-cap monitoring system will be evaluated by collecting representative samples taken in April, July, and November and analyzed for the following parameters:

   a. pH; and

   b. Specific conductance.

   The results of the tri-annual monitoring will be submitted in duplicate to the NHDES within 30 days of receiving the results.

6.5.~~4~~5 Landfill Settlement Monitoring

Annually for the first five year after closure, the elevations of the settlement plates, and the center lines of intermediate benches and perimeter drainage swales, will be surveyed and compared to existing data. The frequency and type of settlement monitoring should be reviewed after five (5) years or periodically and may be modified if reviewed and approved by the NHDES. A letter report will be provided to the NHDES that summarizes the settlement monitoring results and evaluates the effect, if any, that settlement has on the performance of the capping and stormwater management system.

6.6 Annual Report

An annual report will be prepared following closure to summarize facility inspections, evaluate all post-closure monitoring data, and to identify any concerns with achieving post-closure performance requirements. The report will be submitted to the NHDES in duplicate no later than March 31st of each year after closure. Each copy of the annual report will be signed by the person duly authorized to sign for the City.

The report will be completed on the NHDES provided forms and contain the following information:

1. Facility name, location by street and municipality, and permit number;
2. Name and address of the permittee;
3. Name, address, certificate number and telephone number of all facility operators, if applicable
4. Name, address, affiliation and telephone number of the person or persons responsible for managing all post-closure activities at the facility;
5. Facility status, including, as applicable:
   a. Date the facility discontinued receipt of waste;
   b. Anticipated or scheduled date for completing all required post-closure monitoring and maintenance activities.
6. A summary and assessment of all monitoring performed at or for the facility, whether required by the solid waste rules or the permit or undertaken voluntarily, specifically including as applicable:
   a. A summary of the facility inspection and maintenance activities;
   b. Summary of leachate management system monitoring
      1) head;
      2) primary and secondary flow;
      3) primary leachate quality; and
   c. level in storage tanks
   d. Summary of landfill gas monitoring
   ~~d.~~e. Summary of Phase IV above-cap monitoring system monitoring
   ~~e.~~f. Information concerning emergency events or other unexpected or unusual events at the facility relevant to assessing whether the facility is achieving post-closure performance expectations; and

~~f.~~g. A statement by a qualified professional engineer identifying whether the facility is achieving post-closure performance expectations and whether adjustments to the approved post-closure monitoring and maintenance period and/or provisions are recommended in light of the performance evaluation.

If monitoring information was already reported in writing to the NHDES during the calendar reporting year, then it need not be submitted in the annual report if a written statement is provided which identifies:

a. nature of information already submitted;
b. date the information was submitted;
c. title of document containing information; if applicable; and
d. name of person who submitted information

If monitoring information is unchanged from the previous calendar year reporting year, then the City may mark the item "unchanged from last annual report" and cite the date of the last annual report which contained the information.

6.7 Damage or Sub-Standard Performance

If damage, malfunction or sub-standard performance occurs at the facility, the the City will notify the NHDES within 30 days of identification. The notification will include the following

1. Facility name, location by street and municipality, and permit number
2. A description of the problem;
3. A site plan showing the location of the problem;
4. Proposed corrective actions;
5. Date corrective actions will commence or anticipated duration of sub-standard performance.

7.0 RECORD KEEPING AND RECORDING

Following facility closure the City will maintain all facility operating records and monitoring reports at the Department of Public Works. The following information will be recorded and maintained following closure.

7.1 Inspection Reports

The inspection reports will be submitted to the NHDES on an annual basis. The facility components identified in Section 6.4 will be inspected and maintained by the City.

7.2 Leachate Management System

The City will maintain the records relating to head monitoring, leachate collection, secondary flow rates, primary leachate quality, and liquid levels in storage tanks. The monitoring frequency of each of the leachate system components is specified in Section 6.5.1. The quarterly reports on secondary leachate flow will be maintained.

7.3 Landfill Gas Monitoring

The results and letter reports of the quarterly landfill gas compliance monitoring will be maintained by the City. The written plan for confined space entry, based on the Federal Occupational Health and Safety (OSHA) requirements will be kept with the operating record. The contingency plan for landfill gas concentrations detected above the limits described in Section 6.5.2 will be be maintained.

7.4 Groundwater and Surface Water Monitoring

The annual water quality reports for the site during operations will be maintained by the city after closure. Groundwater and surface water monitoring will continue through the post-closure monitoring period, and these annual summary reports will be maintained.

7.5 Phase IV Above-Cap Monitoring System

The City will maintain the records relating to the Phase IV above-cap monitoring system. The monitoring frequency is specified in Section 6.5.4.

7.~~5~~6 Landfill Settlement Monitoring

The landfill settlement monitoring described in Section 6.5.4 will be summarized and reported to the NHDES in an annual letter report along with the survey data, both of which will be maintained by the City.

7.~~6~~7 Annual Reports

Copies of the annual reports compiled during operation will be maintained by the City. An annual report that summarizes monitoring and evaluates whether the facility is meeting post-closure performance expectations will be performed each year of the post-closure monitoring program as described in Section 6.6. The post-closure annual reports will be maintained by the City.

8.0 OTHER PERMITS AND APPROVALS

In order to implement facility closure, the City will need to obtain and receive construction approval from NHDES. An evaluation of the existing groundwater management and release detection permit also will need to be made at facility closure.

9.0 CLOSURE COST ESTIMATE

Closure of the Phases I, II, III, and IV is proposed to be performed progressively as the landfill is developed. An opinion of the costs to close Phase I, II, III, and IV are summarized below and represents the complete closure of the landfill. Note that actual costs will be established based on final design requirements at the time of closure, bidding, and performance of the selected contractor. A summary breakdown of the preliminary estimates is provided below. A detailed opinion of landfill closure costs is provided as Appendix A.

I	**Design of Final Closure Plans**		$332,000.00
II	**Mobilization, Demobilization & Insurance**		$367,000.00
III	**Erosion Control**		$5,400.00
IV	**Waste Relocation**		$48,000.00
V	**Capping**		
A	Cap (Material and Installation)		$3,074,116.86
B	Gas Vents Devices		$264,000.00
C	Layers		6,682,346.04
VI	**Stabilization, Run-off Control**		$1,092,466.20
VII	**Monitoring Devices**		$0.00
VIII	**Roadway**		$342,400.00
IX	**Miscellaneous**		$41,700.00
X	**Surveying**		$0.00
XI	**Construction Phase Testing**		275,000.00
XII	**Engineering**		$370,000.00
XIII	**Other (list)**		$0.00
XIV	**Contingency (minimum 10percent)**		$1,289,442.91
		Total	$14,184,000.00

The cost for the annual post-closure monitoring is estimated at $116,483 (for year 1-10) and $115,603 (for year 11-30). A summary breakdown of the preliminary estimate is provided below. A detailed opinion of the post-closure monitoring cost estimate is provided as Appendix B.

Item		Annual Cost Year 1-10	Annual Cost Year 11-30
I	Water Monitoring	$32,419	$32,419
II	Gas Monitoring	$2,500	$2,500
III	Settlement Monitoring	$5,700	$5,700
IV	Leachate Collection/Monitoring	~~$19,990~~$20,990	~~$19,990~~$20,990
V	Clean Air Act Requirements	$4,305	$4,305
VI	Repair and Site Maintenance Costs	$34,180	$33,380
VII	Inspections	$4,800	$4,800
VIII	Other	$2,000	$2,000
IX	Contingency (10percent)	$10,589	$10,509
	TOTAL	~~$116,483~~$117,583	~~$115,603~~$116,703

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SANBORN HEAD

Building Trust. Engineering Success.

FINANCIAL ASSURANCE UPDATE

PHASE IV EXPANSION

Four Hills Landfill
Nashua, New Hampshire
Solid Waste Permit No. DES-SW-SP-95-002

Nashua
NEW HAMPSHIRE'S GATE CITY

Prepared for the City of Nashua
File No. 3066.11
~~*July 2020*~~*February 2022*

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TABLES

APPENDICES

1.0 INTRODUCTION

Sanborn, Head & Associates, Inc. (Sanborn Head) prepared this financial assurance update for the closure and post-closure monitoring and maintenance of the Phases I – IV Landfill (Landfill) at the Four Hills Landfill (Facility) in Nashua, New Hampshire. The update was prepared as part of the Type I-A Permit Modification Application for the Phase IV expansion in accordance with Env-SW 1403.02 of the New Hampshire Department of Environmental Services (NHDES) Solid Waste Rules.

2.0 BACKGROUND

The City of Nashua owns and operates the Facility for the express purpose of providing municipal solid waste services to the residents and business of Nashua. The City's currently waste disposal operations are within Phases I, II, and III. Waste disposal in Phase IV is not anticipated begin until around 2030 and the anticipated operating life is estimated to be about 30 years. Closure construction is anticipated to occur over multiple years as described in the Landfill's Closure Plan and is not anticipated to begin until after Phase IV becomes operational.

Sanborn Head understands that the City of Nashua (the City) maintains a capital reserve fund for expenses associated with Closure and Post-Closure for the Landfill. The current account balance of the capital reserve fund is $6,391,294.00 (as of the end of 2019). The City makes annual contributions to the capital reserve fund, the last of which was made in 2019 (FY 2020) in the amount of $355,000. The contribution was in accordance with the previously prepared financial assurance plan update. The City will continue to make annual contributions to the capital reserve fund for each year the Landfill accepts waste.

3.0 CLOSURE COSTS

The closure cost estimate forms in Appendix A were prepared using available applicable cost estimating data, including New Hampshire Department of Transportation Weighted Average Unit Prices, R.S. Means construction cost data, manufacturer quotations, and reflect Sanborn Head's opinion of costs. Please note that in developing the opinion of costs, assumptions were made as to the means, methods, and extent of labor, equipment, and materials that a contractor might employ to perform the work. Actual costs may vary from our estimate due to variations in contractor techniques for determining prices, market conditions at the time the work is performed, and other factors over which we have limited or no control.

Amendments to the financial assurance rules (Env-Sw 1400) became effective on July 1, 2014 and were incorporated in the calculations. These amendments required the inclusion of additional closure costs for replacing 20 percent of the existing active gas collection system and for having a qualified professional oversee all closure activities (Env-Sw 1403.02 [g][3] and [7]).

The Closure Cost Estimate is summarized on the enclosed NHDES Cost Estimate Form for Closure of a Lined Landfill and presents our opinion of the closure costs in year 2020 dollars. As indicated, the estimated cost to close the Facility, including a 10 percent contingency is

about $14,184,000. This is an increase of approximately $5,476,000 from the 2020 financial assurance update. The increase in closure costs is attributed to the inclusion of Phase IV.

4.0 POST-CLOSURE COSTS

The NHDES Cost Estimate Form for Post-Closure of a Landfill provided as Appendix B presents expected post-closure costs in 2020 dollars. The costs presented were developed based on Sanborn Head's experience in conjunction with unit cost data provided by the City and represent Sanborn Head's opinion of the post-closure costs associated with the identified items. According to our calculations, the annual post-closure cost is expected to be about ~~$116,483~~$117,583. Extending these costs over a 30-year post-closure period and accounting for cost reductions and increases over time, the total post-closure cost, in 2020 dollars, is expected to be about ~~$3,477,000~~$3,510,000.

Expected post-closure cost reductions and increases are presented in Table 1. To be conservative, we assumed most of the items will remain constant over the 30-year period; however, the cost for repairs and site maintenance will be lower over time, consistent with the reduced burden on the gas collection and control (GCCS) system. We understand that the GCCS infrastructure inside and outside of the landfill up to the landfill gas-to-energy (LFGTE) facility will be maintained and operated by the City; however, the LFGTE facility and utility flare will be maintained and operated by a third party under contract to the City. Furthermore, we understand that the expansion of the GCCS infrastructure will be made throughout the active life of the landfill and that no additional GCCS infrastructure will be required at closure. As noted above, an allowance was included in the closure cost to replace 20 percent of the well field at that time.

A sinking fund calculation was prepared and is presented as Table 2. The sinking fund calculation is combined for both closure and post-closure needs and assumes an investment interest rate of 1.23 percent[1] and an annual inflation rate of 1.55 percent, which is based on the average inflation rate over the previous 5 years. Our calculations indicate that the City has set aside sufficient funds and is on track to satisfy closure and post-closure requirements for Phases I – IV, assuming an increase in annual deposits to the fund as shown in Table 2.

5.0 CLOSING

Considering the NHDES's April 10, 2020 approval of the previous Financial Assurance Plan, this update includes the capping of Phases I through IV. This area was added to the cost estimate forms and we understand that the City affirms that they will adjust deposits into their capital reserve fun based on this change, as indicated in the attached Table 2.

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[1] Conservative rate based on financial information provided to Sanborn Head by the City.

NHDES COST ESTIMATE FORMS

SANBORN HEAD

Cost Estimate Form for Closure of a Lined Landfill

Facility Name: City of Nashua Four Hills Landfill Expansion - Phases I - IV

Address of Facility: 840 West Hollis Street, Nashua, New Hampshire 03061

Owner: City of Nashua, New Hampshire

Phase: Phase I - IV

Acreage: 54.7 acres (planimetric), 57.4 acres (3-dimensional)

DES Permit #: DES-SW-SP-95-002

Site # (DES Use Only) **Facility #** (DES Use Only)

LOG# (DES use only)

State of New Hampshire
Department of Environmental Services
Waste Management Division
29 Hazen Drive, PO Box 95, Concord, NH 03302-0095
PHONE (603) 271-2925 FAX (603) 271-2456
EMAIL solidwasteinfo@des.nh.gov
TDD Access: Relay NH 1-800-735-2964

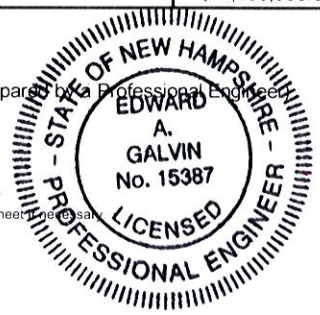
Complete this form in accordance with the NH Solid Waste Rules Part Env-Sw 1400.

Task	DES Use Only	Unit	Unit Cost	Quantity	Total Cost
I Design of Final Closure Plans	**Cat1**				
Engineering Cost	100	*LS*	$317,000.00	1	$317,000.00
Plans	110	*LS*			$0.00
Modification/Closure Plan Review Fees	120	*LS*	$15,000.00	1	$15,000.00
II Mobilization, Demobilization & Insurance	**Cat 2**				
Total Cost	200	*LS*	$367,000.00	1	$367,000.00
Other	210				$0.00
III Erosion Control	**Cat 3**				
Silt Fence	300	*LF*			$0.00
Erosion Matting/ Blanket	310				$0.00
Hay Bale Sediment Barrier	320	*LF*	$5,400.00	1	$5,400.00
Hay Mulch Cover	330				$0.00
Check Dams	340	*EA*			$0.00
Other	350				$0.00
IV Waste Relocation	**Cat 4**				
Test Pits (to define limits of refuse and/or ground water to refuse contact)	400	*DAY*			$0.00
Clearing & Grubbing	410	*SY*			$0.00
Waste Regrading (Refuse Excavation/Relocation & Compaction)	420	*CY*			$0.00
Other (Misc. Grading)	430	*LS*	$48,000.00	1	$48,000.00
V Capping	**Cat 5**				
A Cap (Material and Installation)	500				$0.00
Geomembrane	510	*SF*	$0.48	2,499,282	$1,199,655.36
Soil	520	*CY*			$0.00
Testing	530				$0.00
Anchor Trench	540				$0.00
Other - Drainage Net Composite	550	*SF*	$0.75	2,499,282	$1,874,461.50
B Gas Vents Devices	**Cat 6**				$0.00
Gas Vents/Wells	600	*EA*			$0.00
Other - Replacing 20% of the Active Gas Collection System (Vertical Wells)	610	*LF*	$150.00	1760	$264,000.00
C Layers	**Cat 7**				$0.00
Drainage Layer - Free Draining Sand - 18" thick	700	*CY*	$29.36	46,283	$1,358,868.88
Intermediate Cover Placement	710	*CY*	$13.00	23,142	$300,846.00
Sand - Protective Gas Venting Layer - 12" thick	720	*CY*	$29.36	92,566	$2,717,737.76
Topsoil/Loam or Manufactured Soil	730	*CY*	$24.90	46,283	$1,152,446.70
Other - Moisture Retention Layer - 6" thick	740	*CY*	$24.90	46,283	$1,152,446.70
VI Stabilization, Run-off Control	**Cat 8**				
Seed & Mulch (Include Lime, Fertilizer, Seed & Hay Mulch)	800	*AC*	$3,200.00	57.4	$183,680.00
Surface Water Diversion Swales	810	*LF*	$24.35	14,792	$360,185.20
Stone Rip-Rap	820	*CY*			$0.00
Catch Basins, Manholes & Drop Inlets	830				$0.00
Toe Drain	840	*LF*	$28.50	6,946	$197,961.00
Detention Pond and Associated Outlet Devices	850				$0.00
Other - Downchute	860	*LF*	$240.00	1461	$350,640.00
VII Monitoring Devices	**Cat 9**				
Settlement Monuments/Plates	900	*EA*			$0.00
Groundwater Monitoring Wells	910	*EA*			$0.00
Gas Monitoring Probes	920				$0.00
Other	930				$0.00
VIII Roadway	**Cat 10**				
Access Roadway	1000	*LF*	$107.00	3,200	$342,400.00
Drainage Ditches	1010				$0.00
Culvert Inlet & Outlet Headwalls	1020				$0.00
Guide Rail	1030	*LF*			$0.00
Dust Control - Calcium Chloride	1040				$0.00
New/Replaced Pavement	1050	*SY*			$0.00
Other	1060				$0.00

Task	DES Use Only	Unit	Unit Cost	Quantity	Total Cost
IX Miscellaneous	**Cat 11**				
Signs	1100	LS			$0.00
Perimeter Fence	1110	LF			$0.00
Entry Gate - Double Unit	1120	EA			$0.00
Miscellaneous Work and Cleanup	1130	LS	$41,700.00	1	$41,700.00
Ledge Removal	1140	CY			$0.00
Other	1150				$0.00
X Surveying	**Cat 12**				
Baseline, Bench Marks, and Survey Control	1200				$10,000.00
Other	1210				$0.00
XI Construction Phase Testing	**Cat 13**				
Compaction Testing	1300				$0.00
QAQC	1310	AC	$10,000.00	27.5	$275,000.00
Other	1320				$0.00
XII Engineering	**Cat 14**				
Resident Engineer, Project Manager, Project Engineer	1400	LS	$250,000.00	1	$250,000.00
Record Drawings/ As-Built	1410	LS	$20,000.00	1	$20,000.00
Other	1420				$0.00
Qualified Professional Oversight of all Closure Activities	1430	LS	$100,000.00	1	$100,000.00
XIII Other (list)	**Cat 15**				
	1500				$0.00
	1510				$0.00
	1520				$0.00
XIV Contingency (minimum 10%)	**Cat 16**				
	1600	LS	10%		$1,290,442.91
Total Cost					$14,195,000.00

Signature of Preparer: _____ (Must be prepared by a Professional Engineer)

Date: 7/7/2021



This form provides a basis for cost estimating closure costs for a lined landfill. This form is not inclusive of all costs that may be associated with the landfill closure. The cost estimate must include all items needed to comply with all DES permits. Please use the spaces provided above noted as "Other" or attach an additional sheet if necessary.

Date of Last Form Revision: 7/1/14

Cost Estimate Form for Post Closure of a Landfill

(lined or unlined)

Facility Name: City of Nashua Four Hills Landfill Expansion - Phases I - IV
Address of Facility: 840 West Hollis Street, Nashua, New Hampshire 03061
Owner: City of Nashua, New Hampshire
Phase: Phase I - IV
Acreage: 54.7 acres (planimetric), 57.4 acres (3-dimensional)
DES Permit #: DES-SW-SP-95-002
Site # (DES Use Only) **Facility #** (DES Use Only)

LOG# (DES use only)

State of New Hampshire
Department of Environmental Services
Waste Management Division
29 Hazen Drive, PO Box 95, Concord, NH 03302-0095
PHONE (603) 271-2925 FAX (603) 271-2456
EMAIL solidwasteinfo@des.nh.gov
TDD Access: Relay NH 1-800-735-2964

Complete this form in accordance with the NH Solid Waste Rules Part Env-Sw 1400.

Task	Unit	Unit Cost	Quantity	Total Cost
I Water Monitoring				
Surface Water Sampling & Analysis	LS	$1,284.00	1	$1,284.00
Other (Permit Requirement) _____				$0.00
Ground Water Sampling & Analysis	LS	$26,135.00	1	$26,135.00
Other (Permit Requirement) _____				$0.00
Other (Annual Report)	LS	$5,000.00	1	$5,000.00
II Gas Monitoring				
Landfill Gas Migration Monitoring	LS	$2,500.00	1	$2,500.00
Replacing 20% of the Active Gas Collection System				$0.00
Other				$0.00
III Settlement Monitoring				
Field Survey	LS	$5,700.00	1	$5,700.00
Data Tabulation				$0.00
Other				$0.00
IV Leachate Collection/Monitoring				
Sewer Charges				$0.00
Electricity	LS	$11,500.00	1	$11,500.00
Maintenance of Collection System	LS	$4,080.00	1	$4,080.00
Sampling & Analysis	LS	$5,410.00	1	$5,410.00
Other				$0.00
V Clean Air Act Requirements				
Monitoring & Analysis	LS	$4,305.00	1	$4,305.00
Emissions Fees				$0.00
VI Repair & Site Maintenance Costs				
Snow Removal	LS	$4,260.00	1	$4,260.00
Roadway Maintenance				$0.00
Mowing	LS	$5,470.00	1	$5,470.00
Soil Cover Maintenance and Planting	LS	$3,200.00	1	$3,200.00
Maintenance of Gas System	LS	$17,110.00	1	$17,110.00
Subsidence Repair	LS	$1,140.00	1	$1,140.00
Stormwater Maintenance	LS	$3,000.00	1	$3,000.00
Other				$0.00
VII Inspections				
Annual Report	LS	$3,000.00	1	$3,000.00
Annual Site Inspections	LS	$1,800.00	1	$1,800.00
Other				$0.00
VIII Other				
Third Party Management of Post-Closure Activities	LS	$2,000.00	1	$2,000.00
				$0.00
				$0.00
IX Contingency (10 % minimum)				
	LS	10%		$10,689.40
Total Yearly Cost				$117,583.40
Total 30-Year Cost *				$3,510,000.00

Signature of Preparer: _____ (Must be prepared by a Professional Engineer)

Date: 2/10/2022

STATE OF NEW HAMPSHIRE - EDWARD A. GALVIN No. 15387 LICENSED PROFESSIONAL ENGINEER -

The cost estimate must include all expenses associated with compliance of all DES permits. Please use the spaces provided above to add as "Other" or attach an additional sheet if necessary.

* The 30-year total costs (2020 dollars) assumes reductions in the repairs and maintenance costs beginning in the eleventh year following closure (see attached Table 1)

Date of Last Form Revision: 7/1/14

TABLE 1
Post-Closure Cost Reductions
Four Hills Landfill
Nashua, New Hampshire

Item		Annual Cost Year 1-10	Annual Cost Year 11-30
I	Water Monitoring	$32,419	$32,419
II	Gas Monitoring	$2,500	$2,500
III	Settlement Monitoring	$5,700	$5,700
IV	Leachate Collection/Monitoring	$20,990	$20,990
V	Clean Air Act Requirements	$4,305	$4,305
VI	Repair and Site Maintenance Costs	$34,180	$33,380
VII	Inspections	$4,800	$4,800
VIII	Other	$2,000	$2,000
IX	Contingency (10%)	$10,689	$10,609
	TOTAL	$117,583	$116,703

Notes:

1. Task designations are consistent with those identified on NHDES Cost Estimate Form For Post Closure of a Landfill.

2. Costs are 2020 dollars.

TABLE 2
Sinking Fund for Combined
Closure & Post-Closure (30-Years) Fund
Four Hills Landfill
Nashua New Hampshire

Sinking Fund for CLOSURE and POST CLOSURE of Phases I, II, III and IV
Assumes Phase IV is the Last Phase Built

ASSUMPTIONS

Inflation Rate[1]	1.55%
Interest Rate Projected for 2020	1.23%

FUND REQUIREMENTS

Combined fund balance as of November 2019 for Closure & Post Closure	$6,391,294
Base Contribution (in 2020$) for 2020	$0
Base Contribution (in 2020$) annually after 2020 =	varies (see below)
Landfill Closure Cost (in 2020$)	$14,195,000

	Year	Closure/Post Closure Cost (2020 value)	Closure/ Post Closure Cost with Inflation	Deposit to Fund by City (2020 value)	Interest Accumulated by Fund	Balance of Fund (end of year)
Begin Phase I Oper.	2002					
	2003					
	2004					
	2005					
	2006					
	2007					
	2008					
	2009					
Begin Phase II Oper.	2010					
	2011					
	2012					
	2013					
	2014					
	2015					
	2016					
	2017					
	2018					
	2019					
Begin Phase III Oper.	2020					$6,391,294
	2021			$405,000	$81,104	$6,877,398
	2022			$430,000	$87,236	$7,394,634
	2023			$435,000	$93,629	$7,923,263
End Phase II Oper.	2024			$435,000	$100,131	$8,458,395
	2025			$435,000	$106,714	$9,000,108
	2026			$435,000	$113,377	$9,548,485
	2027			$435,000	$120,122	$10,103,606
	2028			$435,000	$126,950	$10,665,556
	2029			$435,000	$133,862	$11,234,418
Begin Phase IV Oper.	2030			$435,000	$140,859	$11,810,276
	2031			$435,000	$147,942	$12,393,218
	2032			$435,000	$155,112	$12,983,330
	2033			$435,000	$162,370	$13,580,700
End Phase III Oper.	2034			$435,000	$169,718	$14,185,418
	2035			$435,000	$177,156	$14,797,574
	2036			$440,000	$184,716	$15,422,290
	2037			$440,000	$192,400	$16,054,690
	2038			$440,000	$200,179	$16,694,869
	2039			$440,000	$208,053	$17,342,922
	2040			$440,000	$216,024	$17,998,946
	2041			$440,000	$224,093	$18,663,039
	2042			$440,000	$232,261	$19,335,300
	2043			$440,000	$240,530	$20,015,830
	2044			$440,000	$248,901	$20,704,731
	2045			$440,000	$257,374	$21,402,105
	2046			$440,000	$265,952	$22,108,057
	2047			$440,000	$274,635	$22,822,692
	2048			$440,000	$283,425	$23,546,117
	2049			$440,000	$292,323	$24,278,440
	2050			$440,000	$301,331	$25,019,771
	2051			$440,000	$310,449	$25,770,220
	2052			$440,000	$319,680	$26,529,900
	2053			$440,000	$329,024	$27,298,924
	2054			$440,000	$338,483	$28,077,407
	2055			$440,000	$348,058	$28,865,465
	2056			$440,000	$357,751	$29,663,216
	2057			$440,000	$367,564	$30,470,780
	2058			$440,000	$377,497	$31,288,276
	2059			$440,000	$387,552	$32,115,828
Close Phases I-IV	2060			$440,000	$397,731	$32,953,559
Start Post Closure - Yr 1	2061	$14,195,000	$26,669,350		$405,329	$6,689,537
Post Closure - Yr 2	2062	$117,583	$224,338		$82,281	$6,547,480
Post Closure - Yr 3	2063	$117,583	$227,815		$80,534	$6,400,199
Post Closure - Yr 4	2064	$117,583	$231,346		$78,722	$6,247,575
Post Closure - Yr 5	2065	$117,583	$234,932		$76,845	$6,089,488
Post Closure - Yr 6	2066	$117,583	$238,574		$74,901	$5,925,815
Post Closure - Yr 7	2067	$117,583	$242,272		$72,888	$5,756,431
Post Closure - Yr 8	2068	$117,583	$246,027		$70,804	$5,581,208
Post Closure - Yr 9	2069	$117,583	$249,840		$68,649	$5,400,017
Post Closure - Yr 10	2070	$117,583	$253,713		$66,420	$5,212,724
Post Closure - Yr 11	2071	$117,583	$257,645		$64,117	$5,019,195
Post Closure - Yr 12	2072	$116,703	$259,681		$61,736	$4,821,250
Post Closure - Yr 13	2073	$116,703	$263,706		$59,301	$4,616,846
Post Closure - Yr 14	2074	$116,703	$267,793		$56,787	$4,405,840
Post Closure - Yr 15	2075	$116,703	$271,944		$54,192	$4,188,088
Post Closure - Yr 16	2076	$116,703	$276,159		$51,513	$3,963,442
Post Closure - Yr 17	2077	$116,703	$280,440		$48,750	$3,731,753
Post Closure - Yr 18	2078	$116,703	$284,786		$45,901	$3,492,867
Post Closure - Yr 19	2079	$116,703	$289,201		$42,962	$3,246,629
Post Closure - Yr 20	2080	$116,703	$293,683		$39,934	$2,992,879
Post Closure - Yr 21	2081	$116,703	$298,235		$36,812	$2,731,456
Post Closure - Yr 22	2082	$116,703	$302,858		$33,597	$2,462,195
Post Closure - Yr 23	2083	$116,703	$307,552		$30,285	$2,184,928
Post Closure - Yr 24	2084	$116,703	$312,319		$26,875	$1,899,483
Post Closure - Yr 25	2085	$116,703	$317,160		$23,364	$1,605,686
Post Closure - Yr 26	2086	$116,703	$322,076		$19,750	$1,303,360
Post Closure - Yr 27	2087	$116,703	$327,068		$16,031	$992,323
Post Closure - Yr 28	2088	$116,703	$332,138		$12,206	$672,390
Post Closure - Yr 29	2089	$116,703	$337,286		$8,270	$343,374
Post Closure - Yr 30	2090	$116,703	$342,514		$4,224	$5,084

Notes:
1. Inflation rate based on the average of the last 10 years of historical annual U.S. inflation rate data.

POST CLOSURE COSTS SUPPORTING DOCUMENTATION

SANBORN HEAD

The following assumptions were made in developing the post-closure cost estimate summarized in the New Hampshire Department of Environmental Services (NHDES) Post Closure Form and Table 1. The tasks identified on Table 1, and discussed below, are consistent with the tasks presented on the NHDES forms. Table 1 is provided, as the NHDES Post Closure form does not allow for consideration of reduced costs that are likely to occur over time.

Task I Water Monitoring

Years 1 Through 30

- The current program of annual water quality monitoring involves biannual sampling of:
  - 19 release detection wells associated with Phases I-IV of the landfill at an annual cost of $16,000;
  - 15 groundwater management wells sampled biannually at an annual cost of $10,135; and
  - 2 surface water sampling points sampled biannually at an annual cost of $1,284.
- Assume the current program of annual and semiannual water quality monitoring continues at an annual cost of $27,419 per year (price information provided by the City of Nashua).
- Assume annual report is prepared at a cost of $5,000.
- With these assumptions, the annual cost for years 1 through 30 is estimated to be $32,419.

Task II Gas Monitoring

- Assume an annual cost of $2,500 for the quarterly monitoring of landfill gas will continue throughout the post-closure monitoring period (inflated based on Eastern Analytical, Inc. quote dated 1/20/15 and information provided by the City of Nashua). NHDES may permit some reductions to the frequency and locations after several years; however, such reductions should not be relied upon.

Task III Settlement Monitoring

Years 1 through 30

- Assume an annual cost of $5,700 for settlement survey based upon information provided by the City of Nashua.

Task IV Leachate Collection/Monitoring

- Currently, the City of Nashua does not pay leachate disposal costs because leachate is discharged directly to the City of Nashua sewer system. Assume this agreement continues through the post-closure time period.
- Maintenance of the collection system is assumed to be an annual lump sum amount of $4,080 (Assume bi-yearly manhole cleaning at $1,800 and leachate pipe cleaning every 5 years at

$4,500, and $2,280 each year for routine maintenance of the Phase III and IV leachate pumps; therefore, a total yearly costs of $4,080).

- The current program of tri-annual sampling of the primary and secondary leachate has an annual total cost of $4,410. Assume this program continues at this same cost.
- Assume sampling associated with the Phase IV above-cap monitoring program to have an annual cost of $1,000.
- Assume the annual electrical costs for the secondary leachate pump (0.4 hp submersible pump) used to transfer secondary leachate into the primary leachate discharge pipe, and electricity use by the flow control building (including heat) is $1,900.
- Assume the annual electrical costs for the Phase III sump riser building pumping system is $9,600 (based actual costs of an equivalent NH landfill pumping system).
- With these assumptions, the annual cost for years 1 through 30 is estimated to be ~~$19,990~~$20,990.

Task V Clean Air Act Requirements

- Currently, the City of Nashua completes air monitoring (surface emissions monitoring) and reporting utilizing landfill employees. Assume it takes a field technician/engineer 41 hours each year to complete these tasks.
- Assume this program continues with the same scope and an hourly rate of $105 for an outside company to complete the monitoring/reporting.
- With these assumptions, the annual costs for years 1 through 30 is estimated to be $4,305.00

Task VI Repair and Site Maintenance Costs

Assume limited maintenance will be required to include; mowing the cap, snow removal, and repairs to soil cover and stormwater features. We understand that the City will maintain the GCCS infrastructure and utility flare.

Years 1 through 10

- Snow removal is assumed to be an annual lump sum amount of $4,260 (assumes plowing 3 times a year at $1,420/plowing).
- Mowing assumed to be $100/acre annually, the site is 54.7 acres, annual mowing cost is $5,470.
- Soil Cover Maintenance and Planting is assumed to be an annual lump sum amount of $3,200 (assumes Seeding & Mulching 1 Acre/year @ $3,200/acre).
- Maintenance/Operation of GCCS Infrastructure:

- Routine maintenance of control system, monthly monitoring of collection system, and well field balancing. Assumed 15 hours per month for monthly maintenance tasks and balancing the well field. Assuming an hourly rate of $60/hour, the annual cost is approximately $10,800 per year.

- Assume $1,600/year for minor repairs to wellheads that may be required.

- Assume that a condensate knockout pump will need to be replaced once every two years at a cost of $2,700 (based on a price quotation from QED on November 6, 2019). This equates to a cost of $1,350 per year.

- Semi-annual maintenance of blower bearings, testing automated devices, gas canister maintenance/refill, and coordinating any unscheduled maintenance. Assumed 4 hours at $60/hour labor per event or $240 per year.

- Replacement of blower/flare/control parts. Assumed 8 hours labor at $60/hour and $1,200 parts or total of $1,680 per year.

- Unscheduled responses to alarm conditions, expected to occur 4 times per year. Assumed 6 hours labor at $60/hour per event, which equates to an annual cost of $1,440.

Totaling these items, the annual cost of Maintenance/Operation of GCCS Infrastructure is $14,950.

- During the 30year post closure period, following closure of Phases I, II, and III, the City assumes a third party will continue to be responsible for operating the landfill gas-to-energy (LFGTE) facility.

- Subsidence Repair ($5,700/5 years) is assumed to be an annual lump sum amount of $1,140 (assume 1 day of bull dozer work @ $2,400/day and $3,300 of soil materials).

- Stormwater Maintenance is assumed to be an annual lump sum amount of $3,000.

- With these assumptions, the annual cost for years 1 through 10 is estimated to be $26,300.

Years 11 through 30

- Assume $800/year (reduced by about half from years 1-10) for minor repairs to wellheads that may be required.

- All other maintenance and repair costs will remain unadjusted.

- With these assumptions, the annual cost for years 11 through 30 is estimated to be $25,500.00.

Task VII Inspections

- Assume an annual facility report may be prepared at a lump sum annual cost of $3,000.

- Assume annual site inspections at a lump sum annual cost of $1,800.
- Therefore, the annual cost for years 1 through 30 for post-closure inspections and reporting is estimated to be $4,800.

Task VIII Other

- Assume $2,000 annual cost for third party management of post-closure activities.

Task IX Contingency (10 percent)

- Assume 10 percent contingency.

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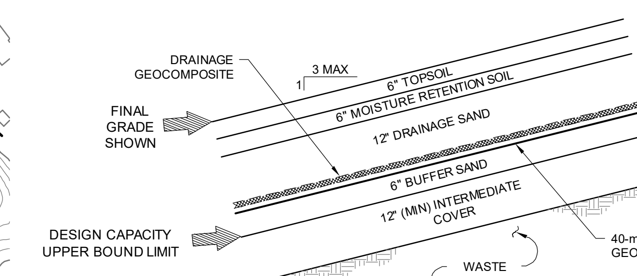
Comment #2

Revised Phase IV Design Drawings
(Sheet 10A)

NOTES:

1. SEE SHEET 1 FOR ADDITIONAL NOTES AND LEGEND INFORMATION.
2. THE PROPOSED GRADES IN THE PROPOSED OVERLAY AREA ARE BASED ON HISTORICAL TOPOGRAPHY DATA AND SHOULD BE CONSIDERED CONCEPTUAL ONLY. THE EXISTING GRADES AT THE TIME OF CONSTRUCTION MAY BE LOWER DUE TO WASTE SETTLEMENT. THEREFORE, THE OVERLAY AREA WILL BE SURVEYED PRIOR TO PREPARING THE CONSTRUCTION DRAWINGS AND THE PROPOSED GRADING WILL BE ADJUSTED ACCORDING TO THE PERMITTED LIMIT OF WASTE AS NECESSARY.
3. EXISTING GAS EXTRACTION WELL AND COLLECTION TRENCHES NOT SHOWN FOR CLARITY.



GRADING KEY

NOT TO SCALE

- NOT FOR CONSTRUCTION -
FOR PERMITTING PURPOSES ONLY

SANBORN HEAD

GRAPHICAL SCALE
120' 60' 0' 120' 240'

NO.	DATE	DESCRIPTION	BY

DRAWN BY: L. ZUCHOWSKI
DESIGNED BY: L. ZUCHOWSKI
REVIEWED BY: E. STEINHAUSER
PROJECT MGR: E. GALVIN
PIC: E. STEINHAUSER
DATE: JANUARY 2022

PHASE IV DESIGN DRAWINGS
TYPE I-A PERMIT MODIFICATION APPLICATION
FOUR HILLS LANDFILL
CITY OF NASHUA
NASHUA, NEW HAMPSHIRE

FINAL CAP GRADING PLAN

PROJECT NUMBER: 3066.11

SHEET NUMBER: 10A OF 30

Comment #3

Secondary Compression Ratio Demonstration

WSP USA, Inc. Existing Conditions Survey (Dec 2021)

Primary Drainage Geocomposite – Critical Path Profile Worksheet, Revised Table 1, Additional HELP Output

Secondary Travel Time Critical Path Profile Worksheet

PURPOSE:

Demonstrate how the secondary compression ratio index, C_α, of 0.07 was determined as part of the Phase IV Liner Settlement Calculation, which was included in the July 16, 2021 response to the New Hampshire Department of Environmental Services' request for additional information related to the Phase IV Type I-A Modification to Solid Waste Management Facility Permit Application.

GIVEN:

1. Final Closure Grades – Attachment A presents excerpts from the Unlined Landfill Closure Record Drawings, prepared by CMA Engineers, Inc. (CMA), dated March 2005, that depict the Unlined Landfill final closure grades. Electronic AutoCAD files of this plan set were not available, so Sanborn Head digitized the final grade contours from the PDF.
2. Landfill Grades from June 2010 – Sheet 2 of the Phase IV Design Drawings (Overall Site Plan) includes a base map that was obtained from drawings prepared by CMA that reference a survey of the Unlined Landfill that occurred in June 2010. This 2010 topography was used to determine the secondary compression ratio included in the July 2021 response document.
3. Landfill Grades from December 2021 – Attachment B presents the Existing Conditions Survey of the Unlined Landfill that was prepared by WSP USA, Inc., which includes survey data captured on December 14, 2021.

ASSUMPTIONS:

Assume MSW is homogeneous and material properties are as follows:

- Unit Weight, γ_{MSW} = 85 pcf [Ref. 1]
- The thickest portion of the Unlined Landfill is profiled along Alignment A-A' (see Attachment C)

METHOD:

1. Use the Sowers Method and AutoCAD Civil 3D to interpret/back-calculate the secondary compression index. By comparing the profiled closure grades and actual ground survey data (i.e., 2010 survey data), the amount of settlement that occurred since closure (6.5 years) can be quantified. By knowing the actual amount of secondary settlement (no load placed on the Unlined Landfill since closure) and the time it took to happen (difference between closure grades and 2010 survey), the specific secondary compression index can be iterated until the modeled settled surface matches the actual settled surface. Use computer programming within AutoCAD to perform this calculation.

   Sowers Equation:

$$\Delta H = \underbrace{H \cdot Cr \log\left(\frac{\sigma_0 + \Delta\sigma}{\sigma_0}\right)}_{\text{Primary}} + \underbrace{H \cdot C_\alpha \log\left(\frac{t_2}{t_1}\right)}_{\text{Secondary}} \qquad \text{[Ref. 2]}$$

where:

H = height of existing waste layer
CR = primary compression ratio*
σ_o = existing overburden pressure at the midpoint of the layer*
$\triangle\sigma$ = increase in overburden pressure*
$C\alpha$ = secondary compression ratio
t_1 = time at start of interval
t_2 = time of interest (end of interval)

* Because the iteration process begins after closure, it represents secondary consolidation only as no additional load was placed on the landfill after closure. As such, the values that affect primary consolidation do not exist and the primary settlement term of the equation cancels out allowing for the direct calculation of the secondary compression index.

2. Compare settlement model (i.e., Sowers equation with a secondary compression ratio of 0.07) to 2021 survey data and compare results.

CALCULATION:

1. Using the Sowers Method, the settlement calculation was performed at each individual grid point within the AutoCAD Civil 3D surface along Alignment A-A.' The settled surface is presented within the section view in Attachment D (Profile 1).

Sample Settlement Calculation at STA 3+00 of Profile 1 shown on Attachment D:

Unlined Landfill Base El. = 213.5 ft
Closure Grade El. = 274.8 ft
H = Closure Grade El. – Unlined Landfill Base El. = 61.3 ft
Time of interest = 6.5 years (2,373 days) (time between closure and 2010 survey)
Assume C_α, of 0.07 (this was iterated within AutoCAD until settlement profile surface aligned well with 2010 survey – see Attachment A)
Secondary Consolidation of Existing MSW from t1 to t2:

$\triangle H = (61.3 \text{ ft})(0.07)*\log(2{,}373 \text{ days}/25 \text{ days}) = \underline{8.5 \text{ ft}}$

This calculation is performed by the program at every data point along Alignment A-A.' A new surface is created from the settled points and added to the profile. The secondary compression index was adjusted until the settled surface aligned well with the 2010 survey. Please note that the profiles shown on Attachment D have a vertical exaggeration of 2.0.

2. The procedure above was used to compare the projected settled surface to survey of the Unlined Landfill that was performed in December 2021 (see Attachment B). The time of interest was extended to 17 years and is shown in Profile 2 on Attachment D.

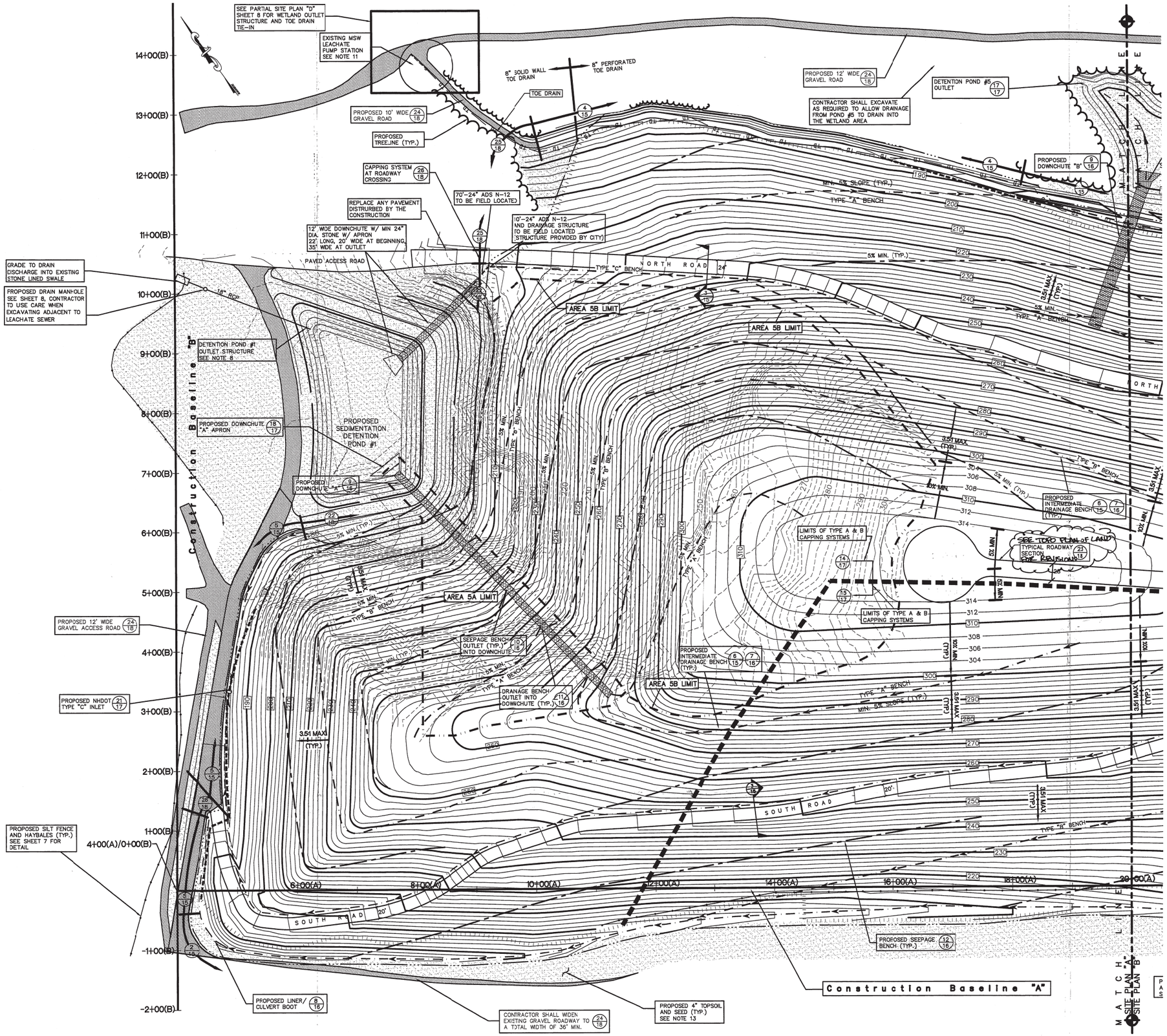
RESULTS:

It is important to note that the profiles shown on Attachment D are displayed at a vertical exaggeration of 2.0 for ease of presentation. When displayed at a vertical exaggeration of 1.0, there is almost no difference between the projected settled surface and the surveys, which for a settlement model is very encouraging. Even at the displayed vertical exaggeration, the two surface are nearly identical in Profile 1. The projected settled surface is lower than the 2021 survey in most areas of Profile 2, indicating the selected secondary compression index may be conservative.

REFERENCES:

[1] Qian, X., Koerner, R. M., and Gray, D. H, Geotechnical Aspects of Landfill Design and Construction, Prentice-Hall, Inc., 2002, p. 184.

[2] Babu, G. L. S., Reddy, K. R., Chouskey, S. K., and Kulkarni, H. S., "Prediction of Long-Term Municipal Solid Landfill Settlement Using Constitutive Model," in Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management, ASCE, 2010, p. 140.



Notes - Site Plan

1. Topography shown taken from field survey by Haynor Swanson [illegible] have c[illegible] since [illegible]
2. Bou[illegible] References 1 and 2. The property boundary as shown has been located by field survey performed by Haynes/Swanson.
3. Project elevations are based on USGS NGVD (Mean Sea Level = 0.00).
4. See Special Conditions for requirements associated with landfill access roads and temporary haul roads. The Contractor shall be responsible to control dust at the site during the time the Contractor is on-site. The use of calcium chloride is not acceptable.
5. The Contractor shall install all required erosion control devices to control erosion and prevent transportation of sediment beyond the work area.
6. Monitoring wells on site shall be protected throughout construction. Contractor is responsible for all repairs if any damage occurs.
7. This site is an operating landfill and must continue to operate during the contract period. Significant coordination with the City is required. Contractor shall coordinate construction traffic with the landfill operator such that landfill operations can continue without interruption.
8. The final grades shown are approximate and are shown to indicate capping system slopes. Final elevations will vary depending on settlement and final waste placement/relocation. The minimum or maximum slopes, horizontal location of the swales, benches, roadways and toe shall govern. The finish slopes within the limit of the liner shall not be steeper than 3.5:1 and the slope of the drainage swales/seepage benches shall not be less than 5%. See Sheets 11 and 12 for Horizontal Layout Information.
9. In areas where additional material is required to meet the slope ranges shown on the Plans, the Contractor shall use the City supplied waste(MSW) or Alternative Daily cover(ADC) materials as the shimming material. The Contractor shall coordinate with the City landfill staff to identify locations within the landfill for this material.
10. The Contractor shall cover any exposed waste within the work area at the end of the day to control odors(See Special Conditions)
11. The Contractor shall provide all the capping system penetrations specified on Sheet 13. The Contractor shall also coordinate with the landfill gas leasing company to ensure gas features are extended in a time frame which does not impact the Contractor's overall schedule.
12. The Contractor shall coordinate the closure work with the City's final landfill operations and the bid alternate #1 if exercised by the City. The Contractor shall ensure the City has access to the Filling Areas throughout the construction period.
13. The Contractor shall place 4"(min.) of Topsoil and seed the areas outside the capping system as shown. The Contractor shall also restore all areas which are disturbed during construction with 4" (min.) of Topsoil and seed per specifications.
14. See sheets 11 & 12 for the limit of Geomembrane Liner, proposed settlement monuments and restricted access signs.

Legend:

- Existing 2' Contour(March 2001)
- 280 — Existing 10' Contour(March 2001)
- Approximate Existing Property Line
- Existing Gravel Road
- Approximate Existing Edge of Wet
- Existing Stone Wall
- x — x — Existing Fence
- ohe — Existing Overhead Electric
- fm — Existing Force Main
- Existing Sewer line
- Existing Ditch Line
- Existing Trestle Brook
- Approximate Existing Limit of Waste
- td — Approximate Existing Toe Drain
- Approximate Existing Tree Line
- Existing Utility Pole
- B HA1 — Approximate Boring Location
- Existing Sewer Manhole
- Existing Leachate Manhole
- WELL B-9 — Existing Monitoring Well
- TP1 — Existing Test Pit
- Approximate Existing Wetland Area
- Proposed Crushed Gravel Roadway
- Area Outside Capping system to receive 4" topsoil and shall be seeded
- Proposed Limit of Waste
- Approximate Limit of Work Area This Contract
- Proposed Intermediate Drainage Bench
- Proposed Seepage Bench
- Proposed Silt Fence

ATTACHMENT A

Revisions	Date
Issued for City Review	5/16/00
Issued for NHDES Review	5/26/00
Issued for Bids	5/5/00
Area 5, Grades Revised for C.O. #5	8/01
Record Drawings	3/05

CMA Engineers, Inc.
Civil/Environmental Engineers
35 Bow Street
Portsmouth, N.H. 03801

Nashua, NH MSW Landfill Closure
Construction Drawings
Area 5 Final Closure Grading
2002/2003

City of Nashua, NH
Nashua Four Hills Landfill
MSW Landfill Closure

Designed by:	ETR/JFH
Drawn by:	DMO/ETR
Approved by:	WAS
Date:	MAY 2000
Scale:	1" = 60'
Project No:	407.3

Sheet No: 5b of 24

Co#6

Notes - Site Plan

1. Topography shown taken from photogrammetric mapping completed by James W. Sewall Co., Old Town, Maine from photographs obtained December 1999. Areas within limits of landfill have changed due to additional filling and settlement of waste since December 1999 Survey.

2. Boundary bearings and distances shown are taken from Plan References 1 and 2. The property boundary as shown has been located by field survey performed by Hayner/Swanson.

3. Project elevations are based on USGS NGVD (Mean Sea Level = 0.00).

4. See Special Conditions for requirements associated with landfill access roads and temporary haul roads. The Contractor shall be responsible to control dust at the site during the time the Contractor is on-site. The use of calcium chloride is not acceptable.

5. The Contractor shall install all required erosion control devices to control erosion and prevent transportation of sediment beyond the work area.

6. Monitoring wells on site shall be protected throughout construction. Contractor is responsible for all repairs if any damage occurs.

7. This site is an operating landfill and must continue to operate during the contract period. Significant coordination with the City is required. Contractor shall coordinate construction traffic with the landfill operator such that landfill operations can continue without interruption.

8. The final grades shown are approximate and are shown to indicate capping system slopes. Final elevations will vary depending on settlement and final waste placement/relocation. The minimum or maximum slopes, horizontal location of the swales, benches, roadways and toe shall govern. The finish slopes within the limit of the liner shall not be steeper than 3.5:1 and the slope of the drainage swales/seepage benches shall not be less than 5%. See Sheets 11 and 12 for Horizontal Layout information.

9. In areas where additional material is required to meet the slope ranges shown on the Plans, the Contractor shall use the City supplied waste(MSW) or Alternative Daily cover(ADC) materials as the shimming material. The Contractor shall coordinate with the City landfill staff to identify locations within the landfill for this material.

10. The Contractor shall cover any exposed waste within the work area at the end of the day to control odors.

11. The Contractor shall provide all the capping system penetrations specified on Sheet 13. The Contractor shall also coordinate with the landfill gas leasing company to ensure gas features are extended in a time frame which does not impact the Contractor's overall schedule.

12. The Contractor shall coordinate the closure work with the City's final landfill operations and the bid alternate #1 if exercised by the City. The Contractor shall ensure the City has access to the Filling Areas throughout the construction period.

13. The Contractor shall place 4"(min) of Topsoil and seed the areas outside the capping system as shown. The Contractor shall also restore all areas which are disturbed during construction with 4" (min.) of Topsoil and seed per specifications.

AS-BUILT REVISION NOTE
DRAINAGE SWALES, DRAINAGE BENCHES, TOPOGRAPHY AND OTHER SURFACE FEATURES ARE REVISED. SEE AS BUILT TOPO PLAN, DEC. 16, 2004, SHEET 1 OF 1 FOR LOCATIONS

RECORD DRAWINGS

Legend:

- Existing 2' Contour(Dec. 1999)
- 210 — Existing 10' Contour(Dec. 1999)
- Approximate Existing Property Line
- Existing Gravel Road
- Approximate Existing Edge of Wet
- Existing Stone Wall
- Existing Fence
- ohe — Existing Overhead Electric
- fm — Existing Force Main
- Existing Sewer line
- Existing Ditch Line
- Existing Trestle Brook
- Approximate Existing Limit of Waste
- td — Approximate Existing Toe Drain
- Approximate Existing Tree Line
- Existing Utility Pole
- B-NA1 — Approximate Boring Location
- Existing Sewer Manhole
- Existing Leachate Manhole
- WELL B-9 — Existing Monitoring Well
- TP11 — Existing Test Pit
- Approximate Existing Wetland Area
- Proposed Crushed Gravel Roadway
- Area Outside Capping system to receive 4" topsoil and shall be seeded
- Proposed Limit of Waste
- Approximate Limit of Work Area This Contract
- Proposed Intermediate Drainage Bench
- Proposed Seepage Bench
- Proposed Silt Fence

Revisions		
Date	Revisions	Date
5/16/00	Issued for City Review	
5/26/00	Issued for NHDES Review	
6/5/00	Issued for Bids	
8/00	Issued for Construction	
5/05	Record Drawings	

CMA ENGINEERS, INC.
CIVIL/ENVIRONMENTAL ENGINEERS
35 BOW STREET
PORTSMOUTH, N.H. 03801

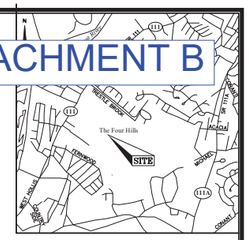
Nashua, NH MSW Landfill Closure
Construction Drawings
Final Closure Grading
Site Plan "B"

City of Nashua, NH
Nashua Four Hills Landfill
MSW Landfill Closure

Designed by:	ETR/JFH
Drawn by:	DMO/ETR
Approved by:	WAS
Date:	MAY 2000
Scale:	1" = 60'
Project No:	407.3

Sheet No:
6 of 24

ATTACHMENT B



LOCUS MAP
(N.T.S.)

NOTES

1. THE PURPOSE OF THIS PLAN IS TO SHOW THE EXISTING CONDITIONS OF THE CLOSED MSW PORTION OF THE FOUR HILLS LANDFILL. THIS PLAN WAS PREPARED FROM AERIAL MAPPING WITH A PHOTOGRAPHY DATE OF DECEMBER 14, 2021.

2. THE HORIZONTAL AND VERTICAL DATUMS SHOWN HEREON ARE BASED ON CONTROL POINTS PROVIDED TO WSP BY SANBORN, HEAD & ASSOCIATES, INC.

LEGEND

- UNIDENTIFIED STRUCTURE
- UNIDENTIFIED STRUCTURE
- UTILITY POLE
- WETLAND
- POST
- BOULDER
- DECIDUOUS TREE
- SHRUB
- +209.1 SPOT ELEVATION
- 250 INDEX CONTOUR
- 248 INTERMEDIATE CONTOUR
- TREE LINE
- SHRUB LINE
- STONEWALL
- GUARDRAIL
- EDGE OF WATER/ WETLAND

GRAPHIC SCALE

80 0 40 80 160 320

(IN FEET)
1 inch = 80 ft.

REVISION	
DATE	DESCRIPTION
--/--/--	---

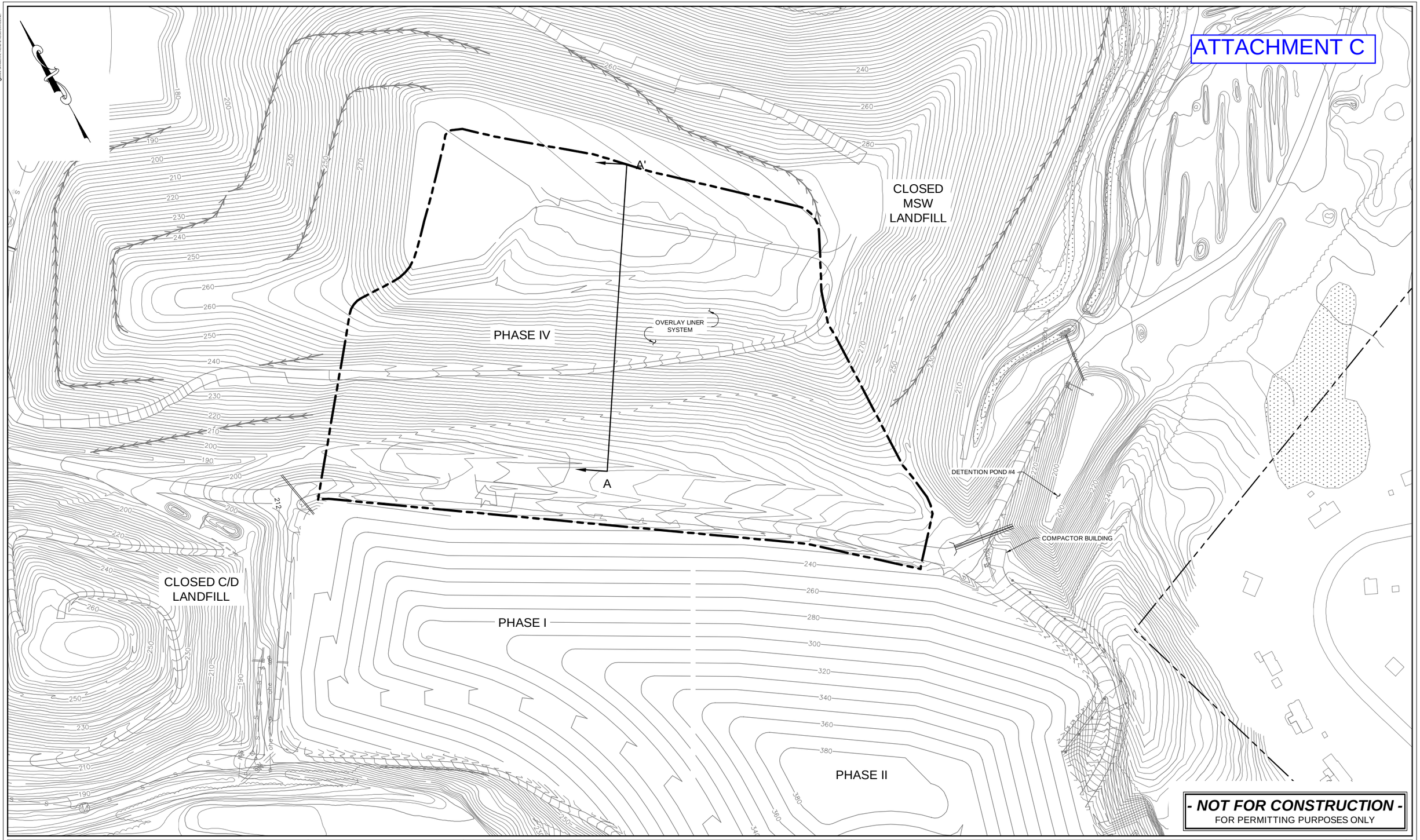
EXISTING CONDITIONS SURVEY
FOUR HILLS LANDFILL
840 WEST HOLLIS STREET
NASHUA, NEW HAMPSHIRE
PREPARED FOR
CITY OF NASHUA

WSP USA Inc.
9 Executive Park Dr, Suite 101
Merrimack, NH 03054
603-324-0894

Drawn By CG	Date JANUARY 11, 2022	Job No. 30901205.002
Surveyed By AT		
Checked By DPP	Scale 1" = 80'	Sheet No. 1 OF 1
Book No. N/A		

30901205.002-1.dwg

ATTACHMENT C



- NOT FOR CONSTRUCTION -
FOR PERMITTING PURPOSES ONLY

SANBORN HEAD

GRAPHICAL SCALE
100' 50' 0 100' 200'

NO.	DATE	DESCRIPTION	BY

DRAWN BY: L. ZUCHOWSKI
DESIGNED BY: E. GALVIN
REVIEWED BY: E. STEINHAUSER
PROJECT MGR: E. GALVIN
PIC: E. STEINHAUSER
DATE: JANUARY 2022

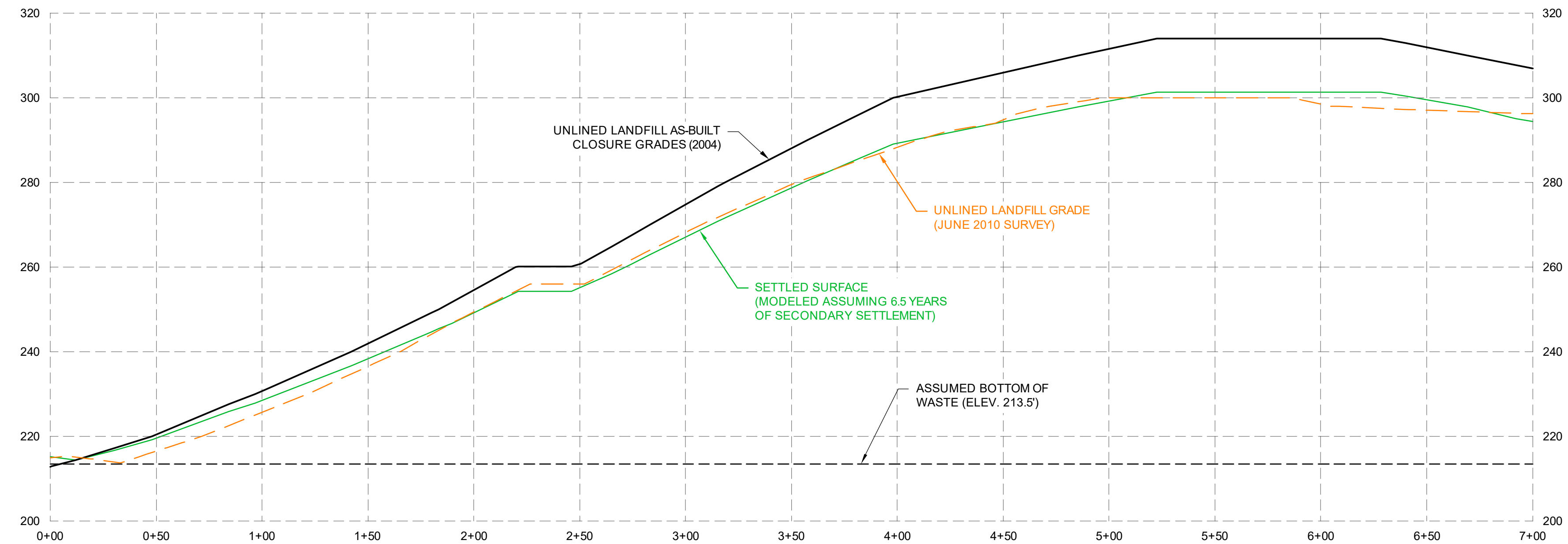
TYPE I-A PERMIT MODIFICATION APPLICATION
FOUR HILLS LANDFILL
CITY OF NASHUA
NASHUA, NEW HAMPSHIRE

PROJECT NUMBER: 3066.11

SECONDARY COMPRESSION RATIO EVALUATION SECTION PLAN

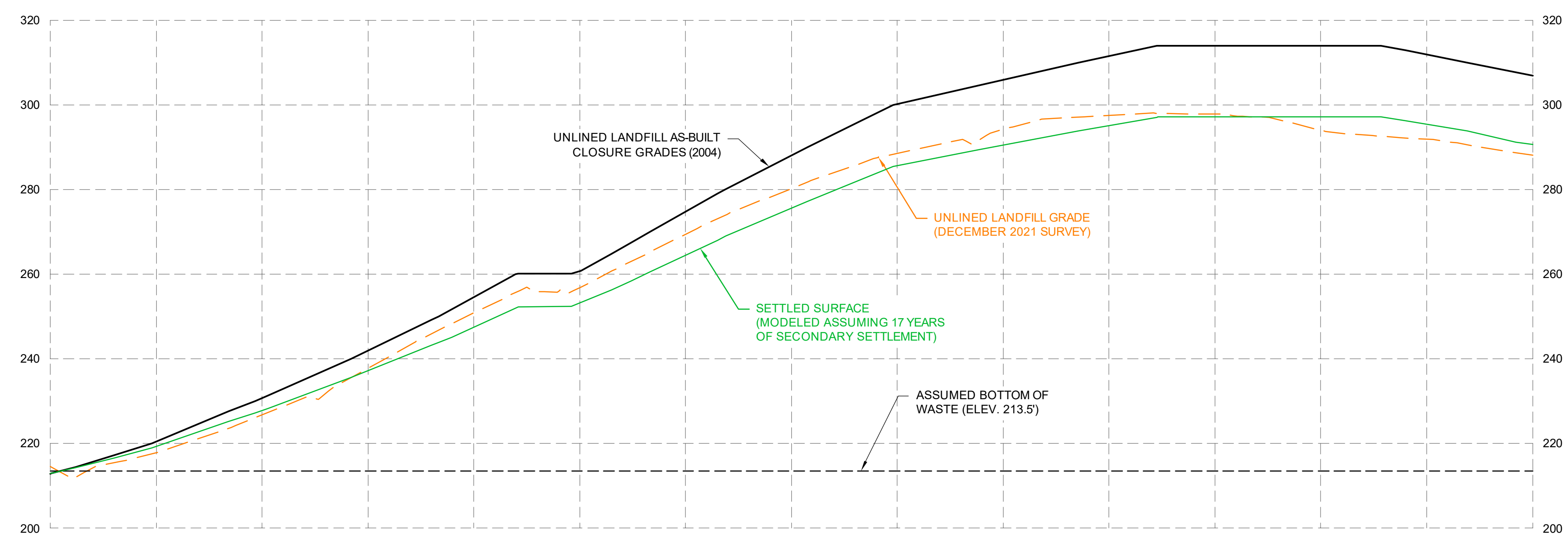
SHEET NUMBER: 1 OF 2

ATTACHMENT D



1 SETTLED CLOSURE GRADES VS. 2010 SURVEY

NOT TO SCALE



2 SETTLED CLOSURE GRADES VS. 2021 SURVEY

NOT TO SCALE

SANBORN HEAD

VERTICAL SCALE: 20.0' 10.0' 0' 20.0' 40.0'

HORIZONTAL SCALE: 40' 20' 0' 40' 80'

NO.	DATE	DESCRIPTION	BY

DRAWN BY: E. GALVIN
DESIGNED BY: E. GALVIN
REVIEWED BY: E. STEINHAUSER
PROJECT MGR: E. GALVIN
PIC: E. STEINHAUSER
DATE: FEBRUARY 2022

TYPE I-A PERMIT MODIFICATION APPLICATION
FOUR HILLS LANDFILL
NASHUA, NEW HAMPSHIRE

SECONDARY COMPRESSION RATIO EVALUATION WORKSHEET

PROJECT NUMBER: 3066.11

SHEET NUMBER: 1 OF 1

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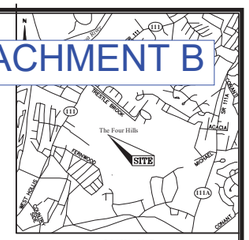
ATTACHMENT B



LOCUS MAP
(N.T.S.)

NOTES

1. THE PURPOSE OF THIS PLAN IS TO SHOW THE EXISTING CONDITIONS OF THE CLOSED MSW PORTION OF THE FOUR HILLS LANDFILL. THIS PLAN WAS PREPARED FROM AERIAL MAPPING WITH A PHOTOGRAPHY DATE OF DECEMBER 14, 2021.

2. THE HORIZONTAL AND VERTICAL DATUMS SHOWN HEREON ARE BASED ON CONTROL POINTS PROVIDED TO WSP BY SANBORN, HEAD & ASSOCIATES, INC.

LEGEND

- UNIDENTIFIED STRUCTURE
- UNIDENTIFIED STRUCTURE
- UTILITY POLE
- WETLAND
- POST
- BOULDER
- DECIDUOUS TREE
- SHRUB
- +209.1 SPOT ELEVATION
- 250 INDEX CONTOUR
- 248 INTERMEDIATE CONTOUR
- TREE LINE
- SHRUB LINE
- STONEWALL
- GUARDRAIL
- EDGE OF WATER/ WETLAND

GRAPHIC SCALE

80 0 40 80 160 320

(IN FEET)
1 inch = 80 ft.

REVISION	
DATE	DESCRIPTION
--/--/--	---

EXISTING CONDITIONS SURVEY
FOUR HILLS LANDFILL
840 WEST HOLLIS STREET
NASHUA, NEW HAMPSHIRE
PREPARED FOR
CITY OF NASHUA

WSP USA Inc.
9 Executive Park Dr, Suite 101
Merrimack, NH 03054
603-324-0894

Drawn By CG	Date JANUARY 11, 2022	Job No. 30901205.002
Surveyed By AT		
Checked By DPP	Scale 1" = 80'	Sheet No. 1 OF 1
Book No. N/A		

30901205.002-1.dwg

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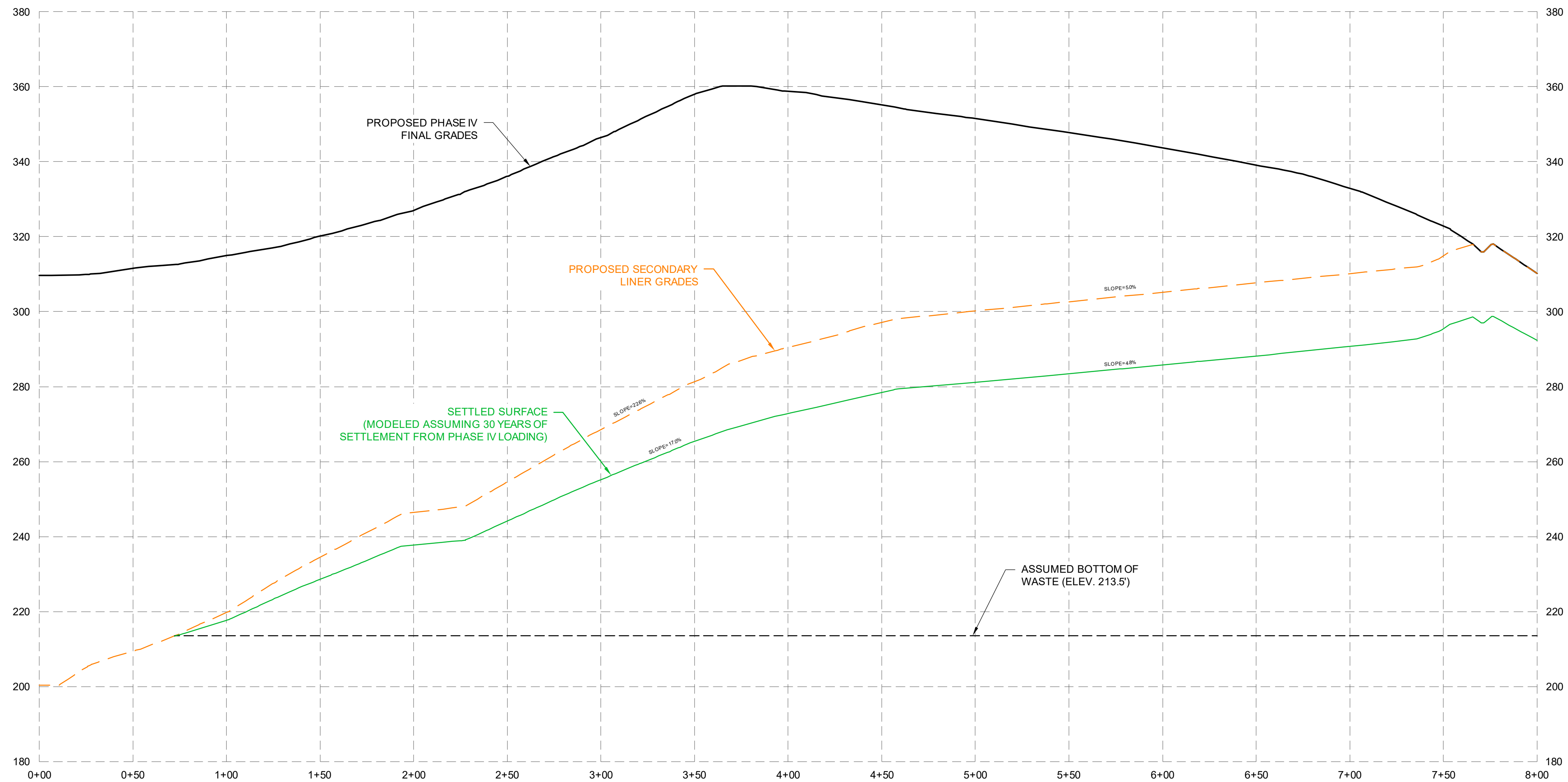

PRIMARY GEOCOMPOSITE CRITICAL PATH (POST-SETTLEMENT)

1

NOT TO SCALE

SANBORN HEAD

VERTICAL SCALE

20.0' 10.0' 0' 20.0' 40.0'

40' 20' 0' 40' 80'

HORIZONTAL SCALE

NO.	DATE	DESCRIPTION	BY

DRAWN BY: E. GALVIN
DESIGNED BY: E. GALVIN
REVIEWED BY: E. STEINHAUSER
PROJECT MGR: E. GALVIN
PIC: E. STEINHAUSER
DATE: FEBRUARY 2022

TYPE I-A PERMIT MODIFICATION APPLICATION
FOUR HILLS LANDFILL
NASHUA, NEW HAMPSHIRE

PRIMARY GEOCOMPOSITE CRITICAL PATH PROFILE WORKSHEET

PROJECT NUMBER: 3066.11

SHEET NUMBER: 1 OF 1

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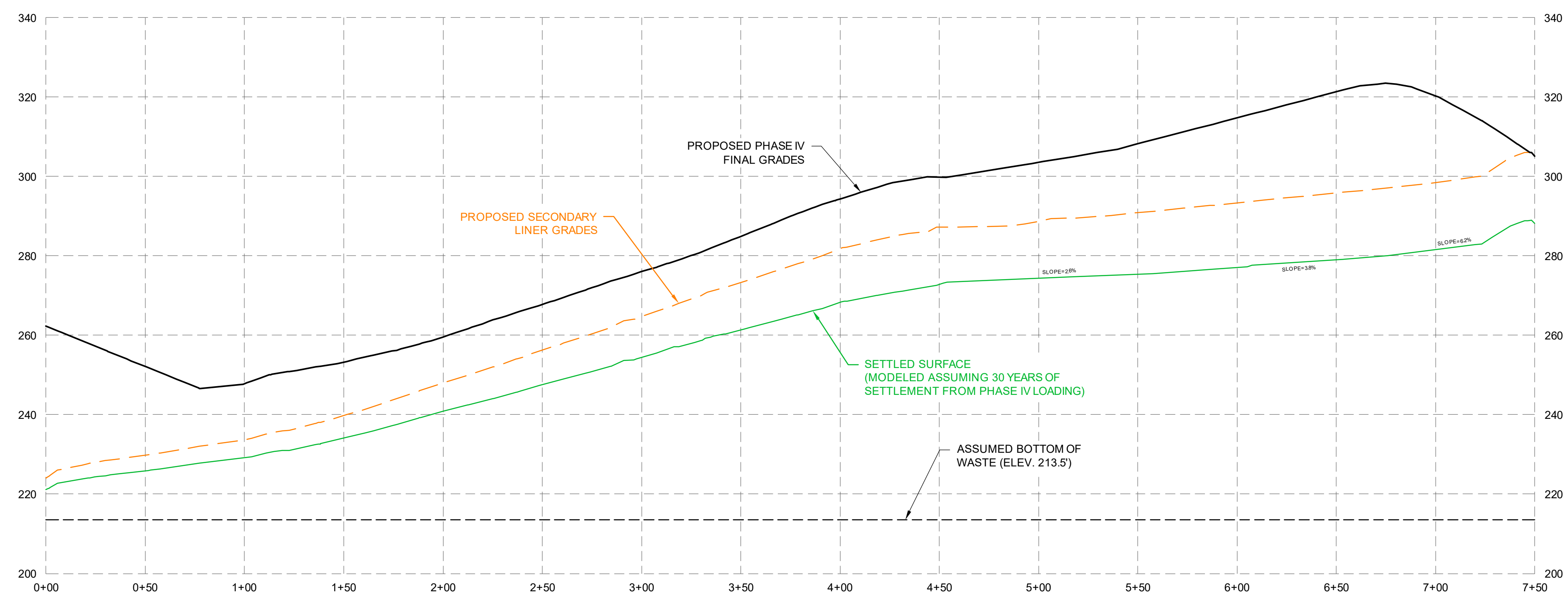


SECONDARY TRAVEL TIME CRITICAL PATH (POST-SETTLEMENT)

1

NOT TO SCALE

SANBORN HEAD

VERTICAL SCALE: 20.0' 10.0' 0' 20.0' 40.0'

HORIZONTAL SCALE: 40' 20' 0' 40' 80'

NO.	DATE	DESCRIPTION	BY

DRAWN BY: E. GALVIN
DESIGNED BY: E. GALVIN
REVIEWED BY: E. STEINHAUSER
PROJECT MGR: E. GALVIN
PIC: E. STEINHAUSER
DATE: FEBRUARY 2022

TYPE I-A PERMIT MODIFICATION APPLICATION
FOUR HILLS LANDFILL
NASHUA, NEW HAMPSHIRE

SECONDARY TRAVEL TIME CRITICAL PATH PROFILE WORKSHEET

PROJECT NUMBER: 3066.11

SHEET NUMBER: 1 OF 1

Comment #4

Existing Leachate Discharge System Capacity Calculation

PURPOSE:

Calculate the estimated flow capacity of the existing leachate sewer gravity main at the Nashua Four Hills Landfill and compare the value to what the City of Nashua needs to discharge to the City's sewer system following a contingency storm event (i.e., 100-year, 24-hour storm).

GIVEN:

The following information was provided in the Phase I Secure Landfill Expansion Record Drawings, prepared by CMA Engineers, Inc. in February 2001. Refer to Attachment A.

Segment 1: STA 2+02 to STA 6+16 Upslope elevation: 173.7ft Downslope elevation: 173.5ft Elevation difference: 0.2ft Segment length: 414ft Segment slope: 0.0005 Segment length proportional to total system length: 0.157	Segment 5: STA 16+18 to STA 18+63 Upslope elevation: 177.2ft Downslope elevation: 176.6ft Elevation difference: 0.6ft Segment length: 245ft Segment slope: 0.0024 Segment length proportional to total system length: 0.093
Segment 2: STA 6+16 to STA 9+15 Upslope elevation: 175.0 ft Downslope elevation: 173.7ft Elevation difference: 1.3ft Segment length: 299ft Segment slope: 0.0043 Segment length proportional to total system length: 0.114	Segment 6: STA 18+63 to STA 22+49 Upslope elevation: 179.0ft Downslope elevation: 177.2ft Elevation difference: 1.8ft Segment length: 386ft Segment slope: 0.0047 Segment length proportional to total system length: 0.147
Segment 3: STA 9+15 to STA 13+21 Upslope elevation: 176ft Downslope elevation: 175ft Elevation difference: 1.0ft Segment length: 406ft Segment slope: 0.0027 Segment length proportional to total system length: 0.154	Segment 7: STA 22+49 to STA 26+62 Upslope elevation: 182.8ft Downslope elevation: 179.0ft Elevation difference: 3.8ft Segment length: 413ft Segment slope: 0.0092 Segment length proportional to total system length: 0.157
Segment 4: STA 13+21 to STA 16+18 Upslope elevation: 176.6ft Downslope elevation: 176ft Elevation difference: 0.6ft Segment length: 297ft Segment slope: 0.002 Segment length proportional to total system length: 0.113	Segment 8: STA 26+62 to STA 28+32 Upslope elevation: 184.3ft Downslope elevation: 182.8ft Elevation difference: 1.5ft Segment length: 170ft Segment slope: 0.0088 Segment length proportional to total system length: 0.065

METHOD:
Find the total weighted average slope of the sewer system piping from the Record Drawings and use the Manning's Equation to determine the flow capacity of the existing sewer system.

CALCULATION:

The portion of the existing sewer system piping used to determine the flow capacity spans from STA 2+02 to STA 28+32, which results in a total length of 2,630 ft.

The weighted average slope for the entire system is determined by summing the product of each individual segment slope and length proportional to the total system, as follows:

Segment 1: (0.0005) x (0.157) = 0.00008
Segment 2: (0.0043) x (0.114) = 0.00049
Segment 3: (0.0027) x (0.154) = 0.00042
Segment 4: (0.0020) x (0.113) = 0.00023
Segment 5: (0.0024) x (0.093) = 0.00022
Segment 6: (0.0047) x (0.147) = 0.00069
Segment 7: (0.0092) x (0.157) = 0.00144
Segment 8: (0.0088) x (0.065) = 0.00057

(0.00008) +(0.00049) +(0.00042) +(0.00023) +(0.00022) +(0.00069) +(0.00144) +(0.00057) = 0.00414

≈ 0.004

RESULTS:
The weighted average slope of the leachate system is approximately 0.004. This value will be used to calculate the maximum capacity flow in this piping system.

CONCLUSION:
The maximum capacity flow in the leachate pipes can be found using the Manning's equation.

$$Q = \frac{1.49 * \mathrm{A} * R^{2/3} * s^{1/2}}{\mathrm{n}}$$

Where:
Q = Maximum flow ft^3/s
A = Area of the pipe (ft^2)
R = Hydraulic radius (ft)
s = Slope (percent, dimensionless)
n = Roughness coefficient (dimensionless)

This system uses 18-inch diameter pipes, which have a cross sectional area of $1.77 ft^2$
A = 1.77 ft^2

The hydraulic radius is defined as the area in flow divided by the wetted perimeter. The greatest hydraulic radius occurs when the pipe is under 81 percent flow, which for an 18 -inch diameter pipe results in a hydraulic radius of 0.4566ft
R = 0.4566 ft

The slope was found in the calculation above
s = 0.004

The roughness coefficient for smooth HDPE pipe is 0.013
n = 0.013

These values result in the following calculation

$$Q = \frac{1.49 * 1.77\ ft^2\ *\ 0.4566\ ft^{2/3} * 0.004^{1/2}}{0.013}$$

Q = 7.61 cfs

Multiply by 448.831 to convert cfs to gpm

Q = 7.61 cfs * $\frac{448.831\ gpm}{1c\ fs}$

Q = 3,416 gpm

The leachate pipes can handle a capacity of over 3,000 gpm. This value is well over the required value of 173 gpm.

ATTACHMENTS:

Attachment A Nashua Four Hills Record Drawing pages 15 and 16

ADDITIONAL LEACHATE STORAGE TANK CAPACITY AS REQUIRED

EXISTING LEAF AND YARD WASTE TO BE REMOVED BY THE CITY PRIOR TO CONSTRUCTION

FUTURE LEACHATE STORAGE TANK IF REQUIRED TO PROVIDE ADDITIONAL LEACHATE STORAGE (NOT THIS CONTRACT)

PROPOSED FLOW CONTROL BUILDING (SEE SHEET 18)

PROPOSED LMH #10
STA 1+11.00
RIM = 178.15
N 84587.57
E 1023422.08

ex SMH #7
0+00
RIM = 175.39
INV. IN = 171.75 (EST.)
INV. OUT = 171.65

PROPOSED FIBERGLASS PACKAGED METERING MANHOLE
N 84602.78
E 1023435.08

PROPOSED LMH #9
STA 2+01.72
RIM = 180.89
N 84500.69
E 1023347.78

PROPOSED LMH #8
STA 6+42.33
RIM = 179.15
N 84118.51
E 1023180.95

PROPOSED LMH #7
STA 9+18.76
RIM = 182.10
N 83915.71
E 1022959.87

PROPOSED LMH #6
STA 13+23.90
RIM = 184.49
N 83629.42
E 1022673.15

PROPOSED LMH #5
STA 16+18.90
RIM = 184.48
N 83403.76
E 1022428.95

STONE BOUND
N 84491.30
E 1023291.30
ELEV = 181.69

EXISTING CONCRETE BLOCK RETAINING WALL TO BE RELOCATED BY OTHERS PRIOR TO CONSTRUCTION

PIPE TO BE COVERED W/3' BACKFILL

PROPOSED CRUSHED GRAVEL DRIVE

PROPOSED FUTURE SOLID WASTE BALING FACILITY LOCATION

IRON ROD
N 84106.72
E 1023014.22
ELEV = 185.38

IRON ROD
N 84106.72
E 1023014.22
ELEV = 185.60

PK SET
N 83815.06
E 1023206.89
ELEV = 188.50

MW-1S
MW-1M
MW-2
MW-3
MW-4

Existing Detention Pond

Existing Condensate Pump Station

Existing Leachate Storage Facility

Recycling Facilities

Maintenance Building

City of Nashua Fire Training Area

IRON ROD
N 83662.60
E 1022434.82
ELEV = 179.62

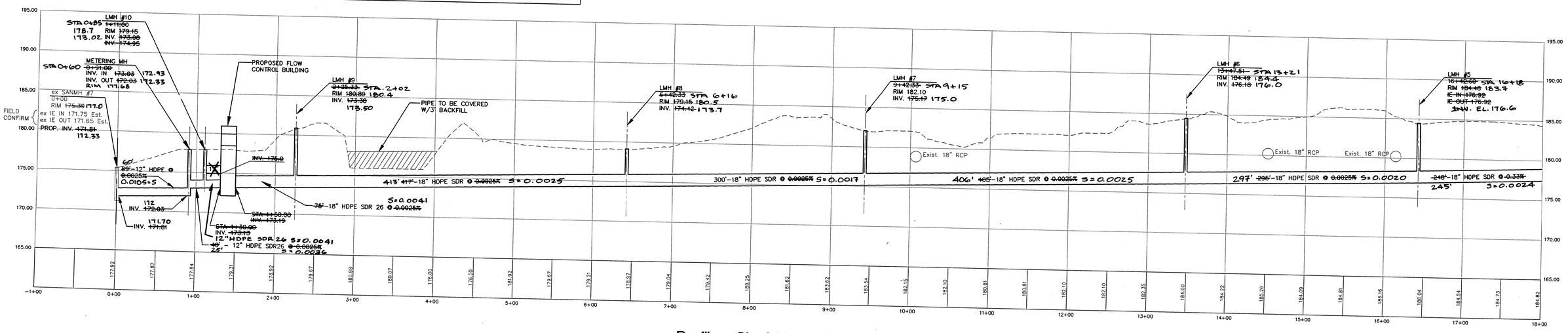
MW-M9R
MW-M9D
MW-M9S

SEE PROFILE FOR AS-BUILT SLOPES STATIONS AND ELEVATIONS

Plan - Sta 0+00 - 18+00

Scale: 1" = 50'

NOTE: SEE SHEET 17 FOR TYPICAL LEACHATE MANHOLE, LEACHATE MANHOLE #3, LEACHATE MANHOLE #9, LEACHATE MANHOLE #10, FLOW METERING MANHOLE & TYPICAL PIPE TRENCH DETAILS.



Profile - Sta 0+00 - 18+00

Scale: 1" = 50' (Horizontal)
1" = 5' (Vertical)

RECORD DRAWINGS

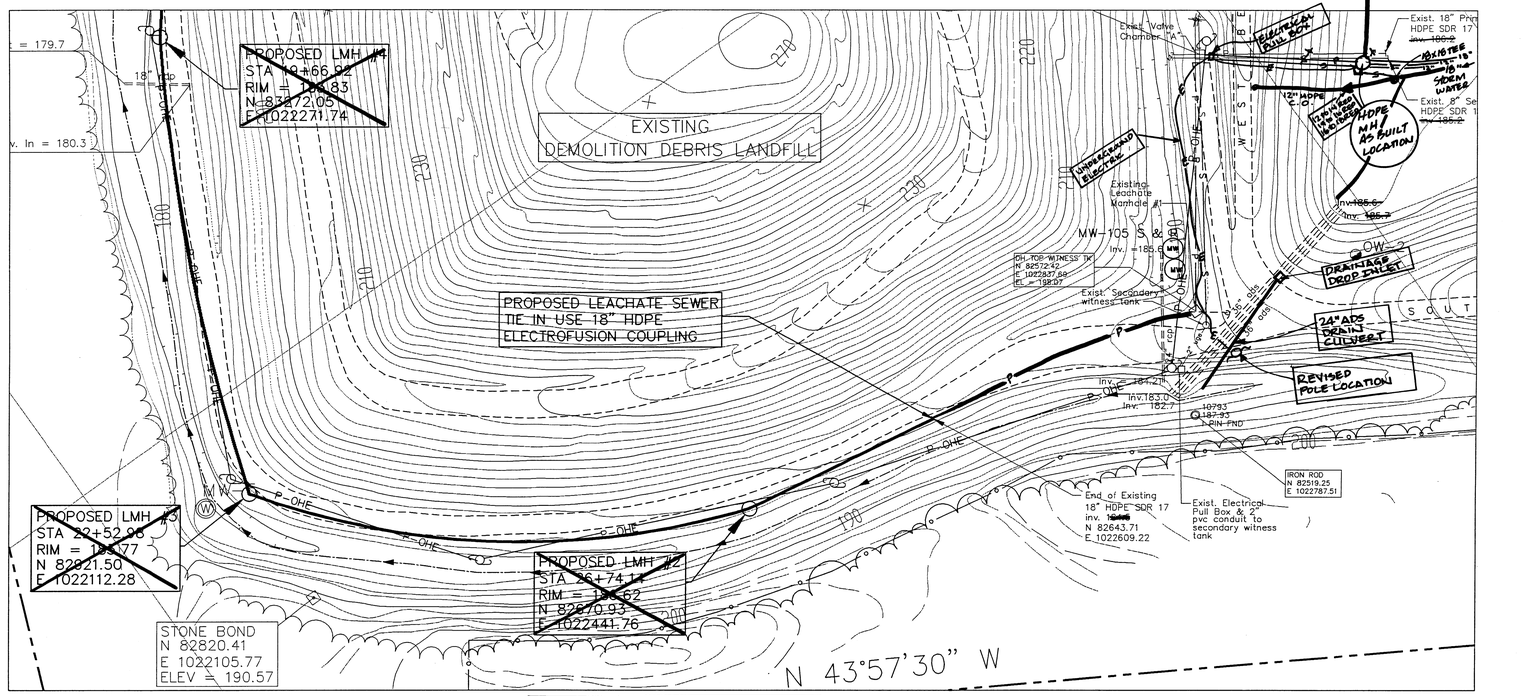
DATE	REVISIONS	DATE	REVISIONS
3/99	ISSUED FOR NHDES REVIEW		
4/99	ISSUED FOR BIDS		
5/99	ISSUED FOR CONSTRUCTION		
2/01	RECORD DRAWINGS		

CMA ENGINEERS, INC.
CIVIL/ENVIRONMENTAL ENGINEERS
35 BOW STREET
PORTSMOUTH, N.H. 03801

City of Nashua, NH
Nashua Four Hills Landfill
Phase I Secure Landfill Expansion

Date: MARCH 1999	Project: Phase I Secure Landfill Expansion Construction Drawings
Designed by: ETR/JFH	Scale: As Shown
Drawn by: ETR/LAG	Project No: 373
Approved by: WAS	Title: Leachate Sewer Plan and Profile Sta 0+00 - Sta 18+00
	Sheet No: 15 of 21

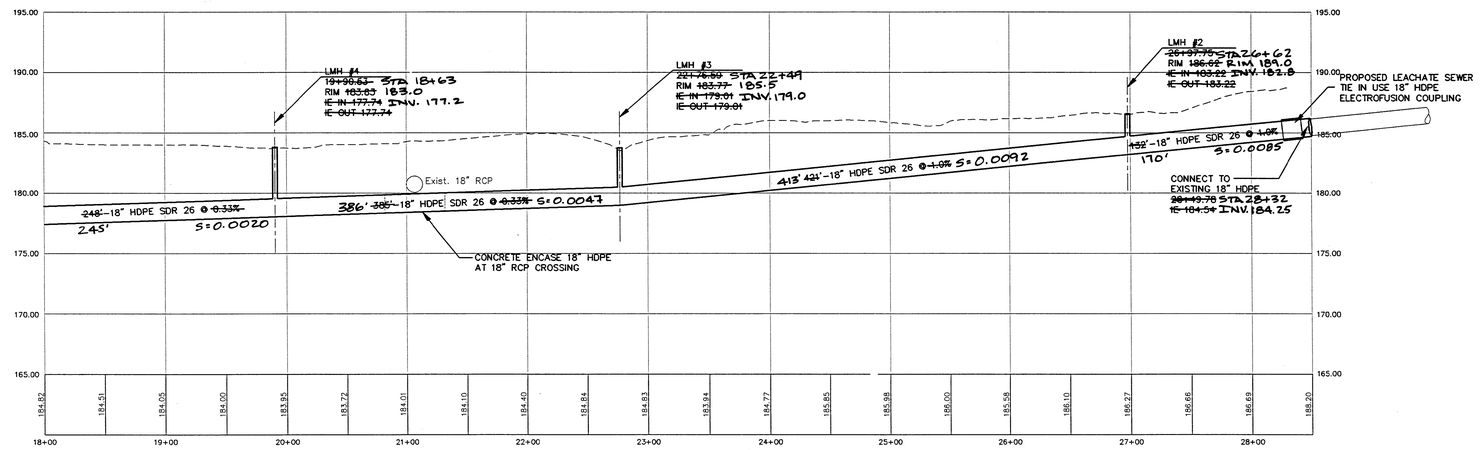
373clpro.dwg 5-20-99 12:28:08 pm EST



SEE PROFILE FOR AS BUILT SLOPES, STATIONS AND ELEVATIONS

Plan - Sta 18+00 - 28+94

Scale: 1" = 50'



Profile - Sta 18+00 - 28+94

Scale: 1" = 50' (Horizontal)
1" = 5' (Vertical)

RECORD DRAWINGS

DATE	REVISIONS	DATE	REVISIONS
3/99	ISSUED FOR NHDES REVIEW		
4/99	ISSUED FOR BIDS		
5/99	ISSUED FOR CONSTRUCTION		
2/01	RECORD DRAWINGS		

CMA ENGINEERS, INC.
CIVIL/ENVIRONMENTAL ENGINEERS
35 BOW STREET
PORTSMOUTH, N.H. 03801

City of Nashua, NH
Nashua Four Hills Landfill
Phase I Secure Landfill Expansion

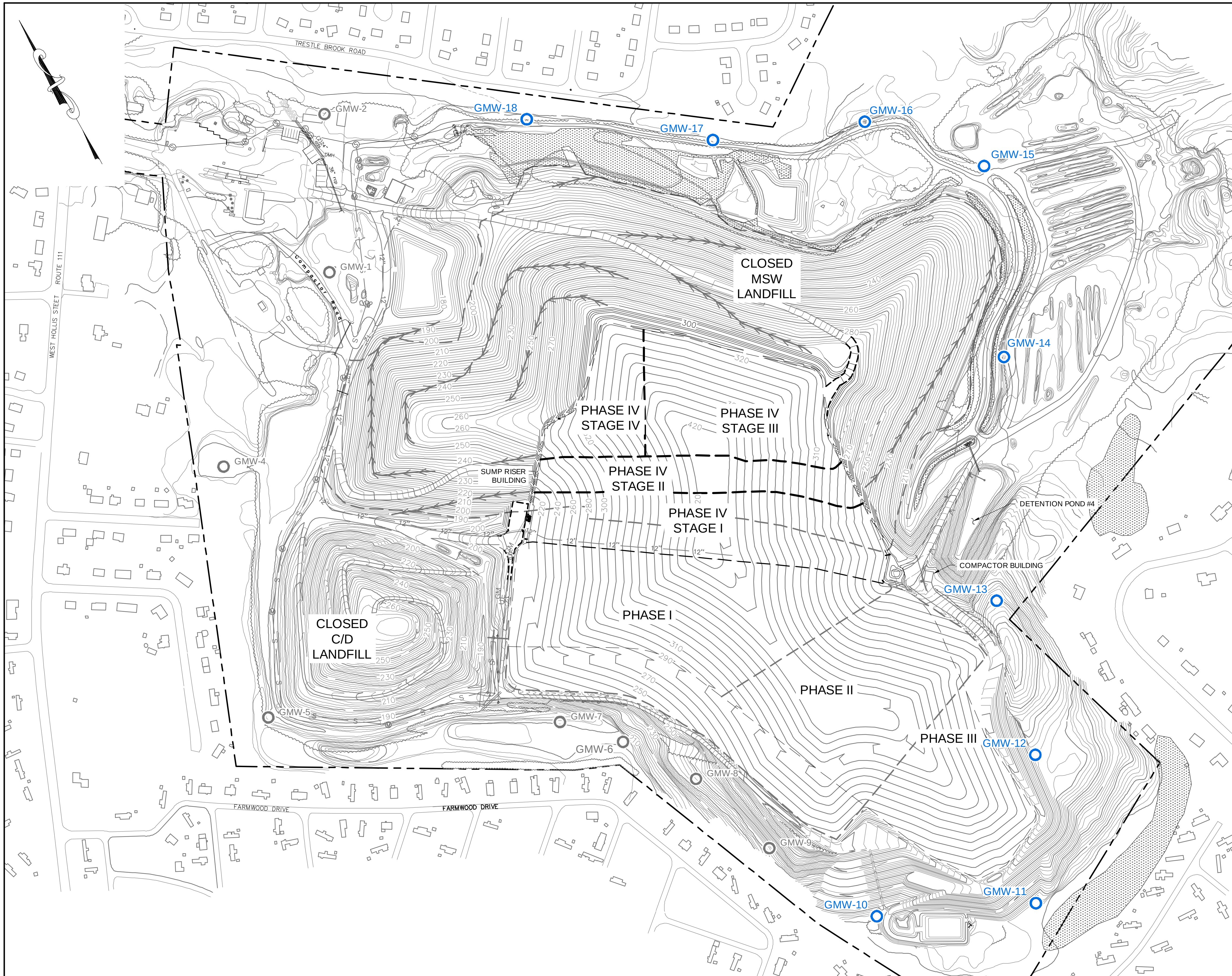
Date: MARCH 1999
Designed by: ETR/JFH
Drawn by: ETR/LAG
Approved by: WAS

Project: *Phase I Secure Landfill Expansion Construction Drawings*
Scale: As Shown
Project No: 373
Title: *Leachate Sewer Plan and Profile Sta 18+00 - Sta 28+94*
Sheet No: 16 of 21

373clpro.dwg 5-20-99 12:28:08 pm EST

Comment #5

Revised Gas Monitoring Well Location Plan



NOTES:

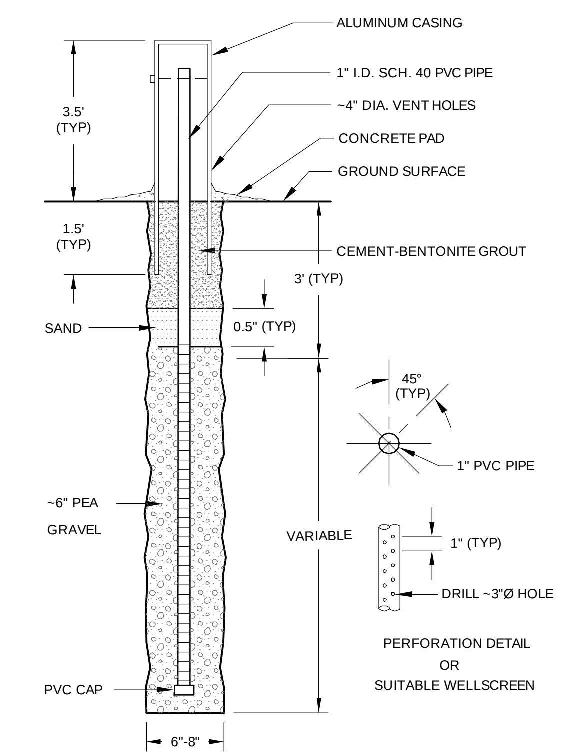
1. THE BASE MAP, INCLUDING LOCATIONS OF SUBSURFACE UTILITIES, PROPERTY LINES, AND LANDFILL LIMIT INFORMATION, WAS OBTAINED FROM A DRAWING PREPARED BY CMA ENGINEERS INC. OF PORTSMOUTH, NH (CMA), TITLED, "CITY OF NASHUA , NH, FOUR HILLS LANDFILL, PHASE II SECURE SOLID WASTE, PHASE II OPERATING PLAN, FILLING SEQUENCE DRAWINGS, PHASE II, STAGE 1- INITIAL LIFT," DATED JUNE 2010.

   HORIZONTAL DATUM: NAD83 (2001)
   HORIZONTAL PROJECTION: NH STATE PLANE
   VERTICAL DATUM: NGVD 1929

2. RESIDENTIAL BUILDING LOCATIONS WERE SUPPLEMENTED WITH ELECTRONIC GIS DATA OBTAINED FROM THE CITY OF NASHUA, NH GIS DEPARTMENT'S OPEN DATA SITE ON MARCH 22, 2017.
3. WETLAND AREA LIMITS WERE OBTAINED FROM THE US FISH AND WILDLIFE SERVICE NATIONAL WETLAND INVENTORY WETLANDS MAPPER.
4. EXISTING GAS EXTRACTION WELL AND COLLECTION TRENCHES NOT SHOWN FOR CLARITY.
5. GAS MONITORING WELL LOCATIONS WERE PROVIDED BY THE CITY AND SHOULD BE CONSIDERED APPROXIMATE.
6. OPERATING PLAN STATES THAT MONITORING WILL ALSO BE PERFORMED AT VAULTS AND LEACHATE CONTROL STRUCTURES.

LEGEND:

- EXISTING GAS MONITORING WELL
- GMW-10 PROPOSED GAS MONITORING WELL



BOTTOM OF WELL SHOULD EXTEND INTO A SATURATED ZONE OR TO A DEPTH EQUIVALENT TO THE BASE OF LANDFILL

GAS MONITORING WELL DETAIL

1 NOT TO SCALE

- NOT FOR CONSTRUCTION -
FOR PERMITTING PURPOSES ONLY

SANBORN HEAD

GRAPHICAL SCALE
120' 60' 0' 120' 240'

NO.	DATE	DESCRIPTION	BY

DRAWN BY: L. ZUCHOWSKI
DESIGNED BY: L. ZUCHOWSKI
REVIEWED BY: E. STEINHAUSER
PROJECT MGR: E. GALVIN
PIC: E. STEINHAUSER
DATE: FEBRUARY 2022

TYPE I-A PERMIT MODIFICATION APPLICATION
FOUR HILLS LANDFILL
CITY OF NASHUA
NASHUA, NEW HAMPSHIRE

PROPOSED GAS MONITORING WELL LOCATION PLAN

PROJECT NUMBER: 3066.11

FIGURE NUMBER: 1

Comment #7

Revised Public Benefit Statement

SANBORN HEAD

Building Trust. Engineering Success.

PUBLIC BENEFIT DEMONSTRATION

PHASE IV EXPANSION

Four Hills Landfill
Nashua, New Hampshire
Solid Waste Permit No. DES-SW-SP-95-002

Nashua
NEW HAMPSHIRE'S GATE CITY

Prepared for the City of Nashua
File No. 3066.11
Revised February 2022

TABLE OF CONTENTS

1.0 INTRODUCTION

On behalf of the City of Nashua (City), Sanborn Head prepared this public benefit demonstration as part of the application for a Type I-A Modification to Solid Waste Management Facility Permit (Type I-A PMA) for the Phase IV Secure Landfill Expansion (Phase IV expansion), a proposed double-lined disposal area at the Four Hills Landfill Facility (Facility) located in Nashua, New Hampshire. The Facility is a *limited public facility*, serving only the residents and businesses of the City ~~of Nashua (City)~~.

This document was prepared to fulfill the requirements of Env-Sw 1005.05(c), which requires that the City demonstrate that the Phase IV expansion at the Facility provides a substantial public benefit meeting the criteria listed under RSA 149-M:11 III (b) and (c), which are listed below.

> *(b) The ability of the proposed facility to assist the state in achieving the implementation of the hierarchy and goals under RSA 149-M:2 and RSA 149-M:3.*
>
> *(c) The ability of the proposed facility to assist in achieving the goals of the state solid waste management plan, and one or more solid waste management plans submitted to and approved by the department under RSA 149-M:24 and RSA 149-M:25.*

In considering the public benefit of a solid waste facility, the following items from RSA 149-M:11 ~~V~~ are to be considered:

> *M:11 III. The department shall determine whether a proposed solid waste facility provides a substantial public benefit based upon the following criteria:*
>
> *(a) The short- and long-term need for a solid waste facility of the proposed type, size, and location to provide capacity to accommodate solid waste generated within the borders of New Hampshire, which capacity need shall be identified as provided in paragraph V.*
>
> *(b) The ability of the proposed facility to assist the state in achieving the implementation of the hierarchy and goals under RSA 149-M:2 and RSA 149-M:3.*
>
> *(c) The ability of the proposed facility to assist in achieving the goals of the state solid waste management plan, and one or more solid waste management plans submitted to and approved by the department under RSA 149-M:24 and RSA 149-M:25.*
>
> *M:11 V. In order to determine the state's solid waste capacity need, the department shall:*
>
> *(a) Project, as necessary, the amount of solid waste which will be generated within the borders of New Hampshire for a 20-year planning period. In making these projections the department shall assume that all unlined landfill capacity within the state is no longer available to receive solid waste.*
>
> *(b) Identify the types of solid waste which can be managed according to each of the methods listed under RSA 149-M:3 and determine which such types will be received by the proposed facility.*
>
> *(c) Identify, according to type of solid waste received, all permitted facilities operating in the state on the date a determination is made under this section.*

(d) Identify any shortfall in the capacity of existing facilities to accommodate the type of solid waste to be received at the proposed facility for 20 years from the date a determination is made under this section. If such a shortfall is identified, a capacity need for the proposed type of facility shall be deemed to exist to the extent that the proposed facility satisfies that need.

~~*(a) Project, as necessary, the amount of solid waste which will be generated within the borders of New Hampshire for a 20-year planning period. In making these projections the department shall assume that all unlined landfill capacity within the state is no longer available to receive solid waste.*~~

~~*(b) Identify the types of solid waste which can be managed according to each of the methods listed under RSA 149-M:3 and determine which such types will be received by the proposed facility.*~~

~~*(c) Identify, according to type of solid waste received, all permitted facilities operating in the state on the date a determination is made under this section.*~~

~~*(d) Identify any shortfall in the capacity of existing facilities to accommodate the type of solid waste to be received at the proposed facility for 20 years from the date a determination is made under this section. If such a shortfall is identified, a capacity need for the proposed type of facility shall be deemed to exist to the extent that the proposed facility satisfies that need.*~~

Because the Facility is a *limited public facility* (serving only Nashua residents and businesses), and as stated in Env-Sw 1005.05 (c), the proposed Phase IV landfill expansion is not subject to the 20-year planning period requirements of RSA 149-M:11 III(a) and V. The City, however, notes that in reviewing the NHDES *Biennial Solid Waste Report*, dated October 2019, the NHDES projects that there will be a statewide landfill capacity shortfall after 2025. The construction and operation of the proposed Phase IV landfill will ease this overall state-wide deficit by removing the waste disposal needs of the City from the State's future waste disposal deficit.

Since 1971, the City has operated the Facility for the disposal of municipal solid waste (MSW) and construction and demolition debris (C&D). On June 26, 1995, the New Hampshire Department of Environmental Services (NHDES) issued Solid Waste Permit No. DES-SW-95-002 for the development and operation of a "Secure Landfill." At the time of the original permit, the Secure Landfill consisted of double-lined disposal areas Phases I, II, and III. MSW disposal operations began in the lined Phase I area in 2003 and in the lined Phase II area in 2009. MSW disposal operations are anticipated to begin in the lined Phase III area in 2020. Currently, the permitted disposal capacity (airspace) is anticipated to be exhausted by 2030, and, as such, the City anticipates that the Phase IV expansion will need to be operational no later than 2028.

The City of Nashua has a well-developed and managed waste management program for the residents and businesses of the City. The City promotes waste reduction, material reuse, recycling, and composting; provides for curbside recycling; and maintains a recycling center and a composting operation at the Facility. The Facility also has a landfill gas to energy facility, a residential drop-off area, and manages numerous other waste materials (e.g.,

recyclables, electronic waste, bulky waste, white goods, scrap metal, tires, etc.). Because not all waste materials can be reused, recycled, or composted (e.g., MSW, C&D, asbestos, contaminated soil), the City needs a secure disposal facility.

A key provision of the Solid Waste permit was that the Secure Landfill provided at least 20 years of disposal capacity and that the City expand its recycling efforts. As noted above, the Secure Landfill will provide more than 20 years of disposal capacity and the City has a robust recycling program. Considering the upcoming end of service life of the Secure Landfill, the Phase IV expansion is a benefit to the City residents and business and does not place a burden on other waste disposal locations in the State of New Hampshire. The proposed Phase IV expansion would provide the City with an estimated 30 years of new disposal capacity.

The remainder of this document provides the required demonstration of public benefit of the continued operation of double-lined disposal areas at the Facility.

2.0 WASTE GENERATION

Because the Facility is a limited public facility serving only the residents and businesses of the City, the requirements of RSA 149-M:11 III(a) and 149-M:11 V(a) do not apply. At present, the City estimates an upper end MSW generation rate of approximately 80,000 tons per year. Based on reports to the NHDES, the waste generation, which appears to be tied to economic conditions, has been relatively steady for the past few years.

As noted above, the City recycling and waste diversion initiatives reduce the volume and toxicity of materials disposed of in the Secure Landfill. To the degree practical, recyclables, electronics, tires, white goods, textiles, batteries, digital media (CDs, DVDs, VHS tapes, etc.), mercury containing devices, used motor oil, and used automotive anti-freeze and other materials are diverted from disposal and managed by appropriate and permitted means. Also, the City hosts and participates in regional household hazardous waste collection events, which are held several times a year. These events provide City residents the opportunity to properly and safely dispose of unwanted flammables, corrosives, and other toxic materials.

In 2020, 40% of the participants in the collection events were from Nashua and a total of 129,965 pounds of household hazardous wastes were diverted from the waste stream. By hosting this event, the City assists neighboring communities in the Nashua Regional Solid Waste Management District (Mont Vernon, Amherst, Milford, Brookline, Hollis, Merrimack, Litchfield, Hudson, Windham and Pelham) increase their waste diversion efforts.~~To the degree practical, recyclables, electronics, yard waste, tires, white goods, and other materials are diverted from the landfill and managed by appropriate and permitted means.~~ The City intends to continue these important initiatives to extend the life expectancy of the disposal resource provided by the Secure Landfill.

~~In addition to the recycling and waste diversion initiatives described above, the City promotes efforts to further reduce the toxicity of the waste stream through the separate collection and recycling of mercury containing devices, rechargeable batteries, used motor~~

~~oil, and used automotive anti-freeze. The City also hosts several regional household hazardous waste collection events each year in which residents have the opportunity to properly and safely dispose of unwanted flammables, corrosives, and other toxic materials.~~

3.0 WASTE REDUCTION GOAL (RSA 149-M:2)

The waste reduction goal of RSA 149-M:~~11~~ 2 is a statewide goal. Legislation recently passed in 2021 (i.e., House Bill 413) revises the waste diversion goal in RSA 149-M:2 by adding a *solid waste disposal reduction goal*. The legislation also established a Solid Waste Working Group (Group) (RSA 149-M:61) consisting of representatives from business, industry, and government. The Group has several goals, including assisting the NHDES in long-range planning and making recommendations with regard to solid waste disposal and the reduction of solid waste generated in New Hampshire. The legislation acknowledges that solid waste disposal capacity in New Hampshire is rapidly diminishing to the detriment and expense of the state's citizens, municipalities, and businesses. It also directs the NHDES to develop rules for composting and update the state's Solid Waste Plan.

The City's current solid waste management program is detailed in the following paragraphs; however, additional efforts to reduce waste disposal beyond the existing programs may be developed and implemented, subject to approval by the City's Board of Public Works and Board of Alderman. In addition, the City looks forward to future guidance and recommendations from the NHDES that could be implemented to further reduce the disposal of MSW in the City.

The City, through its well-developed and managed waste management program, actively seeks to reduce the amount of waste disposed of at the Facility. According to the values reported in the 2017, 2018, ~~and~~ 2019, and 2020 Annual Reports, (see table below) the weight of MSW disposed is decreasing and the City's waste diversion rate, ~~is~~ estimated to be between 2~~0~~8 and 3~~0~~5 percent, is on an increasing trend. The City believes that the actual diversion rate is on the higher side of these values due to the fact that:

- The unit weight of recycles has been on a decreasing trend as manufactures are reducing the amount of materials used;
- Actions taken by businesses and residents to reduce their overall generation of waste is not measured; ~~and~~
- Materials are r~~R~~euse~~d of materials~~;
- The sale of approximately 10,000, 96-gallon dedicated recycling toters to City residents since 2009. The toters are picked up curbside and allow for increased residential recycling. The toters are offered as an option to the two 18-gallon bins the City issues to eligible households.

Year	Population[1] (estimate)	Waste Generation Projection[2] (tons)	MSW Landfilled (tons)	Materials Diverted (tons)	Percent Diversion[3, 4]
2017	89,246	94,467	67,925	14,963	28.1 / 22.0
2018	89,663	94,908	67,135	12,994	29.3 / 19.4
2019	90,080	95,350	67,669	6,317A	29.0 / 9.3A
2020	90,323	95,607	62,354	6,824	34.8

Notes:

1. 1. Population estimate taken from https://worldpopulationreview.com/us-cities/nashua-nh-population/, last accessed January 26, 2022.
2. 2. Waste generation projection calculated based on the product of the population estimate times the 5.8 pounds of waste generated per person per day (based on data from NHDES 2019 Biennial Solid Waste Report, see Footnote 1), times 365 day, divided by 2000 pounds per ton.
3. 3. Percent diversion was calculated two ways:as
   1. the difference in the waste generation projection and the MSW landfilled, divided by the waste generation projection, times 100; and
   2. 1. materials diverted divided by the MSW landfilled times 100.

A – These values do not account for yard waste diversions.

The City understands that the waste disposal reduction goal in RSA 149-M:2 calls for reducing the quantity of solid waste disposed of in the state by 25% by 2030 and 45% by 2050, using the quantity of solid waste dispose of in 2018 as the baseline.[1][2] In 2018, 67,135 tons of MSW was disposed at the Facility. To meet the new goal, the City's waste disposal quantities would have to be reduced by nearly 17,000 tons by 2030, and 30,000 tons by 2050. Again, the City looks forward to NHDES guidance and recommendations to further reduce the disposal of MSW in the City.

4.0 ACHIEVING GOALS, HIERARCHY (RSA 149-M:3)

The City of Nashua, through its operations and activities at the Facility, assists the State towards the legislated waste reduction goal established in RSA 149-M:2. RSA 149-M:3 defines the hierarchy through which the goal is to be achieved and includes:

- Source reduction;
- Recycling and reuse;
- Composting;
- Waste-to-Eenergy technologies (WTEincluding incineration);
- Incineration without resource recovery; and

[1] RSA 149-M:2 clearly states that the purpose of the section is to establish a "goal" and does not establish a mandate.

[2] The solid waste disposal reduction goal of RSA 149-M:2 applies to "*on a combined basis, to disposal of municipal solid waste and construction and demolition debris.... For the purposes of this goal only, municipal solid waste means solid waste generated at residences, commercial or industrial establishments, and institutions, but excludes automobile scrap and other motor vehicle waste, infectious waste, asbestos waste, contaminated soil and other absorbent media, sludge, industrial process waste, and ash other than ash from household stoves.*"

- Landfilling.

As previously noted, the City maintains a robust recycling and composting operations and promotes material reuse. The City does not own or operate a waste-to-energy facility or other incinerator, nor is there one within the City limits. However, there is a landfill gas-to-energy operation at the Facility that is fueled by the decomposition gases extracted from the closed, unlined MSW landfill and the Secure Landfill. The landfill-gas-to energy plant has a total generating capacity of 2.4 megawatts, which is enough energy to power approximately 1,500 homes. The landfill-gas-to energy plant has operated on the Four Hills site since 1995, and landfill gas generated by the proposed Phase IV landfill would continue to supply the plant well into the future.

Despite the current difficulties in the recycling markets due to the China National Sword policy, the City has maintained its recycling programs with no reduction in service. The City has absorbed the increased costs for the recycling program and continues to encourage residents and businesses to reuse and recycle over landfilling. The City has also taken steps to increase the value of recyclable materials collected in Nashua. These include increased public outreach and education on how to recycle right, and investment in the construction of a canopy over the recycling storage area to keep the materials dry.

While listed last, landfills are a necessary component in the waste management hierarchy and are required for disposal of waste that cannot be safely or economically managed in other ways. The City, through its Facility operations, takes proactive steps to preserve disposal capacity by using alternate daily cover (ADC) materials to replace virgin soil daily cover when appropriate. The City currently uses approved ADC materials from several sources and plans to continue to use ADC materials as sources become approved, and its use is effective. ADC materials included

- Natural soil;
- Street wastes (catch basin debris, roadside ditch soils, street sweepings, and asphalt grindings)
- Wood chips;
- Compost pursuant to Env-Sw 1503.10;
- Bottom ash from wood fired boilers (NHDES Certified Waste Derived Product No. 10);
- Synthetic tarps (Tarpomatic);
- C~~/~~&D fines mixed with soil;
- C~~/~~&D residuals mixed with soil (Certified Waste Derived Product No. 6);
- Non-hazardous, low level contaminated soil; and
- Aggregate for Construction Made with Crushed glass (Certified Waste-Derived Product No. 11).

5.0 PUBLIC NEED (RSA 149-M:11 III)

Nashua is the second largest city in New Hampshire and constitutes nearly 7 percent of the state's total population. The continued MSW disposal operations at the Facility, through the development of Phase IV, will provide a much-needed service to the City, and its residents and businesses for the foreseeable future. According to the 2019 Biennial Solid Waste Report,[3] on or about 2033, there will be a precipitous drop in MSW disposal capacity in the State. The Phase IV expansion helps bridge the States disposal shortfall, at least as it concerns the City.

The operating Secure Landfill also provides a safe disposal location for asbestos waste generated in Nashua. This is an important resource considering Nashua has a large number of asbestos disposal sites that may be subject to future remediation.

Also, the existing Secure Landfill and proposed Phase IV expansion provide the City with the resources necessary to efficiently manage large amounts of waste that may be generated by natural disasters or catastrophic storm events. This would also relieve stress on other disposal facilities in the state in cleaning up and disposing of disaster debris.

Any future reduction of waste generated and disposed in Nashua would result in preserving landfill capacity and extending the life of the proposed Phase IV landfill, which would also preserve and extend landfill capacity statewide; therefore, assisting the state in achieving their waste disposal reduction goals.

The State of New Hampshire Solid Waste Plan, dated April 2003, addresses five goals to achieve safe, environmentally sound, and economically viable management of solid waste. The goals and the City's response to each are listed below:

1. *Reduce the volume of the waste stream*

   Source reduction of a waste stream is related to activities that occur prior to the collection of waste, and as such, is related to behaviors and actions of residents, businesses, and industry. To help affect a reduction in waste being generated, the City promotes material reuse, food and yard waste composting, and recycling materials that can be diverted from disposal.

2. *Reduce the toxicity of the waste stream*

   Again, the toxicity of the waste stream is related to activities that occur prior to the collection of waste, and as such, is related to behaviors and actions of residents, businesses, and industry. Still, and as previously summarized, the City participates in an annual regional household hazardous waste collection program to remove toxic materials from the waste stream. To do so, the City collects and recycles other

[3] NHDES (2019), Biennial Solid Waste Report, October 2019, https://www.des.nh.gov/organization/commissioner/pip/publications/documents/r-wmd-19-02.pdf

potentially toxic materials, such as electronics, batteries, used oil, automotive anti-freeze, mercury containing devices, and fluorescent light bulbs.

3. *Maximize diversion of residential and commercial/industrial solid wastes*

As previously noted, the City operates a comprehensive integrated solid waste management program for City residents and businesses. This program, which promotes and prioritizes reuse, composting, and recycling over landfilling, has allowed the City to extend the projected life of the existing Phase I/II/III landfill approximately 7 years beyond the permit required life span of 20 years. The landfill also provides for secure disposal of asbestos waste generated in Nashua and uses approved ADCs that have no other disposal or diversion options.

With respect to recycling, the City operates a robust recycling program for residents, which includes curbside, single-stream recycling collection, the option for residents to use large, 96-gallon dedicated recycling toters, and provides a recycling drop-off location at the Facility. The City has maintained its recycling program despite the China National Sword policy and has absorbed the associated costs without any reduction in service.

4. *Assure disposal capacity for New Hampshire*

The proposed Phase IV expansion will provide up to 30 years of disposal capacity to City residents and businesses and as such, helps the State address its projected disposal capacity shortfall.

5. *Assure that solid waste management activities are conducted in a manner protective of human health and the environment*

The proposed Phase IV expansion will be a double lined landfill designed, constructed and operated in accordance with all applicable local, state, and federal rules and statutes. The City has nearly 20 years of experience operating a permitted, lined-landfill (Phase I/II/III Secure Landfill Expansion), and has a trained, experienced staff with a focus on environmental protection and compliance.

6.0 SUMMARY

The Phase IV expansion provides the City with the ability to continue to serve it residents and businesses with a safe and economical MSW disposal location well into the future, and therefore, provides a substantial public benefit to the state. The solid waste management operations at the Facility will continue to fulfill the objectives of the State Solid Waste Management Plan and the solid waste disposal reduction goals described in RSA 149-M:2.

Comment #8

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01/28/2022

Sent To: NH Fish & Game
Street and Apt. No., or PO Box No.: 11 Hazen Drive
City, State, ZIP+4®: Concord NH 03301

PS Form 3800, April 2015 PSN 7530-02-000-9047 See Reverse for Instructions

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1. Article Addressed to:

NH Fish & Game
11 Hazen Drive
Concord NH 03301

9590 9402 5942 0062 9170 32

2. Article Number (*Transfer from service label*)

7020 0090 0001 1004 7618

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X [signature] ☐ Agent ☐ Addressee

B. Received by (*Printed Name*): G WAIVIRE
C. Date of Delivery: 2-1

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If YES, enter delivery address below: ☐ No

3. Service Type
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PS Form 3811, July 2015 PSN 7530-02-000-9053 Domestic Return Receipt

THE CITY OF NASHUA
Division of Public Works
Solid Waste Department

"The Gate City"

New Hampshire Fish & Game (NHF&G)
11 Hazen Drive
Concord, NH 03301

January 28, 2022
File No. 3066.11

Re: Four Hills Landfill
Nashua, New Hampshire
Type I-A Permit Modification
DES-SW-SP-95-002

To Whom it May Concern:

The purpose of this correspondence is to notify you that The City of Nashua (City) filed a Type I-A permit modification application with the New Hampshire Department of Environmental Services (NHDES) on July 17, 2020. This application is being filed to obtain permit approval for the proposed Phase IV expansion at the Four Hills Landfill located at 840 West Hollis Street in Nashua, New Hampshire.

The facility, and the land where it is located, is owned and operated by the City's Department of Public Works. This project received approval from the Alteration of Terrain Bureau (Permit: AoT-2028) on October 4, 2021. As part of AoT permitting, the City coordinated with the NH Heritage Bureau and the NHF&G departments in regards to this project. This notice is being provided in accordance with the RSA 149-M and the NHDES Solid Waste Rules.

This project is proposed to be constructed on the Four Hills Landfill property between two existing landfill units. The type of material managed, and the operation of the facility, are not proposed to change as part of this permit modification. Only waste generated within the City of Nashua is accepted at the facility including municipal solid waste, construction and demolition debris, and special non-hazardous wastes that are approved by NHDES. The project will add about 3.9 million cubic yards of capacity and extend the facility's site life by approximately 30 years.

Copies of this permit application will be available for review at the Four Hills Landfill office building, City of Nashua Town Hall, and at the NHDES office located at 29 Hazen Drive in Concord, New Hampshire. Appointments to review the application will be made with the City Solid Waste Department (603-589-3410), the City Clerk's Office (603-589-3010), or the NHDES Public Information & Permitting Office (603-271-2919) to review a hard copy of the permit application.

As part of this application, the City of Nashua is required to inform you of the basic steps that will be involved in the processing of this permit application. Upon receipt of this application, the NHDES will review its contents and determine whether it is complete and that it contains all the information required for their approval. If the application is complete, a technical review will then be made to determine whether the proposed activity meets all application requirements of the New Hampshire Solid Waste Rules. If it is decided that the application satisfies these requirements, then

it will be approved, and the permit will be issued. A public hearing on this application is required and will be scheduled upon completion of the technical review. Please refer to the enclosed application flow chart.

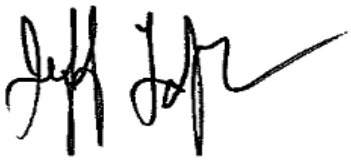
Included with the Type I-A permit modification is an Application for Waiver specific to Env-Sw 805.05(j).

Information regarding this application may be obtained by calling Ms. Jaime Colby, P.E., NHDES Permit Engineer, at (603) 271-5185, Jaime.Colby@des.nh.gov, or by writing to her at the following address:

NH Department of Environmental Services
Waste Management Division
PO Box 95
Concord, NH 03301

If you have any questions or comments regarding the application, please contact me at (603) 589-3410 or LafleurJ@nashuanh.gov. You may also contact Ms. Jamie Colby, P.E. at the NHDES, 29 Hazen Drive, Concord, New Hampshire 03301.

Very truly yours,
The City of Nashua



Jeffrey Lafleur
Superintendent of Solid Waste

Copies to: Jaime Colby – NHDES
Lisa Fauteux – City of Nashua
Darrin Santos – City of Nashua
Eddie Galvin – Sanborn, Head & Associates, Inc.

Enclosure: Permit Application Flow Chart
Type I-A Permit Application for Solid Waste Management Facility

840 West Hollis Street • Nashua, New Hampshire 03062 • Phone (603) 589-3410 • Fax (603) 589-3448

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Concord NH 03301
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PS Form 3811, July 2015 PSN 7530-02-000-9053
Domestic Return Receipt

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1. Article Addressed to:

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172 Pembroke Rd
Concord NH 03301

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2. Article Number *(Transfer from service label)*

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A. Signature

X Aaron Yeaton ☒ Agent ☐ Addressee

B. Received by *(Printed Name)* Aaron Yeaton

C. Date of Delivery 1-31

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

172 Pemproke Rd
Concord NH 03301

3. Service Type

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Postage	$15.10
Total Postage and Fees	$21.90

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CONCORD NH RETAIL
JAN 28 2022
01/28/2022

Sent To: NH Natural Heritage Bureau
Street and Apt. No., or PO Box No.: 172 Pembroke Rd
City, State, ZIP+4®: Concord NH 03301

PS Form 3800, April 2015 PSN 7530-02-000-9047 See Reverse for Instructions

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THE CITY OF NASHUA
Division of Public Works
Solid Waste Department

"The Gate City"

New Hampshire Natural Heritage Bureau (NHB)
172 Pembroke Road
Concord, NH 03301

January 28, 2022
File No. 3066.11

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Nashua, New Hampshire
Type I-A Permit Modification
DES-SW-SP-95-002

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Waste Management Division
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Concord, NH 03301

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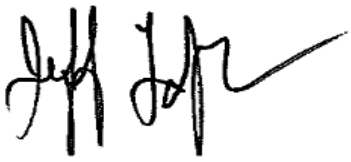
Very truly yours,
The City of Nashua



Jeffrey Lafleur
Superintendent of Solid Waste

Copies to: Jaime Colby – NHDES
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Enclosure: Permit Application Flow Chart
Type I-A Permit Application for Solid Waste Management Facility