Davidson, Tyler

From: Lindsey Menard <lindsey.menard@casella.com>
Sent: Monday, July 15, 2024 5:08 PM
To: DES: Solid Waste Management Bureau Enforcement
Cc: Joe Gay; Kevin Roy; Bruce Grover; Kimberly Crosby; Shelley Sayward; Samuel Nicolai
Subject: NCES Response to NHDES LOD No. SWMB 24-006; Items #2, #3, #4, & #5
Attachments: NCES LOD July 15 Secondary Flow Submission and Items 2 3 4 5.pdf

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Lindsey Menard
Environmental Engineer
Casella Waste Systems, Inc.

1855 VT Route 100, Hyde Park, VT 05655
p. 802.851.6606 | c. 802.585.0551

July 15, 2024

Tyler J. Davidson, Enforcement Program Coordinator
NH Department of Environmental Services
Solid Waste Management Bureau
29 Hazen Dr. / P.O. Box 95
Concord, NH 03302-0095
swmbenforcement@des.nh.gov

RE: North Country Environmental Services, Inc.
Lined Landfill Facility – Bethlehem, New Hampshire
Response to NHDES Letter of Deficiency Items #2, #3, #4 & #5

Dear Mr. Davidson,

Pursuant to the requirements of the June 14, 2024 Letter of Deficiency (LOD) for the Landfill Facility owned and operated by North Country Environmental Services, Inc. (NCES) and located in Bethlehem, New Hampshire, we are providing an updated response to Item 2, and responses to Items 3-5 of the LOD.

LOD Item #2

As of July 1, 2024, the flow and 30-day average flows in the secondary leachate collection system exceeded 25 gallons per acre per day in Pump Station #2 as depicted in the table below.

Pump Station #3		Pump Station #2		Pump Station #1		Pump Station #4	
Date	30 Day Average Gal/AC/Day	Date	30 Day Average Gal/AC/Day	Date	30 Day Average Gal/AC/Day	Date	30 Day Average Gal/AC/Day
7/1/2024	10.07	7/1/2024	49.10	7/1/2024	22.41	7/1/2024	5.06
7/2/2024	9.69	7/2/2024	48.51	7/2/2024	22.41	7/2/2024	4.47
7/3/2024	9.71	7/3/2024	47.96	7/3/2024	22.41	7/3/2024	4.47
7/4/2024	9.71	7/4/2024	47.44	7/4/2024	18.87	7/4/2024	4.47
7/5/2024	10.08	7/5/2024	47.32	7/5/2024	22.29	7/5/2024	3.87
7/6/2024	9.67	7/6/2024	46.73	7/6/2024	22.29	7/6/2024	3.87
7/7/2024	9.26	7/7/2024	46.86	7/7/2024	18.83	7/7/2024	3.87
7/8/2024	8.93	7/8/2024	46.66	7/8/2024	18.83	7/8/2024	3.90
7/9/2024	8.95	7/9/2024	46.77	7/9/2024	18.83	7/9/2024	3.90
7/10/2024	9.37	7/10/2024	47.23	7/10/2024	22.04	7/10/2024	4.35
7/11/2024	8.95	7/11/2024	47.33	7/11/2024	21.28	7/11/2024	4.41
7/12/2024	8.94	7/12/2024	47.42	7/12/2024	18.68	7/12/2024	3.98
7/13/2024	8.56	7/13/2024	47.92	7/13/2024	18.62	7/13/2024	3.98
7/14/2024	8.57	7/14/2024	47.68	7/14/2024	18.62	7/14/2024	3.98

Field calibration of the secondary flowmeters in Pump Station #1 and Pump Station #2 was conducted on July 11, 2024, and confirmed flow measuring devices were within acceptable tolerance. Video inspection of secondary piping (to the extent possible) in Pump Station #2 has been commissioned to evaluate potential sources of water getting into the secondary, and will be accomplished on July 18.

LOD Item #3

Item #3(a) –Attached please find an evaluation conducted by Sanborn, Head & Associates regarding the landfill's management, storage and disposal of leachate.

Item #3(b) – NCES is making operational and maintenance improvements at the facility to minimize stormwater flow into the waste mass and control generation of leachate. The completed and planned improvements include:

- Placing approximately 13 acres of intermediate cover on the north slope and top deck areas of the landfill along with constructing stormwater diversion berms and letdown structures.
- Seeding nearly 8 acres of the landfill following installation of intermediate cover and stormwater controls, to establish vegetation in those areas.
- Completing the installation of the initial fluff layer in Stage VI Phase II, which will provide a sufficient waste lift (and cover) over the leachate collection system to minimize direct infiltration of stormwater into the landfill.
- Installing nearly 140,000 square feet of synthetic stormwater diversion membrane over the exposed cell during the initial filling sequence to divert stormwater away from the leachate collection system.
- Constructing 6.2 acres of final cap on the north slope. This work began in April 2024 and will be substantially completed by the Fall of 2024 provided the weather does not adversely impact schedule. This capping event along with larger capping events scheduled for 2026 and 2027 will provide further reduction in leachate generation rates.
- Performing maintenance on the primary and secondary sumps which includes pulling the pumps and transducers for cleaning, service, and calibration.
- Checking the placement and location of the transducers for greater accuracy in reporting leachate levels on the liner.
- Securing additional leachate disposal outlets and transporters to provide redundancy so that the landfill has the capacity to effectively manage leachate generation rates as well as on-site leachate volumes. These additional disposal outlets and transporters give the landfill the flexibility needed to manage leachate demands and provide the on-site storage capacity to maintain leachate compliance levels.
- Providing leachate management training for site personnel. Training will be conducted by a third-party consultant and is scheduled for July 24.
- Establishing a centralized leachate sump and storage tank tracking system to provide greater visibility for routine review of leachate levels and flow rates in the primary leachate collection system, secondary detection system, and the storage tanks.

LOD Item #4:

Attached please find the July 15 letter report and attachments prepared by CMA Engineers concerning secondary leachate collection system flow rates and stormwater diversion improvements.

LOD Item #5:

Attached please find the July 15 letter report and attachments prepared by CMA concerning secondary leachate collection system flow rates and stormwater diversion improvements. See response to LOD Item #3 which also responds to LOD Item #5.

If you have any questions or concerns, please contact Sam Nicolai at (802) 345-2725, or me at (802) 651-5454.

Sincerely,

NORTH COUNTRY ENVIRONMENTAL SERVICES, INC.

FOR John Gay
Permits, Compliance, & Engineering

c. Kevin Roy, NCES (via email w/ enc.)
Bruce Grover, NCES (via email w/ enc.)
Lindsey Menard, NCES (via. email w/ enc.)
Kim Crosby, NCES (via. email w/ enc.)
Shelley Sayward, NCES (via email w/enc.)

SANBORN HEAD

6 Bedford Farms Drive
Bedford, New Hampshire, 03110

Mr. Joe Gay
Engineer
North Country Environmental Services, Inc.
P.O. Box 9
Bethlehem, NH 03574

July 15, 2024
File No. 2493.25

Re: Action Item 3a Evaluation
Letter of Deficiency No. SWMB 24-006
North Country Environmental Services, Inc. Landfill
Bethlehem, NH

Dear Joe:

Sanborn, Head & Associates (Sanborn Head) has performed an evaluation of the North Country Environmental Services, Inc. (NCES) Landfill located in Bethlehem, New Hampshire. This evaluation was performed in response to the New Hampshire Department of Environmental Services (NHDES) Letter of Deficiency (LoD) No. SWMB 24-006, dated June 14, 2024. As part of the LoD, NHDES requires that NCES submit an analysis of the cause(s) of the excessive leachate head buildup on the primary liner system, which includes the amount of leachate generated per day from the primary leachate collection system, and the capabilities of the facility to manage, store, and dispose of such leachate (Action Item 3a).

OBJECTIVES

Sanborn Head was tasked with evaluating the capabilities of the facility to manage, store, and dispose of such leachate. The evaluation includes taking historic site-specific leachate generation data, and evaluating whether the existing primary and contingency leachate storage infrastructure are adequately sized, given the anticipated maximum off-site disposal trucking rate, in accordance with the New Hampshire Code of Administrative Rules, Chapter Env-Sw 800, Section Env-Sw 805.06.

ASSUMPTIONS

To effectively and efficiently evaluate the capabilities of the facility regarding leachate management, some assumptions have been made. They include, but are not limited to, the following:

1. Leachate generation data from the facility (from January 1, 2023 to June 30, 2024) was used to assess an operational peak daily leachate generation rate for the facility.
2. Using time of concentration values provided by CMA Engineers (CMA) for prior leachate collection system design calculations for the facility as a guide, we assumed the leachate generation time of concentration of the drainage area to be 48-hours. In accordance with the regulations in Section Env-Sw 805.06, the storm duration for the 100-year storm event is to be equivalent to the time of concentration. Therefore, the 100-year storm event duration is 48-hours. Because the 100-year storm event duration is 48-hours, or two days, the peak daily leachate generation rate from the facility data was multiplied by 2, to be representative of a 48-hour storm duration.
3. The Hydrologic Evaluation of Landfill Performance (HELP) Model (Version 4.0) was used to estimate a peak daily leachate generation rate for the 48-hour 100-year storm event of 165,798 gallons per day (gpd). Because the HELP Model peak daily leachate generation rate is less than

the peak rate from the leachate generation data provided of 186,927 gpd, it was not used in this evaluation.

4. By assuming a peak flow contingency volume of 373,854 gallons (two times the peak leachate generation rate of 186,927 gpd) as representative of a 48-hour storm event in the calculations, we are conservatively comparing the regulatory requirements to a leachate volume well in excess of the 48-hour 100-year storm event volume from the HELP model.

RESULTS

To evaluate the capabilities of the facility to manage, store, and dispose of leachate, a calculation package was prepared (Calculation C.1 – Leachate Storage) which is enclosed with this letter. In summary, the calculation demonstrates that the NCES facility maintains more leachate storage capacity than required by Env-Sw-805.06(f) and (g), specifically:

- The largest volume of leachate to be generated by a contingency event and the anticipated base flow of the facility is about 373,854 gallons, which can be pumped from the sumps at a rate of 37 gallons per minute to evacuate the Landfill within seven (7) days, which is well within the capacity of the existing sump primary pumps;
- The existing tanks and sumps at the NCES facility provide a combined primary leachate storage volume of 210,000 gallons, which exceeds the required 15% of the 100-year storm event (peak flow contingency) volume of 373,854 gallons [Env-SW 805.06(g)(1)];
- The existing primary and contingency leachate storage volume provided at the NCES facility is approximately 472,000 gallons [253,600 gallons (primary storage) + 218,400 gallons (contingency storage)] which is significantly more storage capacity than the 100-year storm event (peak flow contingency) volume of 373,854 gallons [Env-SW 805.06(g)(3)]; and
- NCES will be able to transport collected leachate off-site for disposal at a rate of approximately 96,000 gpd which is based on an anticipated daily trucking rate of 12 tanker truck loads per day, at 8,000 gallons per truck, which is below the actual observed peak daily transported amount between January 1, 2022 and March 31, 2024 of 16 tanker truck loads transporting a total of 123,500 gpd. The anticipated 96,000 gpd off-site transport rate is significantly more than the contingency event requirement which was calculated to be about 17,200 gpd [Env-SW 805.06(g)(3)].

We appreciate the opportunity to be of service to NCES. Please let us know if you require additional information.

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

Derek T. Long, P.E.
Senior Project Manager

Brian J. Beaudoin
Senior Vice President

MCP/DTL/BJB: mcp

Encl. Attachment A – Calculation C-1: Leachate Management

cc: Robert Cox, NCES
Kevin Roy, NCES

P:\2400s\2493.25\Source Files\2024\Leachate Storage Evaluation\Cover Letter.docx

C-1: Leachate Management

PURPOSE:

Section Env-Sw 805.06(f) and (g) of the New Hampshire Solid Waste Rules requires that leachate collection and removal systems be designed to manage the quantity of leachate generated by the 100-year storm event (i.e., contingency storm) with a duration equivalent to the time of concentration (T_c) of the drainage area that contributes to leachate generation, in a manner that:

(1) Does not allow a hydraulic head greater than one foot to exist on any portion of the liner system, excluding the leachate collection sumps, if any, for longer than 7 days;

(2) Provides at least 15% of the 100-year storm storage volume in primary storage units located outside the waste deposition area or sumps located within the waste deposition area; and

(3) Does not rely on leachate recirculation as a factor in assessing the required storage and removal capabilities, even if leachate recirculation will be a routine operating procedure at the facility.

This calculation considers the following critical components of the leachate management system:

(1) Storage capacity required to contain at least 15% of the 100-year storm storage volume in primary storage units outside the landfill or sumps located within the waste deposition area;

(2) Pumping capacity required to remove leachate generated by the 100-year storm event during operations from the liner system within a 7-day period; and

(3) Disposal capacity required to manage the volume of leachate generated by the 100-year storm event.

ASSUMPTIONS AND DATA:

- NCES daily primary leachate flow data from January 1, 2023 to June 30, 2024 (See Exhibit C-1.1).
- NCES daily leachate hauling data from January 1, 2022 to March 31, 2024 (See Exhibit C-1.2).
- Section Env-Sw 805.06(f) of the New Hampshire Solid Waste Rules requires that leachate collection and removal systems be designed to manage the quantity of leachate generated by the 100-year storm event (i.e., contingency storm) with a duration equivalent to the Tc of the drainage area that contributes to leachate generation. Prior leachate collection system calculations performed by CMA Engineers, Inc. calculated the Tc for Stages IV, V, and VI to be 36 hours, 48 hours, and 41 hours respectively (See Exhibit C-1.3). Therefore, we're conservatively assuming the storm duration for the 100-year storm event to be 48 hours.
- The Hydrologic Evaluation of Landfill Performance (HELP) Model (Version 4.0) was used to estimate a peak daily leachate generation rate for the 48-hour 100-year storm event of 165,798 gallons/day. Since this rate is less than the peak daily leachate generation rate in the NCES daily primary leachate flow data provided of 186,927 gallons/day, it was not used in this evaluation.

METHOD:

Use the provided existing leachate generation data and compare it to the available leachate storage in accordance with Section Env-Sw 805.06.

CALCULATION:

The following steps were performed to evaluate if the existing leachate storage provided at the North Country Environmental Services, Inc. (NCES) Landfill is adequate in accordance with the New Hampshire Code of Administrative Rules, Chapter Env-Sw 800, Section Env-Sw 805.06:

Step 1: Peak Daily Leachate Flow

The peak daily primary leachate flow, in the data provided, was 186,927 gallons on July 26, 2023 (See Exhibit C-1.1).

$$Q_{Peak} = 186{,}927 \text{ gallons/day}$$

Step 2: Volume of Leachate Generated by the 100-Year Storm

As stated above in the assumptions, we're conservatively assuming the storm duration for the 100-year storm event to be 48 hours (2 days). Therefore, the volume of leachate generated by the 100-year storm event can be estimated to be representative of two times the peak daily leachate flow.

$$V_{100} = 186{,}927 \frac{gallons}{day} \times 48 \text{ hours} \times \frac{1\ day}{24\ hours} = 373{,}854 \text{ gallons}$$

$$V_{100} \approx 373{,}900 \text{ gallons}$$

Step 3: Required Sump Pumping Rates

The pumping rate required to remove leachate from the sumps due to the 100-year storm event within a 7-day period is:

$$Q_{pump} = V_{100} \,/\, 7\ days$$

$$Q_{pump} = 373{,}900\ gal \,/\, 7\ days = 53{,}414\ gpd$$

$$Q_{pump} = 53{,}414\ gpd\ x\ \frac{1\ day}{24\ hours}\ x \frac{1\ hour}{60\ minutes} = 37\ gpm$$

Estimating the maximum head to be 100 ft, based on the elevation difference between the sump and adjacent perimeter road for Sump 3, the existing primary leachate pumps in all three sumps are rated for a flow of 80 gpm or more (See Exhibit C-1.4). Therefore, the existing pumps are adequately sized to handle the contingency event.

Step 4: Existing Primary Leachate Storage Capacity

Per Section Env-Sw 805.06(g)(1) of the New Hampshire Solid Waste Rules, primary leachate storage capacity includes both primary storage units outside the landfill or sumps located within the waste deposition area. The total available existing primary leachate storage capacity is calculated below:

Primary storage units outside the Landfill (See Exhibit C-1.5):
Aboveground Storage Tank – 150,000 gallons
Tank A – 30,000 gallons
Tank B – 30,000 gallons

Sumps (See Exhibit C-1.6):
Sump 1 – 29,780 gallons
Sump 2 – 5,663 gallons
Sump 3 – 8,132 gallons

$$V_{primary} = 150{,}000\ gallons + 30{,}000\ gallons + 30{,}000\ gallons + 29{,}780\ gallons + 5{,}663\ gallons + 8{,}132\ gallons\ = 253{,}575\ gallons$$

$$V_{primary} \approx 253{,}600 \text{ gallons}$$

Section Env-Sw 805.06(g) of the New Hampshire Solid Waste Rules requires that leachate collection and removal systems provides at least 15% of the 100-year storm event volume in primary storage units located outside the waste deposition area or sumps located within the waste deposition area:

$$V_{req,primary} = 373{,}900 \text{ gallons} \times 15\% = 56{,}085 \text{ gallons}$$

$$56{,}085 \text{ gallons} < 253{,}600 \text{ gallons} \ \therefore \text{OKAY}$$

Step 5: Existing Contingency Leachate Storage Capacity

Per Section Env-Sw 805.06(g)(3) of the New Hampshire Solid Waste Rules, contingency leachate storage capacity includes both contingency storage units outside the landfill or on the uppermost liner within a waste deposition area provided that storage on the liner in excess of one-foot of hydraulic head shall be limited to a period of 7 days or less. The total available existing contingency leachate storage capacity is calculated below:

Area Tributary to Sump 1 *(from CMA Engineers January 2009 Leachate Collection System Calculations for Stage IV – Phase II area – See Exhibit C-1.7)*
Leachate Pipes – 3,923 gallons
12-inches above the sump in the 18-inch-thick Select Sand/Crushed Stone Layer – 157,105 gallons

Area Tributary to Sump 2 (*from CMA Engineers November 2013 Leachate Collection System Calculations for Stage V – See Exhibit C-1.7)*[1]
Leachate Pipes – 799 gallons
12-inches above the sump in the 18-inch-thick Select Sand/Crushed Stone Layer – 4,331 gallons

Area Tributary to Sump 3 *(from CMA Engineers November 2022 Leachate Collection System Calculations for Stage III area – See Exhibit C-1.7)*

[1] Information related to Stage II and Stage IV Phase I contingency leachate storage capacity was not ~~available~~. It's omission conservatively reduces the contingency leachate storage capacity from what is actually provided.

Leachate Pipes – 1,003 gallons
12-inches above the sump in the 18-inch-thick Select Sand/Crushed Stone Layer – 51,282 gallons

$$V_{contingency} = 3{,}923\ gallons + 157{,}105\ gallons + 799\ gallons + 4{,}331\ gallons + 1{,}003\ gallons + 51{,}282\ gallons = 218{,}443\ gallons$$

$$V_{contingency} \approx 218{,}400 \text{ gallons}$$

The required contingency leachate storage volume is calculated by taking the 100-year storm event volume and subtracting the existing primary leachate storage unit capacity volume:

$$V_{100} - V_{primary} = V_{req,contingency}$$

$$373{,}900\ gallons - 253{,}600\ gallons = 120{,}300\ gallons$$

$$V_{req,contingency} \approx 120{,}300 \text{ gallons}$$

$$120{,}300 \text{ gallons} < 218{,}400 \text{ gallons} \ \therefore \text{OKAY}$$

Step 6: Check Leachate Hauling Capacity

In the NCES daily leachate hauling data, the maximum number of tanker truck loads of leachate removed from the site in one day was 16 loads on February 1, 2024, with total gallons transported off-site that day of 123,521 (See Exhibit C-1.2). Conservatively, we anticipate a more realistic daily trucking rate that can be maintained over a period of 7 days to be 12 tanker truck loads per day, at 8,000 gallons per truck, which equates to a total of 96,000 gallons per day of leachate transported off-site. Using this assumption, the disposal capacity was evaluated:

$$Q_{disposal} = \frac{120{,}300\ gal}{7\ days} = 17{,}186\ \frac{gal}{day}$$

$$Q_{disposal} \approx 17{,}200 \text{ gallons/day}$$

$$17{,}200 \text{ gallons/day} < 96{,}000 \text{ gallons/day} \ \therefore \text{OKAY}$$

RESULTS:

This calculation confirms that the existing leachate management system meets the following design requirements from Section Env-Sw 805.06(f) and (g) of the New Hampshire Solid Waste Rules:

(1) Storage capacity required to contain at least 15% of the 100-year storm storage volume in primary storage units outside the landfill or sumps located within the waste deposition area;

(2) Pumping capacity required to remove leachate generated by the 100-year storm event during operations from the liner system within a 7-day period; and

(3) Disposal capacity required to manage the volume of leachate generated by the 100-year storm event during initial operations.

North Country Environmental Services, Inc. Landfill
Leachate Storage Evaluation
Daily Primary Leachate Flow Data Summary

2023 Summary		
Month	Max. Daily Combined Flow (gallons)	Avg. Daily Combined Flow (gallons)
January	57,619	29,581
February	43,469	29,695
March	75,183	30,439
April	73,684	29,851
May	87,372	28,629
June	55,429	32,683
July	186,927	65,331
August	109,381	53,034
September	71,149	39,540
October	102,979	39,005
November	130,597	38,224
December	118,186	49,839

2024 Summary		
Month	Max. Daily Combined Flow (gallons)	Avg. Daily Combined Flow (gallons)
January	123,056	61,448
February	110,234	48,935
March	95,039	50,041
April	132,519	58,007
May	121,029	67,701
June	97,572	50,401

EXHIBIT C-1.2

NORTH COUNTRY ENVIRONMENTAL SERVICES INC

Destination Report

Transactions from 2/01/2024 through
2/29/2024
Outbound Tickets Only
Third Party and Intercompany Customers

Ticket	Date	Truck	Trailer	In/Out	Gallons
CONCORD - CONCORD WASTE TREATMENT PLANT					
545659	2/1/2024	2503L	2842	O	8,297
545662	2/1/2024	4JF	2056	O	6,923
545664	2/1/2024	30JC	12	O	7,669
545668	2/1/2024	2302L	TK-02	O	7,662
545673	2/1/2024	940L	1708	O	7,859
545677	2/1/2024	2097L	2383	O	7,624
545679	2/1/2024	2096L	2402	O	8,343
545681	2/1/2024	2503L	2842	O	8,153
545685	2/1/2024	4JF	2056	O	7,034
545687	2/1/2024	30JC	12	O	7,547
545690	2/1/2024	1466L	2383	O	7,451
545693	2/1/2024	2302L	TK-02	O	7,662
545697	2/1/2024	940L	1708	O	7,832
545704	2/2/2024	2503L	2842	O	8,297
545712	2/2/2024	2302L	TK-02	O	7,657
545719	2/2/2024	30JC	12	O	7,600
545725	2/2/2024	940L	1708	O	7,918
545731	2/2/2024	23JC	10	O	7,381
545734	2/2/2024	2097L	2388	O	7,614
545738	2/2/2024	2096L	2402	O	8,300
545747	2/2/2024	2302L	TK02	O	7,659
545750	2/2/2024	30JC	12	O	8,007
545752	2/2/2024	1466L	2383	O	7,597
545758	2/2/2024	940L	1708	O	7,882
545759	2/2/2024	23JC	10	O	7,381
546666	2/26/2024	2503L	2842	O	8,317
546686	2/26/2024	2957L	2388	O	7,556
546701	2/26/2024	2503L	2842	O	8,235
546712	2/26/2024	2462L	2056	O	6,089
546755	2/27/2024	2503L	2842	O	8,168
546762	2/27/2024	2956L	2402	O	8,302
546773	2/27/2024	2957L	2388	O	7,518
546778	2/27/2024	2503L	2842	O	8,230
546799	2/28/2024	2503L	2842	O	8,293
546804	2/28/2024	1421L	2383	O	7,619
546826	2/28/2024	2503L	2842	O	8,362
546834	2/28/2024	1421L	2383	O	7,664
546877	2/29/2024	2956L	2842	O	8,424
546887	2/29/2024	2503L	2842	O	8,189
546895	2/29/2024	2462L	2056	O	6,811
546899	2/29/2024	1421L	2383	O	7,516
CONCORD - CONCORD WASTE TREATMENT PLANT					**318,642**

16 truckloads totaling 123,521 gallons

FRANKLIN - FRANKLIN WASTE WATER TREATMENT PLANT

545654	2/1/2024	2097L	2388	O	7,554
545657	2/1/2024	2096L	2402	O	8,271
545670	2/1/2024	1466L	2383	O	7,640
545702	2/2/2024	2096L	2402	O	8,211
545718	2/2/2024	1466L	2383	O	7,444
545743	2/2/2024	2503L	2842	O	8,173
545764	2/3/2024	2096L	2402	O	8,662
545765	2/3/2024	2097L	2388	O	7,595
545766	2/3/2024	2503L	2842	O	8,436
545767	2/5/2024	2096L	2402	O	8,273
545770	2/5/2024	2503L	2842	O	8,168
545789	2/5/2024	2096L	2402	O	8,362
545823	2/6/2024	2096L	2402	O	8,293
545836	2/6/2024	2462L	2388	O	7,360
545859	2/6/2024	2503L	2842	O	8,012
545879	2/7/2024	2097L	2388	O	7,588
545881	2/7/2024	2096L	2402	O	8,329
545917	2/7/2024	2503L	2842	O	8,086
545934	2/8/2024	2097L	2388	O	7,612
545937	2/8/2024	2096L	2402	O	8,173
545973	2/8/2024	2503L	2842	O	7,926
545994	2/9/2024	2096L	2402	O	8,350
546008	2/9/2024	1396L	2383	O	7,506
546027	2/9/2024	2503L	2842	O	7,710
546052	2/10/2024	2096L	2402	O	8,592
546053	2/10/2024	5JF	2056	O	7,127
546054	2/10/2024	2097L	2388	O	7,585
546055	2/12/2024	2097L	2388	O	7,621
546056	2/12/2024	2096L	2402	O	8,180
546082	2/12/2024	2096L	2402	O	8,278
546117	2/13/2024	2503L	2842	O	8,254
546118	2/13/2024	2096L	2402	O	8,192
546124	2/13/2024	2097L	2388	O	7,535
546175	2/14/2024	2097L	2388	O	7,614
546176	2/14/2024	2096L	2402	O	8,161
546218	2/14/2024	2503L	2842	O	7,878
546246	2/15/2024	2097L	2388	O	7,571
546249	2/15/2024	2096L	2402	O	8,185
546252	2/15/2024	2503L	2842	O	8,177
546451	2/20/2024	2097L	2388	O	7,573
546471	2/20/2024	2503L	2842	O	8,002
546481	2/20/2024	2096L	2402	O	8,175
546502	2/21/2024	2957L	2388	O	7,588
546506	2/21/2024	2096L	2402	O	8,338
546513	2/21/2024	1421L	2383	O	7,034
546559	2/22/2024	2957L	2388	O	7,657
546561	2/22/2024	2956L	2402	O	8,158
546593	2/22/2024	2503L	2383	O	8,170
546604	2/23/2024	2956L	2402	O	8,355
546630	2/23/2024	2957L	2388	O	7,585
546648	2/23/2024	1421L	2383	O	6,650

546659	2/26/2024	2957L	2388	O	7,576
546661	2/26/2024	2956L	2402	O	8,269
546676	2/26/2024	1421L	2383	O	7,535
546725	2/27/2024	2503L	2842	O	8,252
546729	2/27/2024	2956L	2402	O	8,261
546749	2/27/2024	2957L	2388	O	7,535
546791	2/28/2024	2957L	2388	O	7,590
546794	2/28/2024	2956L	2802	O	8,317
546821	2/28/2024	2956L	2402	O	8,422
546850	2/29/2024	2957L	2388	O	7,535
546852	2/29/2024	2956L	2402	O	8,225
546868	2/29/2024	2462L	2056	O	6,782
FRANKLIN - FRANKLIN WASTE WATER TREATMEN					**498,268**

ALLENSTOWN - ALLENSTOWN WASTE WATER TREATMENT PLANT

545779	2/5/2024	1466L		O	7,554
545795	2/5/2024	2503L	2842	O	8,165
545814	2/5/2024	2096L	2402	O	8,427
545825	2/6/2024	2503L	2842	O	8,199
545852	2/6/2024	2097L	2383	O	7,360
545868	2/6/2024	2462L	2388	O	7,504
545886	2/7/2024	2503L	2842	O	8,002
545900	2/7/2024	2097L	2388	O	7,609
545922	2/7/2024	1396L		O	7,585
545943	2/8/2024	2503L	2842	O	7,928
545949	2/8/2024	1396L	2383	O	7,319
545956	2/8/2024	2097L	2388	O	7,532
545988	2/9/2024	2503L	2842	O	8,194
546010	2/9/2024	2097L	2388	O	7,564
546035	2/9/2024	1396L	2383	O	7,468
546062	2/12/2024	2503L	2842	O	8,019
546100	2/12/2024	2503L	2842	O	7,933
546108	2/12/2024	2097L	2388	O	7,535
546141	2/13/2024	2503L	2842	O	7,998
546152	2/13/2024	2097L	2056	O	7,588
546156	2/13/2024	1421L	2383	O	7,331
546182	2/14/2024	2503L	2842	O	7,878
546192	2/14/2024	1421L	2383	O	7,360
546198	2/14/2024	2097L	2388	O	7,564
546264	2/15/2024	1421L	2383	O	7,113
546304	2/15/2024	1421L	2383	O	7,559
ALLENSTOWN - ALLENSTOWN WASTE WATER TRE					**200,288**

MANCHESTER - MANCHESTER WASTE WATER TREATMENT PLANT

545831	2/6/2024	5JF	2056	O	7,161
545845	2/6/2024	2096L	2402	O	8,331
545863	2/6/2024	5JF	2056	O	7,177
545892	2/7/2024	4JF	2056	O	6,988
545907	2/7/2024	2096L	2402	O	8,317
545926	2/7/2024	4JF		O	7,017
545945	2/8/2024	4JF	2056	O	6,921
545961	2/8/2024	2096L	2402	O	8,336
545979	2/8/2024	4JF	2056	O	6,990

545997	2/9/2024	4JF		O	7,019
546022	2/9/2024	2096L	2402	O	8,211
546033	2/9/2024	4JF		O	7,038
546066	2/12/2024	4JF	2056	O	6,993
546104	2/12/2024	4JF	2056	O	6,969
546110	2/12/2024	2096L	2402	O	8,350
546129	2/13/2024	4JF	2056	O	6,995
546146	2/13/2024	2096L	2402	O	8,293
546159	2/13/2024	4JF	2056	O	7,022
546187	2/14/2024	4JF	2056	O	6,856
546204	2/14/2024	2096L	2402	O	8,249
546229	2/14/2024	4JF	2056	O	6,954
546267	2/15/2024	2097L	2388	O	7,585
546280	2/15/2024	2096L	2402	O	8,170
546281	2/15/2024	2503L	2842	O	8,125
546315	2/16/2024	2096L	2402	O	8,302
546316	2/16/2024	2097L	2388	O	7,552
546321	2/16/2024	2503L	2842	O	7,839
546381	2/17/2024	2096L	2402	O	8,585
546382	2/17/2024	2097L	2388	O	7,659
546383	2/17/2024	1421L	2383	O	7,276
546384	2/19/2024	2097L	2388	O	7,602
546385	2/19/2024	2503L	2402	O	8,141
546403	2/19/2024	1421L	2383	O	7,134
546433	2/20/2024	2503L	2842	O	8,158
546435	2/20/2024	2096L	2402	O	8,091
546448	2/20/2024	1421L	2383	O	6,796
546522	2/21/2024	2957L	2388	O	7,643
546528	2/21/2024	2096L	2402	O	8,314
546546	2/21/2024	1421L	2383	O	7,633
546565	2/22/2024	2503L	2842	O	8,209
546578	2/22/2024	2957L	2388	O	7,525
546584	2/22/2024	2956L	2402	O	8,379
546615	2/23/2024	2503L	2842	O	8,115
546623	2/23/2024	1421L	2383	O	7,451
546642	2/23/2024	2956L	2402	O	8,180
546656	2/24/2024	2956L	2402	O	8,683
546657	2/24/2024	2957L	2388	O	7,755
546658	2/24/2024	2503L	2842	O	8,516
546692	2/26/2024	2956L	2402	O	8,283
546715	2/26/2024	1421L	2383	O	7,640
546744	2/27/2024	1421L	2383	O	7,376
546781	2/27/2024	1421L		O	7,578
546789	2/27/2024	2956L	2402	O	8,307
546815	2/28/2024	2957L	2388	O	7,573
546843	2/28/2024	2956L	2942	O	8,360
546848	2/28/2024	2462L	2156	O	6,811
546857	2/29/2024	2503L	2842	O	8,283
546863	2/29/2024	1421L	2383	O	7,566
546872	2/29/2024	2957L	2388	O	7,504
MANCHESTER - MANCHESTER WASTE WATER TRE/					**454,886**

Report Grand Totals **1,472,084**

EXHIBIT C-1.3

CMA ENGINEERS, Inc. Civil/Environmental Engineers 35 Bow Street Portsmouth, NH 03801	Project: NCES Stage IV - Phase II Project No: 656 Date: January 2009 Calc. By: JSM Chkd. By: RJG

LEACHATE COLLECTION SYSTEM CALCULATIONS

100 Year Storm - Base Area and Base Flow

Input Variables:			
Cell area (Ac)	0.98	acres	Base Expansion Area
Run-on area (Ar)	2.00	acres	Phase II Side Slope & Overlay Liner
Percent from run-on area Ar (Pr)	40%		*
Time of Concentration	2161	min	
Rainfall Intensity	0.2	in/hr	Figure 6-3 (Appendix A-1-8)
Base flow	7,474	gpd	Site Data (See Base Flow Calculation)

Total Inflow Stage IV, Phase I Volume (Vb)

Vb = I*Tc * Ac			
Vb =	46,424	CF	
	347,254	gal	
Total Volume (Vb + Base flow)	**354,728**	**gal**	Stage IV, Phase II, Stage I Base Flow

100 Year Storm - Overlay Liner

Input Variables:			
Overlay Liner Area (Ac)	2.50	acres	**Southern Overlay Exposed Select Sand
Time of Concentration	121	min	
Rainfall Intensity	1.5	in/hr	Figure 6-3 (Appendix A-1-8)

Total Overlay Liner Flow			
Rainfall Intensity	1.06E-03	cm/s	
Drainage Sand Permeability	3.10E-03	cm/s	Permeability >> Intensity; all Infiltration
Total Overlay Liner Volume (Vo)	27,400	CF	through Sand and into Composite
	204,953	gal	

Total Stage I, Phase II Volume			
Vt = Vb + Vo + Vbase	**559,682**	**gal**	Stage IV, Phase II, Stage I
	0.85	**cfs**	< 2.436 cfs pipe capacity

Available Storage on Liner in Stage IV, Phase I w/2ft Freeboard:

Sump and Header	33,703	gal
Drainage Sand	157,105	gal
MSW	919,674	gal
Total Available Storage on Liner, Stage IV, Phase II	**1,110,482**	**gal**

CMA ENGINEERS, Inc. Civil/Environmental Engineers 35 Bow Street Portsmouth, NH 03801	Project: NCES Stage V Project No: 833 Date: November 2013 Calc. By: LBK Chkd. By: RJG

LEACHATE COLLECTION SYSTEM CALCULATIONS

100 Year Storm - Base Area and Base Flow

Input Variables:			
Cell area (Ac)	4.03	acres	1/2 New Cell Area
Run-on area (Ar)	2.50	acres	Stage I and V Side Slopes
Percent from run-on area Ar (Pr)	40%		*
Time of Concentration	2863	min	
Rainfall Intensity	0.16	in/hr	Figure 6-3 (Appendix A-1-8)
Base Flow	5950	gal/day	

Total Inflow Stage V

Vb = I*Tc * Ac			
Vb =	139,385	CF	
	1,042,602	gal	
Total Volume (Vb + Base flow)	**1,048,552**	**gal**	Stage V, Run-on

Total Stage V Volume			
Vt = Vb + Vbase	**1,048,552**	**gal**	Stage V
	1.61	**cfs**	< 2.25 cfs pipe capacity

Available Storage on Liner in Stage V w/2ft Freeboard:

Drainage Sand	564,455	gal
MSW	1,882,095	gal
Total Available Storage on Liner, Stage V	**2,446,550**	**gal**

Total Leachate Generation

Stage V	**1,048,552**	**gal**
Total Landfill Inflow	**1,048,552**	**gal**

Available Tank Storage:

Existing Stage III Tanks	60,000	gal
150,000 gal AST	150,000	gal
Sump Storage	**10,794**	gal
Total Storage	**220,794**	**gal**

15% of Total Leachate Volume	**157,283**	**gal**	Meets Regulations

CMA ENGINEERS
35 Bow Street
Portsmouth, NH 03801

Project:	NCES Stage VI Phase II
Project No:	1063
Date:	Nov-22
Calc. By:	AJS
Chkd. By:	

LEACHATE COLLECTION SYSTEM CALCULATIONS

Stage VI-Phase II, 100 Year Storm - Base Area and Base Flow
Flow to Pump Station 3

Input Variables:			
S6P2 Cell area to Phase III (Ac)	2.16	acres	
Run-on area (Ar)	1.25	acres	Area under lowest swale draining to Stage III
Percent from run-on area Ar (Pr)	40%		*
Time of Concentration	2474	min	
Rainfall Intensity	0.16	in/hr	Figure 6-3 (Appendix A-1-8)
Base Flow (Stsage III)	5,000	gal/day	

Total Inflow Phase III

Vb = I*Tc * Ac		
Vb =	63,701	CF
	476,485	gal
Total Volume (Vb + Base flow)	**481,485**	**gal**

Total Stage VI Volume			
Vt = Vb + Vbase	**481,485**	**gal**	
	0.74	**cfs**	< 0.79 cfs pipe capacity

Available Storage on Liner in Stage III, 6' assumed MSW Depth:

1.5" Sump Stone and Sand	59,414	gal
6' MSW Layer	1,515,965	gal
Pipe	1,003	gal
Total Available Storage on Liner, Stage III	**1,576,382**	**gal**

Total Leachate Generation

Stage VI-Phase II	**476,485**	**gal**
Base Flow, Stage III	**5,000**	**gal**
Total Inflow (Stage III)	**481,485**	**gal**

Available Tank Storage:

Existing Stage III Tanks	60,000	gal
150,000 gal AST	150,000	gal
Total Storage Outside Landfill	**210,000**	gal
Sump Storage	**59,414**	gal
Total Storage	**269,414**	**gal**

15% of Total Leachate Volume	**72,223**	**gal**	Meets Regulations

Leachate Removal Rates:

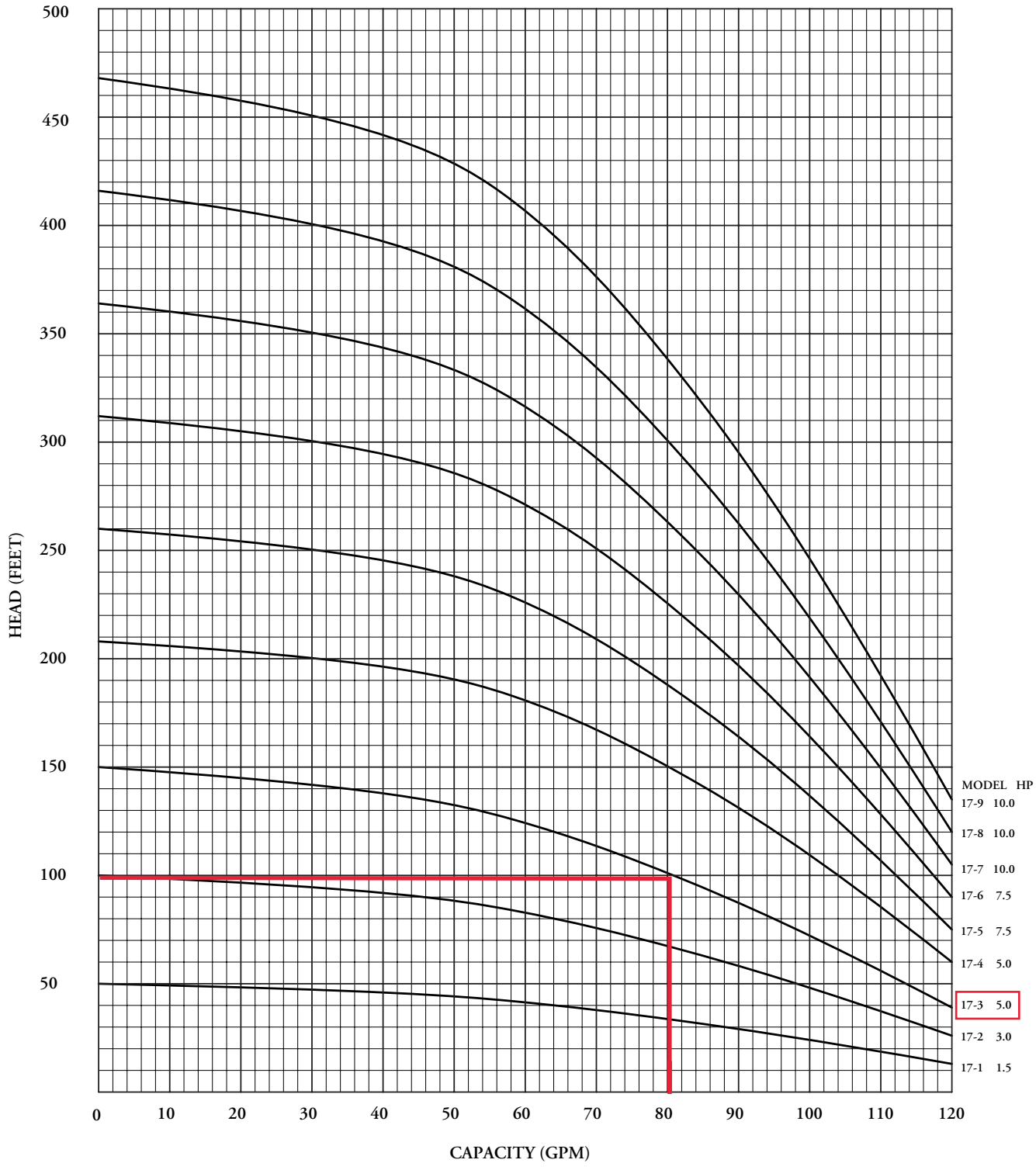
Tanker Trucks	5		
Volume per Truck	5,000	gal/truck	
	0.29	trip/hr	1 per 3.5 hours round trip to Concord
	85,714	gal/day	(12 hours/day per Operating Plan)
	6	days	

* Remaining percent is stored in drainage sand or infiltrates to geocomposite and collection pipe sooner than precipitation and run-off infiltrates through waste, and would be managed prior to other flow.

SERIES 17 SurePump™

Flow Range 20-120 GPM

60 Hz

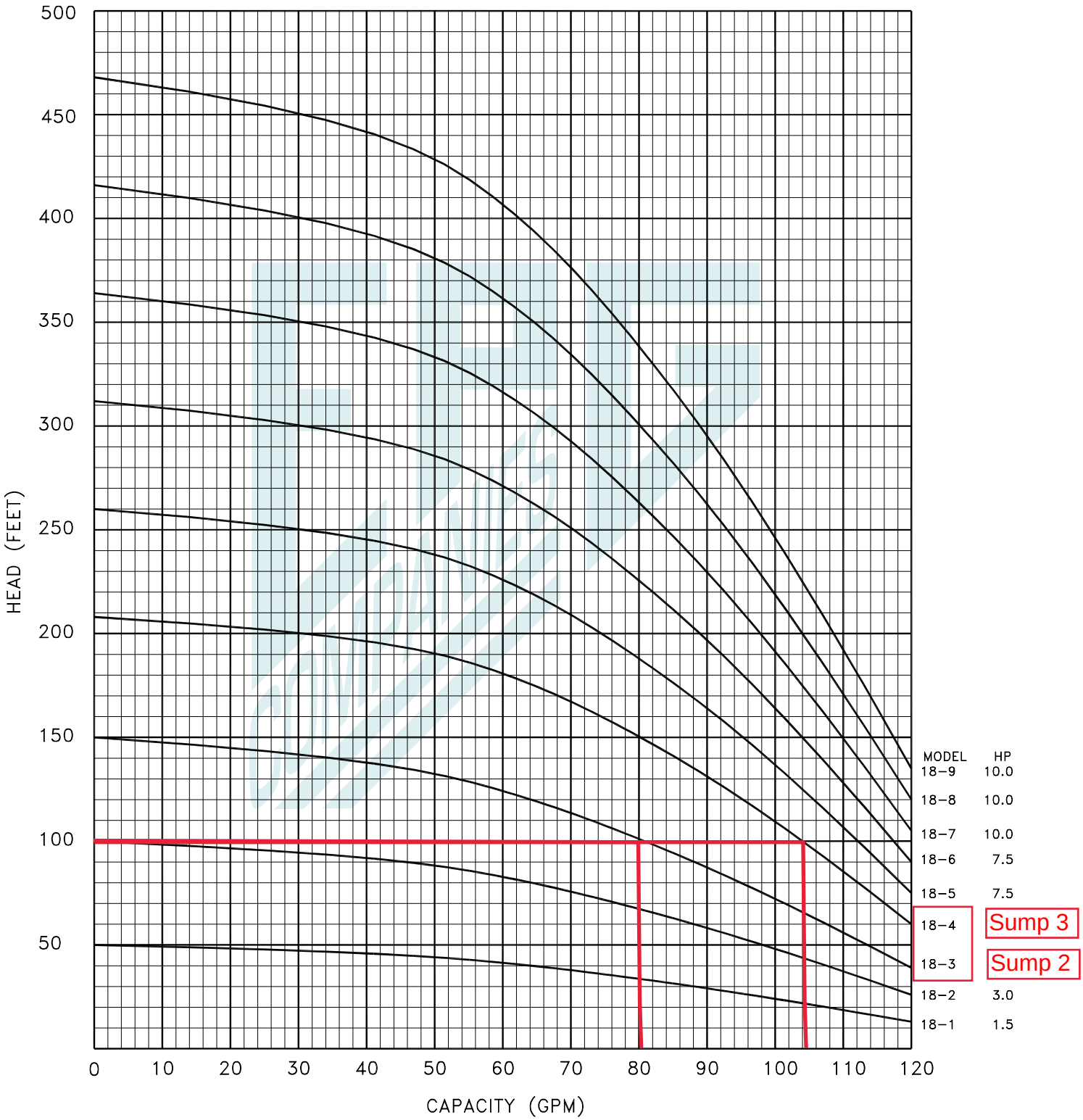


DATA SUBJECT TO CHANGE WITHOUT NOTICE

SERIES 18 SurePump™

Flow Range 20–120 GPM

60 Hz



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

09766–0000

EXHIBIT C-1.5

CMA ENGINEERS 35 Bow Street Portsmouth, NH 03801	Project: NCES Stage VI Phase II Project No: 1063 Date: Nov-22 Calc. By: AJS Chkd. By:

LEACHATE COLLECTION SYSTEM CALCULATIONS

Stage VI-Phase II, 100 Year Storm - Base Area and Base Flow
Flow to Pump Station 3

Input Variables:			
S6P2 Cell area to Phase III (Ac)	2.16	acres	
Run-on area (Ar)	1.25	acres	Area under lowest swale draining to Stage III
Percent from run-on area Ar (Pr)	40%		*
Time of Concentration	2474	min	
Rainfall Intensity	0.16	in/hr	Figure 6-3 (Appendix A-1-8)
Base Flow (Stsage III)	5,000	gal/day	

Total Inflow Phase III

Vb = I*Tc * Ac		
Vb =	63,701	CF
	476,485	gal
Total Volume (Vb + Base flow)	**481,485**	**gal**

Total Stage VI Volume			
Vt = Vb + Vbase	**481,485**	**gal**	
	0.74	**cfs**	< 0.79 cfs pipe capacity

Available Storage on Liner in Stage III, 6' assumed MSW Depth:

1.5" Sump Stone and Sand	59,414	gal
6' MSW Layer	1,515,965	gal
Pipe	1,003	gal
Total Available Storage on Liner, Stage III	**1,576,382**	**gal**

Total Leachate Generation

Stage VI-Phase II	**476,485**	**gal**
Base Flow, Stage III	**5,000**	**gal**
Total Inflow (Stage III)	**481,485**	**gal**

Tank A - 30,000 gallons
Tank B - 30,000 gallons

Available Tank Storage:

Existing Stage III Tanks	60,000	gal
150,000 gal AST	150,000	gal
Total Storage Outside Landfill	**210,000**	gal
Sump Storage	**59,414**	gal
Total Storage	**269,414**	**gal**

15% of Total Leachate Volume	**72,223**	**gal**	Meets Regulations

Leachate Removal Rates:

Tanker Trucks	5		
Volume per Truck	5,000	gal/truck	
	0.29	trip/hr	1 per 3.5 hours round trip to Concord
	85,714	gal/day	(12 hours/day per Operating Plan)
	6	days	

* Remaining percent is stored in drainage sand or infiltrates to geocomposite and collection pipe sooner than precipitation and run-off infiltrates through waste, and would be managed prior to other flow.

EXHIBIT C-1.6

CMA ENGINEERS, Inc.	Project:	NCES Stage IV - Phase II
Civil/Environmental Engineers	Project No:	656
35 Bow Street	Date:	January 2009
Portsmouth, NH 03801	Calc. By:	JSM
	Chkd. By:	RJG

100 Year Storm Event Leachate Storage Capacity
Porosity of Class D Stone 0.45
Porosity of MSW: 0.671

Elevation (ft)	Area (ft^2)	Avg Area (ft^2)	Total Volume (ft^3)	Total Volume (gal)	Total Storage Volume (gal)
In Leachate Pipes					
Primary Risers	3.14	-	132	987	987
Primary Header	0.79	-	393	2,936	2,936
Pipe Max Storage			**524**	**3,923**	**3,923**
In D-Stone in Sump					
2' Deep Sump w/2' Risers	45.72	-	960	7,183	3,232
1'Deep Sump w/1' Header	19.72	-	7,886	58,995	26,548
Sump Max Storage			**960**	**7,183**	**29,780**
In 1.5' D-Stone Over Liner					
1322	13,935	31,112	46,668	349,123	157,105
1324	48,289				
Drainage Sand Max Storage			**46,668**	**349,123**	**157,105**
In 4.5' Waste					
1324	48,289	91,606	183,211	1,370,601	919,674
1326	134,922				
Max Storage in Waste			**183,211**	**1,370,601**	**919,674**
				Total Storage	**1,110,482**

Sump 1

CMA ENGINEERS, Inc. Civil/Environmental Engineers 35 Bow Street Portsmouth, NH 03801	Project: NCES Stage V Project No: 833 Date: November 2013 Calc. By: LBK Chkd. By: RJG

100 Year Storm Event Leachate Storage Capacity
Porosity of Class D Stone 0.4
Porosity of MSW: 0.671

Sump Storage

Elevation (ft)	Area (ft^2)	Avg Area (ft^2)	Total Volume (ft^3)	Total Volume (gal)	Total Storage Volume (gal)
In Leachate Pipes					
Primary Risers	3.14	-	107	799	799
Pipe Max Storage			**107**	**799**	**799**
In D-Stone in Sump					
2.5' Deep Sump w/2' Risers	63.9	-	1,725	12,902	5,161
1.0' Deep Sump Over Seconondary Risers	7.00		168	1,257	503
Sump Max Storage			**1,893**	**14,159**	**5,663**
In 1.5' D-Stone Over Liner					
1315.5	965	-	1,448	10,829	4,331
Drainage Sand Max Storage			**1,448**	**10,829**	**4,331**
				Total Storage	**10,794**

Sump 2

Total Storage

In 6' of MSW					
1320	5087				
		19787	39,574	296053	198652
1322	34487				
		61025	122,049	913049	612656
1324	87562				
		106658	213,315	1595810	1070788
1326	125753				
MSW Max Storage			**374,938**	**2,804,911**	**1,882,095**
In 1.5' of Drainage Sand					
	125753	-	188,630	1,411,137	564455
Drainage Sand Max Storage			**188,630**	**1,411,137**	**564,455**
				Total Storage	2,446,550

CMA ENGINEERS
35 Bow Street
Portsmouth, NH 03801

Project:	NCES Stage VI Phase II
Project No:	1063
Date:	Nov-22
Calc. By:	AJS
Chkd. By:	

LEACHATE COLLECTION SYSTEM CALCULATIONS

100 Year Storm Event Leachate Storage Capacity

Porosity of Drainage Sand	0.457
Porosity of Pipe Trench Stone (3/4")	0.450
Porosity of Class D Stone (1.5")	0.400
Porosity of MSW:	0.671

Stage III

1-ft Sump Storage - Stage VI South (Stage VI Phase II Sump)

Elevation (ft)	Area (ft^2)	Avg Area (ft^2)	Total Volume (ft^3)	Total Volume (gal)	Total Storage Volume (gal)
In Leachate Pipes					
Primary Leachate Pipe	0.31	-	93	699	699
18" Primary Riser Pipe (1)	1.35		20	152	152
18" Primary Riser Pipe (2)	1.35		20	152	152
Pipe Max Storage			**134**	**1,003**	**1,003**
In Sump (3 feet of 1.5" stone)					
1323.5 (bottom of sump)	180	-			
1326.5 (top of sump)	900	540	1,620	12,119	8,132
Sump Max Storage			**1,620**	**12,119**	**8,132**
In 1.5' Drainage Sand Layer					
Drainage Sand Layer (1326.5 to 1328)	10,000	-	**15,000**	**112,215**	**51,282**
Storage in Drainage Sand			**15,000**	**112,215**	**51,282**
In 6-foot MSW Layer					
1328	20,000				
1330	44,000	32,000	64,000	478,784	**321,264**
1332	62,000	53,000	106,000	792,986	**532,094**
1334	70,000	66,000	132,000	987,492	**662,607**
Storage through 6-feet MSW Depth			**302,000**	**2,259,262**	**1,515,965**

Sump 3

EXHIBIT C-1.7

CMA ENGINEERS, Inc.	Project:	NCES Stage IV - Phase II
Civil/Environmental Engineers	Project No:	656
35 Bow Street	Date:	January 2009
Portsmouth, NH 03801	Calc. By:	JSM
	Chkd. By:	RJG

100 Year Storm Event Leachate Storage Capacity
Porosity of Class D Stone 0.45
Porosity of MSW: 0.671

Elevation (ft)	Area (ft^2)	Avg Area (ft^2)	Total Volume (ft^3)	Total Volume (gal)	Total Storage Volume (gal)	
In Leachate Pipes						
Primary Risers	3.14	-	132	987	987	
Primary Header	0.79	-	393	2,936	2,936	
Pipe Max Storage			**524**	**3,923**	**3,923**	Sump 1
In D-Stone in Sump						
2' Deep Sump w/2' Risers	45.72	-	960	7,183	3,232	
1'Deep Sump w/1' Header	19.72	-	7,886	58,995	26,548	
Sump Max Storage			**960**	**7,183**	**29,780**	
In 1.5' D-Stone Over Liner						
1322	13,935	31,112	46,668	349,123	157,105	
1324	48,289					
Drainage Sand Max Storage			**46,668**	**349,123**	**157,105**	Sump 1
In 4.5' Waste						
1324	48,289	91,606	183,211	1,370,601	919,674	
1326	134,922					
Max Storage in Waste			**183,211**	**1,370,601**	**919,674**	
				Total Storage	**1,110,482**	

CMA ENGINEERS, Inc. Civil/Environmental Engineers 35 Bow Street Portsmouth, NH 03801	Project: NCES Stage V Project No: 833 Date: November 2013 Calc. By: LBK Chkd. By: RJG

100 Year Storm Event Leachate Storage Capacity
Porosity of Class D Stone 0.4
Porosity of MSW: 0.671

Sump Storage

Elevation (ft)	Area (ft^2)	Avg Area (ft^2)	Total Volume (ft^3)	Total Volume (gal)	Total Storage Volume (gal)	
In Leachate Pipes						
Primary Risers	3.14	-	107	799	799	
Pipe Max Storage			**107**	**799**	**799**	Sump 2 (assumed)
In D-Stone in Sump						
2.5' Deep Sump w/2' Risers	63.9	-	1,725	12,902	5,161	
1.0' Deep Sump Over Seconondary Risers	7.00		168	1,257	503	
Sump Max Storage			**1,893**	**14,159**	**5,663**	
In 1.5' D-Stone Over Liner						
1315.5	965	-	1,448	10,829	4,331	
Drainage Sand Max Storage			**1,448**	**10,829**	**4,331**	Sump 2 (assumed)
				Total Storage	**10,794**	

Total Storage

In 6' of MSW						
1320	5087					
		19787	39,574	296053	198652	
1322	34487					
		61025	122,049	913049	612656	
1324	87562					
		106658	213,315	1595810	1070788	
1326	125753					
MSW Max Storage			**374,938**	**2,804,911**	**1,882,095**	
In 1.5' of Drainage Sand						
	125753	-	188,630	1,411,137	564455	
Drainage Sand Max Storage			**188,630**	**1,411,137**	**564,455**	
				Total Storage	2,446,550	

CMA ENGINEERS
35 Bow Street
Portsmouth, NH 03801

Project:	NCES Stage VI Phase II
Project No:	1063
Date:	Nov-22
Calc. By:	AJS
Chkd. By:	

LEACHATE COLLECTION SYSTEM CALCULATIONS

100 Year Storm Event Leachate Storage Capacity

Porosity of Drainage Sand	0.457
Porosity of Pipe Trench Stone (3/4")	0.450
Porosity of Class D Stone (1.5")	0.400
Porosity of MSW:	0.671

Stage III

1-ft Sump Storage - Stage VI South (Stage VI Phase II Sump)

Elevation (ft)	Area (ft^2)	Avg Area (ft^2)	Total Volume (ft^3)	Total Volume (gal)	Total Storage Volume (gal)	
In Leachate Pipes						
Primary Leachate Pipe	0.31	-	93	699	699	
18" Primary Riser Pipe (1)	1.35		20	152	152	
18" Primary Riser Pipe (2)	1.35		20	152	152	
Pipe Max Storage			**134**	**1,003**	**1,003**	Sump 3
In Sump (3 feet of 1.5" stone)						
1323.5 (bottom of sump)	180	-				
1326.5 (top of sump)	900	540	1,620	12,119	8,132	
Sump Max Storage			**1,620**	**12,119**	**8,132**	
In 1.5' Drainage Sand Layer						
Drainage Sand Layer (1326.5 to 1328)	10,000	-	**15,000**	**112,215**	**51,282**	
Storage in Drainage Sand			**15,000**	**112,215**	**51,282**	Sump 3
In 6-foot MSW Layer						
1328	20,000					
1330	44,000	32,000	64,000	478,784	**321,264**	
1332	62,000	53,000	106,000	792,986	**532,094**	
1334	70,000	66,000	132,000	987,492	**662,607**	
Storage through 6-feet MSW Depth			**302,000**	**2,259,262**	**1,515,965**	

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

Letter of Deficiency No. SWMB 24-006
Partial Response – Action Items 4 & 5

North Country Environmental Services Landfill
581 Trudeau Road
Bethlehem, NH 03574

NHDES Site #: 123456789
Project Type: SW-LNDFILL
Project Number: 0021939
Permit: DES-SW-SP-03-002

Prepared for:

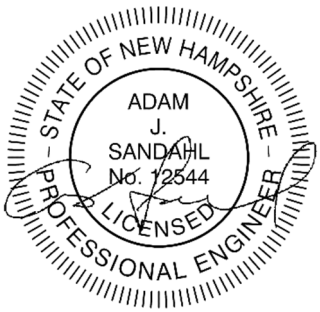
North Country Environmental Services
1855 VT Route 100
Hyde Park, VT 05655

Phone Number (802) 651-5454
RP Contact Name: John Gay
RP Contact Email: john.gay@casella.com

Prepared by:

CMA Engineers, Inc.
35 Bow Street
Portsmouth, NH 03801

Phone Number: (603) 431-6196
Contact Name: Adam Sandahl, P.E.
Contact Email: asandahl@cmaengineers.com



Date of Report: July 15, 2024

Cover Sheet for Reports Template - Revised December 2020

CMA ENGINEERS, INC.
CIVIL | ENVIRONMENTAL | STRUCTURAL

35 Bow Street
Portsmouth
New Hampshire
03801-3819

P: 603|431|6196
www.cmaengineers.com

July 15, 2024

Mr. Tyler J. Davidson
Solid Waste Management Bureau
New Hampshire Department of Environmental Services
29 Hazen Drive, P.O. Box 95
Concord, New Hampshire 03302-0095

Re: North Country Environmental Services, Bethlehem, NH
NHDES Permit No. DES-SW-SP-03-002
Letter of Deficiency No. SWMB 24-006, Action Items 4 & 5
CMA #665

Dear Mr. Davidson:

On behalf of North Country Environmental Services, Inc. (NCES), CMA Engineers, Inc. is providing requested Items 4 and 5 as outlined on page 9 of the Letter of Deficiency (No. SWMB 24-006) dated June 14, 2024. These items relate to secondary flow investigations at the NCES landfill and implementation of corrective measures. The items as they appear in the letter are presented below in *italicized* text with NCES's response following in **bold** text.

4. No later than July 15th, 2024, perform the investigation required by Env-Sw 806.09(e) for secondary leachate collection system flow rates exceeding 100 G/A/D and submit the proposed response action plan required by Env-Sw 806.09(f)

Sections Env-Sw 806.09(e) and (f) of the Solid Waste Rules are copied below for reference.

> **(e) The permittee shall investigate the occurrence of flow rate in the secondary leachate collection system that exceeds 100-gallons per tributary acre per day and which cannot be reasonably attributed to the dewatering of the drainage layer following construction.**
>
> **(f) The investigation in (e) above shall be for the purpose of identifying the potential cause(s) and appropriate response actions related thereto, which shall be reported to the department in writing in the form of a proposed response action plan.**

This submittal serves as the response action plan described in (f) above in conformance with the response action plan criteria outlined by Env-Sw 806.09(g). Secondary flows at NCES are calculated on a 30-day rolling average in compliance with NHDES requirements based on quantities pumped from secondary liner systems for each pump station. The LOD states that the 100 gallon per tributary acre per day (G/A/D) secondary flow threshold was exceeded for Pump Station 2 from November 14, 2023 to November 20, 2023 and from December 20, 2023 to June 12, 2024. The other three pump stations did not exceed this threshold. Pump Station 2 has a secondary liner contributary area of 13 acres and includes Stage II (both Phase I and II), Stage IV Phase I, and the northern portion of Stage VI Phase II.

The 2.4-acre Stage VI Phase II landfill expansion was constructed in 2023, which expanded the landfill 100 feet to the east by extending the existing 3H:1V liner slopes. The expansion tied into existing cells including 800 linear feet along Stage III and 220 liner feet along Stage II. The tie-in to Stage II along these 220 linear feet drains to Pump Station 2. The Stage VI Phase II disposal area has a "V-shaped" cross section with the 3H:1V landfill waste slopes on the west and a 30-foot-tall berm with 3H:1V slopes to the east. When constructed, the Stage VI Phase II cell drains to the west down the 3H:1V liner slope into Stages III and II. Because of

construction disturbance and the rapid drainage from the exposed 3H:1V slope area, not all stormwater runoff gets into the collection system at the bottom of the new slope. A portion flows to the north and collects over the low point of the cell, which is within the Pump Station 2 drainage footprint. The enclosed Secondary Liner Area Figure highlights the 220-foot tie-in location.

The secondary liner system to Stage II and III were opened for the Stage VI tie-in on October 17, 2023 and the primary liner installation was completed on November 3, 2023 which sealed the secondary liner systems. Over these 17 days, the following rain events were observed:

- October 21: 1.4 inches
- October 22: 1.0 inches
- October 30: 0.1 inches

Secondary flow is expected to be elevated following tie-ins to existing cells to account for this infiltration of stormwater while the secondary is exposed. The contributory surface water area draining from Stage VI to Pump Station 2 is 0.6 acres. When considering the total 2.5 inches of rain over this area, approximately 40,000 gallons of stormwater entered the Pump Station 2 secondary collection system. As previously described, the base of Stage VI Phase II is sloped to the north towards the Pump Station 2 footprint, so any stormwater that does not drain directly west into the Stage III/II landfill will flow north. The footprint from Stage VI Phase II that could drain stormwater to Pump Station 2 is 2.9 acres which corresponds to 200,000 gallons of stormwater. Therefore, the total amount of stormwater that could have entered the Pump Station 2 secondary footprint between the above dates is between 40,000 and 200,000 gallons.

The Stage II secondary liner system in base areas consists of a 12-inch sand layer over a drainage geocomposite or drainage net between the primary and secondary liners that would have been largely saturated after exposure to this stormwater. Of the 13 acres of the Pump Station 2 footprint, approximately 3.4 acres is base liner with 12" of sand between liners. The remaining 9.6 acres is a slope liner section that does not utilize sand between the liners. A foot of sand over 3.4 acres equates to approximately 385,000 gallons of liquid storage capacity in the Pump Station 2 base areas assuming a sand porosity of 0.35. Additional capacity exists in other areas in the drainage composite. This water normally takes several months to fully drain from the sand. Secondary flow removal is also constrained by the sizes of the secondary sump and pumps as they are designed to remove the comparatively small volumes of liquid that may pass through a defect in the primary liner and not to remove significant quantities of stormwater over a short period of time.

As depicted on the enclosed chart, secondary flow did not subside over the winter and appears to increase after large rain events. After review of the data, NCES worked with CMA Engineers and J.A. McDonald to expose the Stage II/Stage VI anchor trench to inspect for construction-related damage on April 9 and 10, 2024. At the low northern point of the anchor trench where stormwater had been standing, a quarter-inch diameter hole in the primary liner was observed. The location of this hole was GPS located and is depicted in plan view in Attachment 1. The hole was upslope and outside of the area where leachate accumulates on the primary liner. Stormwater contacting the waste mass could not end up over the hole as contributing water only came from intermediate cover surfaces or the surface of the new cell. Any stormwater that comes in contact with waste in Stage VI Phase II flows to the Stage II or III liner system, where it is directed to the leachate collection system. Any stormwater that accumulates in the Stage II anchor trench, where this hole was discovered, does not come into contact with leachate. CMA Engineers removed the geomembrane in the area of the hole and inspected the underlying secondary drainage geocomposite and found no damage. A patch was extrusion welded over the damaged area and vacuum box tested to confirm that there were no leaks. A single quarter-inch square hole over a free-flowing drainage geocomposite with several inches of head over it can generate

3,000 gallons per day, or the equivalent of 230 G/A/D over the 13 acre Pump Station 2 footprint (*Geotechnical Aspects of Landfill Design and Construction*, Qian, Koerner and Gray, 2002, Equation 4.5.1, p. 121).

J.A. McDonald is the contractor that completed the Stage VI Phase II construction and is currently on site for the CAP4 6-acre closure project. The repair work was completed by RTD Enterprises of Madison, Maine and overseen by Brett Deyling, P.E. of CMA Engineers. Brett Deyling's field reports for April 9th and 10th are enclosed.

The enclosed Pump Station 2 Secondary Liner Figure summarizes and depicts the following information

- Daily secondary flow based on a 30-day rolling average
- Rainfall data (NCES rain gauge)
- Date secondary tie-in was opened (October 17, 2023)
- Date secondary tie-in was closed (November 3, 2023)
- Date liner repair was completed (April 10, 2024)
- Date scrim placed (April 26, 2024)

The figure depicts flow increases following large rain events and secondary flows dropping significantly following the April repair work. Currently, Pump Station 2 secondary flows are below the 100 G/A/D threshold but still above the 25 G/A/D threshold, although continuing to trend downward rapidly. The sequence of events suggests that the repair work completed in April has remedied the elevated flows and NCES expects to be back below the 25 G/A/D threshold in the coming weeks.

NCES bench tested secondary pump station flow meters on July 11, 2024 and confirmed that the flow measuring devices were within acceptable tolerance. NCES has also scheduled camera inspection for of the Stage II and Stage IV Phase I secondary leachate pipes the week of July 15th.

5. No later than July 15, 2024, identify, implement, and submit a report on improvements in stormwater diversion and other measures taken to control to the greatest extent practical the generation of leachate.

NCES received operating approval to begin filling Stage VI Phase II on March 7, 2024 and has begun filling the southern end of the cell. Operations over the north side of the cell, including the Pump Station 2 area had been delayed until secondary flow began to recede. To divert stormwater from the leachate collection system, NCES:

1. Maintains the existing landfill bench swales adjacent to the Stage VI Phase II cell to divert as much stormwater as practical from the leachate collection system.
2. Installed a scrim liner on April 27th along the base of the northern end of Stage VI Phae II so that significant quantities of clean stormwater can be removed from the new cell before it drains to the primary leachate collection system. The scrim is being removed as filling progresses to the north.
3. Completes weekly inspections of the landfill surface, including stormwater swales, to ensure their integrity.
4. Grades the active face of the landfill inward so that stormwater that contacts waste will drain to the leachate collection system and clean stormwater can be shed away.
5. Maintains the stormwater ponds, including the outlet control structures and removal of sediment to ensure that surface water from the landfill is appropriately managed.

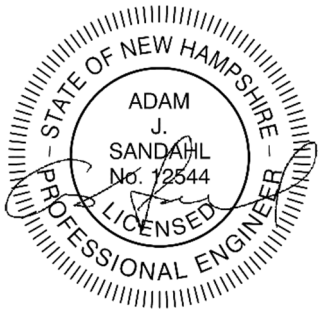
Please feel free to contact me or Joe Gay (802-651-5454 or John.Gay@casella.com) if you have any questions regarding this submittal.

Very truly yours,

CMA ENGINEERS, INC.

Adam J. Sandahl, P.E., BCEE
Project Manager

Enclosures: Secondary Liner Area Figure
Pump Station 2 Secondary Liner Figure
Brett Deyling Field Reports (April 9 & 10, 2024)



Notes:

1. Topography shown was developed from aerial photography performed by Eastern Topographic on June 11, 2023 combined with field surveys completed on October 4, 2023, November 27, 2023 and January 3, 2024 by Horizons Engineering, Inc.
2. Overlay liner area is included in the Pump Station 2 liner areas. The area below the overlay liner is included in the Stage I total liner area.
3. Values provided in table below represent actual slope areas and not plan view areas.

Legend:

PUMP STATION 1

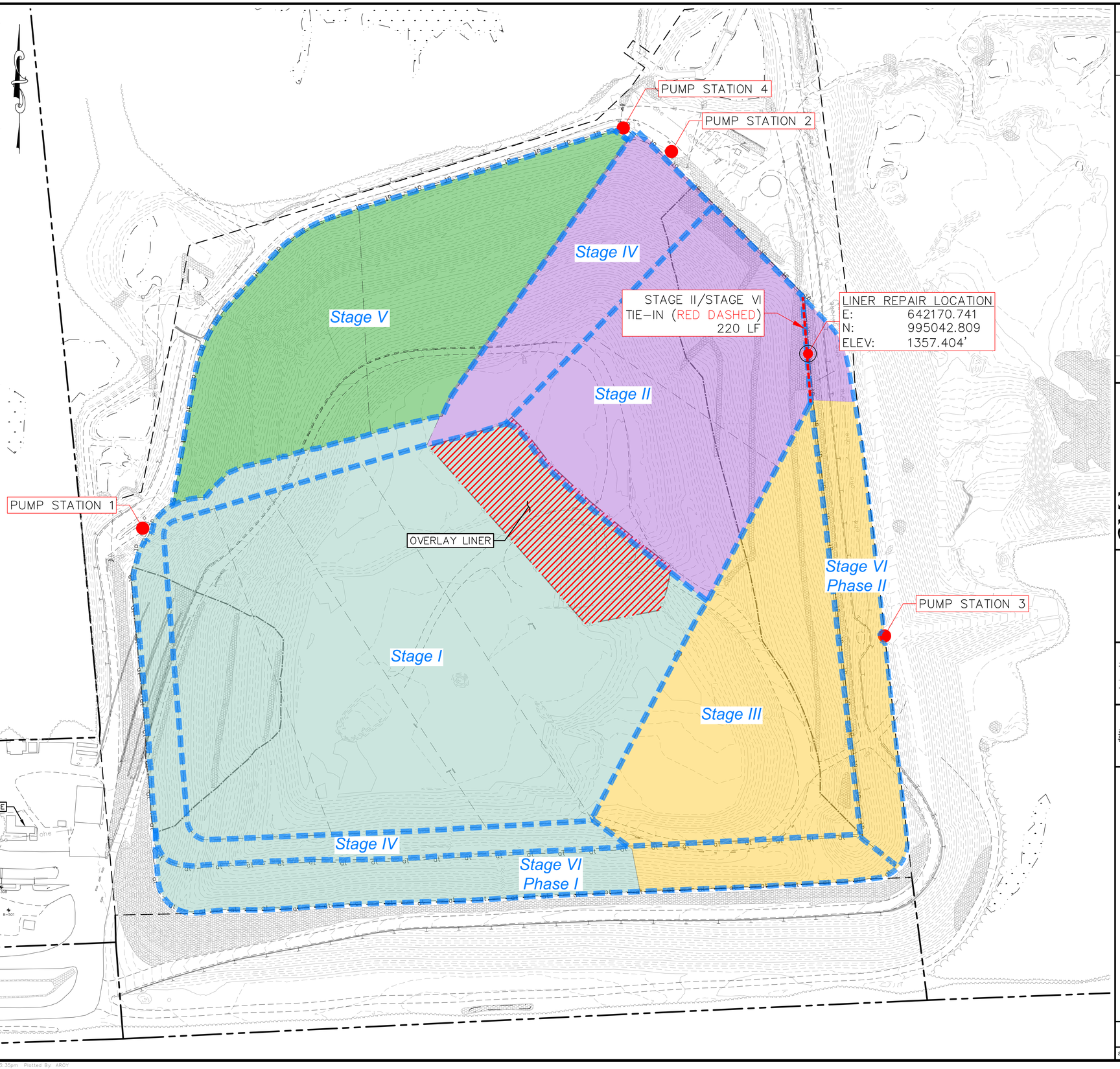
PUMP STATION 2

PUMP STATION 3

PUMP STATION 4

Secondary Liner Area Table:

PORTION OF SITE	TOTAL LINER AREA (AC)
PUMP STATION 1	
STAGE I	18.07
STAGE IV, PHASE II	4.24
STAGE VI, PHASE I	2.29
TOTAL	24.60
PUMP STATION 2	
STAGE II	7.30
OVERLAY LINER	2.28
STAGE IV, PHASE I	3.06
STAGE VI, PHASE II	0.37
TOTAL	13.01
PUMP STATION 3	
STAGE III	6.78
STAGE VI, PHASE I	1.26
STAGE VI, PHASE II	2.34
TOTAL	10.38
PUMP STATION 4	
STAGE V - Cell I & Cell II	8.23
TOTAL	8.23
TOTAL	56.22



no.	revision	date	by

CMA ENGINEERS
CIVIL/ENVIRONMENTAL/STRUCTURAL
Portsmouth, NH • Manchester, NH • Portland, ME
603/431-6196 • 603/627-0708 • 207/541-4223
cmaengineers.com

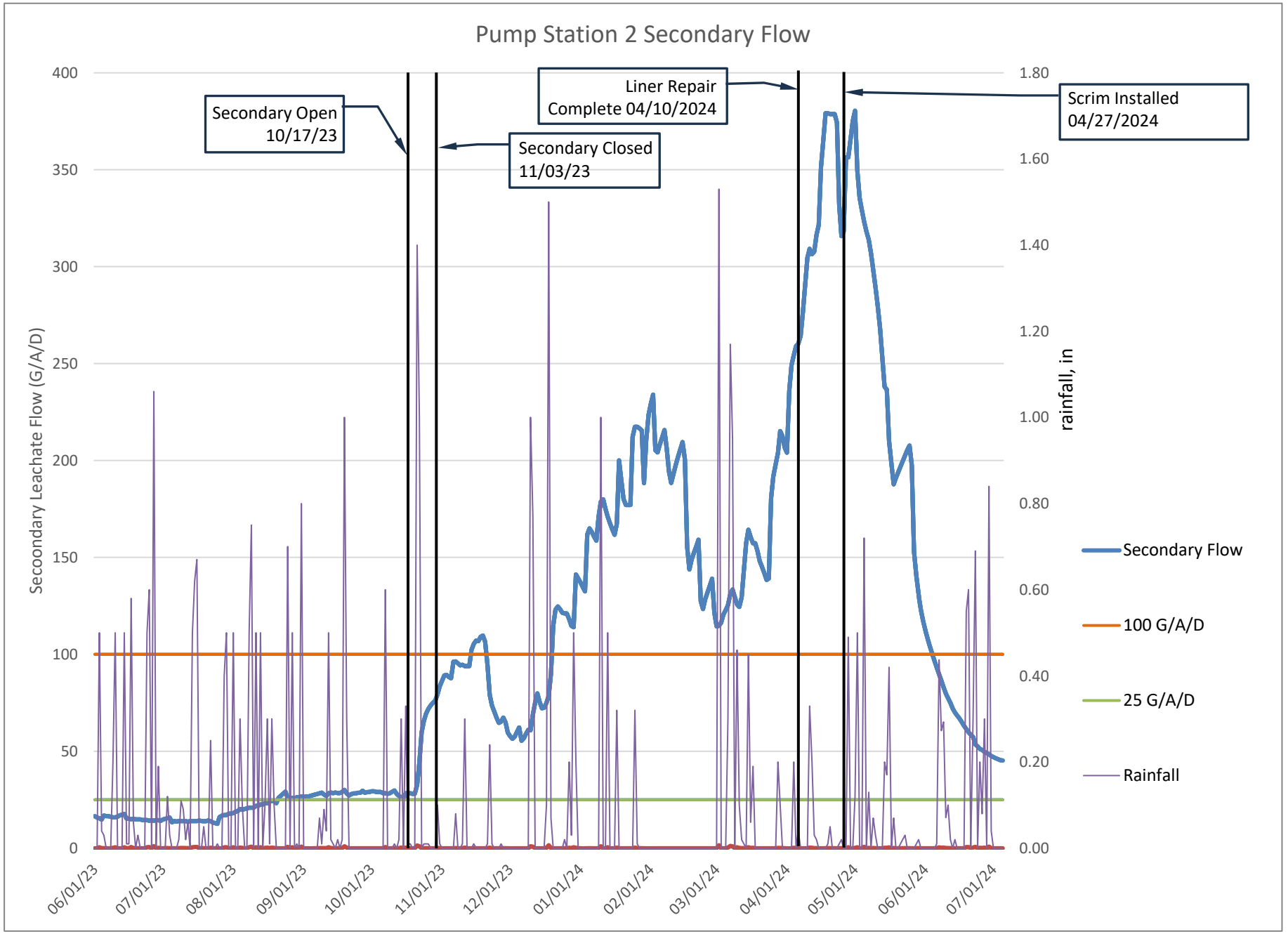
designed by: RJG
drawn by: ATR
approved by: AJS
date: July 2024
project no: 665
file name:
scale: 1" = 100'

North Country Environmental Services
Bethlehem, New Hampshire
Stage VI Landfill Expansion
DES-SW-SP-03-002
Secondary Liner Areas
Stage VI Phase II

drawing no. 1

sheet: 1 of 2

F:\CADD\PROJECTS\665\dwg\Engineer\665-NCES Primary & Secondary Areas-Stage VI PH II.dwg Date Plotted: Jul 12, 2024 – 3:35pm Plotted By: AROY


Pump Station 2 Secondary Flow
Secondary Open 10/17/23
Secondary Closed 11/03/23
Liner Repair Complete 04/10/2024
Scrim Installed 04/27/2024
Secoondary Leachate Flow (G/A/D)
rainfall, in
400
350
300
250
200
150
100
50
0
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
06/01/23
07/01/23
08/01/23
09/01/23
10/01/23
11/01/23
12/01/23
01/01/24
02/01/24
03/01/24
04/01/24
05/01/24
06/01/24
07/01/24
Secondary Flow
100 G/A/D
25 G/A/D
Rainfall

Field Report

CMA ENGINEERS, INC.	**REPORT NO:** 050
35 BOW STREET	**DATE:** 2024.04.09
PORTSMOUTH, NH 03801	**WEATHER: AM:** Sunny 40F **PM:** Sunny 40F

Project: North Country Environmental Services Landfill – Stage VI Phase II
Bethlehem, NH
CMA Project No: 1063 (*file:1063-NCES-FR-20240409 050 BMD)*

Contractor: J.A. McDonald, Inc.
585 Gilman Road
Lyndon Center, VT 05850

Excavators:	**Dozers:**	**Haul Trucks:**
Cat 349	Cat D9	Cat 735
Cat 345	John Deere 700 LGP	Cat 735
Cat 324	John Deere 550 LGP	Cat 735
		Cat 735
Grader:	**Fusion Machines:**	Cat D350
		Cat D350
Cat 16G	McElory TS 412	
	TD Williamson 618	

Loaders:	**Water/Fuel Truck:**	**Roller/Compactor:**
Cat 980	Cat D350 H2O	Cat CS 563
Cat 930	Cat D350 Fuel	Cat CS 533
Cat 926		

Engineer: CMA Engineers: Brett Deyling, P.E.

Others:
McDonald:
Hunter, Superintendent
10 Operators
1 mechanic

Construction Activities:

0800: BMD on site

Mcdonald and RTD were on-site to attempt to locate the cause of elevated flows within the secondary flows in Stage II pump station. The flows appeared to elevate in response to rain events, indicating a direct conduit through the primary liner into the secondary system. CMA Engineers and McDonald assumed the most likely location for the leak was at the tie in between Stage VI Phase II and Stage II towards the north end of the site.

Initially McDonald exposed the area at the far northern extent of the tie in where Phase II terminated. Finding no leaks at that location, McDonald moved to the southern extent of the interaction area between Stage II and Phase II, approximately 80 LF south of the lowest point in the cell. Excavation to the composite was completed in sections approximately 50LF at a time. Following exposure of the composite RTD folded the composite away from the anchor trench tie in so the extrusion weld could be inspected.

On the third section of excavation, approximately 20 LF north of the low point of the cell, RTD observed air bubbling through water flowing across the primary liner. During heavy rain events the location of the leak would have been saturated as water moved into Stage II through the waste mass at the base of the new cell. The location was marked and left exposed so water flow could decrease overnight for repair tomorrow. The hole appeared to be a very small <0.25" scuff mark approximately 8" from the anchor trench tie in weld on the existing Stage II liner system. The leak did not appear to be related to work completed during

Stage VI Phase II. It was most likely a remnant of stage II construction and, due to its location, would not have been subjected to saturation before completion of Stage VI Phase II.

1600: McDonald offsite.

1600: BMD off site.

END OF REPORT

Submitted by: Brett Deyling, P.E., CMA Engineers, Inc.
cc: Adam Roy, P.E. CMA Engineers, Inc.
Robert Grillo, P.E. CMA Engineers, Inc.

Excavating from south to north

Air bubbles at the leak location

Field Report

CMA ENGINEERS, INC.	**REPORT NO:** 051
35 BOW STREET	**DATE:** 2024.04.10
PORTSMOUTH, NH 03801	**WEATHER: AM:** Sunny 40F **PM:** Sunny 40F

Project: North Country Environmental Services Landfill – Stage VI Phase II
Bethlehem, NH
CMA Project No: 1063 (*file:1063-NCES-FR-20240410 051 BMD)*

Contractor: J.A. McDonald, Inc.
585 Gilman Road
Lyndon Center, VT 05850

Excavators:	**Dozers:**	**Haul Trucks:**
Cat 349	Cat D9	Cat 735
Cat 345	John Deere 700 LGP	Cat 735
Cat 324	John Deere 550 LGP	Cat 735
		Cat 735
Grader:	**Fusion Machines:**	Cat D350
		Cat D350
Cat 16G	McElory TS 412	
	TD Williamson 618	

Loaders:	**Water/Fuel Truck:**	**Roller/Compactor:**
Cat 980	Cat D350 H2O	Cat CS 563
Cat 930	Cat D350 Fuel	Cat CS 533
Cat 926		

Engineer: CMA Engineers: Brett Deyling, P.E.

Others:
McDonald:
Hunter, Superintendent
2 Operators

Construction Activities:

0800: BMD on site

RTD completed a single patch repair on the primary liner. A trial weld was completed that passed specification, the patch was welded and vacuum box tested in accordance with the project manual. Following successful repair, the location was marked with GPS, the geocomposite was folded back into place and the anchor trench was backfilled.

1400: McDonald offsite.

1400: BMD off site.

END OF REPORT

Submitted by: Brett Deyling, P.E., CMA Engineers, Inc.
cc: Adam Roy, P.E. CMA Engineers, Inc.
Robert Grillo, P.E. CMA Engineers, Inc.

Leak location

Patch being prepared for extrusion welding.